CS4365 – 5354 Problem Solving and Algorithms
Final Examination
June 30, 2016 – Take-home final exam

Available on:
Piazza.com/utep/summer2016/cs43655354/home on June 30 at 7 a.m.
Due on:
July 2nd by 11:59 p.m. as a private note on piazza attaching the docx **answer sheet** as specified in the exam's description.

Exam's Rules:
You are not allowed to look up solutions of the below questions online.
You are allowed to brainstorm on solutions with a group of your classmates. However, you should be able to fully understand the solution and clearly articulate it in your answer sheet.
If there is any doubt that the solution was yours, I reserve the right to ask you to complete your exam with an oral examination.

Total number of points:	**/ 110 + 10 points extra credit**
Question 1.	**/10**
Question 2.	**/10**
Question 3.	**/10**
Question 4.	**/10**
Question 5.	**/10**
Question 6.	**/10**
Question 7.	**/10**
Question 8.	**/10**
Question 9.	**/10**
Question 10.	**/10**
Question 11.	**/10**
Question 12.	**/10**

Question 1. Warm-up problem.
Solve the following problem. Explain the reasoning that supports your answer.

During his sabbatical, Professor Flugel visited that favorite puzzleland country in which there are only two types of inhabitants: those who always speak the truth and those who always lie. They also answer "Yes" or "No" to any question for which such an answer is meaningful. During his visit, the professor amused himself by asking a question which none of the inhabitants could answer, although the question could be answered "Yes" or "No" and did not require any factual knowledge of which the inhabitants were unaware. What was the question?

Question 2. A weight problem.
Propose a solution to the problem. Explain how you reached this solution. What was your strategy?

A chemist has a set of five weights. She knows that it includes one 1-gram weight, and also one each 2-, 3-, 4-, and 5-gram weights, but because they are unmarked, she has no way of telling them apart except by placing them on a balance. She may place any combination of weights on each of the two pans and determine if one side is heavier than the other or if they balance.
Show how in five weighings she can identify each of the weights.

Question 3. Rabbits.
Explain how you approach this problem. Describe your reasoning and show your solution in details.

A man puts a pair of rabbits in a place surrounded on all sides by a wall. The initial pair of rabbits (male and female) are newborn. All rabbit pairs are not fertile during their first month of life but give birth to one new male/female pair at the end of the second month and every month thereafter. How many pairs of rabbits will there be in a year?

Question 4. Survival problem.
Explain how you approach this problem. Describe your reasoning and show your solution.

There are 12 very smart prisoners in a jail. To get rid of them, the warden comes up with the following test. He will put a hat, either black or white, on the head of each of these prisoners. There will be at least one hat of each color, and the prisoners will be informed about this fact. They will be able to see everyone else's hat but their own; there will be no communications of any kind among the prisoners. The warden will line up the prisoners every 5 minutes starting at 12:05 pm and ending at 12:55 pm. To pass the test, all the prisoners with a black hat and only those prisoners will have to step forward during the same line up.
If they do, all the prisoners will have to step forward during the same line up. If they do, all prisoners will be freed, otherwise they will be executed.
How can the prisoners pass the test?

Question 5. Logic 1.
For each of the following sentences, write an English sentence that conveys its negation.

(1) No lecture was attended by every student.
(2) Every football team has a quarterback.
(3) No animal is both a cat and a dog.

Question 6. Logic 2.
Is the following argument valid? 1/ Translate the following reasoning in formal logic formula, and 2/ show (in details) whether the reasoning is valid.

John, a student in this class, is 16 years old. Everyone who is 16 years old can get a driver's license. Therefore, someone in this class can get a driver's license.

Question 7. Logic 3.
Is the following argument valid? 1/ Translate the following reasoning in formal logic formula, and 2/ show (in details) whether the reasoning is valid.

If it is right for me to lie and not right for you to lie, then there is a relevant difference between our cases. There is no relevant difference between our cases. It is not right for you to lie. Therefore it is not right for me to lie.

Problem 8. Posing problems properly 1.
Read the following problem and pose it to be solved (with unknowns, domains, and knowns): explain why you pose it the way you do. Then solve it.

At 8 a.m., a train leaves Topeka for Santa Fe and another train leaves Santa Fe for Topeka. The trains maintain constant speeds with no stops. The first train requires five hours to complete the trip and the second train requires seven hours.
At what time do the trains pass each other?

Problem 9. Posing problems properly 2.
Read the following problem and pose it to be solved (with unknowns, domains, and knowns): explain why you pose it the way you do. Then solve it.

One fourth of a heard of camels was seen in the forest. Twice the square root of that herd had gone to the mountain slopes. Three times five camels remained on the riverbank. How many camels were there in the herd?

Problem 10. Posing problems properly 3.
Read the following problem and pose it to be solved (with unknowns, domains, and knowns): explain why you pose it the way you do. Then solve it.

If I were to give 7 cents to each of the beggars at my door, I would have 24 cents left. I lack 32 cents of being able to give them 9 cents apiece. How many beggars are there? And how much money do I have?

Problem 11. Reading well and posing the problem.
Read the following problem and pose it: explain the strategy you use to solve it and show how you do.

Adam, Robert, Clifton, Stephen, and Brent are the five starters on the Doylestown Dribblers basketball team. Two are left-handed and three right-handed. Two are over 6 feet tall and three are under 6 feet. Adam and Clifton are of the same handedness, whereas Stephen and Brent use different hands. Robert and Brent are of the same height range, while Clifton and Stephen are in different height ranges.
The man who plays center is over 6 feet and is left handed.
Who is he?

Problem 12. Last problem ☺
Read the following problem. Clearly present the model you use to solve it and the approach to solve the given model. Then solve it and describe your solution throroughly.

Show that in a room full of people (more than one person), there are at least two people who have the same number of friends in the room. (Assume that if B is A's friend, then A is also B's friend).