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Semantically Enriched Derivation of Legal Advice in the Palestinian Labour Domain

الاشتقاق المعزز دلاليا للاستشارة القانونية في مجال العمل الفلسطيني

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أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

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الاشتقاق المعزز دلاليا للاستشارة القانونية في مجال العمل الفلسطيني

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة شئون البحث العلمي والدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحث/ **محمد عبدالفتاح محمد سعيد العفيفي** لنيل درجة الماجستير في **كلية *تكنولوجيا المعلومات*** برنامج **تكنولوجيا المعلومات** وموضوعها:

الاشتقاق المعزز دلالياً للاستشارة القانونية في مجال العمل الفلسطيني

Semantically Enriched Derivation of Legal Advice in the Palestinian Labor Domain

وبعد المناقشة التي تمت اليوم السبت 25 رجب 1438هـ، الموافق 2017/04/22م الساعة الحادية عشر صباحاً ، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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وبعد المداولة أوصت اللجنة بمنح الباحث درجة الماجستير في **كلية *تكنولوجيا المعلومات*/ برنامج تكنولوجيا المعلومات.**

واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله ولي التوفيق،،،

نائب الرئيس لشئون البحث العلمي والدراسات العليا

أ.د. عبدالرؤوف علي المناعمة

Abstract

The Palestinian labour legal law is a rich and complex field with various parts, chapters and articles and is related to other articles and laws. Working with such legal domain to derive legal advice using traditional methods such as face-to-face meetings between the lawyer and the worker is time consuming and does not guarantee the retrieval of useful information and legal cases related to the required advice. Recent technologies and techniques pertinent to information management and retrieval, such as semantic web techniques based on ontology and related knowledge bases, can strongly benefit the legal domain.

In this research, we build a semantically enriched approach for the derivation of legal advice in the labour domain based on the Palestinian labour law. We design and build a domain ontology called *LabourLawOnt* together with a knowledge base for the labour law. The ontology contains terms, relationships, and object and data properties. The set of parts, chapters and articles of the labour law together with various legal cases are added as instances to the ontology to form the legal knowledge base. Also a set of semantic (SWRL) rules are defined and written to be used to infer new knowledge from the knowledge base.

The approach is realized through a system prototype designed and implemented as a prove of the concept for the approach including the ontology, the SWRL rules, the knowledge base, a reasoner and a user interface.

The system, respectively the approach, is evaluated with the help of a domain expert using 150 legal cases divided into two sets. The first set contains 100 cases entered to the system by the expert and the second set contains 50 cases previously entered as instances in the knowledge base. The results show a success rate of 77% correct legal advice cases related to child labour, a success rate of 80% correct legal advice cases related to women labour, and a success rate of 87.5% correct legal advice cases related to the end of service benefits. The overall accuracy of the system in correctly giving the legal advice is 84%.

Keywords: Labour Law, Legal, Semantic Web, SWRL rule, OWL, Inference Engine.

الملخص

قانون العمل الفلسطيني هو حقل غني بالمعلومات ومعقد وذلك لاحتوائه على اجزاء وفصول مختلفة وارتباط هذه القوانين بقضايا عمالية مختلفة. للحصول على نصيحة قانونية بالشكل التقليدي يتم من خلال الاجتماع بين العامل والمحامي وجها لوجه وذلك يستغرق وقتا طويلا ولا يضمن استرجاع المعلومات المفيدة او الاستناد الى القضايا القانونية المتعلقة بقضية العامل الطالب للنصيحة القانونية، ومع ذلك يمكن استخدام التقنيات الحديثة ذات الصلة بإدارة المعلومات واسترجاعها، مثل تقنيات الويب الدلالية القائمة على علم الأنطولوجيا وقواعد المعارف ذات والتي تفيد بقوة المجال القانوني.

في هذا البحث قمنا ببناء طريقة معززة دلاليا لاشتقاق الاستشارة القانونية في مجال العمل استنادا إلى قانون العمل الفلسطيني. الطريقة المقترحة تتكون من تصميم وبناء الأنطولوجيا وأطلقنا عليها اسم *LabourLawOnt* اضافة الى حالات قانونية لتكوين قاعدة المعرفة في قانون العمل، وتحتوي هذه الأنطولوجيا على المصطلحات والعلاقات وخصائص الكائنات والبيانات الخاصة بقانون العمل ومتعلقاته، وكتابة مجموعة من القواعد الدلالية (SWRL) وذلك لاستخدامها في استنتاج المعرفة الجديدة والاستشارة القانونية من قاعدة المعرفة.

تم تحقيق هذه الطريقة المقترحة من خلال تصميم وتطبيق نظام تجريبي يحتوي على الانطولوجيا مع قاعدة المعرفة والقواعد الدلالية ومحرك الاستدلال (Reasoner) مع واجهة استخدام للخبير القانوني مثل المحامي والقاضي وواجهة استخدام للعامل.

وتم اختبار النظام بمساعدة خبير في مجال قانون العمل ومن خلال 150 قضية قانونية مقسمة إلى مجموعتين. المجموعة الأولى تحتوي على 100 حالة ادخلت إلى النظام من قبل الخبير والمجموعة الثانية تحتوي على 50 قضية عمالية ادخلت مسبقا قضايا سابقة في قاعدة المعرفة، وأظهرت النتائج أن نسبة 77٪ من القضايا القانونية الصحيحة المتعلقة بعمل الأطفال، ونسبة 80٪ من القضايا القانونية الصحيحة المتعلقة بعمل المرأة، ونسبة نجاح 87.5٪ من الحالات القانونية الصحيحة المتعلقة بمكافأة نهاية الخدمة، وشكلت نسبة الدقة للنظام في اشتقاق النصيحة القانونية بشكل صحيح بلغت 84٪.

كلمات مفتاحية: قانون العمل الفلسطيني، الويب الدلالي، انطولوجيا، لغة انطولوجيا الويب، لغة قواعد الويب الدلالي، محرك استدلال

Dedication

To my beloved parents

To my lovely wife

To my Kids

To my brothers and sisters

Acknowledgment

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Mohammed A. Al-Afifi

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Chapter 1

Introduction

Chapter 1

Introduction

This chapter introduces the thesis by describing the domain and the concepts of derivation of legal advice in the Palestinian labour law based on ontology development. We also state the thesis problem, research objectives, importance of the research, the scope and limitations as well as the methodology to be followed to achieve the research objectives.

The legal domain is one of the richest domains. It contains a large number of articles, rules, issues, and legal cases. For instance, the labour law is used as a reference between the worker and the employer. The lawyer, judge and worker in the labour law, for example, face difficulties searching in articles and looking for similar cases to get advice for the current case. They waste time to get related articles to prove and advocate the current case.

There is an important role for recent and contemporary concepts and tools such as Semantic Web and ontology in dealing with the legal domain. Semantic Web "Provides machine understandable and meaningful descriptions of Web resources" (Kalfoglou et al., 2007). It allows applications to access various types of resources, processing and integrating the content, and producing meaningful value for users based on ontologies and Semantically links these resources to each other (Saeed Al-Bukhitan et al., 2014).

Ontologies are a concept of Semantic Web that can be used in many applications such as information retrieval and decision support systems (Kalfoglou et al., 2007). Based on these applications, for instance, ontologies can also be useful in the legal advice.

There are many studies dealing with ontology as approach for giving advice in various domains like health advice derivation in medicine (Satoru Izumi, 2007), diagnosing date palm diseases in agriculture (El-Askary, 2015), Arabic question answering in NL (AbuTaha, 2015) and research legal domain (Taylor, 2013). To our knowledge no specific approaches use ontology and semantic web in Arabic labour law.

1.1 Statement of the Problem

The labour legal domain is one of the richest and most complex domains. The Palestinian labour law is related to other laws in Palestine which produce huge number of legal articles and codes, leading to time consumption, and difficulties for judges, lawyer and workers. For instance the Palestinian jurisprudence database includes approximately 13,000 articles and more than 50,000 pages of legislations and (Ministry of Justice, 2016). Searching in such legal database does not guarantee the recovery of useful documents because it is usually based on simple traditional search criteria.

The problem of this research is divided into two parts:

- The lack of formal knowledge base for legal domain in Palestine necessitates the development of appropriate domain ontology and knowledge base.
- The need to develop an efficient legal ontology-based approach to serve in retrieving of relevant articles and/or similar legal cases for the judge, the lawyer and the workers.

1.2 Objectives

1.2.1 Main Objective

The main objective of this research is to build an efficient and accurate ontology-based approach for legal advice in the Palestinian labour law.

1.2.2 Specific Objectives

- To collect data on the labour legal domain with rules, codes and real labour legal cases. Based on that, we determine the relation between articles and cases.
- To build a domain ontology and knowledge base for Palestinian labour law based on the collected data.
- To build a legal advice approach based on the ontology and the knowledge base that can be used by judges, lawyers and workers.

- To evaluate the approach including the ontology based on experimental results for accuracy in the retrieved of relevant articles and/or similar legal cases offered and hence minimizing the time needed to get the result.

1.3 Importance of the Research

Legislation is fundamental for the management of any country and controlling all life aspects. Palestine has especial complexity of legislation due to the multiplicity of laws related to Ottoman, British, Egyptian, Jordanian, and finally Palestinian governance.

The proposed approach saves time and efforts in recovery of legal articles. It will be one of the few such studies looking at the possibility of creating a legal knowledge base based on legal conceptual ontology and interpret and provide legal advice to all parties including judge, lawyer and worker. Most of the previous studies have used traditional complex programmatic ways and need an expert to use them.

The legal field is considered a rich and complex domain because it is linked to the achievement of justice, and approximately the number of applicable legal articles in Palestine are more than 13,000 legal articles. This research contributes to creating a knowledge base for legal concepts and provides legal advice for concerned parties including judge, lawyer and worker.

The approach can be useful in the governmental as well as the private institutions related to labour legal domain.

1.4 Scope and Limitations of the Research

- This research is limited to the domain of legal labour law no. 7 issued by the Palestinian state in the year 2000 and consists of 140 articles and the approach is proposed for offering legal advice related to this law.
- The ontology covers the labour law. It does not cover legal history or any other Palestinian laws.
- There are different elements to identify legal ontology (Taylor, 2013) such as identifying the legal concepts, jurisprudence, codes, observation and case. We focus mainly on how to get legal advice for labour domain.

- Measuring accuracy of legal advice is performed through experiments and also through human experts in the labour domain.
- We only implement a prototype of the approach to prove our view but not a complete working system.
- The implemented system is not be considered as an expert system, although it has some features similar to an expert system.
- The request for advice in this prototype is formulated as SPARQL query. Natural formulation of request for advice needs further effort and time. Therefore, it is beyond our research and is left as a future endeavor.

1.5 Methodology

To accomplish the objectives of the research, the following methodology is followed:

1. Research and survey: it includes a review of recent literature related to the thesis research problem especially in the field of labour legal domain.
2. Data collection: we collect various articles in legal domain in Palestine related to building the legal ontology and dealing with the huge number of related legal articles.
3. Building the ontology and the knowledge base: in this phase we build the ontology, following ontology engineering approach and using tools such as, OWL-API, DL-Query, and Protégé 5.0 (Stanford University, 2015). This includes the following tasks:
    a. Determine the domain and scope of the ontology.
    b. Consider reusing existing Legal ontology and extend it as an option.
    c. Indicate the important terms in the ontology.
    d. Define the classes and the class hierarchy (taxonomy).
    e. Define the properties of classes.
    f. Define the facets (Value type, Allowed values, Cardinality).
    g. Create instances of Law, case, Articles etc. as a knowledge base.

h. Use a Reasoner to get new knowledge for Legal advices.

i. Use some SPARQL to perform quires on the ontology that ensure the correct building of ontology and check whether it returns what we want?

4. Build the approach for legal advice: we develop the approach based on the legal ontology and the related knowledge base using programming language such as JAVA and related APIs and tools, for example JENA.

5. Test the approach: to test the proposed approach for legal advice by queries and results using a human expert and using SPARQL queries.

6. Results and discussions: in this stage, we analyze the obtained results and evaluate the accuracy of the legal advices and compare with results obtained from the human expert.

1.6 Thesis Structure

This thesis consists mainly of seven chapters as follows:

- **Chapter 1 (Introduction):** gives a short introduction to the Palestinian labour domain, ontology development, and the thesis problem and objectives.
- **Chapter 2 (Theoretical and Technical Foundation):** describes the theoretical and technical background needed for the research, ontology concepts, RDF, RDFs, SWRL rules.
- **Chapter 3 (Related Work):** presents works related to deriving legal advices, using the ontology to deduce knowledge and making decisions.
- **Chapter 4 (Labour Law Ontology Development):** describes the development of the labour law ontology with the knowledge base and its evaluation.
- **Chapter 5 (*LabourLawOnt* System and Implementation):** presents the approach and ontology implementation.
- **Chapter 6 (Experimental Results and Evaluation):** presents an evaluation of *LabourLawOnt* system by conducting a number of experiments on the system.
- **Chapter 7 (Conclusions and Future Works):** presents the conclusions and the possible future works.

Chapter 2

Theoretical and Technical Foundation

Chapter 2

Theoretical and Technical Foundation

In this chapter, we present the background and theoretical concepts of legal domain, especially in Palestine, labour law in Palestine, ontology development, and we also present ontology formalisms such as RDF, RDFS, OWL, Reasoning, SWRL rules and SPARQL.

2.1 The Palestinian Judicial System and Labour Law

The Palestinian judicial system differs from other systems used in the various countries of the world. There still exists a patchwork of Ottoman (1516 –1917), British (1918-1948), Jordanian and Egyptian (1948–1967) laws in operation within Palestinian law. The first decree of the President of the Palestinian National Authority (PNA), issued on 20 May 1994, declared that the legislation and laws that were effective prior to 5 June 1967 in the West Bank and Gaza strip have should continue to be valid. However, in the past 20 years the PNA has tried to unify the system, particularly with laws pertaining to the economy and the judicial system, which includes more than 13,000 articles and more than 50,000 pages of legislation (Ministry of Justice, 2016). So the Palestinian legal system is often characterized as complex since it consists of different layers of colonial codes and rules (MAS, 2008) (Jamil Salem, 2010).

The Palestinian labour force participation rate of persons aged 15 years and above is more than 46%, as the number of persons participating in the labour force in Palestine reached 1,356,300 in the 3rd quarter of 2016. (PCBS, 2016).

The number of labour legal case present the court was 1937 case for the year 2016. The number of judicial cases was 563 while the 1374 is still under processing (Ministry of Justice, 2016).

Lawyers, judges and users are facing complexities on the legal documentation when they use and retrieve the articles, therefore they need better management retrieved of the knowledge. As to the case of Palestine, lawyers, for example, find the articles by traditional way (looking for in Journals, or in published database which provide by Ministry of Justice but it’s difficult to use and manage the different sources of

jurisprudence (Dhouib et al., 2013). Legal ontologies can be, in this case, very useful especially in the extraction and the retrieval of legal knowledge.

2.2 Ontology

Ontology is the most important part and player in the world of the Semantic Web since most Semantic Web processes are based on ontologies. Therefore, if an appropriate ontology is built for a specific area, the objectives of the Semantic Web will be achieved. In general ontology is defined in the computer science community as the following:

"*a shared and common understanding of a domain that can be communicated between people and heterogeneous and distributed systems*" (Fensel et al., 2000).

Legal ontologies have been proposed as conceptual models for the various legal applications, such as information retrieval, interoperability frameworks and inference drawing. (Sartor et al., 2010).

2.3 Ontology Building Methodologies

Ontology building is a complex task; it needs effort, expertise and time, in the domain in which we want to build the ontology. The following steps can be followed on the ontology development process (Antoniou et al., 2004; Noy et al., 2001).

1- Determine the domain and scope of the ontology
2- Consider reusing existing ontologies
3- Enumerate important terms in the ontology
4- Define the classes and the class hierarchy
5- Define the properties of classes-slots
6- Define the facets of the slots
7- Create instances

Next, we give further details on these steps.

Step 1. Determine the domain and scope of the ontology

This step defines the domain and the purpose of the ontology. Developing an ontology is not an aim or a goal in itself but we build the ontology for a particular purpose. This stage includes multiple and basic questions to be answered: what is the domain that

the ontology will cover? For what we are going to use the ontology? For what types of questions should the ontology provide answers? Who will use and maintain the ontology? (Boyce et al., 2007).

Step 2. Consider reusing existing ontologies

This step is to ascertain if ontology has been developed previously in the same subject area. If such ontology exists, it is easier to modify the existing ontology to suit ones needs than to create a new ontology (Boyce et al., 2007). Reusing existing ontology may be required if our system needs to interact with other applications that have been committed to a specific ontology or controlled vocabulary.

Step 3. Enumerate important terms in the ontology

This step is considered as the first step or the actual definition of the ontology where we make a list of an expected terms that will be used on the ontology building. It is important to get a comprehensive list of these terms regardless of overlap between concepts they represent or relations among the terms (Boyce et al., 2007).

Step 4. Define the classes and the class hierarchy

After the identification of the relevant terms, these terms have to be organized in a hierarchical way. There are several possible approaches in developing a class hierarchy: A top-down development process starts with the definition of the most general concepts in the domain and subsequent specialization of the concepts. For example, we can start with creating classes for the general concepts. Then we specialize the class by creating some of its subclasses and so on. A bottom-up development process starts with the definition of the most specific classes then leaves of the hierarchy with subsequent grouping of these classes into more general concepts. For example, we start by defining classes then we create a common superclass for these classes. A combination development process of the top-down and bottom up approaches is also possible (Noy et al., 2001).

Step 5. Define the properties of classes (Slots)

In this step, the classes that are created in the previous step does not provide enough information alone. Once the classes have defined, the next step is to describe the internal structures (properties/attributes) of the concepts. So, we have two kinds of properties (Object and Data properties). Object properties are used to link together,

while Data Properties are used to link objects to xml schema data type. Once we defined the classes, we clarify and reflect the internal structure of concepts. This is considered as the property of the developed classes, for example: case has object property *caseCited, caseType, hasArno, hasChapter* and each case has some data property such as *hasCaseID, hasCaseStatus, hasCaseType, hasCity, hasDecision, hasEndWork, hasExpYear and hasLastRate*. These properties and other will be illustrated in Table 4.3 (Noy et al., 2001).

Step 6. Define the facets of the slots

In this step, we add facets to the properties. These facets include value type, allowed values, the number of the values (cardinality), and other features of the values the slot can take.

Step 7. Create instances

The last step allows the data to be entered and displayed an instance is the information that entered into the knowledge base, to create an instance needed to carried out: (1) choosing a class, (2) creating an instance of that class, and (3) filling in the slot values. So, we define about 215 instances that are representing all ontology concepts includes (Case types, Area of Law, Labour law legal person and others). Examples of these instances are end of service benefits which contains 25 cases.

2.4 RDF and RDFS

Resource Description Framework (RDF) is a framework for representing information about resources in a graph form. Since it was primarily intended for representing metadata about WWW resources, it is built around resources with Uniform Resource Identifier URI. RDF documents are written in XML, the XML language used by RDF is called RDF/XML. By using XML, RDF information can easily be exchanged between different types of computers using different types of operating systems and application languages. Information is represented by triples subject-predicate-object in RDF. All of the elements of the triple are resources with the exception of the last element, object, that can be also a literal. Literal in the RDF sense is a constant string value such as string or number (W3C, 2004).

Many ontologies exist for RDF. They are usually defined using the Web Ontology Language (OWL) or, in a simpler fashion, using the RDF Schema (RDFS) system.

RDF Schema is a semantic extension of RDF. It provides mechanisms for describing groups of related resources and the relationships between these resources. In RDFS, predefined Web resources rdfs: Class, rdfs: Resource, and rdf: Property can be used to declare classes, resources, and properties respectively These resources are used to determine characteristics of other resources, such as the domains and ranges of properties (Pan et al., 2007).

2.5 Web Ontology Language (OWL)

OWL is standard of ontology language recommended by W3C. OWL describes the domain through define the structure of classes terms, properties, individual and restrictions. Its constructors of classes and properties have rigorous formal foundation based on Description Logic and there exists decidable reasoning algorithms when OWL is used under some restrictions. Individuals represent objects in the domain, maybe members of one or more classes. Properties describe the relationships between individuals, link two individuals. Classes, also known as sets members of classes, share some properties or characteristics (W3C, 2012).

OWL has three increasingly-expressive sublanguages: OWL-Lite, OWL-DL, and OWL-Full designed for use by specific communities of implemented and users. OWL-Lite is the least expressive sub-language it intended to use in situations where only a simple class hierarchy and simple constraints needed. For example, while it supports cardinality constraints, it only permits cardinality values of 0 or 1. It should be simpler to provide tool support for OWL-Lite than its more expressive relatives, and OWL-Lite provides a quick migration path for thesauri and other taxonomies. OWL-Lite also has a lawyer formal complexity than OWL-DL. OWL-DL considered as an extension of OWL-Lite and OWL-Full an extension of OWL-DL. OWL-DL includes all OWL language constructs, but they can be used only under certain restrictions (for example, while a class may be a subclass of many classes, a class cannot be an instance of another class). OWL-Full is the most expressive sub-language it intended to use in situations where very high expressiveness is more important than being able to guarantee the decidability or computational completeness of the language. It is therefore not possible to perform automated reasoning on OWL-Full ontologies (Horridge et al., 2009).

There are two important types of properties in OWL: data type properties and object properties. Data type properties help describe individuals, they are not typically used to describe classes and are certainly not dependent on classes. Object properties allow you to create associations or relationships between two individuals. That means the subject and the object the triple are both individuals (Jeffrey, 2009).

2.6 DL-Query

The DL Query provides a powerful and easy-to-use feature for searching a classified ontology. The query language (class expression) based on the Manchester OWL syntax, a user-friendly syntax for OWL DL that fundamentally based on collecting all information about a particular class, property, or individual into a single construct, called a frame (Protege Wiki, 2016).

2.7 JENA

JENA is A free and open source Java framework for building Semantic Web and Linked Data applications, we will use Jena Ontology API that work with models, RDFS and the Web Ontology Language (OWL) to add extra semantics to your RDF data (Apache Jena, 2016).

2.8 Reasoning

Reasoner is a key component for working with OWL ontologies. Virtually all querying of an OWL ontology should be done using a reasoner. This is because knowledge in an ontology might not be explicit and a reasoner is required to deduce implicit knowledge so that the correct query results are obtained. There following reasoners provide implementations of the OWL API OWL Reasoner interface: FaCT++, JFact, Hermit and Pellet. We like Pellet is an OWL2 reasoner. Pellet provides standard and cutting-edge reasoning services for OWL ontologies (Palmisano, 2016).

OWLViz plugin used in protégé software that enables class hierarchies in an OWL ontology to be viewed and incrementally navigated and allowing comparison of the asserted class hierarchy and the inferred class hierarchy (Horridge, 2010).

2.9 SPARQL

SPARQL (pronounced "sparkle", an acronym for SPARQL Protocol and RDF Query Language) is an RDF query language used for databases, able to retrieve and manipulate data stored in RDF format (Wikipedia, 2013).

SPARQL is the standardized query language for RDF, it is closed to SQL is the standardized query language for relational databases, and it is share several keywords such as SELECT, WHERE, etc. Also has special keywords that not used in SQL such as OPTIONAL, FILTER and much more as shown in next example (Gorenjak et al., 2011; Wikipedia, 2013).

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?name
       ?email
WHERE
  {
    ?person  a          foaf:Person .
    ?person  foaf:name  ?name .
    ?person  foaf:mbox  ?email .
  }
```

This query joins together all of the triples with a matching subject, where the type predicate, "a", is a person (foaf:Person), and the person has one or more names (foaf:name) and mailboxes (foaf:mbox).

SPARQL is strong, flexible, and allows the use of RDF, with all advantages as traditional databases. However, SPARQL query structure is difficult and need experienced users (McCarthy et al., 2012).

Another SPARQL query is shown in the next example. It that models the question "What are capitals of all countries in Africa?":

```
PREFIX ex: <http://example.com/exampleOntology#>
SELECT ?capital
       ?country
WHERE
  {
```

```
    ?x  ex:cityname       ?capital   ;
        ex:isCapitalOf    ?y         .
    ?y  ex:countryname    ?country   ;
        ex:isInContinent  ex:Africa  .
}
```

Variables are indicated by a "?" or "$" prefix. Bindings for ? capital and the ?country will be returned.

2.10 SWRL Rules

Semantic Web Rule Language (SWRL) based on a combination of the OWL DL and OWL Lite sublanguages of the OWL Web Ontology Language with the Unary/Binary Data log Rule ML sub languages of the Rule Markup Language. SWRL includes a high-level abstract syntax for Horn-like rules in both the OWL DL and OWL Lite sublanguages of OWL. A model-theoretic semantics is given to provide the formal meaning for OWL ontologies including rules written in this abstract syntax. An XML syntax based on Rule ML and the OWL XML Presentation Syntax as well as an RDF concrete syntax based on the OWL RDF/XML exchange syntax are also given, the OWL expressiveness may not be sufficient to model all kinds of problems, as several need rules in the Hor-like (IF-THEN) format. To present this Type of Rules, in 2004 the Semantic Web Rule Language (SWRL) was proposed to the W3C as a recommendation. SWRL complements OWL because it includes a high-level abstract syntax for Horn-like rules. SWRL rules can be added to an OWL file as valid OWL. Even if SWRL in not a W3C recommendation (standard), it is a popular language with support in many tools, such as Protégé, Pellet and Hermit (Horrocks et al., 2004).

2.11 Ontology Evaluation

The evaluation of the quality of ontology is an important part of ontology development. Because this we present in this section the evaluation methodology we carried out to evaluate the *LabourLawOnt* ontology.

An ontology can be evaluated based on many criteria: its coverage of a particular domain and the richness, complexity and granularity of that coverage; the specific use cases, scenarios, requirements, applications, data sources it was developed to address,

formal properties such as the consistency and completeness of the ontology and the representation language in which it is modeled (Obrst et al., 2007).

There are various approaches to the evaluation of ontologies, depending on what kinds of ontologies are evaluate and for what purpose, most evaluation approaches fall into one of the following categories (Brank et al., 2005):

- Based on compare the ontology to a golden standard, that may itself be ontology.
- Based on use the ontology in an application and evaluating the results (Task-Based) (Porzel et al., 2004).
- Involve comparisons with a source of data (e.g. a collection of documents) about the domain to cover by the ontology.
- Evaluate by humans who try to assess how well the ontology meets a set of predefined criteria, standards, requirements, etc.

Task-based evaluations offer a useful framework for measuring practical aspects of ontology deployment such as the human ability to formulate queries using the query language provided by the ontology. The accuracy of responses provided by the system's inferential component, the degree of explanation capability offered by the system, the coverage of the ontology in terms of the degree of reuse across domains, the scalability of the knowledge base, and the ease of use of the query component.

Task-Based evaluations can leverage use-cases or scenarios to characterize the target knowledge requirements (Obrst et al., 2007). In a Task-Based evaluation, the results should show the following shortcomings:

- Insertion errors indicating superfluous concepts,
- Deletion errors indicating missing concepts, and
- Substitution errors indicate off-target or ambiguous concepts.

With this, we can provide performance measures that can:

- Evaluate one or more ontologies in terms of their performance on a given task (ideally to measure only the ontology-specific aspect of the performance),
- Quantify the respective gains and losses of the insertion, deletion and substitution errors,

- Populate/improve the ontology as derived from the individual error type specific results, and
- Re-evaluate the respective performance increases resulting from the improvements.

By applying this evaluation scheme, we can test and measure the respective improvements that brought about by learning approaches that target the same levels and issues in the ontology learning and population field (Porzel et al., 2004).

2.12 Summary

In this chapter, we have presented the legal domain, especially in Palestine, and Palestinian judicial system. Also, we have discussed the ontology concepts and its building methodology. We also reviewed notions and technologies related to RDF, RDFS, OWL, Reasoning, SWRL rules, SPARQL and ontology evaluation. We have explained Task-Based framework which is used for the evaluation of the ontology.

Chapter 3

Related Work

Chapter 3
Related Work

In this chapter, we present various related works we studied and investigated. The related works are related to various domains. Most of the presented related works are for English legal domain, while for Arabic language there are few published works in this field. Also, we present related works for the derivation of advice such as health and business domains.

3.1 Ontology in the Legal Domain

Legal ontologies are proposed as conceptual basis for diverse legal applications, such as information retrieval, interoperability and inference engines (Sartor et al., 2010). Therefore, a legal ontology should consider and conceptually reflect these different viewpoints. It should include all terms, relationships, attributes, characteristics, and instances related to how each role sees the law. Yet it should provide a common-law vocabulary among these roles.

The challenges of Chinese building a Chinese legal ontology, for instance, are from the inner legal systems and ambiguity of legal language. (Ni et al., 2015), analyze the challenges of building a legal ontology system, every case is related to other cases and mentioned in different article to support the decision, also every word in the law has various meanings and sometime ambiguous.

An ontology based approach for Tunisian lawyers to find and retrieve legal textual corpuses; especially extraction and information retrieval from legal textual corpuses from sources of jurisprudence is proposed by (Dhouib et al., 2013). The approach focuses on the description of the ontology construction from the jurisprudence decision based on top level ontology as DOLCE and a core legal ontology that we have used. They have not used the ontology at the decision search process.

Legal information system and ontology-based system should not be confused with face-to-face legal advice. In conversation (face-to-face), the advisor will direct question, and maybe checks back, or switch to more adequate language if necessary, and has good chance to detect misconceptions. On the contrary, an information portal

has to work on a more abstract level and without a direct human verification loop. (Francesconi et al., 2010) focus on a legal ontology-based system restricted narrow legal advice at its abstract level and simulate the face-to-face advice.

An ontology framework to improve legal information retrieval is used to overcome, the traditional information system based on keywords for text retrieval, they perform poorly when literal term matching is done for query processing, due to synonymy and ambivalence of words. The ontological framework is used to enhance the user query for retrieval of truly relevant legal judgments. The ontology ensures efficient retrieval by allowing the inferences based on the knowledge of the domain, which are collected during the construction of the knowledge base (Saravanan et al. (2009). Compared to traditional search method making exact matching for keyword, using ontology produces new facts through inference and reasoning.

The Palestinian government ontology framework consists of agreed-upon vocabulary (naming), meaning, structure and business. The ontology is built as asset of subontologies (e.g., Legal Person, Address, Organization, Car, Land, etc.). The framework called Zinnar and tackles the semantic interoperability issues in the government domain in Palestine.

Zinnar is composed of five components: *(i)Government Ontology,* where a meaningful, precise and agreed-upon description of concepts of the Palestinian Government exists, (ii) *Entities,* which contains agreed-upon national classifications and coding and naming schemes, (iii) *Address (Geo-Entities),* where unified addressing data in Palestine is kept, (iv) *Service Repository,* where all governmental services (i.e., business processes) are identified and their as-is and to-be models are specified formally and informally. The repository is also used to publish web services, (v) *Database of State Databases,* which contains information and metadata about all state registries and databases. (Jarrar et al., 2011a, 2011b). So, in our search when building labour law ontology tack the interoperability in consideration, and commitment in unification (i.e. Address, coding, legal person, etc..), the labour law ontology which build in this research differs than Zin focus on derivation a legal advice for users through showing the related article which support legal case, in addition calculating end of services benefits.

The semantic Web is one solution to deal with challenges of traditional search engines and retrieval techniques. Ontologies represents information in a manner so that information can also be readable by machines, automated, integrated, and reused (Jain et al., 2013).

It can be used as a framework to represent implied domain concepts terms in different languages (Abusalah et al., 2009). In the legal domain, there are complex relations with articles and cases, so ontology can add power to represent these complex relations.

(Mezghanni et al., 2014) propose an approach for ontology learning from Tunisian legal texts for the recovery of legal information. It suggests exploiting the user's profile and a mechanism for query reformulation based on ontology learning. The purpose of the system is to satisfy the specific recovery requirement of a user in finding the best answer to a legal question. In our research, we build labour law ontology which contains labour law articles and previous cases as instances to produce labour legal advices for new cases.

A legal recommendation system makes use of the Semantic Web (Kant et al., 2014) and is used for the proactive legal decision making. Lawyer handling a new case can filter out similar cases from the court case repository implemented using RDF. Such a recommendation system helps lawyers to be better prepared with similar judgments in hands which guide them to an improved argumentation**.**

3.2 Ontology in Health Domain

A health advice derivation system takes appropriate advice as to the purpose of the user and the user's health where ontology is introduced into the system to describe knowledge about exercise, meal and user's health. New relationships are on the knowledge found by the deduction system and are eventually provided with advice to the user (Satoru Izumi, 2007). The derivation system shows an appropriated presentation advice for users by asking some question and the system retrieves a better exercise based on health situation which input through the system, this system like self-herbs treatment.

Medical domain can be improved significantly through a coherent whole and unambiguous clinical terminologies based on an ontology for clinical terminology (Abusalah et al., 2009). There is some similarity between medical and legal domains. Both of them have a large number of terminologies, ambiguous with complexity of every word probabilities giving more than one meaning and used in various situations such as one drug used for treatment many illness, and one article is used to support many cases.

In Thailand Thai herbs are used instead of traditional medical treatment. While, there are various Thai herbs sorts, it is difficult to find an appropriate one. In order to help find suitable Thai herbs to cure diseases (Kato et al., 2009; Takumi Kato et al., 2010) develop an e-health system based on ontology and Semantic Web technologies.

3.3 Ontology in Business

In the e-business domain, ontology is used to build the e-catalog system for e-business. An organization has a good command of the knowledge of its markets, customers, products and services, methods and processes, competitors and employee skills. Product information consists of many attributes and relationships between products. For this purpose the ontology can play an important role in the formalization of product information to build e-catalogs (Feng et al., 2010). E-business is large domain and have a lot of attributes and relationships. Also, the legal domain is rich and complex domain, it has many attributes and relations, that can help in driving legal advice.

In addition, in e-commerce, the recommender systems are ontology based and important part of some e-commerce sites such as Amazon.com and Netflix.com. They are real world examples of these systems (Musa MILLI et al., 2016), The main aim of the recommender systems is to find products that the user is interested in and, offer meaningful advice among millions of products (Ricci et al., 2011). Recommender systems have some problem such as news system, new user and new item. They solve these problems by using knowledge base structure of semantic web technology, because the ontologies are knowledge based technologies and achieve meaningful advice.

3.4 Summary

In this chapter, we have presented ontology in various domains such as health, business and legal. We focus on how to use ontology to advice derivation in legal domain, there are many challenges on building these ontologies such complex languages in Chinese legal ontology, unification codes and teams in Palestinian government Ontology, Tunisian legal textual corpuses retrieval. In addition, recommender system is important part in e-commerce such as in Amazon. Also, in Thai herbal domain self-treatment is possible using Thai herbs which reduces cost and the need to visit doctors. All these systems use ontology to produce an advice in one way or another.

Chapter 4
Labour Law Ontology Development

Chapter 4
Labour Law Ontology Development

In this chapter, we present the steps to develop the labour law ontology (*LabourLawOnt)* to be used as a basis to get labour legal advice and speed up the acquisition of related knowledge. We present concrete steps on developing the ontology and realizing it in a specific development environment namely, Protégé.

4.1 *LabourLawOnt* Development

The proposed *LabourLawOnt* ontology is important for giving legal advice in labour legal domain. The ontology content is related to legal domain, specifically from the labour law, and is collected from a number of sources mainly the Palestinian labour law, relevant research papers and documentations related to labour issues and labour laws. The *LabourLawOnt* ontology is developed with the assistance of a domain expert. He helped to identify concepts, relationships, and definitions from the articles of the labour law.

There are many different tools available for developing ontologies such as Hozo, DOML, and Altova Semantic Works etc. We use Protégé which is one of the most widely used ontology development editors that defines ontology concepts (classes), properties, taxonomies, various restrictions and class instances. It also supports several ontology representation languages, including OWL (Jain et al., 2013). We use OWL for representing and modelling the ontology due its ability to express all aspect of the complex labour legal domain and its efficient reasoning and scalability. Building the ontology consists of the following steps (Noy et al., 2001):

Step 1: Determining the domain and scope of the ontology

Step 2: Reuse Existing Ontologies

Step 3: Overview of Ontology

Step 4: Enumerate the Important Terms in *LabourLawOnt*

Step 5: Define Classes and Class Hierarchy of *LabourLawOnt*

Step 6: Define the Properties of classes (Slots)

Step 7: Define the Facets of the Slots

Step 8: Create instances of *LabourLawOnt* .

Step 9: Apply Ontology Reasoner

Step 1: Determining the Domain and Scope of the Ontology

Ontology is an abstraction of the construction of a domain determined by the use to which the ontology will be put and anticipated future extensions. Defining the ontology in the labour legal domain and scope requires answering some basic questions:

1. ***What is the domain that the ontology will cover?***
   The domain of the ontology is Palestinian labour legal domain.
2. ***What is the use of the ontology?***
   The ontology is to provide a knowledge base of labour law, articles, and issues. It will be used in a system for giving legal advices in the labour domain and determine similar legal cases.
3. ***What types of questions would be answered by the information contained in the ontology?***
   The ontology would provide comprehensive answers to questions related to labour legal domain such as:
   - What are the detail of article?
   - What are the articles related to given legal?
   - What are the resignation cases?
   - What are the end of services benefit for unemployed?
   - What are the expected end of services amount for given legal case?
   - What are the expected result of judge for given case?
   - What article supports given case?
   - What are the cases mentioned in the current case?
4. ***Who will use the ontology?***
   The ontology will be available to the *LabourLawOnt* system to be developed in this research to giving legal advice. Users including workers, experts and

specialists in the legal filed. Users who are interested in labour law. Other legal systems related to labour law or needs some relevant knowledge from the labour law.

5. ***Why to develop such ontology?***

By developing the labour law ontology, we can share the common understanding of the structure of the labour legal information among users or related software agents. Different websites may contain variety of details about bulletins of the labour rights awareness, labour law articles, and former cases. Legal information and knowledge retrieval is done through the querying and reasoning as will be explained later. Through ontology such information and knowledge can be aggregated and knowledge published. The users and agents can use this aggregated information to answer user queries or as input data to other applications. The developed ontology can be reused in the future for other purposes. To build a larger ontology, the existing ontologies describing portions of the large domain can be integrated.

Step 2: Reuse Existing Ontologies

With the enormous application of semantic web, ontologies are becoming more widely available. There is no single standard way to develop ontology. It is not necessary to start from scratch always. Some existing legal system; are based on ontology (i.e. Zinnar) and some other just retrieval systems (i.e. Al Mustashar). We have to take advantage of some of the classes and relations and use them to determine the method of building the ontology, as well as to identify some relationships and properties needed to give legal advice.

Step 3: Overview of Ontology

We identify articles, former cases and write some rules that are needed in the process of giving legal advices in our approach. The ontology is represented in OWL. it can be reused by other applications interested in the same domain. We name our ontology *LabourLawOnt* as a short name for Labour Law Ontology. Figure 4.1 illustrates the core classes of the *LabourLawOnt* as well as the relationships among them. It has 250 classes, 15 object properties, and 35 data properties.

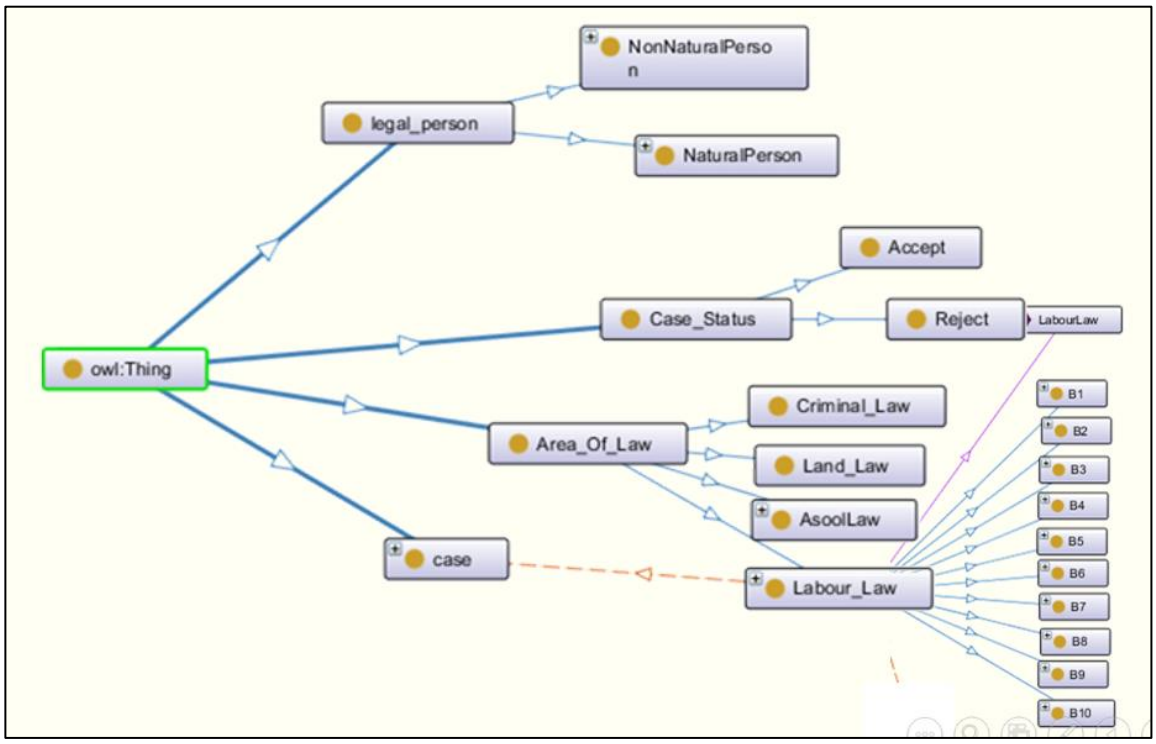


Figure (4.1): Main classes in *LabourLawOnt*

Step 4: Enumerate the Important Terms in the *LabourLawOnt*

We add terms and properties for these terms by studying the Palestinian labour law and some labour cases, and through analyzing the structure of cases and laws. The following questions guide our activity to determine the terms:

1. ***What are the main terms that we need to represent?***

   The main terms we talk about are Case, Area_of_Law, Law_Chapters, Articles, and Legal_Person. Table 4.1 shows these terms, describes each one with its name in English and Arabic, its importance and why we need it in our ontology. Choosing these terms has direct relation with user requirements used in the process of legal advice and search.

Table (4.1): Main Terms in *LabourLawOnt*

No	Term	Full name in English	In Arabic	Importance
1	*Legal_Person*	Legal person	الشخص القانوني	This class clarifies the type of legal person be natural person or company.
2	*Area_of_Law*	Area of law	المجال القانوني	This class is used to classify the type of law in Palestine, such as Labour Law
3	*Case*	Case	القضايا السابقة	This class contains some of previous cases which are classified by the reasoner
4	*Case_status*	Case Status	حالة القضية	This class classifies cases as Accept and Reject.
5	*Labour_Law*	Labour Law	قانون العمل	This class contains all labour law articles, classified to chapters, sections and piece of articles.
6	*CaseCat*	Case Category	تصنيف القضايا	This class is used to classify previous cases to 9 classes.

Step 5: Define Classes and Class Hierarchy of *LabourLawOnt*

This step starts by defining classes. From the list, which is created in Step 3, terms are selected whether they describe objects having independent existence or terms that describe these objects. The terms in Table 4.2 are sub classes in the ontology and will become anchors in the class hierarchy. Classes also are organized into a hierarchical taxonomy.

Table (4.2): LabourLawOnt Sub-classes

No.	Class in English	In Arabic	Description
1	*Area_of_Law*	مجالات القانون	Represents the top class of law types.
2	*Criminal_Law*	القانون الجنائي	Represents the articles of Criminal law.
3	*Labour_Law*	قانون العمل	Represents all articles of labour law.
4	*B1*	الباب الأول	Represents chapter 1.
5	*B11*	الفصل الأول	Represents section 1 of chapter 1 and title.

No.	Class in English	In Arabic	Description
6	*Ar1*	مادة 1	Represents the Articles of law, Code, description and detail.
7	*B12*	الفصل الثاني	Represents section 2
8	*Ar2*	مادة 2	Represents Articles of law, Code, description and detail.
9	*Ar3*	مادة 3	Represents Articles of law, Code, description and detail.
10	*Ar i*	مادة i	Represents Articles of law, Code, description and detail.
11	*B2*	الباب الثاني	Represents chapter 2
12	*B3*	الباب الثالث	Represents chapter 3
13	*Bi*	الباب i	Represents chapter i
14	*Land_Law*	قانون الاراضي	Represents another law "Land Law".
15	*Case*	القضايا السابقة	Represents the previous cases
16	*CaseCat*	تصنيف القضايا	Represents the case types
17	*C1*	نهاية خدمة	Represents the End of Services cases under this class
18	*C2*	فصل تعسفي	Represents the Firing cases
19	*C3*	عمل اضافي	Represents the Overtime cases
20	*C4*	ترك عمل	Represents the Leave cases
21	*C5*	اصابة عمل	Represents the work enjories Cases, same as C4
22	*C6*	استقالة	Represents Resignation cases.
23	*C7*	احداث	Represents the Children Cases
24	*C8*	نساء	Represents the Women Cases
25	*Case_Status*	حالة القضية	Represents the Case status; final Decision: Accepted or Rejected
26	*Accept*	قبول	Represents the Accepted cases

No.	Class in English	In Arabic	Description
27	*Reject*	رفض	Represents the Rejected cases
28	*Legal_Person*	الشخصية القانونية	Represents the stance of legal personality
29	*NaturalPerson*	الانسان العادي	Represents Natural Person with any type of work
30	*NonNaturalPerson*	الشخصيات الاعتبارية	Represents the type of non-natural persons. What type of employer. Classes 30 - 44 express where the employee work, some of these places are not cover by Palestinian labour law such as (LocalGovernmentUnit) Also, some types of work places under the class Shareholding Company differ when calculating the end of services benefits such as banks when year is 14 or 16 month
31	*Association*	جمعية	
32	*CooperativeAssociation*	الجمعية التعاونية	
33	*ForeignNGO*	مؤسسات NGOs الدولية	
34	*LocalNGO*	مؤسسات NGOs المحلية	
35	*CompaniesUnion*	الاتحادات	
36	*Company*	الشركة	
37	*PartnershipCompany*	شراكة	
38	*ShareholdingComany*	شركة مساهمه	
39	*LocalGovernmentUnit*	جهة حكومية محلية	
40	*LocalAdministrativeCommitee*	اللجان المحلية	
41	*MunicipalCouncil*	مجالس البلدية	
42	*VillageCouncil*	المجالس القروية	
43	*ProfessionalAssociation*	الجمعيات المهنية	
44	*ProfessionalAssociationUnion*	اتحاد الجمعيات المهنية	

After the identification of key terms, these terms must be organized in a taxonomic hierarchy. There are three possible ways to develop the class hierarchy: top-down approach, bottom-up approach, or combination of both. It is important to ensure that the hierarchy is a taxonomic hierarchy. That is if B is a subclass of A, then every instance of B must also be an instance of A. Only this will ensure that we follaw the built in semantics of primitives such as *owl:subclassOf* and *rdfs:subClassOf*. In our ontology, we use top-level concepts such as *Area_of_Law*, *Case*, and *Legal_Person*. Area_of_Law as upper classes which consist of the type of law such as labour_law, land_law, criminal_law. Each law type contains sub-classes for example labour_law class is upper class and the law chapters are subclass, a chapter is an upper class for articles. These classes are conjoined together through object properties as shown in the Table 4.3.

Classes are the domain concepts and the building blocks of ontology. In *LabourLawOnt , Area_of_Law, Criminallow, LandLaw, LabourLaw, case, CaseCat, CaseStatus, LegalPerson, NatrualPerson* and *NonNatrualPerson,* are top-level classes of OWL:Thing. Figure 4.2 is a protégé snapshot of the class hierarchy of the ontology.

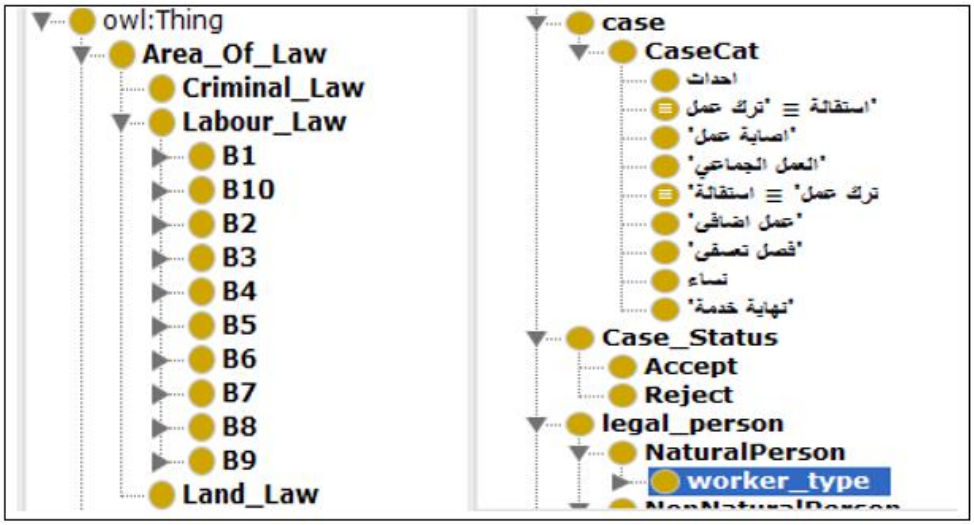


Figure (4.2): Top Level LabourLawOnt Class Hierarchy

A class can have subclasses which represent the middle level Taxonomy. Figure 4.3 shows a taxonomy of *LabourLawOnt*. It has chapters B1 to B10 and legal sections under B11 as sub classes of B1 based on Palestinian labour law.

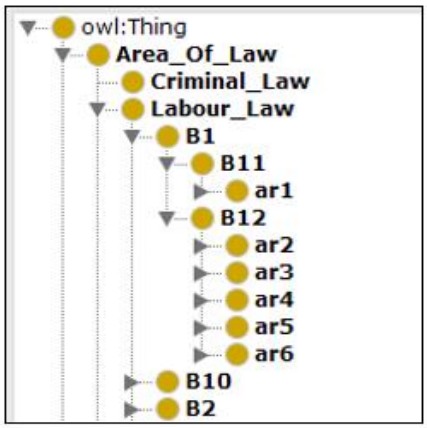


Figure (4.3): Middle level LabourLawOnt Taxonomy

Step 6: Define the Properties of Classes (Slots)

Properties define the relationships between two objects. Object properties are used to link objects to objects. Data Properties are used to link objects to xml schema data

type. Once we defined the classes, we clarify and reflect the internal structure of concepts. This is considered as the property of the developed classes. These properties are extracted from classes and are illustrated in Table 4.3 For Example: Area_of_law have many types of law such as *Criminal_law, Lan_Law and Labour_Law*. Labour_law *have 10 chapters*, and each chapter has one or more sections which include articles. The Figure 4.4 illustrates two object properties: isPart and hasLawType, isPart object property is used when an article is mentioned in the legal case such as (**بالمادة رقم4** وذلك حسب ما ورد), and hasLawType is used to connect a law chapter with labour law.

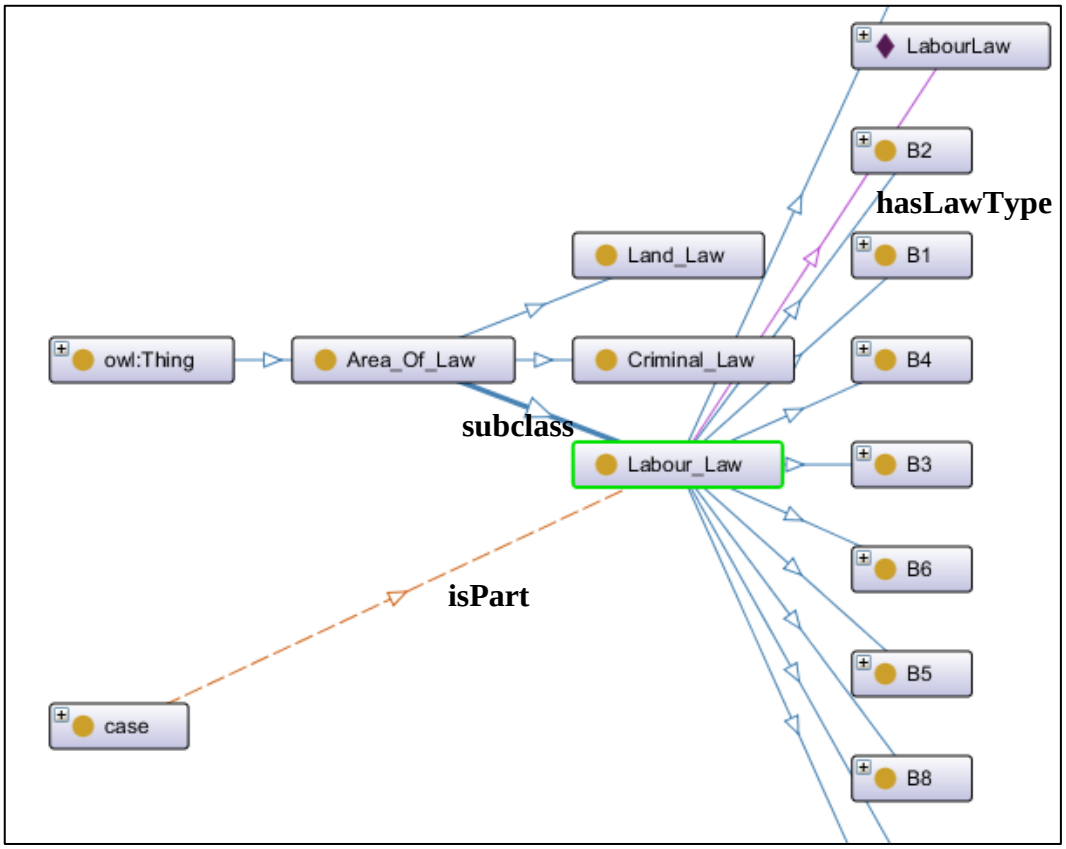


Figure (4.4): *LabourLawOnt* Properties

Table (4.3): *LabourLawOnt* Object Properties

No.	Object Properties	In Arabic	Domain	Range	Characteristic
1	caseCited	مشار لقضية سابقة	Case, caseCat	Some of caseID, caseDecision	-
2	caseType	نوع القضية	Case, caseCat	String	Functional
3	hasArNo	له رقم القانون	Area_of_Law	someLabour_law	-
5	has Article	له مادة قانونية	Area_of_Law	someLabour_law	-
6	hasChapter	مرتبط بباب	Area_of_Law	someLabour_law	-
7	hasSection	مرتبط بفصل	Area_of_Law	someLabour_law	-
9	isEmp	هل هو عامل	NaturalPerson	String	Functional
10	isPart	جزء من	Case	Labour_Law	Functional
11	lawCited	قانون مشار له	Some of Labour_Law	hasDescText	Symmetric
12	lawType	نوع القضية	caseCited	hasLawType	-

LabourLawOnt data properties are defined in Table 4.4. Figure 4.5 shown these data properties and data property description in Protégé editor. It also show *hasCaseID* data property domain is Case and its range is Literal.

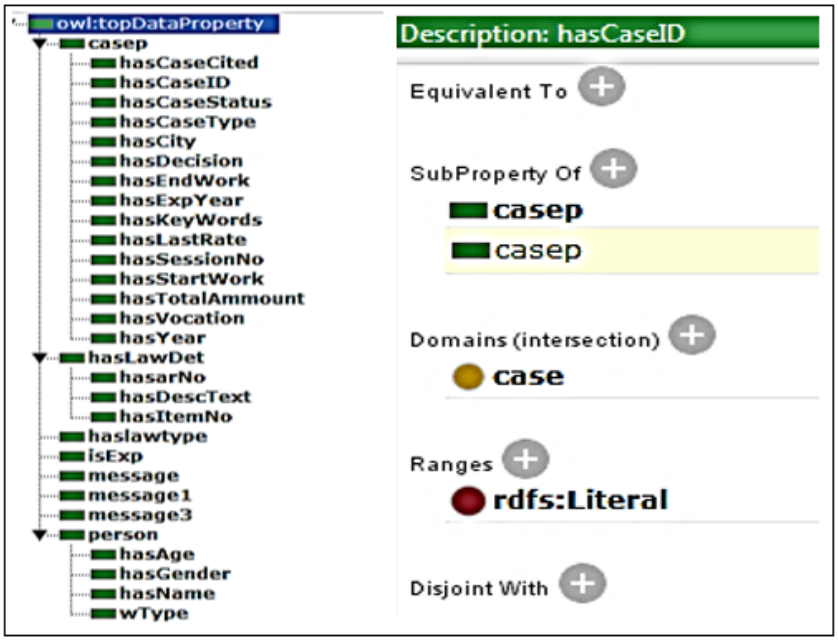


Figure (4.5): Data Properties Hierarchy and Data Property Description

We present more explanation for object properties in the next two example.

Example 1, The *hasArNo* object property links an individual in the domain *Area_of_Law* with class ar2 (article 2). Also, we use data properties for *article* instance as illustrated in Figure 4.6, *hasArNo, hasItemNo and hasDescText*; *hasarNo* to indicate the article number, *hasItemNo* to indicate for the number of paragraph in article – most articles consist of many paragraph (i, ii, iii, ...) shown in Figure 4.10 - and *hasDescText* it is the full text article.

Figure (4.6): Object Property hasArNo

Example 2, The caseCited object property links the current case with another case or cases mentioned in the case. For example, when we take the case (وبالإشارة للقضية رقم 282/2013) caseID 282/2013, the reasoner infers the content of the case 282/2013 as shown in Figure 4.7 between the object property assertions.

Figure (4.7): Object Property caseCited

The labour legal case has some data properties illustrated in Figure 4.7. These data properties describe the legal case such as *hasStartWork* when the worker starts work, *hasCaseID* every legal case has ID consist of serial/year, *hasDecision* show the final decision in the case. The Palestinian labour law in article 4 classifies labour issues into 6 main types the *hasCaseType* indicates the type of the legal case, *hasCaseStatus* is a Boolean data type indicates the case decision is accept or not (true/false), *hasEndWork* the termination work date and *hasLastRate* indicates last salary gained.

Data properties are applicable to each instance of a class. Table 4.4 contains the data properties used in *LabourLawOnt* ontology.

Table (4.4): *LabourLawOnt* Data Properties

No	Data properties	In Arabic	Domain	Range
1	*hasCaseCited*	قضية مشار لها	*Case*	Literal
2	*hasCaseID*	له رقم القضية	*Case*	Literal
3	*hasCaseStatus*	له نتيجة الحكم على القضية	*Case*	Boolean
4	*hasCaseType*	له تصنيف القضية	*Case, caseCat*	Literal
5	hasCity	له مدينة القضية	*Case*	Literal
6	*hasDecision*	له نص قرار الحكم	*Case*	Literal
7	*hasEndWork*	له تاريخ نهاية العمل	*Case*	Literal
8	*hasExpYear*	له عدد سنوات خدمه	*Case*	Literal
9	*hasLastRate*	له اخر راتب	*Case*	Literal
10	*hasSessionNo*	له رقم جلسة	*Case*	Literal
11	*hasStartWork*	له تاريخ بادية العمل	*Case*	Literal
12	*hasTotalAmount*	له مبلغ متوقع	*Case*	Literal
13	*has Arno*	له رقم مادة القانون	*Labour_law*	Literal
14	*hasDescText*	له نص مادة القانون	*Labour_law*	Literal
15	*hasItemNo*	له رقم بند مادة القانون	*Labour_law*	Literal
17	*has Age*	عمره	*NatrualPerson*	Literal
18	*hasGender*	جنسه	*NatrualPerson*	Literal
19	*hasName*	اسمه	*NatrualPerson*	Literal

20	*Message1*	عرض المادة/المواد القانونية الداعمة للقضية		Literal
21	*Message2*	عرض المادة/المواد القانونية المشار اليها		Literal
22	*Message3*	عرض قضية سابقة		Literal
23	*Message4*	عرض النصيحة القانونية		Literal

The data properties illustrated in Table 4.4 are comprehensive to cover labour ontology. By analyzing the legal case shown in Figure 4.8, it consists of the following data properties:

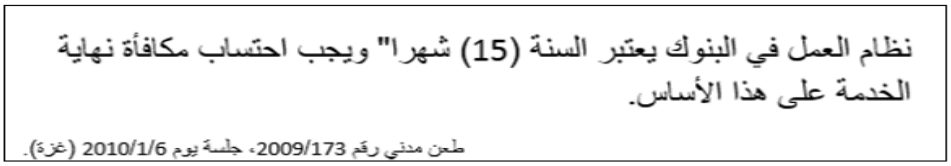
أخطأ الحكم المطعون فيه حين احتسب بدل الساعات الإضافية على أساس الراتب الأساسي فقط دون العلاوات لمخالفته لنص المادة (71) فقرة (2) من قانون العمل التي نصت على "يدفع للعامل أجر ساعة ونصف عن كل ساعة عمل إضافية" والمادة (1) التي عرفت الأجر أنه "الأجر الكامل هو الأجر الأساسي مضافا إليه العلاوات والبدلات، كما لا يمتلك الحكم الطعين التدخل في قناعة محكمة الموضوع بتحديد عدد ساعات العمل الإضافية ثم تخفيضها مما يتعين معه نقض الحكم وإعادة الملف 2012/567 لمحكمة الاستئناف لنظره من هيئة مغايرة.

طعن مدني رقم 2013/343، جلسة يوم 2013/12/18 (غزة).

Figure (4.8): Sample of Labour Case

hasCaseID, hasCaseCited, hasCaseStatus, hasCity, hasDecision, hasSession, hasStartWork, hasEndWork, hasArno. The property *hasCaseID* has value 343/2013, *hasCity*: غزة, *hasSession*: 2013/12/18, *hasCaseStatus*: قبول, *hasDecision*: full text, *hasCaseCited*: 567/2012, *hasArNo*:71 .

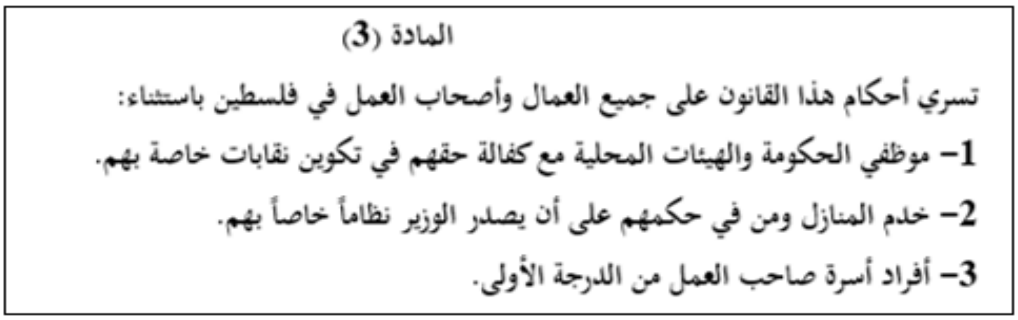
We have four data properties namely message 1, message 2, message 3 and message 4 used to return messages to the user. Message 1 returns law articles supporting current case, message 2 returns the full text of the article cited, message 3 returns the full text of the case cited and message 4 returns the legal law advice. Also, the data property *hasTotalAmount* is used to return expected amount based on a SWRL rule calculation. Also, the message returned is based on SWRL rule. As show in Figure 4.9 the worker works for a bank, so the end of service benefits will consider the number of months of the years as 15 months not 12 months. It returns *hasTotalAmount* based on *hasLastRate* data property.


نظام العمل في البنوك يعتبر السنة (15) شهرا" ويجب احتساب مكافأة نهاية الخدمة على هذا الأساس.

طعن مدني رقم 2009/173، جلسة يوم 2010/1/6 (غزة).

Figure (4.9): Returned Result Labour Case for Bank Employee

Figure 4.10, show an article data properties: *hasArNo, hasItemNo, hasDescText*. *hasArNo* is: 3, *hasItemNo*: 1, *hasDescText*: most articles consists of paragraphs such as موظفي الحكومة والهيئات المحلية مع كافة حقهم في تكوين نقابات خاصة بهم .


المادة (3)

تسري أحكام هذا القانون على جميع العمال وأصحاب العمل في فلسطين باستثناء:

1- موظفي الحكومة والهيئات المحلية مع كفالة حقهم في تكوين نقابات خاصة بهم.

2- خدم المنازل ومن في حكمهم على أن يصدر الوزير نظاماً خاصاً بهم.

3- أفراد أسرة صاحب العمل من الدرجة الأولى.

Figure (4.10): Returned Labour Law Article

Figure 4.10 shows article 3 of Palestinian labour law applied to all work types except the government employees, municipal employees, maids, business owners and employees first degree relatives.

Step 7: Create Instances of *LabourLawOnt*

Adding individual classes to the ontology creates a knowledge base. We use the ontology to organize sets of instances. Since the number of instances in *LabourLawOnt* is quite large compared to the number of classes. The creation of individuals allows for all the properties of the classes to be recorded through adding various types of previous legal cases which help a lot when a driving legal advice.

We defined around 264 instances that are representing all ontology concepts in labour law and cases including previous one. An example of instances is *Case* which contains 50 case instances. One of these case instances is shown in Figure 4.11.

إعمالا" لقاعدة العقد شريعة المتعاقدين فإن عقد العمل المحددة المدة لا ينتهي إلا باتفاق الطرفين أو بانتهاء مدته ، وحيث لم يثبت وجود اتفاق على إنهاء العقد حيث الثابت إنهاءه من جانب صاحب العمل خلافا" للعقد ولأحكام المادتين (40) و (41) من قانون العمل فإن صاحب العمل ملزم بدفع أجر العامل عن كامل مدة العقد وهي سنة كاملة ، وبما أن الثابت في الأوراق أن المدة التي أمضاها العامل هي 4 شهور + 18 يوما" فإن المحكمة تقضي للمدعي بهذا البند (بدل أجرة) أمام بالنسبة لمكافأة نهاية الخدمة فلا تحسب لأنه لم يمض سنة كاملة في العمل.

طعن مدني رقم 2010/20، جلسة يوم 2012/5/15 (غزة).

Figure (4.11): Labour Case Example

This case refers to the end of service benefit and it refers to two articles 40 and 41. The object property *lawCited* which is present in Table 4.3 is used to connect this case with an article.

Figure 4.11 present the final decision: labour case instance is rejected case is incompatible with articles 41, 42. The worker worked 4 months and 18 days and has not proved the contract termination by the owner, therefore the employee shall not receive end of service benefit.

Individuals are defined based on the ontology and constitute a vital part of the knowledge base. All labour law articles are individuals Figure 4.12 shows article 2 as instance, the object property *hasArNo* has value ar2 is used to connect the article details with article 2.

Figure (4.12): hasArNo Object Property

Each article uses the object property *hasArNo* as shown Figure 4.14, and three data properties; *hasarNo, hasItemNo and hasDescText*. These properties are explained as follaws:

- *hasarNo:* refers to the article number of law such as Article 45.
- *hasItemNo*: an article paragraph number is important to determine the part of article mentioned in the case. Figure 4.13 shows the article to consist of multi paragraphs in article 22.
- *hasDescText:* refers to the legal text of an article, and its meaning or expression as shown in Figure 4.14 article 2 instance in Protégé.

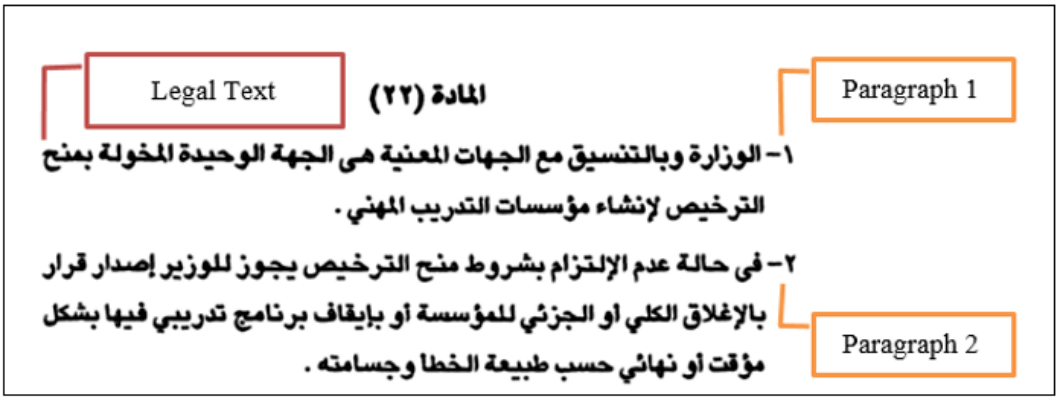


Figure (4.13): Article 22 of the Palestnnian Labour Law

Figure (4.14): Indiviual Example for Article 2 in Protégé

Step 8: Apply Ontology Reasoner

After creating instances, we apply an ontology reasoner (namely Pellet reasoner) on the ontology. This is necessary to identify new relations from existing ones. The reasoner may identify new inferences such as the articles mentioned in the legal case based on case type, decision case full text for cited cases and driving the legal advice. Figure 4.15 shows the new reasoner infers: case accept, articles used is labour law, worker is natural person not firm and the case type is work injury.

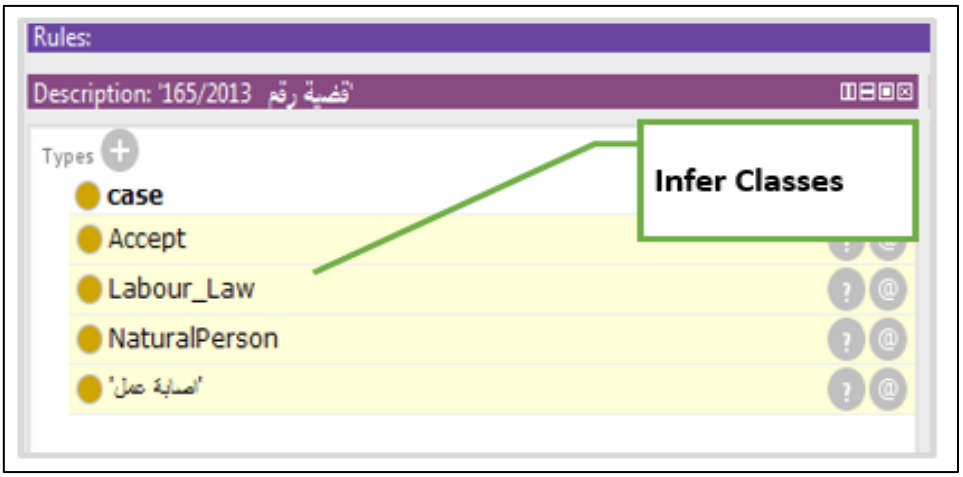


Figure (4.15): Inferring Hidden Knowledge

4.2 SWRL rules

SWRL is a Semantic Web language combining OWL DL with function-free Horn logic and is written in Unary/Binary Datalog RuleML. A rule in SWRL has the form

$$B1, \ldots, Bn \rightarrow A1, \ldots, Am$$

where the commas are conjunctions and A1, . . . , Am, B1, . . ., Bn can be of the form C(x), P(x, y), sameAs(x, y), or different From(x, y), where C is an OWL description, P is an OWL property, and x, y are Datalog variables, OWL individuals, or OWL data values. Despite of the complexity of the SWRL language, it has features which adds significant expressive power to OWL.

Figure 4.16 illustrates inferred hidden knowledge related to legal case ID 165/2013. The messages from 1 to 4 are data properties to present inferred. *Message 1* shows a full text articles supporting the legal case for instance 47, 123, 124, 125 that are inferred from Palestinian labour law individuals, *message 2* show a full text articles mentioned by object property *lawCited* and has value article 120 which present how to calculate compensation amount, *message 3* shows a full text for any cases cited by object property *caseCited* and has value 78/2008 and *message 4* presents the legal advice based on the attribute inputs. Also, the object property *isEmp* has value *wo1* which indicates the worker is covered by the Palestinian labour law like Figure 4.15 the same case ID 165/2013 the inferred result case is accepted.

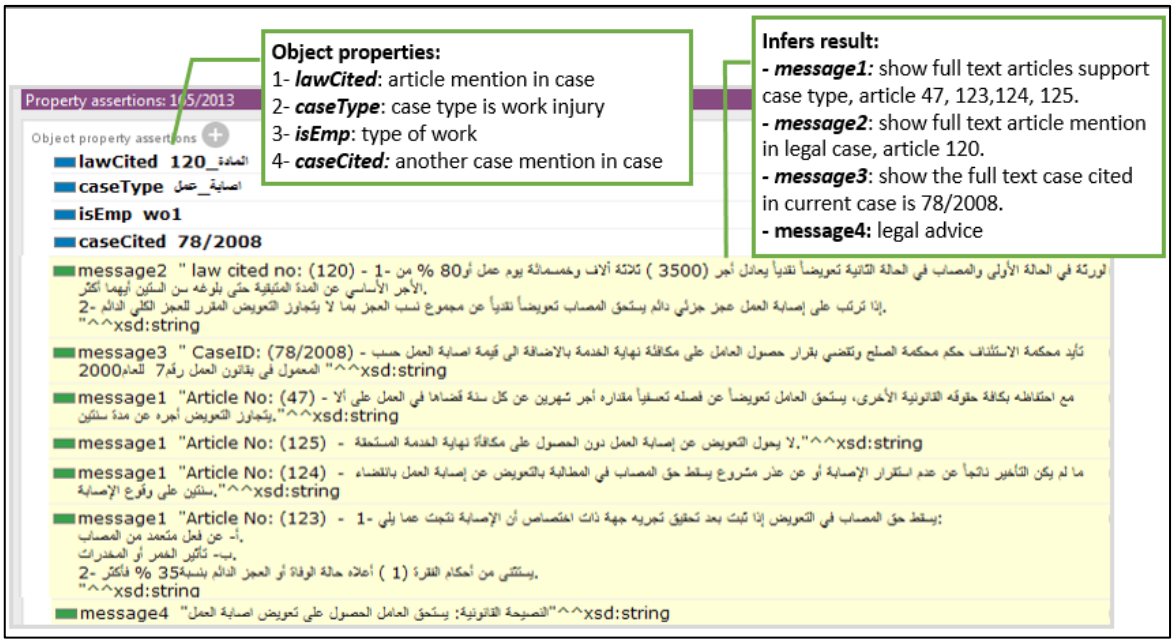


Figure (4.16): Reasoner Results

Also, we present inferred result for the expected amount for end of service benefit in data property *hasTotalAmount* by SWRL rule. This amount calculated based on the years of work. The Palestinian labour law specifies the end of service benefit for a working period of more than one year as indicated by Rule 1, Rule 2 and Rule 3 explained next.

Figure 4.17 shows paragraph 2 of article 42 of the Palestinian labour law which define how calculate the end of service benefits for workers.

٢- استثناء مما ورد في البند (١) أعلاه يحق للعامل إذا استقال من عمله خلال السنوات الخمس الأولى ثلث مكافأة نهاية الخدمة، وثلثي مكافأة نهاية الخدمة إذا كانت الاستقالة خلال السنوات الخمس التالية، ويستحق المكافأة كاملة إذا أمضى عشر سنوات أو أكثر في العمل.

Figure (4.17): Paragraph 2 of Article 42

- Rule 1: 33% of the end of service benefits amount for those who work less than 5 years,
- Rule 2: 66% of the end of service benefits amount for those who work between 5 to 10 years and

- Rule 3: 100% of the end of service benefits amount for who work 10 or more year.

These three rules are written in SWRL as follaws:

Rule 1: case(?p), xsd:integer[< 5](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?salary), hasStartWork(?p, ?syear), swrlb:multiply(?x, ?salary, ?exp), multiply(?y, "0.33"^^xsd:double, ?x), swrlb:subtract(?exp, ?eyear, ?syear) -> hasTotalAmount(?p, ?y)

Rule 2: case(?p), xsd:integer[> 5](?exp), xsd:integer[<= 10](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?salary), hasStartWork(?p, ?syear), multiply(?x, ?salary, ?exp), swrlb:multiply(?y, "0.66"^^xsd:double, ?x), subtract(?exp, ?eyear, ?syear) -> hasTotalAmount(?p, ?y)

Rule 3: case(?p), xsd:integer[> 10](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?salary), hasStartWork(?p, ?syear), multiply(?y, ?salary, ?exp), swrlb:subtract(?exp, ?eyear, ?syear) -> hasTotalAmount(?p, ?y)

Example 1: The Palestinian labour law prevents children form work. So if the case is a child worker, he does not get end of services benefits. So, the legal advice returns 0 amount for end of services benefits. Rule 4 is written to reflect this law as indicated by article 93 shown in Figure 4.18.

المادة (٩٣)

يحظر تشغيل الأطفال قبل بلوغهم سن الخامسة عشر.

Figure (4.18): Article 93 of the Palestinian Labour Law

Rule 4: case(?p), xsd:integer[> 15](?age), hasAge(?p, ?age), -> hasTotalAmount(?p, 0), message4(?p," بناء على قانون العمل الفلسطيني لا يستحق العامل مكافئة نهاية خدمة كونه اقل من 15 سنة")

Example 2: Every legal case should be supported by related articles based on the case type. So, if the case type is work injury, the reasoner infers the full text articles

with this case type. In the Rule 5 the *message1* data property presents the full text of the article supporting the case which is shown in Rule 5 and Figure 4.19.

Rule 5: Labour_Law(?i), case(?r), hasCaseType(?r, ?x), hasarNo(?i, ?n), hasDescText(?i, ?t), hasDecision(?r, ?d), swrlb:contains(?t, ?x), swrlb:stringConcat(?y, "Article No: (", ?n, ") - ", ?t) -> message1(?r, ?y)

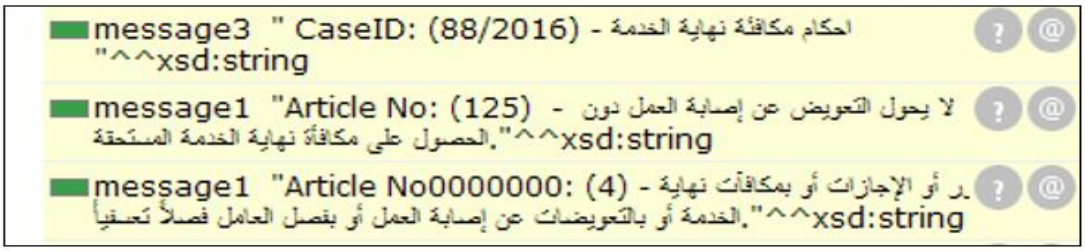


Figure (4.19): Reasonring Results

4.3 Summary

In this chapter, we have explained the development and evaluation of the *LabourLawOnt* . We have explained the steps to build the ontology. At the beginning, we identified the domain and scope of the ontology. Then we defined the terms and the properties. We have used the ontology development environment protégé OWL to implement and realize the ontology. We have added individuals to *LabourLawOnt* ontology create the needed knowledge. We applied reasoner ontology to check the consistency of the ontology and identifying new relations based on existing ones. Finally, we defined and wrote a number of SWRL rules related to the ontology and added individuals including legal articles and cases.

Chapter 5

LabourLawOnt System

Chapter 5

LabourLawOnt System

In this chapter, we present in details the *LabourLawOnt* system prototype to realize the proposed approach for deriving the legal advice in Palestinian labour law. The development of the system consists of three phases: system analysis, system design and system implementation. The system design phase constitutes the effort of the proposed legal advice approach. It brings together the main components that make up the derivation of the article namely the knowledge base (the ontology and the legal instances), SWRL Rules, the reasoner as well as the querying interface. In the following three sections, we describe each phase.

5.1 System Analysis

In this section, we present a complete description of the behavior of *LabourLawOnt* system including a set of use cases that describe the interactions as well as the functionality which impose constraints on the design and implementation of the system.

5.1.1 Overall Description

We develop a system prototype for the ontology-based labour legal advice that automatically derives legal advice based on the rules of the Palestinian labour law. To satisfy this goal we divide the system into the following four components:

1- User Interface: to allow users to interact with the system and enter legal data and get the legal advice.

2- *LabourLawOnt* Ontology and knowledge base: to identify labour law articles and previous legal case. It is the core of the approach it was covered on chapter 4.

3- Labor Law Rules: SWRL rules are designed based on the Palestinian labour law.

4- Labour Legal Advice Engine: to derive a legal advice through inferring hidden knowledge based on SWRL rule, reasoner, legal ontology and knowledge base which included enriched instances of articles and pervious legal cases.

5.1.2 System Functions

We visualize the system functions and requirements by drawing use case diagrams, which contain primarily actors and use cases. Actors are entities that interact with the *LabourLawOnt* system, while use cases are the system functions related to legal advice derivation actors involve. The *LabourLawOnt* system needs the following use cases:

Use case	Actor	Figure No.
Display the legal case by browsing	Specialist (Lawyer, judge)	5.1
Derivation of labour legal advice	Worker	5.2
Add new legal labour case	Administrator	5.3
Update legal labour case	Administrator	5.3

- **User Characteristics**

Two type of users are started; worker and specialist. Worker should be familiar with computer system and specialist (lawyer or judge) should be familiar with the labour law and its terminology.

- **Principal Actors**

The two principal actors in *LabourLawOnt* system are the users (worker, Lawyer and judge) and the administrator.

5.1.3 Specific Requirements

This section presents the specific requirements of *LabourLawOnt* system that covers its various functions, as follaws:

- The system shall enable the lawyer and the judge to display the cases by browsing case category, mention case and article and related supporting case as shown in use case 1 in Figure 5.1.
- The system shall enable the worker to get the labour advice for his case as shown in the use case 2 in Figure 5.2.
- The system shall enable the administrator to add new labour case as shown in the use case 3 in Figure 5.3.
- The system shall enable the administrator to update a labour case as shown in the use case 4 in Figure 5.3.

Next, we describe each of these functional requirements and their respective use cases through defining interactions between a role and *LabourLawOnt* system.

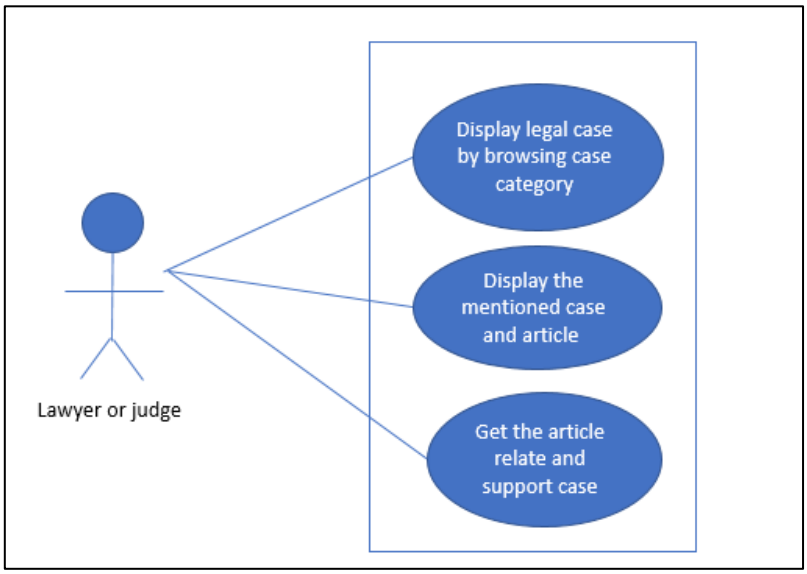


Figure (5.1): Specialist (Lawyer or Judge) Legal Case Reviews Use Case

Use case 1: Displays the categories of labour legal cases by browsing, as shown in Figure 5.1.

Primary Actor	Specialist (Lawyer or Judge)
Main scenario	1- User selects one category case from the case list. 2- User selects one case related to the case category. 3- System displays the cases full text, mentioned (articles and another case) in the case and related articles to case.

Use case 2: Derivation of labour legal advice, as shown in Figure 5.2.

Primary Actor	Workers
Main scenario	1- Select work type from a list, if type is not supported in labour law, system will return error message. 2- Enter start date, end date, last salary, gender and age if selected is age under 15, system returns error message. 3- Enter contract type, contract method, legal deadline, yearly vacation, religious vacation and cultural vacation. 4- Select reason behind leaving the work. 5- Display the appropriate labour legal advice and articles supporting the case.

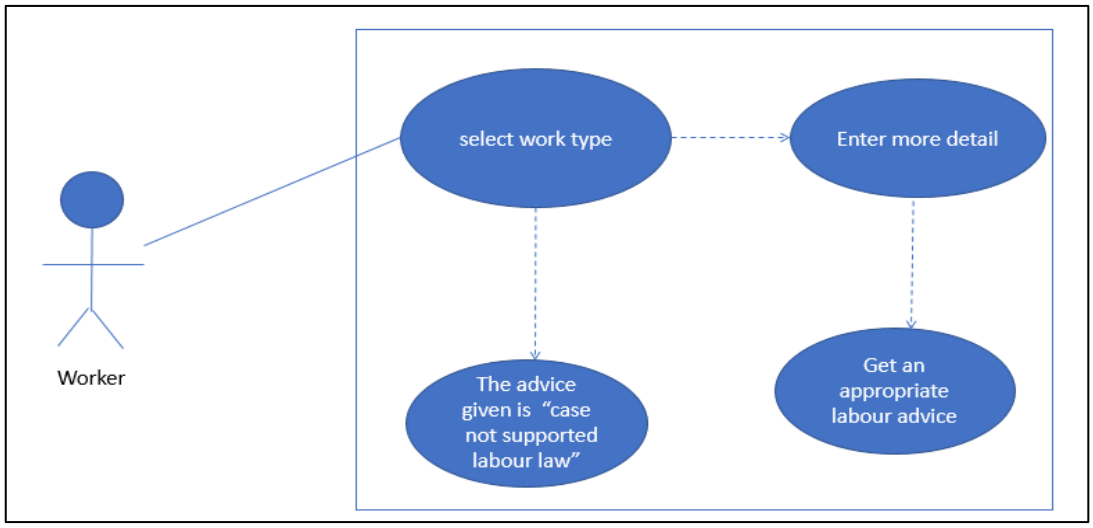


Figure (5.2): Worker is Given a Legal Advice Use Case

Use case 3: Add a new legal labour case, Figure 5.3.

Primary Actor	Administrator
Main scenario	1- Administrator adds new labour case information. 2- System displays the form to add the labour case information contains the follawing: Table 3 and 4. 3- Administrator enters the labour case information and submits.
Alternate scenario	1- If the labour case exists, the system gives hints to the administrator such as "This Case already exists".

Use case 4: Update legal labour case, Figure 5.3.

Primary Actor	Administrator
Main scenario	1- Administrator updates the labour case information. 2- System displays the form to add the labour case information contains the follawing: Table 3 and 4. 3- Administrator enters the labour case information and submits.

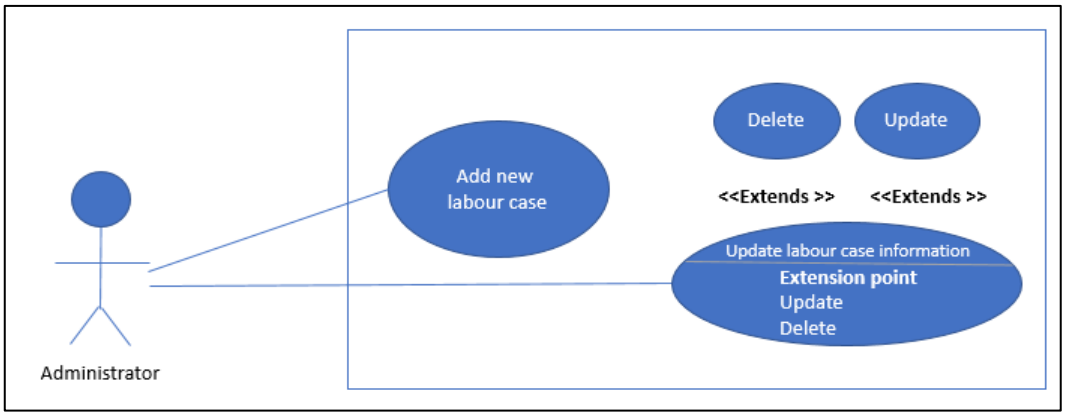


Figure (5.3): Administrator Use Case

5.2 System Architecture and Design

In this section, we present how the system is designed to satisfy requirements identified in the previous phase. The requirements, identified in the system analysis phase, are transformed into system design that accurately describes the approach and that can be used in the system implementation in the next phase. We start the design by the system architecture which essentially reflects the proposed approach. We provide a detailed description of the labour law advice system and its abstract main components. The system architecture which is shown in Figure 5.4 presents the components and dependencies and interactions among them. It consists of five components. Next, we explain the design of each one:

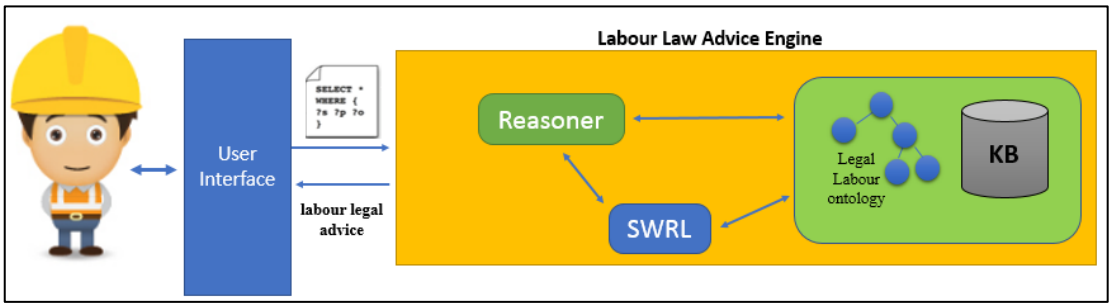


Figure (5. 4): Labour Law Advice System Architecture

5.2.1 User Interface

We have two interfaces. The first is the specialist interface (lawyer or judge interface) to help them in browsing legal cases based on six case categories which are wages, vacations, end of service benefits, injury, fired and compensation as classified by the Palestinian labour law in law article no. 4. To get an accurate browsing we add new

categories such as child and woman Figure 5.5 shows the interface with six elements as follaws:

1- legal case categories which allows the specialist to pick out of the above legal case categories (the 6 classified by the law and additional two we added, child and woman).
2- Case ID which allows the specialist to pick out of the above cases which populated based on DL-Query in case categories.
3- Presenting a full text case decision for selected case ID.
4- Presenting all articles which are mentioned in selected legal case by object property *lawCited* based.
5- Presenting all legal cases which are mentioned by object property *caseCited* for pick out the above legal case.
6- Displaying inferring law articles related and supporting the selected cases based on object property *caseType*.

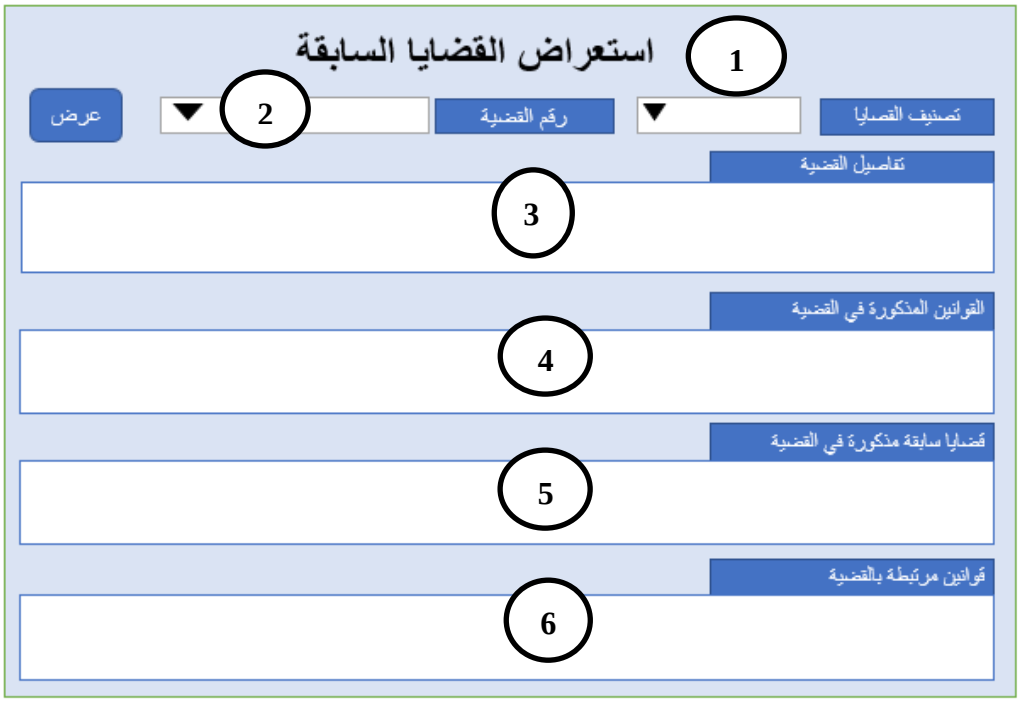


Figure (5. 5): Case Retrieve Interface for Specialist (Lawyer or Judge)

The second is the worker interface which consists of five tabs/steps as shown in Figure 5.6. Each one allows the worker to answer some question such as work type, start date, end date, last salary, age, gender and contract type. In Figure 5.6 the final result tab is highlighted to show the given legal advice together with articles

supporting the worker case based on his answers to the questions posted on steps 1 to 4 which are related to the pre-designed rules based on Palestinian labour law. More on these steps/tabs can be found on Section 5.3.1.

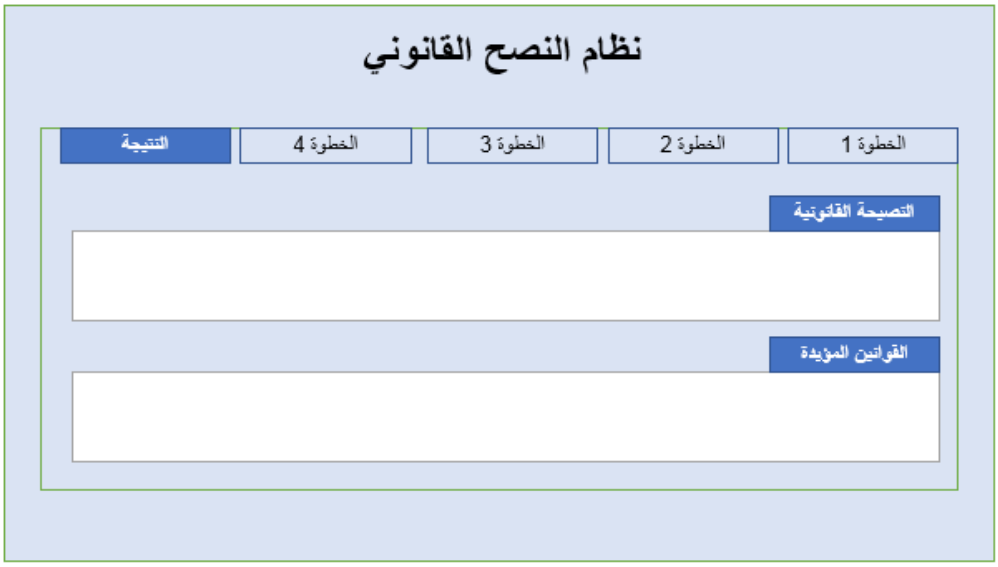


Figure (5. 6): Advice Derivation – Result Interface

5.2.2 SWRL Rules

We design needed labour SWRL rules based on the Palestinian labour law as discussed in Section 4.10 and Section 4.3.1. the system depends heavily on SWRL rules they derive the reasoning needed for extracting and inferring legal knowledge from the knowledge base. They are used to related user entered legal information with existing legal articles and cases found in knowledge base. As an additional example, we present a SWRL rule for article 45 of the Palestinian labour law as shown in Figure 5.7. The article 45 says " if the worker worked for one year, he/she shall get end of service benefits of one month salary for each year worked based on the last salary without calculating additional working hours".

المادة (٤٥)

للعامل الذى أمضى سنة من العمل الحق في مكافاه نهاية خدمة مقدارها أجر شهر عن كل سنة قضاها فى العمل على أساس أخر أجر تقاضاه دون احتساب ساعات العمل الإضافية، وتحتسب لهذا الغرض كسور السنة .

Figure (5.7): Article no. 45 of the Palestinian Labour Law

This various information found in the article is written in the following rule.

Rule 1: case(?p), xsd:integer[=1](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?salary), hasStartWork(?p, ?syear), swrlb:subtract(?exp, ?eyear, ?syear) -> hasTotalAmount(?p, ?salary)

5.2.3 Reasoner

We use a resoaner to infer logical consequences from a set of asserted facts or axioms related to legal articles and cases in the knowledge base and written in various rules. After worker completed questions in the steps 1 to 4 (shown in Figure 5.6 and explained above), the reasoner (i.e. Pellet Reasoner) uses the ontology concepts and their relationships and the rules in the knowledge base to produce the legal advice for the specific case. After running the reasoner over the ontology and SWRL rules, all inferred knowledge is stored as values for inferred data properties inferred knowledge include end of service benefits and case decision being accepted or not. For example, *hasExpYear* is inferred data property used to calculate end of service benefit amount using SWRL rules based on start and end date work entered by the worker.

5.2.4 Legal Labour Ontology

LabourLawOnt ontology contains Palestinian labour law articles and pervious labour case information and the relations among them. Instances are used to identify the article, similar legal case and information that is needed in the process of derivation of labour advice. We explained the design of *LabourLawOnt* ontology in Chapter 4.

5.2.5 Knowledge Base (KB)

The knowledge base is built using OWL ontology. It consists of the ontology and enriched with 50 individuals related to previous legal labour cases and 114 articles included in the Palestinian labour law. More details on creating the knowledge base together with labour law article individuals as well as legal case individuals can be found in Section 4.1 Step7: Creating Instances of *LabourLawOnt.*

The knowledge base (*LabourLawOnt* together with labour law articles and legal cases), the SWRL Rues, and the Reasoner from the labour law advice Engine which is the core of the system. The user, specialist or worker interacts with engine to view

legal knowledge and to get legal advice. Next we discuss the implementation of these components forming a system prototype.

5.3 System Implementation

In this section, we present how the system is implemented according to the previous design of labour legal advice system components. Design is implemented in the following steps and translated into code and functional interfaces.

5.3.1 User Interface

The design of the user interface in Section 5.2.1 is realized as show in Figure 5.8 illustrates that the user interface contains six parts. First part is a list of case categories. The second part is for displayed the case ID related to case category. The third part is for displaying full text labour cases which are selected in part one. The fourth part is for displaying the mentioned articles. The fifth part for displaying mentioned cases for the selected case respectively. The sixth part is to display inferred articles related to the case type selected before. In the implementation of this interface we create, a GUI form containing that six parts. It is special for lawyer and judge, as in the next example which is also shown Figure 5.8.

Example: The lawyer or judge selects case category as work injury. Part 2 in Figure 5.8 displays all case IDs related to the selected case category. When selecting one case ID the full text case is displayed in the part 3 as shown the Figure 5.8. The case text defines how to deal with work injury and end of service benefits. Also, this case mentions both article no. 120 and pervious with case ID 78/2006. Also, the part 4 and part 5 display the full text for both articles and cases mentioned in the selected case. This exempts the specialist from returning these related information manually search. Finally, the part 6 displays other articles supporting the kind of case selected. these related articles in this injury case category include articles 47, 124, 129, 130 based on Palestinian labour law.

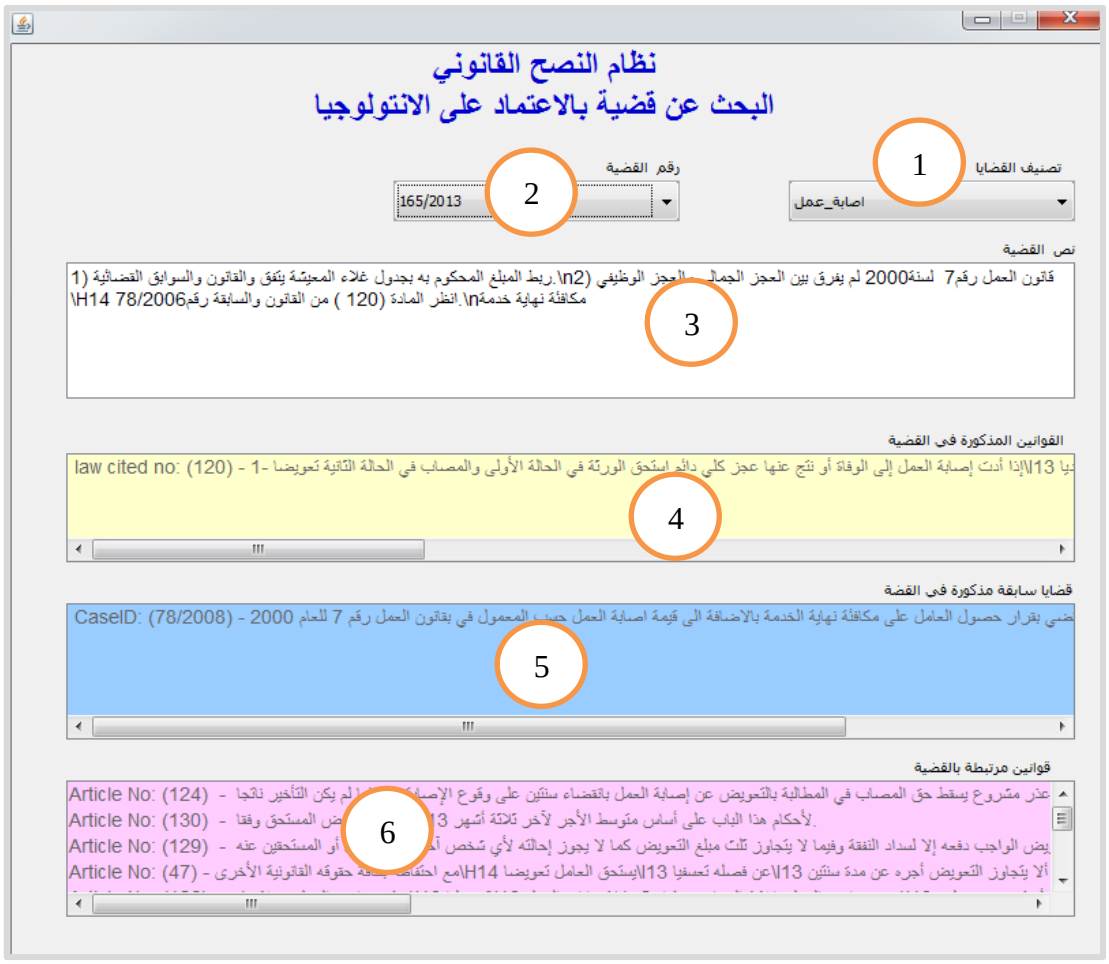


Figure (5.8): Labour Case Retrieve Based on Ontology

The second part of the user interface is the worker interface. The worker can use it to look for labour legal advice as shown in Figure 5.9. It illustrates that the worker interface contains five tabs (steps). For example, in the first step the worker select the work type, if it is not supported in the Palestinian labour law, the system show the result " بناء على متقدم من معلومات لا ينطبق عليك قانون العمل الفلسطيني رقم 7 لسنة 2000 وذلك حسب المادة رقم 3" based on the information the Palestinian labour law is not supported your case based on article 3 and the system justified it through displaying article 3 as presented in Figure 5.9.

Figure (5.9): The Labour Legal Advice Result

If worker selects a work type supported by the Palestinian labour law, step 2 (الخطوة 2) enables the worker to enter some work details such as start and end dates, gender, last salary and age as show in Figure 5.10.

Figure (5.10): Work Details Setp in the Worker Interface

Also, the Palestinian labour law prevents children from work. Figure 5.11 presents a worker with age under 15. The system displays, based on SWRL rules and reasoner infer; the legal advice " بناء على ما تقدم من معلومات وحسب قانون العمل الفلسطيني رقم 7 لسنة 2000

93 رقم المادة حسب وذلك خدمة نهاية مكافأة تستحق لا". This is article 93 prevents the work of children under 15 years, in addition displaying related articles 94, 95, 96 and 97 which control the work of children such as the work environment, count of work hours and vacations.

Figure (5.11): Legal Advice Preventing Children from Work

Figure 5.12 shows step 3 (الخطوة 3) in the worker interface implemented in such a way the continues the question answering about the contract type, contract method, legal deadline, yearly vacation, official vacation and cultural vacation.

Figure (5. 12): The Contract Type, Method and Vacation (Step 3)

The implementation of step 4 (4 الخطوة) results in the interface shown in Figure 5.13 which contains 3 questions about contract termination reason, work leave reason and firing reason.

Figure (5.13): The Contract Termination Reason (Step 4)

Part of the codes of these interfaces in Java is illustrated in Figure 5.14. It defines *getExp* method to check whether the worker is excluded from the labour law and the

data property *isExp* with the individual *workType*. The reasoner returns the values of selected properties on the individual. The *getExp* method returns true if the values of selected properties are true.

```
    jLlawcited.setModel(model);
}
public boolean getExp(String workType) {
    OWLDataProperty hasDecision = factory.getOWLDataProperty(":isExp", pm);
    OWLNamedIndividual workTypes = factory.getOWLNamedIndividual(":" + workType + "", pm);
    String result = "";
    for (OWLLiteral value : reasoner.getDataPropertyValues(workTypes, hasDecision)) {
        result = value.getLiteral();
    }
    if (result.equalsIgnoreCase("true")) {
        return true;
    } else {
        return false;
    }
}
public void getworkType() {
    OWLClass CaseClass = factory.getOWLClass(":worker_type", pm);
    for (OWLNamedIndividual Case : reasoner.getInstances(CaseClass, false).getFlattened()) {
        jComboBox1.addItem(renderer.render(Case));

    }
```

Figure (5.14): Check The Worker is Excluded From The Labour Law

5.3.2 SWRL Rules

We implemented the designed needed SWRL rules (presented in Section 2.10 And Section 4.2). to display related articles supporting a legal case, and Figure 5.15 shows an article 93 related to preventing the work of children, designing as SWRL rule in presenting in Protégé and it is implemented based on the code showing in the Figure 5. how to use the getOWLDataPropertyValues() stored in data property *message 1* to show a full text of article law and *hasTotalAmount* to show the end of service benefits calculated by SWRL rule as shown in Figure 5.16, also a datatype property is one of two main categories of properties. It links individuals to data values, and is defined as an instance of the built-in OWL class owl:DatatypeProperty.

المادة (93)

يحظر تشغيل الأطفال قبل بلوغهم سن الخامسة عشر.

Figure (5.15): Article 93 of the Palestinian Labour Law

Rule 1: Case(?c), hasAge(?p, ?age), xsd:integer[> 15](?age) -> message1(?c, " يحظر تشغيل الأطفال قبل بلوغهم سن الخامسة عشر")

Figure (5.16) shows a Java code to calculate the end of service total amount though the data property *hasTotalAmount* and with the help of the reasoner.

```
OWLDataProperty hasTotalAmmount = factory.getOWLDataProperty(":hasTotalAmmount", pm);
OWLNamedIndividual TotalAmmount = factory.getOWLNamedIndividual(":" + jCBcaseNo.getSelectedItem().toString()

for (OWLLiteral value : reasoner.getDataPropertyValues(TotalAmmount, hasTotalAmmount)) {

    jLTotalAmmount.setText(value.getLiteral());
}
//*********************************************************

OWLDataProperty message = factory.getOWLDataProperty(":message 1", pm);
OWLNamedIndividual hasmessageValue = factory.getOWLNamedIndividual(":" + jCBcaseNo.getSelectedItem().toString

for (OWLLiteral value : reasoner.getDataPropertyValues(hasmessageValue, message)) {

  model.addElement(value.getLiteral());
}
```

Figure (5.16): End of Service Benefits Calculation

5.3.3 Reasoner

When running the reasoner new and hidden facts are inferred based on SWRL rules and relations among classes through object properties as presented in Section 4.2, Figure 5.17 presents inferred facts by the reasoner for legal case ID 165/2013. The messages from 1 to 4 are data properties presenting inferred results such as: *message 1* show a full text articles support the legal case for instance 47, 123, 124, 125 that are infers from Palestinian labour law individuals, *message 2* show a full text articles mention by object property *lawCited* has value article 120 is present how calculated compensation amount, *message 3* show a full text for any case cases cited by object property *caseCited* has value 78/2008 and *message 4* is presents the legal advice based on the attributes inputs, also the object property *isEmp* has value wo1 is indicate the worker is covers by Palestinian labour law and the Figure 5.17 illustrate infer result is accept case . Also, we present inferred result for the end of service benefit expected amount in data property *hasTotalAmount* by SWRL rule.

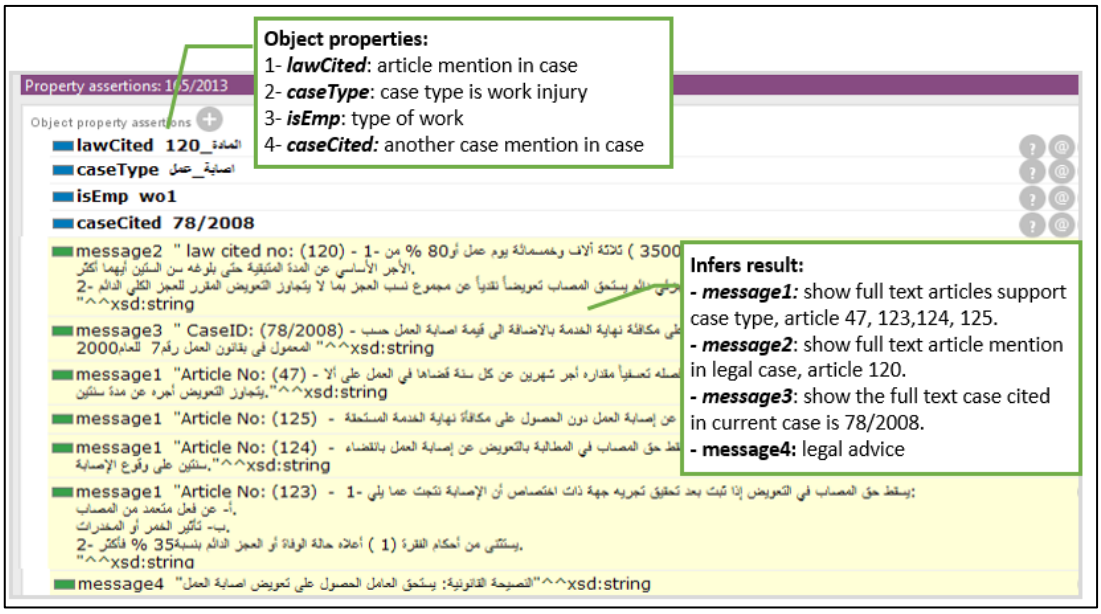


Figure (5.17): Reasoner Inferred Hidden Results

The code shown in Figure 5.18 illustrates how to import the required OWL API files and our ontology.

```
import javax.swing.UnsupportedLookAndFeelException;
import com.clarkparsia.pellet.owlapiv3.PelletReasonerFactory;
import de.derivo.sparqldlapi.QueryEngine;
import org.semanticweb.owlapi.reasoner.NodeSet;
import org.semanticweb.owlapi.reasoner.OWLReasoner;
import org.semanticweb.owlapi.reasoner.OWLReasonerFactory;
public final class Advice extends javax.swing.JFrame {

    private static final String BASE_URL = "http://www.semanticweb.org/afifitech/ontologies/2016/5/legal";
    private static OWLObjectRenderer renderer = new DLSyntaxObjectRenderer();
    static File file = new File("e:/legal.owl");
```

Figure (5.18): Import the Required OWL API Files

5.3.4 *LabourLawOnt* Ontology and Knowledge Base

We explain the developments and implementation of *LabourLawOnt* in Chapter 4. The knowledge base is built using OWL ontology. It consists of the ontology and enriched with individuals related to legal labour cases and articles for. The roles of the ontology vital in is deriving legal advice based on the Palestinian labour law.

5.4 Summary

In this chapter, we have presented the phases of building the labour legal advice system. In the analysis phase, we analyzed and specified the requirements of the system and divided the system into five components: user interface, SWRL rule,

Reasoner, *LabourLawOnt* ontology, and Knowledge base. We also described the functionality of the system through the use cases.
In the design phase, we explained the interaction and dependencies between these five components in the labour legal advice system architecture. Then we explained the design of these five components. Then we explained how the labour legal advice system operates at a high level and how processes of labour legal advice system operate with one another.

In the implementation phase, we explained some implementation issues related to these five components according to the design phase. The implementation of the user interface contained items that have identified in the design phase implemented using Java language and relation to SWRL rules, the reasoner, the ontology and the knowledge base.

Chapter 6
Experimental Results and Evaluation

Chapter 6
Experimental Results and Evaluation

In this chapter, we present the experimental results and evaluation of the proposed *LabourLawOnt* ontology and labour legal system. The evaluation of the *LabourLawOnt* is based on the ontology evaluation method presented in Section 2.11 and is done through legal case examples, ontology querying and SWRL rules. This is presented in Section 6.1. The evaluation of labour system is based on its ability to give correct legal advice compared to a domain expert using two sets of test cases. The first set of test cases is entered newly by the expert, contains 100 cases and is divided into 4 subsets. The first 25 cases are legal cases that are not covered by the Palestinian labour law. The second 25 subgroup contains legal cases with different work types covered by the Palestinian labour law. This subgroup is used to evaluate the expected end of services benefit amount for workers who are under 15 years old. The third subgroup contains 10 cases related to female workers who are fired from work due to birth vacation and fourth 40 cases to evaluate the expected amount of end of service benefits calculated based on work duration. The second set of test cases is 50 previously entered legal cases in the knowledge base when the ontology was built. The evaluation of the system based on these sets of cases is presented in Section 6.2.

6.1 Evaluation of the *LabourLawOnt* Ontology

In this section, we evaluate the quality of the created ontology in representing all terms, properties, and relations through ontology querying. The evaluation approaches are explained in Section 2.11. it is worth mentioning that the ontology is checked for correctness and consistency as well as for its ability to infer new relations among classes and individuals based on existing ones and using a reasoner. This explained in Section 4.1 step 8 (Applying Ontology Reasoner).

6.1.1 Quality Evaluation through the End of Services Benefits Example

To evaluate the quality of the *LabourLawOnt*, we select two legal case. We use this example to check if the ontology represents terms and properties correctly.

Figure 6.1 shows example 1 a legal case prepared by a lawyer to calculate the end of service benefits.

Example 1:

لدى محكمة صلح غزة الموقرة
في القضية رقم 2014/490
المدعي: ابراهيم
وكلاء المحامون: محمد واحمد وحسين
المدعى عليه: فارس
نوع الدعوى: حقوق عمالية
قيمة الدعوى: (21448شيكل)

لائحة الدعوى

المدعي عمل لدى المدعى عليه منذ تاريخ 2011/7/1 حتى تاريخ 2015/6/18 وكان يعمل بوظيفة بائع لدى المدعي عليه بصورة دائمة ومنتظمة وتحت اشرافه وذلك باجر شهري مقداره (1400 شيكل)

قام المدعي عليه بفصل المدعي فصلا تعسفيا دون وجه حق او مصوغ قانوني

طالب المدعي عليه مستحقاته العمالية الا ان المدعي عليه تمنع عن الدفع دون وجه حق او مبرر قانوني مما حدا بالمدعي لإقامة هذه الدعوى امام محكمتكم الموقرة مطالبا بحقوقه العمالية حسب قانون العمل الفلسطيني رقم / 7 لسنة 2000 على النحو التالي:

بدل مكافئة نهاية خدمة = 4 سنوات × 1400 شيكل × 33% = 5600 شيكل

بدل الاجازات السنوية = 28 × 54 شيكل = 1512 شيكل

بدل مهلة قانونية (مهلة اشعار) = 1400 شيكل

بدل فصل تعسفي = 1400 شيكل × 8 أشهر = 11200 شيكل

بدل اجازات دينية واعياد رسمية = 17 أيام × 4 سنة × 54 شيكل = 3762 شيكل

بدل إجازة ثقافية= 7 أيام × 4 سنة × 54 شيكل = 1512 شيكل

المجموع الكلي للمستحقات العمالية هي: 21448شيكل

Figure (6.1): List Lawsuit Example

In this case, the lawyer asks for the worker right based on the Palestinian labour law no. 7. We evaluate the quality of *LabourLawOnt* ontology by entering this case as follaws: *hasCaseType*: فصل تعسفي, *hasStartDate*: 1/7/2011, *hasEndDate*: 18/6/2015, *hasLastRate*: 1400, *hasAge*: 35, *hasCity*: Gaza, *hasSession*: 5/10/2015, *hasGender*: male, *wType*: buyer and *hasName*: محمد احمد.

It *LabourLawOnt* ontology achieves the same amount as expert domain mentioned in list lawsuit which is 21448NIS. The worker in this case worked less than 5 years and based on Palestinian labour law he should be given 33% of the salary plus various vacations. After running the reasoner, the hidden knowledge related is (*hasTotalAmount*, *messages 1* show articles supported case, *message 2* shows article full text mentioned in case, *message 3* show case cited and *message 4* shows legal

case) as illustrated in Figure 6.2. It shows the *hasTotalAmount* is 21448NIS, in addition it shows articles 4, 46, 47 and 48 which support the case "الفصل التعسفي".

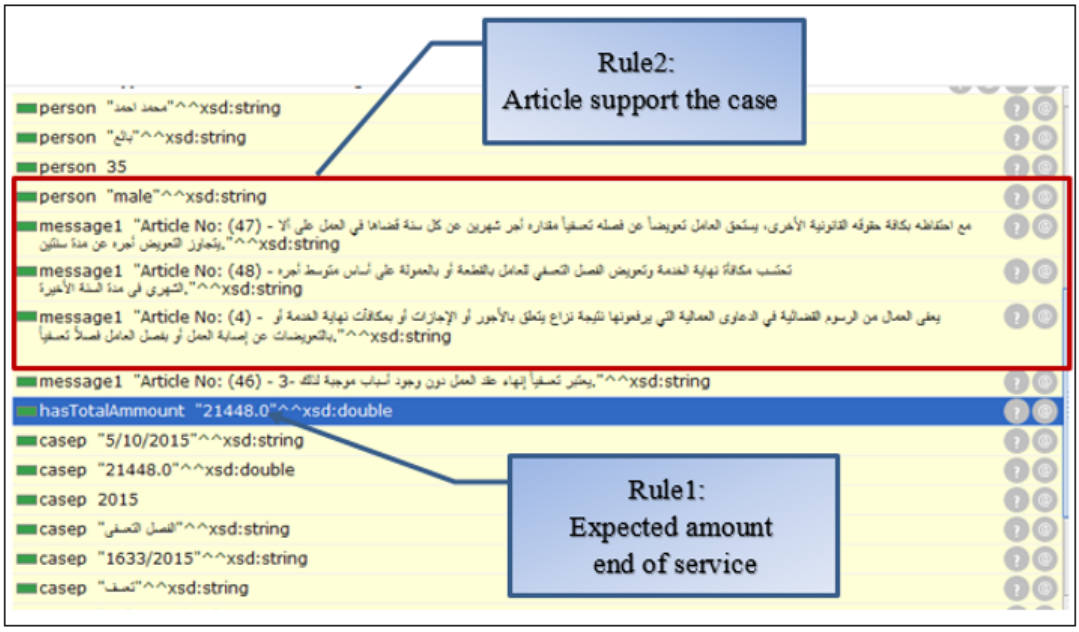


Figure (6.2): LabourLawOnt Ontology Evaluation

SWRL rules, explained in Rule 1 and Rule 2, present the case and the expected end of service benefits respectively, deduce and returns the results.

Rule 1: case(?p), hasAge(?p, ?age), xsd:integer[> 15](?age), xsd:integer[< 5](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?salary), hasStartWork(?p, ?syear), multiply(?x, ?salary, ?exp), multiply(?y, "0.33"^^xsd:double, ?x), subtract(?exp, ?eyear, ?syear), divide(?drate, ?salary, 26), multiply(?dv, 28, ?drate), multiply(?df, 60, ?drate, ?exp), multiply(?dd, 17, ?drate, ?exp), multiply(?dc, 7, ?drate, ?exp) ,add(?tt,?y,?dv, ?df ,?dd, ?dc) -> hasTotalAmount(?p, ?tt), message1(?p,'Daily Rate',?drate), message1(?p, ?dv), message1(?p, ?df) , message1(?p, ?dd), message1(?p, ?dc)
Rule 2: Labour_Law(?l), case(?r), hasCaseType(?r, ?x), hasarNo(?l, ?n), hasDescText(?l, ?t), contains(?t, ?x), stringConcat(?y, "Article No: (", ?n, ") - ", ?t) -> message1(?r, ?y)

Rule 1 checks if the worker has worked more than 15 years based on the calculated years of experience. If less than 5 year the worker gets 33% of last rate, then adds the

amount for vacation (ثقافية، دينية، أعياد رسمية). Rule 2 retrieves the supporting article for the current case used in Rule 1.

Example 2: The case in Figure 6.3 is about a worker with daily contract. This case has different calculation for the end of service. So there is a special rule to achieve accurate results when running the reasoner. The reasoner proves the wrong calculation in preparing the list lawsuit. In this case the worker worked for 8 years and based on the Palestinian labour law should receive 66% of last salary rate.

لدى محكمة صلح غزة الموقرة
في القضية رقم 2014/490
المدعي: ابراهيم
وكلاء المحامون: سعيد
المدعى عليه: ماهر
نوع الدعوى: حقوق عمالية
قيمة الدعوى: (7800 شيكل)

لائحة الدعوى

المدعي عمل لدى المدعى عليه منذ تاريخ 2005/9/7 حتى تاريخ 2013/6/15 وكان يعمل بوظيفة عامل ميكانيكي سيارات لدى المدعي عليه ويتقاضى اجره بشكل يومي وكان اخر اجر له 25 شيكل لليوم

قام المدعي عليه بإنهاء عمل المدعي بسبب تخفيض الأجرة اليومية

طالب المدعي المدعي عليه مستحقاته العمالية الا ان المدعي عليه تمنع عن الدفع دون وجه حق او مبرر قانوني مما حدا بالمدعي لإقامة هذه الدعوى امام محكمتكم الموقرة مطالبا بحقوقه العمالية حسب قانون العمل الفلسطيني رقم / 7 لسنة 2000 على النحو التالي:

بدل مكافئة نهاية خدمة = 8 سنوات × 25 شيكل × 30 يوم = 6000 شيكل

بدل الاجازات السنوية = 42 × 25 شيكل = 1050 شيكل

بدل مهلة قانونية (مهلة اشعار) = 750 شيكل اجرة شهر

المجموع الكلي للمستحقات العمالية هي: 7800 شيكل

Figure (6.3): Daily Contract Legal Case

6.1.2 Quality Evaluation Through Ontology Querying

In order to further verify and validate the ontology in accordance to competency questions (see Section 4.1), we use the Description Logic Query (DL-Query) which is a standard Protégé plugin based on the Manchester OWL syntax of the ontology. We present some querying examples related the questions that are asked in the development process of the ontology (see Section 4.1) such as what are the resignation cases? what are the end of service benefits for the unemployed?

Example 1:

The question: What are the cases related to work resignation in *Palestine*?

DL-Query: (*case and caseType value* استقالة *or caseType value* ترك_عمل *)

The result of DL-Query is shown in Figure 6.4 which returns individuals of cases (workers) who leave work (Resign). The (استقالة، ترك_عمل) individual are same individuals, illustrated in Figure 6.5.

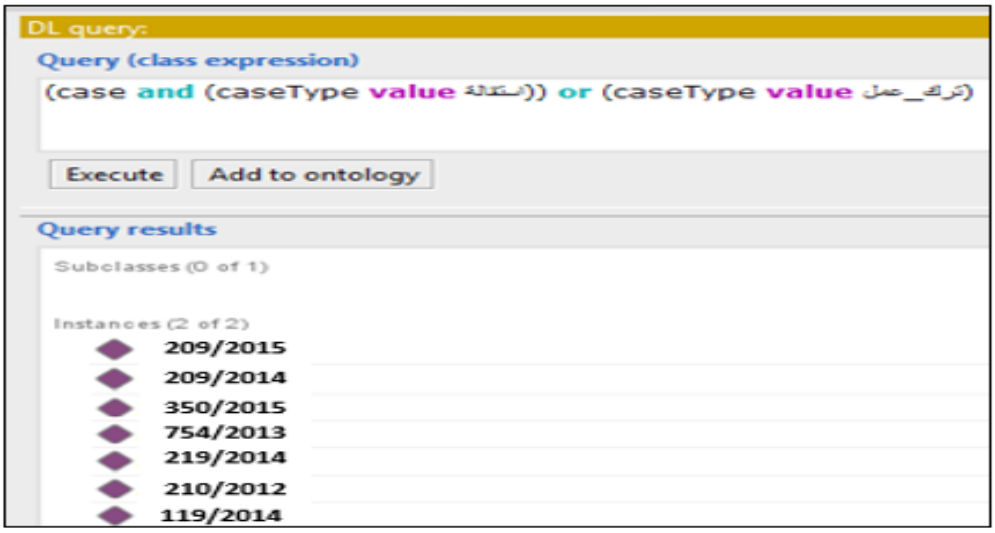
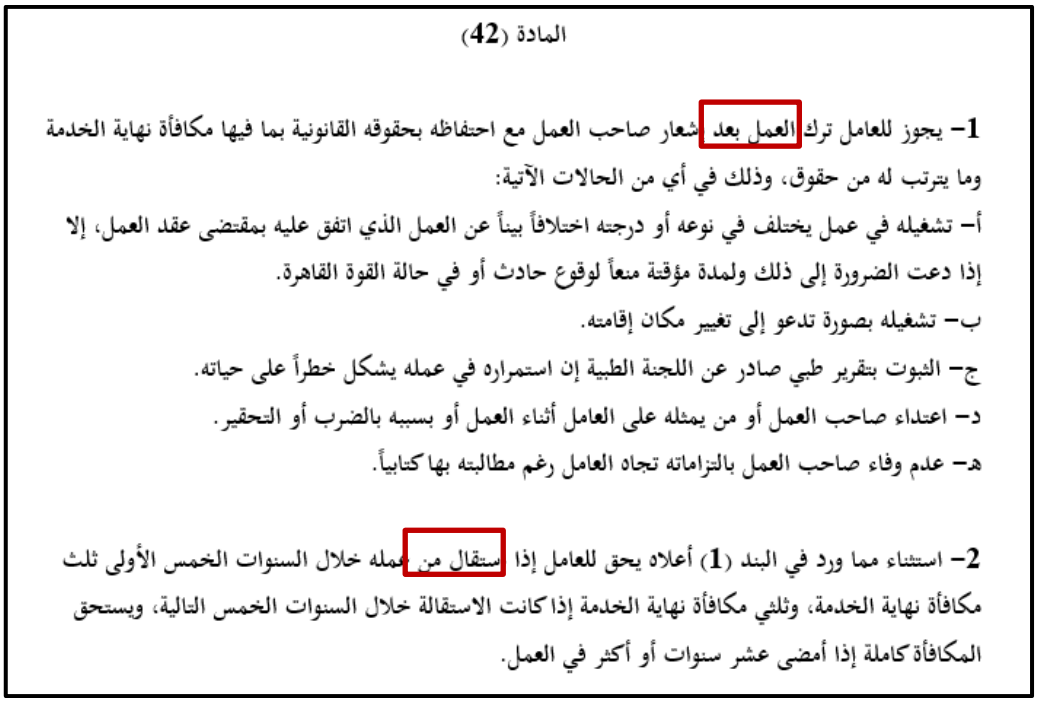


Figure (6. 4): Dl-Query for resignation/leave work case

Figure (6.5): Result of the Same Indiviual As Property

All cases shown in DL-Query result are for workers who leave (resign) work. The Palestinian labour law defines the resignation as the same as leaving work as illustrated in Figure 6.6 which shows article no. 42 presents which leaving work and resignation (ترك العمل ، استقال) as shown in Figure 6.5 the same meaning.



المادة (42)

1- يجوز للعامل ترك العمل بعد إشعار صاحب العمل مع احتفاظه بحقوقه القانونية بما فيها مكافأة نهاية الخدمة وما يترتب له من حقوق، وذلك في أي من الحالات الآتية:

أ- تشغيله في عمل يختلف في نوعه أو درجته اختلافاً بيناً عن العمل الذي اتفق عليه بمقتضى عقد العمل، إلا إذا دعت الضرورة إلى ذلك ولمدة مؤقتة منعاً لوقوع حادث أو في حالة القوة القاهرة.

ب- تشغيله بصورة تدعو إلى تغيير مكان إقامته.

ج- الثبوت بتقرير طبي صادر عن اللجنة الطبية إن استمراره في عمله يشكل خطراً على حياته.

د- اعتداء صاحب العمل أو من يمثله على العامل أثناء العمل أو بسببه بالضرب أو التحقير.

هـ- عدم وفاء صاحب العمل بالتزاماته تجاه العامل رغم مطالبته بها كتابياً.

2- استثناء مما ورد في البند (1) أعلاه يحق للعامل إذا استقال من عمله خلال السنوات الخمس الأولى ثلث مكافأة نهاية الخدمة، وثلثي مكافأة نهاية الخدمة إذا كانت الاستقالة خلال السنوات الخمس التالية، ويستحق المكافأة كاملة إذا أمضى عشر سنوات أو أكثر في العمل.

Figure (6.6): Article 42 for Leaving Work or Resignation

Example 2:

The question: What are the end of services benefit for the unemployed?

DL-Query: (case and caseType value نهاية_خدمة and workType value بطالة).

As shown in Figure 6.7, one result appears for this type of case (end of services benefits for worker who is unemployed). The Palestinian labour law does not support the unemployed worker.

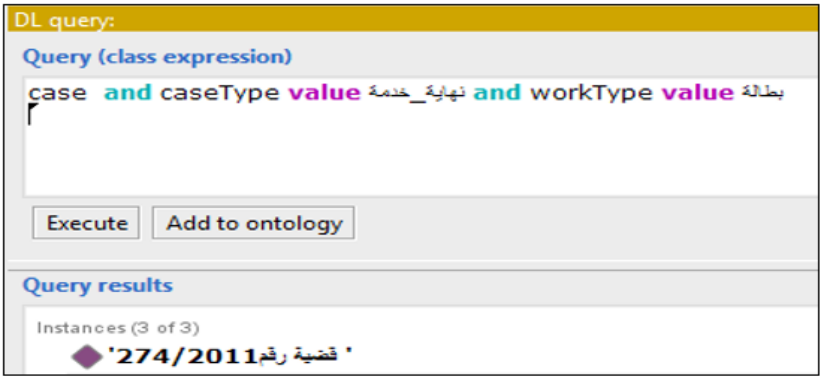


Figure (6.7): Dl-Query for End of Service Benefits and Work Type is Unemployed

Example 3:

The question: what is the expected amount for end of services benefit if the worker has worked 7 years with last monthly salary of 4000 NIS?

SWRL Rule:

case(?p), xsd:integer[> 5](?exp), xsd:integer[<= 10](?exp) ,
hasStartWork(?p, ?syear), hasEndWork(?p, ?eyear), subtract(?exp, ?eyear, ?syear),
hasLastRate(?p, ?salary), multiply(?x, ?salary, ?exp),
multiply(?y, "0.66"^^xsd:double, ?x) -> hasTotalAmount(?p, ?y)

The Palestinian labour law article no. 42 defines how to calculate the end of service benefits. So, in this example, the worker worked 7 years which is located in the 5 to 10 years working range. In this situation, the worker is given 66% of the last monthly salary for each year of his work which is calculated in the equation 66% × no. year × 4000. Through the rule, we used some data properties: *hasStartWork*, *hasEndWork*, *hasLastRate*. Based on the rule we define some variables (?syear) for *hasStartYear*, (?eyear) for *hasEndYear*, (?salary) for *hasLastRate*, (?exp) to calculate syear and eyear, (?x) to multiply salary by experience , (?y) to save the total and present in the data property is *hasTotalAmount*. The expected amount result by running the reasoner is: 214480 NIS which is illustrated in Figure 6.8.

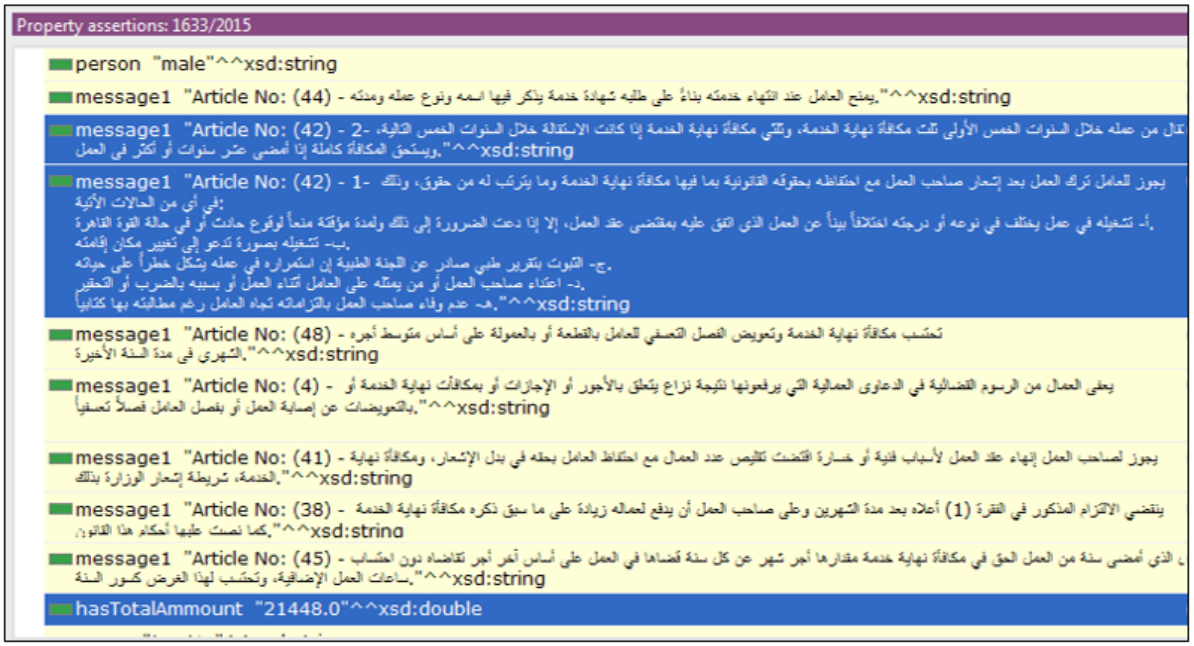


Figure (6.8): Evalute Qulity Result by SWRL Rule

6.2 System Evaluation Based on New Cases from the Domain Expert

The evaluation of the labour system is based on its ability to give correct legal advice compared to a domain expert using two sets of test cases. One set is entered newly by

the expert and the other set is those cases which were previously entered in the knowledge base.

The first test set includes 100 newly entered cases by the domain expert. The second test set includes 50 previously entered cases upon building the ontology and they individuals in the knowledge base.

This experimental test is performed to measure the accuracy of the *LabourLawOnt* system according to 100 new labour cases entered by the legal domain expert. We divided them into 4 general subsets of cases. Each subset is used to evaluate a number of cases. The first subset includes cases related to the work types not covered by the Palestinian labour law, the second subset includes cases related to child employment, the third subset includes cases related to female employment and the fourth subset includes cases related to the end of service benefits. We conducted 4 experiments, one for each subset.

Experiment 1: Evaluating the System Through Cases Related to the Work Type

The legal domain expert entered new 25 legal cases that are not covered by the Palestinian labour law such as the worker is son of the employer, worker is unemployed, worker is governorate employee. Figure 6.9 show these exceptions based on article no. 3 of the Palestinian labour law.

المادة (3)

تسري أحكام هذا القانون على جميع العمال وأصحاب العمل في فلسطين باستثناء:

1- موظفي الحكومة والهيئات المحلية مع كفالة حقهم في تكوين نقابات خاصة بهم.

2- خدم المنازل ومن في حكمهم على أن يصدر الوزير نظاماً خاصاً بهم.

3- أفراد أسرة صاحب العمل من الدرجة الأولى.

Figure (6.9): Article 3 of the Palestinian Labour Law Exceptions

The legal domain expert entered data for each case Figure 6.10 shows the result of the legal advice. The result says: the Palestinian labour law is not applied to your case based on article no. 3 of the labour law. So the worker will not receive the end of service benefits.

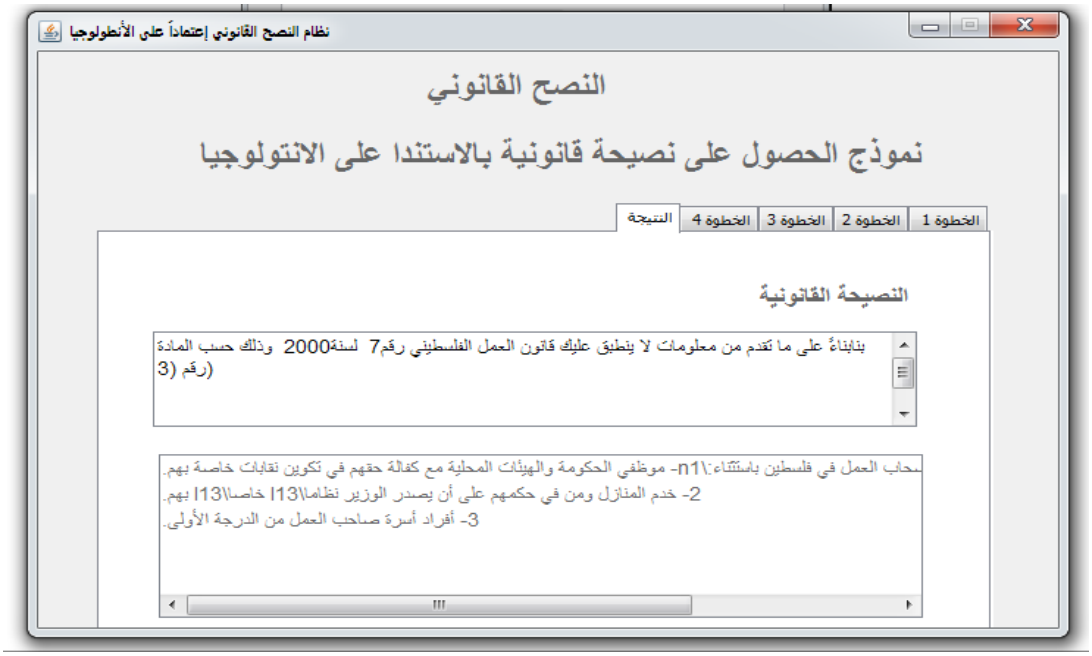


Figure (6.10): Legal Advice Not Supported Work Type

Experiment 1 evaluates 25 legal advices based on the 25 test cases related to the exceptions, the Palestinian labour law is not applied to your case based on article no. 3 of the labour law. All the 25 test cases of experiment 1 gives success of 100% of system the same results, i.e., is not applied based on article3.

Experiment 2: Evaluating the System Through Cases Related to Child Employment

The legal domain expert entered new 25 legal case with different work types which applied by Palestinian labour law, to evaluate the expected of the end of services benefit amount for workers is under 15 years old. The Palestinian labour law prevents child employment. Therefore, the end of services amount should be zero based on chapter 6 of the labour law which includes articles 93 to 99. Our system achieves 77% success based on the legal domain expert evaluation. According to the expert all articles in chapter 6 of the labour law justifying and controlling child employment should be returned. Since the system returned only 5 out of these 7 articles (Figure 6.11), the accuracy is 5/7 that is 77%.

Figure (6.11): Experiment 2 Child Employment

The result (Figure 6.11) also shows the legal advice for child employment and returned zero for expected amount for end of service benefits. It also returns the full text of the 5 articles to justify these return decision.

Experiment 3: Evaluating the System Through Cases Related to Female Employment

The legal domain expert entered new 10 cases related to female worker firing from work due to birth vacation. The Palestinian labour law is organizing and controlling women employment through Chapter 7 of the labour law. Article 103 in paragraph 2 shown in Figure 6.12, prevents firing female worker due to birth vacation unless the contrary is proved, i.e., the employer proved the female worker worked in another job during birth vacation.

المادة (١٠٣)

١- للمرأة العاملة التي أمضت في العمل قبل كل ولادة مدة مائة وثمانين يوماً الحق في إجازة وضع لمدة عشرة أسابيع مدفوعة الأجر منها ستة أسابيع على الأقل بعد الولادة.

٢- لا يجوز فصل المرأة العاملة بسبب الإجازة المذكورة في الفقرة (١) أعلاه إلا إذا ثبت أنها اشتغلت بعمل آخر خلالها.

Figure (6.12): Article 103 of the Palestinian Labour Law

The legal domain expert entered new cases for female and in Step 4 selected the contract termination due to "*worker has worked in another job during birth vacation*". Figure 6.13 shows the legal advice with the expected end of service benefits based on the article justifying the advice.

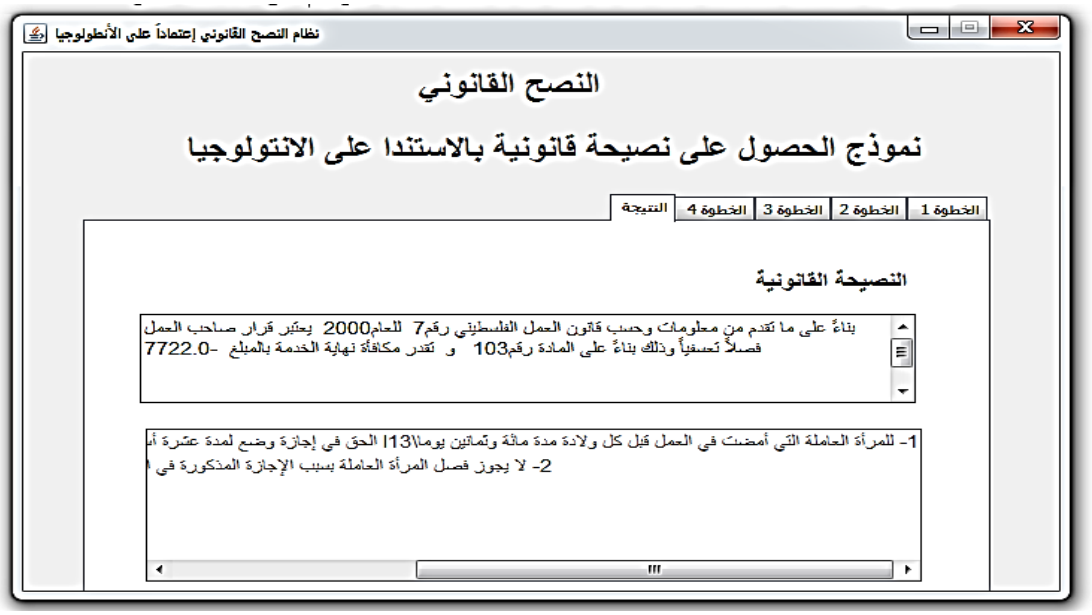


Figure (6. 13): Experment 3 Female Worker Being Fired

Experiment 3 achieved 80% success. The 20% failure is because the employer has proven the contrary, i.e., the female worker has worked during the birth vacation and the Palestinian labour law prevents the female worker from working in another job during birth vacation.

Experiment 4: **Evaluating the System Through Cases Related to End of Service Benefits**

The legal domain expert entered new 40 cases to evaluate the expected amount of end of service benefits calculated based on work duration. The Palestinian labour law

defines the end of service benefit calculation based on article no. 42 as follows: 100% of end of service benefits for a worker who worked more than 10 years, 66% for a worker who worked between 5 to 10 years and 33% for a worker who worked between 1 to 5 years as shown in Figure 6.14.

Whether the worker has resigned or has been fired, in most cases, the worker deserves the end of service benefits, unless the employer proves the worker has committed a legal offense.

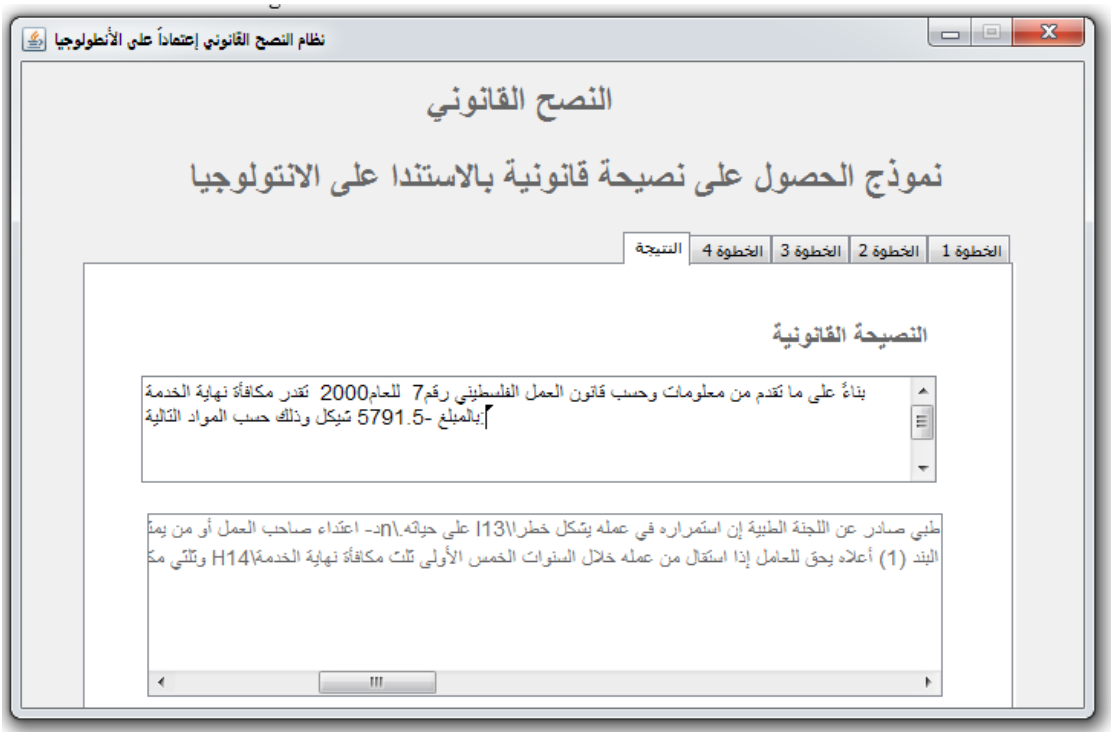


Figure (6.14): Experiment 4 End of Service Benefits

Experiment 4 achieved a total of 87.5% success which is distributed as follaws:

- 10 cases for working more than 10 years achieved 80%
- 10 cases for working between 5 to 10 achieved 70%
- 10 cases for working between 1 to 5 years achieved 80%
- 10 cases for working less than 1 year achieved 100%

The legal domain expert justified the 12.5% as not failures but not related cases have been calculated accurately because of the work type and because there are errors in calculating holidays.

6.3 System Evaluation Based on Entered Previous Cases

We performed an experiment based on 50 previously entered cases to the ontology as individuals. That means, the cases are already in the knowledge base and we just query the knowledge base for legal helpful information based on these cases.

Experiment 5: Evaluating the System Through Cases Related to Case Categories, Articles and Cases Mentioned in the Given Case

The legal domain expert evaluates the second part of the system based on 50 previously entered cases. A part of the experiment is shown in Figure 6.7. The legal domain expert evaluates the accuracy of the system in returning the correct legal cases mentioned in the returned cases and articles. In addition, it returns the articles which may support the cases in question. It achieved 85% success rate, i.e., 42 cases success out of 50 previously entered cases. Figure 6.15 shows these cases and articles.

Figure (6.15): Retreived Cases and Articles Related to a Given Case

6.4 Summary

Through the evaluation and experimental results, the domain expert evaluated the system using 150 test cases. 100 newly entered cases by the domain expert divided into 4 general subsets of cases. Each subset is used in the evaluation of a number of labour cases. The first subset included cases related to the work types which are not covered by the Palestinian labour law, the second subset included cases related to child employment, the third subset included cases related to female employment and the fourth included cases related to the end of service benefits. The other 50 test cases were previously entered in the knowledge base and used to test the ability of system to retrieve specific labour cases with their related and similar cases and labour law articles.

Based on these results, the labour legal advice system built based on the legal ontology is helpful to the worker, the lawyer and the judge. The results can be improved further if the knowledge base is enriched with more legal cases. The system also can be superior to existing systems based on store and retrieve operations only.

Chapter 7
Conclusion and Future Works

Chapter 7
Conclusion and Future Works

In this research, we have developed an ontology-based approach for the derivation of labour legal advice based on the Palestinian labour domain. We have built a legal domain ontology based on the various legal law chapters and articles, we have enriched the ontology with two kinds of individuals in order to create a legal articles and legal cases.

The ontology and its related knowledge base played an important role in providing intelligent view over legal information resources and supported the derivation of legal advice. This is one important contribution of this research.

We have designed a set of SWRL rules based on the Palestinian labour law to support the derivation of legal advice based on the knowledge based. Therefore, rules have connected ontology concepts, such as object and data properties, with legal case information items. Based on these rules, the reasoner has been able to infer legal advices together with relevant legal articles.

Based on these essential components, we have designed and implemented the labour law advice system consisting of the user interface, the SWRL Rules, the reasoner, the legal labour ontology and the knowledge base.

The system, respectively the approach, have been evaluated with the help of an expert in the labour legal domain using 150 various legal employment cases. The cases have been divided into two sets; the first set contained 100 cases entered to the system by the expert and the second set contained 50 cases which we have previously entered as instances in the knowledge base during the construction and consistency checking of the ontology. The results showed an 84% overall accuracy of the system in correctly giving the legal advice.

The main contribution of this research is the ability to semantically derive legal advices form the Palestinian labour law and its related previous labour cases. This supports the worker to understand the complex law and get legal advice related to a given new case giving accuracy and user satisfaction better than traditional methods.

Success of our proposed system and the accurate results encourage us to look for ways to cover all aspects of Palestinian labour domain such as extending the ontology with the rest of the chapters and articles of the labour law, enriching the knowledge base with more legal cases and be able to answer more types of questions such as comparative and similarity phrases. This would enable the system to be better tested and used in practice. The system can be extended to cover other legal domains such as criminal law and land law and integrating the system with governmental and institutional systems related to the legal domain.

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APPENDIX A: SWRL RULES

Rule1: case(?p), hasContractType(?p, ?c), swrlb:contains(?c, "يومي"), hasAge(?p, ?age), xsd:integer[> 15](?age), xsd:integer[> 5](?exp), xsd:integer[<= 10](?exp), hasEndWork(?p, ?eyear), hasStartWork(?p, ?syear), swrlb:subtract(?exp, ?eyear, ?syear), hasLastRate(?p, ?pounds), swrlb:multiply(?x, ?drate, ?exp, 30), swrlb:multiply(?y, "0.66"^^xsd:double, ?x), swrlb:divide(?drate, ?pounds, 30), swrlb:multiply(?dv, 42, ?drate), swrlb:multiply(?df, 30, ?drate), swrlb:add(?tt, ?y, ?dv, ?df) -> hasTotalAmmount(?p, ?tt)
Rule2: Labour_Law(?l), case(?r), hasCaseType(?r, ?x), hasarNo(?l, ?n), hasDescText(?l, ?t), swrlb:contains(?t, ?x), swrlb:stringConcat(?y, "Article No: (", ?n, ") - ", ?t) -> message1(?r, ?y)
Rule3: case(?p), hasContractType(?p, ?c), swrlb:contains(?c, "شهري"), hasCaseType(?p, ?ct), swrlb:contains(?ct, "تعسف"), hasAge(?p, ?age), xsd:integer[> 15](?age), xsd:integer[> 5](?exp), xsd:integer[<= 10](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?pounds), hasStartWork(?p, ?syear), swrlb:multiply(?x, ?pounds, ?exp), swrlb:multiply(?y, "0.66"^^xsd:double, ?x), swrlb:subtract(?exp, ?eyear, ?syear), swrlb:divide(?drate, ?pounds, 26), swrlb:multiply(?dv, 28, ?drate), swrlb:multiply(?dd, 17, ?drate, ?exp), swrlb:multiply(?dc, 7, ?drate, ?exp), swrlb:multiply(?df, 60, ?drate, ?exp), swrlb:add(?tt, ?y, ?df, ?dv, ?dd, ?dc) -> hasTotalAmmount(?p, ?tt)
Rule4: case(?p), xsd:integer[> 10](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?pounds), hasStartWork(?p, ?syear), swrlb:multiply(?y, ?pounds, ?exp), swrlb:subtract(?exp, ?eyear, ?syear) -> hasTotalAmmount(?p, ?y)
Rule5: case(?p), hasAge(?p, ?age), xsd:integer[> 15](?age), xsd:integer[< 5](?exp), hasEndWork(?p, ?eyear), hasLastRate(?p, ?pounds), hasStartWork(?p, ?syear), swrlb:multiply(?x, ?pounds, ?exp), swrlb:multiply(?y, "0.33"^^xsd:double, ?x), swrlb:subtract(?exp, ?eyear, ?syear), swrlb:divide(?drate, ?pounds, 26), swrlb:multiply(?dv, 28, ?drate), swrlb:multiply(?df, 60, ?drate, ?exp), swrlb:multiply(?dd, 17, ?drate, ?exp), swrlb:multiply(?dc, 7, ?drate, ?exp), swrlb:add(?tt, ?y, ?dv, ?df, ?dd, ?dc) -> hasTotalAmmount(?p, ?tt)

Rule6: case(?r), hasCaseStatus(?r, ?d), swrlb:contains(?d, "false") -> Reject(?r)
Rule7: case(?r), hasCaseStatus(?r, ?d), swrlb:contains(?d, "true") -> Accept(?r)
Rule8: Labour_Law(?l), case(?r), hasCaseType(?r, ?x), hasCodeNo(?l, ?n), hasCodeText(?l, ?t), hasDecision(?r, ?d), swrlb:contains(?t, ?x), swrlb:stringConcat(?y, "Article No: (", ?n, ") - ", ?t) -> message1(?r, ?y)
Rule9: hasCodeNo(?id, ?d), CaseCat(?r), hasCodeText(?id, ?iid), swrlb:stringConcat(?x, " law cited no: (", ?d, ") - ", ?iid), lawCited(?r, ?id) -> message2(?r, ?x)
Rule10: Labour_Law(?l), case(?r), hasCaseType(?r, ?x), hasCodeNo(?l, ?n), hasCodeText(?l, ?t), hasDecision(?r, ?d), swrlb:contains(?t, ?x), caseType(?r, اصابة_عمل), hasCaseStatus(?r, ?s), swrlb:contains(?s, "true"), swrlb:stringConcat(?advice, " النصيحة القانونية: يستحق العامل الحصول على تعويض اصابة العمل") -> message4(?r, ?advice)
Rule11: CaseCat(?r), caseCited(?r, ?id), hasCaseID(?id, ?iid), hasDecision(?id, ?d), swrlb:stringConcat(?x, " CaseID: (", ?iid, ") - ", ?d) -> message3(?r, ?x)
Rule12: case(?r), hasCodeText(?r, ?t), hasDecision(?r, ?g), swrlb:contains(?g, "خدمة"), swrlb:contains(?t, " خدمة") -> message4(?r, ?t)
Rule13**:** Case(?c), hasAge(?p, ?age), xsd:integer[> 15](?age) -> message1(?c, ""يحظر تشغيل الأطفال قبل بلوغهم سن الخامسة عشر"

APPENDIX B: PART OF OWL SOURCE CODE

@prefix : <http://www.semanticweb.org/afifitech/ontologies/2017/4/untitled-ontology-32#> .

@prefix owl: <http://www.w3.org/2002/07/owl#> .@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .@prefix xml: <http://www.w3.org/XML/1998/namespace> .@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .@base <http://www.semanticweb.org/afifitech/ontologies/2017/4/untitled-ontology-32> .

http://www.semanticweb.org/afifitech/ontologies/2017/4/untitled-ontology-32 rdf:type owl:Ontology .

###

Object Properties

###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#caseCited###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#caseType###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasArNo###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasArNom###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasArticle###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasChapter###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLawtype###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasSection###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#isEmp###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#isPart###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#is_a###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#is_a_Defenition###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#lawCited<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#lawCited>

rdf:type owl:ObjectProperty ;

owl:equivalentProperty

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#relatedTo> .###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#lawType###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#relatedTo<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#relatedTo> rdf:type owl:ObjectProperty .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#workType###
http://www.w3.org/2002/07/owl#topObjectProperty
###
Data properties
###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#MsCaseCitedDecision###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#MsCaseCitedID###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#QAMsg###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasAge<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasAge>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#person> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseCited<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseCited>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseID<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseID>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseStatus<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseStatus>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseType<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCaseType>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCity<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCity>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCodeNo###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasCodeText###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasContractType<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasContractType>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasDecision<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasDecision> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasDescText<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasDescText> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLawDet> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasEndWork<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasEndWork> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasExpYear<http://w
ww.semanticweb.org/afifitech/ontologies/2016/5/legal#hasExpYear> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasGender<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#hasGender> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#person> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasItemNo<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#hasItemNo> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLawDet> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasKeyWords<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasKeyWords> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLastRate<http://w
ww.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLastRate> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLawCited###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLawDet###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasName<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#hasName> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#person> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasSessionNo<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasSessionNo> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasStartWork<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasStartWork> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasTotalAmmount<h
ttp://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasTotalAmmount>
rdf:type owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasVocation<http://w
ww.semanticweb.org/afifitech/ontologies/2016/5/legal#hasVocation> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasWorkType###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasWorkTypeOk###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasYear<http://www.
semanticweb.org/afifitech/ontologies/2016/5/legal#hasYear> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#casep> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasarNo<http://www.
semanticweb.org/afifitech/ontologies/2016/5/legal#hasarNo> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#hasLawDet> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#haslawtype###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#isExp###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#message1###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#message2###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#message3###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#message4###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#msgGender###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#person###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#wType<http://www.s
emanticweb.org/afifitech/ontologies/2016/5/legal#wType> rdf:type
owl:DatatypeProperty ;
rdfs:subPropertyOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#person> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#تصنف_ب<http://www.
semanticweb.org/afifitech/ontologies/2016/5/legal#تصنف_ب> rdf:type
owl:DatatypeProperty ;
owl:equivalentProperty
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#نوع_القضية> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#نتيجة_القضية###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#نوع_القضية<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#نوع_القضية> rdf:type
owl:DatatypeProperty .### http://www.w3.org/2002/07/owl#topDataProperty
##############################
Classes
##############################
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#A_B12<http://www.s
emanticweb.org/afifitech/ontologies/2016/5/legal#A_B12> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#AsoolLaw> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#A_B121<http://www.
semanticweb.org/afifitech/ontologies/2016/5/legal#A_B121> rdf:type owl:Class ;

rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#A_B12> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#A_ar200<http://www
.semanticweb.org/afifitech/ontologies/2016/5/legal#A_ar200> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#A_B121> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Accept<http://www.s
emanticweb.org/afifitech/ontologies/2016/5/legal#Accept> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Case_Status> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Applied<http://www.
semanticweb.org/afifitech/ontologies/2016/5/legal#Applied> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#AppliedRange> ,
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#case> ,
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#AppliedRange<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#AppliedRange> rdf:type
owl:Class .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Area_Of_Law<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#Area_Of_Law> rdf:type
owl:Class .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#AsoolLaw<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#AsoolLaw> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Area_Of_Law> .##
#
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Association<http://w
ww.semanticweb.org/afifitech/ontologies/2016/5/legal#Association> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson>
.###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B1<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B1> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B10<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B10> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B101<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B101> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B10> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B102<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B102> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B10> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B11<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B11> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B1> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B12<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B12> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B1> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B13<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B13> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B14<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B14> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B15<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B15> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B16<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B16> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B17<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B17> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B2<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B2> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B2> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B2> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B3<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B3> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B3> .###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B32<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B32> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B3> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B33<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B33> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B3> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B4<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B4> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B41<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B41> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B4> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B42<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B42> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B4> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B43<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B43> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B4> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B44<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B44> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B4> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B5<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B5> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B51<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B51> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B5> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B52<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B52> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B5> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B53<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B53> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B5> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B54<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B54> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B5> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B6<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B6> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B61<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B61> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B6> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B7<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B7> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B7> .###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B8<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B8> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B81<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B81> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B8> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B911<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B911> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9111<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9111> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B911> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9112<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9112> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B911> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9113<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9113> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B911> .###

http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9114<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B9114> rdf:type owl:Class ; rdfs:subClassOf <http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B911> .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B912<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B912> rdf:type owl:Class ; rdfs:subClassOf <http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B91> .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CaseCat<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CaseCat> rdf:type owl:Class ; rdfs:subClassOf <http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#case> .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Case_Status<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Case_Status> rdf:type owl:Class .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CompaniesUnion<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CompaniesUnion> rdf:type owl:Class ; rdfs:subClassOf <http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson> .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Company<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Company> rdf:type owl:Class ; rdfs:subClassOf <http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson> .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ConType<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ConType> rdf:type owl:Class ; rdfs:subClassOf <http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#x> .### http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Con_Dur<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Con_Dur> rdf:type owl:Class ; rdfs:subClassOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#x> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CooperativeAssociati
on<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CooperativeAsso
ciation> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Association> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Criminal_Law<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#Criminal_Law> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Area_Of_Law> .##
#
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ForeignNGO<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#ForeignNGO> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Association> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Have_Con<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#Have_Con> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#x> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#Labour_Law> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Area_Of_Law> .##
#
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Land_Law<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#Land_Law> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Area_Of_Law> .##
#
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocaNGO<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#LocaNGO> rdf:type
owl:Class ; rdfs:subClassOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Association> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalAdministrative
Commitee<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalAd
ministrativeCommitee> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalGovernmentU
nit> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalGovernmentUni
t<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalGovernment
Unit> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson>
.###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#MunicipalCouncil<ht
tp://www.semanticweb.org/afifitech/ontologies/2016/5/legal#MunicipalCouncil>
rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalGovernmentU
nit> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NaturalPerson<http://
www.semanticweb.org/afifitech/ontologies/2016/5/legal#NaturalPerson> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#legal_person> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson<ht
tp://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson>
rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#legal_person> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#PartnershipCompany
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#PartnershipCompan
y> rdf:type owl:Class ;
rdfs:subClassOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Company> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ProfessionalAssociation<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ProfessionalAssociation> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson>
.###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ProfessionalAssociationUnion<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ProfessionalAssociationUnion> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NonNaturalPerson>
.###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Reject<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Reject> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Case_Status> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ShareholdingComany
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ShareholdingComany> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#Company> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#VillageCouncil<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#VillageCouncil> rdf:type owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#LocalGovernmentUnit> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#WorkTypes<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#WorkTypes> rdf:type owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#x> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar1<http://www.sema

nticweb.org/afifitech/ontologies/2016/5/legal#ar1> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B11> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar10<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar10> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar100<http://www.se
manticweb.org/afifitech/ontologies/2016/5/legal#ar100> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar101<http://www.se
manticweb.org/afifitech/ontologies/2016/5/legal#ar101> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar102<http://www.se
manticweb.org/afifitech/ontologies/2016/5/legal#ar102> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar103<http://www.se
manticweb.org/afifitech/ontologies/2016/5/legal#ar103> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar104<http://www.se
manticweb.org/afifitech/ontologies/2016/5/legal#ar104> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar105<http://www.se
manticweb.org/afifitech/ontologies/2016/5/legal#ar105> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar106<http://www.se

manticweb.org/afifitech/ontologies/2016/5/legal#ar106> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B71> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar11<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar11> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar12<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar12> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar13<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar13> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar14<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar14> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar15<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar15> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar16<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar16> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar17<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar17> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B21> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar18<http://www.sem

anticweb.org/afifitech/ontologies/2016/5/legal#ar18> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar19<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar19> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar2<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#ar2> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B12> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar20<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar20> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar21<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar21> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar22<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar22> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar23<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar23> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B22> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar24<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar24> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar25<http://www.sem

anticweb.org/afifitech/ontologies/2016/5/legal#ar25> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar26<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar26> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar27<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar27> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar28<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar28> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar29<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar29> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar3<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#ar3> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B12> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar30<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar30> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#B31> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#ar31<http://www.sem
anticweb.org/afifitech/ontologies/2016/5/legal#ar31> rdf:type owl:Class ;
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w1<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w1> rdf:type owl:Class ;
rdfs:subClassOf

<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w2<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w2> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w3<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w3> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w4<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w4> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w5<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w5> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w6<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w6> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#w7<http://www.sema
nticweb.org/afifitech/ontologies/2016/5/legal#w7> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type<http://w
ww.semanticweb.org/afifitech/ontologies/2016/5/legal#worker_type> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#NaturalPerson> .##
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#x<http://www.semant
icweb.org/afifitech/ontologies/2016/5/legal#x> rdf:type owl:Class .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#استقالة<http://www.se

manticweb.org/afifitech/ontologies/2016/5/legal#استقالة> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CaseCat> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#اصابة_عمل<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#اصابة_عمل> rdf:type owl:Class ;
rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CaseCat> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#عمل_اضافي<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#عمل_اضافي> rdf:type
owl:Class ; rdfs:subClassOf
<http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#CaseCat> .###
http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#عمل_جماعي<http://ww
w.semanticweb.org/afifitech/ontologies/2016/5/legal#عمل_جماعي> rdf:type
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http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#فصل_تعسفي<http://ww
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owl:Class ;
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anticweb.org/afifitech/ontologies/2016/5/legal#نساء> rdf:type owl:Class ;
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http://www.semanticweb.org/afifitech/ontologies/2016/5/legal#نهاية_خدمة<http://www
.semanticweb.org/afifitech/ontologies/2016/5/legal#نهاية_خدمة> rdf:type owl:Class ;
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