CA-Assignment 3

IMT2021066, IMT2021067, IMT2021078

How to run cache1.py file

Open the file on any editor and run it using the 'python3 IMT2021066_IMT2021067_IMT2021078_cache.py' command on the terminal.

It will ask for inputs of cache size, block size and number of ways. Enter the values.

Output for all trace files will be displayed in terminal.

Q1 a)

Cache size = 512 kb ; Block size = 4 bytes ; Number of ways = 4 ; lines = 2^15

To calculate number of lines we use this formula: lines = (cache size * 1024)/ (block size * n-ways)

DATA

TRACE FILE NAME	HIT COUNT	MISS COUNT	HIT RATE	MISS RATE	HITS/MISSES
gcc.trace	483893	31790	93.8353 %	6.1646 %	15.2215
gzip.trace	320883	160161	66.7055%	33.2944%	2.0035
mcf.trace	7508	719722	1.0324%	98.9675%	0.0104
swim.trace	280825	22368	92.6225%	7.3774%	12.5547
twolf.trace	476844	5980	98.7614%	1.2385%	79.7397

```
4 way set associatice cache
512 = cache size(kB)  ,4 = block size(bytes)  ,32768 = lines


***** gcc.trace *****
Hit count->  483893   Hit rate-> 93.83536009525231 %
Miss count->  31790   Miss rate-> 6.164639904747684 %
Hits/Misses 15.221547656495753
---------------------------------------------------------------


***** gzip.trace *****
Hit count->  320883   Hit rate-> 66.70554044952229 %
Miss count->  160161   Miss rate-> 33.29445955047771 %
Hits/Misses 2.003502725382584
---------------------------------------------------------------


***** mcf.trace *****
Hit count->  7508   Hit rate-> 1.03241065412593 %
Miss count->  719722   Miss rate-> 98.96758934587407 %
Hits/Misses 0.01043180561383423
---------------------------------------------------------------


***** swim.trace *****
Hit count->  280825   Hit rate-> 92.62252096849201 %
Miss count->  22368   Miss rate-> 7.377479031507983 %
Hits/Misses 12.554765736766809
---------------------------------------------------------------


***** twolf.trace *****
Hit count->  476844   Hit rate-> 98.76145344887578 %
Miss count->  5980   Miss rate-> 1.238546551124219 %
Hits/Misses 79.73979933110368
---------------------------------------------------------------
```

Q1 b)

Cache size = 2048 kb ; Block size = 4 bytes ; Number of ways = 4 ; lines = 2^17

To calculate number of lines we use this formula: lines = (cache size * 1024)/ (block size * n-ways).

DATA

TRACE FILE NAME	HIT COUNT	MISS COUNT	HIT RATE	MISS RATE	HITS/MISSES
gcc.trace	483894	31789	93.8355%	6.1644%	15.2220
gzip.trace	320883	160161	66.7055%	33.2944%	2.0035
mcf.trace	7508	719722	1.0324%	98.9675%	0.0104
swim.trace	280825	22368	92.6225%	7.3774%	12.5547
twolf.trace	476844	5980	98.7614%	1.2385%	79.7397

OBSERVATION

In gcc.trace output we can see that hit rate has increased by 0.004%. For every other trace file output is the same as a) part with 512kB cache size.

```
4 way set associatice cache
2048 = cache size(kB)  ,4 = block size(bytes)  ,131072 = lines


***** gcc.trace *****
Hit count->  483894   Hit rate-> 93.83555401283347 %
Miss count->  31789   Miss rate-> 6.164445987166534 %
Hits/Misses 15.222057944572022
-----------------------------------------------------------------


***** gzip.trace *****
Hit count->  320883   Hit rate-> 66.70554044952229 %
Miss count->  160161   Miss rate-> 33.29445955047771 %
Hits/Misses 2.003502725382584
-----------------------------------------------------------------


***** mcf.trace *****
Hit count->  7508   Hit rate-> 1.03241065412593 %
Miss count->  719722   Miss rate-> 98.96758934587407 %
Hits/Misses 0.01043180561383423
-----------------------------------------------------------------


***** swim.trace *****
Hit count->  280825   Hit rate-> 92.62252096849201 %
Miss count->  22368   Miss rate-> 7.377479031507983 %
Hits/Misses 12.554765736766809
-----------------------------------------------------------------


***** twolf.trace *****
Hit count->  476844   Hit rate-> 98.76145344887578 %
Miss count->  5980   Miss rate-> 1.238546551124219 %
Hits/Misses 79.73979933110368
-----------------------------------------------------------------
```

Q1 c)

Cache size = 512 kb ; Block size = 1- 16 bytes ; Number of ways = 4 ;

DATA

TRACE FILE NAME	BLOCK SIZE	HIT RATE	MISS RATE
gcc.trace	1 byte	93.1987 %	6.8012 %
	4 bytes	93.8353 %	6.1646 %
	8 bytes	95.9263 %	4.0736 %
	16 bytes	97.8246 %	2.1753 %
gzip.trace	1 byte	66.7038 %	33.2961 %
	4 bytes	66.7055 %	33.2944 %
	8 bytes	66.7072 %	33.2927 %
	16 bytes	66.7855 %	33.2144 %
mcf.trace	1 byte	1.0245 %	98.9754 %
	4 bytes	1.0324 %	98.9675 %
	8 bytes	1.0383 %	98.9616 %
	16 bytes	50.5030 %	49.4969 %
swim.trace	1 byte	92.5443 %	7.4556 %
	4 bytes	92.6225 %	7.3774 %
	8 bytes	93.4642 %	6.5357 %
	16 bytes	96.2324 %	3.7675 %
twolf.trace	1 byte	98.4768%	1.5231%
	4 bytes	98.7614 %	1.2385 %
	8 bytes	98.8598 %	1.1401 %
	16 bytes	99.3879 %	0.6120 %

OBSERVATION

Cache lines decrease in the order:

1 byte = 2^17 lines

4 bytes = 2^15 lines

8 bytes = 2^ 14 lines

16 bytes = 2^13 lines

For all trace files, **as block size increases, hit rate increases, miss rate decreases.**

Q1 d)

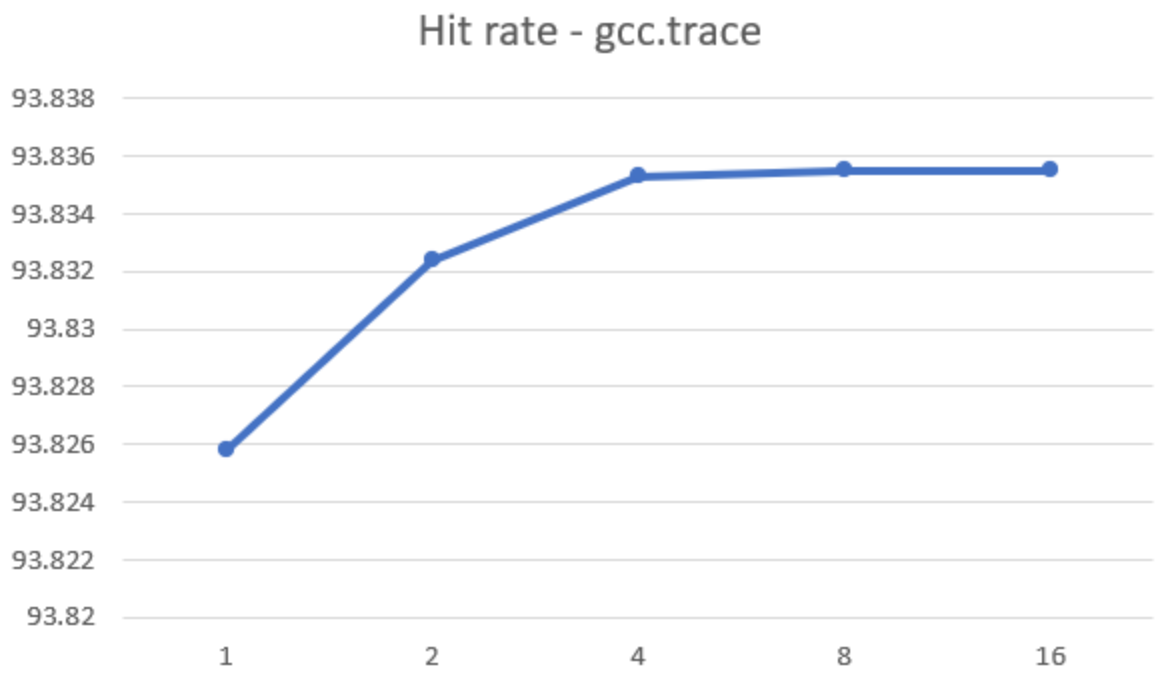
Cache size = 512kb ; Block size = 4 bytes ; Number of ways = 1-16 ways
->For each way size run the file separately as you need to change input value of way. We have noted results from terminal and put it in the table.

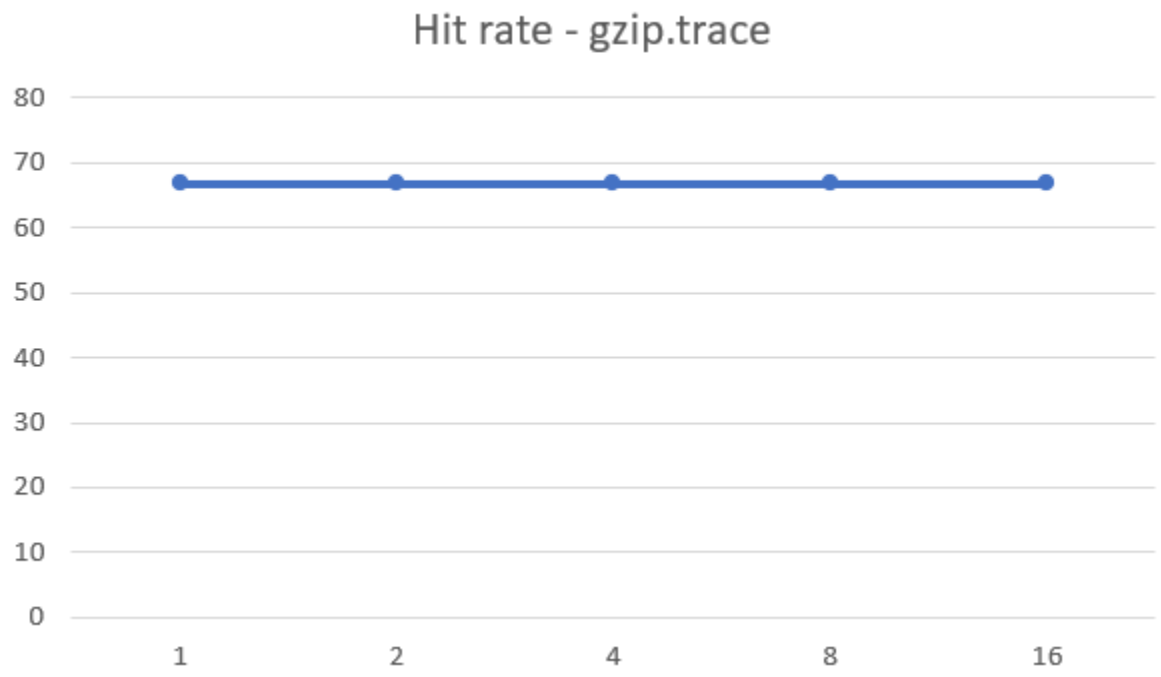
DATA

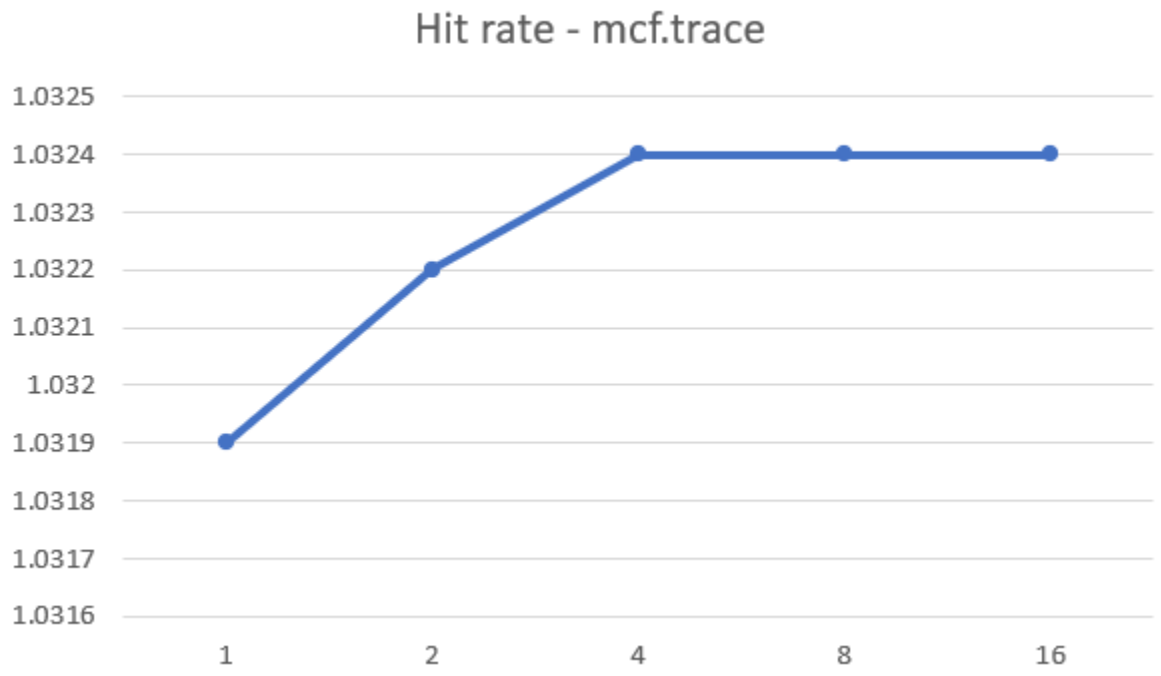
TRACE FILE NAME	NUMBER OF WAYS	HIT RATE	MISS RATE
gcc.trace	1	93.8258 %	6.1741 %
	2	93.8324 %	6.1685 %
	4	93.8353 %	6.1648 %
	8	93.8355%	6.1644 %
	16	93.8355 %	6.1644 %
gzip.trace	1	66.7055 %	33.2944 %
	2	66.7055 %	33.2944 %
	4	66.7055 %	33.2944 %
	8	66.7055 %	33.2944 %
	16	66.7055 %	33.2944 %

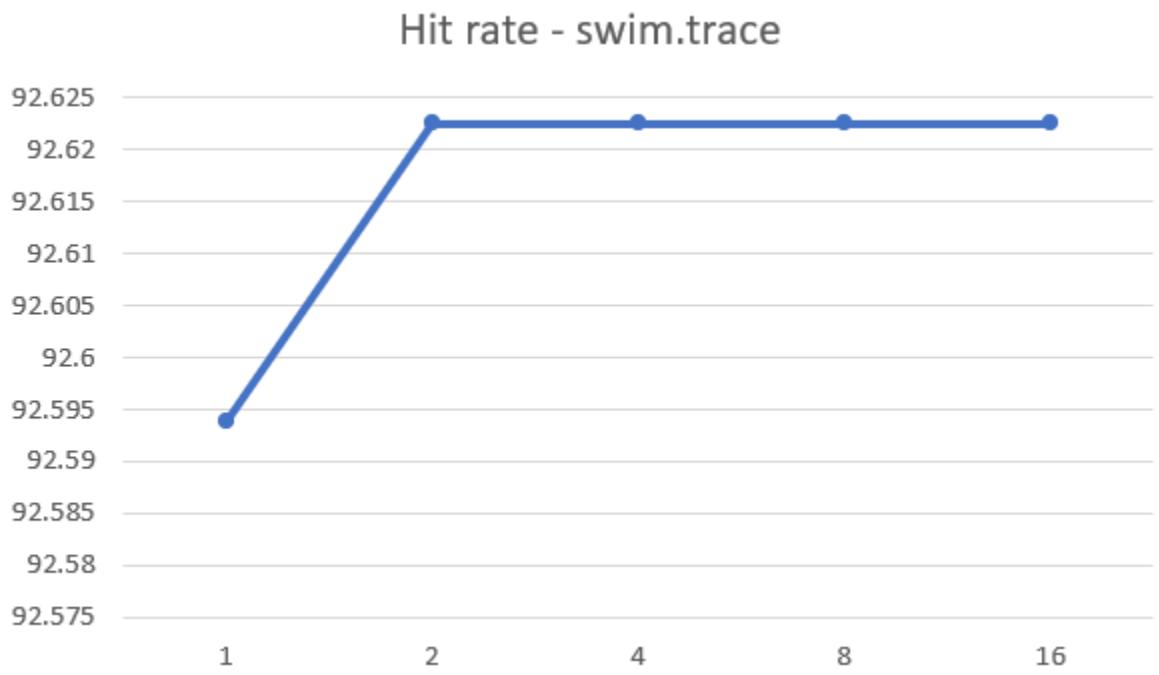
mcf.trace	1	1.0319 %	98.9680 %
	2	1.0322 %	98.9677 %
	4	1.0324 %	98.9675 %
	8	1.0324 %	98.9675 %
	16	1.0324 %	98.9675 %
swim.trace	1	92.5938 %	7.4061 %
	2	92.6225 %	7.3774 %
	4	92.6225 %	7.3774 %
	8	92.6225 %	7.3774 %
	16	92.6225 %	7.3774 %
twolf.trace	1	98.7463 %	1.2536 %
	2	98.7608 %	1.2391 %
	4	98.7614 %	1.2385 %
	8	98.7614 %	1.2385 %
	16	98.7614 %	1.2385 %

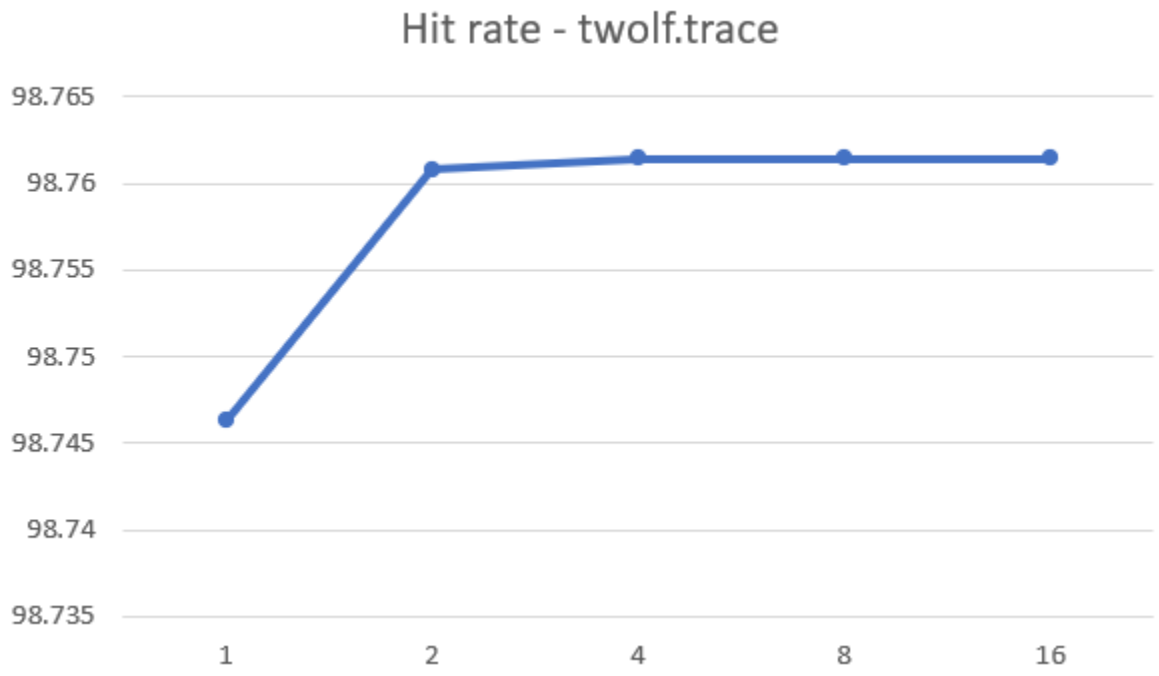
GRAPH - HIT RATES VS SET ASSOCIATIVITY

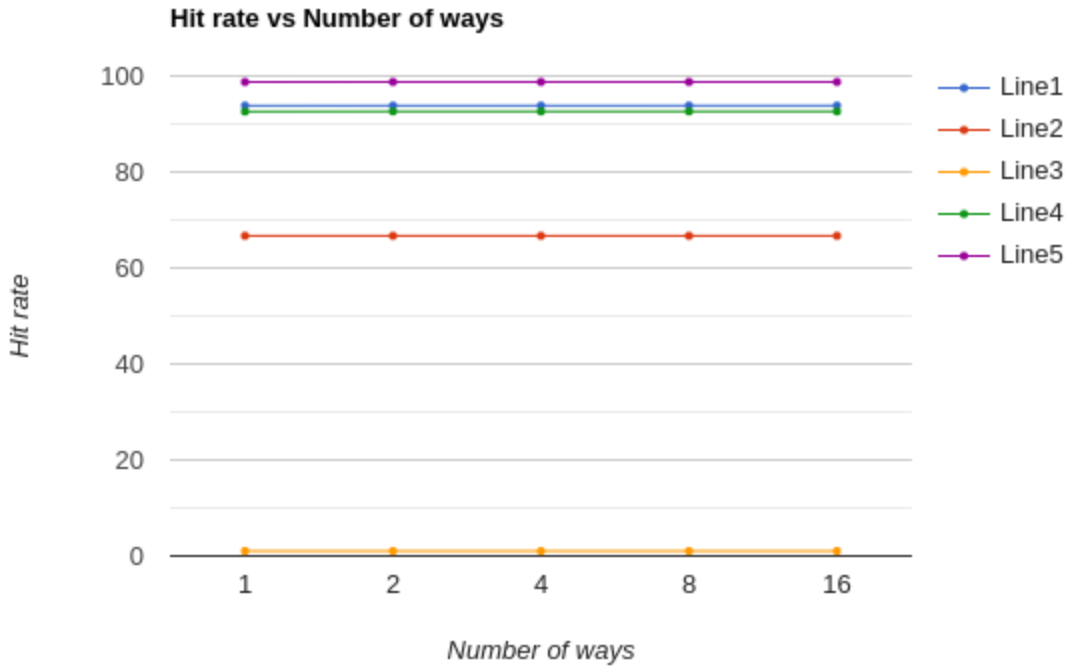



Hit rate - gzip.trace
80
70
60
50
40
30
20
10
0
1
2
4
8
16


Hit rate - mcf.trace
1.0325
1.0324
1.0323
1.0322
1.0321
1.032
1.0319
1.0318
1.0317
1.0316
1
2
4
8
16


Hit rate - swim.trace
92.625
92.62
92.615
92.61
92.605
92.6
92.595
92.59
92.585
92.58
92.575
1
2
4
8
16


Hit rate - twolf.trace
98.765
98.76
98.755
98.75
98.745
98.74
98.735
1
2
4
8
16



Line 1= gcc

Line 2 =gzip

Line 3 = mcf

Line 4 = swim

Line 5 = twolf

OBSERVATION

As the **number of ways increases, the hit rate increases**. It is seen that it initially increases rapidly, and then saturates.

THE END