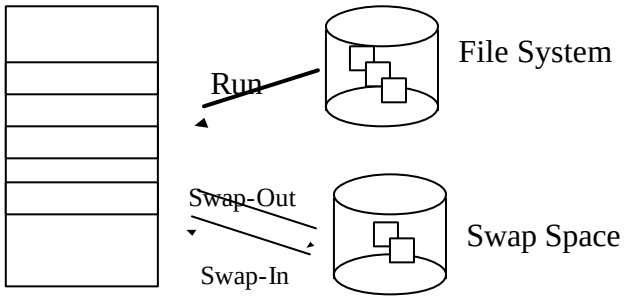
UNIX

- Introduction
- Programmer Interface
- User Interface
- Process Management
- Memory Management
- File System
- I/O System
- Interprocess Communication

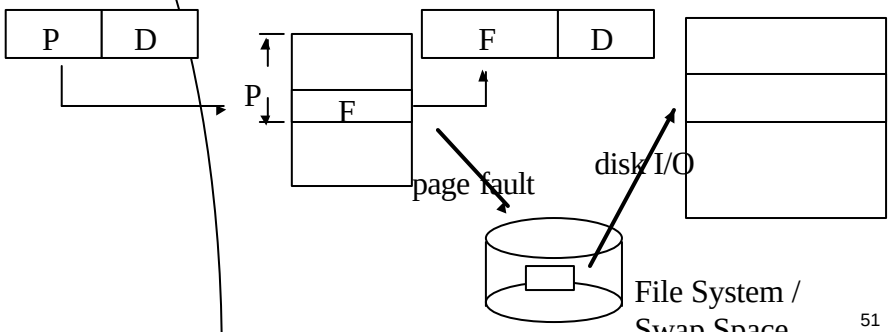
Memory Management

- Virtual Memory – Demand paging



Memory Management

- Demand Paging
  - Page fault -> disk I/O -> modify the page table -> rerun the instruction!



Memory Management

- 4.3BSD
  - Reasons for page fault
    - Initialized data and text
      - Corresponding page-table entries are marked as fetch-on-demand (fod)
    - Un-initialized data
      - Corresponding page-table entries are marked as invalid -> zero-filled

Memory Management

- Page Replacement
  - When the number of free pages is under a threshold, some pages are paged out to release space so that the needed pages can be moved in from disks.
  - Done by pageout() – system process pagedaemon is waked up when the number of free memory is less than *lotsfree*, e.g., ¼ MM size!
  - Approximate Least-Recently-Used (LRU) policy

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Memory Management

- Working Set Model
  - Each process in memory should be allocated with at least those pages in the working set to prevent trashing.
- Swapping
  - It is invoked only when paging is unable to keep up with memory needs.
  - pagedaemon – waked up when free memory is under *minfree* ,e.g., 1/16 MM size.

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Memory Management

- 3BSD
  - Virtual memory – demand paging
  - Page replacement – approx. LRU
  - Pre-allocated swap area
- 4.1BSD
  - Logical page – cluster
  - pre-paging
  - Caching recently used text pages
- 4.3BSD
  - Text images and page tables retained in cache after exit

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