**CSC369-A3 UTORid: lixueer**

**1.Table in Task2**

| Memory size | 50 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 70.8822 | 7247 | 2977 | 2927 | 345 | 2582 |
| FIFO | 70.8725 | 7246 | 2978 | 2928 | 333 | 2595 |
| LRU | 72.7895 | 7442 | 2782 | 2732 | 207 | 2525 |
| CLOCK  (1 ref-bit) | 72.7700 | 7440 | 2784 | 2734 | 206 | 2528 |
| OPT | 73.8948 | 7555 | 2669 | 2619 | 113 | 2506 |

| Memory size | 100 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 72.7993 | 7443 | 2781 | 2681 | 180 | 2501 |
| FIFO | 73.0340 | 7467 | 2757 | 2657 | 163 | 2494 |
| LRU | 73.7258 | 7538 | 2686 | 2586 | 120 | 2466 |
| CLOCK  (1 ref-bit) | 73.6796 | 7533 | 2691 | 2591 | 123 | 2468 |
| OPT | 74.1491 | 7581 | 2643 | 2543 | 43 | 2500 |

./sim -f ./traceprogs/tr-simpleloop.ref -m -s

| Memory size | 150 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 73.4742 | 7512 | 2712 | 2562 | 137 | 2425 |
| FIFO | 73.4253 | 7507 | 2717 | 2567 | 135 | 2432 |
| LRU | 73.7578 | 7541 | 2683 | 2533 | 118 | 2415 |
| CLOCK  (1 ref-bit) | 73.7578 | 7541 | 2683 | 2533 | 118 | 2415 |
| OPT | 74.1491 | 7581 | 2643 | 2493 | 2 | 2491 |

| Memory size | 200 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 73.4742 | 7512 | 2712 | 2512 | 134 | 2378 |
| FIFO | 73.5035 | 7515 | 2709 | 2509 | 131 | 2378 |
| LRU | 73.7578 | 7541 | 2683 | 2483 | 118 | 2365 |
| CLOCK  (1 ref-bit) | 73.7480 | 7540 | 2684 | 2484 | 118 | 2366 |
| OPT | 74.1491 | 7581 | 2643 | 2443 | 2 | 2441 |

| Memory size | 100 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 88.8008 | 2565163 | 323509 | 323409 | 315974 | 7435 |
| FIFO | 62.4898 | 1805124 | 1083548 | 1083448 | 1061223 | 22225 |
| LRU | 65.1494 | 1881456 | 1006456 | 1006356 | 1005396 | 960 |
| CLOCK  (1 ref-bit) | 65.3106 | 1886113 | 1001799 | 1001699 | 1000736 | 963 |
| OPT | 96.7867 | 2795114 | 92798 | 92698 | 91738 | 960 |

./sim -f ./traceprogs/tr-matmul.ref -m -s

| Memory size | 50 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 65.5255 | 1892818 | 995854 | 995804 | 956318 | 39486 |
| FIFO | 60.9766 | 1761415 | 1127257 | 1127207 | 1083214 | 43993 |
| LRU | 63.9452 | 1846682 | 1041230 | 1041180 | 1040201 | 979 |
| CLOCK  (1 ref-bit) | 63.9451 | 1846679 | 1041233 | 1041183 | 1040205 | 978 |
| OPT | 79.6581 | 2300455 | 587457 | 587407 | 586445 | 962 |

| Memory size | 150 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 96.6826 | 2792842 | 95830 | 95680 | 93386 | 2294 |
| FIFO | 98.8089 | 2854264 | 34408 | 34258 | 32943 | 1315 |
| LRU | 98.8612 | 2855025 | 32887 | 32737 | 31777 | 960 |
| CLOCK  (1 ref-bit) | 98.7980 | 2853198 | 34714 | 34564 | 33603 | 961 |
| OPT | 99.0784 | 2861297 | 26615 | 26465 | 25505 | 960 |

| Memory size | 200 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 98.0462 | 2832232 | 56440 | 56240 | 54606 | 1634 |
| FIFO | 98.8269 | 2854785 | 33887 | 33687 | 32433 | 1254 |
| LRU | 98.8616 | 2855036 | 32876 | 32676 | 31716 | 960 |
| CLOCK  (1 ref-bit) | 98.8611 | 2855023 | 32889 | 32689 | 31729 | 960 |
| OPT | 99.3329 | 2868647 | 19265 | 19065 | 18105 | 960 |

./sim -f ./traceprogs/tr-blocked.ref -m -s

| Memory size | 50 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 99.6530 | 2409745 | 8391 | 8341 | 5962 | 2379 |
| FIFO | 99.7381 | 2411651 | 6485 | 6435 | 4310 | 2125 |
| LRU | 99.7842 | 2412917 | 5219 | 4469 | 2249 | 2220 |
| CLOCK  (1 ref-bit) | 99.7616 | 2412371 | 3428 | 5715 | 3428 | 2287 |
| OPT | 99.8466 | 2414426 | 3710 | 3660 | 2700 | 960 |

| Memory size | 100 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 99.7785 | 2412780 | 5356 | 5256 | 3609 | 1647 |
| FIFO | 99.8206 | 2413798 | 4338 | 4238 | 2881 | 1357 |
| LRU | 99.8434 | 2414349 | 3787 | 3687 | 2727 | 960 |
| CLOCK  (1 ref-bit) | 99.8235 | 2413869 | 4267 | 4167 | 2747 | 1420 |
| OPT | 99.8755 | 2415125 | 3011 | 2911 | 1963 | 948 |

| Memory size | 150 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 99.8168 | 2413707 | 4429 | 4279 | 2910 | 1369 |
| FIFO | 99.8252 | 2413909 | 4227 | 4077 | 2776 | 1301 |
| LRU | 99.8441 | 2414366 | 3770 | 3620 | 2680 | 940 |
| CLOCK  (1 ref-bit) | 99.8436 | 2414354 | 3782 | 3632 | 2692 | 940 |
| OPT | 99.8954 | 2415607 | 2529 | 2379 | 1427 | 952 |

| Memory size | 200 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 99.8405 | 2414280 | 3856 | 3656 | 2434 | 1222 |
| FIFO | 99.8686 | 2414959 | 3177 | 2977 | 2001 | 976 |
| LRU | 99.8471 | 2414439 | 3697 | 3497 | 2557 | 940 |
| CLOCK  (1 ref-bit) | 99.8673 | 2414926 | 3210 | 3010 | 2059 | 951 |
| OPT | 99.9058 | 2415857 | 2279 | 2079 | 1139 | 940 |

**2. Fourth program: traffic in Assignment2-synchronization**

When the memory size is 50, the difference of the hit rates is relatively big. It is obvious that OPT > CLOCK ~= LRU >FIFO>RAND. When the memory size reaches 150 and 200, the hit rates of RAND, FIFO, LRU, CLOCK, OPT are very close.

./sim -f ./traceprogs/tr-traffic.ref -m -s

| Memory size | 50 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 94.6936 | 8530 | 478 | 428 | 364 | 64 |
| FIFO | 95.2376 | 8579 | 429 | 379 | 315 | 64 |
| LRU | 96.5142 | 8694 | 314 | 264 | 232 | 32 |
| CLOCK  (1 ref-bit) | 96.5142 | 8694 | 314 | 264 | 231 | 33 |
| OPT | 97.7353 | 8804 | 204 | 154 | 133 | 21 |

| Memory size | 100 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 97.3579 | 8770 | 238 | 138 | 111 | 27 |
| FIFO | 97.8020 | 8810 | 198 | 98 | 78 | 20 |
| LRU | 98.0906 | 8836 | 172 | 72 | 64 | 8 |
| CLOCK  (1 ref-bit) | 98.0129 | 8829 | 179 | 79 | 71 | 8 |
| OPT | 98.2238 | 8848 | 160 | 60 | 57 | 3 |

| Memory size | 150 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 98.1905 | 8845 | 163 | 13 | 11 | 2 |
| FIFO | 98.1461 | 8841 | 167 | 17 | 13 | 4 |
| LRU | 98.2238 | 8848 | 160 | 10 | 9 | 1 |
| CLOCK  (1 ref-bit) | 98.1572 | 8842 | 166 | 16 | 13 | 3 |
| OPT | 98.2238 | 8848 | 160 | 10 | 9 | 1 |

| Memory size | 200 | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Hit rate | Hit count | Miss count | Overall eviction count | Clean eviction count | Dirty eviction count |
| RAND | 98.2238 | 8840 | 160 | 0 | 0 | 0 |
| FIFO | 98.2238 | 8840 | 160 | 0 | 0 | 0 |
| LRU | 98.2238 | 8840 | 160 | 0 | 0 | 0 |
| CLOCK  (1 ref-bit) | 98.2238 | 8840 | 160 | 0 | 0 | 0 |
| OPT | 98.2238 | 8840 | 160 | 0 | 0 | 0 |

**3.** **One paragraph comparing the various algorithms in terms of the results you see in the tables**

By comparing the hit rates in the tables, we find FIFO hit rate < LRU hit rate ~= CLOCK hit rate < OPT hit rate. OPT always gives the best hit rate. It makes sense because OPT uses future information. It replaces the page that will not be referenced for the longest time thus always making the most optimal choice. I also find when the memory size is 50, the difference of the hit rates is relatively big. It is obvious that OPT > CLOCK ~= LRU >FIFO>RAND. When the memory size reaches 150 and 200, the hit rates of RAND, FIFO, LRU, CLOCK, OPT are very close. It gives me a sense that a good replacement policy has better performance for improving the hit rate when the memory size is relatively small.

**4. A second paragraph explaining the data you obtained for LRU as the size of memory increases.**

LRU hit rate increase as the size of memory increases. In LRU, the page that is used least recently will be replaced. When the size of memory increases, we can get more information about the recently used pages thus improving the performance of the LRU policy. Also, we can find that the increasing speed slows down as the memory size increases. The hit rate at the memory size 150 is very close to the hit rate at the memory size 200.