CPSC 121: Models of Computation
Quiz #1: Section **SAMPLE**, 2009 February 4/5

Name: _____ Student ID: _____

Signature: _____

- The cover page on the real quiz will be identical to this one except that it will not include this line and will indicate the appropriate section and date above. **Read these instructions now!**
- You have **30 minutes** to write the 4 questions on this quiz.
- A total of **16 marks** are available. You may want to complete what you consider to be the easiest questions first!
- Ensure that you clearly indicate a single legible answer for each question.
- You are allowed a single 8.5" x 11" reference sheet. The sheet must have your name on it and may contain any content you like. Otherwise, no notes, aides, or electronic equipment are allowed.
- Good luck!

UNIVERSITY REGULATIONS

1. Each candidate must be prepared to produce, upon request, a UBCcard for identification.

2. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions.

3. No candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination.

4. Candidates suspected of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action:

   - having at the place of writing any books, papers or memoranda, calculators, computers, sound or image players/recorders/transmitters (including telephones), or other memory aid devices, other than those authorized by the examiners;
   - speaking or communicating with other candidates; and
   - purposely exposing written papers to the view of other candidates or imaging devices. The plea of accident or forgetfulness shall not be received.

5. Candidates must not destroy or mutilate any examination material; must hand in all examination papers; and must not take any examination material from the examination room without permission of the invigilator.

6. Candidates must follow any additional examination rules or directions communicated by the instructor or invigilator.

Notes about this Sample Quiz

Along with the *many* other practice resources available to you in the textbook and on the course website, this sample quiz is intended to prepare you for the upcoming in-class quiz on February 4 or 5, 2009.

Although the in-class quiz will of course differ from this sample, its structure and some of the features of its questions will also appear on the actual quiz. We note guaranteed similarities in footnotes on each question.

1 Describing Relationships with Predicate Logic[1] [4 marks]

Definitions: Let I be the set of all valid input text. Let P be the set of all valid Java programs. Let Runs(p, i) mean that program p runs to completion on input text i. (In other words, we start up program p and then type in the input text i. If the program ever stops, it runs to completion. If it never stops for some reason, then it does not run to completion.)

Using these definitions, translate the following statement into predicate logic:

Some program runs to completion on every input.

[1] The in-class quiz will contain a question on describing relationships with predicate logic that uses the same definitions but likely with a somewhat more complex statement to translate.

2 Critiquing Propositional Logic Proofs[2] [4 marks]

Consider the following propositional logic proof. Some steps in the proof are invalid. Circle the step or steps that are invalid and explain why they are invalid.

(Note: any explanation that clearly describes a flaw in the step is acceptable, but the easiest explanations will typically indicate how a logical equivalence or rule of inference was applied inappropriately.)

1.	$q \wedge \sim u$	premise
2.	$r \vee \sim s$	premise
3.	$p \rightarrow s$	premise
4.	$q \leftrightarrow \sim r$	premise
5.	q	by specialization on 1
6.	$(q \rightarrow \sim r) \wedge (\sim r \rightarrow q)$	by definition of biconditional on 4
7.	$q \rightarrow \sim r$	by specialization on 6
8.	$\sim r$	by modus ponens on 5 and 7
9.	$\sim s$	by disjunctive syllogism on 8 and 2
10.	p	by modus tollens on 9 and 3
11.	$p \vee r$	by addition on 10

[2] The quiz will have a problem with the same structure and instructions—a propositional logic proof critique—but a different proof with (perhaps) a different number and different types of flaws.

3 Number Representation[3] [4 marks]

Is the following statement about representing fractions in binary true? If so, explain how this relates to a shortfall of the representation. If not, prove the statement is false by giving values for n and k that make the statement false.

Every fraction representable as $\frac{2^k}{n}$ for some pair of non-negative integers n and k is representable as a fraction in binary using a finite number of bits.

[3] There will likely be a number representation question on the quiz, though it may not closely resemble this one.

4 Circuit Design[4] [4 marks]

Design a circuit using only inverters and two-input AND, OR, and XOR gates that calculates the average of two 2-bit (unsigned) binary numbers, rounding fractions down.

[4] The actual quiz will contain a circuit design question of roughly the same complexity.