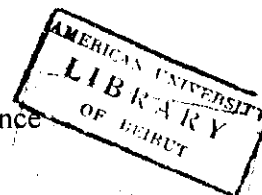


# CMPS 287 – Artificial Intelligence

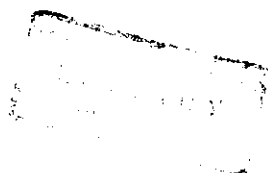
FINAL EXAM (2-HOURS)

Department of Mathematics and Computer Science  
American University of Beirut  
Winter 2002



- Every question is worth 10% for a total of 100
- Read all questions **BEFORE** you start answering. No questions after first ½ hour

1. Represent the following in first order logic:
  - a) Some governments do not allow any form of public expression
  - b) A demonstration is a form of public expression
  - c) A government that does not allow a public demonstration will arrest any demonstrator
  - d) John demonstrates against any country
  - e) There are countries whose governments do not allow any demonstration
2. Show, using the inference rules of FOL, that (a-e) imply “will be arrested by some government” (remember to show the proof “formally”, using the rules of inference of Logic, not English, and remember to justify every step!)
3. Show the parse tree and represent the meaning (showing the type) of every component of the parse tree of the following sentence (use the higher-order logic (and the Lambda abstraction operator):  
*Every famous author wrote some best seller novel*
4. Suppose that some individual has a quantificational constraint  $QC(\text{Write}, \text{Author}, \text{Novel}) = \langle [1..3], [1..|\text{Novel}|] \rangle$ , that is, that some individual believes that it makes sense to speak of 1 to 3 people writing a specific novel, and that a specific author could write many (up to all) novels. Work out the plausibility measures of the direct ( $\forall\exists$ ) and the indirect ( $\exists\forall$ ) reading of the following sentences:
  - a) Every author wrote some novel
  - b) Every famous author wrote some best seller novel
5. Suggest what the defining attributes might be for the following concepts. Use these attributes to suggest (with justification) a suitable inheritance hierarchy that would classify the following concepts:



6. Suppose the following is a definition of a concept  $C$  in terms of its attributes  $p_1, p_2, \dots, p_n$ , where each  $p_i$  is necessary, and all are sufficient to define the concept  $C$ :

$$C(x) \equiv_{df} p_1(x) \wedge \dots \wedge p_n(x)$$

For example,  $Father(x) \equiv_{df} Male(x) \wedge (\exists y)(Parent(x,y))$  could be the definition of *Father*

Use the same format (of necessary and sufficient conditions) to represent the meaning of the following concepts (**Hint:** use adjectives and verbs that are unique to those concepts):

- Human*
- Book*
- Bird*
- Computer*
- Water*



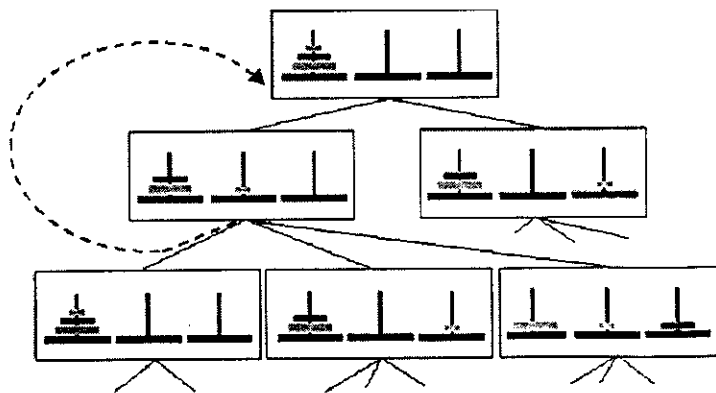
7. Suggest a logical representation for the following compound concepts:

- computer program*
- late (as in "the now dead") president*
- artificial intelligence*
- artificial flower*
- previous senator*

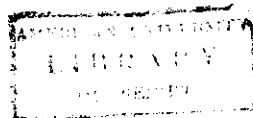
**HINT:** in some cases you might have to introduce a relation that is

implicit between the two concepts

8. (a) How would you represent the towers of hanoi game in Prolog (shown below)?  
 (b) How would you right some of the rules for legal moves?  
 (c) Suggest a reasonable heuristic function to reach the goal  
 (d) Given your heuristic function, is there a preference as to whether a breadth-first search or a depth-first search strategy is better in this problem?



The rules are as follows: (1) you can move one disk at a time; (2) you can only remove the disk at the top of a bar; and (3) you can put a disk on smaller disk or on an empty bar, only



9. Fill in the blanks

- (a) The "Chinese Room Argument" was an attempt to refute the plausibility of the \_\_\_\_\_.
- (b) The problem of determining what relevant changes to consider in a knowledge base after some new information has been received is known as the \_\_\_\_\_ in AI.
- (c) While the expressions  $(3*5)$  and  $(11+4)$  have the same \_\_\_\_\_ they do not have the same \_\_\_\_\_.
- (d) The fact that some type of birds (such as penguins) do not fly is called \_\_\_\_\_ exception while the fact that some bird, that typically flies, but whose wings are broken, or stuck in cement..., does not fly is called \_\_\_\_\_.
- (e) Prototypes theory is very related to the concept of \_\_\_\_\_ concepts, in that in both cases membership in a set/concept is not all or nothing but is a matter of \_\_\_\_\_.

10. State whether the following is **True** or **False**

- (a) [ \_\_\_\_\_ ] Lexical disambiguation refers to the process of selecting the most appropriate meaning of sentence
- (b) [ \_\_\_\_\_ ] Semantic networks can modeled using different logics
- (c) [ \_\_\_\_\_ ] Default Logic is non-monotonic because we facts in a non-monotonic knowledge base can never decrease
- (d) [ \_\_\_\_\_ ] Neural Networks (as opposed to symbolic approaches) can only represent and reason with numeric values
- (e) [ \_\_\_\_\_ ] Higher-Order logic (lambda-abstraction) was introduced in modeling the semantics of natural language to allow for a proper representation for partial meanings

