Introduction to Computer Systems 2018

Assignment 1

This assignment is due in by 4pm on Thursday 15 March, and must be submitted via the 'E-submissions' tab of the module Study Direct site. The submission should be a single PDF file.

The assignment mark contributes 15% of the overall mark for the module (the second coursework assignment also contributes 15%, and the examination contributes 70%).

1. Design an XNOR gate using only AND gates and NOT gates (inverters). The truth table for an XNOR gate is:

Inputs		Output
0	0	1
0	1	0
1	0	0
1	1	1

Implement your design in Simulink (see the document "Quick guide to building logic models in Simulink" on the Study Direct site). Your answer should include a screenshot of the Simulink model, an explanation of how you came up with the design, and a description of how the circuit works.

[15 marks]

2. Briefly (in around 250 words) describe the concept of *parity* in relation to computer systems, and how parity may be used to make information storage more reliable. You will need to look up parity in a textbook or find a reliable source on the web to answer this question. Make sure you reference your information sources. [20 marks]

3. Design a 4-bit parity generator that generates odd parity. This is a logic circuit that accepts 4 inputs and produces one output whose value depends on whether an odd or an even number of the inputs are 1. Your circuit

should have the following behaviour:

> Odd number of inputs with value 1: output is 0
> Even number of inputs with value 1: output is 1

Zero is an even number, so the inputs 0 0 0 0 should produce the output 1.

For this question, you may use any of Simulink's selection of 2-input logic gates (but you may not use gates with more than 2 inputs). Implement your design in Simulink. Your answer should include a screenshot of the Simulink model, an explanation of how you came up with the design, and a description of how the circuit works.   [20 marks]

4. Give diagrams of the electronic circuits (not **logic** circuits) used to store one bit in (a) static RAM chips and (b) dynamic RAM chips. Compare the space occupied on a chip for each type of circuit cell, and give up-to-date figures for typical access times; hence explain the different ways in which the two kinds of memory are used in a computer. You will need to refer to a textbook or the web for some of the information required to answer this question. Make sure you reference your information sources.   [20 marks]

5. Estimate how much memory would be needed in order to store everything a person sees and hears in his or her lifetime.

Assume a person lives for 70 years, but is asleep for one third of the time. Sound is to be recorded at stereo CD quality (see the laboratory class 1 exercise sheet). Visual information is to be recorded from two cameras, each with 1 million pixels, 3 bytes per pixel, and 30 frames per second. Assume compression is then used to reduce the total amount of data to be stored to 10% of its original value. Show how you worked out your answer.

What duration of recording could fit on a 500 GB solid state disk? Discuss whether current storage technology would make it practical to record a person's lifetime memories.

The document 'Road Map for Memories For Life Research' at https://core.ac.uk/download/pdf/21720655.pdf suggests that advances in computing technology will eventually allow a full lifetime AV recording to be stored in a cube of silicon the size of a grain of dust. Is this a reasonable claim? Explain your answer.   [25 marks]