1.4 DATA TYPES & STRUCTURES · 1.4.1

Binary arithmetic & two's complement

Original practice questions · 30 marks · about 40 minutes · spec 1.4.1(c)(d)

Instructions. Answer all questions. The number of marks is shown in brackets [ ]. Show your working for all calculations — method marks are available.

1

Total: 5 marks

(a) Add the following unsigned 8-bit binary integers. Show your working. **[2]**

```
  0 1 0 0 1 1 0 1
+ 0 0 1 0 1 0 1 0
-----------------
```

(b) Add the following unsigned 8-bit binary integers, then state the problem with the result. **[3]**

```
  1 1 0 0 0 0 0 1
+ 1 0 0 0 0 0 0 1
-----------------
```

2

Total: 5 marks

(a) Show how +6 and −6 are represented in one byte using **sign and magnitude**. **[2]**

(b) Give **one** reason why sign and magnitude is not commonly used by processors. **[1]**

(c) State **two** advantages of two's complement over sign and magnitude. **[2]**

3 Total: 6 marks

(a) Convert the denary number `−40` into an 8-bit two's complement binary number. Show your working. **[2]**

(b) Convert the 8-bit two's complement number `11101100` to denary. Show your working. **[2]**

(c) Explain why the most significant bit in a two's complement number is described as having a negative weight. **[2]**

4 Total: 6 marks

> Subtraction can be performed using two's complement addition.

(a) Using 8-bit two's complement, calculate `83 − 37`. Show your working, including the two's complement of 37. **[4]**

(b) State what happens to any carry produced out of the most significant bit. **[1]**

(c) State the denary result of your calculation. _____ **[1]**

5 **Total: 8 marks**

(a) State the largest and smallest values that can be stored in an 8-bit two's complement number. **[2]**

(b) Calculate the largest unsigned integer that can be stored in two combined bytes (16 bits). Show your working. **[2]**

(c) A program adds two 8-bit unsigned integers and the result is 312. Explain why this causes a problem if the result must also be stored in 8 bits. **[2]**

(d) State the name given to this type of error. **[1]**

(e) Suggest one way the program could avoid it. **[1]**

END OF QUESTIONS