CSC369 Tutorial 1

Some review material
(part 2)
Architecture Review
CPU

- The Program Counter (PC)
- The Stack Pointer (SP)
- Data Registers
- Flow of normal execution
  - Memory address and load/store instructions
- Interrupts!
INC A  0011 1100  3C
CPU

INC A 0011 1100 3C
CPU

INC A  0011 1100  3C
CPU

INC A   0011 1100   3C
CPU

INC A  0011 1100  3C

End of FETCH
CPU

INC A  0011 1100  3C

DECODE
CPU

INC A  0011 1100  3C

EXECUTE
CPU

INC A  0011 1100  3C

EXECUTE
Memory Hierarchy and Trade-off

• Can’t have the fastest memory, largest capacity, and be the cheapest...

• OS must do smart things to efficiently use different types of memory (Caching)
Memory

- Program sees linear address space, segmented
  - Code
  - Data
  - Stack
  - Heap
- Where does the OS go?
- Do programs share the same space?
The Stack grows down!

 Every function puts a "frame" onto the stack. The frame contains local variables and then lots of system registers. (More on this later.)

 The SP (stack pointer) points to the TOP of the stack -- the next free piece of memory. The FP (frame pointer) points to a specific location in the frame -- like the beginning.

 Constant section (.data): Constants and global variables go here.

 Code section (.text): Your program goes here!

 2**n - 1, where n is 32 on a 32-bit machine. Note that this is a small lie: the OS needs some space, so you don't actually get all of this memory. We'll talk about this more in 369.

 The PC (program counter) is a CPU register that stores a pointer to the next instruction. It points into this section.

 "Static" memory

 "Dynamic" section of memory

 00000000 is an illegal address. Why?
Stack Frame of Function Call

Function 1

Function 2

Function 3

Function 4

P1 Local Variable 2
P1 Local Variable 1
Stack Frame of Function Call

Function 1

Function 2

Function 3

Function 4

SP

FP

P2 Local Variable 2
P2 Local Variable 1
Return address of P1
Parameter 1
Parameter 2
P1 Local Variable 2
P1 Local Variable 1
Stack Frame of Function Call

Function 1

Function 2

Function 3

Function 4

SP

FP

P3 Local Variable 2
P3 Local Variable 1
Return address of P2
Parameter 1
Parameter 2
P2 Local Variable 2
P2 Local Variable 1
Return address of P1
Parameter 1
Parameter 2
P1 Local Variable 2
P1 Local Variable 1
Stack Frame of Function Call

Function 1

Function 2

Function 3

Function 4

SP

FP

P4 Local Variable 2
P4 Local Variable 1
Return address of P3
Parameter 1
Parameter 2
P3 Local Variable 2
P3 Local Variable 1
Return address of P2
Parameter 1
Parameter 2
P2 Local Variable 2
P2 Local Variable 1
Return address of P1
Parameter 1
Parameter 2
P1 Local Variable 2
P1 Local Variable 1
Stack Frames

- First 4 arguments: $a0-$a3
- Return value (or pointer to it): $v0
- Return address: $ra
- Frame pointer: $fp

http://www.cs.ucsb.edu/~franklin/30/spim/BookCallConvention.htm