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CIS 451

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Superscalar Homework

1. This problem explores the benefit of the predication technique discussed in class.

(a) Write the straightforward MIPS assembly for the following segment of code. Assume all

variables are already loaded in registers.

if (t0 == t1) {

t2 = t2 + 10;

} else {

t3 = t4 + t5;

}

MIPS:

beq r1, r2, EQUAL  
add r4, r5, r6   
jmp Both  
EQUAL:   
 addi r3, r2, 10   
Both:

(b) On average, how many cycles does this segment of code require if

• If the condition is true half of the time,

• The branch predictor is 90% accurate, and

• The branch penalty is 7 cycles.

If true (t0 = t1): 8 cycles for 50%

If False: 9 cycles for 50%

So, the average is 8.5 cycles

(8.5\*.9) + ((8.5+7)\*.1) = 9.15 Cycles

The average number of cycles will be about 9 (assuming a 5 stage pipeline)

(c) Now suppose your CPU has the following new features:

• a cmp r1, r2 instruction that compares r1 and r2 and store the result in a specialpurpose

register.

• predicated arithmetic instructions (e.g., add eq and add ne) that will store the result

of the instruction only if the previous cmp instruction returned the indicated value.

Rewrite your assembly code form part 1a using these new features.

New MIPS:

cmp $sr, $r1, $r2   
add ne   
add eq

(d) On average, how many cycles does your predicated code take?

8 cycles. We eliminated the branch and branch penalty possibility.

(e) At what accuracy is the standard MIPS code more efficient than the predicated code?

Accuracy = old / new

= 9.15 / 8

= 1.14375

= 1.14375 - 1

= 14.375%

The new predicated code would be about 1.14375 times better than the standard MIPS code