Chapter 04: Instruction Sets and the Processor organizations

Lesson 09:

Processor Instructions - Part 2

Objective

- Learn Instructions
- Subroutine Call and Return
- Logic Instructions
- Add, subtract, Test and Comparison

Subroutine call and return

Subroutine

- A subroutine is also called routine
- Called function in c or C++
- Called method in Java
- A set of instructions or sub-program
- For a specific purpose
- At last instruction in subroutine, there is RET instruction for return to the calling program

Examples of Subroutine call

1. Delay according to some parameter and the parameter passed as input to the routine
2. Cube of a parameter and the parameter passed as input to the routine
3. Sum of N- numbers in a table with the values of N and table start address passed as inputs to the routine

CALL

- Subroutine call **CALL—** Save the next instruction PC (IP) on to stack-top or on to a register called link register (LR) and set the PC equal to the value of its input operand for the called routine address

RET

- Return from the subroutine RET Retrieve the next instruction PC (IP) from stack-top or from the LR (link register) and set the PC equal to the next instruction address of the routine calling program

Example

- StepK: (instruction k);
  (instruction k + 1);
  (instruction k + 2);
- CALL SBR_X;
- StepL:
- .....
- SBR_X: (instruction l)....

Operation

- PC for StepL saves at stack-top or at LR
- PC gets the address of SBR_X after the CALL instruction

Subroutine SBR_X

```
SBR_X: (instruction l)
.
.
            RET
```

PC for gets the address of StepL from the stack-top or from the LR after the RET

Addition and Subtraction

Addition and Subtraction Instructions

- Simple arithmetic operations are addition and subtraction, which are provided in all processors
- They generally take one or two inputs, and generate one output
- In general, arithmetic operations read their input operands from and write their outputs to the register file

Add, FADD and ADC

- **Addition— Add** Add its second integer operand to its first
- **Floating Point Add— FAdd** Add its second floating point operand to its first
- **Addition with carry— ADC** Add previous carry and its second integer operand to its first

SUB, FSUB

- **Subtraction— SUB** Subtract its second integer operand from its first
- **Floating Point subtraction— FSUB** Subtract its second floating point operand from its first
- **Subtract with borrow— SUBB** Subtract previous borrow (in carry flag) and its second integer operand from its first

INC, DEC

- **Increment— INC** Increment the operand input by 1
- **Decrement— DEC** Decrement the operand input by 1

Logic, test and comparison Instructions

Complement, OR, AND and XOR

- **Logical NOT— CPL** Complement its operand
- **Logical OR— OR** OR its second operand to its first
- **Logical AND— AND** AND its second operand to its first
- **Logical XOR— XOR** XOR its second operand to its first

Test and Compare for Equality

- **Test— Test** Test its two operands whether they are equal by a hypothetical logical AND
- **Equality— EQ** Test its two integer operands whether they are equal by a hypothetical subtraction

Compare GT and NEQ

- **Greater— GT** Test its two integer operands or whether first is greater by a hypothetical subtraction
- **Not Equality — NEQ** Test its two integer operands whether they are not equal by a hypothetical subtraction

Compare LT and GEQ

- **Lesser— LT** Test its two integer operands or whether first is lesser by a hypothetical subtraction
- **Greater or Equality— GEQ** Test its two integer operands whether first is greater by a hypothetical subtraction or whether they are equal by a hypothetical subtraction

Compare LEQ

- **Lesser or Equality— LEQ** Test its two integer operands whether first is lesser by a hypothetical subtraction or whether they are equal by a hypothetical subtraction

Summary

We learnt

- Instructions for Subroutine Call and RET
- Logical AND, OR, XOR, NOT
- Add
- Subtract
- Test
- Comparison Instructions

End of Lesson 09 on

Processor Instructions - Part 2