Artificial Intelligence for Robotics 1

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Sample test 2

1 Propositional Logic

Given the following formulas in propositional logic

- φ_1: $(p \rightarrow q)$
- φ_2: $(r \rightarrow (s \wedge t))$
- φ_3: $(p \vee r)$
- φ_4: $(\neg p \vee q) \wedge (p \vee r)$
- φ_5: $(q \rightarrow (s \wedge t))$

show whether the formula $s \wedge t$ is a logical consequence of the theory $\Phi = \{\varphi_1, \varphi_2, \varphi_3, \varphi_4, \varphi_5\}$. State your answer as a proof using either a deduction mechanism of your choice. Truth-tables are not accepted as an answer.

2 First Order Logic

Consider the following first order theory about dressing tastes:

1. $\forall x.(Likes(x, sneakers) \vee Likes(x, boots))$.
2. $\forall x.(Likes(x, slipon) \rightarrow Likes(x, boots))$.
3. $\exists x.\neg Likes(x, slipon)$.
4. $\exists x.(Likes(x, sneakers) \rightarrow \neg Likes(x, boots))$

and tell whether each of the following sentences is either a logical consequence of the theory or not:

1. $\exists x.(\neg Likes(x, boots) \wedge \neg Likes(x, slipon))$.
2. $\forall x.(\neg Likes(x, sneakers) \rightarrow Likes(x, slipon))$.
3. $\forall x.(Likes(x, slipon) \vee Likes(x, sneakers))$.

4. $\forall x.(Likes(x, sneakers))$.
5. $\forall x.((Likes(x, slipon) \wedge \neg Likes(x, sneakers)) \rightarrow Likes(x, boots))$.

Please state your answers using a deductive mechanism of your choice or a semantic argument.

3 Description Logic

Consider a knowledge base Σ in $\mathcal{ALC}$ where the TBox is the following:

- $Pizza \equiv \neg\ Topping$
- $Pizza \sqcup Topping \equiv \top$
- $VeggiePizza \sqsubseteq Pizza$
- $Margherita \sqsubseteq VeggiePizza$
- $MushroomPizza \sqsubseteq Pizza$
- $VeggieTopping \sqsubseteq Topping$
- $CheeseTopping \sqsubseteq Topping$
- $Mushrooms \sqsubseteq VeggieTopping$
- $Tomato \sqsubseteq VeggieTopping$
- $Mozzarella \sqsubseteq CheeseTopping$
- $Pizza \equiv \forall hasTopping.Topping$
- $MushroomPizza \equiv \exists hasTopping.Mushrooms$
- $MushroomPizza \equiv \exists hasTopping.Mozzarella$
- $Margherita \equiv \exists hasTopping.Tomato$
- $Margherita \equiv \exists hasTopping.Mozzarella$

Consider now the ABox given by the statements:

- $Margherita$(myPizza)
- $Tomato$(freshTomatoes)
- $Mozzarella$(buffaloMozzarella)
- $hasTopping$(myPizza, buffaloMozzarella)
- $\neg hasTopping$(myPizza, freshTomatoes)

Tell whether the Abox is consistent with the TBox and, if not, what should be modified to make it consistent.