

## COSC 3P92 Assignment 1

Due date: 12:00 noon Tuesday, February 10.  
Late date: 12:00 noon Friday, February 13 (-25%)

Instructions: **Show all your work.** Correct answers without supporting work will get partial marks only. Incorrect answers without supporting work will receive zero. Type all your written answers. Draw legibly when diagrams are required.

Some hints or changes to the text questions may be given. When “Change” is specified, do the question for the required change described, and NOT the textbook version.

### Chapter 1:

10. Assume that indexing and indirect addressing are unavailable.
11. Please give your speculations on why the discrepancy exists.
- 14.

100. On the website,

[http://www.blikstein.com/paulo/projects/project\\_water.html](http://www.blikstein.com/paulo/projects/project_water.html)

a half-adder consisting of 2 gates (AND, XOR) is implemented using water. The gate is approximately 50 square cm in area (guessing from the photographs). Let’s say that AND gates use 2 transistors to construct, and XOR uses 5. Hence this water circuit represents 7 transistors.

Elsewhere, this website says that a Pentium i7-920 has 731 million transistors.

<http://www.intel.com/pressroom/kits/quickreffam.htm>

Question: What is the area in square meters for this Pentium, if implemented with the water gate technology? How many football fields? (1 field is 110m by 49m)

### Chapter 2:

1. Change: Do this question, with load time of 3 nsec, ALU time of 9 nsec, and store back time of 4 nsec. Note that 1 nsec (nanosecond) is  $10^{-9}$  sec = 0.000000001 sec (or one-billionth sec). Also note that MIPS is millions of instructions per second.
- 3, 9, 10.

### Chapter 3:

3. Change: Do this question on the expression:  $X = (X \text{ OR } Y) \text{ AND } (X \text{ OR NOT } Y)$
- 4.
5. Verify your answer with a truth table.

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10. Change: Do this question for the minority logic function, ie. one or fewer of the 3 inputs are 1.

12.

200. a) Recall the prime number sequence: 2, 3, 5, 7, 11, ... Each is divisible only by 1 and itself. Construct a truth table for a 4-bit prime numbers. This outputs true if the 4-bit input number is prime. Otherwise it outputs false.

b) Using the scheme discussed in class, construct a circuit for the function in a).

c) The circuit in (b) above uses 7 basic gates (not counting inverted lines). Can you design an even smaller equivalent circuit using fewer basic gates (and, or, nand, nor, xor)?

d) If your circuit were implemented with water gates (see question 100), what area in square cm would it be? (Assume each gates takes about  $30 \text{ cm}^2$ .)