

CPSC 121 Midterm 1
Tuesday, October 15th, 2013

Name: _____ Student ID: _____

Signature: _____

- You have 70 minutes to write the 8 questions on this examination.
A total of 50 marks are available.

- **Justify all of your answers.**

- You are only allowed to bring in one double-sided 8.5 x 11 in sheet of notes, either handwritten or printed using a font size of at least 11pt.

- Keep your answers short. If you run out of space for a question, you have 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 determine how much time you should spend on each question.

- Use the back of the pages for your rough work.

- **Good luck!**

Question	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total	

UNIVERSITY REGULATIONS:

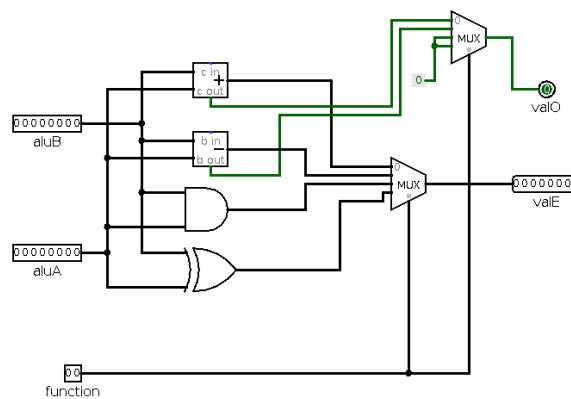
- Each candidate should be prepared to produce, upon request, his/her UBC card.
- No candidate shall be permitted to enter the examination room after the expiration of one half hour, or to leave during the first half hour of the examination.
- **CAUTION:** candidates guilty of any of the following, or 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.

[1] 1. Do you want your tutorial attendance to count towards your grade?

If you answered 'YES', then 1% of your final course mark will be based on your tutorial attendance (# attended divided by total number minus 2, but no more than full credit). Online quizzes will be worth 5%. If you answered 'NO', then tutorial attendance is worth nothing in your mark, and online quizzes count for 6% of your final course mark.

[6] 2. Short Answers

[3] a. Recall the arithmetic and logic unit from lab #4:

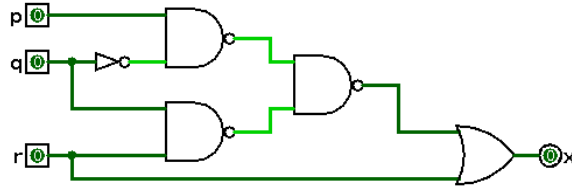


This circuit can not compute the OR of its two inputs (i.e. $aluA \vee aluB$). Describe briefly the changes you would need to make to the circuit to add the OR function to it. You are not allowed to remove one of the functions it currently computes to make room for OR.

[3] b. How could you determine if the following is a valid rule of inference, knowing that it can not be proved by applying the rules listed on the lectures slides and/or in Epp ?

$$\frac{(p \rightarrow q) \wedge (r \rightarrow s) \quad p \vee r}{\therefore q \vee s}$$

[9] 3. Consider the following circuit:



[3] a. Write an unsimplified boolean algebraic expression for the output of this circuit.

[4] b. Using a sequence of logical equivalences, simplify this expression as much as possible.

[2] c. Finally, draw the circuit corresponding to the simplified expression. Hint: you should only need three gates.

[11] 4. A political sciences major is studying the political deeds (and misdeeds) before an election in the country of Borduria. He learns the following facts:

- Either Syldavia is a much nicer country to visit than Borduria, or the bordurian secret police planted stolen art in someone's bedroom.
- If colonel Sponz had a rival thrown in jail on a fake charge, then the bordurian secret police planted stolen art in someone's bedroom.
- Marshal Pleksy-gladz is proud of his facial hair, and either colonel Sponz had a rival thrown in jail on a fake charge or general Tapioca likes bananas.
- If Boris is a friend of the king of Syldavia, then colonel Sponz did not have a rival thrown in jail on a fake charge and general Tapioca does not like bananas.
- If Syldavia is not a much nicer country to visit than Borduria, then either Boris is a friend of the king of Syldavia or colonel Sponz did not have a rival thrown in jail on a fake charge.
- Either colonel Sponz had a rival thrown in jail on a fake charge or Boris is a friend of the king of Syldavia.

Note: Syldavia is a country that borders Borduria.

[3] (a) Rewrite each of these statements using propositional logic. Make sure to define the propositions you are using (that is, state something like: “s: Syldavia is a much nicer country to visit than Borduria.” before writing the proposition $\sim s$). You can abbreviate these (e.g. “s: Syldavia is a . . . Borduria”) if you wish.

[8] (b) Using your answer from part (a), known logical equivalences, and the rules of inference, prove that Syldavia is a much nicer country to visit than Borduria (note: there is additional space at the top of the next page).

[6] 5. The Ant-el 9099 CPU uses 9 bit integers and represents signed integers using two's complement.

[2] a. What sequence of bits would the Ant-el 9099 CPU use to represent the integer -215 ? Hint: $215 = 128 + 64 + 16 + 4 + 2 + 1$.

i	2^i
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1024
11	2048

[2] b. The Ant-el then adds -80 to **your** answer from part (a). Knowing that $-80_{10} = 110110000_2$, what will be the decimal value of the sum ?

[2] c. Why is the sum of these two negative integers on the Ant-el 9099 positive?

[6] 6. Given the following definitions:

- P : the set of people.
- C : the set of the kinds of creatures.
- $Likes(x, y)$: person x likes creature y .
- $AfraidOf(x, y)$: person x is afraid of creature y .

translate each of the following English statements into predicate logic. For instance, the statement “Paul likes dogs” would be translated as $Likes(Paul, dogs)$.

[3] a. One or more people are afraid of ghosts and witches, but are not afraid of (and like) black cats.

[3] b. People do not like creatures they are afraid of.

[3] 7. Using the same definitions as in the previous question, translate

$$\forall p \in P, \forall q \in P, \exists c \in C, Likes(p, c) \wedge Likes(q, c)$$

into English.

- [8] 8. Design a circuit that takes as input a four bit unsigned integer $b_3b_2b_1b_0$ and outputs the integer part of its square root as a two bit unsigned integer x_1x_0 . For instance, if the input was 4, then the output would be 2, and if the input was 8 then the output would also be 2. Hint: think about the outputs individually; your circuit should not attempt to “compute” the square root mathematically!