Ashlin Kanawaty   1220399
Prakhar Garg   1204351

PA5 Analysis

The execution time of the code is measured form the first line that the code is called to the last second last line. Just before it returns 0.

The following image was used to test run times. The image was scaled to 5 different dimensions.

Figure 2: Before

Figure 1: After

CUDA

Using grid(5,5,4) and block(5,5)

RADIUS	500X280	1000X560	1500X842	2000X1123	2500X1403
0	0.07	0.12	0.20	0.30	0.44
10	0.59	2.61	5.97	10.51	16.69
20	1.98	9.47	21.93	39.24	62.13
30	4.19	20.56	47.64	85.27	136.16
40	7.11	35.66	82.97	148.92	213.90

Linear

RADIUS	500X280	1000X560	1500X842	2000X1123	2500X1403
0	0.020	0.05	0.09	0.21	0.24
10	1.90	7.81	17.38	31.30	47.74
20	7.10	30.15	67.67	172.36	193.5
30	14.92	65.21	148.19	376.12	419.32
40	24.88	112.78	251.04	475.12	719.6

Ashlin Kanawaty   1220399
Prakhar Garg   1204351

Speedup

RADIUS	500X280	1000X560	1500X842	2000X1123	2500X1403
0	0.285714	0.416667	0.45	0.7	0.545455
10	3.220339	2.992337	2.911222781	2.97811608	2.860395
20	3.585859	3.183738	3.085727314	4.392456677	3.114437
30	3.560859	3.171693	3.110621327	4.410929987	3.079612
40	3.499297	3.162647	3.02567193	3.190437819	3.364189

Sample Calculation

$$S(n, p) = \frac{T_{serial}(n)}{T_{parallel}(n, p)}$$

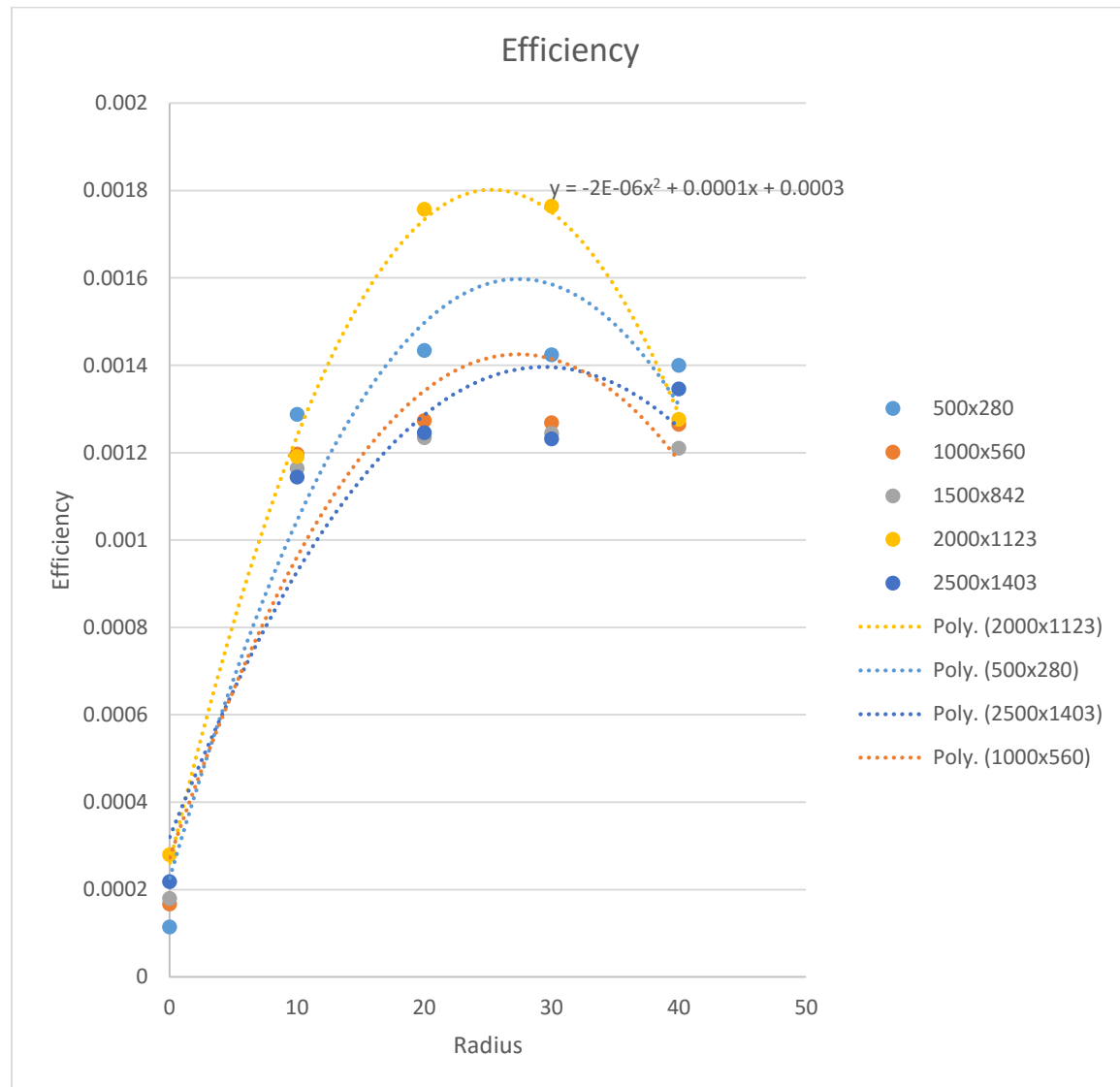$$S(n, p) = \frac{89.79}{32.48}$$

$$S(n, p) = 2.76447\ldots$$

Speedup scatter plot with polynomial trendlines. The equation shown: $y = -0.006x^2 + 0.3039x + 0.6526$

Ashlin Kanawaty 1220399
Prakhar Garg 1204351
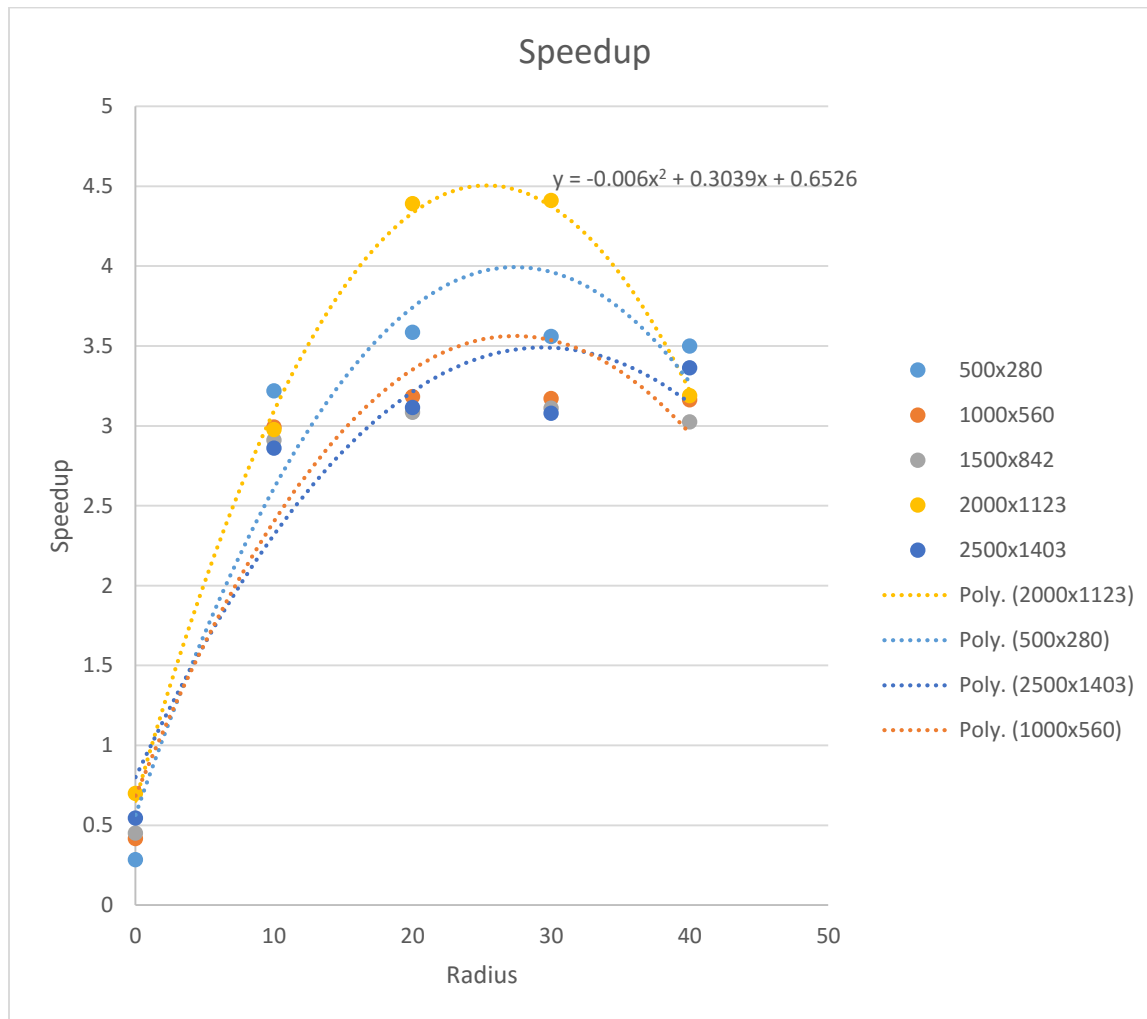
Efficiency

RADIUS	500X280	1000X560	1500X842	2000X1123	2500X1403
0	0.000114	0.000167	0.00018	0.00028	0.000218
10	0.001288	0.001197	0.001164489	0.001191246	0.001144
20	0.001434	0.001273	0.001234291	0.001756983	0.001246
30	0.001424	0.001269	0.001244249	0.001764372	0.001232
40	0.0014	0.001265	0.001210269	0.001276175	0.001346

Sample Calculation

$$E(n,p) = \frac{T_{serial}(n)}{p \times T_{parallel}(n,p)}$$

$$S(n,p) = \frac{89.79}{2 \times 32.48}$$

$$S(n,p) = 1.3822 \ldots$$

Efficiency

$y = -2E\text{-}06x^2 + 0.0001x + 0.0003$

Legend:
- 500x280
- 1000x560
- 1500x842
- 2000x1123
- 2500x1403
- Poly. (2000x1123)
- Poly. (500x280)
- Poly. (2500x1403)
- Poly. (1000x560)

Ashlin Kanawaty   1220399
Prakhar Garg   1204351

Grid Size

All measurements for this were done using the 2500x1403 image and a block size of (5,5)

RADIUS	10X10X10	20X20X20	30X30X30	40X40X40	50X50X50	60X60X60
0	0.45	1.3	11.46	41.27	186.38	462.22
20	52.31	22.35	16.67	65.95	241.10	628.70
40	140.67	99.57	23.15	68.08	196.72	
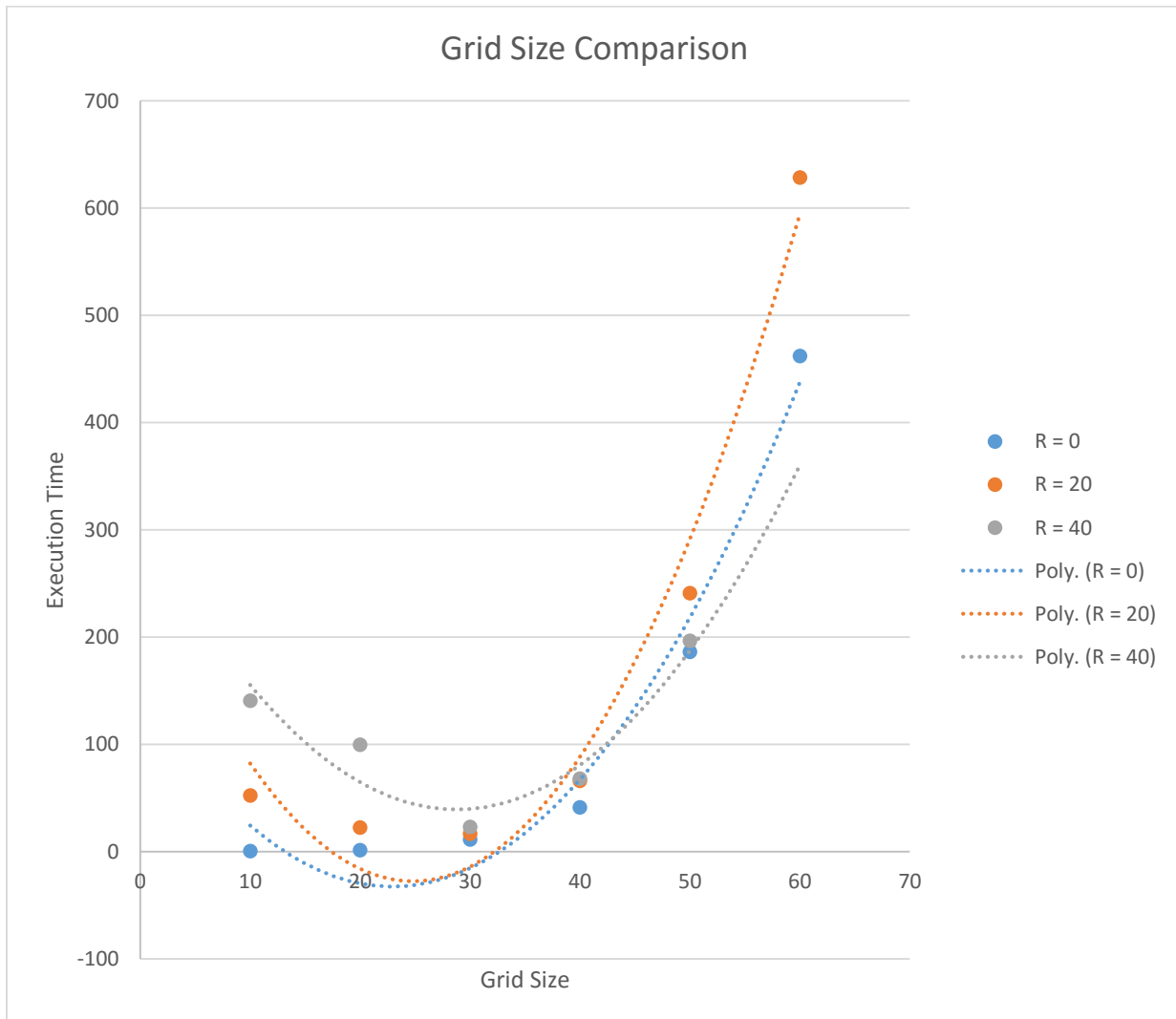
It looks like a grid size of approximately 30 x 30 x 30 is optimal while using most radius values.

Ashlin Kanawaty   1220399

Prakhar Garg   1204351

Block Size

Based on the results in grid Size, a grid size of (30 x 30 x 30) was used with the 2500x1403 pixel image

RADIUS	1X1	2X2	3X3	4X4	5X5	6X6	7X7
0	0.86	2.00	4.10	4.34	11.45	10.33	22.87
20	45.4	22.95	18.62	7.37	16.66	21.05	16.70
40			58.87	57.40	17.35	19.10	19.48

Grid Size Comparison
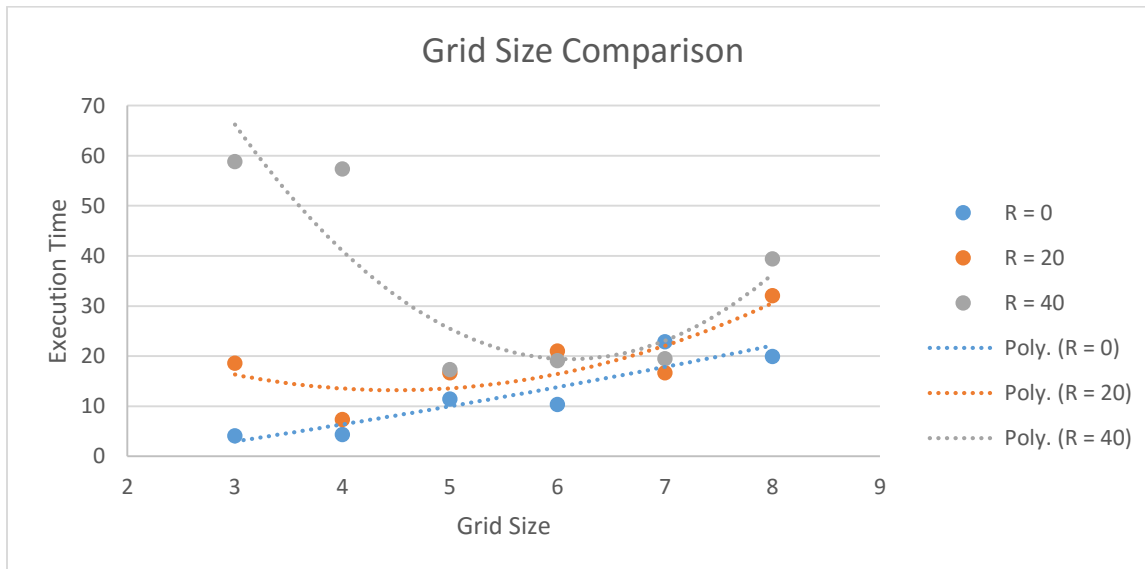
There isn't a very strong correlation between execution time and block size. As the block increases, execution times appears to go up. There appears to be a region between 5x5 and 5x6 blocks where execution times appear to converge.

Scalability

Definition

Strongly scalable = constant efficiency for a varying number of processes, and a constant problem size. Weakly scalable = constant efficiency for a varying number of processes, for a fixed problem size *per processor*.

Conclusion

The Program is not strongly scalable as there is a parabolic relationship between the number of processes and efficiency

The program is not weakly scalable as the efficiency of code changes with varying number of processes.