University of California, Berkeley
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Fall 1997 D.A. Patterson

Prerequisite Quiz Solutions
CS152 Computer Architecture and Engineering

This document contains solutions and grading scales for the prerequisite quiz. Most of the questions had multiple solutions; one method for each is given here. The penalties for the most common errors are listed here.

1. This problem was worth 30 points. There were four main things we were looking for: that you initialize `$v0` (worth 6 points), that you count the words correctly (worth 8 points), that you copy the words correctly (worth 8 points), and that you advance the pointers correctly (worth 8 points). Here is one of the correct versions of the loop:

```
      add   $v0, $0, $0     # initialize $v0
loop: lw    $v1, 0($a0)     # read next word from source
      sw    $v1, 0($a1)     # write to destination
      beq   $v1, $0, done   # exit on terminating word
      addi  $v0, $v0, 1     # count word
      addi  $a0, $a0, 4     # advance pointer one word
      addi  $a1, $a1, 4     # advance pointer one word
      b     loop
done:
```

2. This problem was worth 30 points. For this problem, we took 10 points off if you made a large error but still showed understanding of caches, and 2 points off for each small error (such as arithmetic errors). Here are the completed tables:

Reference Address	Hit or Miss?
1	Miss
4	Miss
8	Miss
5	Miss
20	Miss
17	Miss
19	Miss
56	Miss
9	Miss
11	Miss
4	Miss
43	Miss
5	Hit
6	Miss
9	Hit
17	Hit

Cache Line	Contents
0	
1	~~M[1]~~ M[17]
2	
3	M[19]
4	~~M[4]~~ ~~M[20]~~ M[4]
5	M[5]
6	M[6]
7	
8	~~M[8]~~ M[56]
9	M[9]
10	
11	~~M[11]~~ M[43]
12	
13	
14	
15	

3. The first three parts of this question were worth 7 points each; the last part was worth 9 points. The least-optimized version is given here.

- X contains only one 1

  $(x2 \cdot \overline{x1} \cdot \overline{x0}\ ) + (\overline{x2} \cdot x1 \cdot \overline{x0}) + (\ \overline{x2} \cdot \overline{x1} \cdot x0)$

- X contains an even number of 1s (zero is an even number)

  $(x2 \cdot x1 \cdot \overline{x0}\ ) + (x2 \cdot \overline{x1} \cdot x0) + (\overline{x2} \cdot x1 \cdot x0) + (\overline{x2} \cdot \overline{x1} \cdot \overline{x0})$

- X when interpreted as an unsigned binary number is less than 3

  $(\overline{x2} \cdot x1 \cdot \overline{x0}) + (\overline{x2} \cdot \overline{x1} \cdot x0) + (\overline{x2} \cdot \overline{x1} \cdot \overline{x0})$

- X when interpreted as a signed (two's complement) number is less than -1

  $(x2 \cdot x1 \cdot \overline{x0}) + (x2 \cdot \overline{x1} \cdot x0) + (x2 \cdot \overline{x1} \cdot \overline{x0})$

4. This question was worth 10 points. The key to this question was remembering that the only difference between `addi` and `addiu` is that `addi` can potentially cause an exception. Both instructions sign-extend the immediate value before the addition. Thus, the answer is `0xFFFFFFFF`.