

RISC vs CISC

Reduced Instruction Set Architecture (RISC) –

The main idea behind this is to make hardware simpler by using an instruction set composed of a few basic steps for loading, evaluating, and storing operations just like a load command will load data, a store command will store the data.

Complex Instruction Set Architecture (CISC) –

The main idea is that a single instruction will do all loading, evaluating, and storing operations just like a multiplication command will do stuff like loading data, evaluating, and storing it, hence it's complex.

Both approaches try to increase the CPU performance

- **RISC:** Reduce the cycles per instruction at the cost of the number of instructions per program.
- **CISC:** The CISC approach attempts to minimize the number of instructions per program but at the cost of an increase in the number of cycles per instruction.

$$CPU\ Time = \frac{Seconds}{Program} = \frac{Instructions}{Program} \times \frac{Cycles}{Instructions} \times \frac{Seconds}{Cycle}$$

Earlier when programming was done using assembly language, a need was felt to make instruction do more tasks because programming in assembly was tedious and error-prone due to which CISC architecture evolved but with the uprise of high-level language dependency on assembly reduced RISC architecture prevailed.

Characteristic of RISC –

1. Simpler instruction, hence simple instruction decoding.
2. Instruction comes undersize of one word.
3. Instruction takes a single clock cycle to get executed.
4. More general-purpose registers.
5. Simple Addressing Modes.
6. Fewer Data types.
7. A pipeline can be achieved.

Characteristic of CISC –

1. Complex instruction, hence complex instruction decoding.
2. Instructions are larger than one-word size.
3. Instruction may take more than a single clock cycle to get executed.
4. Less number of general-purpose registers as operations get performed in memory itself.
5. Complex Addressing Modes.

6. More Data types.

Example – Suppose we have to add two 8-bit numbers:

- **CISC approach:** There will be a single command or instruction for this like ADD which will perform the task.
- **RISC approach:** Here programmer will write the first load command to load data in registers then it will use a suitable operator and then it will store the result in the desired location.

So, add operation is divided into parts i.e. load, operate, store due to which RISC programs are longer and require more memory to get stored but require fewer transistors due to less complex command.

Difference –

RISC	CISC
Focus on software	Focus on hardware
Uses only Hardwired control unit	Uses both hardwired and microprogrammed control unit
Transistors are used for more registers	Transistors are used for storing complex Instructions
Fixed sized instructions	Variable sized instructions
Can perform only Register to Register Arithmetic operations	Can perform REG to REG or REG to MEM or MEM to MEM
Requires more number of registers	Requires less number of registers
Code size is large	Code size is small
An instruction executed in a single clock cycle	Instruction takes more than one clock cycle
An instruction fit in one word.	Instructions are larger than the size of one word
Simple and limited addressing modes.	Complex and more addressing modes.

RISC	CISC
RISC is Reduced Instruction Cycle.	CISC is Complex Instruction Cycle.
The number of instructions are less as compared to CISC.	The number of instructions are more as compared to RISC.
It consumes the low power.	It consumes more/high power.
RISC is highly pipelined.	CISC is less pipelined.
RISC required more RAM.	CISC required less RAM.
Here, Addressing modes are less.	Here, Addressing modes are more.

Advantages of RISC:

Simpler instructions: RISC processors use a smaller set of simple instructions, which makes them easier to decode and execute quickly. This results in faster processing times.

Faster execution: Because RISC processors have a simpler instruction set, they can execute instructions faster than CISC processors.

Lower power consumption: RISC processors consume less power than CISC processors, making them ideal for portable devices.

Disadvantages of RISC:

More instructions required: RISC processors require more instructions to perform complex tasks than CISC processors.

Increased memory usage: RISC processors require more memory to store the additional instructions needed to perform complex tasks.

Higher cost: Developing and manufacturing RISC processors can be more expensive than CISC processors.

Advantages of CISC:

Reduced code size: CISC processors use complex instructions that can perform multiple operations, reducing the amount of code needed to perform a task.

More memory efficient: Because CISC instructions are more complex, they require fewer instructions to perform complex tasks, which can result in more memory-efficient code.

Widely used: CISC processors have been in use for a longer time than RISC processors, so they have a larger user base and more available software.

Disadvantages of CISC:

Slower execution: CISC processors take longer to execute instructions because they have more complex instructions and need more time to decode them.

More complex design: CISC processors have more complex instruction sets, which makes them more difficult to design and manufacture.

Higher power consumption: CISC processors consume more power than RISC processors because of their more complex instruction sets.