VIRTUAL MEMORY

Subject: Computer Organization & architecture

Saviya Varghese
Dept of BCA

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VIRTUAL M/Y MAPPING

- The memory-page table consists of eight words, one for each page.
- The address in the page table denotes the page number and the content of the word gives the block number where that page is stored in main memory.
- The table shows that pages 1, 2, 5 and 6 are now available in main memory in blocks 3, 0, 1, and 2, respectively.

VIRTUAL M/Y MAPPING

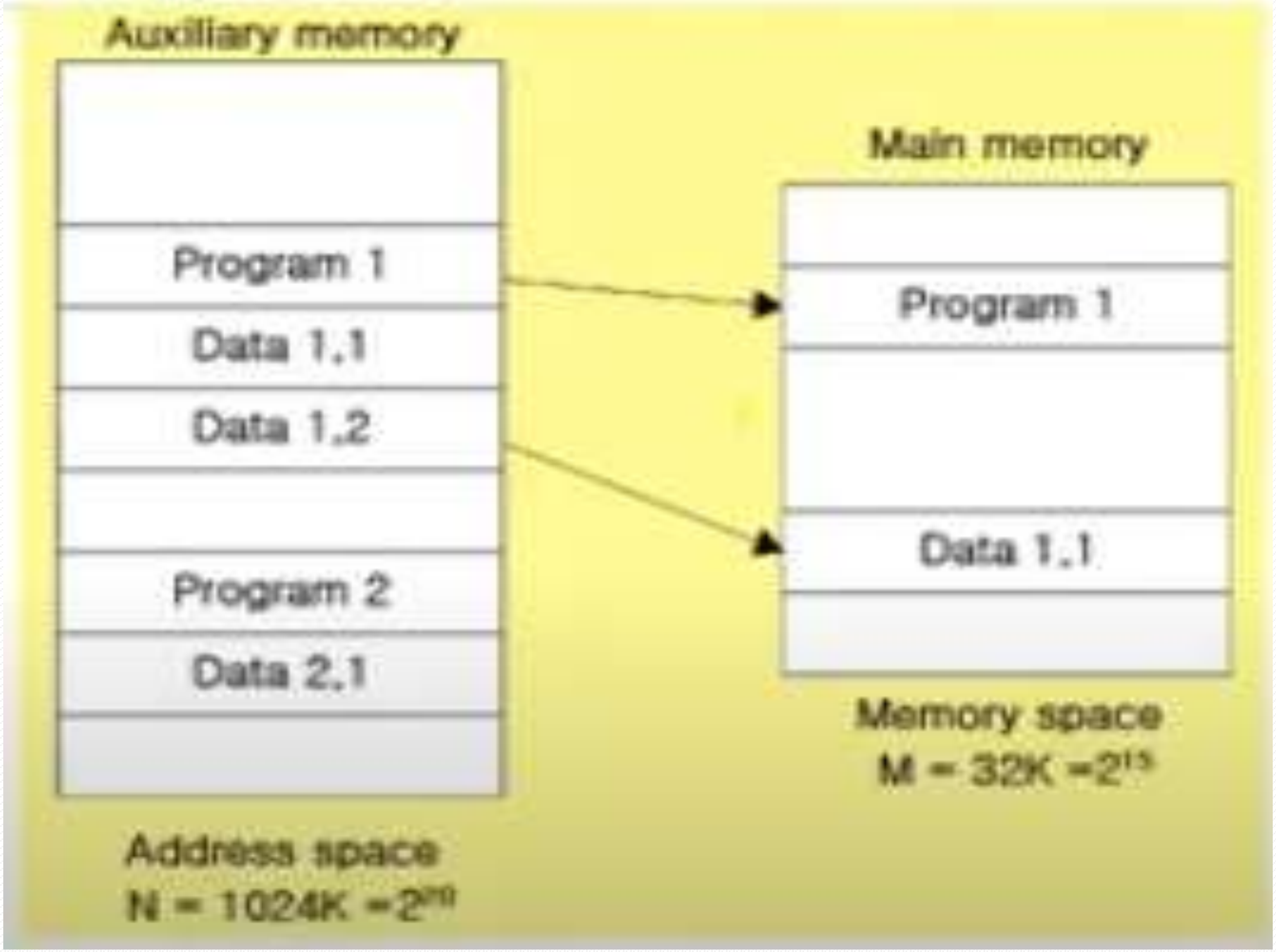
- A presence bit in each location indicates whether the page has been transferred from auxiliary memory into main memory.
- A 0 in the presence bit indicates that this page is not available in main memory.
- The CPU references a word in memory with a virtual address of 13 bits.
- The three high-order bits of the virtual address specify a page number and also an address for the memory-page table.

- The content of the word in the memory page table at the page number address is read out into the memory table buffer register.
- If the presence bit is a 1, the block number thus read is transferred to the two high-order bits of the main memory address register.
- The line number from the virtual address is transferred into the 10 loworder bits of the memory address register.

- A read signal to main memory transfers the content of the word to the main memory buffer register ready to be used by the CPU.
- If the presence bit in the word read from the page table is 0, it signifies that the content of the word referenced by the virtual address does not reside in main memory.
- A call to the operating system is then generated to fetch the required page from auxiliary memory and place it into main memory before resuming computation.

FIGURE-

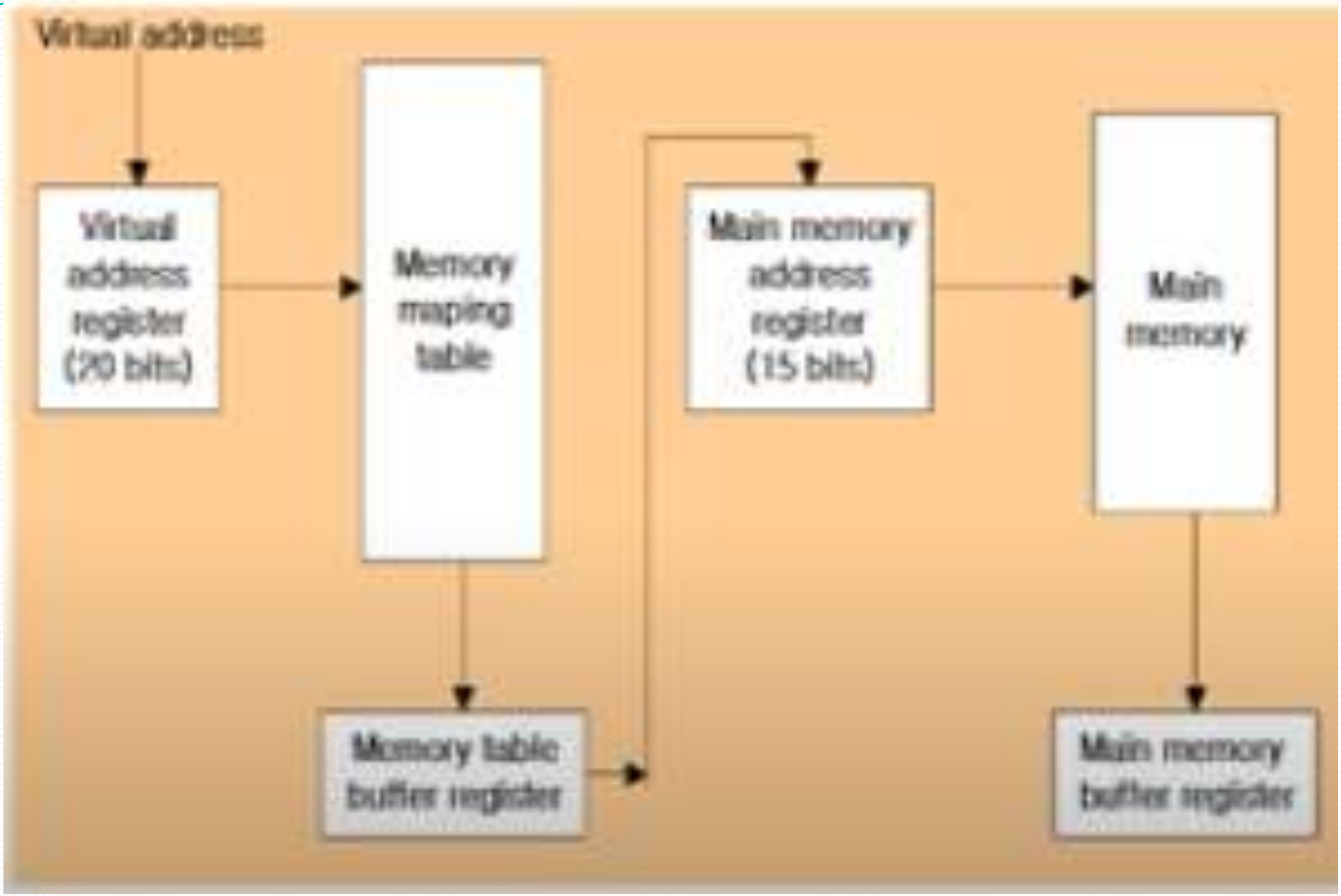
Address space and memory space split into groups of 1K words.



Auxiliary memory
Program 1
Data 1,1
Data 1,2
Program 2
Data 2,1
Address space
N = 1024K = 2^20
Main memory
Program 1
Data 1,1
Memory space
M = 32K = 2^15

FIGURE-

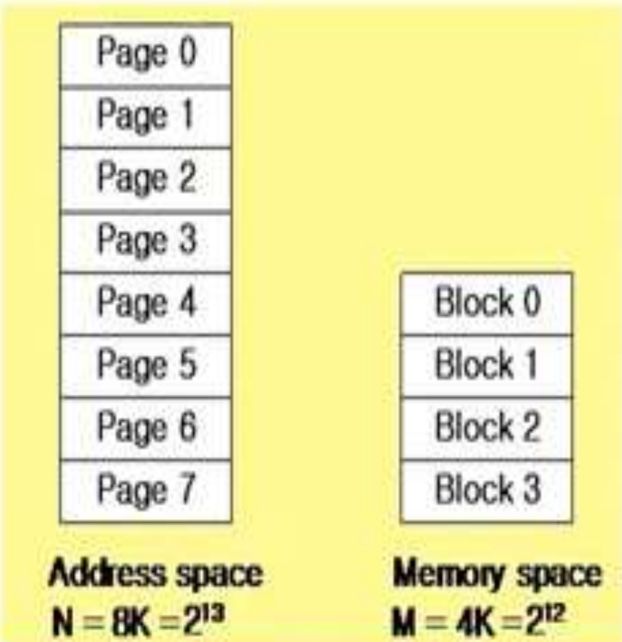
Memory table for mapping a virtual address.


Virtual address
Virtual address register (20 bits)
Memory maping table
Memory table buffer register
Main memory address register (15 bits)
Main memory
Main memory buffer register

Address Mapping Using Pages

Block(Page Frame): Physical memory is divided in to groups of equal size range from 64 to 4096 words each

Page: groups of address space of equal size



- Virtual address:-Page number and line number
- 2^p words per page :p bits- specify line address remaining bits – page number [1k=2^{10}.→ 10 bit line number, 10-13=3 bit page number]
- Line number in address space and memory space are same
- Mapping needed from page number to block number

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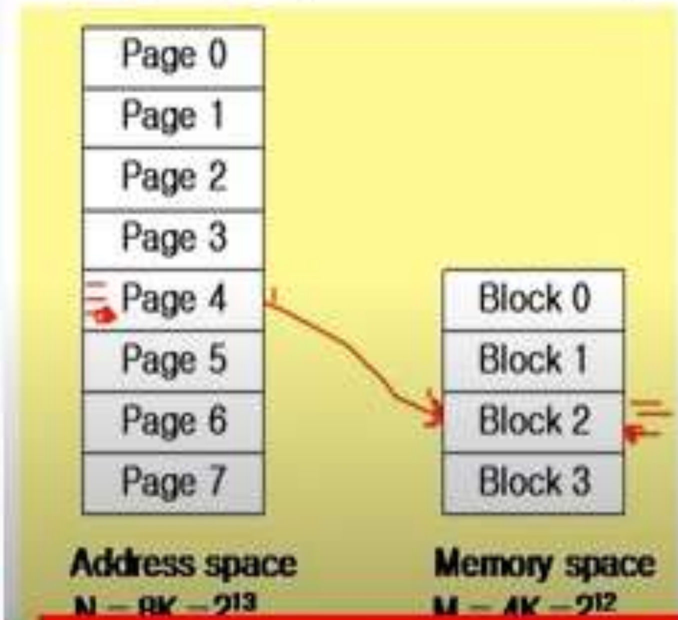

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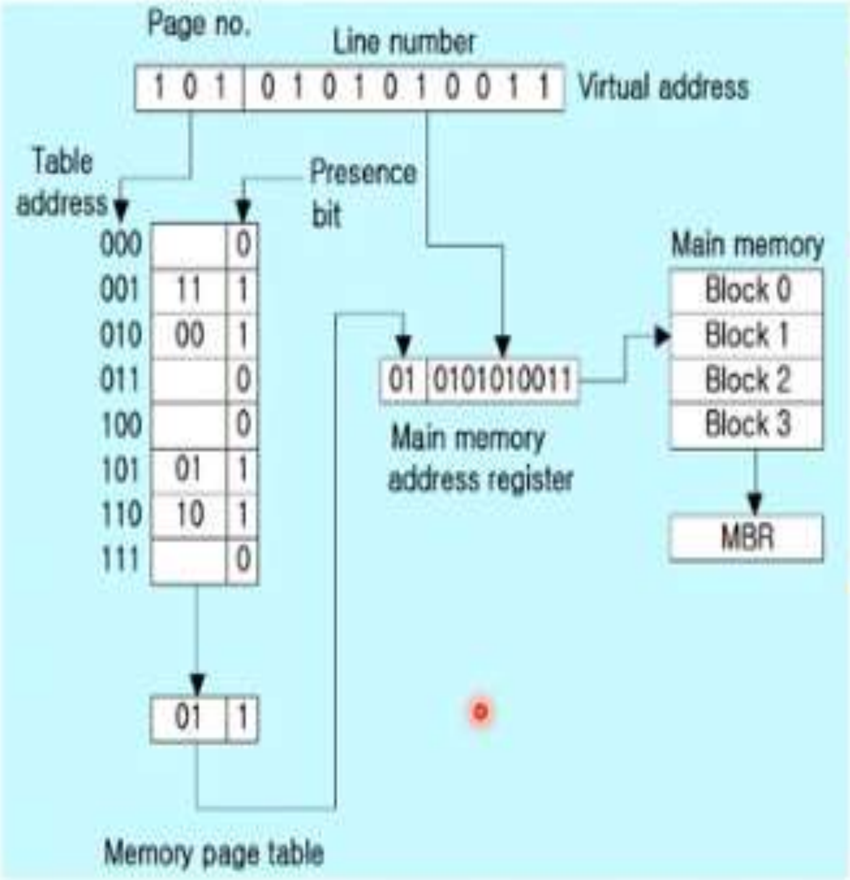
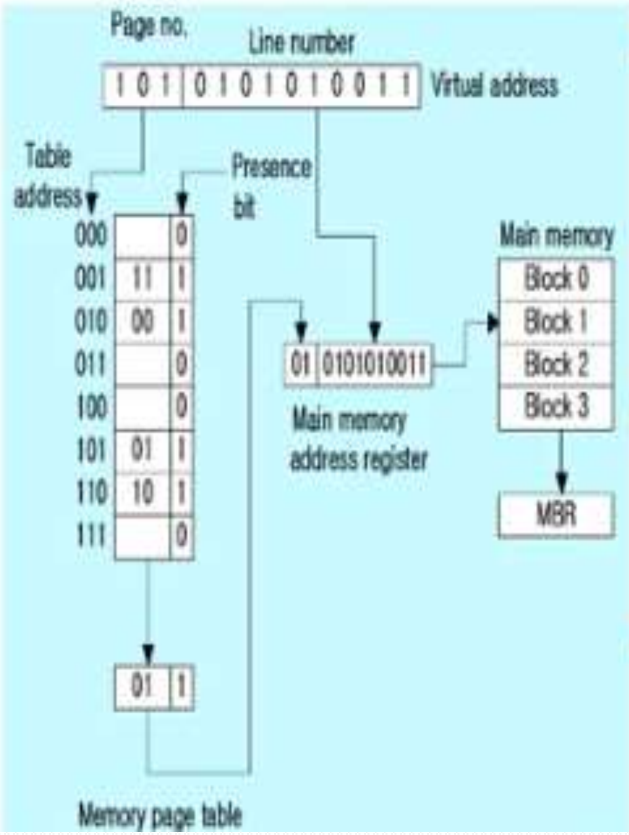
Organization Of The Memory Mapping Table



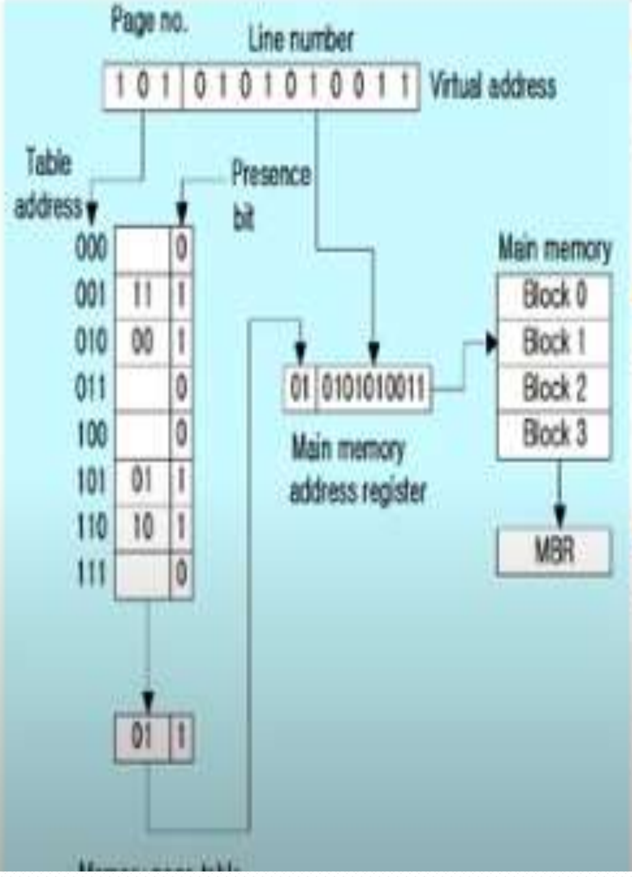
- The memory-page table consists of eight words, one for each page.
- The address in the page table denotes the page number and the content of the word gives the block number where that page is stored in main memory.
- **A presence bit** in each location indicates whether the page has been transferred from auxiliary memory into main memory

Organization Of The Memory Mapping Table Working



- The CPU references a word in memory with a virtual address of 13 bits.
- The 3 high-order bits specify a page number and also an address for the memory-page table.
- The content of the word (Block Number)in the memory page table is read out into the memory table buffer register.
- If the presence bit is a 1, the block number thus read is transferred to the two high-order bits of the main memory address register.

Organization Of The Memory Mapping Table Working



- A read signal to main memory transfers the content of the word to the main memory buffer register ready to be used by the CPU.
- If the presence bit in the word read from the page table is 0, it means page is not transferred to main memory.
- A call to the operating system is then generated to fetch the required page from auxiliary memory and place it into main memory before resuming computation.