Overflow and Underflow

Monday, 04 April 2022

Learning Intention

To develop knowledge
by Understanding what an 8 bit register is.

To secure understanding by Explaining the concept of overflow and underflow in relation to an 8 bit register

To achieve excellence by Applying the concept of overflow and underflow in relation to an 8 bit register using examples

Keywords

Register
Small area of temporary memory within a CPU

https://www.bbc.com/bitesize/clips/zycqmp3

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Task 1:

Explain what an 8 bit register is? Must include:

- How many binary digits can be stored
- An example of binary number that can fit in an 8 bit register

Task 2:

1. Explain overflow and include the exam board definition of Overflow

2. Choose your own binary numbers **which when added together will cause an overflow:**

- Write both numbers down and perform the addition
- Label where the overflow is and explain it

Task3:

1. **Write a definition of Underflow**

2. Draw a diagram showing how right shifting 00000001 will cause an Underflow

THINK IT

- **Write a user guide** for
- converting denary numbers to binary and binary to denary.
- You need to include how a computer uses numbers and include the rules for binary addition

How many bits is this binary number?

1	0	0	0	1	0	1	1
1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit

Most significant bit
MSB

Least significant bit
LSB

What is a bit?

A **bit** **(or binary digit)**, is the **smallest unit of data** in computing

Binary numbers are made up of **binary digits**

1 = 1 bit 0 = 1 bit

8 bit register

Register
Small area of temporary memory within a CPU

So…

1 is a 1 bit number (it has 1 bit in it)

111 is a 3 bit number

11111111 is an 8 bit number

A register is a small storage location in the CPU

An 8 bit register can only store data that is up to 8 bits long.

1 1 1 1 1 1 1 1

To develop knowledge

by Understanding what an 8 bit register is.

Overflow

If the result of an addition process results in a number that is **too large to fit in the space available** then an **overflow has occurred**.

For example if we tried to store the addition of the following **two 8 bit numbers** in an **8 bit register** (small area of memory).

```
  11011011
  11111011 +
-----------
111010110
```

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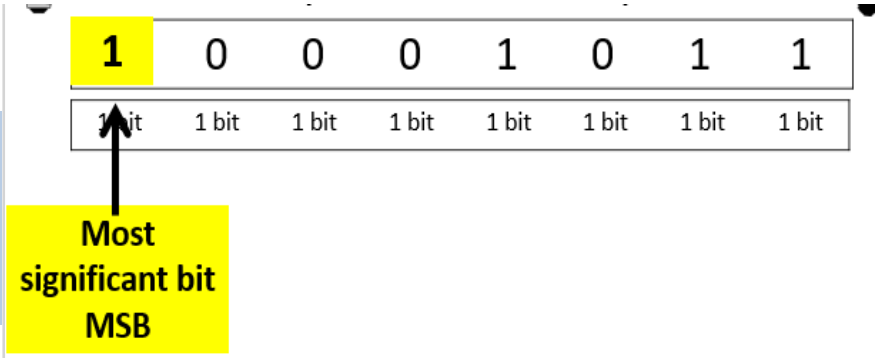
The answer is too large to fit into the register (it is 9 bits in length).
Where this happens, an overflow is said to have occurred.

Exam board says:

The computer processor detects that there has been a carry on the **MSB** and sets the overflow flag to true



Overflow

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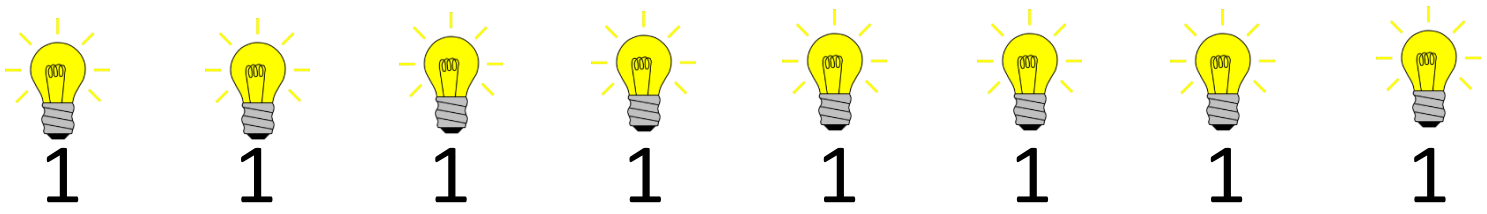
Take the biggest possible 8 bit binary number:



1 1 1 1 1 1 1 1

128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255

And add 1 to it:

1

8 bit number							
1	**1**	**1**	**1**	**1**	**1**	**1**	**1**
0	0	0	0	0	0	0	1
1	1	1	1	1	1	1	
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**

255
+
1
=
0

	8 bit number								
	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	255
	0	0	0	0	0	0	0	1	+ 1
1	1	1	1	1	1	1	1		=
	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0

The computer processor detects that there has been a carry on the **MSB** and sets the overflow flag to true

ERROR

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Underflow

Underflow would occur when the number resulting from a calculation **is too small** to be represented

e.g. in an 8 bit register an arithmetic shift right on
000 0001 would result in a number that can't be represented.

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Underflow example

Right shift 1 place

	128	64	32	16	8	4	2	1
	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	1

In an <u>8 bit register:</u>

An arithmetic shift right on 0000001 would result in a number that can't be represented.

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