University of Glasgow

Friday, 5 May 2017
2.00 pm – 3.00 pm
(Duration: 1 hour)

DEGREES of MSci, MEng, BEng, BSc, MA and MA (Social Sciences)

Computing Science 1S

(Answer All Questions)

This examination paper is worth a total of 50 marks

The use of a calculator is not permitted in this examination

INSTRUCTIONS TO INVIGILATORS

Please collect all exam question papers and exam answer scripts and retain for school to collect. Candidates must not remove exam question papers.

1. **(a)** Convert 1001 0110 to a decimal number, assuming binary representation.

[2]

(b) Convert 1001 0110 to a decimal number, assuming two's complement representation.

[3]

(c) Translate the statement `a = b + x[i]` into Sigma16 assembly language, assuming that `a`, `b`, and `i` are integer variables and `x` is an array. You do not need to write data statements to define the variables or the array.

[4]

(d) Show the sequence of steps performed by the processor as it executes the instruction `load R2,x[R1]`.

[4]

(e) There is an array named `x` that contains `n` integers, where `n` is an integer variable in memory. Write a Sigma16 assembly language program that calculates the sum of the positive elements of the array (i.e. the elements that are greater than 0) and stores this sum in the variable `SumPos`. The program should define `n = 6` and define the initial elements of the array as 6, -9, 7, 4, -1, 2. After the program runs the variable `SumPos` should have the value 19. The program must work correctly for any nonnegative `n` and initial array elements.

[12]

2. **(a)** Give the circuit design for a multiplexer (the mux1 circuit). You may give either a diagram or an equation describing the circuit. The circuit takes inputs `c`, `x`, `y` and produces output `z`, where `z = (if c=0 then x else y)`. Use Boolean algebra to show that if `c=1` then `z=y`.

[5]

(b) Explain why the speed of a synchronous circuit depends on the longest path through logic gates. Describe how a suitable clock speed for the circuit is determined, and explain what can happen if the clock speed is too fast.

[5]

(c) Define the terms *interrupt* and *process*. Describe how the operating system uses interrupts to implement concurrent processes.

[5]

(d) Define the terms *circuit switching* and *packet switching*, and state which technique is used in the Internet. Give two advantages of using packet switching.

[5]

(e) Give two services provided by the TCP protocol in the Internet, and describe how TCP recovers from errors. Explain what the IP protocol does.

[5]