Broadcast disks and caching

Solution

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1.

\[f_{P1} = \left\lfloor \sqrt{0.6 \ 0.1} \right\rfloor = 2, f_{P2} = \left\lfloor \sqrt{0.2 \ 0.1} \right\rfloor = 1, f_{P3} = f_{P4} = \left\lfloor \sqrt{0.1 \ 0.1} \right\rfloor = 1\]

\[C_{\text{max}} = \text{LCM}(2,1,1,1) = 2\]

\[C_{11} = \{P1\}, C_{12} = \{P2, P3\}, C_{21} = \{P1\}, C_{22} = \{P4, e\}\]

Broadcast schedule \((C_{11}, C_{12}), (C_{21}, C_{22})\) \(
\Rightarrow \{P1\ - \ P2\ - \ P3\ - \ P1\ - \ P4\ - \ E\}\)

2. Request \(P1\ P3\ P1\ P4\ P2\ P1\ P3\ P3\ P1\)

**LRU algorithm**

Sequence of data page consumption events:

- P1 received, consumed and cached.
- P2 received and dropped.
- P3 received and consumed and cached, P1 consumed from the cache.
- P4 received and consumed and cached, P3 is dropped from the cache.
- P2 received and consumed and cached, P1 is dropped from the cache.
- P1 received and consumed and cached, P4 is dropped from the cache.
- P3 received and consumed(twice) and cached, P2 dropped from the cache.
- P1 consumed from the cache.

Total number of steps: **15 steps**.
Sequence of data page consumption events:

Adding P1 to Cache.
Adding P3 to Cache.
Using P1 from cache.
LIX for P3 = 0.16/1 = 0.16, LIX for P1 = 0.41/2 = 0.20 , Removing P3
Adding P4
LIX for P4 = 0/1 = 0, LIX for P1 = 0.5/2 = 0.25, Removing P4
Adding P2
Using P1 from cache.
LIX for P2 = 0.25/1 = 0.25, LIX for P1 = 0.5/2 = 0.25, Removing P2
Adding P3
Using P3 from cache.
Using P1 from cache.

Total = 9 Steps

Note: The above solution is produced using the Data-item based LIX caching, there is also the possibility of answering this part of the question using Disk-based LIX caching.
Here is the Pi table for Disk based LIX caching.

<table>
<thead>
<tr>
<th>Pi</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk1</td>
<td>0.5 / (1 - 0)+ 0.5*0 = 0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5 / (4 - 1)+ 0.5*0.5 = 0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>{P1}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISK2</td>
<td>0</td>
<td>.5 / (2 - 0)+ 0.5*0 = 0.25</td>
<td>0.5 / (3 - 2)+ 0.5*0.25 = 0.625</td>
<td>0.625</td>
<td>0.5 / (5 - 3)+ 0.5*0.625 = 0.5625</td>
</tr>
</tbody>
</table>