CDA 3100

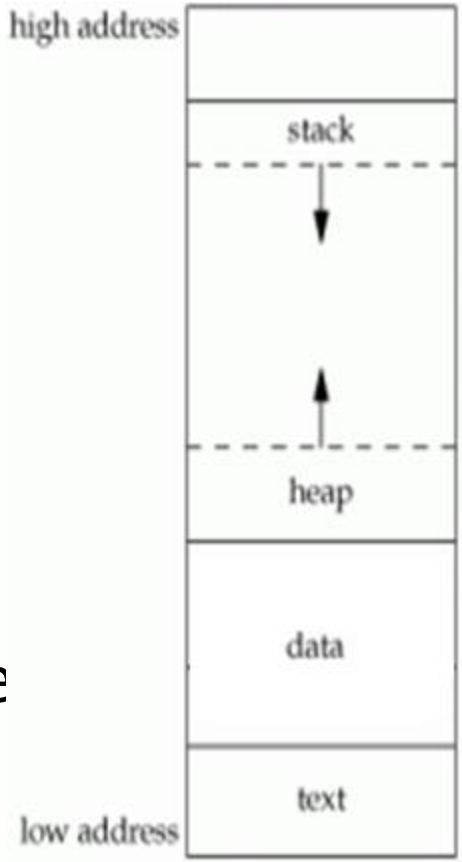
Fall 2013

Recitation – Week 3

MIPS Coding

Structure of a MIPS program

- Text segment
  - Contains all the code
- Data segment
  - Contains the data, like arrays, strings, etc.
  - Data segment begins with .data. Can be written before or after the text segment.



Memory Access

- Data is stored in words. Programmers tend to think in words.
- To move to the next logical memory location, we need to move 4 bytes.
- We can put data in an array, and move using a counter register, incrementing by 4.

LA, LI Pseudoinstructions

- Load Address
- LA d, label
  - Example: la $s0, A
  - Loads the address of the label into the register.

- Load Immediate
- LI d, immediate
  - Example: li $t1, 10
  - Loads the immediate value into the register.

Shifts

Shift instructions move all the bits in a word to the left or to the right.

- Shift left logical (sll) move all the bits to the left by the specified number of bits
  - sll $t2, $t1, 4
- Shift right logical (srl) move all the bits to the right
  - srl $t1, $t0, 3
- Fill the emptied bits with 0's

Branches and loops

- MIPS has conditional and non conditional branches and jumps to manage loops.

beq	s,t,addr	branch if s == t
bne	s,t,addr	branch if s !=t
j	target	after a delay of one machine cycle, PC <-- address of target

SLT, SLTI

- Set if Less Than
- Slt t,s1,s2
- Example: slt $s1,$t1,$t2
- Sets s1 to 1 if t1 < t2. S1 is 0 otherwise

- For slti, s2 is an immediate operand (signed int). Logic is the same.

Program to find the largest number in an array

- Given an array of 10 numbers, write a MIPS program to find the largest
  - Assign a variable to be the largest number. Give it a small value (example 0).
  - Load the array elements one by one.
  - Check if the current element is larger than the variable, correct the value, and record the index.

Program to find the largest number in an array

```
# find the index of the maximum element in an array with 10 positive elements

        .data
A:      .word 34, 67, 10, 45, 90, 11, 3, 67, 19, 100

        .text
        .globl main
main:
        la $s0, A               # starting address of A in $s0
        li $s1, 10              # number of elements in $s1
        li $s2, 0               # i in $s2
        li $s3, 0               # max in $s3
        li $s4, -1              # index in $s4
```

Program to find the largest number in an array (cont)

```
Loop:   sll $t1, $s2, 2          # $t1 = i * 4;
        add $t1, $t1, $s0        # $t1 = i * 4 + $s0
        lw $t0, 0($t1)           # $t0 = A[i]
        slt $t2, $t0, $s3        # $t2 = 1 if $t0  < $s3. $t2 = 0 if $t0 >=  $s3.
        bne $t2, $zero, L1       # if ($t2 != 0), s3 is still max, goto L1
        ori $s3, $t0, 0          # update max value
        ori $s4, $s2, 0          # update max index

L1:     addi $s2, $s2, 1         # i = i + 1
        bne $s2, $s1, Loop       # if (i != $s1), go back to loop

done:   li $v0, 10
        syscall
```