1. Parallel Point Jacobi Iterations:

Verification for $I = 4$ with $TH = 1, 2, 3$ and 4. The result is independent of number of threads used.

Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
1	0.0269607247090807	0.0514704193554673	0.0269607247090807	38
2	0.0269607247090807	0.0514704193554673	0.0269607247090807	38
3	0.0269607247090807	0.0514704193554673	0.0269607247090807	38
4	0.0269607247090807	0.0514704193554673	0.0269607247090807	38

2. b)

For I = 16

Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
Serial	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
1	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
2	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
3	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
4	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
5	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
6	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
7	0.0297950169506737	0.0558781216965981	0.0297950169506737	521
8	0.0297950169506737	0.0558781216965981	0.0297950169506737	521

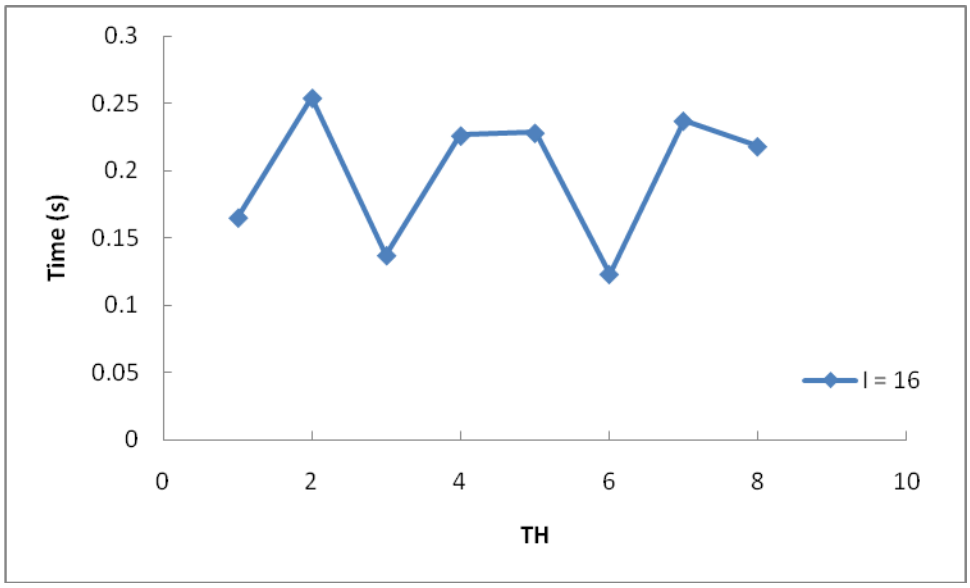
I = 32

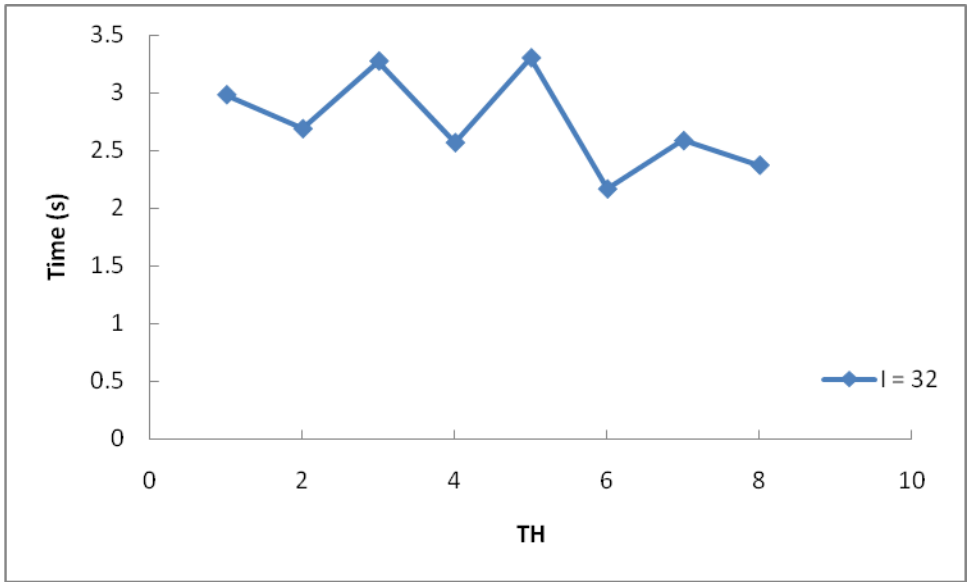
Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
Serial	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
1	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
2	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
3	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
4	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
5	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
6	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
7	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803
8	0.0299595841510452	0.0561177293637668	0.0299595841510452	1803

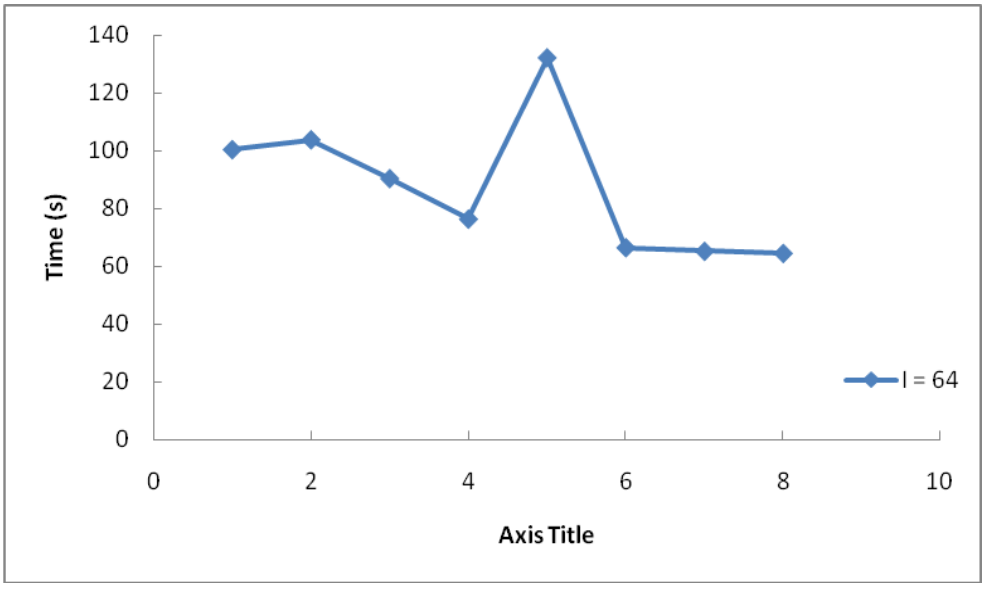
I = 64

Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
Serial	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
1	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
2	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
3	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
4	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
5	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
6	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
7	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066
8	0.0299896780640936	0.0561453177823366	0.0299896780640936	6066

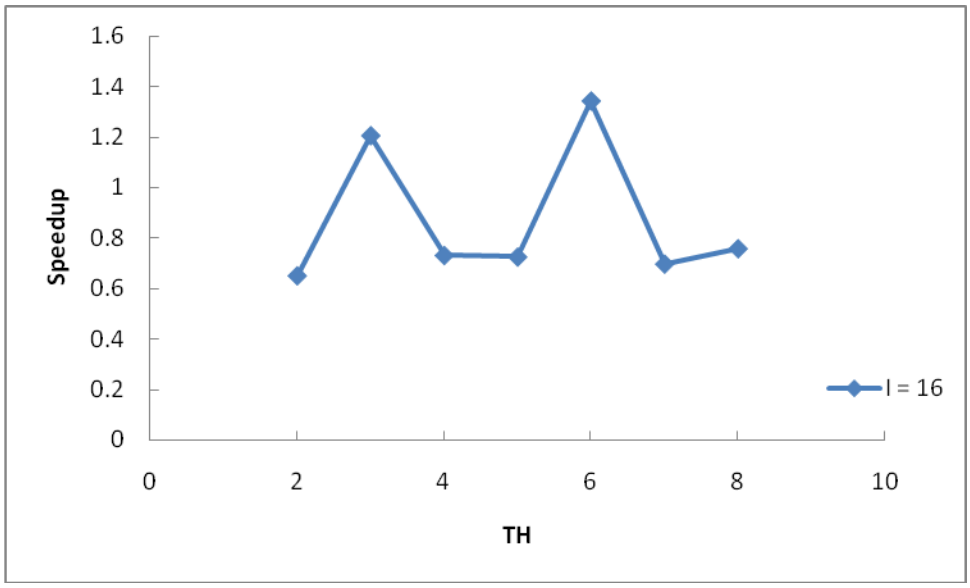
c) **Wall Clock Time Plots**

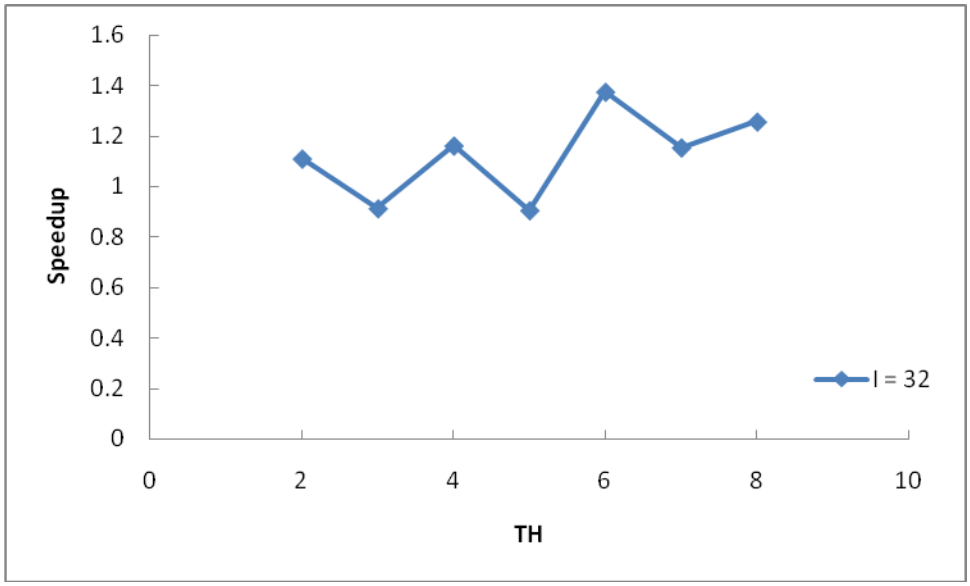


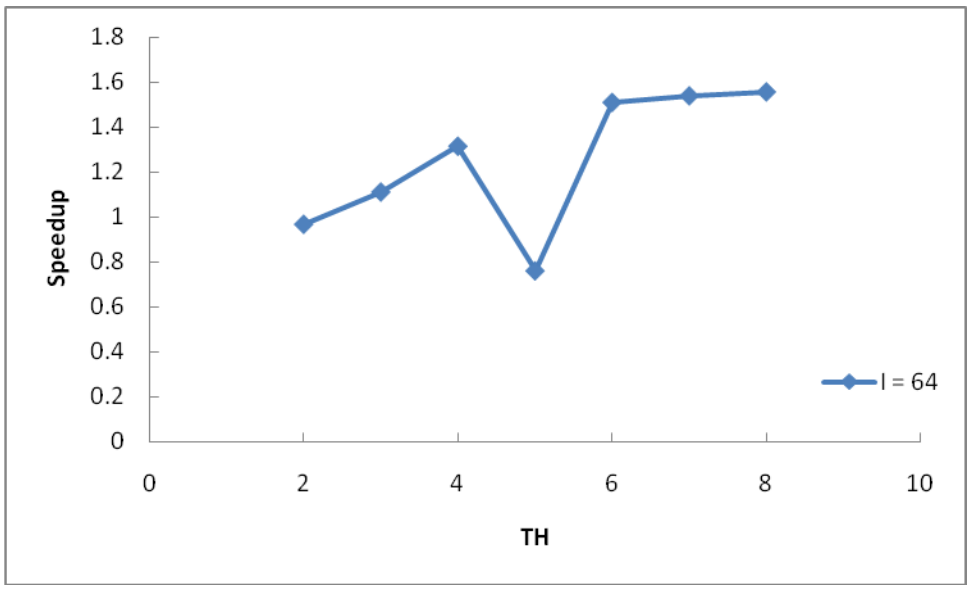




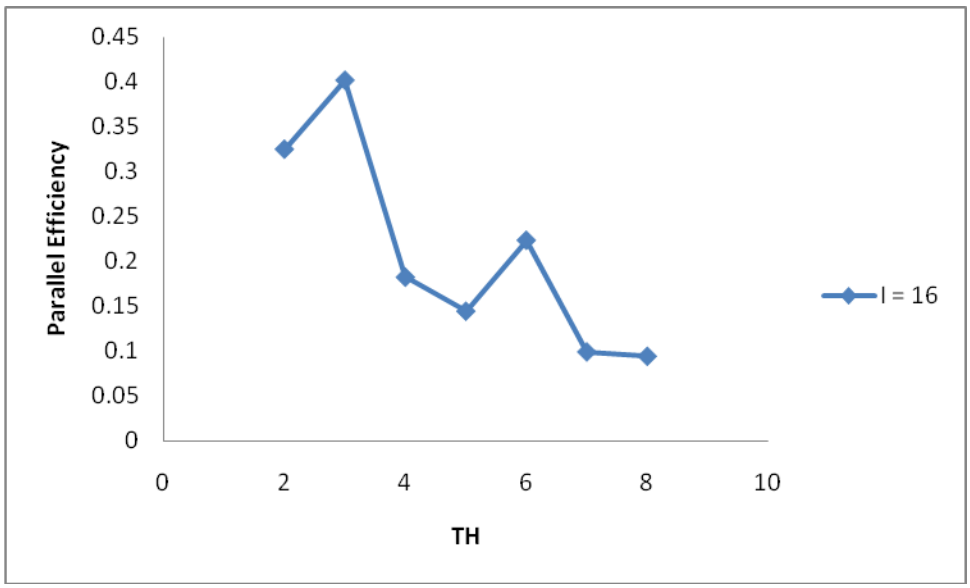
d) **Parallel Speedup Plots**

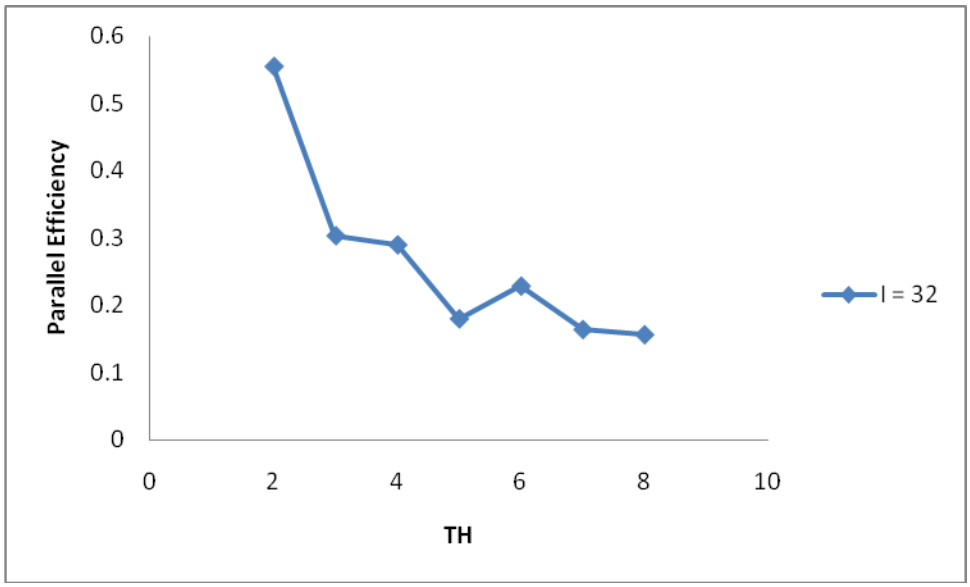


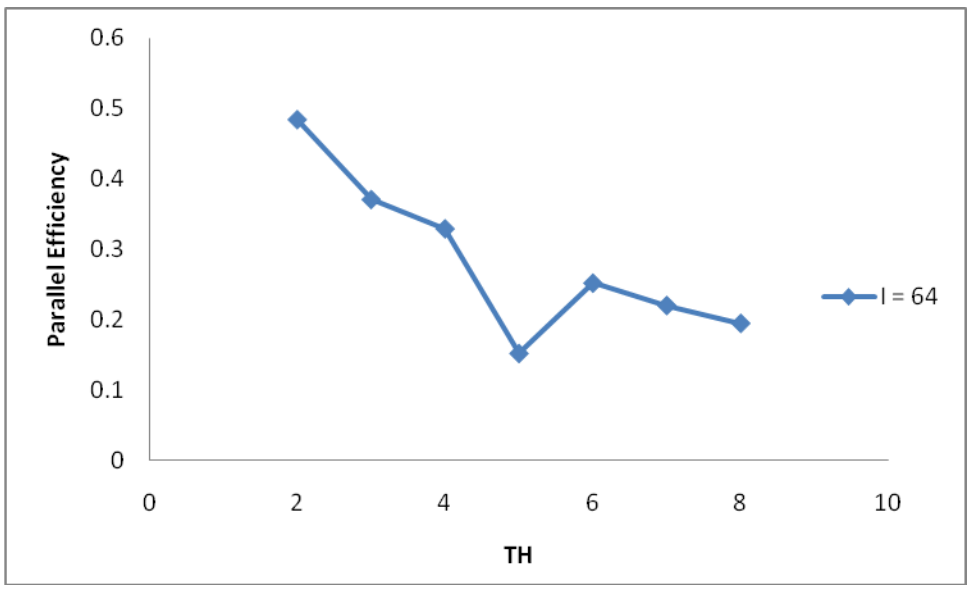




e) **Parallel Efficiency Plots**







3a) Red/black method was implemented for SOR for solving heat equation. It was verified that for I = 4 serial code solution and parallel code solution matches till 7 digits. After 7 digits it differs.

3d) Verification of code at I = 4. It was verified that number of iterations and solution is independent of number of threads. But number of iterations are different from serial program.

Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
serial	0.0269607528250166	0.0514705803962452	0.0269607841004123	12
1	0.0269607783051981	0.0514705493854777	0.0269607783051981	11
2	0.0269607783051981	0.0514705493854777	0.0269607783051981	11
3	0.0269607783051981	0.0514705493854777	0.0269607783051981	11
4	0.0269607783051981	0.0514705493854777	0.0269607783051981	11

3e) Number of SOR iterations for red/black ordering is smaller than the number of iterations with natural ordering.

4b)
For I = 16

Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
Serial	0.0297960230750678	0.0558809957018724	0.0297960340597829	53
1	0.029795974073143	0.0558808344977713	0.029795974073143	41
2	0.029795974073143	0.0558808344977713	0.029795974073143	41
3	0.029795974073143	0.0558808344977713	0.029795974073143	41
4	0.029795974073143	0.0558808344977713	0.029795974073143	41
5	0.029795974073143	0.0558808344977713	0.029795974073143	41
6	0.029795974073143	0.0558808344977713	0.029795974073143	41
7	0.029795974073143	0.0558808344977713	0.029795974073143	41
8	0.029795974073143	0.0558808344977713	0.029795974073143	41

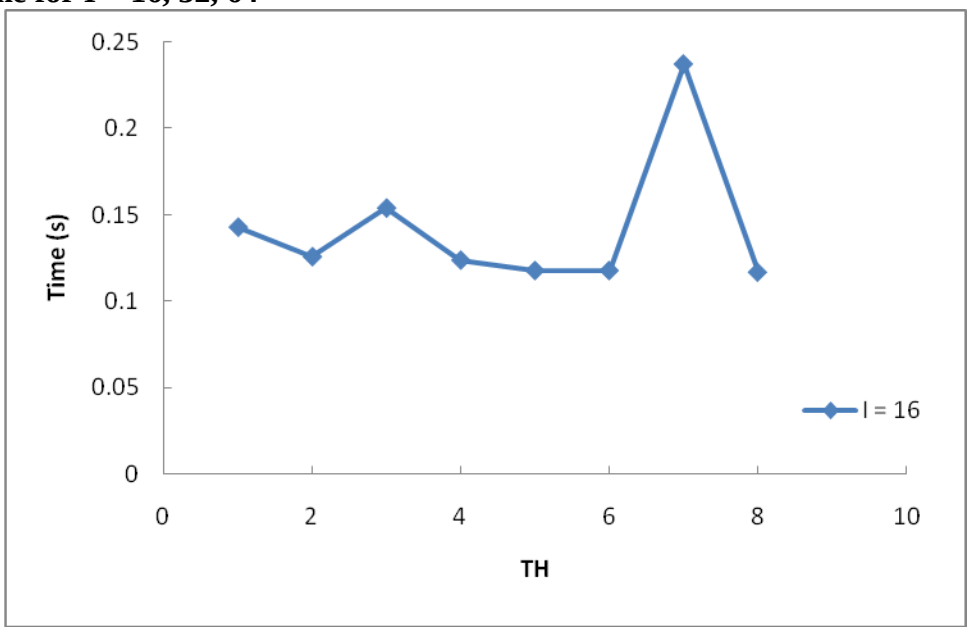
I = 32

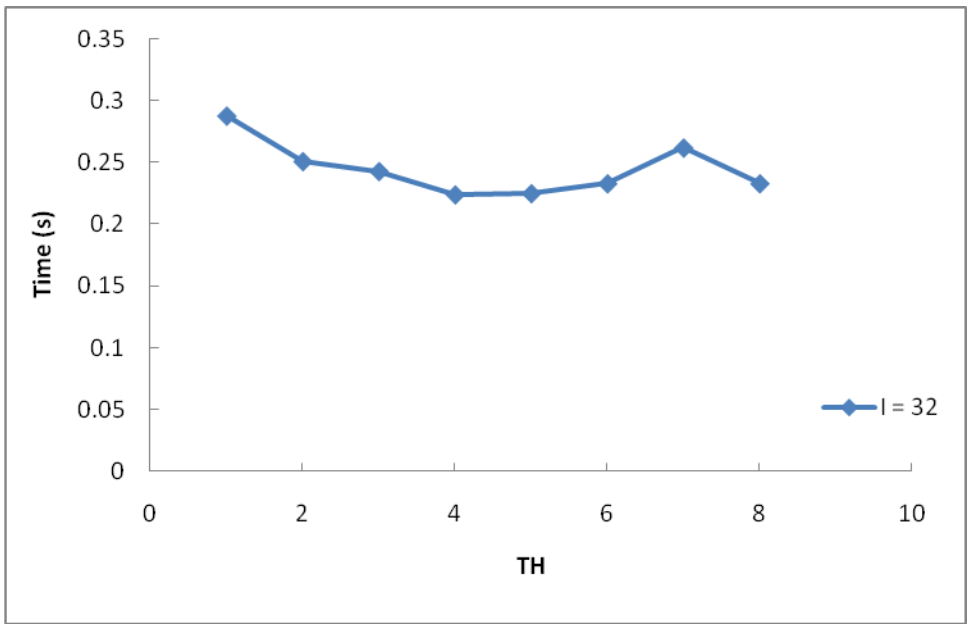
Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
Serial	0.0299636790912345	0.0561293426122005	0.0299636911515066	105
1	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
2	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
3	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
4	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
5	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
6	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
7	0.0299635840367714	0.0561290489696626	0.0299635840367714	78
8	0.0299635840367714	0.0561290489696626	0.0299635840367714	78

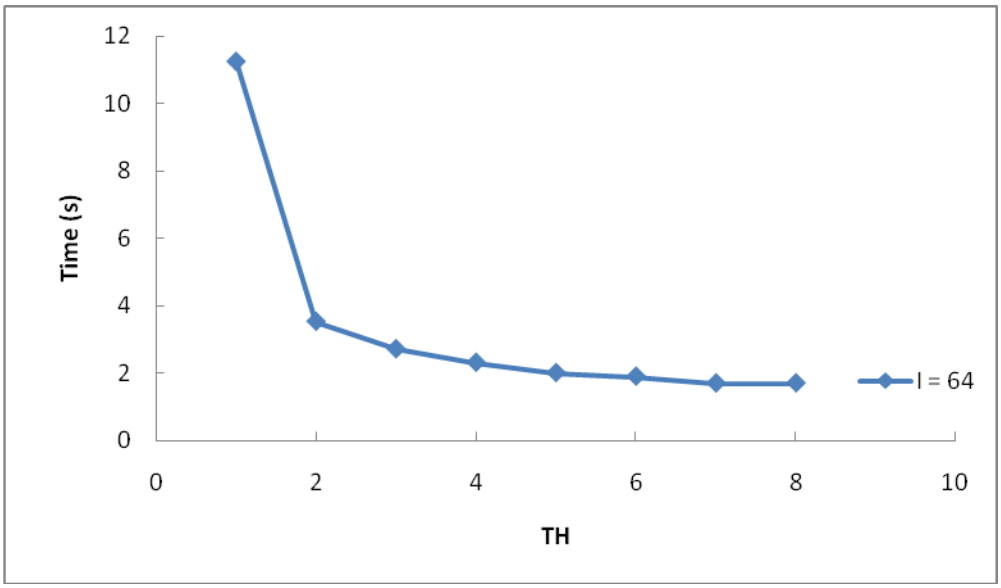
I = 64

Threads	T(0.25,0.25,0.25)	T(0.5,0.5,0.5)	T(0.75,0.75,0.75)	Iterations
Serial	0.0300061411856435	0.0561919213407831	0.0300061562617273	207
1	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
2	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
3	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
4	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
5	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
6	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
7	0.0300059556372673	0.0561913472432724	0.0300059556372673	148
8	0.0300059556372673	0.0561913472432724	0.0300059556372673	148

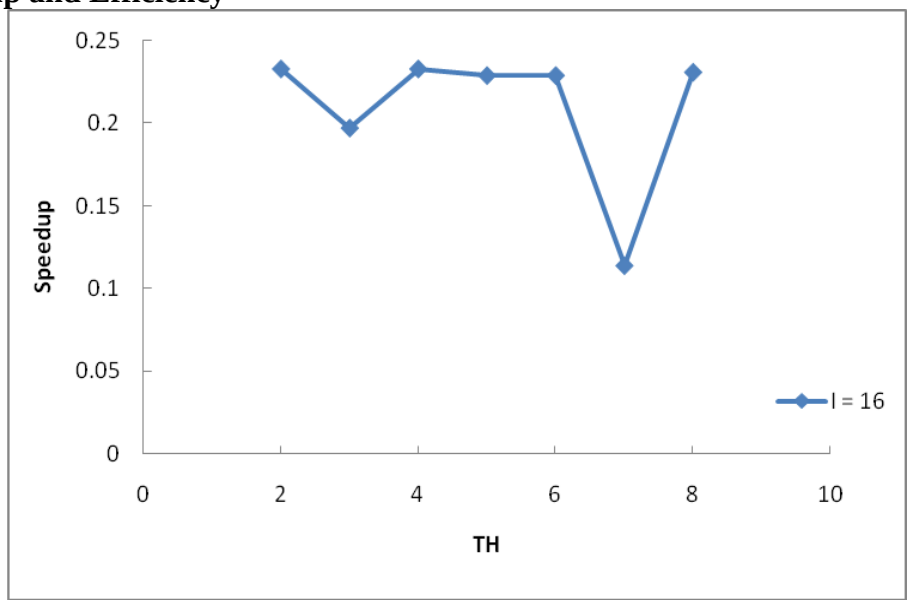
4c) Wall clock time for I = 16, 32, 64

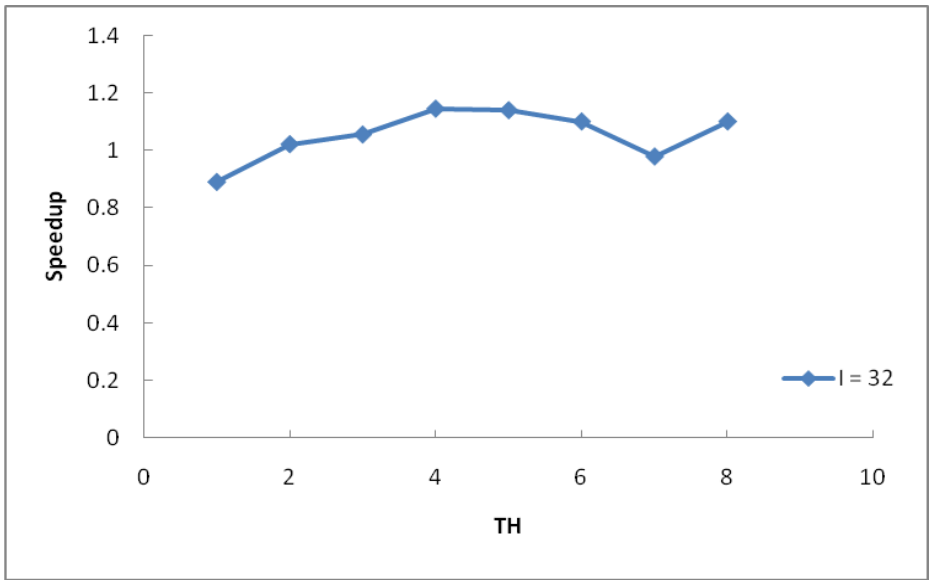


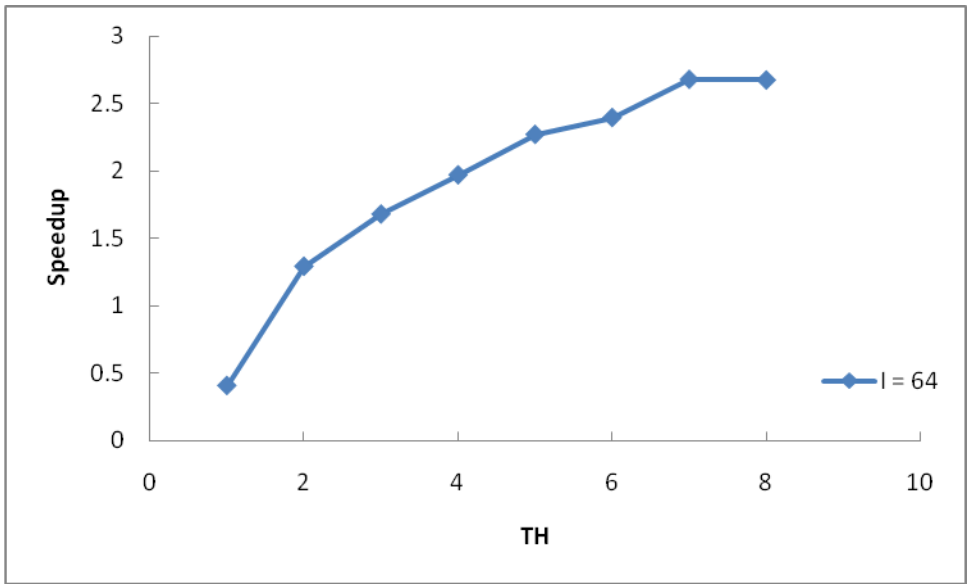


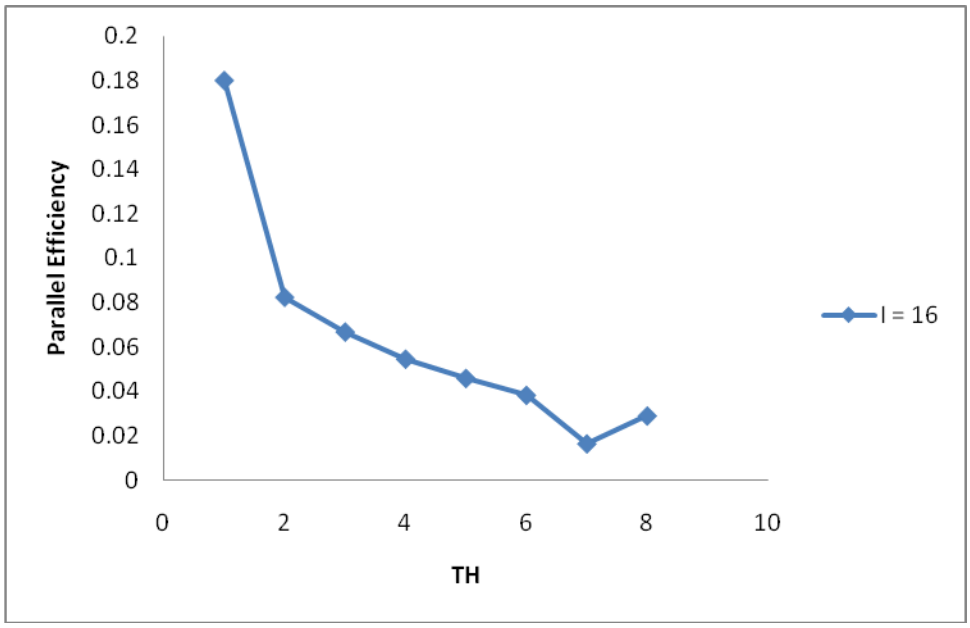


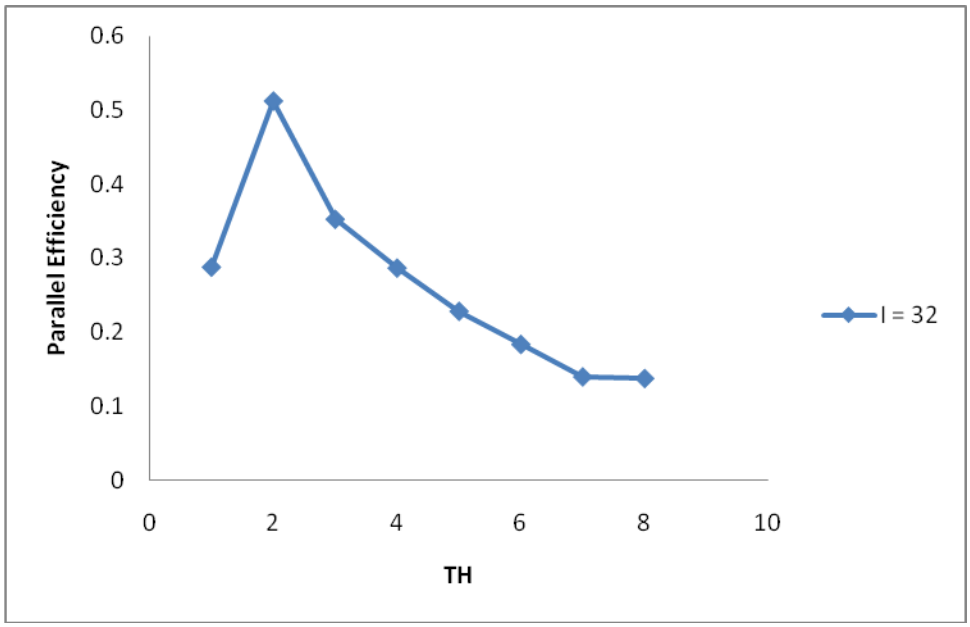
4d) Parallel Speedup and Efficiency –

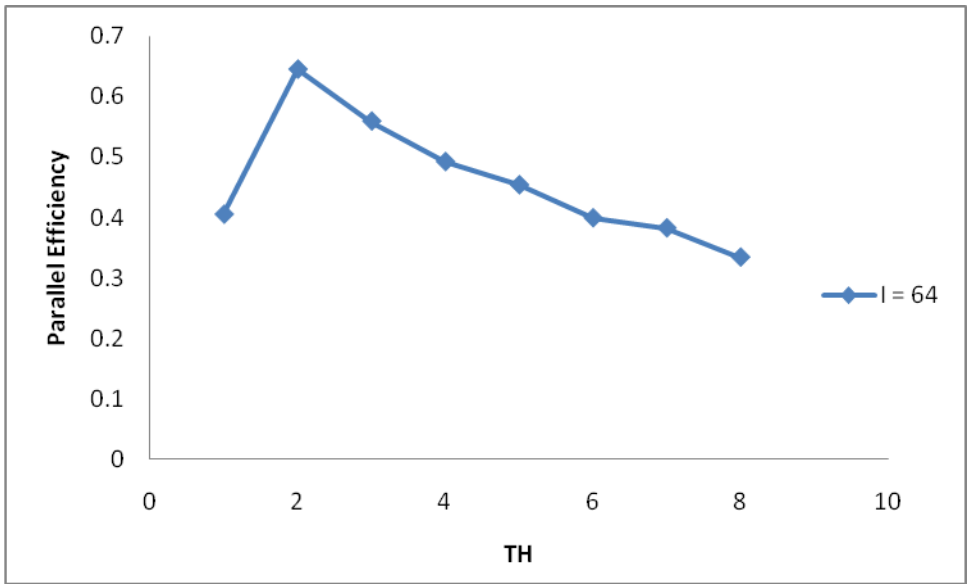





Speedup
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
TH
I = 64


Parallel Efficiency
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
TH
I = 16


Parallel Efficiency
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
TH
I = 32



4e) To compute the speedup serial execution time was used in the above plots. Red/black algorithm uses two separate iterations (Red and Black) and a method slightly different from serial SOR. It is therefore necessary to compare the execution time of the Red/Black SOR with serial execution time.