

CS3280 Homework 1 Due: Friday, January 27, at beginning of class

Consider the following two 8-bit binary numbers A and B:

A = 0100 0000

B = 1101 0000

1. Assume that A and B are two unsigned binary numbers and an 8-bit unsigned adder/subtractor is used

a) Give a convincing reason why or why not there will be an overflow when adding these two numbers (A+B).

```
  0100 0000
+ 1101 0000
-----
(1)0001 0000
```

-> MSB carry out = 1 -> OVERFLOW

or:

unsigned numbers -> A=64, B= 208 -> A+B=272>255 -> result cannot be represented with 8 bits
-> OVERFLOW

b) Give a convincing reason why or why not there will be an overflow when subtracting these two numbers (A-B).

unsigned numbers -> A=64, B=208; A<B -> result negative, but unsigned numbers -> OVERFLOW

2. Assume that A and B are two 2's complement signed binary numbers and an 8-bit signed adder/subtractor is used

a) Give a convincing reason why or why not there will be an overflow when adding these two numbers (A+B).

A=64, B=1101 0000 -> B* = 0011 0000 -> B = -48

A+B = 64 - 48 = 16; 16 can be represented with 8 bits -> NO OVERFLOW

or:

A is positive, B is negative; adding a positive and a negative number will never result in an overflow -
> NO OVERFLOW

b) Give a convincing reason why or why not there will be an overflow when subtracting these two numbers (A-B).

A=64, B=1101 0000 $\rightarrow B^* = 0011\ 0000 \rightarrow B = -48$

A - B = 64 - (-48) = 64 + 48 = 112; $-128 \leq 112 \leq 127 \rightarrow 112$ can be represented with 8 bits
 \rightarrow NO OVERFLOW

or:

A - B = A + B*; B* = 0011 0000

```
  0100 0000
+ 0011 0000
-----
  0111 0000
```

\rightarrow adding 2 positive numbers and result positive \rightarrow NO OVERFLOW

Now consider the following two 8-bit binary numbers A and B:

A = 0100 0001
B = 0100 0000

3. Assume that A and B are two unsigned binary numbers and an 8-bit unsigned adder/subtractor is used

a) Give a convincing reason why or why not there will be an overflow when adding these two numbers (A+B).

```
  0100 0001
+ 0100 0000
-----
(0)1000 0001
```

\rightarrow MSB carry out = 0 \rightarrow NO OVERFLOW

or:

unsigned numbers $\rightarrow A=65, B=64 \rightarrow A+B=129 < 255 \rightarrow$ NO OVERFLOW
(129 can be represented with 8 bits)

b) Give a convincing reason why or why not there will be an overflow when subtracting these two numbers (A-B).

unsigned numbers $\rightarrow A=65, B=64; A > B \rightarrow$ result positive \rightarrow NO Overflow

4. Assume that A and B are two 2's complement signed binary numbers and an 8-bit signed adder/subtractor is used

a) Give a convincing reason why or why not there will be an overflow when adding these two numbers (A+B).

```
  0100 0001
+ 0100 0000
-----
  1000 0001
```

adding 2 positive numbers but result is negative -> OVERFLOW

or:

A=65, B= 64 -> A+B=129; $129 > 127$ -> OVERFLOW
(129 cannot be represented in 8 bits 2's complement system)

b) Give a convincing reason why or why not there will be an overflow when subtracting these two numbers (A-B)

A=65, B= 64 -> A-B = 1; $-128 \leq 1 \leq 127$ -> NO OVERFLOW
(1 can be represented with 8 bits 2's complement)

or:

signed numbers -> $A-B = A+B^*$

B = 0100 0000 -> $B^* = 1100 0000$

```
  0100 0001
+ 1100 0000
-----
  0000 0001
```

-> adding a negative and positive number will never result in overflow
-> NO OVERFLOW