

New MIPS instructions

Instruction	Syntax	Example
sll/srl	sll dest, src0, immediate	sll \$s0, \$s1, 5
slt/sltu	slt dest, src0, src1	slt \$s0, \$s1, \$s2
slti/sltiu	slti dest, src0, immediate	slti \$s0, \$s1, 10
lb/lbu	lb dest, offset(base addr)	lb \$t0, 4(\$s0)
sb	sb src, offset(base addr)	sb \$t0, 4(\$s0)
j/jal	jal jumpAddr	jal funcName
jr	jr dest	jr \$ra

MIPS registers

Register Number	Register Name	Register Use
\$0	\$zero	The "zero-constant"
\$1	\$at	<i>Used by the assembler</i>
\$2-\$3	\$v0-\$v1	Return values
\$4-\$7	\$a0-\$a3	Function arguments
\$8-\$15	\$t0-\$t7	Temporary registers
\$16-\$23	\$s0-\$s7	Saved registers
\$24-\$25	\$t8-\$t9	Temporary registers
\$26-\$27	\$k0-\$k1	<i>Used by the kernel</i>
\$28	\$gp	Global pointer
\$29	\$sp	Stack pointer
\$30	\$fp	Frame pointer
\$31	\$ra	Return address

MIPS functions

If you plan on calling other functions or using saved registers, you'll need to use the following function template:

```

Prologue:      FunctionFoo:
                addiu $sp, $sp, -FrameSize #reserve space on the stack
                sw $ra, 0($sp) #store needed registers
                sw $s0, 4($sp)
                ... save the rest of the registers ...
                sw $sx, FrameSize - 4($sp)

Body:
                ... Do some stuff ...

Epilogue:      lw $sx, FrameSize -4($sp) #restore registers
                ... load the rest of the registers...
                lw $s0, 4($sp)
                lw $ra, 0($sp)
                addiu $sp, $sp, FrameSize #release stack spaces
                jr $ra #return to normal execution
    
```

Exercises:

What are the instructions to branch on each of the following conditions?

\$s0 < \$s1, \$s0 <= \$s1, \$s0 > 1, \$s0 >= 1

What are the 3 meanings unsigned can have in MIPS?

Translate the following MIPS function into C or vice versa:

C	MIPS
	<pre> Foo: add \$v0, \$zero, \$zero Loop: slti \$t0, \$a1, 1 bne \$t0, \$zero, End sll \$t1, \$a1, 2 add \$t2, \$a0, \$t1 lw \$t3, 0(\$t2) add \$v0, \$v0, \$t3 addi \$a1, \$a1, -1 j Loop End: jr \$ra </pre>
<pre> /* What does this program do? */ int Mystery(unsigned int a){ // fill in rest } int Recur(unsigned int a, int b){ // fill in rest } </pre>	<pre> Mystery: addi \$a1, \$0, \$0 addiu \$sp, \$sp, -4 sw \$ra, 0(\$sp) jal Recur lw \$ra, 0(\$sp) addiu \$sp, \$sp, 4 jr \$ra Recur: bne \$a0, \$0, Body add \$v0, \$0, \$0 jr \$ra Body: addi \$a1, \$a1, 1 srl \$a0, \$a0, 1 addiu \$sp, \$sp, -4 sw \$ra, 0(\$sp) jal Recur addi \$v0, \$v0, 1 lw \$ra, 0(\$sp) addiu \$sp, \$sp, 4 jr \$ra </pre>
<pre> void swap(int * a, int * b){ int temp= *a; //use the stack *a = *b; *b = temp; } </pre>	
<pre> void insertionSort(int * arr, int size){ int i, j; for(i=1; i<size; i++){ j=i; while(j>0 && arr[j]<arr[j-1]){ swap(arr + j, arr + (j-1)); j--; } } } </pre>	

