Write Up of Findings for Project 5

This project was hard to implement, and I think I went about it in a noobie way. I utilized a lot of for loops, if and else if and else loops that were very nested. It makes sense that we want specific conditions to run these algorithms under, however, I quickly realized nested for loops become difficult to manage especially if needing to iterate through the number of slots. I encountered many out-of-bounds exceptions. Working past that, I initially started my code with a single for loop with a nested for loop. One of the loops unfortunately prevented me from properly implementing the "Cache Hit Rates:" instead it would loop with the number of slots for each algorithm. I made a copy just for recording cache hit rates and that worked for the printed format requirements, however, this presented other problems. My code is less attractive and more complex. I, unfortunately, was unable to correctly display each algorithm's string of hits "+" , when the page was already in the cache. To my understanding, when they do display they all follow the FIFO algorithm, so they are always the same in every row. The "Cache Rate Hits" and "Worst and Best" printed parts display the correct information.

Besides the hardships, I will discuss a more in-depth review of the algorithms implemented. The FIFO (First in, First out) replacement technique works when the cache is full and we want to replace the oldest page (the one that was first in at the start and now becomes the first out) with the new page so it can be first in. This implementation is great for smaller caches. When using a large number of cache slots FIFO actually starts creating more page faults which is known as Belady's anomaly. If we wanted to use FIFO we should aim to use it for smaller-sized caches.

LRU (Least Recently Used) replacement algorithm's logic follows that when the cache is full we want to remove the least recently used page(which is the page that was last referenced to the longest time ago) in the cache to make room for the new incoming page to be added. LRU acted very similarly to FIFO when a large amount of slot numbers were used in cache, it performed worse. This algorithm is best used for smaller-sized caches where we frequent pages more often than we would in a larger-sized cache.

MIN (minimum) replacement algorithm's logic is replacing the page that will be referenced further out, meaning we are trying to work optimally by saving what will be used later for last because that's when we will need it. Doing so will prevent more page faults from happening, as discussed in class, implementing this is near to impossible to do so we replaced the page with the minimum index in the cache. This algorithm was the most effective and performed best out of all algorithms.

RAND (random) replacement has straightforward logic that is to randomly select a page to replace. This was the easiest algorithm to implement since we could just use a random generator to do most of the work for us. Random replacement seems rarely useful in most situations due to it's nature. The cache hit rates for this algorithm were fairly effective and in most test runs.

(Below are screenshots of 4 example test runs.)

EXAMPLE 1)

```
<terminated> CacheReplacementAlgorithms [Java Application] C:\Users\medin
Enter page reference pattern length: 20
Enter number of unique pages: 10
Enter number of slots: 7
Ref Str: J I D C F E H D G E J E A J B J I C B B
MIN   1: J I D C F E H + G + J + A + B + I C + +
MIN   2: + + D + F E H + G + J + A + B + I C + +
MIN   3: + + D + F E H + G + J + A + B + I C + +
MIN   4: + + D + F E H + G + J + A + B + I C + +
MIN   5: + + D + F E H + G + J + A + B + I C + +
MIN   6: + + D + F E H + G + J + A + B + I C + +
MIN   7: + + D + F E H + G + J + A + B + I C + +
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RAND  1: J I D C F E H + G + J + A + B + I C + +
RAND  2: + + D + F E H + G + J + A + B + I C + +
RAND  3: + + D + F E H + G + J + A + B + I C + +
RAND  4: + + D + F E H + G + J + A + B + I C + +
RAND  5: + + D + F E H + G + J + A + B + I C + +
RAND  6: + + D + F E H + G + J + A + B + I C + +
RAND  7: + + D + F E H + G + J + A + B + I C + +
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FIFO  1: J I D C F E H + G + J + A + B + I C + +
FIFO  2: + + D + F E H + G + J + A + B + I C + +
FIFO  3: + + D + F E H + G + J + A + B + I C + +
FIFO  4: + + D + F E H + G + J + A + B + I C + +
FIFO  5: + + D + F E H + G + J + A + B + I C + +
FIFO  6: + + D + F E H + G + J + A + B + I C + +
FIFO  7: + + D + F E H + G + J + A + B + I C + +
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LRU   1: J I D C F E H + G + J + A + B + I C + +
LRU   2: + + D + F E H + G + J + A + B + I C + +
LRU   3: + + D + F E H + G + J + A + B + I C + +
LRU   4: + + D + F E H + G + J + A + B + I C + +
LRU   5: + + D + F E H + G + J + A + B + I C + +
LRU   6: + + D + F E H + G + J + A + B + I C + +
LRU   7: + + D + F E H + G + J + A + B + I C + +
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Cache Hit Rates:
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```
LRU    6: + + D + F E H + G + J + A + B + I C + +
LRU    7: + + D + F E H + G + J + A + B + I C + +
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Cache Hit Rates:
MIN : 5 of 20 = 0.25
RAND : 8 of 20 = 0.40
FIFO : 7 of 20 = 0.35
LRU : 10 of 20 = 0.50

Best: MIN
Worst: LRU
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59°F
Windy

EXAMPLE 2)

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<terminated> CacheReplacementAlgorithms [Java Application] C:\Users\medin\.p2\pool\plugins\org.eclipse.justj.openjdk.hots
Enter page reference pattern length: 38
Enter number of unique pages: 9
Enter number of slots: 7
Ref Str: A E C I G B F G A I C B G G D A D I E F A D C C E D A C C D A H F B D G E A
MIN    1: A E C I G B F + + + + + + + D A + + E + + + C + + + + + + + + H + + + G + +
MIN    2: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
MIN    3: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
MIN    4: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
MIN    5: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
MIN    6: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
MIN    7: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
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RAND   1: A E C I G B F + + + + + + + D A + + E + + + C + + + + + + + + H + + + G + +
RAND   2: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
RAND   3: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
RAND   4: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
RAND   5: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
RAND   6: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
RAND   7: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
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FIFO   1: A E C I G B F + + + + + + + D A + + E + + + C + + + + + + + + H + + + G + +
FIFO   2: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
FIFO   3: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
FIFO   4: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
FIFO   5: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
FIFO   6: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
FIFO   7: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
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LRU    1: A E C I G B F + + + + + + + D A + + E + + + C + + + + + + + + H + + + G + +
LRU    2: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
LRU    3: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
LRU    4: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
LRU    5: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
LRU    6: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
LRU    7: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
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Cache Hit Rates:
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LRU    6: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
LRU    7: + + + I + B F + A + + + + + D + + + E + + + C + + + + + + + + H + + + G + +
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Cache Hit Rates:
MIN : 22 of 38 = 0.58
RAND : 25 of 38 = 0.66
FIFO : 25 of 38 = 0.66
LRU : 29 of 38 = 0.76

Best: MIN
Worst: LRU
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EXAMPLE 3)

```
<terminated> CacheReplacementAlgorithms [Java Application] C:\Users\medin\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.10.v20240120-1143\jre\bin\javaw.exe  (May 3, 2024, 4:44:54 PM – 4:45:04 PM) [pid: 26660]
Enter page reference pattern length: 99
Enter number of unique pages: 15
Enter number of slots: 10
Ref Str: A O B A J N J N O B K K K K J K D M D E C E O O M L F M M F I E D D J J B K I E J K G A N A J L A A J D H B I H N O H I B N K K H A J K H C G B H G B C I B C B A M M K K I B G O O C K J B G K J L N
MIN    1: A O B + J N + + + + K + + + + + D M + E C + + + + L F + + + I + + + + + B + + + J + G A N + + + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    2: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    3: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    4: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    5: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    6: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    7: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    8: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN    9: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
MIN   10: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
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RAND   1: A O B + J N + + + + K + + + + + D M + E C + + + + L F + + + I + + + + + B + + + J + G A N + + + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   2: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   3: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   4: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   5: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   6: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   7: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   8: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND   9: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
RAND  10: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
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FIFO   1: A O B + J N + + + + K + + + + + D M + E C + + + + L F + + + I + + + + + B + + + J + G A N + + + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   2: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   3: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   4: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   5: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   6: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   7: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   8: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO   9: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
FIFO  10: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
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LRU    9: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
LRU   10: A O + + + + + + + K + + + + + D + + E C + + + M + F + + + I + + + J + B + + + + + G A N + + L + + + D H + + + + O + + + + K + + + + + C + + + + + + I B + + + M + + + + G + + + + J + + + + L N
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Cache Hit Rates:
MIN  : 56 of 99 = 0.57
RAND : 63 of 99 = 0.64
FIFO : 69 of 99 = 0.70
LRU  : 84 of 99 = 0.85

Best: MIN
Worst: LRU
```

EXAMPLE 4)

```
<terminated> CacheReplacementAlgorithms [Java Application] C:\Users\medin\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.10.v20240120-1145\jre\bin\javaw.exe (May 3, 2024, 4:56:15 PM – 4:56:29 PM) [pid: 25566]
Enter page reference pattern length: 96
Enter number of unique pages: 11
Enter number of slots: 6
Ref Str: A A D F A H A C I F E E I I D A J G G E F I B B F B B I B I J A K I A E J B I D D G C J F E B I E C J C G J A C J A C D B I D A A A K J E A B C F K G E E D A I F H A H G D I I A H C D J J G A
MIN   1: A + D F + H + C I + E + + + + A J G + + F + B + + + + I + + + + K + A E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
MIN   2: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
MIN   3: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
MIN   4: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
MIN   5: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
MIN   6: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
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RAND  1: A + D F + H + C I + E + + + + A J G + + F + B + + + + I + + + + K + A E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
RAND  2: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
RAND  3: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
RAND  4: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
RAND  5: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
RAND  6: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
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FIFO  1: A + D F + H + C I + E + + + + A J G + + F + B + + + + I + + + + K + A E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
FIFO  2: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
FIFO  3: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
FIFO  4: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
FIFO  5: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
FIFO  6: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
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LRU   1: A + D F + H + C I + E + + + + A J G + + F + B + + + + I + + + + K + A E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
LRU   2: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
LRU   3: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
LRU   4: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
LRU   5: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
LRU   6: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
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Cache Hit Rates:
MIN  : 50 of 96 = 0.52
RAND : 54 of 96 = 0.56
FIFO : 51 of 96 = 0.53
LRU  : 85 of 96 = 0.89
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LRU   5: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
LRU   6: + + D F + H A C I + E + + + D + J G + + F + B + + + + I + + + A K + + E J + + D + G C + F + B I E + J + G + A C + + + D B I + + + + K J E A + C F + G + + D + I + H A + + + + + + + C + J + G +
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Cache Hit Rates:
MIN  : 50 of 96 = 0.52
RAND : 54 of 96 = 0.56
FIFO : 51 of 96 = 0.53
LRU  : 85 of 96 = 0.89

Best: MIN
Worst: LRU
```