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Code: CS549
Course: Distributed Information Systems
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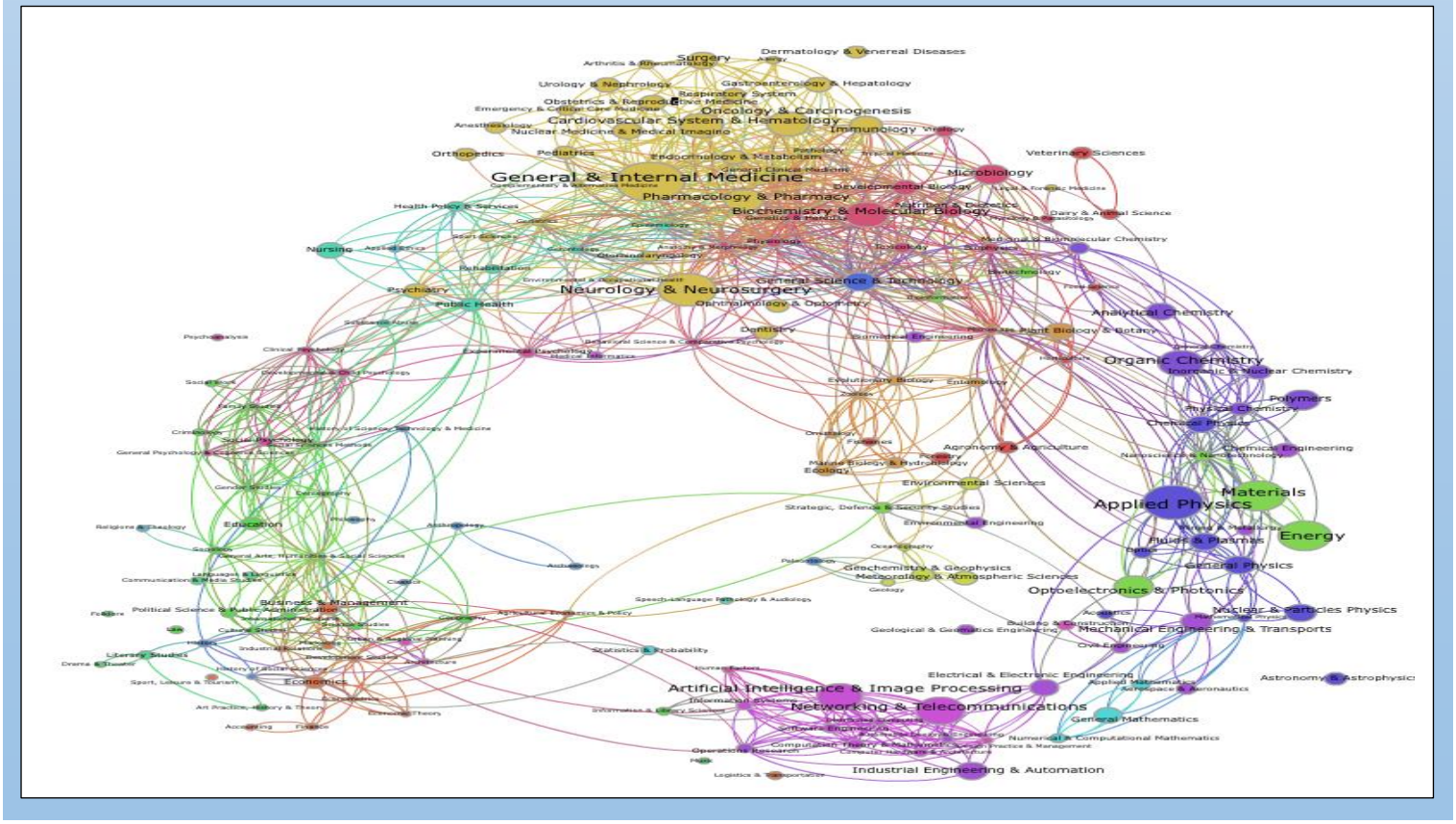
Date: 31/03/2017
Classwork: Building an ontology in OWL



Description of the purpose of the ontology.

The objective was to construct an ontology that represents part of the business of the University of Strathclyde's Centre For Sport & Recreation. The build of the ontology was mainly influenced by the website (http://http://www.strath.ac.uk/sport/) of the Centre for Sport and Recreation of the University of Strathclyde and it was restricted in the Sports Centre domain. An effort was made to incorporate three external ontologies by importing them to Protégé. The external ontologies that were used are the following: a) an ontology for Time that can be found on the web in the ontology IRI: http://www.w3.org/2006/time, b) an ontology for Biography which can be found on the web in the ontology IRI: http://purl.org/vocab/bio/0.1/ and c) an ontology for Date which can also be found on the web in the ontology IRI: http://purl.org/dc/terms/date. The ChartTime subclass of the CardiovascularSuiteOccupancyChart is also a subclass of the external ontology Time. The AthleteBio subclass of the EliteAthlete class is also a subclass of the externally imported ontology Bio. Lastly, the subclasses FromDate and ToDate of the 'CardiovascularSuiteOccupancyChart' class, are also subclasses of the externally imported ontology Bio.

The ontology was designed in a way, that represents the current look of the website (http://http://www.strath.ac.uk/sport/), which is mainly compromised from short and large descriptive texts and a variety of links and images. The website has a homepage and on the left side it has a vertical menu bar. The purpose of the ontology is to categorize the various descriptions, links and images to make it more understandable and coherent to electronic agents who use the RDF language to encode knowledge. Furthermore, it contains many classes, subclasses and self-standing instances, one of which is the subclass Cardiovascular Suite Occupancy section, which provides a chart that demonstrates graphically the occupancy in the Sports Centre. The subclass is constituted by some elements which are the parameters of the chart. Some of which are the ChartTime, Occupancy, FromDate and ToDate.

What kinds of questions should the ontology be able to answer?

Some examples that the ontology should be able to answer, include:

- Find multiple description stories of Elite Athletes.
- Search for the existence of links for the Facility Buildings from the Facilities class.
- Find a link of articles of interest and generate RDF output from the query result.
- Filter the results based on a certain condition (filter on text), for example filter the facility operating hours' description whether it contains the text word 'Operating'.
- Traverse at least two predicates.
  For example, find the news links, contained in the homepage which in turn is contained in one of the main classes 'UniversityOfStrathclydeCentreForSportRecreation'.

Diagrammatic representation and description of the ontology.

The diagrammatic representation of the ontology, which is like the graph summary found in this paper (http://www2007.org/htmlpapers/paper565/), can be seen in **Figure 1**. An effort was made to include in the diagram, as many classes and self-standing instances as possible, however that wasn't possible for the whole ontology. Furthermore, not all predicates (hasDescriptiveInformation, hasLink and isContainedIn) between subjects and objects are depicted in the diagram, due to the size of the ontology and the lack of space.

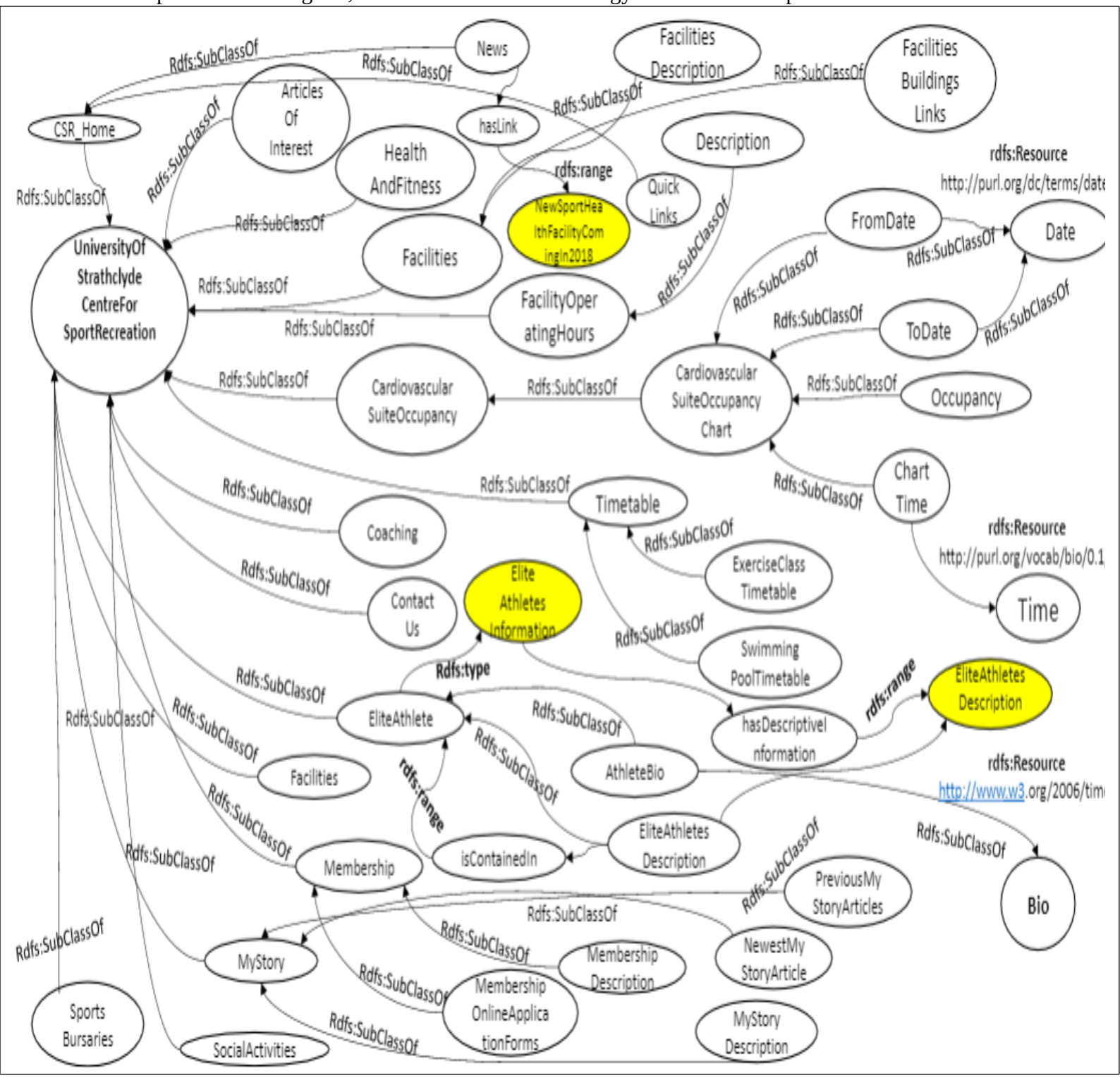


Figure 1

In the diagram the oval circles that have yellow color are examples of individuals. The ontology contains many more than 60 individuals and it would be very difficult to depict more due to limited space

In the following tables, we can see the description of the ontology.

Classes	Self-Standing instances	Modifiers	Relations	Definables
UniversityOfStrathclyde CentreForSport Recreation	SocialActivities	Modifiers	HasLink	AssociateMembershipForm
Time	ArticlesOf Interest		isContainedIn	ContactUsInformation
Bio	Cardiovascular SuiteOccupancy		hasDescriptive Information	EliteAthletesDescription
Date	Coaching		consistsOf	SportsBursariesDescription
	EliteAthlete			SwimmingPoolTimetableInformation
	Facilities			RoyalCollegeGym
	Facility Operating Hours			StaffMembershipForm
	Health And Fitness			SportsHall
	Membership			WeightsRoom
	Timetable	Exercise Class Timetable		AssociateMembershipForm
	MyStory	Exercise Class Timetable Schedule		ConorHart:MyStory
	SportsBursaries			JohnPalmer:MyStory
	CSR_Home			KirstyMcLaren:MyStory
	Image	BPG PNG BMP GIF Exif JPEG/JFIF		NewestMyStoryDescription

By adding the external ontologies (Time, Bio, Date) we acquired many other object properties, data properties, relations, classes and definables, which were included in those ontologies. However, those were not included in the descriptive table as it was not something new. Also, as previously stated it was not possible to include all the new classes, self-standing instances, relations, modifiers and definables which were introduced in this ontology.

Additionally, there are other self-standing instances which are contained in the self-standing instances in the previous table **some** of which are:

- MyStory (MyStoryDescription, NewestMyStoryArticle, PreviousMyStoryArticles);
- SocialActivities (SocialActivitiesDescription);
- SportsBursaries (SportsBursariesDescription);
- Coaching(CoachingDescription)
- CardiovascularSuiteOccupancy(CardiovascularSuiteOccupancyChart,ChartTime,FromDate,Occupancy, ToDate)
- CSR_Home(News, QuickLinks, Image)
- Membership (MembershipDescription, MembershipOnlineApplication Forms)
- HealthAndFitness(GymServices,HealthFitnessAdvice, WorkshopsCourses)
- FacilityOperatingHours(Description)
- EliteAthlete(AthleteBio, EliteAthletesDescription)

And many other self-standing instances included in the ontology.

In the following table, we can see the domains, the ranges as well as the inverses of the relations if there are any.

	Domain	**Range**	**Inverse**
hasLink	Self-Standing instances **and** UniversityOfStrathclyde CentreForSportRecreation	Self-Standing instances	isContainedIn **and** hasDescriptive Information
isContainedIn	**All** Self-Standing instances	**All** Self-Standing instances **and** UniversityOfStrathclyde CentreForSportRecreation	hasDescriptive Information, **and** hasLink
hasDescriptiveInformation	**All** Self-Standing instances **and** UniversityOfStrathclyde CentreForSportRecreation	**All** Self-Standing instances	isContainedIn, **and** hasLink
consistsOf	UniversityOfStrathclyde CentreForSportRecreation	**All** Self-Standing instances	isContainedIn

	Symmetric	**Asymetric**	**Transitivity**	**Functionality**	**Inverse Functionality**	**Reflexivity**
hasLink	**No**	**Yes**	**Yes**	**No**	**Yes**	**No**
isContainedIn	**No**	**Yes**	**Yes**	**No**	**No**	**No**
hasDescriptiveInformation	**No**	**Yes**	**Yes**	**No**	**Yes**	**No**
consistsOf	**No**	**Yes**	**Yes**	**No**	**No**	**No**

Text and output of SPARQL queries that process data structure and produce results

To test the SPARQL queries I used the stand-alone tool Twinkle. I unzipped the source file and executed the jar file to start the Twinkle. I loaded the local ontology from the Data URL. Then I wanted to test the program by running a test query and notice if I retrieve correct results.

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
SELECT ?a
WHERE { ?a   myont:hasLink  ?b . }
```

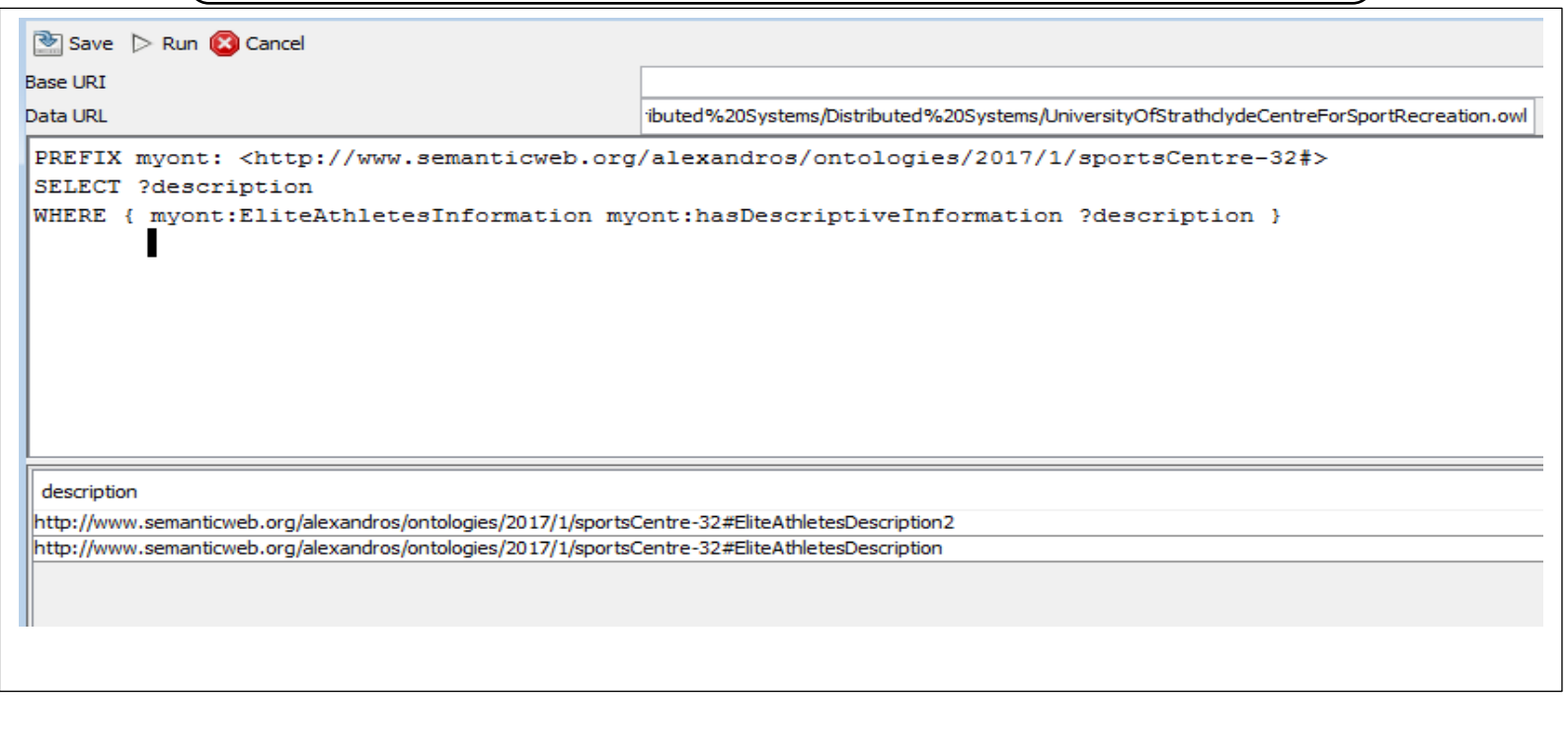
And the output was correct.

a
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#HealthAndFitnessInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#HealthAndFitnessInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#FacilitiesInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#HealthAndFitnessInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#MembershipInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#HealthAndFitnessInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#CSR_Homepage
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ContactUsPage
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#Links
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#SwimmingPoolTimetableInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#MyStoryInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#SwimmingPoolTimetableInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#HealthAndFitnessInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#CSR_Homepage
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#FacilitiesInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ArticlesOfInterestInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ExerciseClassTimetableInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ArticlesOfInterestInformation
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#MyStoryInformation

Text of SPARQL queries

1) **Find multiple description stories of Elite Athletes**.

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
SELECT ?description
WHERE { myont:EliteAthletesInformation   myont:hasDescriptiveInformation  ?description }
```



2) Search for the existence of links for the Facility Buildings from the Facilities class.

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
ASK{ myont:FacilitiesInformation    myont:hasLink    ?x }
```

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
ASK{ myont:FacilitiesInformation     myont:hasLink     ?x }
```

```
yes
```

3) Find all links of articles of interest and generate RDF output from the query result.

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
CONSTRUCT { myont:ArticlesOfInterestInformation    myont:hasLink  ?x }
WHERE {  myont:ArticlesOfInterestInformation    myont:hasLink  ?x  }
```

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
CONSTRUCT { myont:ArticlesOfInterestInformation     myont:hasLink  ?x }
WHERE {  myont:ArticlesOfInterestInformation     myont:hasLink  ?x  }
```

```
<rdf:RDF
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:ns="http://www.w3.org/2003/06/sw-vocab-status/ns#"
    xmlns:bio="http://purl.org/vocab/bio/0.1/"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
    xmlns:terms="http://purl.org/dc/terms/"
    xmlns:dc="http://purl.org/dc/elements/1.1/"
    xmlns:cc="http://web.resource.org/cc/"
    xmlns:terms1="http://open.vocab.org/terms/"
    xmlns:owl="http://www.w3.org/2002/07/owl#"
    xmlns:myont="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#"
    xmlns:skos="http://www.w3.org/2004/02/skos/core#"
    xmlns:label="http://purl.org/net/vocab/2004/03/label#"
    xmlns:vann="http://purl.org/vocab/vann/"
    xmlns:foaf="http://xmlns.com/foaf/0.1/"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema#" >
  <rdf:Description rdf:about="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ArticlesOfInterestInformation">
    <myont:hasLink rdf:resource="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#5StepsToLovingExerciseAHAArticle"/>
    <myont:hasLink rdf:resource="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#AcademyOfMedicalRoyalCollegesArticle"/
    <myont:hasLink rdf:resource="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#BUCSVideo"/>
    <myont:hasLink rdf:resource="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#CIMSPAArticle"/>
    <myont:hasLink rdf:resource="http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#BHFNationalCentreArticle"/>
  </rdf:Description>
</rdf:RDF>
```

4) Filter and retrieve the results based on a certain condition, for example filter the links of the building facilities whether they are unequal to a certain link and retrieve those links that aren't equal to the link.

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
SELECT distinct ?a
WHERE {
  myont:FacilitiesInformation myont:hasLink ?a   .
 filter (str(?a) != "http://www.w3.org/2002/07/owl#")
}
```

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
SELECT distinct ?a
WHERE {
  myont:FacilitiesInformation myont:hasLink ?a   .
  filter (str(?a) != "http://www.w3.org/2002/07/owl#")
}
```

a
<http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#weightsRoom>
<http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#SportsHall>
<http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ConditioningSuite>
<http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ActivitiesRoom>

5) Find the news links, contained in the homepage which in turn is contained in one of the main classes 'UniversityOfStrathclydeCentreForSportRecreation'.

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
SELECT ?newslink
WHERE {
        myont:UniversityOfStrathclydeCentreForSportRecreation   myont:consistsOf    ?homepage .
        ?homepage      myont:hasLink      ?newslink .
}
```

```
PREFIX myont: <http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#>
SELECT ?newslink
WHERE {
        myont:UniversityOfStrathclydeCentreForSportRecreation  myont:consistsOf ?homepage.
        ?homepage myont:hasLink ?newslink.
}
```

newslink
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#2016/17SemesterSwimmingPoolTimetable
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#2016/17CSRLeaflet
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#NewSportHealthFacilityComingIn2018
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#ExerciseClassTimetableApp
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#CSRAppropriateExerciseSupportGuidelines
http://www.semanticweb.org/alexandros/ontologies/2017/1/sportsCentre-32#CSRAdvisoryBoard

Critique of design

The ontology was designed and built similarly to the structure of the elements that consist the Sports Centre website of Strathclyde. The website apart from the homepage which includes links, it has a taxonomy of the following things: Articles Of Interest, Cardiovascular Suite Occupancy, Coaching, ContactUs, CSR_Home, EliteAthlete, Facilities, FacilityOperatingHours, HealthAndFitness, Links, Membership, MyStory, SocialActivities, SportsBursaries, Timetable. Each of these elements contains many other elements including descriptions, links to static pages (Pdf pages, static Html pages, as well other dynamic pages) images and charts. The ontology could be extended even more, however, for the purposes of the assignment it was expanded up to a certain, reasonable point. The ontology contains almost all the elements that are included in each category of the taxonomy menu located on the left side of the website.

Since it was requested to incorporate external ontologies (Time, Bio, Date) and since that is one of the main concepts of the semantic web and of the ontologies, which is to build on other ontologies so that they can be extended even more and get larger I tried to do this by adding 3 large ontologies.

The approach to implement this ontology was one of the many ways to design the Sport's Centre Ontology. Alternative ways to implement the ontology certainly exist. One completely different way of designing the ontology would be to conceive it in a more simplistic-abstract way. For example, introduce classes and self-standing instances such as: main classes (facilities, employees, membership and equipment). Then expand on those by adding further subclasses. For example, under the facilities main class someone could expand by adding all the different names of the buildings that compromise the whole Sport's Centre. Then for each of the buildings that constitute the complete Sport's facility we could then add different rooms such as changing rooms, toilets, free-weights room, aerobic activities room, secretary-customer service room and many more. Examples of modifiers for this section would be for example would be the size of the rooms (large, medium, small). Then for employees we could add general purpose instructors, free weights instructor, zumba and choreography instructor, secretariat, manager and many others. Some modifiers for these self-standing instances could be their age, their weight, years of employment and specialization (zumba, yoga, dance aerobic, pilates etc.). Afterwards, for the membership class I could have added instances such as teacher's membership, undergraduate's membership, postgraduate's membership, retired staff's membership and external customer membership. An example of a modifier could be the time-length of the membership (1-month, 3-month, 6-month or 12-month membership). Lastly, for the 'equipment' class, some self-standing instances I could have added include the kettlebell, dumbbells, Olympic weight bar, smith machine and many more. A modifier for these would be the variety of weights that these are provided.

In the ontology that is described some relations would be the following:

- hasMembership
- hasRoom
- isAvailableIn
- hasSpecializationIn

And some definables could be:

- kilos
- 15 years
- John (a professor)
- Alex (a postgraduate)

The reason why this approach was not chosen to implement the ontology, (even though it represents better the physical structure of the Sports Centre world), is because I felt that the structure of the ontology and the way it was designed in Protégé reflected more accurately the physical structure of the data in the way it was presented on Strathclyde Sports Centre website. But also, incorporates many important things from the physical structure of the world (with slightly alternated names). The aim was to correspond as many elements from Strathclyde's website to primitive and defined classes, subclasses and self-standing instances.

There are many ways to represent an ontology for a Sport's Centre, certain aspects of every ontology are subject to debate since certain elements are hard to classify or taxonomize in certain way without having to face some conflicts. Perhaps, one of the main difficulties in developing a large ontology is the design of it, for example what are the main concepts of it and after that, what are the elements that are included or are subparts of other elements to make it more coherent and sound, as more ideas are introduced and the ontology is expanded.