CS622 : Advanced Computer Architecture
Assignment 2
26th September 2019

Siddharth Jayashankar (170699) | Abir Mukherjee (19111005)

Group Id: 5
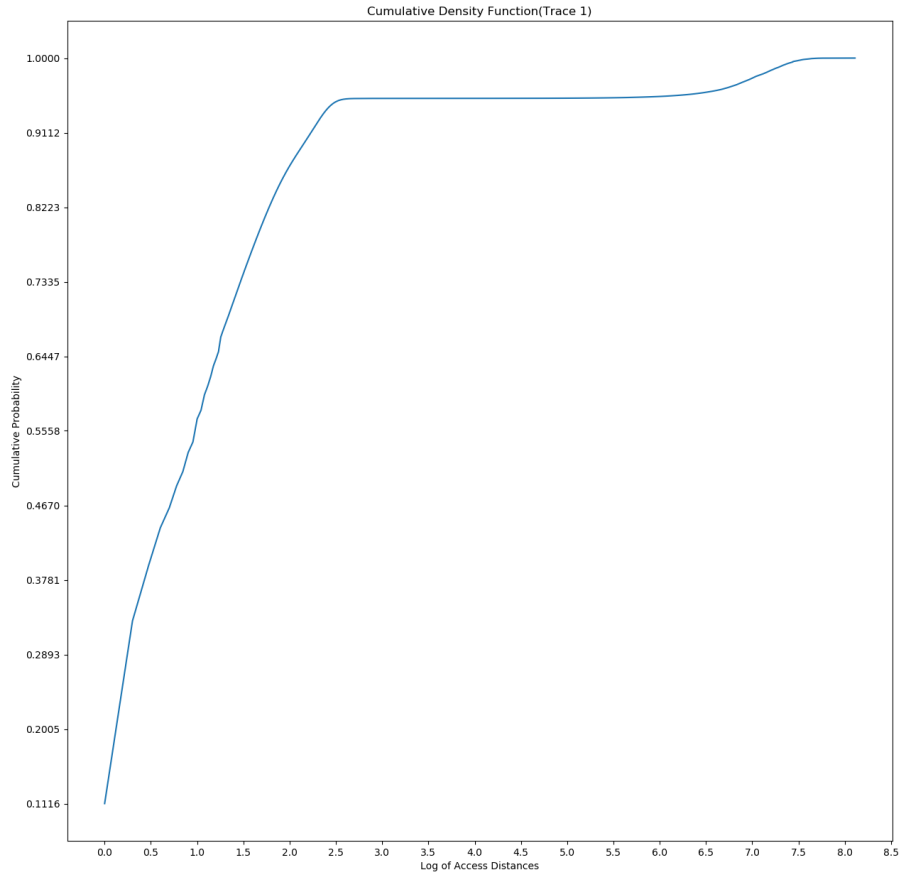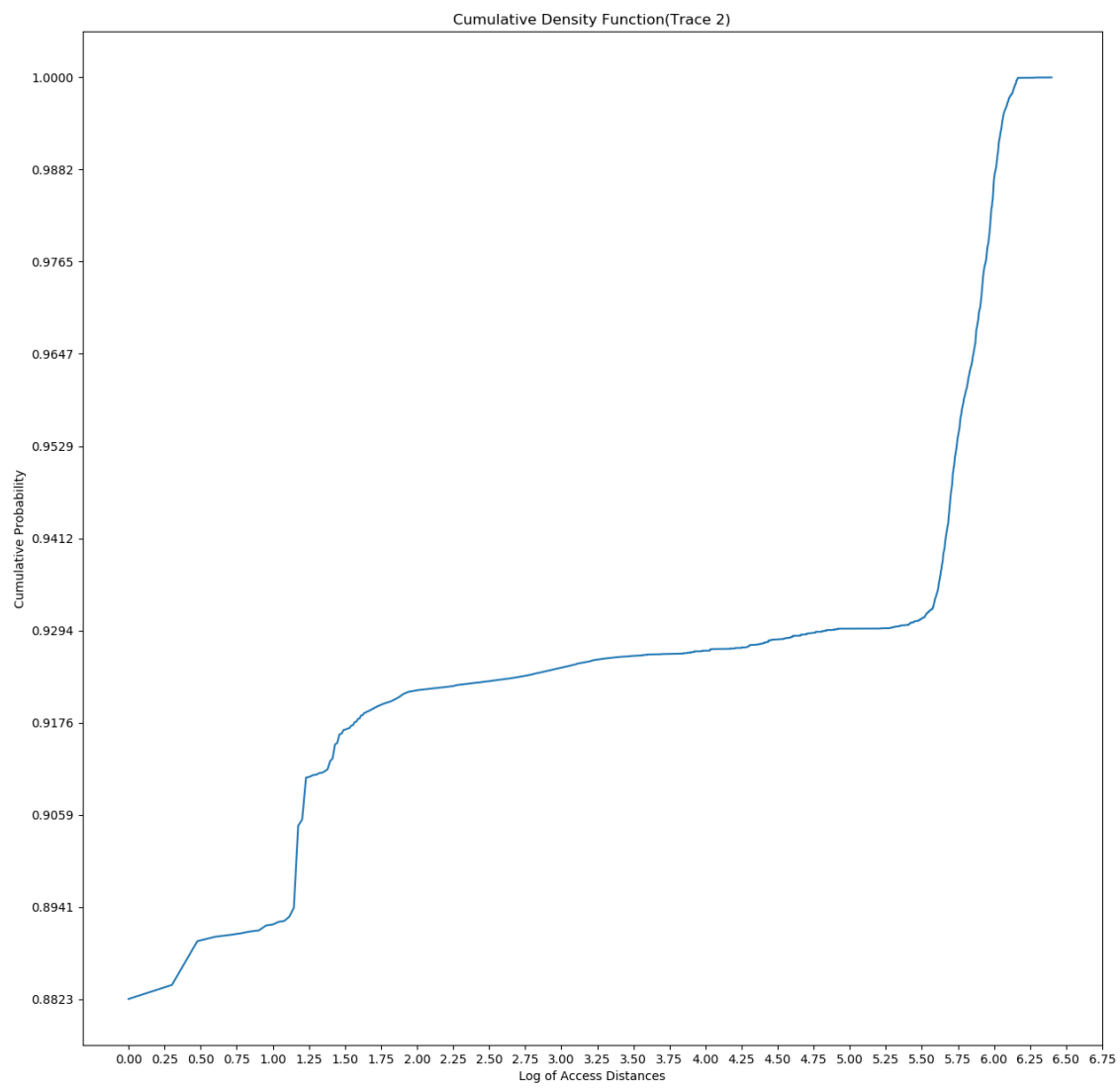
Part 1:

Table 1.1: Machine Accesses

Program	Total Machine Accesses
prog1	128,991,833
prog2	2,512,820
prog3	9,518,961
prog4	1,065,643

Part 2:

Figure 2.1: CDF Plot of Access Distances before Filtering

(a) prog1

Cumulative Density Function(Trace 2)

(b) prog2

Cumulative Density Function(Trace 3)

(c) prog3

Cumulative Density Function(Trace 4)
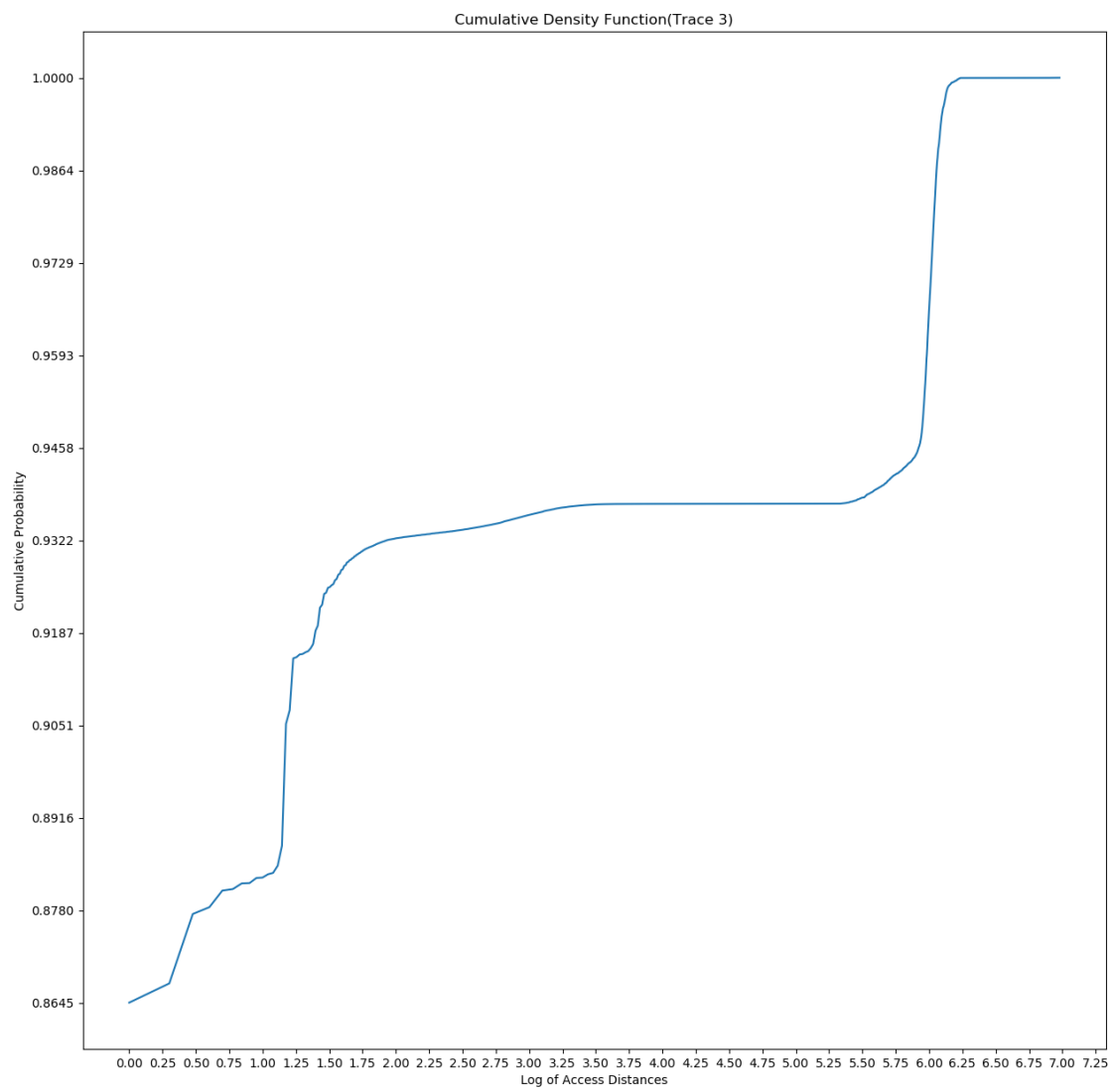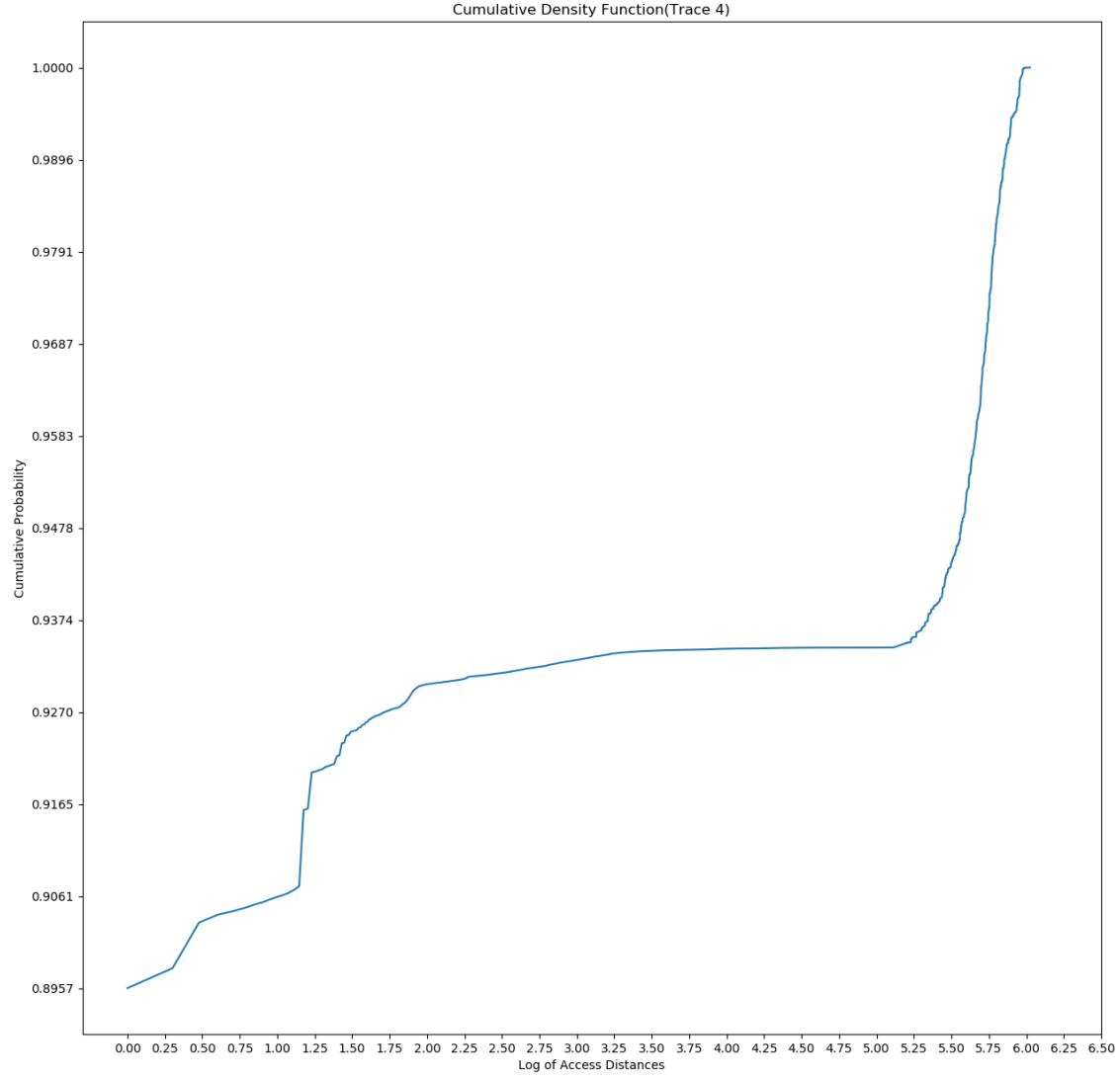
(d) prog4
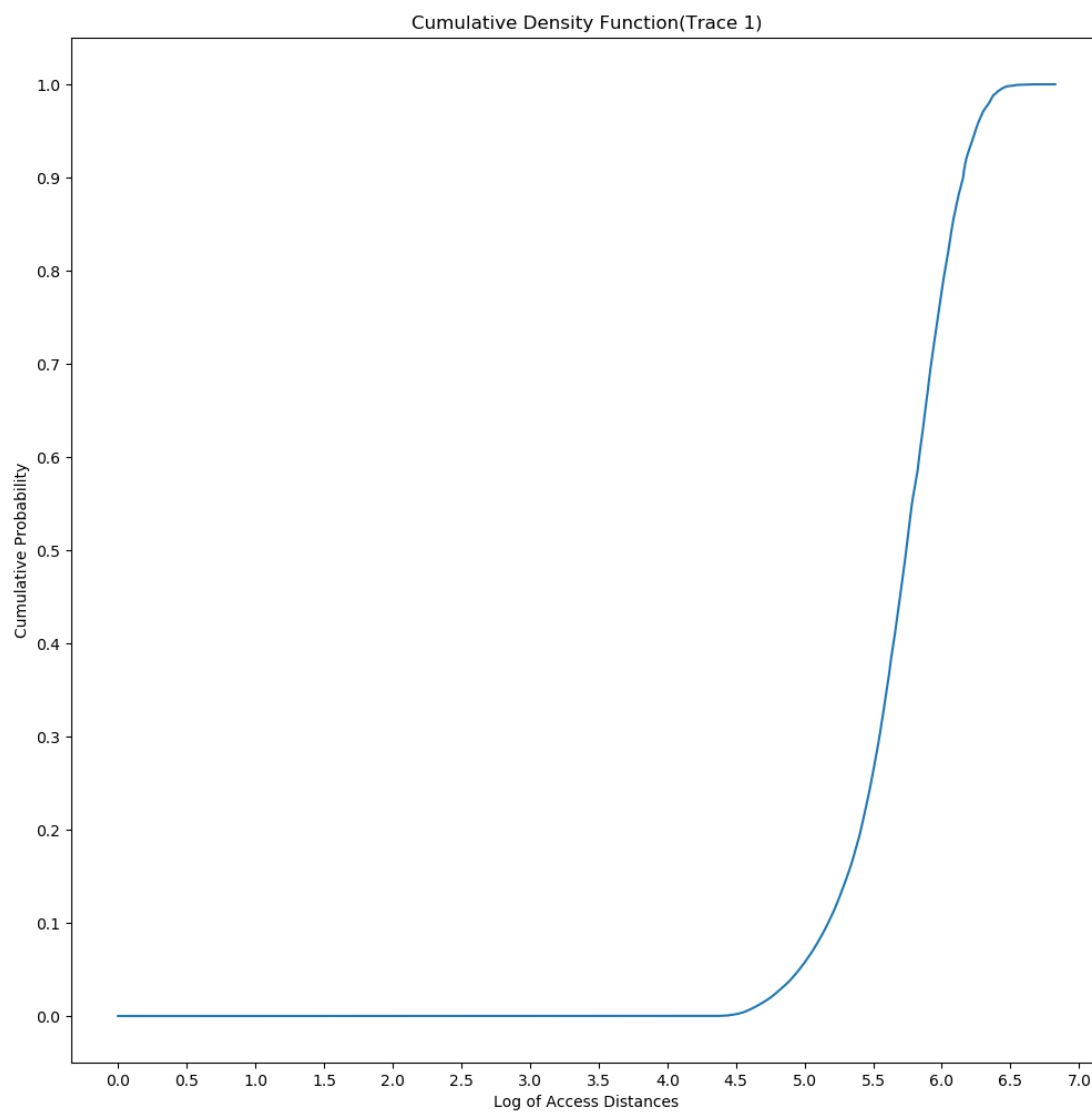
In prog2, prog3 and prog4 an access distance of 1 has a very high frequency ($\approx 85\% - 90\%$) indicating that these programs have a very high degree of locality in access.

In prog1 , access distance of 1 has a much lower frequency ($\approx 10\%$) and shows a gradual increase in the cumulative distribution till $\log(x) \approx 2.5$. Thus prog1 has a relatively lesser degree of locality in access.
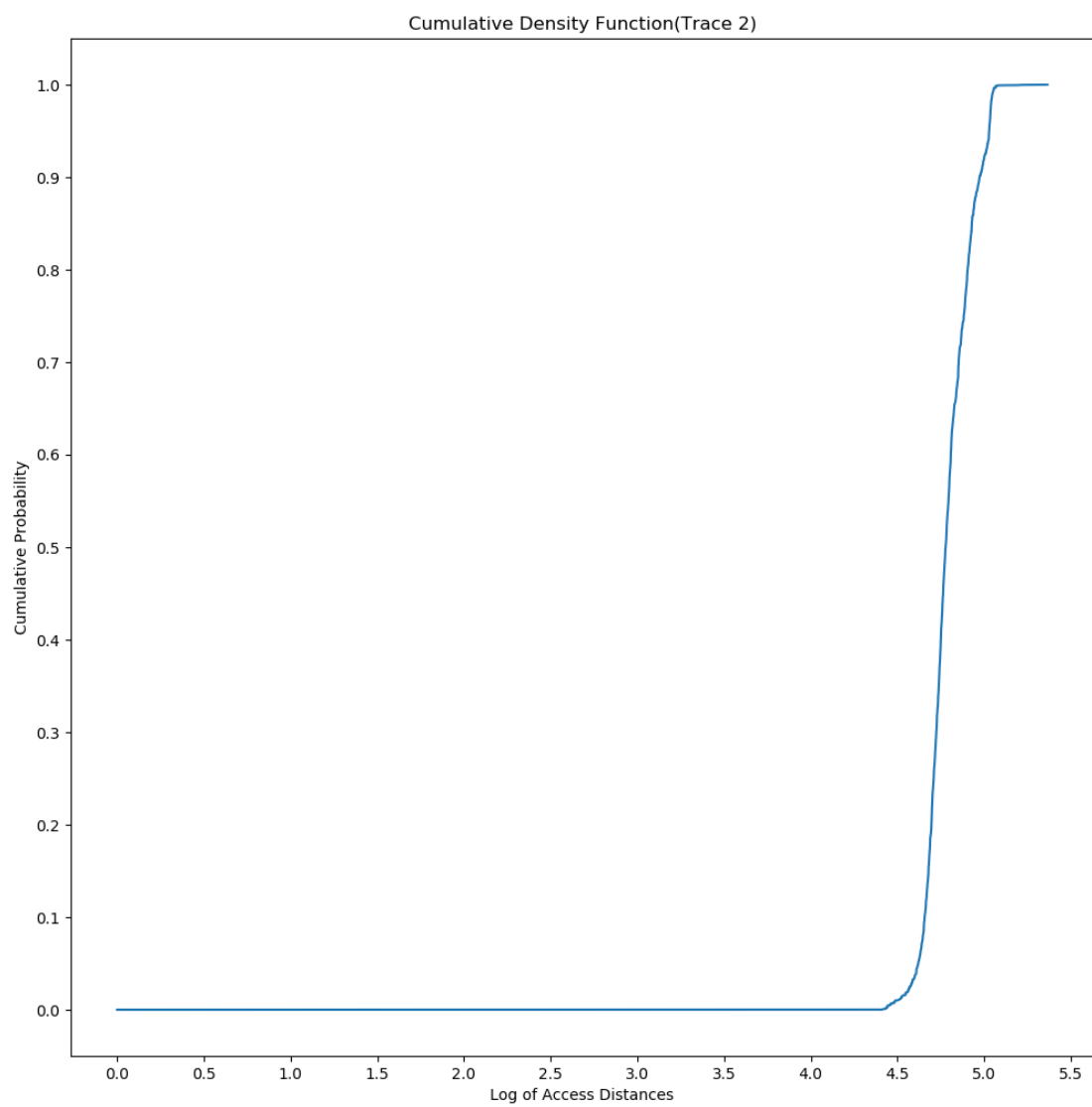
All of the graphs have a knee at around $\log(x) \approx 2.4$ and $y \approx 90\%$. This corresponds to a cache with approximately 256 blocks. Therefore, a fully associative cache of size 256*64B = 16KB should be ideal for a hit rate of greater than 90% for all 4 programs.

Part 3:

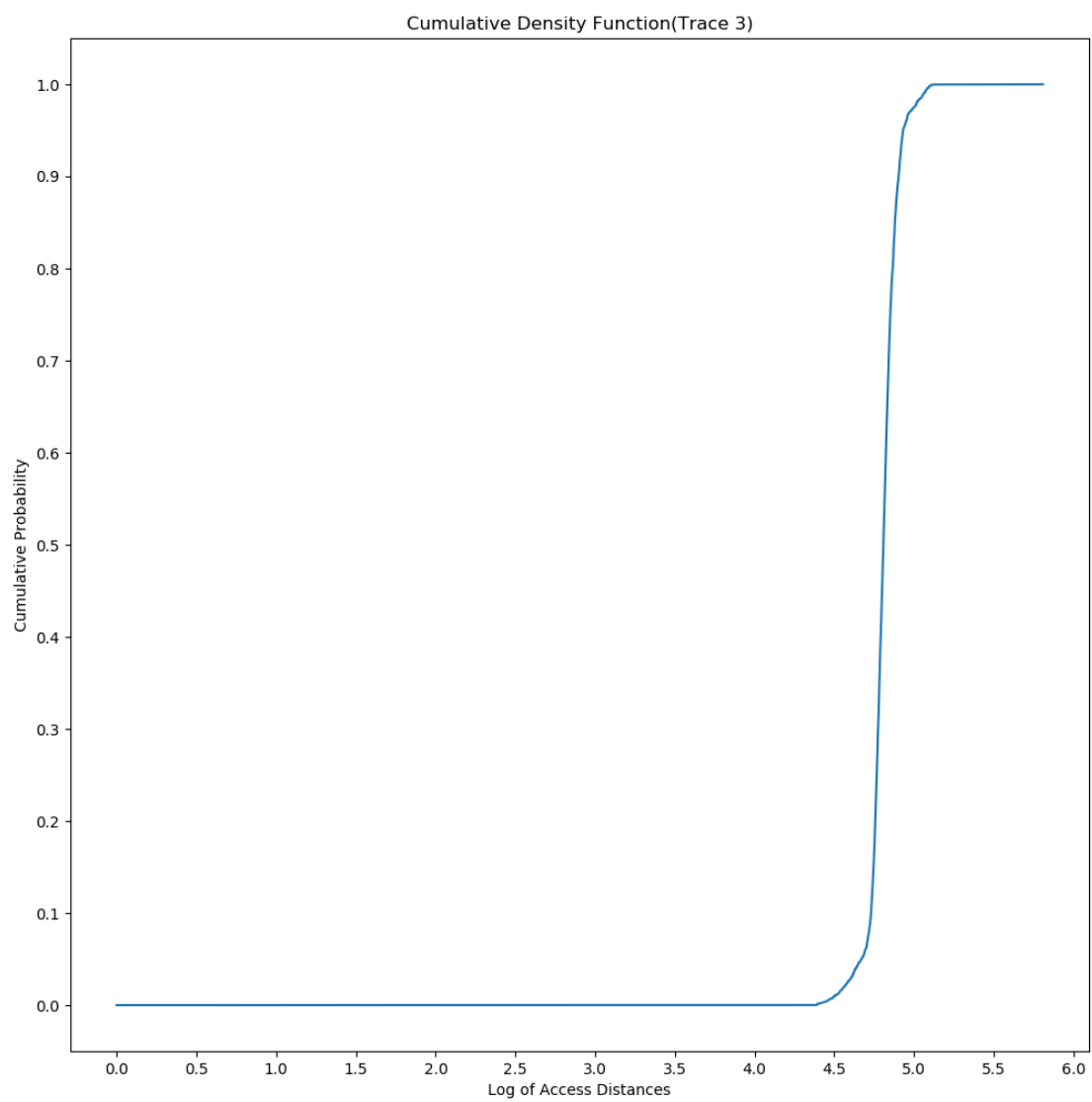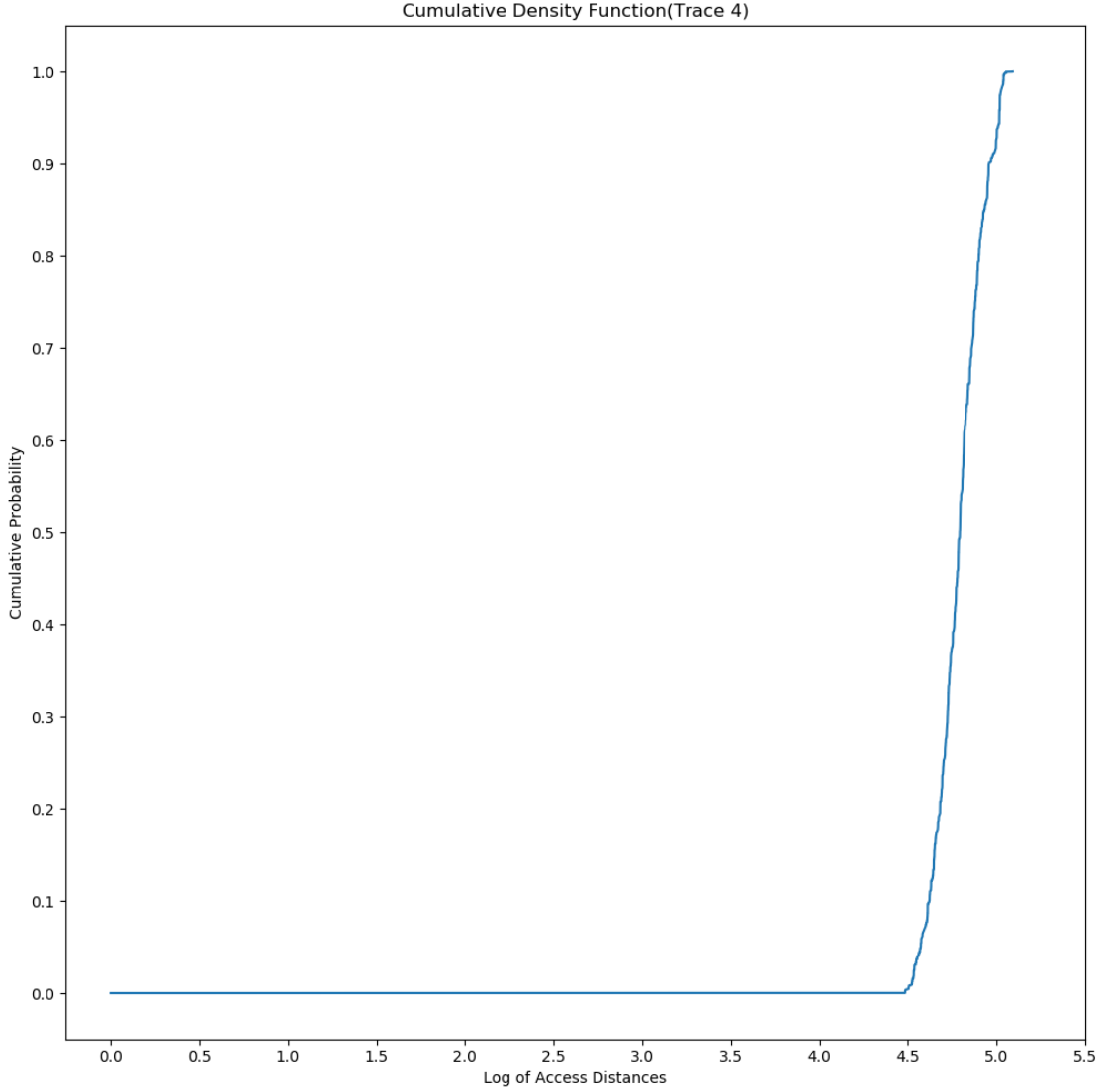Figure 3.1: CDF Plot of Access Distances after Filtering

(a) prog1

Cumulative Density Function(Trace 2)

(b) prog2

Cumulative Density Function(Trace 3)

(c) prog3

Cumulative Density Function(Trace 4)

(d) prog4

The curves before and after the cache filter vary significantly. The CDF plot for the access distances after the cache filter is approximately 0 until $\log(x) \approx 4.5$. Whereas, the CDF for the access distances before the cache filter has a large number of accesses with short access distance. The difference in the shapes of the curves is because accesses to blocks that have a short access distance constitute an access to a recently used block and are highly likely to be a cache hit.

The CDF plot after applying the cache filter is approximately 0 until $\log(x) \approx 4.5$. This corresponds to an access distance of $10^{4.5} \approx 31,622$ which is approximately equal to the number of cache blocks (32,768) in the cache. This signifies that most of the misses in the cache (excluding cold misses) are likely to be capacity misses.

Table 3.1: Hit and Miss Rates

	Program			
	prog1	prog2	prog3	prog4
Total Accesses	128,991,833	2,512,820	9,518,961	1,065,643
Cache Hits	122,303,325	2,280,946	8,878,061	942,405
Cache Misses	668,508	231,874	640,900	123,238
Hit Rate (P1KA)	948.148	907.724	932.671	884.353
Miss Rate (P1KA)	51.852	92.276	67.329	115.647

Part 4:

Table 4.1: Sharing Profile

Blocks shared by	Program			
	prog1	prog2	prog3	prog4
Private	419	417	424	8,608
2 Threads	63	8,255	56	57,402
3 Threads	1,872	16,384	0	6
4 Threads	32,455	40,957	0	0
5 Threads	143,250	4	0	0
6 Threads	244,970	0	0	0
7 Threads	173,831	0	0	0
8 Threads	124,528	10	65,546	11
Total	721,388	66,023	66,026	66,027

The sharing profile indicates that prog1, prog2 and prog3 have approximately the same number of private memory blocks. Most of the blocks are shared among multiple threads and only a small number of variables/memory blocks are local to the threads. In contrast, a relatively larger number of memory blocks are private in prog4 indicating that a lot of computation involves local variables or private memory blocks. Almost all of the other blocks are being shared by a maximum of 2 threads in prog4.