

# CSC165

## In Class Exercises #1

Winter 2015

1. Consider the following definitions for symbols  $E$ ,  $M$ ,  $F$ ,  $L$ ,  $S$ ,  $C$ , and  $R$

$E$ : set of all employees.

$M$ : set of all males.

$F$ : set of all females.

$L(x)$ :  $x$  earns less than \$55,000.

$S(x, y)$ :  $x$  supervises  $y$ .

$C(x)$ :  $x$  is a car.

$R(x)$ :  $x$  is red.

Translate the following sentences to English or logical notation:

- (a) John is not an employee.
  - (b)  $\exists x, x \in E, x \in F, \neg L(x)$ .
  - (c) All employees are supervised by Al or they earn more than or equal to \$55,000.
  - (d) The car is red.
2. Translate the following sentences to logical notation:
    - (a) There is no prerequisite for CSC108.
    - (b) Every course has a prerequisite.
    - (c) Some course is not a prerequisite for any course.
    - (d) No course is a prerequisite for itself.
    - (e) Some courses have several prerequisites.
  3. Work with 1 or 2 other students to solve the following problem. Use the following headings to organize the discussion:

Make a start on the problem for about 5 minutes, when you should stop and review any choices you've made about how to proceed. There are a couple of suggested approaches to consider on the back of this sheet, but you should only look at these after you have made a good start on the problem. Use only one hint at a time, since they lead to different solution paths.

- Understand the problem.
- Devise a plan.
- Carry out the plan.
- Look back, figure out when and how you're stuck.

You are sitting in front of two drawers. The left drawer contains 64 pennies, the right drawer contains nothing. Can you arrange things so that one of the drawers has 48 pennies, using combinations of the following two operations, **l** and **r**?

**l**: If the left drawer has an even number of pennies, you may transfer half of them to the right drawer. If the left drawer has an odd number of pennies, operation **l** is disallowed.

**r**: If the right drawer has an even number of pennies, you may transfer half of them to the left drawer. If the right drawer has an odd number of pennies, operation **r** is disallowed.

Choose another number in the range  $[0,64]$ . Starting from the same initial position, can you arrange things so that one of the drawers has that number of pennies? Are there any numbers in that range that are impossible to achieve? Can you describe a systematic procedure for finding the answer?

Verify your procedure by applying it to different initial values for the number of pennies in the left drawer?

## Hints

**Hint 1**, work backwards: Imagine you have already carried out steps that give you the desired number of pennies in one drawer. What would the second-last step be (the step just before the successful step)?

**Hint 2**, smaller cases: Is there any connection between the steps to get 24 in a drawer when you start with 64, and getting 12 in a drawer when you start with 32?

**Hint 3**, draw a picture: Draw a tree diagram of all the possible results (amounts of pennies in each drawer). Try to be systematic.