Your notes

GCSE Computer Science: revision notes

Binary addition and shifts

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Binary addition

- The rules: 0 + 0 = 0, 0 + 1 = 1, 1 + 1 = 10 (write 0, **carry** 1), and 1 + 1 + 1 = 11 (write 1, **carry** 1).
- Work from right to left, carrying just as in denary. 0101 1010 + 0011 0111 = 1001 0001, which is 90 + 55 = 145.

Overflow

- **Overflow** happens when a result is too big to fit in the number of bits available. In 8 bits, 200 + 100 = 300 needs 9 bits, so the extra bit is lost and the stored answer is wrong.

Binary shifts

- A **logical shift** left by n places multiplies the number by 2^n. 0000 0110 (6) shifted left 2 places is 0001 1000 (24).
- A **logical shift** right by n places divides the number by 2^n. 0001 1000 (24) shifted right 3 places is 0000 0011 (3).
- The gaps are filled with 0s, and bits shifted off the end are lost. So 0000 0111 (7) shifted right 1 place is 0000 0011 (3), not 3.5.

Negative numbers (Edexcel)

- **Two's complement** stores negative numbers. In 8 bits, the leftmost bit is worth –128 instead of 128.
- 1111 1110 = –128 + 64 + 32 + 16 + 8 + 4 + 2 = –2.

Key terms

Carry	A 1 moved to the next column when a column adds up to 2 or 3.

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Overflow	When a result needs more bits than are available.
Logical shift	Moving all the bits left or right, filling the gaps with 0s.
Shift left	Moves the bits left: each place multiplies the number by 2.
Shift right	Moves the bits right: each place divides the number by 2.
Two's complement	A way of storing negative numbers in binary, where the leftmost bit has a negative value. (Edexcel)

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What is 1 + 1 in binary?
2. What is 1 + 1 + 1 in binary?
3. What is 0011 + 0101 in binary?
4. What is overflow?
5. What does a shift left by 1 place do to a binary number?
6. What does a shift right by 2 places do to a binary number?
7. What is 0000 0110 shifted left by 2 places?
8. In 8 bits, what happens when you add 1111 1111 and 0000 0001?

Answers

1. 10
2. 11
3. 1000
4. When a result needs more bits than are available
5. Multiplies it by 2
6. Divides it by 4
7. 0001 1000
8. Overflow: the result needs 9 bits

What to do next

Practise 12 questions on this topic

Try 5 exam questions, with mark schemes

Read the lesson, one step at a time

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