HY425 – Computer Architecture
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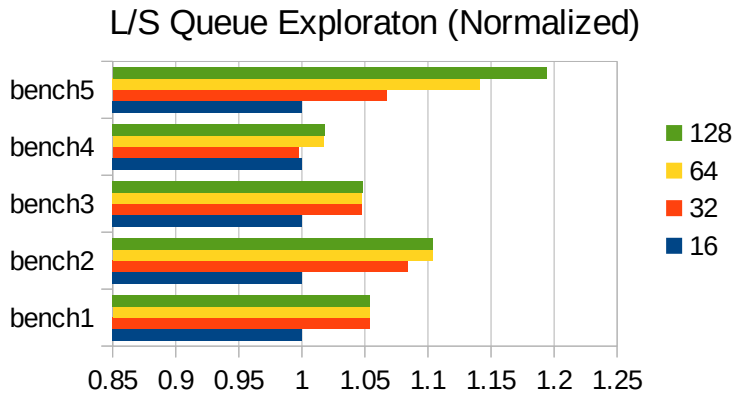
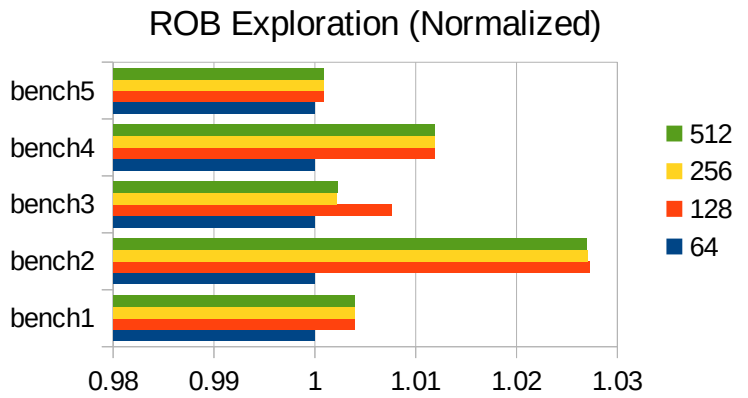
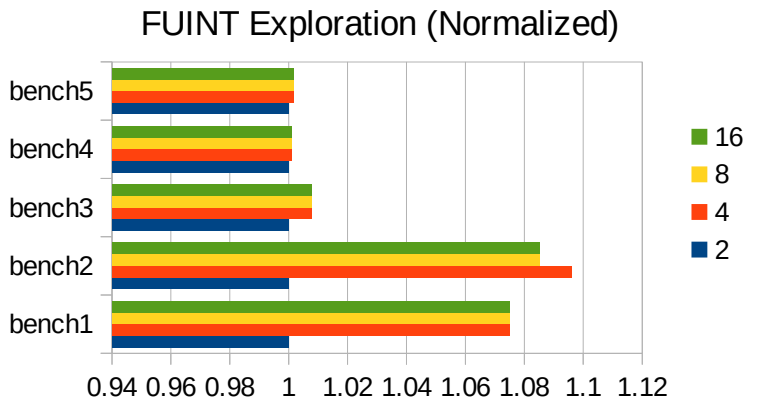
Programming Assignment 2

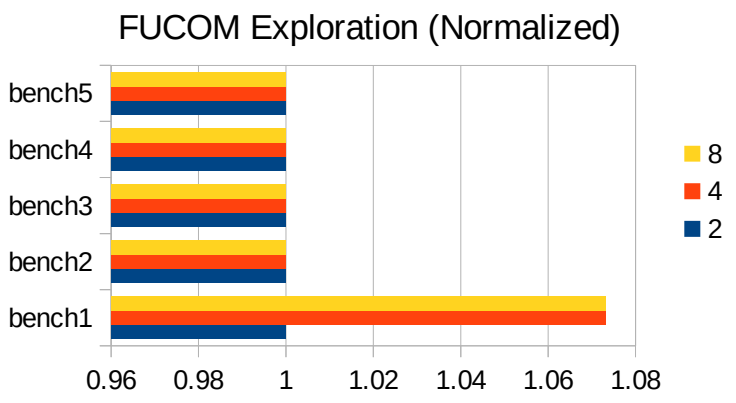
Note: Extensive statistical information about all benchmark runs presented can be found in the file measurements.ods.

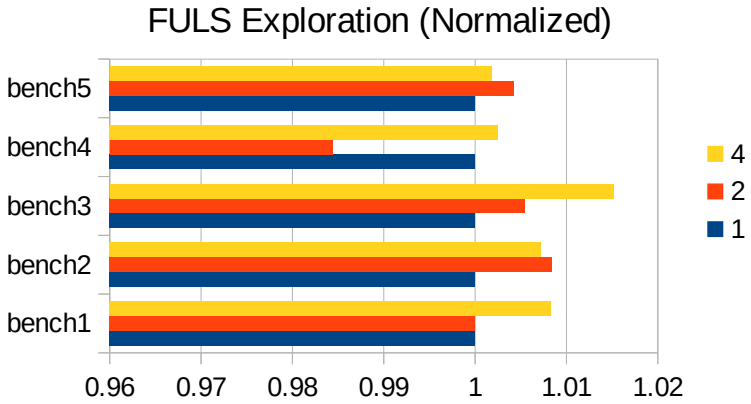
For the first series of benchmarks, I ran a benchmark for every value in the range of the parameter while keeping the other parameters on the default value. The IPC values of each benchmark are very close to each other, therefore the following results are normalized by the first value of each parameter (These benchmarks were ran for 5 million instructions each):











From the above graphs we can extract the following information about each parameter:

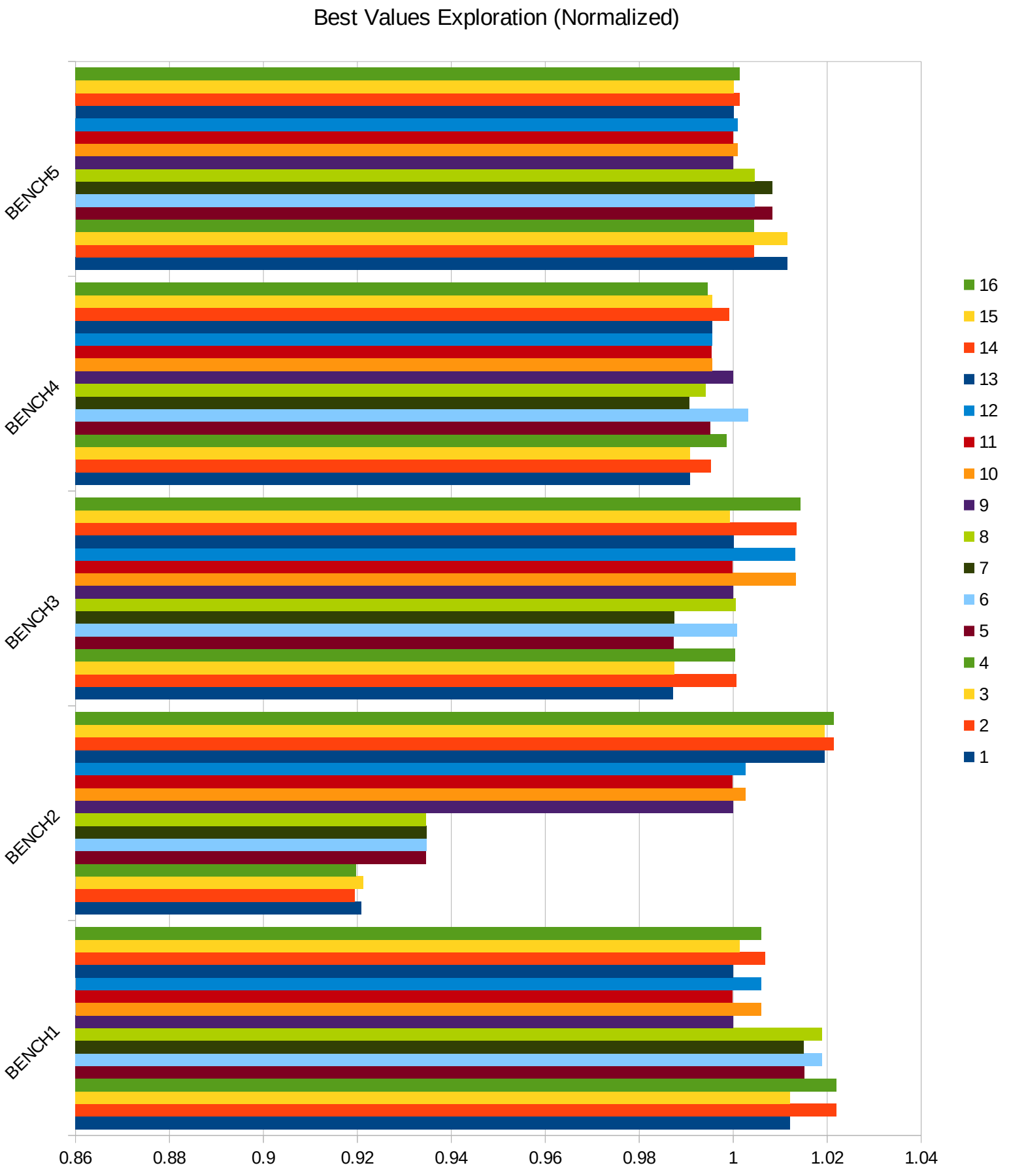
- → L/S Queue Entries: When the value of the L/S queue entries approaches 128 entries, the IPC of the benchmark maximizes.
- → ROB Entries: For benchmarks 1,4 and 5 the IPC maximizes and remains the same for 256 and 512 entries. For benchmarks 2 and 3 though, the maximum value of IPC appears at 128 entries, decreasing for entries more than 128.
- → FUINT: For benchmarks 1,3 and 5 the IPC maximizes and remains the same for entries more than 8, while for benchmarks 2 and 4 the IPC maximizes at 4 entries.
- → FUCOM: All the given number of entries for FUCOM provide the same IPC (except 2 entries on benchmark1).
- → FUFP: For benchmarks 1,4 and 5 the value of IPC was saturated at 4 entries (in benchmak5 at 2 entries) while for benchmarks 2 and 3 the maximum value was achieved at 2 and 4 entries respectively.
- → FULS: The maximum IPC values were achieved at 4 entries for benchmarks 1,3 and 4 while for benchmarks 2 and 5 the maximum values were achieved at 2 entries.

Now I will run benchmarks based on the values that preformed best on the first round of benchmarks above:

From now on the benchmark instruction count was changed back to 50 million The 16 benchmarks I ran had the following parameter setup:

BENCH#	LSQ_ENTRIES	ROB_ENTRIES	FUINT	FUCOM	FUFP	FULS
1	128	128	4	4	2	2
2	128	128	4	4	2	4
3	128	128	4	4	4	2
4	128	128	4	4	4	4
5	128	128	8	4	2	2
6	128	128	8	4	2	4
7	128	128	8	4	4	2
8	128	128	8	4	4	4
9	128	256	4	4	2	2
10	128	256	4	4	2	4
11	128	256	4	4	4	2
12	128	256	4	4	4	4
13	128	256	8	4	2	2
14	128	256	8	4	2	4
15	128	256	8	4	4	2
16	128	256	8	4	4	4

The results of these benchmarks can be seen below



The chart above provides us with the following winners for each benchmark:

- Benchmark 1: #2 (128,128,4,4,2,4) and #4 (128,128,4,4,4,4)
  → For this benchmark the change in FUFP Entries has the same IPC result.
- Benchmark 2: #14 (128, 256,8,4,2,4) and #16 (128, 256,8,4,2,4)
  → Here same values of FUFP generate the same IPC but that is not the general case, like benchmark1
- Benchmark 3: #16 (128, 256,8,4,2,4)
- Benchmark 4: #6 (128, 128, 8, 4, 2, 4)
- Benchmark 5: #1 (128, 128, 4, 4, 2, 2) and #3 (128, 128, 4, 4, 4, 2)

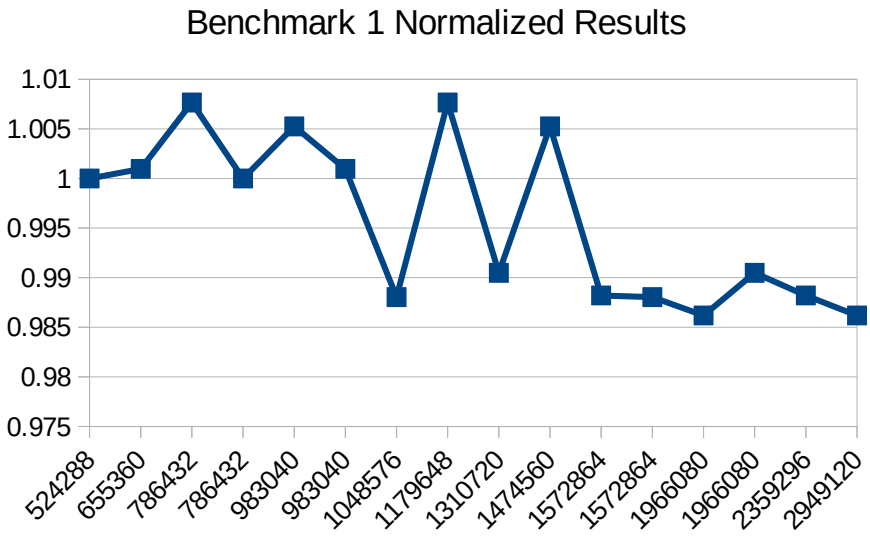
MiP Exploration:

For the purpose of this exploration I created the 16 following parameter cases based on the real life values and the given ranges:

BENCH#	LSQ	ROB	FUINT	FUCOM	FUFP	FULS
1	128	128	4	2	2	2
2	128	128	4	2	2	3
3	128	128	4	2	3	2
4	128	128	4	2	3	3
5	128	128	5	2	2	2
6	128	128	5	2	2	3
7	128	128	5	2	3	2
8	128	128	5	2	3	3
9	128	256	4	2	2	2
10	128	256	4	2	2	3
11	128	256	4	2	3	2
12	128	256	4	2	3	3
13	128	256	5	2	2	2
14	128	256	5	2	2	3
15	128	256	5	2	3	2
16	128	256	5	2	3	3

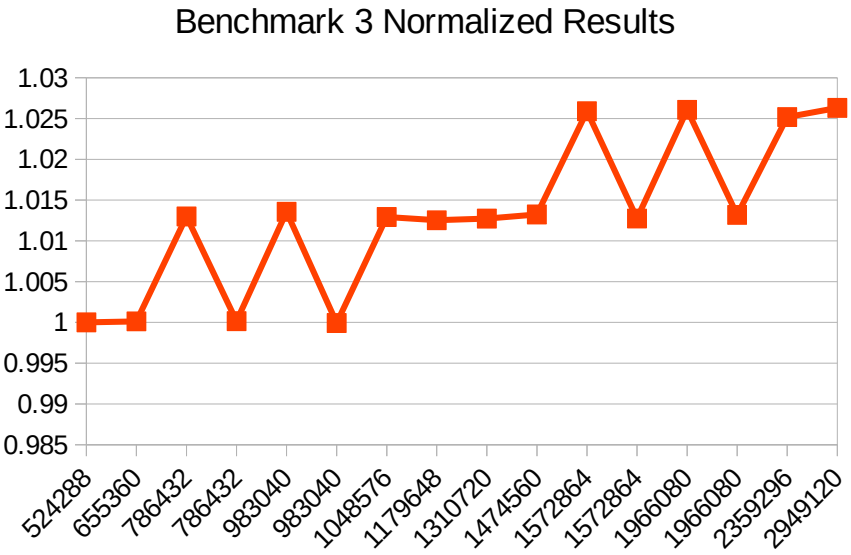
The following charts are normalized to the lowest MiP value and sorted by their MiP value, the #1 combination with MiP of 524288:

- **Benchmark 1:**



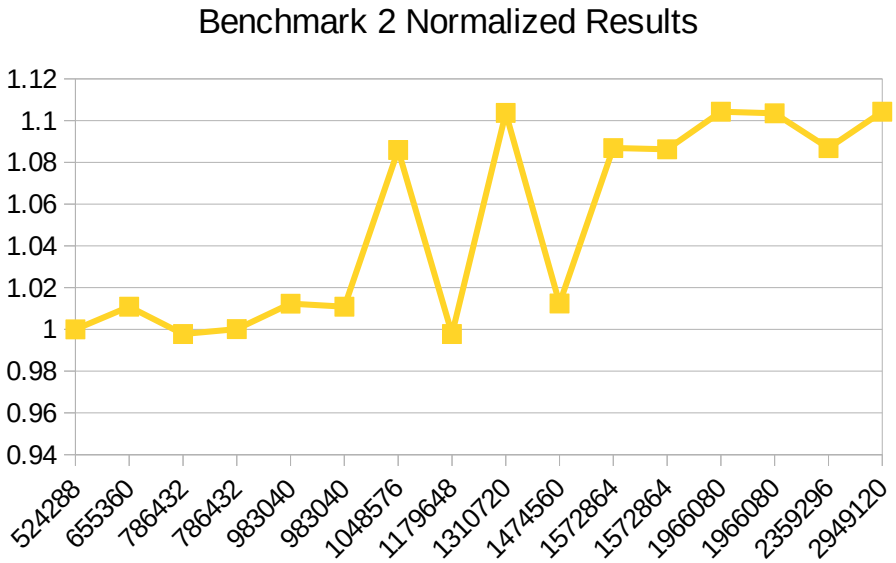
The setups that maximizes the IPC count for benchmark 1 are #2 and #4 with MiP 786432 and 1179648 respectively. Thus the better option for benchmark 1 is #2 since it has the lowest IPC of the two.

- **Benchmark 2**



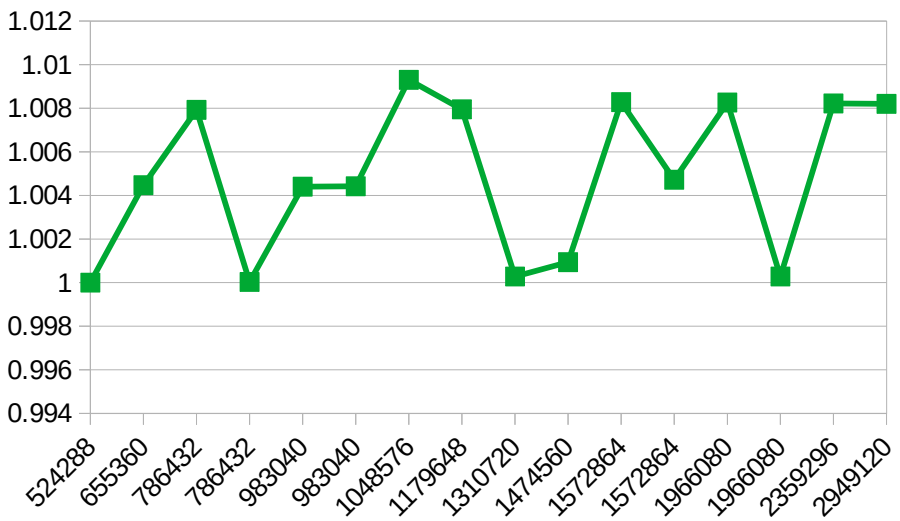
For the second benchmark, the IPC count maximizes at #14 and #16 with MiP 1966080 and 2949120 respectively. The best option is one again the lowest MiP, #14

- **Benchmark 3**



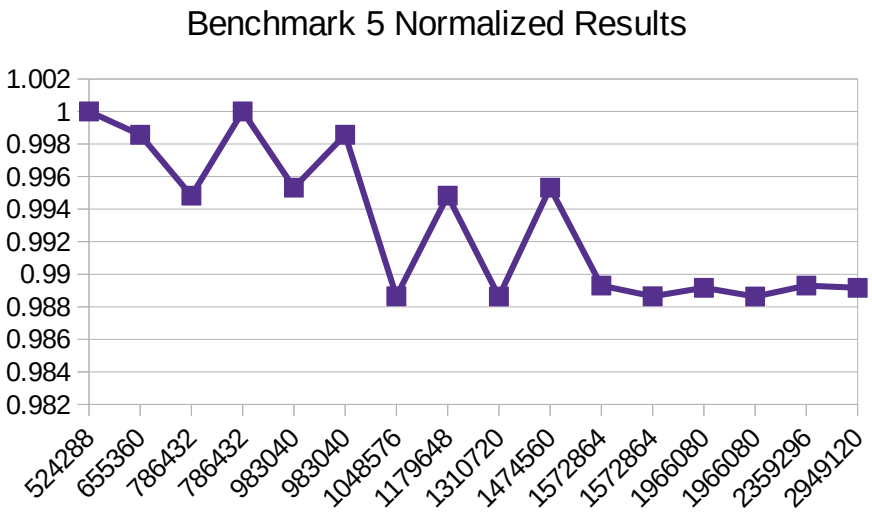
For this benchmark, the IPC count maximizes at #16 which has the best MiP of all setups at 2949120

- **Benchmark 4**



The benchmark 4 maximizes at setup #9 with a MiP value of 1048576.

- **Benchmark 5**



The 5th benchmark weirdly maximizes at the setup with the lowest MiP value (#1), as well as the #3 setup with MiP value 786432.

Saturation Points

Through the exploration on different setups of parameters we can observe a saturation point in each benchmark. A saturation point is a point where even after adding resources the performance of the system (IPC) does not improve. The saturation values can be found by focusing on the Best Values Exploration and the MiP Exploration:

→ Benchmark 1: The saturation value was on the Best Values Exploration on the #2 and #4 setup with a IPC of 0.135885
→ Benchmark 2: The saturation value was on the Best Values Exploration on the #14 and #16 setup with a IPC of 1.793284
→ Benchmark 3: The saturation value was on the Best Values Exploration on the #16 setup with a IPC of 0.7442
→ Benchmark 4: The saturation value was on the Best Values Exploration on the #6 setup with a IPC of 0.127151
→ Benchmark 5: The saturation value was on both the Best Values Exploration and the MiP Exploration on the #1 and #2 setup with a IPC of 1.284618