CSCC69 Assignment 2

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1   Tables

Below is our results from running `sim` on the algorithms `fifo`, `clock`, `lru`, and `opt`, with memory sizes of 50, 100, 150, and 200.

```
Commands used:
./sim -f ./tracefiles/simpleloop.tr -m <memsize> -s 10000 -a <algorithm>
./sim -f ./tracefiles/blocked.tr -m <memsize> -s 10000 -a <algorithm>
./sim -f ./tracefiles/matmul.tr -m <memsize> -s 10000 -a <algorithm>
./sim -f ./tracefiles/sim.tr -m <memsize> -s 10000 -a <algorithm>

simpleloop.tr:
--------------
Memory size: 50
--------------------------------------------
fifo:
Hit count: 5064
Miss count: 2632
Clean evictions: 38
Dirty evictions: 2544
Total references : 7696
Hit rate: 65.8004
Miss rate: 34.1996

clock:
Hit count: 5113
Miss count: 2583
Clean evictions: 36
Dirty evictions: 2497
Total references : 7696
Hit rate: 66.4371
Miss rate: 33.5629

lru:
Hit count: 5116
Miss count: 2580
Clean evictions: 35
Dirty evictions: 2495
Total references : 7696
Hit rate: 66.4761
Miss rate: 33.5239

opt:
Hit count: 5115
Miss count: 2581
Clean evictions: 31
```

```
Dirty evictions: 2500
Total references : 7696
Hit rate: 66.4631
Miss rate: 33.5369

Memory size: 100
---------------------------------------------
fifo:
Hit count: 5092
Miss count: 2604
Clean evictions: 34
Dirty evictions: 2470
Total references : 7696
Hit rate: 66.1642
Miss rate: 33.8358

clock:
Hit count: 5116
Miss count: 2580
Clean evictions: 34
Dirty evictions: 2446
Total references : 7696
Hit rate: 66.4761
Miss rate: 33.5239

lru:
Hit count: 5117
Miss count: 2579
Clean evictions: 34
Dirty evictions: 2445
Total references : 7696
Hit rate: 66.4891
Miss rate: 33.5109

opt:
Hit count: 5092
Miss count: 2604
Clean evictions: 56
Dirty evictions: 2448
Total references : 7696
Hit rate: 66.1642
Miss rate: 33.8358

Memory size: 150
---------------------------------------------
```

```
fifo:
Hit count: 5100
Miss count: 2596
Clean evictions: 34
Dirty evictions: 2412
Total references : 7696
Hit rate: 66.2682
Miss rate: 33.7318

clock:
Hit count: 5116
Miss count: 2580
Clean evictions: 34
Dirty evictions: 2396
Total references : 7696
Hit rate: 66.4761
Miss rate: 33.5239

lru:
Hit count: 5117
Miss count: 2579
Clean evictions: 34
Dirty evictions: 2395
Total references : 7696
Hit rate: 66.4891
Miss rate: 33.510

opt:
Hit count: 5092
Miss count: 2604
Clean evictions: 56
Dirty evictions: 2398
Total references : 7696
Hit rate: 66.1642
Miss rate: 33.8358

Memory size: 200
---------------------------------------------
fifo:
Hit count: 5105
Miss count: 2591
Clean evictions: 34
Dirty evictions: 2357
Total references : 7696
Hit rate: 66.3332
```

```
Miss rate: 33.6668

clock:
Hit count: 5116
Miss count: 2580
Clean evictions: 34
Dirty evictions: 2346
Total references : 7696
Hit rate: 66.4761
Miss rate: 33.5239

lru:
Hit count: 5117
Miss count: 2579
Clean evictions: 34
Dirty evictions: 2345
Total references : 7696
Hit rate: 66.4891
Miss rate: 33.5109

opt:
Hit count: 5092
Miss count: 2604
Clean evictions: 56
Dirty evictions: 2348
Total references : 7696
Hit rate: 66.1642
Miss rate: 33.8358

blocked.tr:
-----------
Memory size: 50
------------------------------------------
fifo:
Hit count: 4794
Miss count: 66
Clean evictions: 6
Dirty evictions: 10
Total references : 4860
Hit rate: 98.6420
Miss rate: 1.3580

clock:
Hit count: 4799
Miss count: 61
```

```
Clean evictions: 5
Dirty evictions: 6
Total references : 4860
Hit rate: 98.7449
Miss rate: 1.2551

lru:
Hit count: 4804
Miss count: 56
Clean evictions: 5
Dirty evictions: 1
Total references : 4860
Hit rate: 98.8477
Miss rate: 1.1523

opt:
Hit count: 4794
Miss count: 66
Clean evictions: 6
Dirty evictions: 10
Total references : 4860
Hit rate: 98.6420
Miss rate: 1.3580

Memory size: 100
--------------------------------------------
fifo:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

clock:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

lru:
```

```
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

opt:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317



Memory size: 150
-------------------------------------------
fifo:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

clock:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

lru:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
```

```
Miss rate: 1.1317

opt:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

Memory size: 200
------------------------------------------
fifo:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

clock:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

lru:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

opt:
Hit count: 4805
Miss count: 55
Clean evictions: 0
Dirty evictions: 0
```

```
Total references : 4860
Hit rate: 98.8683
Miss rate: 1.1317

matmul.tr:
----------
Memory size: 50
-------------------------------------------
fifo:
Hit count: 4727
Miss count: 61
Clean evictions: 4
Dirty evictions: 7
Total references : 4788
Hit rate: 98.7260
Miss rate: 1.2740

clock:
Hit count: 4729
Miss count: 59
Clean evictions: 4
Dirty evictions: 5
Total references : 4788
Hit rate: 98.7678
Miss rate: 1.2322

lru:
Hit count: 4733
Miss count: 55
Clean evictions: 4
Dirty evictions: 1
Total references : 4788
Hit rate: 98.8513
Miss rate: 1.1487

opt:
Hit count: 4727
Miss count: 61
Clean evictions: 4
Dirty evictions: 7
Total references : 4788
Hit rate: 98.7260
Miss rate: 1.2740

Memory size: 100
```

```
-------------------------------------------
fifo:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

clock:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

lru:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

opt:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

Memory size: 150
-------------------------------------------
fifo:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
```

```
Hit rate: 98.8722
Miss rate: 1.1278

clock:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

lru:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

opt:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

Memory size: 200
------------------------------------------
fifo:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

clock:
Hit count: 4734
Miss count: 54
Clean evictions: 0
```

```
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

lru:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

opt:
Hit count: 4734
Miss count: 54
Clean evictions: 0
Dirty evictions: 0
Total references : 4788
Hit rate: 98.8722
Miss rate: 1.1278

sim.tr:
-------
Memory size: 50
-------------------------------------------
fifo:
Hit count: 4901
Miss count: 79
Clean evictions: 15
Dirty evictions: 14
Total references : 4980
Hit rate: 98.4137
Miss rate: 1.5863

clock:
Hit count: 4913
Miss count: 67
Clean evictions: 10
Dirty evictions: 7
Total references : 4980
Hit rate: 98.6546
Miss rate: 1.3454
```

```
lru:
Hit count: 4917
Miss count: 63
Clean evictions: 9
Dirty evictions: 4
Total references : 4980
Hit rate: 98.7349
Miss rate: 1.2651

opt:
Hit count: 4896
Miss count: 84
Clean evictions: 20
Dirty evictions: 14
Total references : 4980
Hit rate: 98.3133
Miss rate: 1.6867

Memory size: 100
-------------------------------------------
fifo:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

clock:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

lru:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
```

Miss rate: 1.2450

opt:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

Memory size: 150
----
fifo:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

clock:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

lru:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

opt:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0

```
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

Memory size: 200
--------------------------------------------
fifo:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

clock:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

lru:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450

opt:
Hit count: 4918
Miss count: 62
Clean evictions: 0
Dirty evictions: 0
Total references : 4980
Hit rate: 98.7550
Miss rate: 1.2450
```

2   Comparison

From the information gathered from the tables above, we can see that for smaller memory sizes, there are a greater amount of evictions performed for all traces where the memory size is around 50. If we inspect `fifo` we can see that it suffers from the most faults since it cannot efficiently "predict" the behavior of the program. For example, the dirty evictions for `fifo` are always the greatest when memory size is set to 50. When we set the memory size to be larger, we get more or less the same results across all algorithms. We can see this in the miss rate for `matmul.tr` is 1.1278, for `blocked.tr` is 1.1317, and `sim.tr` is 1.2450 for memory sizes 100-200. Overall, we can see that `opt` is expected to perform the most efficiently, despite it having the more faults and evictions.

3   LRU Explanation

Observing the `lru` algorithm while the memory size increases in each trace file, we see that in `simpleloop.tr`, miss rate goes from 33.510 to 33.5109. This is a subtle change, however, it shows how `lru` undergoes Belady's anomaly since the increase in memory size from 150 to 200 did not guarantee fewer faults for this case. Furthermore, note the results in `matmul.tr`, `blocked.tr`, and `sim.tr` show that the miss rate stays the same after the memory size greater than 50. Therefore, an increase in memory also has no effect in this case either. Finally, we can see where the memory size is less than 100, the miss rate and dirty evictions for `lru` have either the same or fewer amount of faults than in `fifo` and `clock`. This is of course expected since the performance closely resembles Belady's algorithm on average.