Assignment 6

Due November 28, 12:59pm

NOTE: Late submissions will **NOT** be accepted. Please put your solutions in the CENG 355 **drop-box** (ELW, second floor) – they will be collected at **13:00**.

1. [3 points] Consider a pipelined datapath consisting of five stages:

F – fetch the instruction from the memory,
D – decode the instruction and read the source register(s),
C – execute the ALU operation specified by the instruction,
M – execute the memory operation specified by the instruction,
W – write the result in the destination register.

Identify data hazards in the code below and insert **NOP** instructions where necessary.

```
ADD   R2, R4, R1        // R1 = R2 + R4
ADD   R4, R6, R5        // R5 = R4 + R6
ADD   R0, R2, R3        // R3 = R0 + R2
MOV   R6, (R1)          // MEMORY[R1] = R6
MOV   (R3), R6          // R6 = MEMORY[R3]
MOV   R4, R2            // R2 = R4
ADD   #4, R4, R4        // R4 = R4 + 4
ADD   R0, R2, R1        // R1 = R0 + R2
MOV   R2, R0            // R0 = R2
```

2. [10 points] Solve Problem **12.7** from the textbook. **Hint:** Declare the shared counter variable as "**volatile int thread_id_counter**", initialize it to 0 in **main()**, and check it by each thread as follows: "**while (thread_id_counter != my_id);**". Each thread must increment **thread_id_counter** after updating global **dot_product**.

3. [2 points] Solve Problem **12.8** from the textbook.

4. [10 points]

(a) Show **decimal** number **+5.25** in the 32-bit IEEE-754 floating-point format.
(b) Show 32-bit **IEEE-754** number **0 00000000 10000000000000000000000** in the decimal format.
(c) Show 32-bit **IEEE-754** number **0 01111111 00000000000000000000000** in the decimal format.
(d) Given two 32-bit IEEE-754 floating-point numbers **X** and **Y** below, calculate (in the binary format) **Z = X–Y**, and then convert **Z** to the decimal format:
X = **1100 0001 1001 0100 1111 0000 0000 0000**,
Y = **0011 1110 0100 0000 0000 0000 0000 0000**.