Assignment #5 of Semantic Web*

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Dey 2, 1394

Deadline: Bahman 10, 1394

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Principles

Students are supposed to follow the following rules.

- Once you are done, pack all your documents (if there are multiple ones) into a single ZIP file and send to abarkhordari@ce.sharif.edu. Please format your E-Mail’s title like the item below.
  
  SW - [Your Student ID] - [Assignment Number]
  example: SW-94111111-5

- Deadlines are unlikely to get extended, hence it is highly recommended to do your assignments by their deadlines.

- If you submit your assignments late, the following rules apply:
  - Up to 1 day late, you will lose 25% credits of the assignment at hand.
  - Up to 2 days late, you will lose 50% credits of the assignment at hand.
  - Up to 3 days late, you will lose 75% credits of the assignment at hand.

- You can turn in your assignments in either hand-written or typed format. However typed formats would be more welcomed. Nevertheless, if you would prefer hand-written format, you are expected to:
  - Write legibly!
  - Scan your documents and prepare a well-known image type (e.g. jpg) for sending by E-Mail.

- There will be a zero-tolerance policy for cheating/plagiarism.

- For practical exercises, You are welcome to use any techniques you would want to use.

- Kindly drop me an E-Mail, if you need further information or somethings seem unclear.

*This is our last assignment.
1 Theoretical Part

Problem 1.

In this problem, we’re aiming for playing role of an Ontology Engineer. In the following you’re presented a real world text about music art\(^1\). We would like to build an ontology that represents unstructured knowledges stated by this text, so first read the text carefully while you’re keeping in mind phases and goals of ontology engineering.

Music is an art form, social activity or cultural activity whose medium is sound and silence. The common elements of music are pitch (which governs melody and harmony), rhythm (and its associated concepts tempo, meter, and articulation), dynamics (loudness and softness), and the sonic qualities of timbre and texture (which are sometimes termed the ”color” of a musical sound). Different styles or types of music may emphasize, de-emphasize or omit some of these elements. Music is performed with a vast range of instruments and with vocal techniques ranging from singing to rapping, and there are solely instrumental pieces, solely vocal pieces and pieces that combine singing and instruments. The word derives from Greek (mousike; ”art of the Muses”).\(^1\) In its most general form, the activities describing music as an art form include the production of works of music (songs, tunes, symphonies, and so on), the criticism of music, the study of the history of music, and the aesthetic examination of music.

The creation, performance, significance, and even the definition of music vary according to culture and social context. Indeed, throughout history, some new forms or styles of music have been criticized as ”not being music”, including Beethoven’s Grosse Fuge in 1825\(^2\) and early jazz in the beginning of the 1900s.\(^3\) There are many types of music, including popular music, traditional music, art music, music written for religious ceremonies and work songs such as chanteys. Music ranges from strictly organized compositions (and their recreation in performance), through improvisational music such as jazz and aleatoric (chance-based) 20th and 21st century forms of music. Music can be divided into genres (e.g., Country music) and subgenres (e.g., Country blues), although the dividing lines and relationships between music genres are often subtle, sometimes open to personal interpretation, and occasionally controversial. For example, it can be hard to draw the line between 1980s hard rock and heavy metal from that same era. Within the arts, music may be classified as a performing art, a fine art or as an auditory art. Music may be played or sung and heard live, heard live as part of a dramatic work (a music theater show or opera), or it may be recorded and listened to on a radio, MP3 player or CD player or as part of a film or TV show.

1) Extract the best fitting ontology\(^2\) from the corpus which includes the following items: (Please note that there may be some potential issues in the corpus, you should be able to resolve them)

- Main concepts (aka classes) that are related to music art along with their hierarchies and inheritances.

- Relations between concepts and their types (reflexive, symmetric, transitive, function, additive, etc)

- Individuals. (If there’s not enough individuals in the corpus, you can consider adding arbitrary individuals from your own)

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1\(^{1}\)Two first paragraphs of the ”Music” Wikipedia page. (https://en.wikipedia.org/wiki/Music)

2\(^{2}\)It’s not required your ontology to cover the whole text with all details. It’s enough to grasp the main and music-related concepts within the corpus.
2) Once you’re finished designing the ontology, write at least two sentences (form your own or from the corpus) and map them word by word to your ontology.

It might be still unclear that what tasks are assigned to us to do. If so, please read on. To get ourself started, I’ll analyze the first sentence of the corpus and leave the rest for you.

Music is an art form, social activity or cultural activity whose medium is sound and silence.

After removing unnecessary words and also punctuations, we will reach main key words listed below.

- Music
- art
- social activity
- cultural activity
- medium
- sound
- silence
- is
- possession (implied by the word *whose*)

At this point, we should decide on type and nature of these words. Which is class, which is relation and which is an instance (aka individual).

**Classes and class hierarchies:**

As we know, we should define a class hierarchy that accommodates all of our classes throughout the corpus, so it’s an usual way to adopt a top-down approach and extend our tree accordingly. So, apparently we should consider a general class of type of which all of our subclasses are. A good option would be the class *Thing*. We all concur that everything is of type class *Thing*. Okay, we can now proceed and root our class hierarchy with *Thing*. Now it’s the time to narrow down our tree and add more specific classes. To this end, we summarized our notions as follows.

- We define class *Art* as a subclass of *Thing* in order to accommodate *Music*.

- Since *Music* is kind of art, we can consider it as a subclass of *Art*.

- In order to place *social activity* and *cultural activity* concepts in our tree, we can subclass *Thing* with new class *Activity*.

- *Social activity* and *cultural activity* are both some sorts of a general *Activity*. Therefore we consider them as subclasses of the *Activity* class.

- Also, this sentence claims that *music* is a kind of *activity*, so in this case, we have a multiple inheritance for the *music* class.

- In this sentence *medium* is a concept. Since a *medium* is neither of type *Art* nor of type *Activity*, we should consider adding another class for this sort of concepts. Thus, we end up adding class *Medium* as a subclass of *Thing*.

- *Sound* and *silence* are kind of *mediums* to convey your emotions. So, they should be considered as subclasses of the *Medium* class.
From point of view of classes and their hierarchies, seems we’re done! You can see a visualized version of our class derived so far in the diagram above.

**Relations and relation types:**

In this sentence, the only relation would be the relation between *music* and *medium* which somehow can be modeled as an *uses* relation in the sense that every instances of *music uses* one or more *media* to convey what’s intended. So, domain of this relation is *music* and its range is *medium*.

If we would like to be more specific, we can rename this relation to *is-conveyed-by*. As such, as you can see we wouldn’t reach an unique hierarchy and it may vary according to designer’s opinions. In other side, since every instance of *music* can make use of multiple *media*, so multiplicity of this relation would be *one-to-many*.

At this point, we can extent our hierarchy as follows.

**Instances:**

In this sentence, we can’t find any instances of these classes unless we consider *sound* and *silence* as instances of the *medium* class which we didn’t.

**Sample sentence and mapping:**

In this part we map words of this sentence to our class hierarchy. Figure 3.
Music is an art form, social activity or cultural activity whose medium is sound and silence.

Figure 3: Mapping between words and our class hierarchy

Deliverables:

- Visualized graph of your classes and their hierarchies, besides three items mentioned before.

- (Optional) Port your ontology to Protégé along with all classes, properties and instances.
  - Deliverable: Protégé exported files.

- (Optional) Find at least three rules in our ontology and model them with SWRL in Protégé.
  - Deliverable: Protégé exported files.

Assessment Rule:

Best work will be assigned 1 and other works will be graded accordingly.

Problem 2.

Suppose we have these classes and relations.

- Person(x): x is a person.
- HasChild(x, y): x has a child named y.
- bornIn(x, y): x was born in year y.
- Now(x): x is current year.
- Spouse(x, y): x is spouse of y and vice versa.

Define the following concepts using Semantic Web Rule Language (SWRL).

1. Parent(x): Those who have at least one child.
2. Adolescent(x): Those whose age ranges from 14 to 20.
3. Grangma(x): x is grandmother of another one.
4. Daughter-in-law(x): x is dauther-in-law of another one.
5. HappyCouple(x, y): Both of them were born in the same year and have no children yet. (Is it possible to be expressed in SWRL?)
Problem 3.

Please answer questions below about Semantic Web Services.

1. What’s the main problems of traditional web services? In other words, what kind of problems have motivated researchers to develop semantic web services?

2. Enumerate some pros/cons of semantic web services over traditional web services.

3. What’s main parts of an OWL-S complied web service? Describe their roles.
   - You may want to find answer to this question in practical part 1.

Problem 4.


- What’s it? (Please ask itself to answer. What’s its answer?)

As you may suspected by now, it’s a semantic search engine currently up and running in the wild. You may be impressed how cool is that! Let’s further play around with, ask it some arbitrary questions and let it to answer (For example, ”Who’s Taylor Swift?”).

Just out of curiosity, we’d like to know how it works. (Write half a page about how it works, its properties, advantages and of course its shortcomings)

How about Google?

- Is Google a semantic web engine? (Please ask itself to answer. What’s its answer?)
- How about ”Who’s Taylor Swift?”?

In 3-4 lines, describe what semantic technologies Google Inc. has employed to present a better user experience to its users.

Now, please head to this link http://stackoverflow.com/search.

- What’s it? (Please ask itself to answer. What’s its answer?)
- Is it a search engine? (If yes, why? If no, why?)

For the last try, please go to http://www.cleverbot.com.

- What’s it? (Please ask itself to answer. What’s its answer?)
- Ask it the questions below and write down its answers in your report.
  - Who’s Taylor Swift?
  - How old is she?

Is Cleverbot using semantic technologies in addition to machine learning techniques? Note down how it works in 3-4 lines.

3Feed it with ”who are you?”
2 Practical Part 1 (Optional)

In this part of the assignment, we would like to become familiar with modeling of semantic web services using OWL-S ontology and model a simple web service in Protégé. First, we start by providing an introduction about what an OWL-S service is. You may want to skip this introduction, if you are already familiar with basic concepts of an OWL-S service.

2.1 Introduction

Main building blocks of an OWL-S service is depicted in the diagram below.

![Figure 4: Main building blocks of OWL-S](#)

- The service profile tells "what the service does", in a way that is suitable for a service-seeking agent (or matchmaking agent acting on behalf of a service-seeking agent) to determine whether the service meets its needs.
- The service model tells a client how to use the service, by detailing the semantic content of requests, the conditions under which particular outcomes will occur, and, where necessary, the step by step processes leading to those outcomes.
- A service grounding ("grounding" for short) specifies the details of how an agent can access a service. Typically a grounding will specify a communication protocol, message formats, and other service-specific details such as port numbers used in contacting the service.

2.2 Preparing Protégé Environment

There is a plug-in called OWLSTab for Protégé in order to model an OWL-S service. It is not installed by default in Protégé, so you should first install it in your Protégé. Please go to the following page and follow its instructions to install that plug-in.

- [http://owlseditor.semwebcentral.org/download.shtml](http://owlseditor.semwebcentral.org/download.shtml)

Note: I couldn’t manage to install that plug-in on Protégé 5. However, it seems it works fine on Protégé 3.5. So, if you same as me couldn’t install that plug-in in Protégé 5, you may want to install Protégé 3.5. If so, you can download a local copy of it on my homepage:

- [http://ce.sharif.edu/~abarkhordari/sharedobjects/Protege_3.5.zip](http://ce.sharif.edu/~abarkhordari/sharedobjects/Protege_3.5.zip)

After you have installed the plug-in in your Protégé, your Protégé environment should look like some thing like the following screen-shot.

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4Derived from [http://www.w3.org/Submission/OWL-S/](http://www.w3.org/Submission/OWL-S/)
2.3 Tutorial

There is a good tutorial about modeling semantic web services using OWL-S plug-in of Protégé, find it here at this link.


For saving your time and energy, please start reading from page 18. (Prior pages are generally talking about introductions and what you’re likely already familiar with.)

2.4 Our Service

We are going to model a very simple service that accepts three numbers and calculates their average and returns it. In order to get familiar with nature of atomic and composite processes, our service will have three processes listed in the following:

- An atomic process that takes three numbers and returns their sum.
- An atomic process that takes a number and divides it by 3.
- A composite process consisting of these atomic processes.

As such, our service design should look like this figure:

![Composite Process Diagram]

Figure 6: Design of our service
2.5 Deliverables

- Like the tutorial I’ve liked to, you should deliver a written report in which you’ve noted down in details every step you’ve taken along with proper screen-shots.
- Export WSDL file of your service and attach it to your written report.
- Graph overview of your final service.
  - To generate such a graph, you would need to install GraphViz, which could be installed easily by `sudo apt-get install graphviz` or even simpler by Ubuntu Software Center (USC).

3 Practical Part 2 (Optional) - (For those who code!)

In the previous part, we only modeled a semantic web service, but we didn’t implement logic of our service which is calculating average of three numbers. In this part we are going to implement our service as a real and working service using Java language.

There is an Eclipse plug-in called OWL-S Composer, which allows us to model and implement a semantic web service in Eclipse IDE using Java language. Download and install this plug-in on your local copy of Eclipse.

- https://github.com/FORMAS/OWL-S-Composer

This GitHub repo is headed by default to the develop branch. You should switch to master branch in order to clone the project. Alternatively you can download and install binaries of this project at:

- http://sourceforge.net/projects/owl-scomposer

3.1 To Do

Implement our service using this plug-in and make sure everything runs fine.

3.2 Deliverables

- Step by step written report including proper screen-shots.
- Your complete Eclipse project.
- OWL files of your service.

Good Luck
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