National Taiwan Normal University
Department of Computer Science and Information Engineering
CSU0029, Homework 3

1 Information

1. The assignment is worth 100 points.
2. Individual work.
3. Due at 12:00 on 4/20, i.e., Thursday noon.
4. When asked, use a scientific notation, i.e., show a value in the form $m \times 10^n$, where $1 \leq |m| < 10$ and n is an integer.
5. If any fractional part, round to the second decimal place.
6. Submit the assignment to the course website.
7. Write the assignment in English or Chinese MS Word or PDF format.

2 Contents

1. (20 points) For signed addition ($t0 = $t1 + $t2), the following sequence of MIPS codes can detect two special conditions. The sequence codes are shown as follows:

```
addu    $t0, $t1, $t2
xor     $t3, $t1, $t2
slt     $t3, $t3, $zero
bne     $t3, $zero, T1
addu    $t0, $t1, $t2
xor     $t3, $t0, $t1
slt     $t3, $t3, $zero
bne     $t3, $zero, T2
```

   Please describe which conditions can T1 and T2 indices discover for signed addition?

2. (20 points) Figure 4.1 is a basic multiplication hardware and Figure 4.2 is an improved version of the basic one.

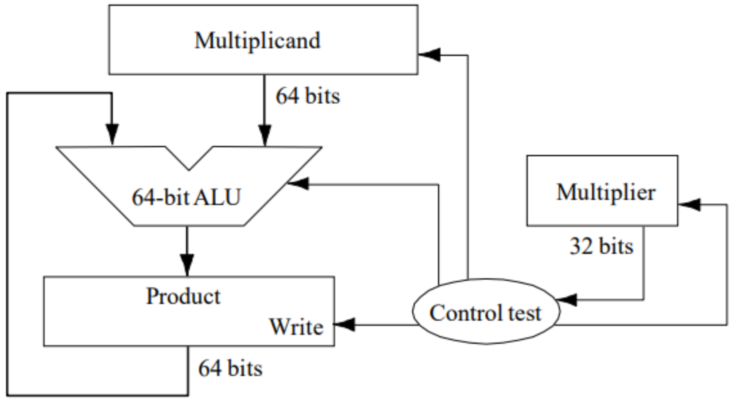


Figure 4.1: Basic multiplication hardware

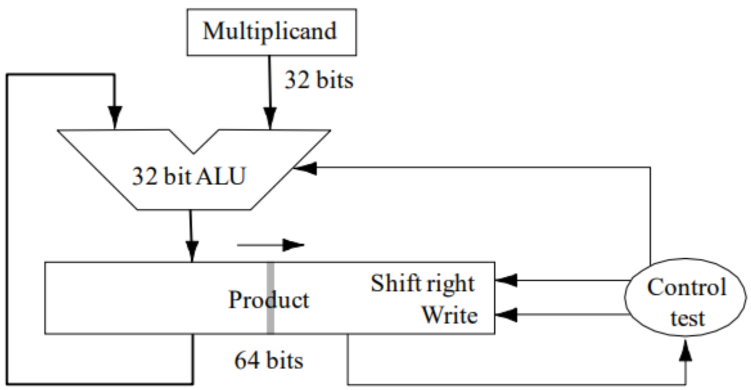


Figure 4.2: Improved multiplication hardware

The following statements are possible observations for the improvement:

S1: The multiplicand register, ALU, Multiplier register and the Product register are all 32 bits wide;

S2: The Product register always shifts right two bits in each iteration;

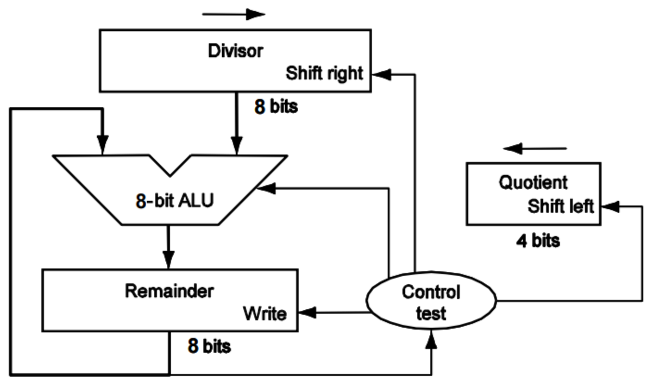
S3: The original Multiplier register disappears and is now placed in the right half of the Product register initially;

S4: The left side of the Product register is initially set to zero.

S5: The Multiplicand register is initially set to zero.

Please Determine if these statements are true or false.

3. (20 points) Given the 4-bit restoring division block diagram below. Please divide 7_{10} by 2_{10} and show the value of each register for each of the steps.



Iteration	Quotient	Divisor	Remainder
0 (initial values)	0000	0010 0000	0000 0111
1			
2			
3			
4			
5			

4. Consider the representations of the floating-point numbers.
   (a) (10 points) A number is often denoted as $(-1)^S \times \mathrm{F} \times 2^E$. What are the English names and meanings of F, and E, respectively?
   (b) (10 points) In the IEEE 754 standard format, a number is denoted as $(-1)^S \times \mathrm{F} \times 2^{E-Bias}$. For single and double precision numbers, what are the values of Bias, respectively?

5. (20 points) Which of the following statements is (are) true for IEEE 754 floating point representation?

   (1) IEEE 754 standard defines the double precision number to be a 128-bit format.
   (2) If a floating point number is shown in the form of $(-1)^S \times (1+\mathrm{F}) \times 2^E$ where S defines the sign of the number, F the fraction field, and E the exponent, this means the leading 1-bit of normalized binary numbers is implicit.
   (3) IEEE 754 binary representation of $-0.75_{(10)}$ is 10111111011000000000000000000000 for single precision.
   (4) The floating point number represented in a biased exponent is actually this value: $(-1)^S \times (1+\mathrm{F}) \times 2^{E-Bias}$
   (5) Since there is no way to get 0.0 from this form: $(-1)^S \times (1+\mathrm{F}) \times 2^E$, we will not be able to represent 0.0 in floating point format.