CPSC 121 Some Sample Questions for Midterm Exam #1
Wednesday, February 12, 2014, 17:30–19:30

Name: ____________________ Student ID: ____________________
Signature: ____________________ Section (circle one): George Steve
Your signature acknowledges your understanding of and agreement to the rules below.
(Note: our cover page will look different, but the rules will be the same.

- You have 65 minutes (individual); 40 minutes (group) to write the 0 questions on this examination. A total of 0 marks are available.
- with any information you choose written or printed on them, as long as they are readable without magnification. **No other aids—including electronic devices—are allowed**; so, no cell phones and no calculators. (We will provide the first two pages of "Dave Tompkins's Awesome CPSC 121 Handout.")
- Keep your answers short. If you run out of space for a question, you have likely written too much.
- The number in square brackets to the left of the question number indicates the number of marks allocated for that question. Use these to help you plan your use of time on the exam.
- Clearly indicate your answer to each problem. If your answer is not in the provided blank, then indicate where the answer is, and at the answer's location indicate the question it addresses.
- **Good luck!**

Question	Marks
Total	

UNIVERSITY REGULATIONS:

- Each candidate should be prepared to produce, upon request, his/her UBC card.
- No candidate shall be permitted to enter the examination room after the expiration of one half hour, or to leave during the first half hour of the examination.
- CAUTION: candidates guilty of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action.
  1. Having at the place of writing, or making use of, any books, papers or memoranda, electronic equipment, or other memory aid or communication devices, other than those authorised by the examiners.
  2. Speaking or communicating with other candidates.
  3. Purposely exposing written papers to the view of other candidates. The plea of accident or forgetfulness shall not be received.
- 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.

[0] 1. Consider the logical equivalence rule $p \wedge q \equiv \sim(\sim p \vee \sim q)$. For each of the following, circle **APPLIES** to indicate this rule **can** be applied **directly** to the given statement or **CANNOT APPLY** to indicate it cannot. If the rule can be applied, provide the resulting statement.

1. $(d \vee c) \wedge \sim r$ **CANNOT APPLY** **APPLIES** with result:

2. $w \oplus v$ **CANNOT APPLY** **APPLIES** with result:

3. $\sim(\sim m \vee \sim n)$ **CANNOT APPLY** **APPLIES** with result:

4. $a \rightarrow (b \wedge c)$ **CANNOT APPLY** **APPLIES** with result:

[4] 2. Each statement below is a “contingency”: true for some assignments of truth values to the variables and false for others. For each statement, give an assignment of truth values that makes the statement true and another that makes it false.

	Statement	**True** assignment	**False** assignment
1.	$\sim a \to a$	$a =$	$a =$
2.	$(p \wedge q) \to \sim(q \to (r \vee p))$	$p =\quad , q = \quad , r =$	$p =\quad , q = \quad , r =$
3.	$(p \vee (\sim p)) \oplus (q \wedge (r \to s))$	$p =\quad , q = \quad , r = \quad , s =$	$p =\quad , q = \quad , r = \quad , s =$

[4] 3. Complete the following table where each row shows a single integer value represented as a "normal" decimal number, a 6-bit unsigned binary number, a 6-bit signed binary number, and a 2-digit unsigned hexadecimal number.

Fill in each blank, unshaded entry. **Write N/A if a value cannot be represented** in some column.

Decimal	6-bit unsigned	6-bit signed	2-digit unsigned hexadecimal
-15			
87			
250			
		101011	
			A1
			1F
	010110		

[0] 4. Consider the following definitions describing a world of time travelers who may observe events in different orders:

- $I \equiv \{\mathrm{e}_1, \mathrm{e}_2, \mathrm{e}_3, \ldots\}$ is the set of "events" (important things that have happened)
- $P \equiv \{\text{Adric}, \text{Ben}, \text{Clara}, \text{Doc}, \ldots\}$ is the set of people
- $\text{ObsOrder}(p, i, j)$ means person p observes that event i occurs before event j
- $\text{Before}(i, j)$ means event i actually happened before event j
- $\text{At}(p, i)$ means person p was at event i
- $\text{Met}(p, q)$ means person p met person q

State the following in predicate logic:

(a) Ben has not met Adric, and Adric has not met Ben.

(b) Clara was at every event.

(c) Doc has observed two different events occurring in both possible orders.

(d) Everyone who was at an event observed that event to occur before some **other** event (but the other event is not necessarily the same for everyone).

Assuming—for just this part—that the statements above are true, evaluate the truth of the following statements. (Circle one of **TRUE**, **FALSE**, or **UNKNOWN**.)

(a) **TRUE** **FALSE** **UNKNOWN** $\text{Before}(\mathrm{e}_1, \mathrm{e}_1)$

(b) **TRUE** **FALSE** **UNKNOWN** $\text{Met}(\text{Ben}, \text{Adric}) \leftrightarrow \text{Met}(\text{Adric}, \text{Ben})$

(c) **TRUE** **FALSE** **UNKNOWN** $\text{At}(\text{Clara}, \mathrm{e}_3)$

(d) **TRUE** **FALSE** **UNKNOWN** $\text{ObsOrder}(\text{Doc}, \mathrm{e}_2, \mathrm{e}_1)$

Now, define the following predicates using $\mathrm{ObsOrder}$, Before, At, and Met:

(a) $\mathrm{Known}(p_1, p_2)$ means that p_1 and p_2 have met each other (both ways).
$\mathrm{Known}(p_1, p_2) \equiv$

(b) $\mathrm{Nexus}(i)$ means that everyone was at event i.
$\mathrm{Nexus}(i) \equiv$

(c) $\mathrm{Traveler}(p)$ means that person p observed some distinct pair of events to occur in the opposite order to the way they actually happened. *Note: "distinct pair" means "two things that are different from each other".*
$\mathrm{Traveler}(p) \equiv$

(d) $\mathrm{Companion}(p)$ means that person p is a $\mathrm{Traveler}$ who was at more than one event with Doc (but is not Doc).
$\mathrm{Companion}(p) \equiv$

[0] 5. Consider the following theorem with a missing premise:

$p \wedge (s \rightarrow r)$
$\sim(r \wedge q)$
$q \leftrightarrow \sim d$
MISSING

$\therefore \sim s$

We know only that the missing premise mentions the variable d in some way but does not mention p.

Because of the missing premise, we cannot prove the theorem. **Instead, give at least two *substantially different*, promising approaches to starting the proof.** Each approach should show at least one step beyond a premise or before the conclusion, and you should briefly justify why each step is promising.

(a) **Approach:**

Brief justification:

(b) **Approach:**

Brief justification:

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If you write answers here (or anywhere other than their intended location), mark them clearly, indicate which question they respond to, and indicate at the provided solution blank for that question where you wrote your solution.