

# Artificial Intelligence for Robotics 1

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Sample test 1

## 1 Propositional Logic

Formalize the following sentences about a group of friends having a party

1. Alberto and Carola are going to the party
2. Either Beatrice or Daniele (or both) are going to the party
3. If Alberto goes to the party then also Enrico goes to the party
4. If Enrico goes to the party then Daniele does not go
5. If Beatrice goes to the party then either Carola or Alberto do not go

Considering the sentences above, is there going to be someone at the party? State your answer as a proof using a deduction mechanism of your choice or a semantic argument. Truth-tables are not accepted as an answer. (**Note:** the disjunction in sentence (2) is inclusive.)

## 2 First Order Logic

Consider the following first order theory about cocktails:

1.  $\forall x. (Loves(x, negroni) \rightarrow Loves(x, americano))$ .
2.  $\forall x. (Loves(x, stinger) \vee Loves(x, negroni))$ .
3.  $\exists x. \neg Loves(x, americano)$ .
4.  $\exists x. (Loves(x, stinger) \vee Loves(x, negroni))$

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

1.  $\exists x. (\neg Loves(x, negroni) \wedge \neg Loves(x, stinger))$ .
2.  $\forall x. (\neg Loves(x, stinger) \rightarrow \neg Loves(x, americano))$ .
3.  $\forall x. (Loves(x, negroni) \vee Loves(x, americano))$ .

4.  $\forall x.(Loves(x, americano)).$
5.  $\forall x.((Loves(x, negroni) \wedge \neg Loves(x, americano)) \rightarrow \neg Loves(x, stinger)).$

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

### 3 Description Logic

Consider a knowledge base  $\Sigma$  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:

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