CENG3420 Homework 1

Due: Feb. 04, 2018

Q1 (10%) Draw the schematic view of four-input NAND gate.

Q2 (20%) Solve the problems about multiplexer.

1. (10%) Write down the logic expression of a multiplexer with 2^n inputs and n selection lines.
2. (10%) Design the multiplexer when $n = 1$ with only **NAND** and **NOT** gates (Use the symbols given in slides L02.13).

Q3 (15%)

1. (10%) Translate the following C function into MIPS assembly.

```
int sum(int n, int rst){
    if (n>0)
        return sum(n-1, rst+n)
    else
        return rst
}
```

2. (5%) Is the access to the stack necessary? Please elaborate the resons.

Q4 (15%) Write an assembly function to clear an array `array[]` with size `size` (i.e. set every elements to zero). Assume two parameters `array` and `size` are stored in `$a0` and `$a1`.

Q5 (10%) A program runs in $10s$ on computer A with 2GHz clock. If we want to design a computer B such that the same program can be finished in $6s$, determine the clock frequency of computer B. Assume it requires 1.2X clock cycles to execute the program on computer B due to different CPU design.

Q6 (10%) Dynamic power of one transistor is proportional to the capacitive load (C), square voltage (V^2) and working frequency (f). Suppose we have developed new versions of a processor with the following characteristics.

Version	Voltage	Clock Rate
Version 1	1.3 V	5 GHz
Version 2	0.8V	4 GHz

1. (5%) How much has the capacitive load varied between versions if the dynamic power of version 2 is 20% less than version 1?
2. (5%) How much has the dynamic power been reduced if the capacitive load does not change?

Q7 (10%) Figure 1 shows a simple multiplication algorithm in ALU design. Write down the step by step procedure to calculate 7×3 or 00000111×0011. Use 4-bit numbers in the calculation.

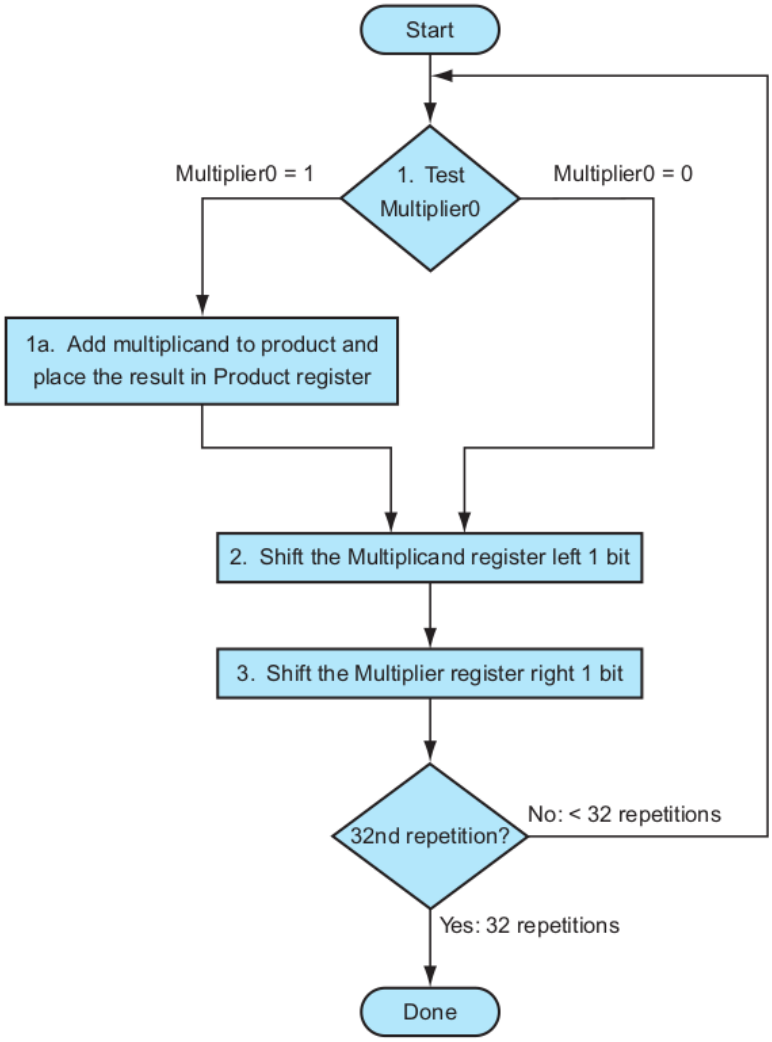

Figure 1: A simple multiplication algorithm.

Q8 (10%) Figure 2 shows a simple division algorithm in ALU design. Write down the step by step procedure to calculate $7 \div 3$ or $00000111 \div 0011$. Use 4-bit numbers in the calculation.

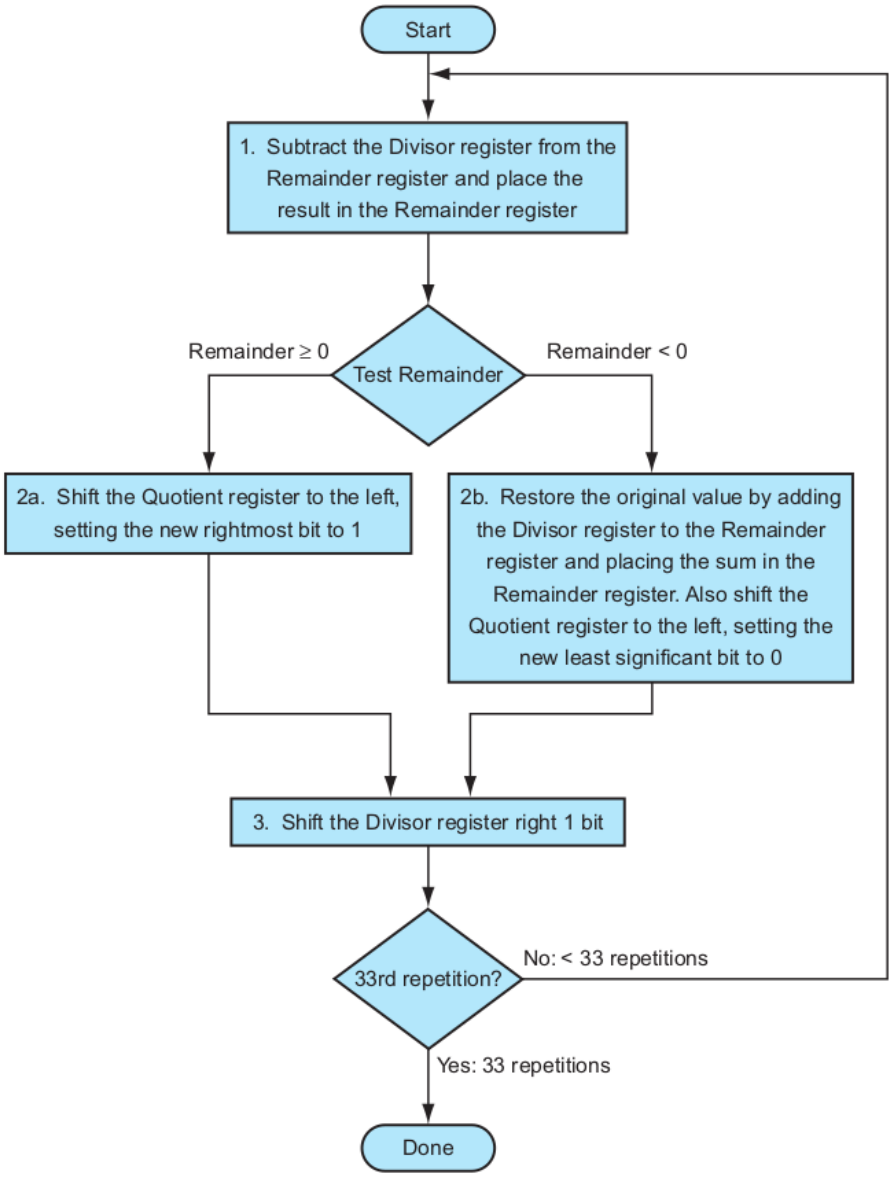

Figure 2: A simple division algorithm.