CS 61C F13 Midterm Review

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Number Representation

For this question, we are using 16-bit numerals. For floating point, use 1 sign bit, 5 exponent bits, and 10 mantissa bits. (Bias = 15)

Indicate in which representation, two’s complement or floating point, the numeral is closest to zero:

1) 0x0000  
2) 0xFFFF  
3) 0x0001
Number Representation (cont.)

For this question, we are using 16-bit numerals. For floating point, use 1 sign bit, 5 exponent bits, and 10 mantissa bits. (Bias = 15)

Indicate in which representation, two’s complement or floating point, the numeral is closest to zero:

4) 0xFFFE  __________
5) 0x8000  __________
We now wish to add the numerals (at left) from top to bottom first in two’s complement, and then in floating point.

For each, state which of the following occurs: overflow, underflow, NaN, or no error.

Numbers:

1) 0x0000
2) 0xFFFFF
3) 0x0001
4) 0xFFFFE
5) 0x8000
Given the following declarations:

```c
char a[14] = "pointers in C";
char c = 'b';
char *p1 = &c, **p2 = &p1;
```

Which of the following are legal in C?

1) `p1 = a+5;`
2) `&p1 = &a[0];`
3) `p2 = a;`
Given the following declarations:

```c
char a[14] = "pointers in C";
char c = 'b';
char *p1 = &c, **p2 = &p1;
```

Which of the following are legal in C?

4) `*(a+10) = 't'`
5) `*p2 = &c;`
C-to-MIPS

We wish to convert the following code to MIPS without using pseudoinstructions:

```c
struct Node { int n; struct Node *next; };  

int sum (struct Node *head) {
    if (head == NULL)
        return 0
    else
        return head->n + sum(head->next);
}
```
C-to-MIPS (cont.)

Fill in the blanks (and where it says “maybe some lines here”) below:

```
sum: li $v0 0

__________________________  # check if head==NULL
# Maybe some lines here?
jal sum  # Recursive call
# Maybe some lines here?
__________________________  # get head->n
__________________________  # compute the sum

done: jr $ra
```
$a0 = \text{the address of an array. } a1 = \text{array length}

\text{Mystery:}
\begin{align*}
\text{move } v0, 0 \\
\text{Label:}
\text{#exit if fewer than 2 elements remaining}
\text{slti } t0, a1, 2 \\
\text{bne } t0, 0, \text{Done}
\text{lw } t0, 0(a0) \\
\text{lw } t1, 4(a0) \\
\text{slt } t2, t1, t0 \\
\text{add } v0, v0, t2
\end{align*}

\begin{align*}
\text{subi } a1, a1, 1 \\
\text{addi } a0, a0, 4 \\
\text{j Label}
\end{align*}

\begin{align*}
\text{Done:}
\text{beq } v0, 0, \text{Return1}
\text{addi } v0, 0, 0 \\
\text{jr } ra
\end{align*}

\begin{align*}
\text{Return1:}
\text{addi } v0, 0, 1 \\
\text{jr } ra
\end{align*}
AMAT

Suppose that for 1000 memory references to a direct-mapped, three level cache, we have

- 40 misses in L1$, L1$ hits in 1 cycle
- 10 misses in L2$, L2$ hits in 10 cycles
- 10 misses in L3$, L3$ hits in 100 cycles
- Main memory access costs 1000 cycles

a) What is the local miss rate for L3$?
b) What is the AMAT?
c) What is the AMAT if we didn’t have L3$?
Caches

Given a direct mapped cache, initially empty, and the following memory access pattern, what is the hit rate and miss rate if the cache has 8 32-bit blocks? Assume that memory is byte-addressed.

8, 0, 4, 32, 36, 8, 0, 4, 16, 0
Caches

Consider a write-back, direct-mapped cache with 16 byte blocks and 64 KiB of data. Assume a byte-addressed machine with 32-bit addresses.

a) Partition the following address and label each field with its name and size in bits

| 31 | 0 |

b) Given the address 0xDEADBEEF, what is the value of the index, offset, and tag?
Consider a write-back, direct-mapped cache with 16 byte blocks and 64 KiB of data. Assume a byte-addressed machine with 32-bit addresses.

c) How many cache management bits are there for each block? List them.

d) What is the total number of bits (data AND cache management) that comprise the cache?
Miscellaneous Questions

Which of the following is not a job of the linker?
   1) Relocation
   2) Compute branch offsets
   3) Combine .o files
   4) Resolve external symbols

Fill in the blanks: The dominant form of parallelism in WSCs is _______.
   1) SISD   2) MISD   3) SIMD   4) MIMD
Miscellaneous Questions (cont.)

True or false:

- The greatest part of monthly expenses for a datacenter are amortized capital expenses (CAPEX).
- MapReduce can give the wrong answer if a worker crashes.
You have to finish your project using Amazon EC2 servers. You know the servers will finish the problem in 1hr using 10 machines, but you need to submit within 10 minutes or be late, so you booted 60 machines.

However, even though the cluster booted instantaneously (!!!) you were still late. This scenario indicates your solution lacked what kind of scaling?
That’s all!

Good luck on the midterm!
Credits

The following questions were adapted from
  Fa03 midterm 1: C programming
  Fa03 midterm 2: Misc questions
  Sp11 midterm 1: Caches, MISC questions
  Sp11 final: AMAT
  Su11 midterm 1: Reading MIPS
  Fa11 midterm: C-to-MIPS
  Fa12 midterm: Misc questions
  Su13 midterm: Number rep