

Intelligent Systems

Exercise sheet 3
Predicate Logic**Exercise 1 (4 points)**

Answer the following question:

What are the differences between predicate logics and propositional logics?

Exercise 2¹ (10 points)

Represent the following sentences in first-order logic, using a consistent vocabulary (which you must define):

- (a) Some students took French in spring 2001.
- (b) Every student who takes French passes it.
- (c) Only one student took Greek in spring 2001.
- (d) The best score in Greek is always higher than the best score in French
- (e) Every person who buys a policy is smart.
- (f) No person buys an expensive policy.
- (g) There is no agent who sells policies only to people who are not insured.
- (h) There is a barber who shaves all men in town who do not shave themselves.(Bertrand Russell's paradox)
- (i) A person born in the UK, each of whose parents is a UK citizen or a UK resident, is a UK citizen by birth
- (j) A person outside the UK, one of whose parents is a UK citizen by birth, is a UK citizen by descent.
- (k) Politicians can fool some of the people all of the time, and they can fool all of the people some of the time, but they can't fool all of the people all of the time.

¹ Exercise from Russell/Norvig

Exercise 3² (6 points)

For each pair of atomic sentences, give the most general unifier if it exists (and indicate if both are unifiable or not):

- (a) $P(A,B,B)$; $P(x,y,z)$
- (b) $Q(y,G(A,B))$; $Q(G(x,x),y)$
- (c) $\text{Older}(\text{Father}(y),y)$, $\text{Older}(\text{Father}(x), \text{John})$
- (d) $\text{Knows}(\text{Father}(y),y)$; $\text{Knows}(x,x)$

Exercise 4³ (10 points)

Transform each of the following formulas to clausal form:

- (a) $\forall x(p(x) \rightarrow \exists yq(x))$
- (b) $\forall x\forall y(\exists zp(z) \wedge \exists u(q(x,u) \rightarrow \exists vq(y,v)))$
- (c) $\exists x(\neg \exists yp(y) \rightarrow \exists z(q(z) \rightarrow r(x)))$

² Exercise from Russell/Norvig

³ Exercise from Ben-Ari