

Adding 8-bit binary numbers

Teacher's Notes

Lesson Plan

| Length | 60 mins | Specification Link | 2.1.4/d | |
|--------------------|---|--|---------|--|
| Learning objective | Candidates should be able to: (a) add two 8-bit binary integers and explain overflow errors which may occur | | | |
| Time (min) | Activity | Further Notes | | |
| 10 | Using a projector, display the Interactive Starter Activity . This is intended to illustrate the similarity of adding in denary and binary. It can be paused to discuss the carrying of digits to a higher place value. It also introduces the concept of an overflow error when a number is greater than can be represented by 8 bits. | | | |
| 10 | Watch the set of videos, pausing to discuss the content. | | | |
| 5 | Discuss the videos. <ul style="list-style-type: none"> In binary, when does a 1 have to be carried to the next column? What is meant by an overflow? | <p>When addition of the digits in a column produces 10 or 11 (which in denary are 2 and 3).</p> <p>This occurs when a calculation produces a result that is greater in magnitude than that which a given storage location can store or represent. When 8 bits are expected to represent a number greater than 255.</p> | | |
| 15 | Pupils to complete Worksheet 1 either on paper or on a computer. Ask individual students for their responses and discuss with the class so that all students have the correct answers. | <p>Answers provided.</p> <p>Ask students with the correct responses to explain to the class how they arrived at their answers.</p> | | |
| 15 | The students use the Interactive Activity 1 They should work through the questions. | | | |
| | Extension Challenge/Homework Students to complete and submit Worksheet 2 for homework. | | | |
| 5 | Plenary Peer questioning Ask the students to work in pairs. Each asks their partner to convert a denary number to binary and a binary one to denary. | | | |

WORKSHEET 1 ANSWERS

1

Complete the following binary additions.

(a)

| | | | | | | | |
|-------|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| <hr/> | | | | | | | |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |

(b)

| | | | | | | | |
|-------|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| <hr/> | | | | | | | |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |

c)

| | | | | | | | |
|-------|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| <hr/> | | | | | | | |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |

2

Explain what is meant by an overflow error or overflow condition.

This occurs when a calculation produces a result that is greater in magnitude than that which a given storage location can store or represent.

Every computer has a well-defined range of values that it can represent. If during execution of a program it arrives at a number outside this range, it will experience an overflow error.

It will occur when 8 bits are expected to represent a number greater than 255.

WORKSHEET 2 ANSWERS

- 1 Add the following two 8-bit numbers and explain the result.
You must show your working.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |