

Midterm Review

2024 Fall ECE454: Computer Systems Programming
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Lecture 13
1.1.0

The Midterm is Oct 24 @ 7:30 PM in PB B150

It's divided into 6 parts:

(15 marks) Short answer, True / False

(8 marks) Compiler Optimization

(6 marks) Program Optimization

(11 marks) Cache Hierarchy

(12 marks) Virtual Memory

(8 marks) Dynamic Memory

Compiler Optimizations

You should know (and name):

- Constant Folding
- Common Subexpression Elimination
- Constant Propagation
- Copy Propagation
- Dead Code Elimination
- Loop Interchange
- Loop Fusion
- Loop-Invariant Code Motion
- Inlining

Program Optimizations

Sometimes the compiler won't perform optimizations because it's conservative with memory

You should be able to apply them, like Lecture 5

Cache Hierarchy

You should be able to determine how many bits are in the tag, index, and offset

You should also be able to find a hit rate given a cache and array accesses

Example Cache Question

Given a 32-bit machine with a 64 KiB byte 4-way set associate cache,
and a line size is 8 bytes

How many bits are there for the tag, index, and offset?

Given the Previous Question, What's In Cache?

Index	Tag	Data
0	0000 0000 0000 0010 0111	0x00_01_02_03_04_05_06_07
	0000 0000 0000 0010 0101	0x08_09_0A_0B_0C_0D_0E_0F
	0000 0000 0000 0110 0111	0x10_11_12_13_14_15_16_17
	0000 0000 0000 1010 0111	0x20_21_22_23_24_25_26_27
1	0000 0000 0000 0010 0111	0x30_31_32_33_34_35_36_37
	0000 0000 0000 0010 0101	0x08_39_3A_3B_3C_3D_3E_3F
	0000 0000 0000 0110 0101	0x10_41_42_43_44_45_46_47
	0000 0000 0000 1010 0110	0x20_51_52_53_54_55_56_57

Is 0x137 in the cache? If so, what's the value?

Is 0x27007 in the cache? If so, what's the value?

Is 0x2700F in the cache? If so, what's the value?

Virtual Memory

Main focus was on TLB, and why it speeds up virtual memory accesses
Translating a VPN to PPN

Give a virtual address, you should know what part is the VPN

The TLB is just another cache, but the data stored is a PTE
(frame number, or PPN, and valid bit)

Dynamic Memory

Know the struct layout and alignment rules

You should have a high level understanding of the following:

- Implicit List

- Explicit List

- Segregated List

Good Luck!

Any other questions, let me know!

I'll be in my office (BA 5110) starting at 3 PM until close to the midterm

Feel free to study at the desks outside my office if I'm not around