CS305: Computer Architecture

World of Instructions-IV (The MIPS language)

https://www.cse.iitb.ac.in/~biswa/courses/CS305/main.html

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Last Lecture: Un(Conditional) Jumps

Conditional: beq, bne

Unconditional: j, jal, jr

Functions (Procedures)

```c
int sum(int a, int b)
{
    int c=a+b;
    return c;
}
void main (void)
{
    int i=1;
    int j=2;
    int k = sum(i,j);
}
```

Simple ☺

```
int sum(int a, int b)
{
    int c=a+b;
    return c;
}
void main (void)
{
    int i=1;
    int j=2;
    int k = sum (i,j);        //jump to function
}
```

Simple ☺

```
int sum(int a, int b)
{
    int c=a+b;
    return c;
}
void main (void)
{
    int i=1;
    int j=2;
    int k = sum(i,j);
}
```

How do you return? ☹

j sum

Awesome Instructions

- jal: Jump and Link   and   jr $ra

jal L1:

go to L1, the instruction that has to be executed next is in L1.

and

save the address of the next instruction in $ra. ra is an awesome register that stores the return address.

Awesome Instructions

- jal: Jump and Link   and   jr $ra

Go to instruction whose address is stored in ra (PC+4)

jal L1:

go to L1, the instruction that has to be executed next is in L1.

and

save the address of the next instruction in $ra. ra is an awesome register that stores the return address (ra).

Let's see

int sum(int a, int b)

{

    int c=a+b;   sum: add $t0, $s0, $s1

    return c;   jr $ra

}

void main (void)

{

    int i=1;

    int j=2;

    int k = sum(i,j); jal sum // sum is a label.

   ……

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Let's Have a Complete Picture

PC+4   addi $R1, $R0, 2   // R0 = 0, R1=2

PC+8   jal sum   // R31 (ra) = PC+12

PC+12   add $R0, $R3, $R3

sum:

PC+100   addi $R2, $R1, 4

PC+104   jr

Let's Have a Complete Picture

PC+4   addi $R1, $R0, 2   // R0 = 0, R1=2

PC+8   jal sum   // R31 = PC+12 (ra)

PC+12   add $R0, $R3, $R3

sum:

PC+100   addi $R2, $R1, 4   // R2 =6

PC+104   jr $R31

Let's Have a Complete Picture

PC+4   addi $R1, $R0, 2   // R0 = R3 = 0, R1=2

PC+8   jal sum   // R31 = PC+12 (ra)

PC+12   add $R0, $R3, $R3   // R0 = 0

sum:

PC+100   addi $R2, $R1, 4   // R2 =6

PC+104   jr $R31

Let's Have a Complete Picture

PC+4   addi $R1, $R0, 2   // R0 = R3 = 0, R1=2

PC+8   jal sum   // R31 = PC+12 (ra)

PC+12   add $R0, $R2, $R2   // R0 = 12

sum:

PC+100   addi $R2, $R1, 4   // R2 = 6

PC+104   jr $R31

Shukriya