Artificial Intelligence for Robotics 1

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Sample test 4

1 Propositional Logic

Given the following formulas in propositional logic

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

show whether the formula $s \wedge t$ is a logical consequence of the theory $\Phi = \{\varphi_1, \varphi_2, \varphi_3, \varphi_4\}$. 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 model for the "sorority world" where an "$\times$" in the cell x, y denotes that x "likes" y

	Abby	Bess	Cody	Dana
Abby	$\times$	-	$\times$	$\times$
Bess	-	$\times$	-	$\times$
Cody	-	-	$\times$	-
Dana	-	$\times$	$\times$	-

and tell which of the following sentences is true in the model:

1. $\forall x.likes(x, x)$
2. $\forall x.\exists y.likes(x, y)$
3. $\exists y.\forall x.likes(x, y)$
4. $\forall x.\forall y.likes(x, y) \rightarrow likes(y, x)$
5. $\forall x.\forall y.(\exists z.likes(x, z) \wedge likes(z, y)) \rightarrow likes(x, y)$.

3 Description Logic

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

- $Person \sqsubseteq Animal \sqcap Biped$
- $Woman \equiv Person \sqcap Female$
- $Mother \equiv Woman \sqcap \exists ParentOf.Person$
- $Parent \equiv Mother \sqcup Father$
- $Man \equiv Person \sqcap \neg Woman$
- conMotherWithoutDaughter $\equiv Mother \sqcap \forall ParentOf.\neg Female$
- $GrandMother \equiv Woman \sqcap \exists\ ParentOf.$Parent

and the ABox is the following:

- $GrandMother$(Sally)
- $(Person \sqcap Man)$(John)

Using a deduction mechanism or a semantic argument, tell whether the following assertions hold:

- $\Sigma \models Woman \sqsubseteq Biped$
- $\Sigma \models Man \sqsubseteq Parent$
- $\Sigma \models \exists ParentOf.Man$
- $\Sigma \models \exists ParentOf.Person \sqsubseteq Woman$
- $\Sigma \models (\neg Woman)$(John)