

# CmpSci 201

## Homework 10

1. Given a 4-stage F-D-E-W pipeline, where register values are read at E, illustrate the flow of the following instructions through the pipeline.

```
MOV    R5 , R4
ADD    R4 , R4 , #1
MUL    R6 , R6 , R7
ADD    R5 , R5 , #2
```

2. Given a 4-stage F-D-E-W pipeline with no forwarding, where register values are read at E, and the following code:

```
MOV    R5 , R4
ADD    R5 , R5 , #1
ADD    R5 , R5 , #2
MUL    R4 , R6 , R4
MOV    R6 , R7
```

- (a) illustrate the flow of these instructions through the pipeline

(b) illustrate the flow of these instructions through the pipeline if it had forwarding

(c) Reorder the instructions (without modifying the outcome of the code sequence) to more efficiently execute through a non-forwarding pipeline.

3. Given the following code, indicate whether or not the conditional branches are biased towards taken (T) or not taken (NT) or neither (N/A).

```
        MOV    R4, #128
        MOV    R5, #0
loop:   CMP    R5, R4
        BGT   end
        ADD   R5, R5, #1
        SWI   #h00F0000F
        BLE  loop
end:    SUB   R5, R5, #1
```