1. Encode the following sentences as Description Logic formulas:
   a) Grandparents are either grandfathers or grandmothers
   b) You can't be both a grandfather and a grandmother
   c) Every person has grandparents
   d) Grandparents are people who have at least one child

Answer 1:
a) $Grandparents \equiv Grandfathers \sqcup Grandmothers$
b) $Person \sqsubseteq \neg(Grandfathers \sqcap Grandmothers)$
c) $Person \sqsubseteq \forall hasGrandparents.Person$
d) $Grandparents \sqsubseteq Person \sqcap \exists hasChild.Person$

2. Translate the following sentence into ALC: *A professor is a person who is an expert in at least one topic, and everything they say is smart.*

Answer 2: $Professor \equiv Person \sqcap \exists expertAt.Topic \sqcap \forall hasSaid.Smart$

3. For each of the formulas 1-6 listed in the green box on slide 19, explain with a calculation why the given extension of that concept is correct.

Answer 3:
1) $Artwork^{\mathcal{I}} \cap (\Delta^{\mathcal{I}} - Sculpture^{\mathcal{I}})$
2) $\mathcal{I} = \emptyset$, iterate every entry in $painted^{\mathcal{I}}$, add the first element into $\mathcal{I}$ whose second element is in $Painting^{\mathcal{I}}$.
3) we first calculate $\exists sculptured.Artwork$ following the same rules as mentioned in 2), then we calculate $\forall created.Sculpture$. We calculate the $created^I$ grouped by the first element, denoted as $created^J$; initialize $\mathcal{I} = \emptyset$, iterate every entry, such as $(michelangelo, (sixtChappel, david))$, in $created^J$, if the second entry minus $Sculpture^{\mathcal{I}}$ is empty, then we add the first element into $\mathcal{I}$. Finally, we take the intersection.
4)

$$Artwork \sqcap \neg Sculpture = \{nightwatch, sixtChappel\} \quad (1)$$
$$\exists created.(Artwork \sqcap \neg Sculpture) = \{rembrandt, michelangelo\} \quad (2)$$
$$\forall created.Sculpture = \{\} \quad (3)$$
$$\forall created.Sculpture \sqcap existscreated.(Artwork \sqcap \neg Sculpture) = \{\} \quad (4)$$

5)

$$\forall created.Painting = \{rembrandt\} \quad (5)$$
$$\exists created.\top = \{rembrandt, michelangelo, rodin\} \quad (6)$$

6) follow the same rule as mentioned in 2), let us iterate every entry: nightwatch is a Painting, so we add "rembrandt" into the result set, and sixtChappel is also a Painting, so we add "michelangelo".