h. There is a barber who shaves all men in town who do not shave themselves.

i. A person born in the UK, each of whose parents is a UK citizen or a UK resident, is a
   UK citizen by birth.

j. A person born outside the UK, one of whose parents is a UK citizen by birth, is a UK
   citizen by descent.

k. Politicians can fool some of the people all of the time, and they can fool all of the people
   some of the time, but they can't fool all of the people all of the time.

l. All Greeks speak the same language.  (Use \( \text{Speaks}(x, I) \) to mean that \( x \) speaks
   language \( I \)).

8.25 Write a general set of facts and axioms to represent the assertion "Wellington heard
   about Napoleon's death" and to correctly answer the question "Did Napoleon hear about
   Wellington's death?"

8.26 Extend the vocabulary from Section 8.4 to define addition for \( n \)-bit binary numbers.
   Then encode the description of the four-bit adder in Figure 8.8, and pose the queries needed
   to verify that it is in fact correct.

8.27 Obtain a passport application for your country, identify the rules determining eligi-
bility for a passport, and translate them into first-order logic, following the steps outlined in
Section 8.4.

8.28 Consider a first-order logical knowledge base that describes worlds containing people,
songs, albums (e.g., "Meet the Beatles") and disks (i.e., particular physical instances of CDs).
The vocabulary contains the following symbols:

- \( \text{CopyOf}(d, a) \): Predicate. Disk \( d \) is a copy of album \( a \).
- \( \text{Owens}(p, d) \): Predicate. Person \( p \) owns disk \( d \).
- \( \text{Sings}(p, s, a) \): Album \( a \) includes a recording of song \( s \) sung by person \( p \).
- \( \text{Wrote}(p, s) \): Person \( p \) wrote song \( s \).
- \( \text{McCartney}, \text{Gershwin}, \text{Holiday}, \text{Joe}, \text{Eleanor Rigby}, \text{The Man I Love}, \text{Revolver} \):
  Constants with the obvious meanings.
Express the following statements in first-order logic:

a. Gershwin wrote "The Man I Love."

b. Gershwin did not write "Eleanor Rigby."

c. Either Gershwin or McCartney wrote "The Man I Love."

d. Joe has written at least one song.

e. Joe owns a copy of Revolver.

f. Every song that McCartney sings on Revolver was written by McCartney.

g. Gershwin did not write any of the songs on Revolver.

h. Every song that Gershwin wrote has been recorded on some album. (Possibly different songs are recorded on different albums.)

i. There is a single album that contains every song that Joe has written.

j. Joe owns a copy of an album that has Billie Holiday singing "The Man I Love."

k. Joe owns a copy of every album that has a song sung by McCartney. (Of course, each different album is instantiated in a different physical CD.)

l. Joe owns a copy of every album on which all the songs are sung by Billie Holiday.