This assignment tests your understanding of the $\mathcal{ALC}$ full tableaux algorithm. This assignment is worth 14% of the total grade and it is due on or before the class starts on November 15th.

1. **(3.0 points)** Show using $\mathcal{ALC}$ full tableaux algorithm that the following knowledge base is satisfiable. (Hint: Keep applying rules until the algorithm terminates with no more rules to apply. You can use single letter symbols to represent the conceptualization.)

   \[
   \begin{align*}
   &\text{Student} \sqsubseteq \exists \text{attends.Lecture} \\
   &\text{Lecture} \sqsubseteq \exists \text{isAttendedBy.}(\text{Student} \cap \text{Eager}) \\
   &\text{Student(paul)} \\
   &\neg \text{Eager(paul)}
   \end{align*}
   \]

2. **(3.0 points)** Show using $\mathcal{ALC}$ full tableaux algorithm that the following knowledge base is unsatisfiable.

   \[
   \begin{align*}
   &\text{Unicorn} \sqsubseteq \text{Animal} \\
   &\text{Unicorn} \sqsubseteq \text{Fictitious} \\
   &\text{Fictitious} \sqcap \text{Animal} \sqsubseteq \bot \\
   &\text{Unicorn(cloverJollyBridle)}
   \end{align*}
   \]

3. **(3.0 points)** The $\mathcal{ALC}$ knowledge base consists of the axioms:

   \[
   \begin{align*}
   &A \sqsubseteq B \sqcap C \\
   &C \sqsubseteq D
   \end{align*}
   \]

   Show that using $\mathcal{ALC}$ full tableaux algorithm that $A \sqsubseteq D$ is a logical consequence of this knowledge base.

4. **(3.0 points)** Show that using $\mathcal{ALC}$ full tableaux algorithm that $\exists \text{speaksWith.} \top \sqsubseteq \text{Primate}$ is a logical consequence of the following knowledge base:

   \[
   \begin{align*}
   &\text{Home} \sqsubseteq \text{Primate} \\
   &\exists \text{speaksWith.} \top \sqsubseteq \text{Home}
   \end{align*}
   \]

5. **(2.0 points)** Extend your ontology to $\mathcal{SHOIQ}(\mathcal{D})$.

6. **(Optional 3.0 points)** You are given the following knowledge base.

   \[
   \begin{align*}
   &\text{RRated} \sqsubseteq \text{CatMovie} \\
   &\text{CatMovie} \sqsubseteq \text{Movie} \\
   &\text{RRated} \equiv (\exists \text{hasScript.ThrillerScript}) \sqcup (\forall \text{hasViolenceLevel.High}) \\
   &\text{Person} \sqsubseteq \neg \text{Movie} \\
   &\exists \text{hasViolenceLevel.} \top \sqsubseteq \text{Movie}
   \end{align*}
   \]

   Using $\mathcal{ALC}$ tableaux algorithm, show that $\text{Person} \sqsubseteq \bot$ is a logical consequence of this edge base.