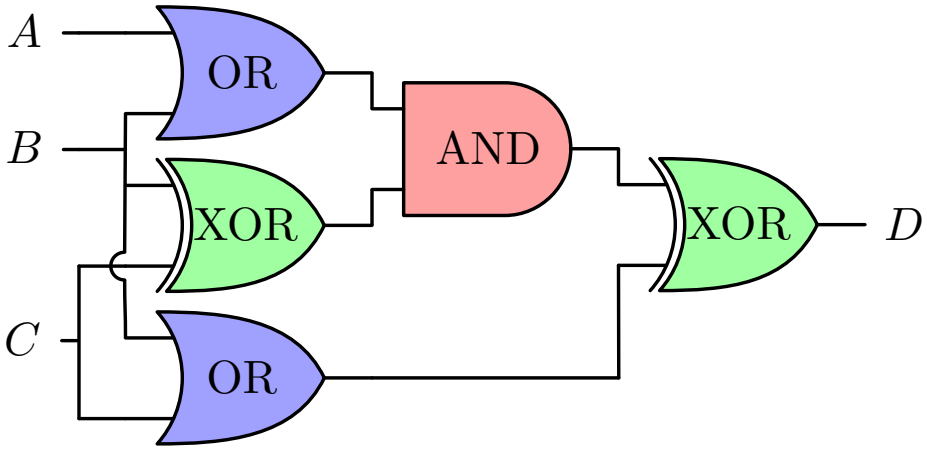
CSC 106 - SPRING 2016
THE PRACTICE OF COMPUTER SCIENCE
ASSIGNMENT 2
UNIVERSITY OF VICTORIA

Due: Tuesday, February 2nd, 2016 at 11:00am.

Submit your answers on paper to the CSC 106 drop box on the second floor of ECS. Answers must be well formatted and legible or they will not be marked. Answers which include research from the internet or paper sources must cite all sources used (using the work of others without proper citation is considered plagiarism). All diagrams in your solutions must be clearly labelled and explained.

Question 1: Logic Circuits [30 marks]
Answer the questions below. For questions which require logic circuit diagrams, clearly label all inputs and outputs and ensure that gates are drawn clearly (you may want to write names like "AND" and "OR" on gates to ensure that the marker can distinguish the different types).

(a) Compute a truth table for the 3-input circuit below.



(b) Draw a circuit diagram for a 3-input circuit with inputs A, B and C and output D which has the truth table below.

Input			**Output**
A	B	C	D
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

(c) The truth table for an AND gate with inputs A and B and output C is given below.

Input		**Output**
A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

Draw a circuit diagram for a 2-input circuit which has the same truth table as above using only NAND gates and NOT gates.

(d) The truth table for an XNOR gate with inputs A and B and output C is given below.

Input		**Output**
A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

Draw a circuit diagram for a 2-input circuit which has the same truth table as above using only AND gates, OR gates and NOT gates.

(e) Consider the following truth table for a circuit with three inputs A, B and C and two outputs X and Y.

Input			**Output**	
A	B	C	X	Y
0	0	0	0	0
0	0	1	1	1
0	1	0	1	0
0	1	1	1	1
1	0	0	0	1
1	0	1	1	0
1	1	0	1	1
1	1	1	1	0

Draw a diagram for a circuit which has the truth table above.

Question 2: Binary Representation [10 marks]

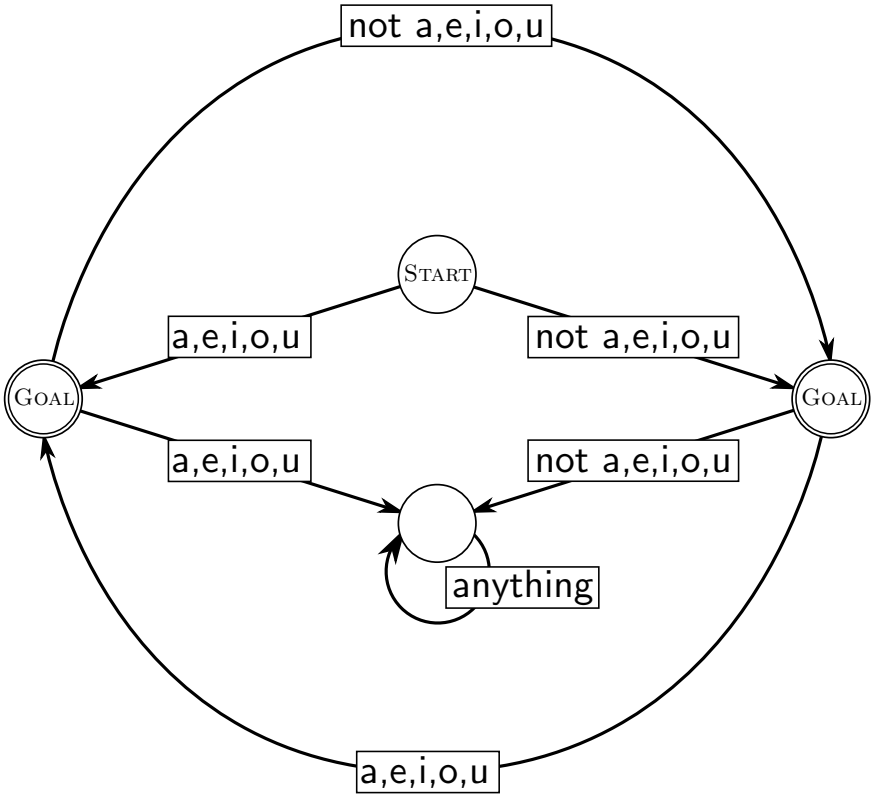
(a) Consider the base-10 value corresponding to the last six digits of **your student number** (for example, if your student number is 'V00951413', the number is 951413). Give the binary representation of this number. You are permitted to use a calculator or online converter for this conversion.

(b) How many bits were needed to represent the number in part (a)?

(c) What is the largest number representable with the same number of bits as the value in part (a)? Give both the binary and base-10 representations.

Question 3: State Machines for Sequence Recognition [20 marks]

(a) Consider the DFA drawn below, which takes sequences of lowercase letters (a-z) as input.



Give an example of one input with 5 characters which is accepted by the DFA, and one input with 5 characters which is not accepted. Your examples do not have to be valid English words.

(b) Draw a state machine diagram for a DFA which takes sequences of lowercase letters (a-z) as input and accepts an input only if it contains exactly three vowels (a, e, i, o, u). Make sure you clearly indicate your start state and any goal states, and remember that every state in the DFA must have a transition for every possible input character.