AL MUSTAQBAL UNIVERSITY

كلية العـــــــلوم
قســـــم علوم الأنظمة الطبية الذكية

LECTURE: (5)

Subject: Clock rate ,

Level: First

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Clock rate

These are two possibilities for increasing the clock rate 'R'.

1. Improving the IC technology makes logical circuit faster, which reduces the time of execution of basic steps. This allows the clock period P, to be reduced and the clock rate R to be increased.

2. Reducing the amount of processing done in one basic step also makes it possible to reduce the clock period P. however if the actions that have to be performed by an instructions remain the same, the number of basic steps needed may increase.

Increase in the value 'R' that are entirely caused by improvements in IC technology affects all aspects of the processor's operation equally with the exception of the time it takes to access the main memory. In the presence of cache the percentage of accesses to the main memory is small. Hence much of the performance gain excepted from the use of faster technology can be realized.

Instruction set CISC & RISC:-

Simple instructions require a small number of basic steps to execute. Complex instructions involve a large number of steps. For a processor that has only simple instruction a large number of instructions may be needed to perform a given programming task. This could lead to a large value of 'N' and a small value of 'S' on the other hand if individual instructions perform more complex operations, a fewer instructions will be needed, leading to a lower value of N and a larger value of S. It is not obvious if one choice is better than the other

But complex instructions combined with pipelining (effective value of S ¿ 1) would achieve one best performance. However, it is much easier to implement efficient pipelining in processors with simple instruction sets.

RISC and CISC are computing systems developed for computers. Instruction set or instruction set architecture is the structure of the computer that provides commands to the computer to guide the computer for processing data manipulation. Instruction set consists of
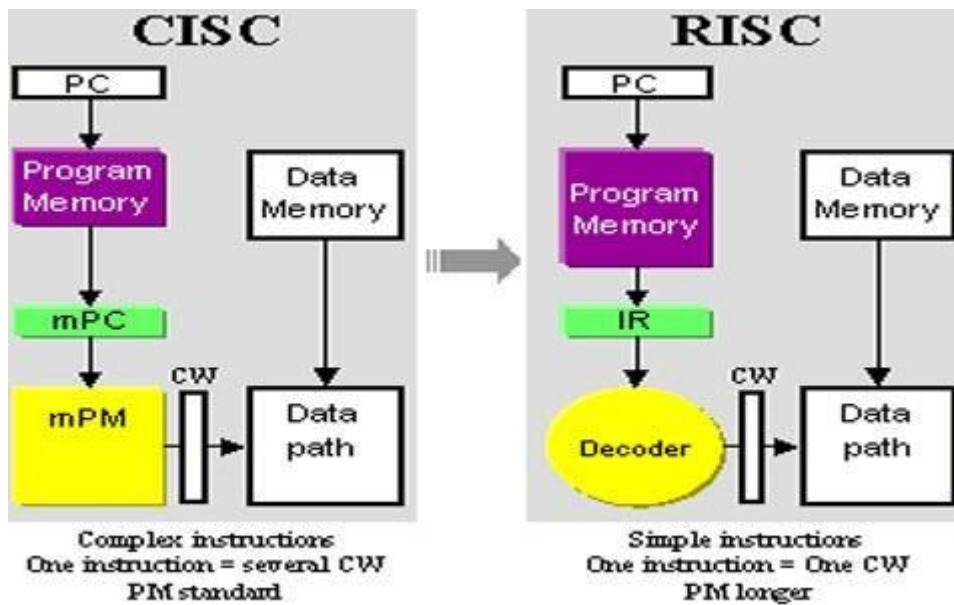
instructions, addressing modes, native data types, registers, interrupt, exception handling and memory architecture. Instruction set can be emulated in software by using an interpreter or built into hardware of the processor. Instruction Set Architecture can be considered as a boundary between the software and hardware. Classification of microcontrollers and microprocessors can be done based on the RISC and CISC instruction set architecture.

Comparison between RISC and CISC:

	RISC	CISC
Acronym	It stands for 'Reduced Instruction Set Computer'.	It stands for 'Complex Instruction Set Computer'.
Definition	The RISC processors have a smaller set of instructions with few addressing nodes.	The CISC processors have a larger set of instructions with many addressing nodes.
Memory unit	It has no memory unit and uses a separate hardware to implement instructions.	It has a memory unit to implement complex instructions.
Program	It has a hard-wired unit of programming.	It has a micro-programming unit.
Design	It is a complex complier design.	It is an easy complier design.
Calculations	The calculations are faster and precise.	The calculations are slow and precise.
Decoding	Decoding of instructions is simple.	Decoding of instructions is complex.
Time	Execution time is very less.	Execution time is very high.
External	It does not require external	It requires external memory

memory	memory for calculations.	for calculations.
Pipelining	Pipelining does function correctly.	Pipelining does not function correctly.
Stalling	Stalling is mostly reduced in processors.	The processors often stall.
Code expansion	Code expansion can be a problem.	Code expansion is not a problem.
Disc space	The space is saved.	The space is wasted.
Applications	Used in high end applications such as video processing, telecommunications and image processing.	Used in low end applications such as security systems, home automations, etc.

CISC	RISC
Emphasis on hardware	Emphasis on software
Multiple instruction sizes and formats	Instructions of same set with few formats
Less registers	Uses more registers
More addressing modes	Fewer addressing modes
Extensive use of microprogramming	Complexity in compiler
Instructions take a varying amount of cycle time	Instructions take one cycle time
Pipelining is difficult	Pipelining is easy

CISC

PC → Program Memory → mPC → mPM → CW → Data path

Data Memory → Data path

Complex instructions
One instruction = several CW
PM standard

RISC

PC → Program Memory → IR → Decoder → CW → Data path

Data Memory → Data path

Simple instructions
One instruction = One CW
PM longer

1.8 Performance measurements

The performance measure is the time taken by the computer to execute a given bench mark. Initially some attempts were made to create artificial programs that could be used as bench mark programs. But synthetic programs do not properly predict the performance obtained when real application programs are run.

A non-profit organization called SPEC- system performance Evaluation Corporation selects and publishes bench marks.

The program selected range from game playing, compiler, and data base applications to numerically intensive programs in astrophysics and quantum chemistry. In each case, the program is compiled under test, and the running time on a real computer is measured. The same program is also compiled and run on one computer selected as reference.

The 'SPEC' rating is computed as follows.
SPEC rating = Running time on the reference computer/ Running time on the computer under test

MULTIPROCESSORS AND MULTICOMPUTER

Multiprocessors and Multicomputers

- Multiprocessor computer
  - Execute a number of different application tasks in parallel
  - Execute subtasks of a single large task in parallel
  - All processors have access to all of the memory – shared-memory multiprocessor
  - Cost – processors, memory units, complex interconnection networks
- Multicomputers
  - Each computer only have access to its own memory
  - Exchange message via a communication network – message-passing multicomputers

multicomputer	multiprocessors
1. A computer made up of several computers.	1. A computer that has more than one CPU on its motherboard.
2. Distributed computing deals with hardware and software systems containing more than one processing element, multiple programs	2. Multiprocessing is the use of two or more central processing units (CPUs) within a single computer system.
3. It can run faster	3. Speed depends on the all processors speed
4. A multi-computer is multiple computers, each of which can have multiple processors.	4. Single Computer with multiple processors
5. Used for true parallel processing.	5. Used for true parallel processing.
6. Processor can not share the memory.	6. Processors can share the memory.
7. Called as message passing multi computers	7. Called as shared memory multi processors
8. Cost is more	8. Cost is low

Data Representation:

Registers are made up of flip-flops and flip-flops are two-state devices that can store only 1's and 0's.

Numbering Systems		
System	Base	Digits
Binary	2	0 1
Octal	8	0 1 2 3 4 5 6 7
Decimal	10	0 1 2 3 4 5 6 7 8 9
Hexadecimal	16	0 1 2 3 4 5 6 7 8 9 A B C D E F

There are many methods or techniques which can be used to convert numbers from one base to another. We'll demonstrate here the following –

- Decimal to Other Base System
- Other Base System to Decimal
- Other Base System to Non-Decimal
- Shortcut method – Binary to Octal
- Shortcut method – Octal to Binary
- Shortcut method – Binary to Hexadecimal
- Shortcut method – Hexadecimal to Binary

Decimal to Other Base System

Steps

- **Step 1** – Divide the decimal number to be converted by the value of the new base.
- **Step 2** – Get the remainder from Step 1 as the rightmost digit (least significant digit) of new base number.
- **Step 3** – Divide the quotient of the previous divide by the new base.
- **Step 4** – Record the remainder from Step 3 as the next digit (to the left) of the new base number.

Repeat Steps 3 and 4, getting remainders from right to left, until the quotient becomes zero in Step 3.

The last remainder thus obtained will be the Most Significant Digit (MSD) of the new base number.

Example –

Decimal Number: 29_{10}

Calculating Binary Equivalent –

Step	Operation	Result	Remainder
Step 1	29 / 2	14	1
Step 2	14 / 2	7	0
Step 3	7 / 2	3	1
Step 4	3 / 2	1	1
Step 5	1 / 2	0	1

As mentioned in Steps 2 and 4, the remainders have to be arranged in the reverse order so that the first remainder becomes the Least Significant Digit (LSD) and the last remainder becomes the Most Significant Digit (MSD).

Decimal Number – 29_{10} = Binary Number – 11101_2.

Other Base System to Decimal System

Steps

- **Step 1** – Determine the column (positional) value of each digit (this depends on the position of the digit and the base of the number system).
- **Step 2** – Multiply the obtained column values (in Step 1) by the digits in the corresponding columns.
- **Step 3** – Sum the products calculated in Step 2. The total is the equivalent value in decimal.

Step	Binary Number	Decimal Number
Step 1	11101_2	$((1 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0))_{10}$
Step 2	11101_2	$(16 + 8 + 4 + 0 + 1)_{10}$
Step 3	11101_2	29_{10}

Example

Binary Number – 11101_2

Calculating Decimal Equivalent –

Binary Number – 11101_2 = Decimal Number – 29_{10}

Other Base System to Non-Decimal System

Steps