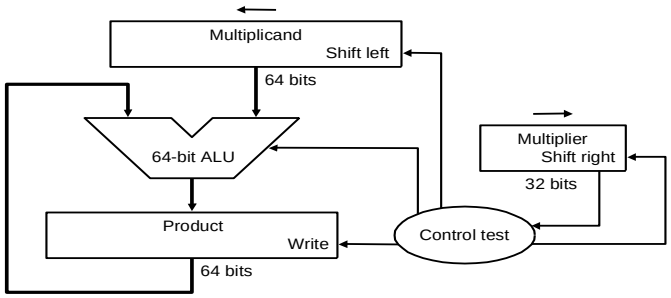
CS3650 Homework #3 (20 points)

Problem 1: Integer multiplication unit. (4 points)



(a) The above shows a 32-bit integer multiplication unit. We reduce the size accordingly to multiple two 5-bit unsigned numbers, i.e. 32 bits => 5 bits etc. Trace the multiplication hardware when multiplying two 5-bit **unsigned** numbers **10101 x 01011**.

Iteration	Multiplicand	Multiplier	Product	Action(s)
0				
1				
2				
3				
4				
5				

(b) Will this multiplication operation issue an overflow warning?

Problem 2: IEEE 754 FP representations - Basics (4 points) Please show your work!

1) What FP number does the following bit pattern represent?
   1 0111 1111 0000 0000 0000 0000 0000 000

2) What FP number does the following bit pattern represent?
   0 1111 1111 0000 0000 0000 0000 0000 000

3) For **64-bit double precision** FP representation, how many bits for the exponent part? How many bits for the fraction part?

4) Chapter 3 defines overflow and underflow. What is the book's definition of FP number **underflow**?
   A. A positive exponent becomes too large to fit in the exponent field
   B. A negative exponent becomes too large to fit in the exponent field
   C. When adding two positive numbers, the result is a negative number
   D. When adding two negative numbers, the result is a positive number
   E. None of above, please write your own definition.

Problem 3: IEEE 754 Representation – Conversion (6 points) Please show your work!

(1) Convert **-126.625** to single precision FP number.

(2) Convert **0.875** to single precision FP number.

(3) Convert FP number **1100 1100 0011 0011 0000 0000 0000 0000** to base-10 decimal number.
Note: Leave the result in the format of $1.x * 2^y$ format where x and y are decimal numbers, e.g. $1.72 * 2^{-5}$.

Problem 4: FP operations (6 points)
(1) Show the step-by-step actions of ***adding*** the following two base-10 floating point numbers. No need to convert to binary.

$9.8942 * 10^4 + 7.9529 * 10^3$

Note: Name the step first, i.e. Step x: Rounding, then illustrate the step using the given numbers.

(2) Show the step-by-step actions of ***multiplying*** the following two base-10 floating point numbers. No need to convert to binary.

$-1.2412*10^{-5} * 3.1002 * 10^9$

Note: name the steps and then use the given numbers to illustrate.

(3) For FP multiplication, how do we detect if there is an **overflow**? How do we detect if there is an **underflow**?