FIFO:

A FIFO replacement algorithm associates with each page the time when that page was brought into memory. When a page must be replaced, the oldest page is chosen.

Optimal page replacement:

Replace the page that will not be used for the longest period of time.

LRU:

LRU replacement associates with each page the time of that page’s last use. When a page must be replaced, LRU chooses the page that has not been used for the longest period of time.

17-18

FIFO

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| String | 2 | 3 | 2 | 1 | 5 | 2 | 4 |
| frame 1 | 2 | 2 | 2 | 2 | 5 | 5 | 5 |
| frame 2 |  | 3 | 3 | 3 | 3 | 2 | 2 |
| frame 3 |  |  |  | 1 | 1 | 1 | 4 |

Page faults: 6

Optimal page replacement

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| String | 2 | 3 | 2 | 1 | 5 | 2 | 4 |
| frame 1 | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| frame 2 |  | 3 | 3 | 3 | 5 | 5 | 5 |
| frame 3 |  |  |  | 1 | 1 | 1 | 1 |

Page faults: 5

16-17

FIFO

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| String | 2 | 3 | 2 | 7 | 5 | 2 | 6 |
| frame 1 | 2 | 2 | 2 | 2 | 5 | 5 | 5 |
| frame 2 |  | 3 | 3 | 3 | 3 | 2 | 2 |
| frame 3 |  |  |  | 7 | 7 | 7 | 6 |

Page faults: 6

Optimal page replacement

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| String | 2 | 3 | 2 | 7 | 5 | 2 | 6 |
| frame 1 | 2 | 2 | 2 | 2 | 2 | 2 | 6 |
| frame 2 |  | 3 | 3 | 3 | 5 | 5 | 5 |
| frame 3 |  |  |  | 7 | 7 | 7 | 7 |

Page faults: 5

15-16

FIFO

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| String | 7 | 0 | 3 | 1 | 3 | 5 | 3 | 4 | 6 | 5 |
| frame 1 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 1 | 6 | 6 |
| frame 2 |  | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 5 |
| frame 3 |  |  | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 |

Page faults: 7

LRU

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| String | 7 | 0 | 3 | 1 | 3 | 5 | 3 | 4 | 6 | 5 |
| frame 1 | 7 | 7 | 7 | 1 | 1 | 1 | 1 | 4 | 4 | 4 |
| frame 2 |  | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 6 | 6 |
| frame 3 |  |  | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 5 |

Page faults: 8

First-Come, First-Served Scheduling (FCFS):

the process that requests the CPU first is allocated the CPU first.

Shortest-Job-First (SJF):

shortest-remaining-time-first. When the CPU is available, it is assigned to the process that has the smallest next CPU burst.

Priority Scheduling:

Apriority is associated with each process, and the CPU is allocated to the process with the highest priority.

Round-Robin Scheduling (RR):

It is similar to FCFS scheduling, but preemption is added to enable the system to switch between processes. To implement RR scheduling, we again treat the ready queue as a FIFO queue of processes. New processes are added to the tail of the ready queue. The CPU scheduler picks the first process from the ready queue, sets a timer to interrupt after 1 time quantum, and dispatches the process.

16-17

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| time | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Process | P1 | P1 | P1 | P1 | P2 | P2 | P3 | P3 | P3 | P3 | P3 | P3 | P3 | P3 | P3 |

Average waiting time: (0+3+4)/3=2.33ms

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| time | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Process | P1 | P2 | P2 | P1 | P1 | P1 | P3 | P3 | P3 | P3 | P3 | P3 | P3 | P3 | P3 |

Average waiting time: (2+0+4)/3=2ms

15-16

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Allocation | | | Max | | |
|  | A | B | C | A | B | C |
| P1 | 0 | 1 | 1 | 6 | 5 | 3 |
| P2 | 3 | 4 | 1 | 3 | 4 | 2 |
| P3 | 3 | 0 | 2 | 9 | 0 | 2 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Need | | | available | | |
|  | A | B | C | A | B | C |
| P1 | 6 | 4 | 2 | 3 | 0 | 1 |
| P2 | 0 | 0 | 1 |  |  |  |
| P3 | 6 | 0 | 0 |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| process order | available | | |
|  | A | B | C |
| P2 | 6 | 4 | 2 |
| P3 | 9 | 4 | 4 |
| P1 | 9 | 5 | 5 |