Exercise 1. Write an ontology about geography: cities, countries, capitals, borders, states, and so on.
<rdf:RDF
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
    <rdfs:Class rdf:ID="country">
        <rdfs:comment>The class of countries</rdfs:comment>
    </rdfs:Class>

    <rdfs:Class rdf:ID="city">
        <rdfs:comment>The class of cities</rdfs:comment>
    </rdfs:Class>

    <rdfs:Class rdf:ID="state">
        <rdfs:comment>The class of states</rdfs:comment>
    </rdfs:Class>

    <rdfs:Property rdf:ID="belongsTo">
        <rdfs:comment>It relates cities to countries</rdfs:comment>
        <rdfs:domain rdf:resource="#city"/>
        <rdfs:range rdf:resource="#country"/>
    </rdfs:Property>
</rdf:RDF>
<rdfs:Property rdf:ID="locates">
    <rdfs:comment>
        It relates cities to states
    </rdfs:comment>
    <rdfs:domain rdf:resource="#city"/>
    <rdfs:range rdf:resource="#state"/>
</rdfs:Property>

<rdfs:Property rdf:ID="isPartOf">
    <rdfs:comment>
        It relates states to countries
    </rdfs:comment>
    <rdfs:domain rdf:resource="#state"/>
    <rdfs:range rdf:resource="#country"/>
</rdfs:Property>

<rdfs:Class rdf:ID="capital">
    <rdfs:comment>
        The class of capitals
    </rdfs:comment>
    <rdfs:subClassOf rdf:resource="city"/>
</rdfs:Class>
<rdfs:Property rdf:ID="border">
    <rdfs:comment>
        It relates borders to countries
    </rdfs:comment>
    <rdfs:domain rdf:resource="#country"/>
    <rdfs:range rdf:resource="#country"/>
</rdfs:Property>

<rdfs:Property rdf:ID="countryName">
    <rdfs:comment>
        It is a property of countries and takes literals as values.
    </rdfs:comment>
    <rdfs:domain rdf:resource="#country"/>
    <rdfs:range rdf:resource="&rdf;Literal"/>
</rdfs:Property>
Exercise 2. Consider the classes of males and females. Name a relationship between them that should be included in an ontology.

Answer: relationship husbandOf; inverse wifeOf
Exercise 3. Consider the classes of persons, males and females. Name a relationship between all the three that should be included in an ontology. Which part of this relationship can be expressed in RDF Schema.

Answer. Husband, Wife, Mother, Father
Exercise 4. Suppose we declare Bob and Peter to be the father of Mary. Obviously there is a semantic error here. How should the semantic model make this error impossible?

Answer: by a cardinality restriction.
Exercise 5. What relationship exist between "is child of" and "is parent of"?

Answer: inverse relationship
Exercise 6. Consider the property *eats* with domain *animal* and range *animal or plant*. Suppose we define a new class *vegetarian*. Name a desirable restriction on *eats* for this class. Do you think that this restriction can be expressed in RDF Schema by using rdfs:range?

Answer: Specifying a subclass by restricting the range of a property is outside the expression power of RDF Schema. In particular, rdfs:range defines the range, e.g., eats, for all classes.
Excercise 7. (OWL-Exercise) Give an OWL-ontology that describes the following:
There are courses and laboratory courses. Homeworks are part of courses. Courses are organized by teachers. Teachers are either professors or assistants. Professors teach courses while assistants only teach laboratory courses.
  <owl:Ontology rdf:about=""/>
  <owl:Class rdf:ID="course">
    <rdfs:comment>Courses form a class.</rdfs:comment>
  </owl:Class>
  <owl:Class rdf:ID="laboratoryCourse">
    <rdfs:comment>Laboratory course is a type of course.</rdfs:comment>
    <rdfs:subClassOf rdf:resource="#course"/>
  </owl:Class>
  <owl:Class rdf:ID="homework">
    <rdfs:subClassOf>
      <owl:Restriction>
        <owl:onProperty rdf:resource="#is_part_of"/>
        <owl:allValuesFrom rdf:resource="#course"/>
      </owl:Restriction>
    </rdfs:subClassOf>
  </owl:Class>
</rdf:RDF>
<owl:Class rdf:ID="teacher">
   <rdfs:comment>Teachers form a class.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="assistant">
   <rdfs:comment>Assistants are exactly those teachers that teach laboratory courses.</rdfs:comment>
   <owl:intersectionOf rdf:parseType="Collection">
      <owl:Class rdf:about="#teacher"/>
      <owl:Restriction>
         <owl:onProperty rdf:resource="#teach"/>
         <owl:allValuesFrom rdf:resource="#laboratoryCourse"/>
      </owl:Restriction>
   </owl:intersectionOf>
</owl:Class>
<owl:Class rdf:ID="professor">
  <rdfs:comment>Professors are exactly those teachers that teach laboratory courses.</rdfs:comment>
  <owl:intersectionOf rdf:parseType="Collection">
    <owl:Class rdf:about="#teacher"/>
    <owl:Restriction>
      <owl:onProperty rdf:resource="#teach"/>
      <owl:someValuesFrom rdf:resource="#course"/>
    </owl:Restriction>
  </owl:intersectionOf>
</owl:Class>

<owl:TransitiveProperty rdf:ID="is_part_of"/>

<owl:ObjectProperty rdf:ID="teachs">
  <rdfs:domain rdf:resource="#teacher"/>
</owl:ObjectProperty>

</rdf:RDF>
Excercise 8. (OWL-Exercise). Give an OWL-ontology that describes the following:

a) Medicinal products are either over the counter drugs or prescription based drugs. Each medicinal product includes an active substance. In addition each medicinal product is substitutable by zero or more medicinal products.

b) Panadol is an instance of over the counter drug, Tramadol is an instance of prescription based drug, and Loperamide is an instance of active substance.
<owl:Ontology rdf:about=""/>

<owl:Class rdf:ID="medicinalProduct">
    <rdfs:comment>Medicinal products form a class.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="overTheCounterDrug">
    <rdfs:subClassOf rdf:resource="#medicinalProduct"/>
    <owl:disjointWith rdf:resource="#prescriptionBasedDrug"/>
</owl:Class>

<owl:Class rdf:ID="prescriptionBasedDrug">
    <rdfs:subClassOf rdf:resource="#medicinalProduct"/>
    <owl:disjointWith rdf:resource="#overTheCounterDrug"/>
</owl:Class>

<owl:Class rdf:ID="activeSubstance">
    <owl:disjointWith rdf:resource="#medicinalProduct"/>
</owl:Class>
<owl:ObjectProperty rdf:ID="includes">
   <rdfs:domain rdf:resource="#medicinalProduct"/>
   <rdfs:range rdf:resource="#activeSubstance"/>
</owl:ObjectProperty>

<owl:TransitiveProperty rdf:ID="substitutes">
   <rdfs:domain rdf:resource="#medicinalProduct"/>
   <rdfs:range rdf:resource="#medicinalProduct"/>
</owl:ObjectProperty>
</rdf:RDF>
Answer b)

<rdf Description rdf : ID="Panadol"/>
   <rdf : type rdf : resource= "#overTheCounterDrug"/>
</rdf : Description>

<rdf Description rdf : ID="Tramadoldol"/>
   <rdf : type rdf : resource= "#prescriptionBasedDrug"/>
</rdf : Description>

<rdf Description rdf : ID="Lopermide"/>
   <rdf : type rdf : resource= "# activeSubstance"/>
</rdf : Description>