merged_topic_0: cycle, fetch, instruction, execute, execution / fetched, instruction, register, memory, counter

- IR instruction register contains the bit opcode instruction to be executed
- Each instruction is made up of shorter subcycles as fetch indirect execute cycle and interrupt
- Fetch and execute cycle of MOV A B in terms of RTL specification Within the fetch cycle the operations performed during execution of instruction MOV A B are i) The program counter contains the address of the next instruction to be executed
- In the first operation of fetch cycle the contents of program counter will be transferred to the memory address register (MAR)
- t IR PC After the fetch cycle completed the execution starts
- The execute cycle steps i) At the start of execution cycle the instruction register (IR) consists of instruction code for instruction MOV A B
- t A t MAR Note MAR A Program consists of instructions which contains different cycles like fetch and execute
- ++++
- Instruction Register (IR) When the instruction is fetched from the memory it is loaded in the instruction register
- Program Control (PC) Contains the address of next byte to be fetched from the memory
- The contents of the program counter are copied to the memory address register before an instruction is fetched from memory
- When the instruction is fetched the control unit updates the program counter to point to the next instruction which is to be fetched
- Both the instruction and data can be fetched from memory concurrently

merged_topic_1: address, field, memory, location, mov / fetched, instruction, register, memory, counter

- The memory address tells the control where to find an operand in memory
- PC program counter contains the address of the next instruction to be fetched from memory
- The PC used to address program memory and always contains the address of next instruction to be executed
- If the next instruction to be executed is MOV A B the program counter contains the address of the memory location where the instruction code for MOV A B resides
- The memory address register then uses the address bus to transmit its contents that specifies

the address of memory location from where that instruction code of MOV A B is to be fetched
- The address field of instructions specifies the addresses of the two memory locations A B
- For this the address field of IR indicating the address of memory location will be transferred to address bus through the MAR
- For this the address field of IR indicating the address of memory location A
- ++++
- Instruction Register (IR) When the instruction is fetched from the memory it is loaded in the instruction register
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merged_topic_2: cpu, microprocessor, chip, single, diagram / chip, cpu, microprocessor, single, binary

- Microprocessor Single chip containing all units of CPU
- Microcomputer Computer having microprocessor as CPU
- Microcontroller single chip consisting of MPU memory IO and interfacing circuits
- MPU Microprocessing unit complete processing unit with the necessary control signals
- Basic Block Diagram of a Computer Traditionally the computer is represented with four components such as memory input output and central processing unit (CPU) which consists of arithmetic logic unit (ALU) and control unit (CU)
- Fig (a) Traditional Block diagram of a computer The CPU contains various registers to store data the ALU to perform arithmetic and logical operations instruction decoders counters and control lines
- Later on around late s traditional block diagram can be replaced with computer having microprocessor as CPU which is known as microcomputer
- Here CPU was designed using integrated circuit technology (ICs) which provided the possibility to build the CPU on a single chip
- Fig (b) Block Diagram of a computer with the Microprocessor as CPU Later on semiconductor fabrication technology became more advanced manufacturers were able to place not only MPU

but also memory and IO interfacing circuits on a single chip known as microcontroller which also includes additional devices such as AD converter serial IO timer etc

- Fig (c) Block Diagram of a Microcontroller Organization of a microprocessor based system Microprocessor based system includes there components microprocessor inputoutput and memory (read only and readwrite)

- Fig Microprocessor Based System with Bus Architecture Microprocessor It is clock driven semiconductor device consisting of electronic logic circuits manufactured by using either a large scale integration (LSI) or very large scale integration (VLSI) technique

- Evolution of Microprocessors (Intel series) The CPU of a computer consists of ALU CU and memory

- If all these components can be organized on a single chip by means of SSI MSI LSI VLSI ULSI ELSI technology then such chip is called microprocessor

- The evolution of microprocessor is dependent on the development of integrated circuit technology from single scale integration (SSI) to giga scale integration (GSI)

- ++++

- Acts as an interface between the CPU and memory

- Hence it requires separate block of RAM chip

- Microprocessor A P is a programmable clock driven electronic device designed with registers flip flops timing elements that reads binary instruction from a storage device called memory accept binary data as input and process data according to those instruction and provide the results as output

- The CPU of computer consists of an ALU CU and memory

- If all these components can be organized on a single silicon chip by means of LSI VLSI technology then such structure is called P

- So the microprocessor is CPU in a single chip

merged_topic_3: architecture, concept, vonneumann, program, storing / memory, address, data, bus, carries

- Stored Program Concept and VonNeumann Machine The simplest way to organize a computer is to have one processor register and instruction code format with two parts opcode and addressoperand

- It is called stored program concept

- It could be facilitated if the program could be represented in a form suitable for storing in

memory alongside the data
- This approach is known as stored program concept was first adopted by John Von Neumann and such architecture is named as Fig Von Neumann Architecture The main memory is used to stare both data and instructions
- The VonNeumann architecture is the fundamental basis for the architecture of modern digital computers
- Harvard Architecture In vonNeumann architecture the same memory is used for storing instructions and data
- The hardvard architecture based computer consists of separate memory spaces for the programs (instructions) and data
- ++++
- Uses a single memory to hold both the instruction and data
- The memory of the Neumanns machine consists of storage location called words each capable of storing bits
- The storage location of the control unit and ALU are called register
- Memory Address Register (MAR) located in the CPU connected to the address lines
- Specifies the address in memory
- Memory Buffer Register (MBR) Located in the CPU connected to the data lines
- Harvard Architecture Consists of separate memory for program and data
- Each memory has its own address and data buses
- Consists of separate data and address buses for program and data memory
- The data memory address bus carries the memory address of data whereas program memory address bus carries the memory address of the instruction
- Similarly program memory data bus carries the instruction and data memory data bus carries the data required to perform the operations

merged_topic_4: bit, pentium, word, microprocessor, bits / chip, cpu, microprocessor, single, binary

- Introduction Introduction A Microprocessor is a multipurpose programmable clock driven register based electronic device that reads binary instructions from a storage device called memory accepts binary data as input processes data according to those instructions and provide result s as output
- The microprocessor operates in binary and known as bits are represented in terms of

electrical voltages in the machine that means represents low voltage level and represents high voltage level

- Each microprocessor recognizes and processes a group of bits called the word and microprocessors are classified according to their word length such as bits microprocessor with bit word and bit microprocessor with bit word etc

- Microprocessor Data bus Address Bus Memory bit bit Bytes bit bit bit b it bit bit bit bit bit bit bit bit bit Pentium bit bit Pentium pro bit bit Pentium II bit bit Celeron bit bit Pentium III bit bit Pentium IV bit bit Itanium bit bit Itanium bit bit Pentium MCentrino (wireless capability) for Mobile version eg

- ++++

- Acts as an interface between the CPU and memory

- Hence it requires separate block of RAM chip

- Microprocessor A P is a programmable clock driven electronic device designed with registers flip flops timing elements that reads binary instruction from a storage device called memory accept binary data as input and process data according to those instruction and provide the results as output

- The CPU of computer consists of an ALU CU and memory

- If all these components can be organized on a single silicon chip by means of LSI VLSI technology then such structure is called P

- So the microprocessor is CPU in a single chip

merged_topic_5: control, readwrite, registers, register, letters / fetched, instruction, register, memory, counter

- Register Array The registers are primarily used to store data temporarily during the execution of a program and are accessible to the user through instruction

- The registers can be identified by letters such as B C D E H and L C Control Unit It provides the necessary timing and control signals to all the operations in the microcomputer

- Control lines include memory readwrite io readwrite bus requestgrant clock reset interrupt requestacknowledge etc

- Control address register contains the address of the next microinstruction to be read As it is read it is transferred to control buffer register

- ++++

- Instruction Register (IR) When the instruction is fetched from the memory it is loaded in the

instruction register
- Program Control (PC) Contains the address of next byte to be fetched from the memory
- The contents of the program counter are copied to the memory address register before an instruction is fetched from memory
- When the instruction is fetched the control unit updates the program counter to point to the next instruction which is to be fetched
- Both the instruction and data can be fetched from memory concurrently

merged_topic_6: memory, read, instructions, information, altered / set, instruction, stored, computer, program

- Memory Memory stores binary information such as instructions and data and provides that information to the up whenever necessary
- Memory has two sections
- Read only Memory (ROM) Used to store programs that do not need alterations and can only read
- The information stored in this memory can be easily read and altered
- Ability to execute the standard programs stored in read only memory
- Instructions are stored in one section of same memory
- So the computer could get its instructions by reading from the memory and program could be set or altered by setting the values of a portion of memory
- So instructions and data can be fetched from memory concurrently and provides significance processing speed improvement
- Hence there are two blocks of RAM chips one for program memory and another for data memory addresses
- ++++
- Programs are stored in ROM data stored in Features Interface easily with keyboards and displays
- Computer could get instruction by reading them from memory and a program could be set or altered by setting the values of a portion of memory
- Such machines are also known as stored program computer
- The main purpose is to sequence the execution of the program
- It has a set of instructions designed to manipulate data and communicate
- It can be programmed to perform specific task by selecting necessary instruction from its set

- It reads one instruction at a time matches it with instruction set and performs the data manipulation as indicated by the instruction

file1_topic_7: control, unit, signals, memory, devices

- The CPU reads instructions from memory and performs the tasks specified
- It is capable of performing various computing functions and making decisions to change the sequence of program execution
- It controls the flow of data between the microprocessor and memory peripherals
- Results are either transferred to the output section for display or stored in memory for later use
- Command signals specify operations to be performed
- Flexibility so it can be used in engineering business or programming without a complete new design
- The program control unit interprets the instruction in memory and causes them to be executed
- The IO unit gets operated from the control unit
- It can fetch instructions from memory decode and execute them perform logical and arithmetic functions accept data from input devices and send results to the output devices
- It gets instruction from memory
- The control unit decides what the instructions mean and directs the necessary data to be moved from memory to ALU
- It must communicate with both ALU and main memory
- It coordinates all activities of processor unit peripheral devices and storage devices
- Two types of control unit can be implemented in computing systems
- Its ip logic signals are transformed into set of op logic signals which are control signals
- The CU performs different operations in the basis of opcodes
- We have to derive the Boolean expression for each control signal as a function of input
- In microprogrammed control unit the control information is stored in control memory
- The control memory is programmed to initiate required sequence of operations
- It also transfers result of the operation to the same or another register
- It can also be used to facilitate the design process of digital systems such as microprocessors

file1_topic_8: world, outside, devices, communicates, inputoutput

- It communicates with inputoutput (IO) devices either to accept or to send data the IO devices

is known as peripherals

- InputOutput It communicates with the outside world using two devices input and output which are also Known as peripherals
- The input device such as keyboard switches and analog to digital converter transfer binary information from outside world to the microprocessor
- The output devices transfer data from the microprocessor to the outside world

file1_topic_9: arithmetic, operations, logic, calculations, automated

- A ArithmeticLogic unit It performs arithmetic operations as addition and subtraction and logic operations as AND OR XOR
- The mill could accept operands from the store add subtract multiply or divide them and return a result to the store
- Automated calculator It is a data processing device that carries out logic and arithmetic operations but has limited programming capability for the user
- It accepts data from a small keyboard one digit at a time performs required arithmetic and logical calculations and stores the result on visual display like LCD or LED
- The calculators programs are stored in ROMs while the data is stored in RAM
- Some important features of automated calculations The ability to interface easily with keyboards and displays
- Extendibility so that mathematical functions such as trigonometric statistical etc
- The arithmetic and logic unit is capable of performing arithmetic and logical operation on binary data
- Since modern processor needs a Boolean equation it is very difficult to build a combinational circuit that satisfies all these operations

file1_topic_10: systems, automatic, analyzers, acquisition, smart

- They include the devices such as LED CRT digital to analog converter printer etc
- Embedded system Used in microcontrollers
- Measurements and testing equipment used in signal generators oscilloscopes counters digital voltmeters xray analyzer blood group analyzers baby incubator frequency synthesizers data acquisition systems spectrum analyzers etc
- Scientific and Engineering research
- Industry used in data monitoring system automatic weighting batching systems etc
- Security systems smart cameras CCTV smart doors etc

- Automatic system Communication system Some Examples are Calculators Accounting system Games machine Complex Industrial Controllers Traffic light Control Data acquisition systems Military applications

file1_topic_11: computer, mechanical, eniac, development, computers

- Historical Background of the Development of Computers The most efficient and versatile electronic machine computer is basically a development of a calculator which leads to the development of the computer
- The older computer were mechanical and newer are digital
- The mechanical computer namely difference engine and analytical engine developed by Charles Babbage the father of the computer can be considered as the forerunners of modern digital computers
- The difference engine was a mechanical device that could add and subtract and could only run a single algorithm
- Its output system was incompatible to write on punched cards and early optical disks
- The evolution of the vacuum tubes led the development of computer into a new era
- The worlds first general purpose electronic digital computer was ENIAC (Electronic Numerical Integrator and Calculator) built by using vacuum tubes was enormous in size and consumed very high power
- However it was faster than mechanical computers
- The ENIAC was decimal machine and performed only decimal numbers
- Each digit was represented by a ring of vacuum tubes
- ENIAC had to be programmed manually by setting switches and plugging and unplug a cable which was the main drawback of it
- The task of entering and altering the programs for ENIAC was tedious
- It also had limited the processing speed for computers

file1_topic_12: consisted, digits, decimal, handle, words

- It consisted mainly four components the store (memory) the mill (computation unit) input section (punched card reader) and output section (punched and printed output)
- The store consisted of s of words of decimal digits used to hold variables and results
- Its memory consisted of accumulators each capable of holding digits decimal numbers
- The ability to handle decimal digits the device is able to handle more than bits at a time
- It consisted of storage locations which can hold words of binary digits and both instructions

as well as data are stored in it

file1_topic_13: cycle, operations, micro, sequences, characterized

- can be easily executed
- Performance of each cycle has a number of shorter operations called microoperations
- Called so because each step is very simple and does very little
- Thus microoperations are functional atomic operation of CPU
- Hence events of any instruction cycle can be described as a sequence of micro operations
- Microinstructions Each instruction is characterized with many machine cycles and each cycle is characterized with many Tstates
- The lower instruction level patterns which are the numerous sequences for a single instruction are known as microinstructions
- Suppose we can visualize the microinstruction with the help of fetch cycle or read cycle or write cycle
- Use sequences of instructions to perform control operations performed by micro operations
- These cycles in turn are made up of the smaller operation called micro operations

file1_topic_14: hardwired, low, unit, cheaper, cost

- Low cost small size and low power consumptions
- Hardwired Control Unit This CU is essentially a combinatorial circuit
- It has faster mode of operation
- A hardwired control unit needs rewiring if design has to be modified
- Microprogrammed Control Unit An alternative to hardwired CU
- It is cheaper and simple than hardwired CU
- It is slower than hardwired CU

file1_topic_15: immediate, language, mar, address, rtl

- Introduction to Register Transfer Language (RTL) The symbolic notation used to describe the micro operation transfers among register is called register transfer language
- It is one of the forms of hardware description language (HDL)
- The term language is borrowed from programmers who apply this term to programming language
- RTL is the convenient tool for describing the internal organization of digital computers in concise and precise manner

- Some RTL Examples) MVI A H Fetch T MAR T MBR MAR T IR MBR Execute TMBR IR address of immediate data T MAR IR address of A T A) LXI B H Execute TMBR IR address of immediate data T MAR IR address of C T MBR IR address of immediate data (MSB) T MAR IR address of (B)) LDA H Execute TMAR IR address of immediate data T MBR IR address of C T MAR IR address of A T A) STA H Execute TMAR IR address of immediate A T MBR T MAR IR address of immediate data T MAR Advantages of Microprocessor ComputationalProcessing speed is high Intelligence has been brought to systems Automation of industrial process and office automation Flexible Compact in size Maintenance is easier Applications of Microprocessors Microcomputer Microprocessor is the CPU of the microcomputer

file1_topic_16: time, let, operation, taken, suppose

- Suppose t is the time period for this operation
- Let t be the time required by the CPU to complete these operations
- Let t be the time taken for that operation
- A will be transferred to MAR in time t