Mem size: 50   Miss rate: 27.0509

Simpleloop:

    RAND: OPT:

        Hit count: 7298   Hit count: 7619

        Miss count: 2990   Miss count: 2669

        Clean evictions: 139   Clean evictions: 18

        Dirty evictions: 2801   Dirty evictions: 2601

        Hit rate: 70.9370   Hit rate: 74.0572

        Miss rate: 29.0630   Miss rate: 25.9428

    FIFO:

        Hit count: 7304

        Miss count: 2984

        Clean evictions: 132

        Dirty evictions: 2802

        Hit rate: 70.9953

        Miss rate: 29.0047

    CLOCK:

        Hit count: 7484

        Miss count: 2804

        Clean evictions: 72

        Dirty evictions: 2682

        Hit rate: 72.7449

        Miss rate: 27.2551

    LRU:

        Hit count: 7505

        Miss count: 2783

        Clean evictions: 67

        Dirty evictions: 2666

        Hit rate: 72.9491

Matmul:

RAND:

Hit count: 1892150

Miss count: 995842

Clean evictions: 478284

Dirty evictions: 517508

Hit rate: 65.5178

Miss rate: 34.4822

FIFO:

Hit count: 1760714

Miss count: 1127278

Clean evictions: 541687

Dirty evictions: 585541

Hit rate: 60.9667

Miss rate: 39.0333

CLOCK:

Hit count: 1846735

Miss count: 1041257

Clean evictions: 520112

Dirty evictions: 521095

Hit rate: 63.9453

Miss rate: 36.0547

LRU:

Hit count: 1846765

Miss count: 1041227

Clean evictions: 520102

Dirty evictions: 521075

Hit rate: 63.9463

Miss rate: 36.0537

OPT:

Hit count: 2300535

Miss count: 587457

Clean evictions: 293415

Dirty evictions: 293992

Hit rate: 79.6586

Miss rate: 20.3414

Blocked:

    RAND:

        Hit count: 2409652

        Miss count: 8516

        Clean evictions: 3116

        Dirty evictions: 5350

        Hit rate: 99.6478

        Miss rate: 0.3522

    FIFO:

        Hit count: 2411656

        Miss count: 6512

        Clean evictions: 2123

        Dirty evictions: 4339

        Hit rate: 99.7307

        Miss rate: 0.2693

    CLOCK:

        Hit count: 2412906

        Miss count: 5262

        Clean evictions: 1468

        Dirty evictions: 3744

        Hit rate: 99.7824

        Miss rate: 0.2176

    LRU:

        Hit count: 2412951

        Miss count: 5217

        Clean evictions: 1434

        Dirty evictions: 3733

        Hit rate: 99.7843

        Miss rate: 0.2157

OPT:

        Hit count: 2414459

        Miss count: 3709

        Clean evictions: 1321

        Dirty evictions: 2338

        Hit rate: 99.8466

        Miss rate: 0.1534

Freq5:

RAND:

Hit count: 391621

Miss count: 826

Clean evictions: 293

Dirty evictions: 483

Hit rate: 99.7895

Miss rate: 0.2105

OPT:

Hit count: 392153

Miss count: 294

Clean evictions: 70

Dirty evictions: 174

Hit rate: 99.9251

Miss rate: 0.0749

FIFO:

Hit count: 391608

Miss count: 839

Clean evictions: 291

Dirty evictions: 498

Hit rate: 99.7862

Miss rate: 0.2138

CLOCK:

Hit count: 391841

Miss count: 606

Clean evictions: 199

Dirty evictions: 357

Hit rate: 99.8456

Miss rate: 0.1544

LRU:

Hit count: 391908

Miss count: 539

Clean evictions: 181

Dirty evictions: 308

Hit rate: 99.8627

Miss rate: 0.1373

Mem Size: 100   Miss rate: 26.1081

Simpleloop: OPT:

    RAND: Hit count: 7644

        Hit count: 7509   Miss count: 2644

        Miss count: 2779   Clean evictions: 0

        Clean evictions: 37   Dirty evictions: 2544

        Dirty evictions: 2642   Hit rate: 74.3002

        Hit rate: 72.9879   Miss rate: 25.6998

        Miss rate: 27.0121

    FIFO:

        Hit count: 7530

        Miss count: 2758

        Clean evictions: 33

        Dirty evictions: 2625

        Hit rate: 73.1921

        Miss rate: 26.8079

    CLOCK:

        Hit count: 7600

        Miss count: 2688

        Clean evictions: 4

        Dirty evictions: 2584

        Hit rate: 73.8725

        Miss rate: 26.1275

    LRU:

        Hit count: 7602

        Miss count: 2686

        Clean evictions: 2

        Dirty evictions: 2584

        Hit rate: 73.8919

Matmul:

    RAND:

        Hit count: 2564985

        Miss count: 323007

        Clean evictions: 157906

        Dirty evictions: 165001

        Hit rate: 88.8155

        Miss rate: 11.1845

    FIFO:

        Hit count: 1804445

        Miss count: 1083547

        Clean evictions: 530672

        Dirty evictions: 552775

        Hit rate: 62.4810

        Miss rate: 37.5190

    CLOCK:

        Hit count: 1846883

        Miss count: 1041109

        Clean evictions: 520031

        Dirty evictions: 520978

        Hit rate: 63.9504

        Miss rate: 36.0496

    LRU:

        Hit count: 1881535

        Miss count: 1006457

        Clean evictions: 502791

        Dirty evictions: 503566

        Hit rate: 65.1503

        Miss rate: 34.8497

OPT:

        Hit count: 2795193

        Miss count: 92799

        Clean evictions: 46006

        Dirty evictions: 46693

        Hit rate: 96.7867

        Miss rate: 3.2133

Blocked:

RAND:

Hit count: 2412871

Miss count: 5297

Clean evictions: 1857

Dirty evictions: 3340

Hit rate: 99.7809

Miss rate: 0.2191

OPT:

Hit count: 2415157

Miss count: 3011

Clean evictions: 1044

Dirty evictions: 1867

Hit rate: 99.8755

Miss rate: 0.1245

FIFO:

Hit count: 2413829

Miss count: 4339

Clean evictions: 1398

Dirty evictions: 2841

Hit rate: 99.8206

Miss rate: 0.1794

CLOCK:

Hit count: 2414144

Miss count: 4024

Clean evictions: 1334

Dirty evictions: 2590

Hit rate: 99.8336

Miss rate: 0.1664

LRU:

Hit count: 2414381

Miss count: 3787

Clean evictions: 1328

Dirty evictions: 2359

Hit rate: 99.8434

Miss rate: 0.1566

Freq5:

OPT:

    RAND:

    Hit count: 392284

        Hit count: 392182

    Miss count: 163

        Miss count: 265

    Clean evictions: 0

        Clean evictions: 31

    Dirty evictions: 63

        Dirty evictions: 134

    Hit rate: 99.9585

        Hit rate: 99.9325

    Miss rate: 0.0415

        Miss rate: 0.0675

    FIFO:

        Hit count: 392199

        Miss count: 248

        Clean evictions: 15

        Dirty evictions: 133

        Hit rate: 99.9368

        Miss rate: 0.0632

    CLOCK:

        Hit count: 392253

        Miss count: 194

        Clean evictions: 2

        Dirty evictions: 92

        Hit rate: 99.9506

        Miss rate: 0.0494

    LRU:

        Hit count: 392257

        Miss count: 190

        Clean evictions: 2

        Dirty evictions: 88

        Hit rate: 99.9516

        Miss rate: 0.0484

Mem size: 150   Miss rate: 26.0886

Simpleloop: OPT:

    RAND: Hit count: 7644

        Hit count: 7574   Miss count: 2644

        Miss count: 2714   Clean evictions: 0

        Clean evictions: 9   Dirty evictions: 2494

        Dirty evictions: 2555   Hit rate: 74.3002

        Hit rate: 73.6198   Miss rate: 25.6998

        Miss rate: 26.3802

    FIFO:

        Hit count: 7570

        Miss count: 2718

        Clean evictions: 8

        Dirty evictions: 2560

        Hit rate: 73.5809

        Miss rate: 26.4191

    CLOCK:

        Hit count: 7601

        Miss count: 2687

        Clean evictions: 0

        Dirty evictions: 2537

        Hit rate: 73.8822

        Miss rate: 26.1178

    LRU:

        Hit count: 7604

        Miss count: 2684

        Clean evictions: 0

        Dirty evictions: 2534

        Hit rate: 73.9114

Matmul:

RAND:

Hit count: 2791617

Miss count: 96375

Clean evictions: 47094

Dirty evictions: 49131

Hit rate: 96.6629

Miss rate: 3.3371

OPT:

Hit count: 2861376

Miss count: 26616

Clean evictions: 12926

Dirty evictions: 13540

Hit rate: 99.0784

Miss rate: 0.9216

FIFO:

Hit count: 2853581

Miss count: 34411

Clean evictions: 16665

Dirty evictions: 17596

Hit rate: 98.8085

Miss rate: 1.1915

CLOCK:

Hit count: 2854779

Miss count: 33213

Clean evictions: 16134

Dirty evictions: 16929

Hit rate: 98.8500

Miss rate: 1.1500

LRU:

Hit count: 2855104

Miss count: 32888

Clean evictions: 16018

Dirty evictions: 16720

Hit rate: 98.8612

Miss rate: 1.1388

Blocked:

RAND:

Hit count: 2413848

Miss count: 4320

Clean evictions: 1517

Dirty evictions: 2653

Hit rate: 99.8214

Miss rate: 0.1786

OPT:

Hit count: 2415640

Miss count: 2528

Clean evictions: 827

Dirty evictions: 1551

Hit rate: 99.8955

Miss rate: 0.1045

FIFO:

Hit count: 2413941

Miss count: 4227

Clean evictions: 1366

Dirty evictions: 2711

Hit rate: 99.8252

Miss rate: 0.1748

CLOCK:

Hit count: 2414232

Miss count: 3936

Clean evictions: 1326

Dirty evictions: 2460

Hit rate: 99.8372

Miss rate: 0.1628

LRU:

Hit count: 2414398

Miss count: 3770

Clean evictions: 1318

Dirty evictions: 2302

Hit rate: 99.8441

Miss rate: 0.1559

Freq5:

RAND:

    Hit count: 392273

    Miss count: 174

    Clean evictions: 0

    Dirty evictions: 24

    Hit rate: 99.9557

    Miss rate: 0.0443

FIFO:

    Hit count: 392268

    Miss count: 179

    Clean evictions: 0

    Dirty evictions: 29

    Hit rate: 99.9544

    Miss rate: 0.0456

CLOCK:

    Hit count: 392281

    Miss count: 166

    Clean evictions: 0

    Dirty evictions: 16

    Hit rate: 99.9577

    Miss rate: 0.0423

LRU:

    Hit count: 392284

    Miss count: 163

    Clean evictions: 0

    Dirty evictions: 13

    Hit rate: 99.9585

    Miss rate: 0.0415

OPT:

    Hit count: 392284

    Miss count: 163

    Clean evictions: 0

    Dirty evictions: 13

    Hit rate: 99.9585

    Miss rate: 0.0415

Mem size: 200   Miss rate: 26.0886

Simpleloop: OPT:

    RAND: Hit count: 7644

        Hit count: 7570   Miss count: 2644

        Miss count: 2718   Clean evictions: 0

        Clean evictions: 8   Dirty evictions: 2444

        Dirty evictions: 2510   Hit rate: 74.3002

        Hit rate: 73.5809   Miss rate: 25.6998

        Miss rate: 26.4191

    FIFO:

        Hit count: 7578

        Miss count: 2710

        Clean evictions: 6

        Dirty evictions: 2504

        Hit rate: 73.6586

        Miss rate: 26.3414

    CLOCK:

        Hit count: 7603

        Miss count: 2685

        Clean evictions: 0

        Dirty evictions: 2485

        Hit rate: 73.9016

        Miss rate: 26.0984

    LRU:

        Hit count: 7604

        Miss count: 2684

        Clean evictions: 0

        Dirty evictions: 2484

        Hit rate: 73.9114

Matmul:

    RAND:

        Hit count: 2831327

        Miss count: 56665

        Clean evictions: 27598

        Dirty evictions: 28867

        Hit rate: 98.0379

        Miss rate: 1.9621

    FIFO:

        Hit count: 2854102

        Miss count: 33890

        Clean evictions: 16250

        Dirty evictions: 17440

        Hit rate: 98.8265

        Miss rate: 1.1735

    CLOCK:

        Hit count: 2855088

        Miss count: 32904

        Clean evictions: 15988

        Dirty evictions: 16716

        Hit rate: 98.8607

        Miss rate: 1.1393

    LRU:

        Hit count: 2855115

        Miss count: 32877

        Clean evictions: 15985

        Dirty evictions: 16692

        Hit rate: 98.8616

        Miss rate: 1.1384

    OPT:

        Hit count: 2868726

        Miss count: 19266

        Clean evictions: 9240

        Dirty evictions: 9826

        Hit rate: 99.3329

        Miss rate: 0.6671

Blocked:

    RAND:

        Hit count: 2414315

        Miss count: 3853

        Clean evictions: 1329

        Dirty evictions: 2324

        Hit rate: 99.8407

        Miss rate: 0.1593

    FIFO:

        Hit count: 2414993

        Miss count: 3175

        Clean evictions: 1001

        Dirty evictions: 1974

        Hit rate: 99.8687

        Miss rate: 0.1313

    CLOCK:

        Hit count: 2414978

        Miss count: 3190

        Clean evictions: 1065

        Dirty evictions: 1925

        Hit rate: 99.8681

        Miss rate: 0.1319

    LRU:

        Hit count: 2414471

        Miss count: 3697

        Clean evictions: 1281

        Dirty evictions: 2216

        Hit rate: 99.8471

Miss rate: 0.1529

OPT:

        Hit count: 2415890

        Miss count: 2278

        Clean evictions: 655

        Dirty evictions: 1423

        Hit rate: 99.9058

        Miss rate: 0.0942

Freq5:

    RAND:

        Hit count: 392284

        Miss count: 163

        Clean evictions: 0

        Dirty evictions: 0

        Hit rate: 99.9585

        Miss rate: 0.0415

    FIFO:

        Hit count: 392284

        Miss count: 163

        Clean evictions: 0

        Dirty evictions: 0

        Hit rate: 99.9585

        Miss rate: 0.0415

    CLOCK:

        Hit count: 392284

        Miss count: 163

        Clean evictions: 0

        Dirty evictions: 0

        Hit rate: 99.9585

        Miss rate: 0.0415

    LRU:

        Hit count: 392284

        Miss count: 163

        Clean evictions: 0

        Dirty evictions: 0

        Hit rate: 99.9585

        Miss rate: 0.0415

    OPT:

        Hit count: 392284

        Miss count: 163

        Clean evictions: 0

        Dirty evictions: 0

        Hit rate: 99.9585

        Miss rate: 0.0415

My program:

The program I chose was an old csc209 program. Briefly, it forks into multiple processes of the users choice and each process reads a .dat filled with genetic code and counts the substrings of length 5 (also known as 5-mers in bioinformatics). These counts are then piped back to the parent where the parent aggregates all counts into one histogram. I thought this one might be interesting because the program forks into multiple processes, given that this simulation is to simulate page translation I thought it might beinteresting to see how it might behave when multiple processes are accessing the memory concurrently.

It doesn't seem all that interesting for memsize=200, probably because for the sake of time I drastically cut down on the size of the .dat files so the trace files would be made faster. Even though a DNA substring of length 5 can create 4^5 combinations, the program only recorded 163 of those combinations, so it only used 163 slots in the histogram and thus memsize was more than enough to carry everything and no evictions were needed.

Comparing algos:

As predicted, the algorithms ordered from worst to best is: FIFO, CLOCK, LRU, OPT. But the time used to execute from worst to best is: OPT, LRU, CLOCK, FIFO. Some other interesting things to note is that LRU and clock on some occasions (mostly when the memsize is small) perform virtually the same, with LRU being slightly better by a negligible amount. Another interesting thing to note is beladys anomaly clearly being shown in the FIFO algorithm on simpleloop: it seems that even though you increase the mem size the number of hits can drastically increase (from 50 to 100 memsize) but also hardly increase at all (from 150 to 200 memsize). The hit rate also does not increase that much from FIFO to LRU in a single memsize but OPT has a huge increase in performance with matmul with memsize =50 and 100. It would seem that temporal locality played a major role in LRU, CLOCK and OPT doing better than the simple FIFO algorithm, by determining time of reference those algorithms performed better, but the incrase in performance varies.

LRU analysis:

The LRU hit rate increases as memory increases. This is probably due to temporal locality: by adding more memory we can store more pages and get a more accurate picture of the current state of memory and make a better choice of which to predict. (e.g if I had memsize = 50 and memsize=200 I could probably make a better decision on who to evict if I had memsize=200 as I have more pages to work with). Again, LRU does better than FIFO and CLOCK, which is not surprising: FIFO only does well in very specific conditions and CLOCK approximates LRU. There seems to be a large jump in hit rate from memsize =100 to memsize=150, this could be due to the nature of matmul itself. If I had to make an educated guess, I would say that it may have something to do with loading large matrices, it's entirely possible that memsize =50 or 100 isn't large enough for the size of the matrices being multiplied so a lot of misses and evictions occur, while memsize = 150+ is enough room to store the matrices so far less swapping is needed and any references to the matrix will already be in memory.