Problem 1 (Knowledge Representation).

1.1. Which of the following are classes, which are instances?
   Berlin, singer, cat, natural number, Mini (the car brand), Mini (the set of cars of that brand).
   Instances: Berlin, Mini (the car brand)
   Classes: singer, cat, natural number, Mini (the set of cars of that brand).

1.2. Consider the following knowledge base about all the marriages of Donald Trump:
   marriedTo(Donald Trump, Ivana Trump)
   marriedTo(Donald Trump, Marla Maples)
   marriedTo(Donald Trump, Melania Trump)
   Assume you want to add the time intervals to these marriage (they are: 1977-1992, 1993-1999, 2005-?). Represent this information using only binary relations.
   One option:
   period(marriedTo(Donald Trump, Ivana Trump), 1977-1992)
   period(marriedTo(Donald Trump, Marla Maples), 1993-1999)
   period(marriedTo(Donald Trump, Melania Trump), 2005-?)
   Second option:
   start(marriedTo(Donald Trump, Ivana Trump), 1977)
   end(marriedTo(Donald Trump, Ivana Trump), 1992)
   Similarly to other facts.

1.3. Represent the same data using n-ary relations.
   marriedTo(Donald Trump, Ivana Trump, 1997, 1992)
   marriedTo(Donald Trump, Marla Maples, 1993, 1999)
   marriedTo(Donald Trump, Melania Trump, 2005, NULL)

1.4. Would you recommend n-ary relations or binary relations if the temporal information is not available for most of the facts? Why?
   N-ary relations would mean that most fields would contain null values, which unnecessarily blows up the data. So binary relations are preferable in this case.

1.5. List all superclass relationships among the following classes (including transitive ones).
   person, brown eyed person, computer science student, blue eyed person, student, performer, singer
   brown eyed person → person
   blue eyed person → person
   computer science student → person
   student → person
   performer → person
   singer → person
   computer science student → student
   singer → performer

1.6. Which of the following relations are functions, inverse functions, both, or neither?
   isBornInCity(person, city), knows(person, person), hasFullTimeEmployee(company, person), hasTaxID(person, id)
   Function: isBornInCity(person, city)
   Inverse function: hasFullTimeEmployee(company, person)
   Both: hasTaxID(person, id)
   Neither: knows(person, person)

1.7. Give an example for an ambiguous label, and explain your example.
   The word “bank” is ambiguous:
– the slope beside a body of water (e.g. the bank of the river)
– a financial institution, etc.

Problem 2 (Data Modeling). Define a schema and express the below information:

In July 1985, Queen performed in the Live Aid concert at Wembley Stadium in London, the capital of England. Queen is a British rock band formed in London in 1970.

Results should include the schema/ontology (taxonomy and relation definitions) and facts, all written as triples.

Relation Definitions
• domain(performEvent, group), range(performEvent, event)
• domain(happenTime, event), range(happenTime, time)
• domain(happenPlace, event), range(happenPlace, location)
• domain(locatedIn, location), range(locatedIn, location)
• domain(capitalOf, city), range(capitalOf, country)
• domain(formedPlace, group), range(formedPlace, location)
• domain(formedTime, group), range(formedTime, time)

Taxonomy
• (group, subClassOf, entity)
• (time, subClassOf, entity)
• (location, subClassOf, entity)
• (event, subClassOf, entity)
• (city, subClassOf, location)
• (country, subClassOf, location)
• (concert, subClassOf, event)
• (music group, subClassOf, group)
• (rock band, subClassOf, music group)
• (british rock band, subClassOf, rock band)

Facts
• (July 1985, type, time)
• (Queen, type, british rock band)
• (the Live Aid concert, type, concert)
• (Wembley Stadium, type, location)
• (London, type, city)
• (England, type, country)
• (Queen, performEvent, the Live Aid concert)
• (the Live Aid concert, happenTime, July 1985)
• (the Live Aid concert, happenPlace, Wembley Stadium)
• (Wembley Stadium, locatedIn, London)
• (London, capitalOf, England)
• (Queen, formedPlace, London)
• (Queen, formedTime, 1970)

Problem 3 (Fact Extraction). Given the text below:

After the war, Harry became an Auror and helped reform and revolutionise the Ministry of Magic. At some point, he married Ginny Weasley, with whom he had three children: James Sirius, Albus Severus, and Lily Luna. He was also named the godfather of Edward Remus Lupin. In 2007 Harry was promoted to Head of the Auror Office at the age of 26 and would occasionally deliver Defence Against the Dark Arts lectures at Hogwarts.

3.1. List all entities that appear in the text.

the war, Harry, Auror, the Ministry of Magic, Ginny Weasley, James Sirius, Albus Severus, Lily Luna, Edward Remus Lupin, 2007, Head of the Auror Office, 26, Defence Against the Dark Arts, Hogwarts

3.2. List all facts appearing the text, using triple format.

– (Harry, hasOccupation, Auror)
– (Harry, reform, the Ministry of Magic)
– (Harry, revolutionise, the Ministry of Magic)
– (Harry, marriedTo, Ginny Weasley)
– (Harry, hasChild, James Sirius)
– (Harry, hasChild, Albus Severus)
– (Harry, hasChild, Lily Luna)
– (Harry, hasTitle, the godfater of Edward Remus Lupin)
– (Harry, promotedTo, Head of the Auror Office)
– ((Harry, promotedTo, Head of the Auror Office), happenIn, 2007)
– (Harry, deliver, Defence Against the Dark Arts)
– ((Harry, deliver, Defence Against the Dark Arts), happenPlace, Hogwarts)

3.3. Which facts would be better represented using n-ary relations? Represent them in that format.

– (Harry, occupation, Auror, after the war)
– (Harry, reform, the Ministry of Magic, after the war)
– (Harry, revolutionise, the Ministry of Magic, after the war)
– (Harry, hasChildren, James Sirius, Albus Severus, Lily Luna)
– (Harry, promotedTo, Head of the Auror Office, 2007)
– (Harry, deliver, Defence Against the Dark Arts, Hogwarts)