Exercise 8.1
Consider the following concepts:

\( \text{male}(p), \text{married}(h,w), \text{has\_child}(p,c) \)

a) Based on the above, define the concepts:

1. Bachelor
2. Mother
3. Single father
4. Grandmother
5. Brother
6. Wife
7. Cousin

You can define additional concepts to help you.

b) Assume the instances Queen Elizabeth II. and Charles Philip Arthur George, Prince of Wales (yes, that Prince Charles). Using information you have or can find about the instances draw the subsumption lattice including the two instances and all concepts in a).

Exercise 8.2
Consider the following formulas:

1. \( \forall x (R(x) \Rightarrow L(x)) \)
2. \( \forall x (D(x) \Rightarrow \neg F(x)) \)

\(^1\)Please use the cover sheet from the home page to stitch all sheets together.
3. $\forall x (D(x) \Rightarrow \neg L(x))$
4. $\neg \forall x (I(x) \Rightarrow \neg D(x))$
5. $\exists x (I(x) \land \neg R(x))$

Convert them into clausal form. By using resolution, refute or prove that formula 5. can be derived from the others. For each resolution step, state the unification you use.

**Exercise 8.3**

Consider the following set of formulae $\Theta$ and the interpretation $I$:

- $\Theta = \{\text{Person}(a), \text{Person}(b), \forall x (\text{Person}(x) \Rightarrow (\text{Small}(x) \lor \text{Stupid}(x)))\}$
- $D = \{d_1, d_2, d_3\}$
- $a^I = d_1, b^I = d_2$
- $\text{Person}^I = \{d_1, d_2, d_2\}$
- $\text{Small}^I = \{d_1\}, \text{Stupid}^I = \{d_3\}$
- $\alpha = \{(x \mapsto d_1), (y \mapsto d_2)\}$

Answer the following questions, i.e. state whether interpretation $I$ under $\alpha$ is a model of the respective formula or not. Explain your answers!

1. $I, \alpha \models \forall x (\text{Person}(x) \Rightarrow (\text{Small}(x) \lor \text{Stupid}(x)))$?
2. $I, \alpha \models \text{Person}(x) \Rightarrow (\text{Small}(x) \lor \text{Stupid}(x))$?
3. $I, \alpha \models \text{Small}(y)$?
4. $I, \alpha \models \exists y \text{ Stupid}(y)$?
5. $I, \alpha \models \Theta$?

**Exercise 8.4**

Compute the most general unifier (if it exists) of:

1. $P(x, x, g(x))$ and $P(g(y), g(h(u)), g(g(g(B))))$, and respectively of
2. $P(g(h(w)), u, x, x, g(u))$ and $P(y, h(C), g(B), g(B), y)$.