Page Replacing Algorithms

Paging

- The mapping from virtual to physical address is done by the memory management unit (MMU) which is a hardware device and this mapping is known as paging technique.

Page Replacement Algorithms

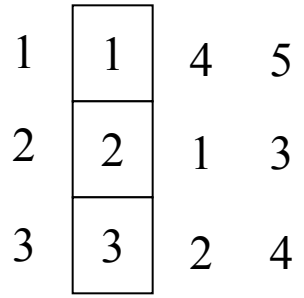
- In an operating system that uses paging for memory management, a page replacement algorithm is needed to decide which page needs to be replaced when new page comes in.

Page Fault

- A page fault happens when a running program accesses a memory page that is mapped into the virtual address space, but not loaded in physical memory.

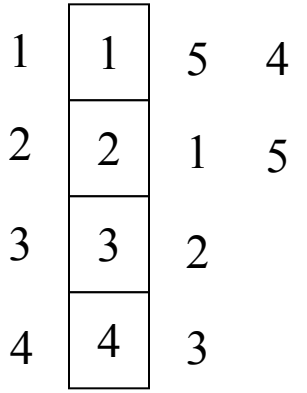
First-In-First-Out (FIFO) Algorithm

- Reference string: 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5
- 3 frames (3 pages can be in memory at a time per process)



9 page faults

- 4 frames



10 page faults

- Belady's Anomaly: more frames ⇒ more page faults

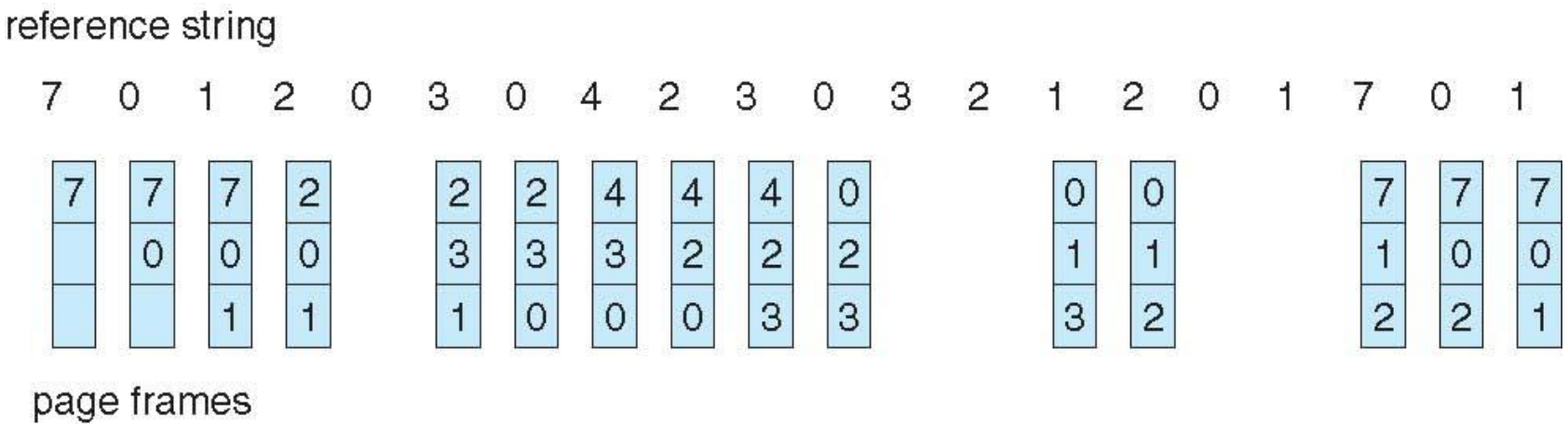
7- -
7 0 –
7 0 1
2 0 1
---
2 3 1
2 3 0
4 3 0
4 2 0
4 2 3
0 2 3

---
0 1 3
0 1 2

---
7 1 2
7 0 2
7 0 1

Page fault: 15

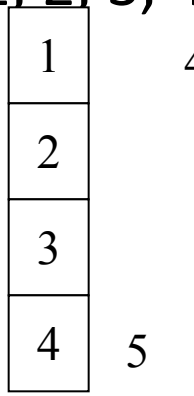
FIFO Page Replacement



Optimal Algorithm

- Replace page that will not be used for longest period of time
- 4 frames example

  1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5



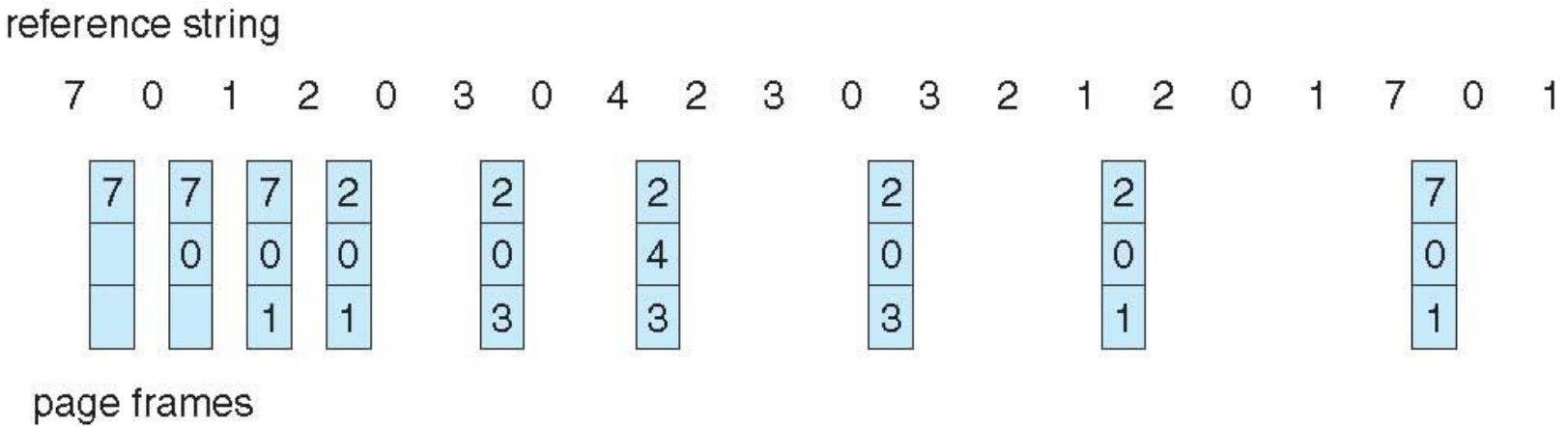
4

5

6 page faults

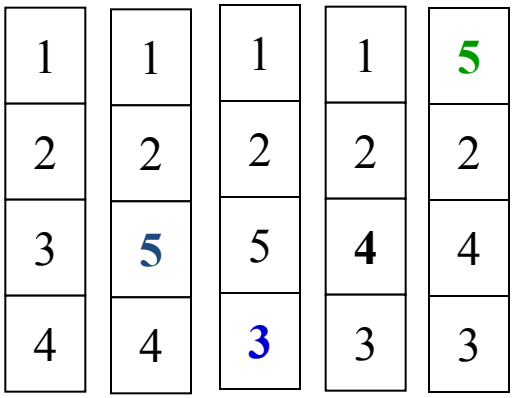
- How do you know this?
- Used for measuring how well your algorithm performs

Optimal Page Replacement



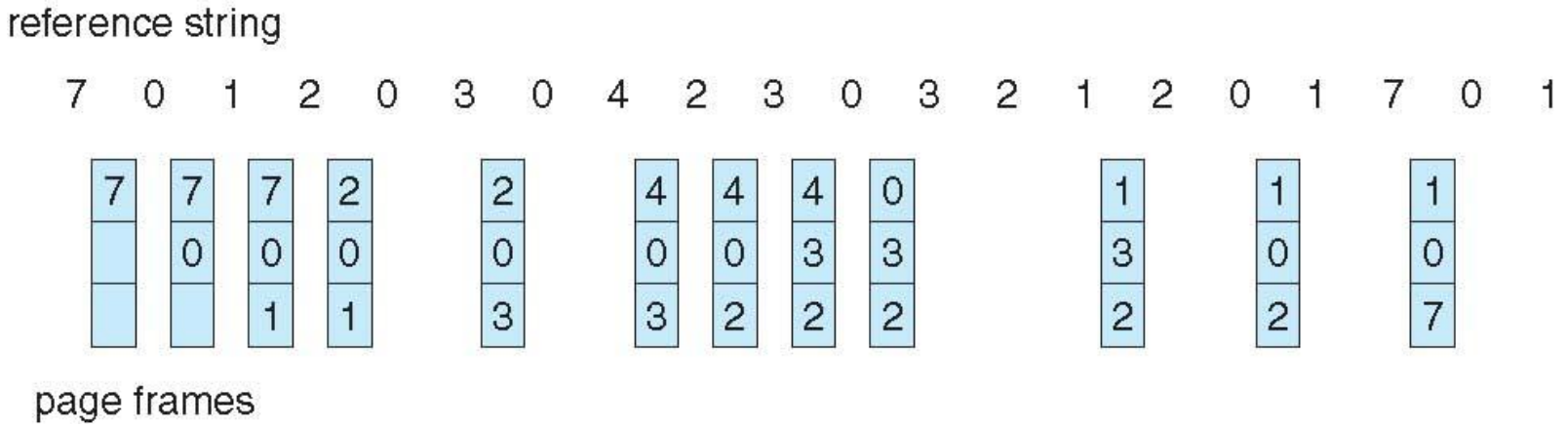
Least Recently Used (LRU) Algorithm

- Reference string: 1, 2, 3, 4, 1, 2, **5**, 1, 2, **3**, **4**, **5**



- Counter implementation
  - Every page entry has a counter; every time page is referenced through this entry, copy the clock into the counter
  - When a page needs to be changed, look at the counters to determine which are to change

LRU Page Replacement



THANK YOU!