Recitation 2

- Here is a set of additional problems. They range from being very easy to very tough. The best way to learn the material in 310 is to solve problems on your own.
- Feel free to ask (and answer) questions about this problem set on Piazza. The TAs will discuss these problems during office hours.
- This is an **optional** problem set; do not turn this in for grading.
- While you don't have to turn this in, be warned that this material **can** appear in a quiz or exam.

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1. For each of the following propositions:

$\forall x, \exists y, 2x - y = 0$

$\forall x, \exists y, 2y - x = 0$

determine which propositions are true when the domain of discourse is specified as:

- the nonnegative integers.
- the integers.
- the real numbers.

2. Let $Q(x, y)$ be the statement:

> *x is a member of the current US Olympic National Team for sport y.*

Let the domain of discourse for x be the set of students at ISU, and the domain of discourse for y be the set of Olympic sports.

Which of the following expressions are equivalent to the statement:

"No student at ISU is a member of the current US Olympic team for any sport."

Clearly state your reasoning.

- $\forall x, \forall y, \neg Q(x, y)$
- $\exists x, \exists y, \neg Q(x, y)$
- $\neg(\forall x, \forall y, Q(x, y))$
- $\neg(\exists x, \exists y, Q(x, y))$

3. You write a software program but find out that it is buggy. There are 4 possible causes for the bug - undeclared variables, syntax errors within the first five lines, missing semicolons, or misspelled variable names. You do some basic debugging, and discover the following information:

- There is an undeclared variable or there is a syntax error in the first five lines.
- If there is a syntax error in the first five lines, then there is a missing semicolon or a variable name is misspelled.
- There is not a missing semicolon.
- There is not a misspelled variable name.

Using rules of inference, find out which of the sources of error caused the bug.

4. Use the rules of inference studied in class to deduce the conclusion from the hypotheses:

$$\begin{array}{c} p \lor q \\ q \implies r \\ p \land s \implies t \\ \neg r \\ \neg q \implies u \land s \\ \hline \therefore t \end{array}$$