

Problem Set 5: Due March 5

1. (10 points) Consider the following symbols that represent specific concepts in propositional logic:

- Sp : Spaghetti is pasta
- Sw : Spaghetti is made of wheat
- W : Wheat is a carbohydrate
- C : Carbohydrates are good
- P : Pasta is good
- T : Sauce has tomatoes

For each sentence below, use the symbols above to represent the concept as a propositional logic sentence **in Conjunctive Normal Form**:

- Carbohydrates are not good.
 - If pasta is good then carbohydrates are good.
 - If spaghetti is made of wheat it is pasta.
 - If spaghetti is made of wheat and sauce has tomatoes then pasta is good.
 - Carbohydrates are good if spaghetti is made of wheat or wheat is a carbohydrate.
2. Consider an initially empty knowledge base to which we add the first three sentences above. Use the tuple (C, P, Sw, Sp) to represent potential models for this KB (each element in the tuple corresponds to the truth value of that symbol).
- (5 points) List the models of the knowledge base.
 - (5 points) Consider the following sentence: *carbohydrates are not good if spaghetti isn't pasta*. Given your answer on the previous part, can you conclude that this sentence is entailed by the knowledge base? Why or why not, be explicit and use only your solution to the previous part to justify your response.

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3. Consider the following quote from Russell & Norvig (pp.238).

If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is either immortal or a mammal, then it is horned. The unicorn is magical if it is horned.

- (a) (5 points) Write the propositional sentences to describe the knowledge in this paragraph. Be sure to describe what each symbol means.
 - (b) (5 points) Using resolution, can you prove that the unicorn is magical? If so, show a proof. If not, describe why you've come to this conclusion.
 - (c) (5 points) Using resolution, can you prove that the unicorn is horned? If so, show a proof. If not, describe why you've come to this conclusion.
 - (d) (5 points) Using resolution, can you prove that the unicorn is mythical? If so, show a proof. If not, describe why you've come to this conclusion.
4. (9 points) Write the following sentences in first-order logic, using a consistent vocabulary. Try to keep the number of predicates and terms to a minimum and be sure to define each one as it is introduced.
- (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.
5. (8 points) Explain what is wrong with the following proposed definition of adjacent squares in the wumpus world:

$$\forall x, y \text{ Adjacent}([x, y], [x + 1, y]) \vee \text{Adjacent}([x, y], [x, y + 1])$$

There are at least three problems with this definition. Full credit will be given for identifying at least two of them.