Betriebssysteme und Systemnahe Programmierung

Kapitel 9 • Page Replacement

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Page Replacement Algorithms

- Optimal replacement

- Not recently used (NRU) replacement

- First-in, first-out (FIFO) replacement

- Second chance replacement

- Clock page replacement

- Least recently used (LRU) replacement
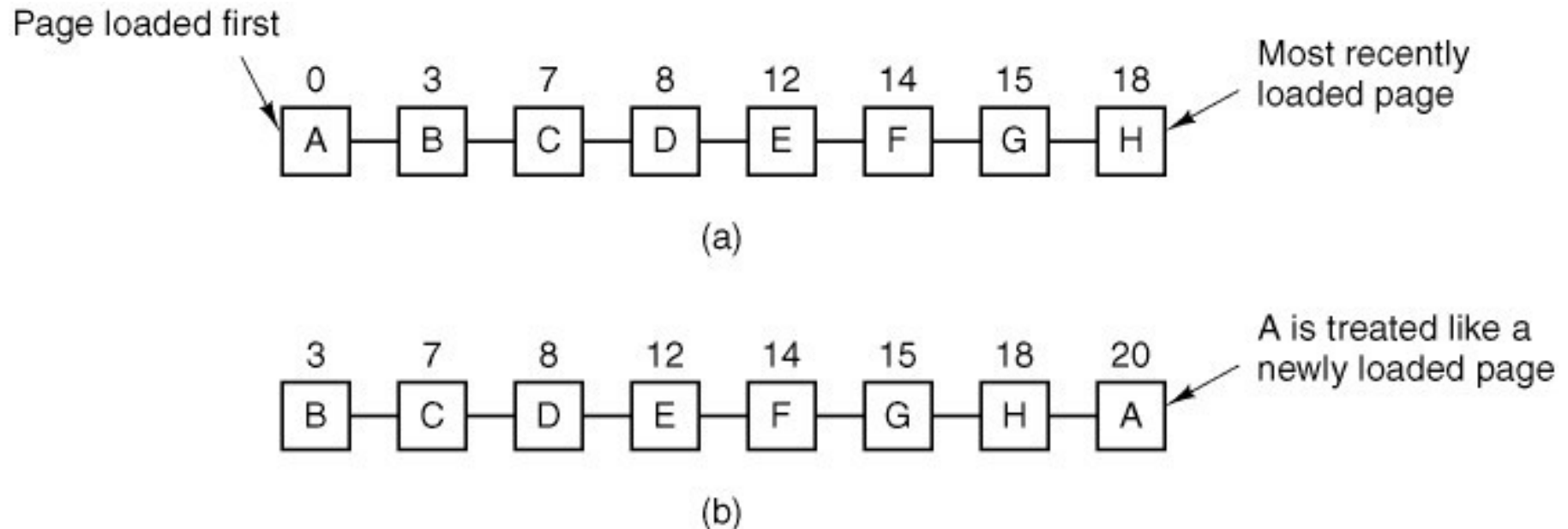
Second Chance Replacement

Figure 4-14. Operation of second chance. (a) Pages sorted in FIFO order. (b) Page list if a page fault occurs at time 20 and A has its R bit set. The numbers above the pages are their loading times.

Clock Page Replacement

When a page fault occurs,
the page the hand is
pointing to is inspected.
The action taken depends
on the R bit:
  R = 0: Evict the page
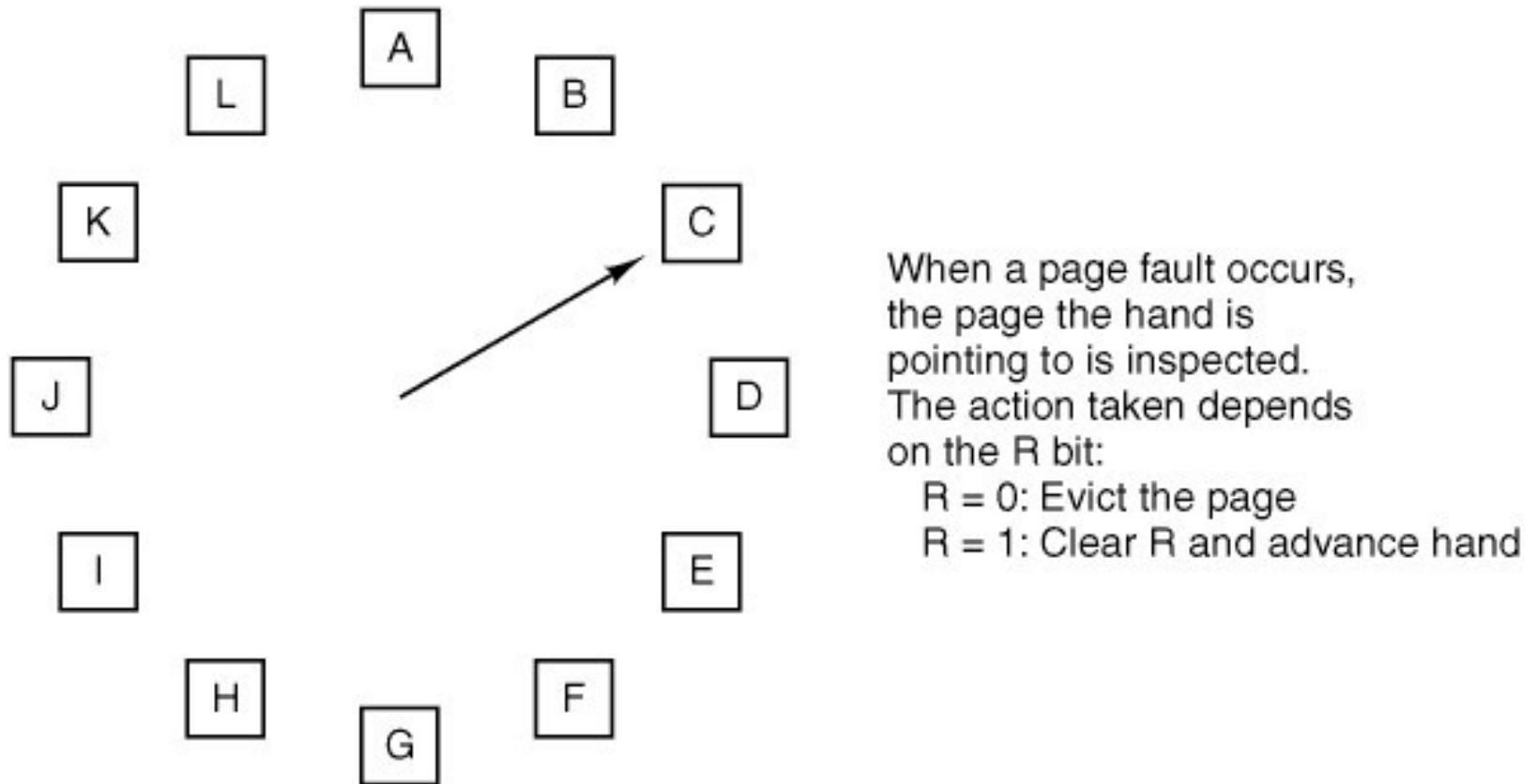 R = 1: Clear R and advance hand

Figure 4-15. The clock page replacement algorithm.

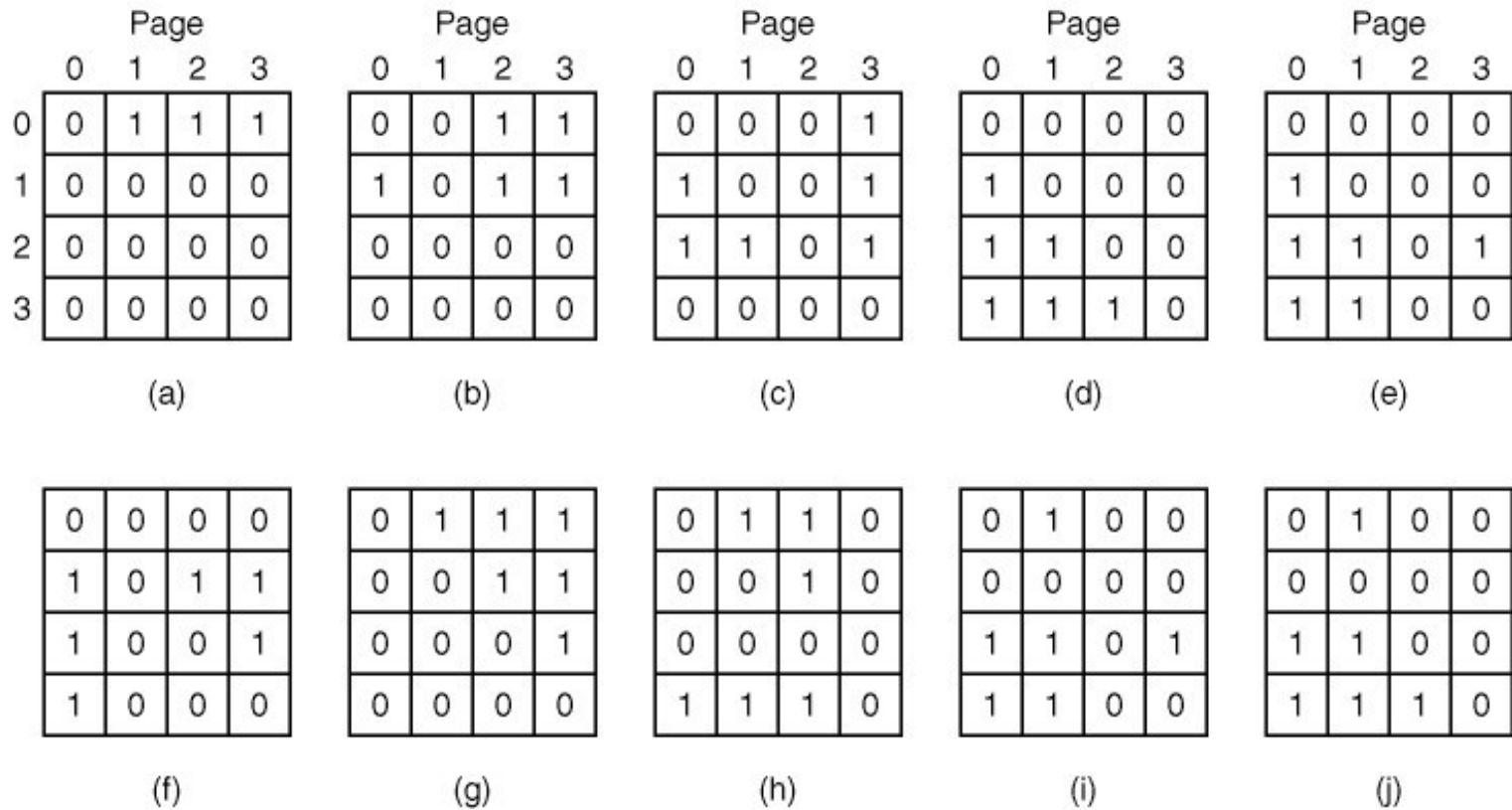# Simulating LRU in Software (1)

Figure 4-16. LRU using a matrix when pages are referenced in the order 0, 1, 2, 3, 2, 1, 0, 3, 2, 3.
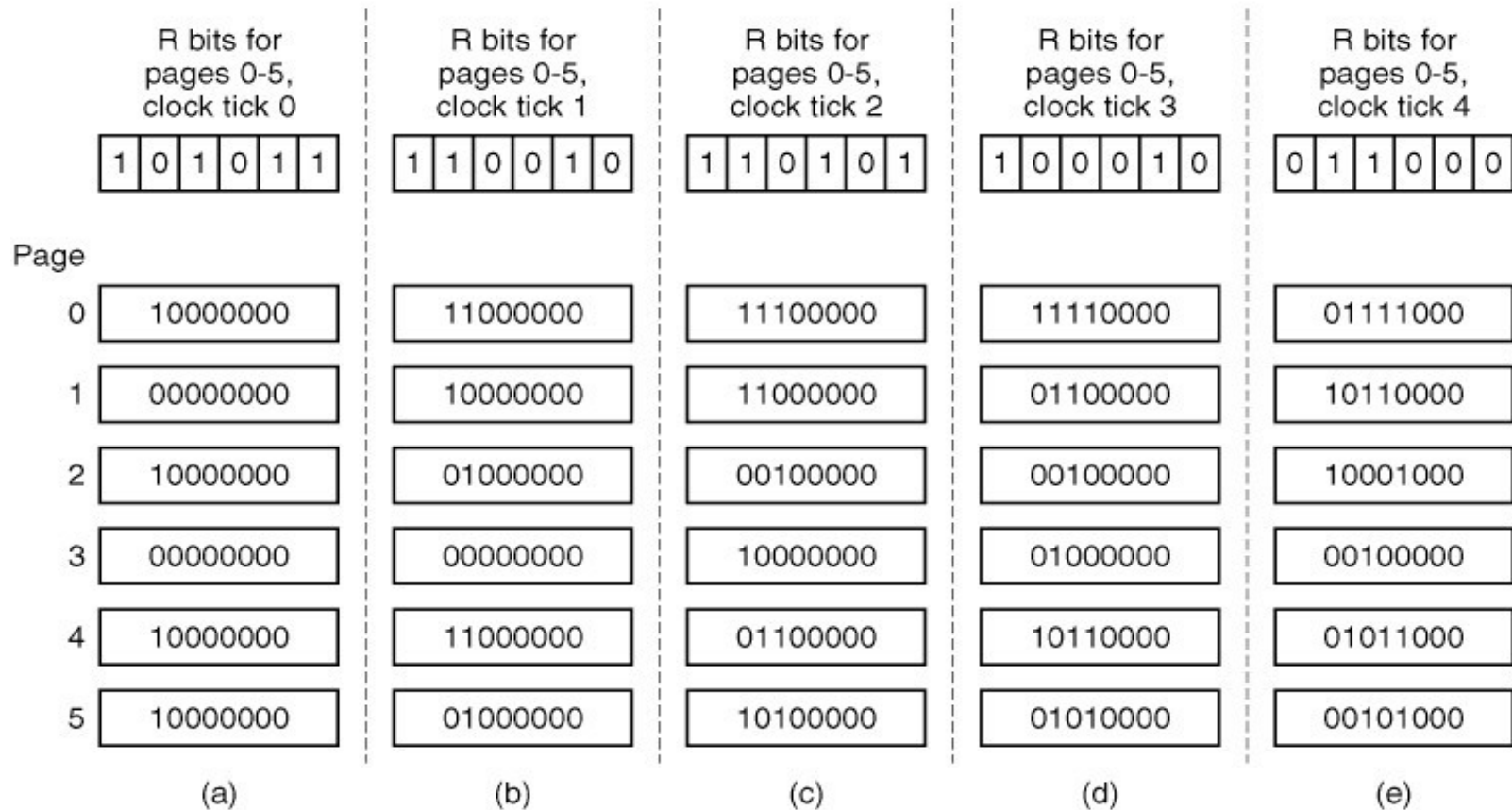
Simulating LRU in Software (2)

Figure 4-17. The aging algorithm simulates LRU in software. Shown are six pages for five clock ticks. The five clock ticks are represented by (a) to (e).
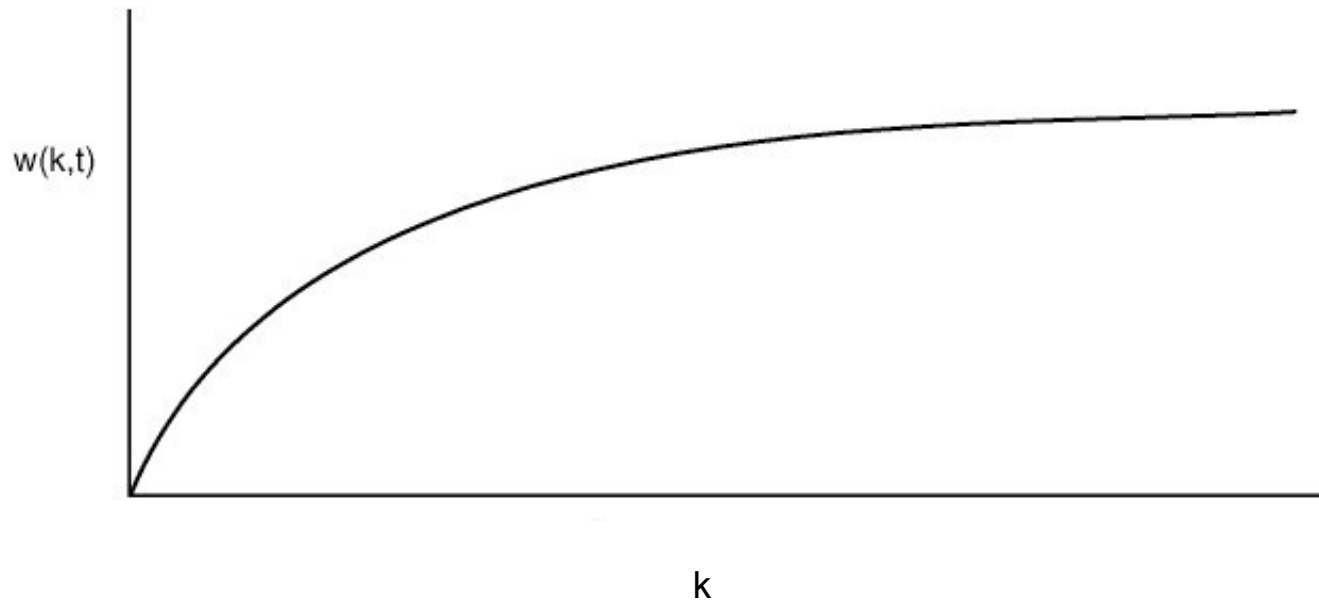
The Working Set Model

Figure 4-18. The working set is the set of pages used by the *k* most recent memory references. The function *w(k, t)* is the size of the working set at time *t*.

Local versus Global Allocation Policies

	Age
A0	10
A1	7
A2	5
A3	4
A4	6
A5	3
B0	9
B1	4
B2	6
B3	2
B4	5
B5	6
B6	12
C1	3
C2	5
C3	6

(a)

A0
A1
A2
A3
A4
(A6)
B0
B1
B2
B3
B4
B5
B6
C1
C2
C3

(b)

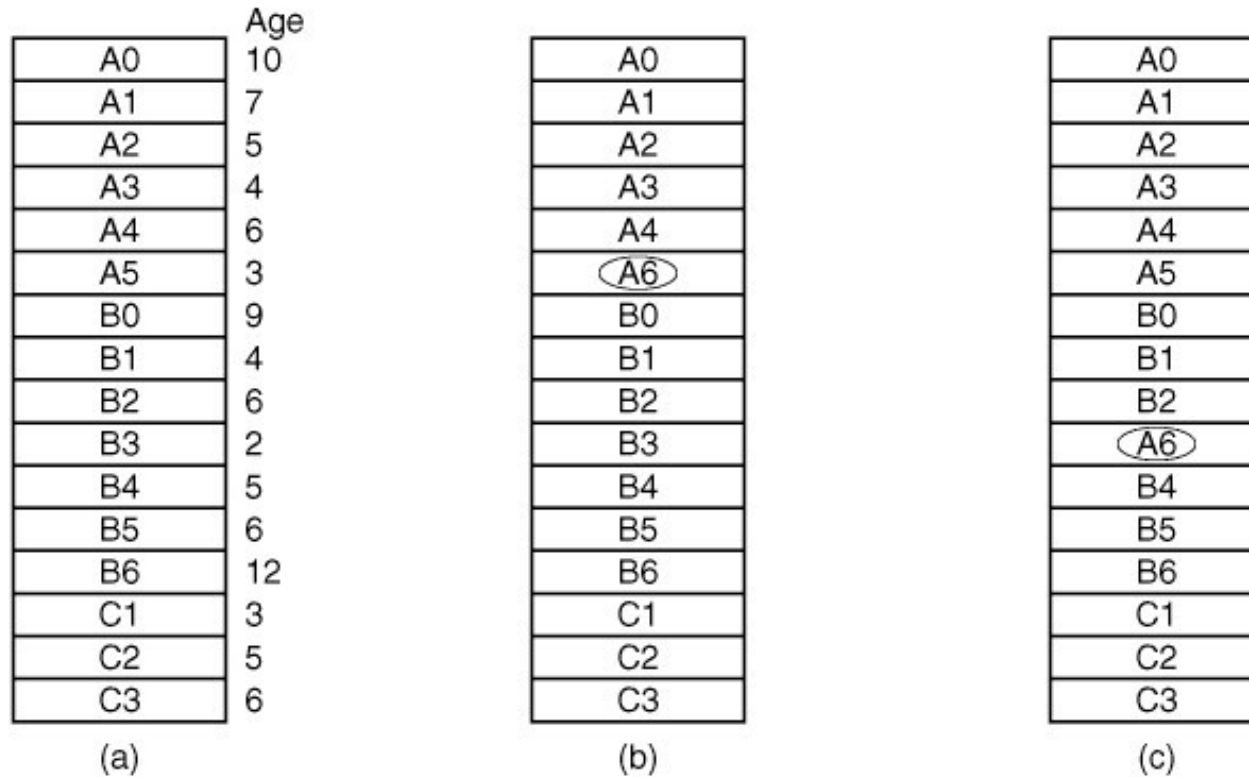| |
|---|
| A0 |
| A1 |
| A2 |
| A3 |
| A4 |
| A5 |
| B0 |
| B1 |
| B2 |
| (A6) |
| B4 |
| B5 |
| B6 |
| C1 |
| C2 |
| C3 |

(c)

Figure 4-19. Local versus global page replacement.
(a) Original configuration. (b) Local page replacement.
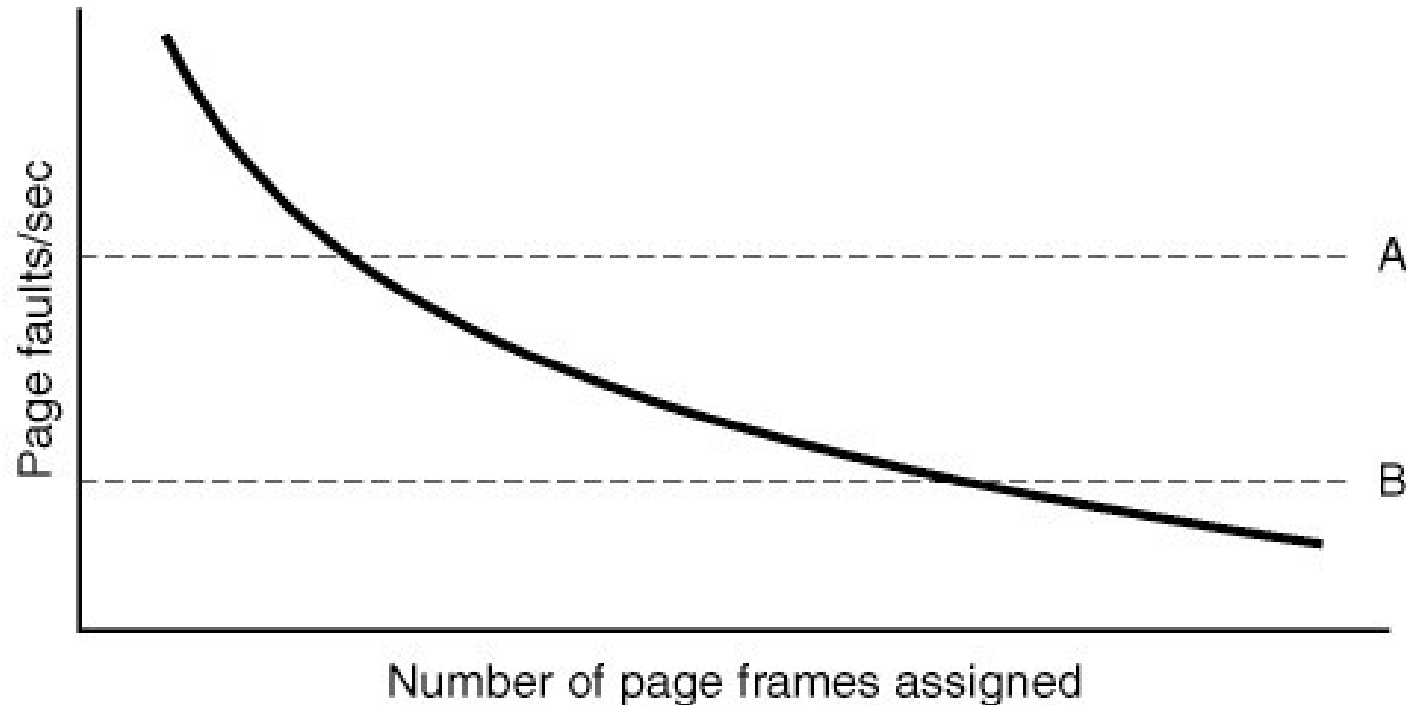(c) Global page replacement.

Page Fault Frequency

Figure 4-20. Page fault rate as a function of the number of page frames assigned.