# CSSE2010/CSSE7201
# Learning Lab 3

# Binary Arithmetic

School of Information Technology and Electrical Engineering
The University of Queensland

# Learning Lab 3
# Binary Arithmetic

- Binary arithmetic revision

- Circuits which do arithmetic

- IN students – use Logic Ics or Logisim

- EX students – use Logisim

# What is -16 (base 10) expressed in 8-bit two's complement format?

20% A. 10010000

20% B. 11101111

20% C. 10010001

20% D. 11110000

20% E. I don't know

**10**

# What is the result of adding the 6-bit two's complement numbers 001110 and 110100?

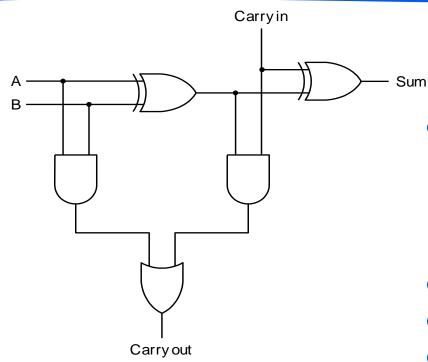| | | |
|---|---|---|
| 0% | A. | 000010 with overflow |
| 0% | B. | 000010 with no overflow |
| 0% | C. | 000110 with overflow |
| 0% | D. | 000110 with no overflow |
| 0% | E. | 001100 with overflow |
| 0% | F. | 001100 with no overflow |
| 0% | G. | 111110 with overflow |
| 0% | H. | 111110 with no overflow |
| 0% | I. | I don't know |

10

# Which of the following operations will result in an overflow in 4-bit two's complement arithmetic?

0%  A. 0100 + 0101

0%  B. 0100 − 0101

0%  C. 1001 − 0001

0%  D. 1001 + 0001

0%  E. None of the above

0%  F. I don't know

10

# 1-bit Full Adder (from lecture)

Carry in

A

B

Sum

Carry out

- Draw a circuit schematic diagram for a circuit which implements a full adder
  - Use switches for the 3 inputs and LEDs for the 2 outputs
- Have it checked by a tutor
- Build it or simulate it
- Test it systematically

# 4-bit adder: 74HCT283

- 74HCT283 = Single chip 4-bit adder
- Draw a circuit schematic that uses this chip to add two 4-bit numbers (on switches) and shows the result (4-bit output and carry out) on LEDs. Connect the carry-in to a push button
  - Use the symbol shown here
    - See details on Blackboard
    - Don't forget power supply connections (16 pin chip)
- Have the schematic checked by a tutor
- Wire up and test the circuit or simulate the circuit
  - Try some unsigned and two's complement test cases
    - Are the results as you expect?
- Extension – add a 2's complement overflow detector circuit with LED output

**EX students: use Logisim adder block with gates as required to simulate**