

4th Edition Exercise 4.13.2-4

| | | | |
|----|---|----|---|
| a. | lw \$6, 40(\$1) add \$6, \$6, \$2 sw \$6, 60(\$1) | b. | lw \$5, -16(\$5) sw \$5, -16(\$5) add \$5, \$5, \$5 |
|----|---|----|---|

4.13.2 Assume there is no forwarding in this pipelined processor. Indicate hazards and add nop instructions to eliminate them.

0|)
add x, x, x
nop
add x, x, x

Answer:

| | | | |
|----|--|----|--|
| a. | | b. | |
|----|--|----|--|

4.13.3 Assume there is full forwarding. Indicate hazards and add nop instructions to eliminate them.

Answer:

| | | | |
|----|--|----|--|
| a. | | b. | |
|----|--|----|--|

In this problem assume the following clock cycle times:

| | Without forwarding | With full forwarding |
|----|--------------------|----------------------|
| a. | 300ps | 350ps |
| b. | 200ps | 250ps |

4.13.4 What is the total execution time of this instruction sequence without forwarding and with full forwarding? What is the speed-up achieved by adding full forwarding to a pipeline that had no forwarding?

Answer:

| | No forwarding | With forwarding | Speed-up due to forwarding |
|----|---------------|-----------------|----------------------------|
| a. | | | |
| b. | | | |

4th Edition Exercise 4.23

In this exercise, assume that the breakdown of dynamic instructions into various instruction categories is as follows:

| | R-Type | beq | jmp | lw | sw |
|-----------|---------------|------------|------------|-----------|-----------|
| a. | 50% | 15% | 10% | 15% | 10% |
| b. | 30% | 10% | 5% | 35% | 20% |

Also, assume the following branch predictor accuracies:

| | Always-taken | Always not-taken | 2-bit |
|-----------|---------------------|-------------------------|--------------|
| a. | 40% | 60% | 80% |
| b. | 60% | 40% | 95% |

4.23.1 Stall cycles due to mispredicted branches increase the CPI. What is the extra CPI due to mispredicted branches with the always-taken predictor? Assume that branch outcomes are determined in the EX stage, that there are no data hazards, and that no delay slots are used.

Answer:

| | Extra CPI |
|-----------|------------------|
| a. | |
| b. | |

4.23.2 Repeat Exercise 4.23.1 for the "always not-taken" predictor.

Answer:

| | Extra CPI |
|-----------|------------------|
| a. | |
| b. | |

4.23.3 Repeat Exercise 4.23.1 for the 2-bit predictor.

Answer:

| | Extra CPI |
|-----------|------------------|
| a. | |
| b. | |