Chapter 10: Virtual Memory

Lesson 04:

Associative Memory [Content Addressable Memory (CAM)] and Page Replacement policy

Objective

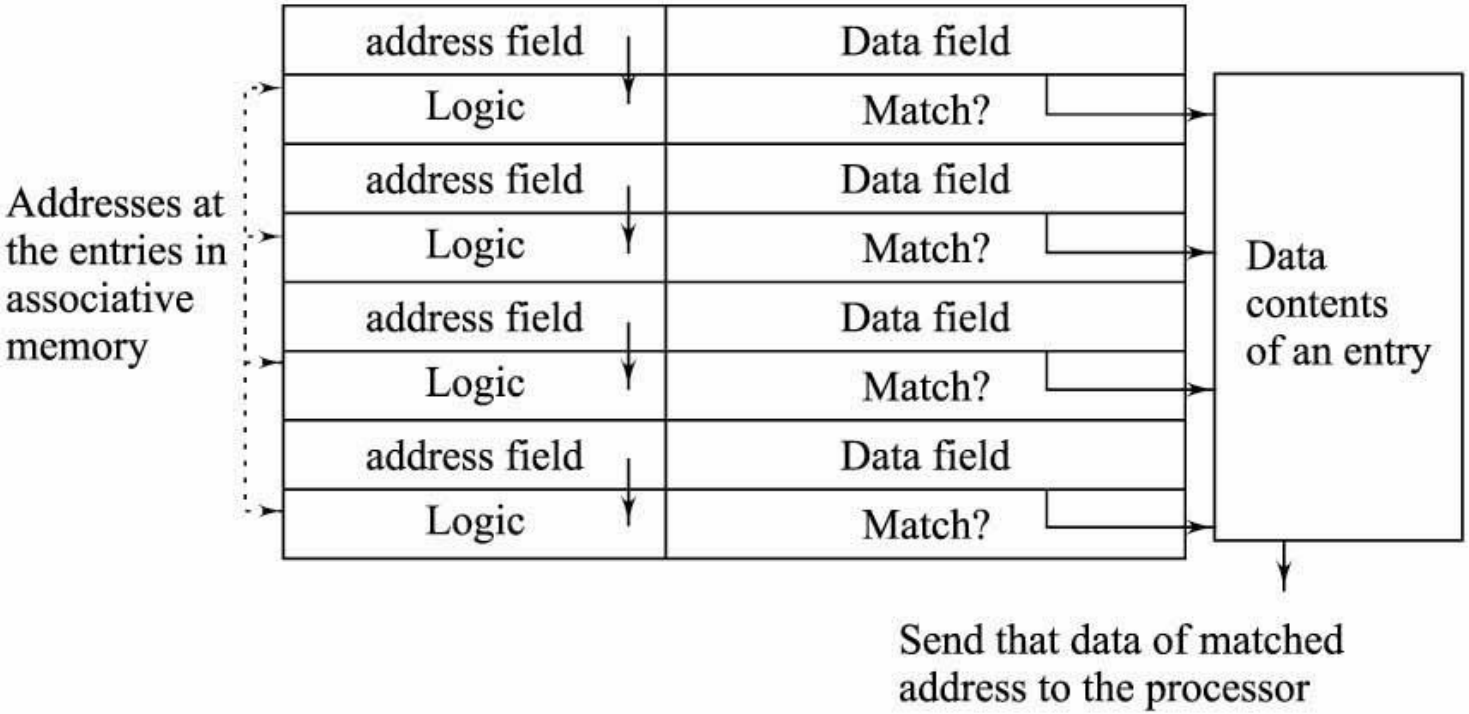
- Understand **Content Addressable Memory** (CAM)
- Associative memory has both address and data fields
- Learn CAM features of allowing any address to be stored in any entry location in the memory
- Page replacement policies LRU or FIFO

Fully associative memory

Content Addressable Memory (CAM)

- Fully associative memory
- Associative memory has both address and data fields
- Each new address storage can be in any not necessarily the next

Fully associative memory



Associative memory write

- Allows any address to be stored in any entry location in the memory
- Write address-field and data field for each entry
- Identical to organisation used in a telephone directory
- For each entry, there is a pair of the name and the number fields

Associative memory read

- When a page address search is made in an operation, the address bits are sent to the memory, the address of the request must be compared (matched) to each entry in the address field to determine whether the data referenced by the operation is contained in the memory

CAM

- Similar organization of memory ideally suited for translation lookaside buffer

Page replacement policy

Least-Recently used (LRU)

- Memory ranks each of the lines in a set according to how recently they have been accessed
- The least-recently used line from a set evicts when an eviction is necessary
- Lines that have not been referenced in the recent past are unlikely to be referenced in the near future

LRU algorithm

- Associate a counter n_{used} for number of times a page is used
- When a page is translated into memory, the n_{used} in page table entry is reset to 0
- Set n_{used} to 1 on first time access to the entry
- Increment

LRU algorithm

- Increment n_{used} on each access to the new entry, which is different from the previously accessed entry
- When replacement is required to translate a new page, the page with entry containing least value of n_{used} is replaced

Replacement policy FIFO (first in first out)

- Replace the page which has been longest in memory
- When a page is translated to memory, a number (VPN) is pushed into FIFO
- FIFO is used to replace the physical page with the new page

FIFO algorithm

(i) When a page is translated into memory, the VPN in page table entry is placed in the FIFO

(ii) When replacement is required to translate a new page, the VPN from front of FIFO deleted

(iii) The page corresponding to that VPN is replaced

Summary

We learnt

- Associative memory has both address and data fields
- Each new address storage can be in any not necessarily the next
- Allows any address to be stored in any entry location in the memory
- LRU replacement policy
- FIFO replacement policy

End of Lesson 04 on

Associative Memory and Page Replacement policy