1.4 DATA TYPES & STRUCTURES · 1.4.1 A-LEVEL

Bitwise manipulation & masks

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

Instructions. Answer all questions. Marks are shown in brackets [ ]. All shifts are logical shifts. Show your working.

1

Total: 6 marks

This question is about logical binary shifts.

(a) Give the result of shifting `00011010` **left** by one place, and state the effect on the value. **[2]**

(b) Give the result of shifting `01101000` **right** by two places, and state the effect on the value. **[2]**

(c) State the effect on a number's value of shifting it left by 3 places. _____ **[1]**

(d) Give one reason a right shift can reduce the accuracy of a value. _____ **[1]**

2

Total: 6 marks

A byte holds the value `10110110`.

(a) Show the result of `10110110 AND 00001111`. _____ **[1]**

(b) State what this operation achieves. _____ **[1]**

(c) Show the result of `10110110 OR 00001111`. _____ **[1]**

(d) State what this operation achieves. _____ **[1]**

(e) Show the result of `10110110 XOR 11111111`. _____ **[1]**

(f) State what XOR with a mask of all 1s achieves. _____ **[1]**

3

Total: 6 marks

A byte controls 8 lights (bit 1 on the left to bit 8 on the right). It currently holds `11010111`.

(a) Show the mask and logical operator that would switch lights 1–4 (the left four) **off** without affecting the others, and give the result. **[2]**

(b) Show the mask and logical operator that would switch lights 5–8 (the right four) **on** without affecting the others, and give the result. **[2]**

(c) Describe how a mask could be used to test whether light 1 is currently on. **[2]**

4

Total: 6 marks

(a) The ASCII code for 'B' is `01000010` and for 'b' is `01100010`. Give the logical operator and 8-bit mask that converts 'B' to 'b', and show the result. **[3]**

(b) Using a combination of shifts and addition, multiply `00000101` (5) by 6. Show your working. **[3]**

5

Total: 6 marks

(a) State the logical operation used to **set** chosen bits to 1. _____ **[1]**

(b) State the logical operation used to **toggle** chosen bits. _____ **[1]**

(c) Describe the logical operator and 8-bit mask needed to set the **most significant bit** of a byte to 1, leaving the other bits unchanged. **[2]**

(d) Explain why applying the same XOR mask to a value twice returns the original value. **[2]**

END OF QUESTIONS