

Paging and Segmented Architectures

- I • Memory references are dynamically translated into physical addresses at run time
 - A process may be swapped in and out of main memory such that it occupies different regions
- II • A process may be broken up into pieces that do not need to be located contiguously in main memory
 - All pieces of a process do not need to be loaded in main memory during execution

Pages/
Segments

Execution of a Program

- Operating system brings into main memory a few pieces of the program
 - *Resident set* - portion of process that is in main memory
- An interrupt is generated when an address is needed that is not in main memory
 - Operating system places the process in a blocking state

mem. fault/
page fault

Execution of a Program

- Piece of process that contains the logical address is brought into main memory
 - Operating system issues a disk I/O Read request
 - Another process is dispatched to run while the disk I/O takes place
 - An interrupt is issued when disk I/O complete which causes the operating system to place the affected process in the Ready state

Advantages

1 • More processes may be maintained in main memory

- Only load in some of the pieces of each process
- With so many processes in main memory, it is very likely a process will be in the Ready state at any particular time

✓ 2 • A process may be larger than all of main memory

→ A programmer is now
impression of large storage
R.P.Gohil 26

more eff^t
utilⁿ of the
processor.

→ O/S & H/W is responsible
for eff. utilⁿ of m.mem.

Types of Memory

- ***Real memory***
 - Main memory
- ***Virtual memory***
 - Memory on disk
 - Allows for effective multiprogramming and relieves the user of tight constraints of main memory

Thrashing

- Swapping out a piece of a process just before that piece is needed
- The processor spends most of its time swapping pieces rather than executing user instructions

Principle of Locality

- Program and data references within a process tend to cluster
- Only a few pieces of a process will be needed over a short period of time
- Possible to make intelligent guesses about which pieces will be needed in the future
- This suggests that virtual memory may work efficiently

Working set Model

Assumes a slowly changing locality of reference

Set periodically changes

Approximate set:

number of pages held versus fault rate.

Set high and low water marks

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- Over a long period of time, the cluster in use change, but
- Over a short period of time, the processor is primarily working with fixed clusters of mem. references.

Virtual Memory Support

- I • Hardware must support paging and/or segmentation ^{slw}
- II • Operating system must be able to manage the movement of pages and/or segments between secondary memory and main memory

Paging

- Virtual and physical memory divided into fixed size pages
- Translations maps virtual page to a physical page.
- Pages marked as resident or non-resident *
- non-resident pages cause page faults
- Policies: Fetch, placement, replacement
 - we focus on prepaging systems

Resident and Modify Bit in PT

- Resident bit indicates if page is in memory (as few pieces are brought in)
- Another modify bit is needed to indicate if the page has been altered since it was last loaded into main memory
- If no change has been made, the page does not have to be written to the disk when it needs to be swapped out