Computer Architecture (CSE 511/ECE 511)
Assignment 1

Nakul Thureja
2020528

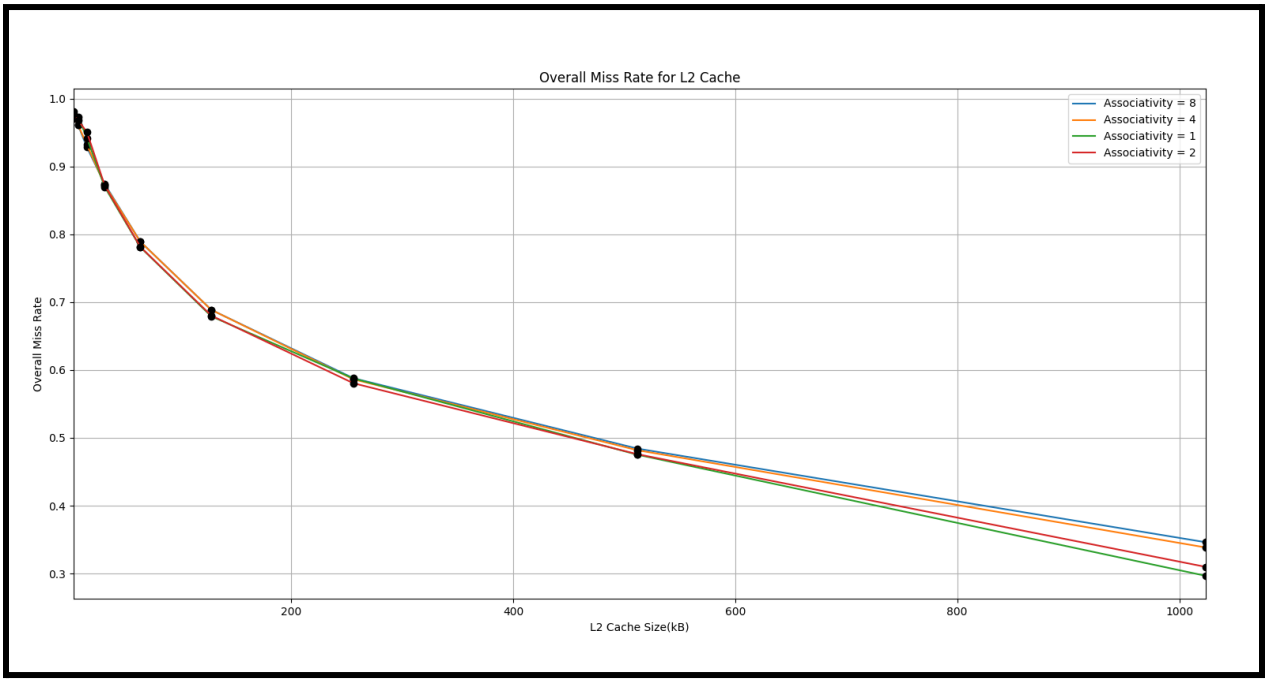
1. The configuration script has been attached in the zip file. 2020518.py is the main file and caches_2020528.py contains the code for L1 and L2 cache.
To run the script open the terminal in gem5 directory and run the command:
"build/X86/gem5.opt configs/A1/2020528.py arg1 arg2"

- arg1 is Cache Size(Ex 4kB)
- arg2 is Cache Associativity (Ex 2)

2. Now I have run the simulations for various configurations of L2 Cache with the benchmark "qsort_small.c" and input data as "input_small.dat"

L2 Cache Size	L2 Cache Associativity	Overall Miss Rate
4 kB	8	0.970802
8 kB	8	0.960969
16 kB	8	0.928261
32 kB	8	0.874102
64 kB	8	0.789305
128 kB	8	0.688655
256 kB	8	0.587901
512 kB	8	0.484101
1024 kB	8	0.346083
4 kB	4	0.971186
8 kB	4	0.961203
16 kB	4	0.931806
32 kB	4	0.872645
64 kB	4	0.78926
128 kB	4	0.688683
256 kB	4	0.586289
512 kB	4	0.481694
1024 kB	4	0.338359

4 kB	2	0.977857
8 kB	2	0.968361
16 kB	2	0.950427
32 kB	2	0.871941
64 kB	2	0.781639
128 kB	2	0.680228
256 kB	2	0.580492
512 kB	2	0.475839
1024 kB	2	0.309756
4 kB	1	0.980573
8 kB	1	0.973244
16 kB	1	0.942022
32 kB	1	0.869723
64 kB	1	0.78117
128 kB	1	0.679113
256 kB	1	0.587593
512 kB	1	0.475079
1024 kB	1	0.296555



Graph generated using Matplotlib for simulations

General Trend:

We can clearly see from the graph that as the size of L2 Cache increases, overall miss rate decreases.
This is happening due to the fact that as the capacity of the cache increases it can hold more data and therefore capacity miss decreases.

Similarly, an increase in associativity shows a slight decrease in miss rate for smaller cache sizes, and with an increase in cache size, the relation between miss rate and associativity changes.
This can be happening due to the fact that as the size of Cache increases the possibility of conflicts decreases and change in associativity does not affect the miss rate a lot.

Note: There are certain outliers in the graph but the observations refer to the general trends.

Source:

Some help has been taken from these sources

- Official gem5 documentation(https://www.gem5.org/documentation/)
- Tutorial uploaded on the classroom