V1

September 29, 1997

cs470 - Computer Architecture 1

Fall 1997

Midterm Exam

open books, open notes

Starts: **6:25 pm** Ends**: 8:00 pm**

Name:_____(please print)

ID:_____

Problem	Max points	Your mark	Comments
1	25		10+10+5
2	25		10+10+5
3	10		10
	60		

1. Your first job as a new employee with ACME Computing is to upgrade your boss' computer with a new disk and and a new disk controller. These changes will make every disk access two times faster. With these enhancements in place, disk accesses account for 20% of the running time. The overall cost of the system increases by 10%.

a) what is the overall speedup?

b) what is the overall speedup if you also improve the graphics system with a new graphics card? The new card will make all graphics 20 times faster. Graphics represent 30% of the workload of the original machine (before any improvment is done).

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c) Assuming just the disk improvement, decide whether the new system will be more cost effective than the current one. We say that one system is more *cost effective* than another if the ratio of performance divided by cost is higher.

2.

Consider the following C statement:

```
a = a*b + a;
```

You have an 8-bit stack machine with 16 bit addresses. **a** and **b** are of type **very short int** (i.e. 8-bit) and are stored in memory starting with the address **0x0DDD** (where DDD stands for the first three digits of your SSN). Their initial values are **0x2a** for **a** and **0x02** for **b**. The code starts in memory at address **0x5ffc**. Below is a list of opcodes (each opcode is one byte wide):

Instruction	Opcode
add	**0x20**
sub	**0x21**
mul	**0x22**
div	**0x23**
push	**0x24**
pop	**0x25**

a) Compile the C code for this stack machine; for each instruction in the program show the

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instruction format on the right hand sid; clearly mark the boundaries of each instruction.

Instruction	Instruction Format						

b) Show the sequence of addresses issued by the CPU to execute this code; for each address indicate whether it's a memory read or write and what's on the data bus for that particular memory access.

Address	R/W	Data		

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Address	R/W	Data		

c) What is the average number of memory accesses per instruction?

3. Write MIPS assembly code for the following piece of a C program:

```
x[5] = x[6] + a;
```

You shall assume that **a** corresponds to register **$t1** and the array of words **x** begins at

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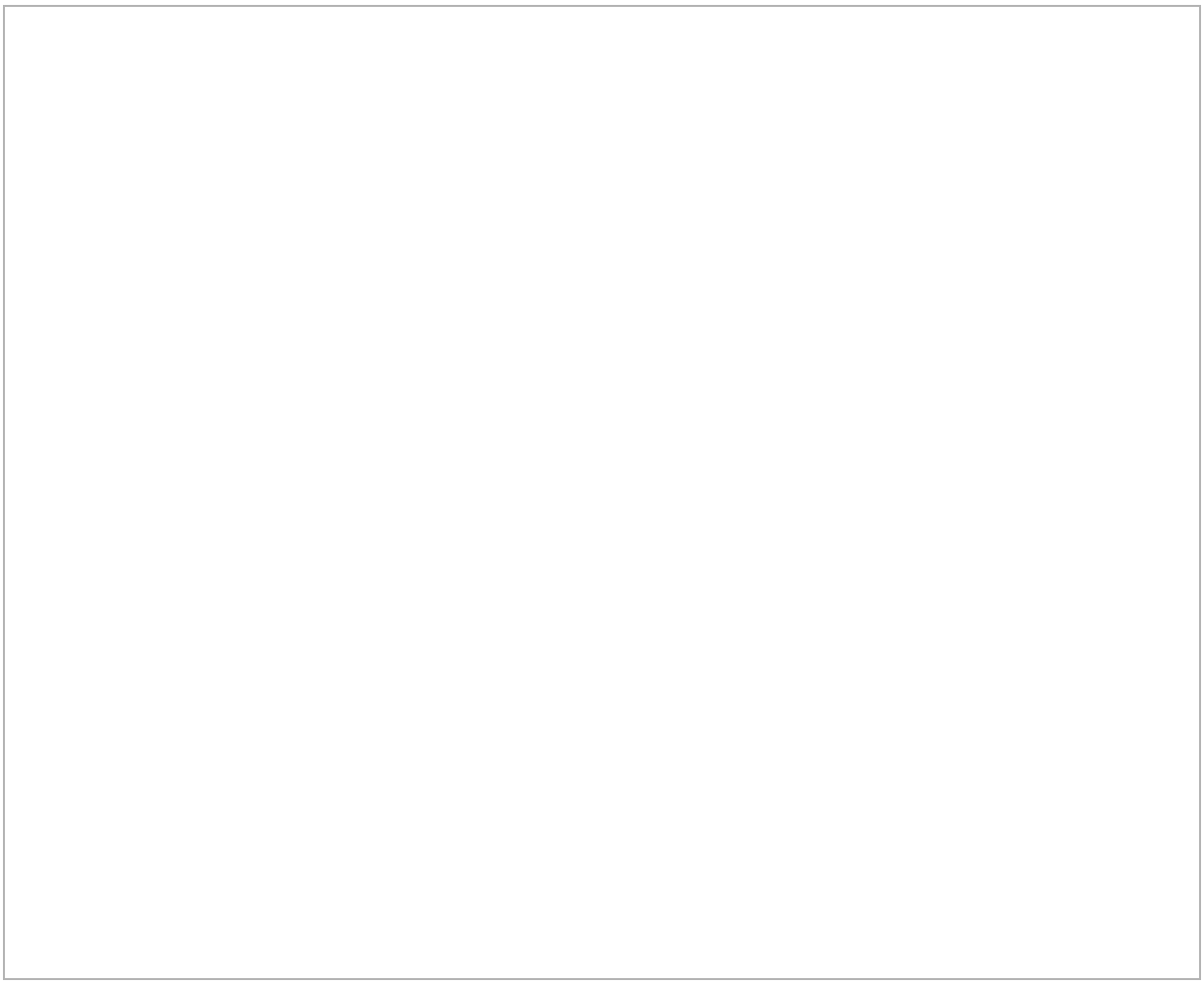
address **`0x10010010`**. You must use the native MIPS instruction set.



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