OS 2022fall 11.3 hw8

20307140008 施君豪

运行环境：Windows 10 (pycharm)

1. **第二十二章**
2. **详见下列代码**

**（1）paging-policy.py -s 0 -n 10，结果为：**

**FIFO**

**Access: 8 MISS [8]**

**Access: 7 MISS [8, 7]**

**Access: 4 MISS [8, 7, 4]**

**Access: 2 MISS [7, 4, 2]**

**Access: 5 MISS [4, 2, 5]**

**Access: 4 HIT [4, 2, 5]**

**Access: 7 MISS [2, 5, 7]**

**Access: 3 MISS [5, 7, 3]**

**Access: 4 MISS [7, 3, 4]**

**Access: 5 MISS [3, 4, 5]**

**LRU：**

**Access: 8 MISS [8]**

**Access: 7 MISS [8, 7]**

**Access: 4 MISS [8, 7, 4]**

**Access: 2 MISS [7, 4, 2]**

**Access: 5 MISS [4, 2, 5]**

**Access: 4 HIT [2, 5, 4]**

**Access: 7 MISS [5, 4, 7]**

**Access: 3 MISS [4, 7, 3]**

**Access: 4 HIT [7, 3, 4]**

**Access: 5 MISS [3, 4, 5]**

**OPT：**

**Access: 8 MISS [8]**

**Access: 7 MISS [8, 7]**

**Access: 4 MISS [8, 7, 4]**

**Access: 2 MISS [7, 4, 2]**

**Access: 5 MISS [7, 4, 5]**

**Access: 4 HIT [7, 4, 5]**

**Access: 7 HIT [7, 4, 5]**

**Access: 3 MISS [4, 5, 3]**

**Access: 4 HIT [4, 5, 3]**

**Access: 5 HIT [4, 5, 3]**

**（2）paging-policy.py -s 1 -n 10，结果为：**

**FIFO：**

**Access: 1 MISS [1]**

**Access: 8 MISS [1, 8]**

**Access: 7 MISS [1, 8, 7]**

**Access: 2 MISS [8, 7, 2]**

**Access: 4 MISS [7, 2, 4]**

**Access: 4 HIT [7, 2, 4]**

**Access: 6 MISS [2, 4, 6]**

**Access: 7 MISS [4, 6, 7]**

**Access: 0 MISS [6, 7, 0]**

**Access: 0 HIT [6, 7, 0]**

**LRU：**

**Access: 1 MISS [1]**

**Access: 8 MISS [1, 8]**

**Access: 7 MISS [1, 8, 7]**

**Access: 2 MISS [8, 7, 2]**

**Access: 4 MISS [7, 2, 4]**

**Access: 4 HIT [7, 2, 4]**

**Access: 6 MISS [2, 4, 6]**

**Access: 7 MISS [4, 6, 7]**

**Access: 0 MISS [6, 7, 0]**

**Access: 0 HIT [6, 7, 0]**

**OPT：**

**Access: 1 MISS [1]**

**Access: 8 MISS [1, 8]**

**Access: 7 MISS [1, 8, 7]**

**Access: 2 MISS [1, 7, 2]**

**Access: 4 MISS [1, 7, 4]**

**Access: 4 HIT [1, 7, 4]**

**Access: 6 MISS [1, 7, 6]**

**Access: 7 HIT [1, 7, 6]**

**Access: 0 MISS [1, 7, 0]**

**Access: 0 HIT [1, 7, 0]**

**（3）paging-policy.py -s 2 -n 10，结果为：**

**FIFO：**

**Access: 9 MISS [9]**

**Access: 9 HIT [9]**

**Access: 0 MISS [9, 0]**

**Access: 0 HIT [9, 0]**

**Access: 8 MISS [9, 0, 8]**

**Access: 7 MISS [0, 8, 7]**

**Access: 6 MISS [8, 7, 6]**

**Access: 3 MISS [7, 6, 3]**

**Access: 6 HIT [7, 6, 3]**

**Access: 6 HIT [7, 6, 3]**

**LRU：**

**Access: 9 MISS [9]**

**Access: 9 HIT [9]**

**Access: 0 MISS [9, 0]**

**Access: 0 HIT [9, 0]**

**Access: 8 MISS [9, 0, 8]**

**Access: 7 MISS [0, 8, 7]**

**Access: 6 MISS [8, 7, 6]**

**Access: 3 MISS [7, 6, 3]**

**Access: 6 HIT [7, 3, 6]**

**Access: 6 HIT [7, 3, 6]**

**OPT：**

**Access: 9 MISS [9]**

**Access: 9 HIT [9]**

**Access: 0 MISS [9, 0]**

**Access: 0 HIT [9, 0]**

**Access: 8 MISS [9, 0, 8]**

**Access: 7 MISS [9, 0, 7]**

**Access: 6 MISS [9, 0, 6]**

**Access: 3 MISS [9, 6, 3]**

**Access: 6 HIT [9, 6, 3]**

**Access: 6 HIT [9, 6, 3]**

1. **对于不重复的序列，无论是FIFO，LRU，MRU，OPT的结果均是百分之百不命中。**

**如果要大幅提高性能接近OPT，理想状态为高速缓存大小为出现的全部序列号个数总数。（即高速缓存能够容纳所有序号）**

**测试代码：paging-policy.py -a 1,2,3,4,5,6,7,8 -C 5 -c (-p OPT/LRU/MRU)**

FIFO:

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -a 1,2,3,4,5,6,7,8 -C 5 -c

ARG addresses 1,2,3,4,5,6,7,8

ARG addressfile

ARG numaddrs 10

ARG policy FIFO

ARG clockbits 2

ARG cachesize 5

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 1 MISS FirstIn -> [1] <- Lastin Replaced:- [Hits:0 Misses:1]

Access: 2 MISS FirstIn -> [1, 2] <- Lastin Replaced:- [Hits:0 Misses:2]

Access: 3 MISS FirstIn -> [1, 2, 3] <- Lastin Replaced:- [Hits:0 Misses:3]

Access: 4 MISS FirstIn -> [1, 2, 3, 4] <- Lastin Replaced:- [Hits:0 Misses:4]

Access: 5 MISS FirstIn -> [1, 2, 3, 4, 5] <- Lastin Replaced:- [Hits:0 Misses:5]

Access: 6 MISS FirstIn -> [2, 3, 4, 5, 6] <- Lastin Replaced:1 [Hits:0 Misses:6]

Access: 7 MISS FirstIn -> [3, 4, 5, 6, 7] <- Lastin Replaced:2 [Hits:0 Misses:7]

Access: 8 MISS FirstIn -> [4, 5, 6, 7, 8] <- Lastin Replaced:3 [Hits:0 Misses:8]

FINALSTATS hits 0 misses 8 hitrate 0.00

LRU:

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -a 1,2,3,4,5,6,7,8 -C 5 -c -p LRU

ARG addresses 1,2,3,4,5,6,7,8

ARG addressfile

ARG numaddrs 10

ARG policy LRU

ARG clockbits 2

ARG cachesize 5

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 1 MISS LRU -> [1] <- MRU Replaced:- [Hits:0 Misses:1]

Access: 2 MISS LRU -> [1, 2] <- MRU Replaced:- [Hits:0 Misses:2]

Access: 3 MISS LRU -> [1, 2, 3] <- MRU Replaced:- [Hits:0 Misses:3]

Access: 4 MISS LRU -> [1, 2, 3, 4] <- MRU Replaced:- [Hits:0 Misses:4]

Access: 5 MISS LRU -> [1, 2, 3, 4, 5] <- MRU Replaced:- [Hits:0 Misses:5]

Access: 6 MISS LRU -> [2, 3, 4, 5, 6] <- MRU Replaced:1 [Hits:0 Misses:6]

Access: 7 MISS LRU -> [3, 4, 5, 6, 7] <- MRU Replaced:2 [Hits:0 Misses:7]

Access: 8 MISS LRU -> [4, 5, 6, 7, 8] <- MRU Replaced:3 [Hits:0 Misses:8]

FINALSTATS hits 0 misses 8 hitrate 0.00

MRU:

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -a 1,2,3,4,5,6,7,8 -C 5 -c -p MRU

ARG addresses 1,2,3,4,5,6,7,8

ARG addressfile

ARG numaddrs 10

ARG policy MRU

ARG clockbits 2

ARG cachesize 5

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 1 MISS LRU -> [1] <- MRU Replaced:- [Hits:0 Misses:1]

Access: 2 MISS LRU -> [1, 2] <- MRU Replaced:- [Hits:0 Misses:2]

Access: 3 MISS LRU -> [1, 2, 3] <- MRU Replaced:- [Hits:0 Misses:3]

Access: 4 MISS LRU -> [1, 2, 3, 4] <- MRU Replaced:- [Hits:0 Misses:4]

Access: 5 MISS LRU -> [1, 2, 3, 4, 5] <- MRU Replaced:- [Hits:0 Misses:5]

Access: 6 MISS LRU -> [1, 2, 3, 4, 6] <- MRU Replaced:5 [Hits:0 Misses:6]

Access: 7 MISS LRU -> [1, 2, 3, 4, 7] <- MRU Replaced:6 [Hits:0 Misses:7]

Access: 8 MISS LRU -> [1, 2, 3, 4, 8] <- MRU Replaced:7 [Hits:0 Misses:8]

FINALSTATS hits 0 misses 8 hitrate 0.00

OPT:

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -a 1,2,3,4,5,6,7,8 -C 5 -c -p OPT

ARG addresses 1,2,3,4,5,6,7,8

ARG addressfile

ARG numaddrs 10

ARG policy OPT

ARG clockbits 2

ARG cachesize 5

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 1 MISS Left -> [1] <- Right Replaced:- [Hits:0 Misses:1]

Access: 2 MISS Left -> [1, 2] <- Right Replaced:- [Hits:0 Misses:2]

Access: 3 MISS Left -> [1, 2, 3] <- Right Replaced:- [Hits:0 Misses:3]

Access: 4 MISS Left -> [1, 2, 3, 4] <- Right Replaced:- [Hits:0 Misses:4]

Access: 5 MISS Left -> [1, 2, 3, 4, 5] <- Right Replaced:- [Hits:0 Misses:5]

Access: 6 MISS Left -> [1, 2, 3, 4, 6] <- Right Replaced:5 [Hits:0 Misses:6]

Access: 7 MISS Left -> [1, 2, 3, 4, 7] <- Right Replaced:6 [Hits:0 Misses:7]

Access: 8 MISS Left -> [1, 2, 3, 4, 8] <- Right Replaced:7 [Hits:0 Misses:8]

FINALSTATS hits 0 misses 8 hitrate 0.00

1. **猜测：OPT > LRU > RAND, CLOCK > FIFO > UNOPT**

**实际结果：OPT >> ( FIFO = RAND > LRU = CLOCK ) > UNOPT**

**（中间四个整体差别不大）**

**测试代码：paging-policy.py -s 0 -C 5 -n 30 -c (-p OPT/LRU/RAND/CLOCK/UNOPT)**

**（限于篇幅下面就只放结论了）**

**FIFO：**

**FINALSTATS hits 14 misses 16 hitrate 46.67**

**OPT：**

**FINALSTATS hits 19 misses 11 hitrate 63.33**

**LRU：**

**FINALSTATS hits 13 misses 17 hitrate 43.33**

**RAND：**

**FINALSTATS hits 14 misses 16 hitrate 46.67**

**CLOCK：**

**FINALSTATS hits 13 misses 17 hitrate 43.33**

**UNOPT：**

**FINALSTATS hits 4 misses 26 hitrate 13.33**

1. **使用tool.py生成局部性序列，思想为选取目前序列最后一位i，再在i，i+1，i-1，以及0-9中一个随机随机数中随机选取一个。（tool.py同时已附在附件中）**

Tool.py:

import random

import sys

numAddr = 10

trace = [random.randint(0, numAddr)]

for i in range(20):

l = trace[-1]

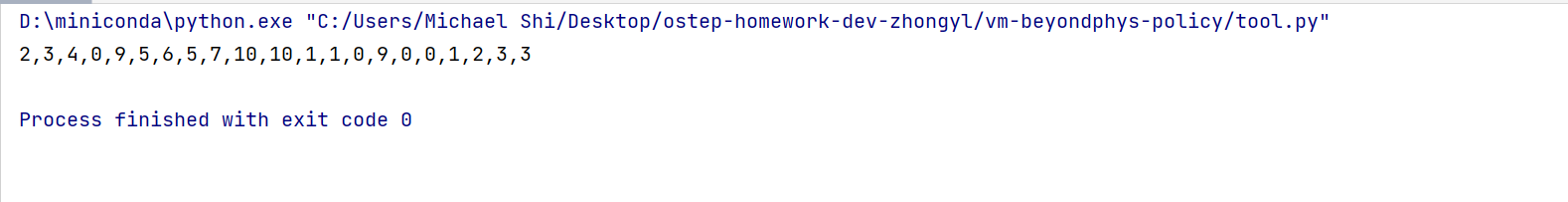
rand = [l, (l + 1) % numAddr, (l - 1) % numAddr, random.randint(0, numAddr)]

trace.append(random.choice(rand))

print(','.join([str(i) for i in trace]))

**为避免不同答案产生影响，故选取一个特定结果序列：**

**2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3**

****

**结论：LRU（33.33）效果比RAND（28.57）好，如果构造序列相关性更强的队列效果会更好。（RAND（28.57）效果与CLOCK（默认）（28.57）效果基本相同。**

**随着CLOCK的参数增大，效果越好，最终趋近于RAND。（23.33，28.57，28.57，之后均为28.57）原因是随着clock参数变大刚开始能够捕捉到序列的关系，过大则所有序号都到不了0，变成随机替换算法。**

**测试代码：paging-policy.py -p LRU -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3**

**paging-policy.py -p RAND -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3**

**paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3**

**paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3 -b 1**

**paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3 -b 2**

**paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3 -b 3**

**LRU：**

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -p LRU -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addresses 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addressfile

ARG numaddrs 10

ARG policy LRU

ARG clockbits 2

ARG cachesize 3

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 2 MISS LRU -> [2] <- MRU Replaced:- [Hits:0 Misses:1]

Access: 3 MISS LRU -> [2, 3] <- MRU Replaced:- [Hits:0 Misses:2]

Access: 4 MISS LRU -> [2, 3, 4] <- MRU Replaced:- [Hits:0 Misses:3]

Access: 0 MISS LRU -> [3, 4, 0] <- MRU Replaced:2 [Hits:0 Misses:4]

Access: 9 MISS LRU -> [4, 0, 9] <- MRU Replaced:3 [Hits:0 Misses:5]

Access: 5 MISS LRU -> [0, 9, 5] <- MRU Replaced:4 [Hits:0 Misses:6]

Access: 6 MISS LRU -> [9, 5, 6] <- MRU Replaced:0 [Hits:0 Misses:7]

Access: 5 HIT LRU -> [9, 6, 5] <- MRU Replaced:- [Hits:1 Misses:7]

Access: 7 MISS LRU -> [6, 5, 7] <- MRU Replaced:9 [Hits:1 Misses:8]

Access: 10 MISS LRU -> [5, 7, 10] <- MRU Replaced:6 [Hits:1 Misses:9]

Access: 10 HIT LRU -> [5, 7, 10] <- MRU Replaced:- [Hits:2 Misses:9]

Access: 1 MISS LRU -> [7, 10, 1] <- MRU Replaced:5 [Hits:2 Misses:10]

Access: 1 HIT LRU -> [7, 10, 1] <- MRU Replaced:- [Hits:3 Misses:10]

Access: 0 MISS LRU -> [10, 1, 0] <- MRU Replaced:7 [Hits:3 Misses:11]

Access: 9 MISS LRU -> [1, 0, 9] <- MRU Replaced:10 [Hits:3 Misses:12]

Access: 0 HIT LRU -> [1, 9, 0] <- MRU Replaced:- [Hits:4 Misses:12]

Access: 0 HIT LRU -> [1, 9, 0] <- MRU Replaced:- [Hits:5 Misses:12]

Access: 1 HIT LRU -> [9, 0, 1] <- MRU Replaced:- [Hits:6 Misses:12]

Access: 2 MISS LRU -> [0, 1, 2] <- MRU Replaced:9 [Hits:6 Misses:13]

Access: 3 MISS LRU -> [1, 2, 3] <- MRU Replaced:0 [Hits:6 Misses:14]

Access: 3 HIT LRU -> [1, 2, 3] <- MRU Replaced:- [Hits:7 Misses:14]

**FINALSTATS hits 7 misses 14 hitrate 33.33**

**RAND：**

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -p RAND -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addresses 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addressfile

ARG numaddrs 10

ARG policy RAND

ARG clockbits 2

ARG cachesize 3

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 2 MISS Left -> [2] <- Right Replaced:- [Hits:0 Misses:1]

Access: 3 MISS Left -> [2, 3] <- Right Replaced:- [Hits:0 Misses:2]

Access: 4 MISS Left -> [2, 3, 4] <- Right Replaced:- [Hits:0 Misses:3]

Access: 0 MISS Left -> [2, 3, 0] <- Right Replaced:4 [Hits:0 Misses:4]

Access: 9 MISS Left -> [2, 3, 9] <- Right Replaced:0 [Hits:0 Misses:5]

Access: 5 MISS Left -> [2, 9, 5] <- Right Replaced:3 [Hits:0 Misses:6]

Access: 6 MISS Left -> [9, 5, 6] <- Right Replaced:2 [Hits:0 Misses:7]

Access: 5 HIT Left -> [9, 5, 6] <- Right Replaced:- [Hits:1 Misses:7]

Access: 7 MISS Left -> [9, 6, 7] <- Right Replaced:5 [Hits:1 Misses:8]

Access: 10 MISS Left -> [9, 7, 10] <- Right Replaced:6 [Hits:1 Misses:9]

Access: 10 HIT Left -> [9, 7, 10] <- Right Replaced:- [Hits:2 Misses:9]

Access: 1 MISS Left -> [9, 7, 1] <- Right Replaced:10 [Hits:2 Misses:10]

Access: 1 HIT Left -> [9, 7, 1] <- Right Replaced:- [Hits:3 Misses:10]

Access: 0 MISS Left -> [7, 1, 0] <- Right Replaced:9 [Hits:3 Misses:11]

Access: 9 MISS Left -> [7, 0, 9] <- Right Replaced:1 [Hits:3 Misses:12]

Access: 0 HIT Left -> [7, 0, 9] <- Right Replaced:- [Hits:4 Misses:12]

Access: 0 HIT Left -> [7, 0, 9] <- Right Replaced:- [Hits:5 Misses:12]

Access: 1 MISS Left -> [7, 9, 1] <- Right Replaced:0 [Hits:5 Misses:13]

Access: 2 MISS Left -> [7, 9, 2] <- Right Replaced:1 [Hits:5 Misses:14]

Access: 3 MISS Left -> [7, 2, 3] <- Right Replaced:9 [Hits:5 Misses:15]

Access: 3 HIT Left -> [7, 2, 3] <- Right Replaced:- [Hits:6 Misses:15]

**FINALSTATS hits 6 misses 15 hitrate 28.57**

**CLOCK：**

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addresses 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addressfile

ARG numaddrs 10

ARG policy CLOCK

ARG clockbits 2

ARG cachesize 3

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 2 MISS Left -> [2] <- Right Replaced:- [Hits:0 Misses:1]

Access: 3 MISS Left -> [2, 3] <- Right Replaced:- [Hits:0 Misses:2]

Access: 4 MISS Left -> [2, 3, 4] <- Right Replaced:- [Hits:0 Misses:3]

Access: 0 MISS Left -> [2, 3, 0] <- Right Replaced:4 [Hits:0 Misses:4]

Access: 9 MISS Left -> [2, 0, 9] <- Right Replaced:3 [Hits:0 Misses:5]

Access: 5 MISS Left -> [0, 9, 5] <- Right Replaced:2 [Hits:0 Misses:6]

Access: 6 MISS Left -> [0, 5, 6] <- Right Replaced:9 [Hits:0 Misses:7]

Access: 5 HIT Left -> [0, 5, 6] <- Right Replaced:- [Hits:1 Misses:7]

Access: 7 MISS Left -> [5, 6, 7] <- Right Replaced:0 [Hits:1 Misses:8]

Access: 10 MISS Left -> [5, 7, 10] <- Right Replaced:6 [Hits:1 Misses:9]

Access: 10 HIT Left -> [5, 7, 10] <- Right Replaced:- [Hits:2 Misses:9]

Access: 1 MISS Left -> [7, 10, 1] <- Right Replaced:5 [Hits:2 Misses:10]

Access: 1 HIT Left -> [7, 10, 1] <- Right Replaced:- [Hits:3 Misses:10]

Access: 0 MISS Left -> [7, 10, 0] <- Right Replaced:1 [Hits:3 Misses:11]

Access: 9 MISS Left -> [10, 0, 9] <- Right Replaced:7 [Hits:3 Misses:12]

Access: 0 HIT Left -> [10, 0, 9] <- Right Replaced:- [Hits:4 Misses:12]

Access: 0 HIT Left -> [10, 0, 9] <- Right Replaced:- [Hits:5 Misses:12]

Access: 1 MISS Left -> [10, 0, 1] <- Right Replaced:9 [Hits:5 Misses:13]

Access: 2 MISS Left -> [10, 1, 2] <- Right Replaced:0 [Hits:5 Misses:14]

Access: 3 MISS Left -> [10, 1, 3] <- Right Replaced:2 [Hits:5 Misses:15]

Access: 3 HIT Left -> [10, 1, 3] <- Right Replaced:- [Hits:6 Misses:15]

**FINALSTATS hits 6 misses 15 hitrate 28.57**

**CLOCK(1):**

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3 -b 1

ARG addresses 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addressfile

ARG numaddrs 10

ARG policy CLOCK

ARG clockbits 1

ARG cachesize 3

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 2 MISS Left -> [2] <- Right Replaced:- [Hits:0 Misses:1]

Access: 3 MISS Left -> [2, 3] <- Right Replaced:- [Hits:0 Misses:2]

Access: 4 MISS Left -> [2, 3, 4] <- Right Replaced:- [Hits:0 Misses:3]

Access: 0 MISS Left -> [2, 3, 0] <- Right Replaced:4 [Hits:0 Misses:4]

Access: 9 MISS Left -> [2, 0, 9] <- Right Replaced:3 [Hits:0 Misses:5]

Access: 5 MISS Left -> [0, 9, 5] <- Right Replaced:2 [Hits:0 Misses:6]

Access: 6 MISS Left -> [0, 5, 6] <- Right Replaced:9 [Hits:0 Misses:7]

Access: 5 HIT Left -> [0, 5, 6] <- Right Replaced:- [Hits:1 Misses:7]

Access: 7 MISS Left -> [0, 6, 7] <- Right Replaced:5 [Hits:1 Misses:8]

Access: 10 MISS Left -> [6, 7, 10] <- Right Replaced:0 [Hits:1 Misses:9]

Access: 10 HIT Left -> [6, 7, 10] <- Right Replaced:- [Hits:2 Misses:9]

Access: 1 MISS Left -> [7, 10, 1] <- Right Replaced:6 [Hits:2 Misses:10]

Access: 1 HIT Left -> [7, 10, 1] <- Right Replaced:- [Hits:3 Misses:10]

Access: 0 MISS Left -> [7, 10, 0] <- Right Replaced:1 [Hits:3 Misses:11]

Access: 9 MISS Left -> [7, 10, 9] <- Right Replaced:0 [Hits:3 Misses:12]

Access: 0 MISS Left -> [10, 9, 0] <- Right Replaced:7 [Hits:3 Misses:13]

Access: 0 HIT Left -> [10, 9, 0] <- Right Replaced:- [Hits:4 Misses:13]

Access: 1 MISS Left -> [10, 9, 1] <- Right Replaced:0 [Hits:4 Misses:14]

Access: 2 MISS Left -> [9, 1, 2] <- Right Replaced:10 [Hits:4 Misses:15]

Access: 3 MISS Left -> [9, 2, 3] <- Right Replaced:1 [Hits:4 Misses:16]

Access: 3 HIT Left -> [9, 2, 3] <- Right Replaced:- [Hits:5 Misses:16]

**FINALSTATS hits 5 misses 16 hitrate 23.81**

**CLOCK(2):**

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3 -b 2

ARG addresses 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addressfile

ARG numaddrs 10

ARG policy CLOCK

ARG clockbits 2

ARG cachesize 3

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 2 MISS Left -> [2] <- Right Replaced:- [Hits:0 Misses:1]

Access: 3 MISS Left -> [2, 3] <- Right Replaced:- [Hits:0 Misses:2]

Access: 4 MISS Left -> [2, 3, 4] <- Right Replaced:- [Hits:0 Misses:3]

Access: 0 MISS Left -> [2, 3, 0] <- Right Replaced:4 [Hits:0 Misses:4]

Access: 9 MISS Left -> [2, 0, 9] <- Right Replaced:3 [Hits:0 Misses:5]

Access: 5 MISS Left -> [0, 9, 5] <- Right Replaced:2 [Hits:0 Misses:6]

Access: 6 MISS Left -> [0, 5, 6] <- Right Replaced:9 [Hits:0 Misses:7]

Access: 5 HIT Left -> [0, 5, 6] <- Right Replaced:- [Hits:1 Misses:7]

Access: 7 MISS Left -> [5, 6, 7] <- Right Replaced:0 [Hits:1 Misses:8]

Access: 10 MISS Left -> [5, 7, 10] <- Right Replaced:6 [Hits:1 Misses:9]

Access: 10 HIT Left -> [5, 7, 10] <- Right Replaced:- [Hits:2 Misses:9]

Access: 1 MISS Left -> [7, 10, 1] <- Right Replaced:5 [Hits:2 Misses:10]

Access: 1 HIT Left -> [7, 10, 1] <- Right Replaced:- [Hits:3 Misses:10]

Access: 0 MISS Left -> [7, 10, 0] <- Right Replaced:1 [Hits:3 Misses:11]

Access: 9 MISS Left -> [10, 0, 9] <- Right Replaced:7 [Hits:3 Misses:12]

Access: 0 HIT Left -> [10, 0, 9] <- Right Replaced:- [Hits:4 Misses:12]

Access: 0 HIT Left -> [10, 0, 9] <- Right Replaced:- [Hits:5 Misses:12]

Access: 1 MISS Left -> [10, 0, 1] <- Right Replaced:9 [Hits:5 Misses:13]

Access: 2 MISS Left -> [10, 1, 2] <- Right Replaced:0 [Hits:5 Misses:14]

Access: 3 MISS Left -> [10, 1, 3] <- Right Replaced:2 [Hits:5 Misses:15]

Access: 3 HIT Left -> [10, 1, 3] <- Right Replaced:- [Hits:6 Misses:15]

**FINALSTATS hits 6 misses 15 hitrate 28.57**

**CLOCK(3):**

(base) C:\Users\Michael Shi\Desktop\ostep-homework-dev-zhongyl\vm-beyondphys-policy>paging-policy.py -p CLOCK -c -a 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3 -b 3

ARG addresses 2,3,4,0,9,5,6,5,7,10,10,1,1,0,9,0,0,1,2,3,3

ARG addressfile

ARG numaddrs 10

ARG policy CLOCK

ARG clockbits 3

ARG cachesize 3

ARG maxpage 10

ARG seed 0

ARG notrace False

Solving...

Access: 2 MISS Left -> [2] <- Right Replaced:- [Hits:0 Misses:1]

Access: 3 MISS Left -> [2, 3] <- Right Replaced:- [Hits:0 Misses:2]

Access: 4 MISS Left -> [2, 3, 4] <- Right Replaced:- [Hits:0 Misses:3]

Access: 0 MISS Left -> [2, 3, 0] <- Right Replaced:4 [Hits:0 Misses:4]

Access: 9 MISS Left -> [2, 0, 9] <- Right Replaced:3 [Hits:0 Misses:5]

Access: 5 MISS Left -> [0, 9, 5] <- Right Replaced:2 [Hits:0 Misses:6]

Access: 6 MISS Left -> [0, 5, 6] <- Right Replaced:9 [Hits:0 Misses:7]

Access: 5 HIT Left -> [0, 5, 6] <- Right Replaced:- [Hits:1 Misses:7]

Access: 7 MISS Left -> [5, 6, 7] <- Right Replaced:0 [Hits:1 Misses:8]

Access: 10 MISS Left -> [5, 7, 10] <- Right Replaced:6 [Hits:1 Misses:9]

Access: 10 HIT Left -> [5, 7, 10] <- Right Replaced:- [Hits:2 Misses:9]

Access: 1 MISS Left -> [7, 10, 1] <- Right Replaced:5 [Hits:2 Misses:10]

Access: 1 HIT Left -> [7, 10, 1] <- Right Replaced:- [Hits:3 Misses:10]

Access: 0 MISS Left -> [7, 10, 0] <- Right Replaced:1 [Hits:3 Misses:11]

Access: 9 MISS Left -> [10, 0, 9] <- Right Replaced:7 [Hits:3 Misses:12]

Access: 0 HIT Left -> [10, 0, 9] <- Right Replaced:- [Hits:4 Misses:12]

Access: 0 HIT Left -> [10, 0, 9] <- Right Replaced:- [Hits:5 Misses:12]

Access: 1 MISS Left -> [10, 0, 1] <- Right Replaced:9 [Hits:5 Misses:13]

Access: 2 MISS Left -> [10, 1, 2] <- Right Replaced:0 [Hits:5 Misses:14]

Access: 3 MISS Left -> [10, 1, 3] <- Right Replaced:2 [Hits:5 Misses:15]

Access: 3 HIT Left -> [10, 1, 3] <- Right Replaced:- [Hits:6 Misses:15]

**FINALSTATS hits 6 misses 15 hitrate 28.57**

**5、 本电脑为intel x64架构，物理地址 39 位,虚拟地址 48 位.,命令可以看到页大小为 4k(12 位)**

**intel x64 采用四级页表，即9-9-9-9-12分页，每级索引为 9 位,得到的地址直接右移 39 位即可。**

**根据结果至少10KB大小缓存。**

**以下为测试结果：**

**==5192==**

**==5192== Counted 0 calls to main()**

**==5192==**

**==5192== Jccs:**

**==5192== total: 96,040**

**==5192== taken: 47,991 (50%)**

**==5192==**

**==5192== Executed:**

**==5192== SBs entered: 92,692**

**==5192== SBs completed: 62,247**

**==5192== guest instrs: 468,723**

**==5192== IRStmts: 2,930,905**

**==5192==**

**==5192== Ratios:**

**==5192== guest instrs : SB entered = 50 : 10**

**==5192== IRStmts : SB entered = 316 : 10**

**==5192== IRStmts : guest instr = 62 : 10**

**==5192==**

**==5192== Exit code: 0**