Assignment

(1)

Consider executing the code given below on the pipelined datapath of Figure 6.46 on page 492 in the book:

```plaintext
add $1, $2, $3
add $4, $1, $5
lw $7, 0($8)
add $10, $7, $9
sw $10, 0($8)
```

(a) At the end of sixth cycle of execution, which registers are being read and which are being written?

(b) With regard to the above question, explain what the forwarding unit is doing during the sixth cycle of execution. Mention the comparisons being made, if any.

(c) With regard to the program in (1), explain what the hazard detection unit is doing during the fifth cycle of execution. Mention the comparisons being made, if any.

(2)

Consider executing the code given below on the pipelined datapath of Figure 6.46 in book on page 492.

```plaintext
addi $5, $1, 200
lw $4, 100($5)
add $6, $4, $4
sw $6, 100($5)
xor $6, $3, $6
```

How many cycles will it take to execute this code? Draw a diagram like that on page 489 in book and illustrate the dependencies that need to be resolved and draw another diagram like that on page 491 (Figure 6.45) to illustrate how the code will actually be executed (incorporating any stalls or forwarding) so as to resolve the identified problems.
(3)

Rewrite the following code to MINIMIZE performance along this datapath—that is, reorder the following instructions so that this sequence takes the most clock cycles to execute while still obtaining the same result.

```assembly
loop: ......
  add $8, $2, $2
  lw $4, 0($8)
  lw $5, 4($8)
  lw $6, 8($8)
  add $9, $5, $6
  add $10, $2, $6
  add $8, $7, $4
  sw $10, 12($8)
  beq $9, $1, loop
```