Architecture assignment Report

This report summarizes the execution times and speedups achieved by loop unrolling with degrees of 4, 8, 16, and 64 across three different array sizes.

Unrolling Time Table

Array Size	Normal Time	Unrolled-4 Time	Unrolled-8 Time	Unrolled-16 Time	Unrolled-64 Time
1024	0.000003	0.000002	0.000002	0.000004	0.000005
1024*1024	0.002590	0.001570	0.001541	0.001515	0.002636
1024*1024*16	0.017450	0.012979	0.012979	0.028906	0.033658

Unrolling Speedup Table

Array Size	normal	Unrolled-4 Speedup	Unrolled-8 Speedup	Unrolled-16 Speedup	Unrolled-64 Speedup
1024	1	1.500000	1.500000	0.750000	0.600000
1024*1024	1	1.649682	1.680727	0.850016	0.982549
1024*1024*16	1	1.335630	1.344480	0.603681	0.518450

Observations

1. Execution Time:

- Loop unrolling significantly reduces execution time for smaller array sizes and lower degrees of unrolling (4 and 8).

- Larger array sizes and higher degrees of unrolling (16 and 64) sometimes increase execution time due to overheads.

2. Speedup:

- Speedup is most noticeable with unrolling degrees of 4 and 8, especially for larger arrays.

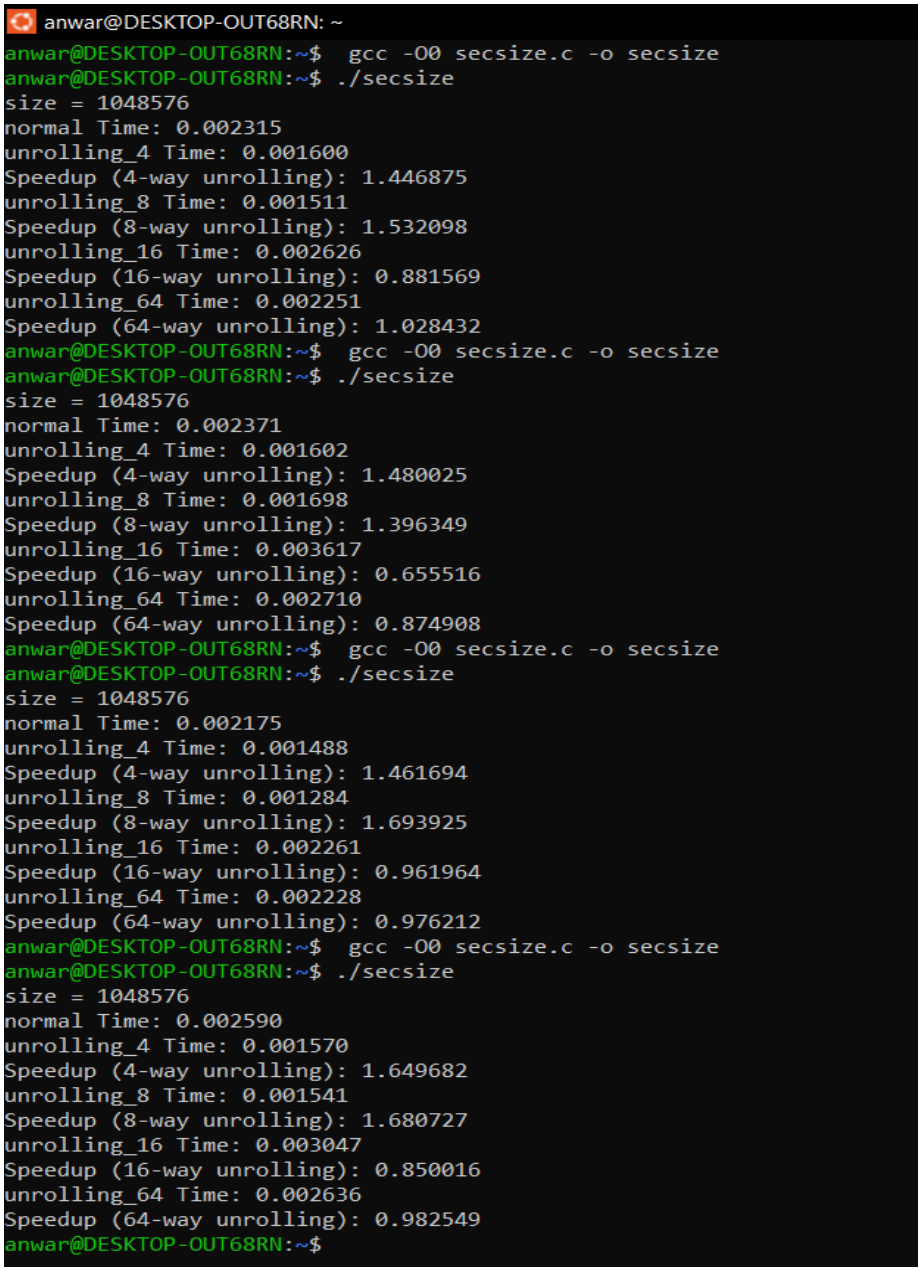
- Higher degrees of unrolling (16 and 64) show reduced speedups or even slowdowns due to diminishing returns and potential cache inefficiencies.

3. Optimal Configuration:

- Unrolling with degrees of 4 or 8 achieves the best balance between speedup and performance consistency across different array sizes.

Explain the way of solving :

I have used the wsl ubunto to compile the code with disabling the optimization and I have compile it a lot of time and take the average and record it in the result tables as show above , this picture example of code compilation using ubunto :



"I did like this for each array size"

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anwar@DESKTOP-OUT68RN: ~
anwar@DESKTOP-OUT68RN:~$  gcc -O0 lastsize.c -o lastsize
anwar@DESKTOP-OUT68RN:~$ ./lastsize
size = 16777216
normal Time: 0.016907
unrolling_4 Time: 0.012808
Speedup (4-way unrolling): 1.320034
unrolling_8 Time: 0.012671
Speedup (8-way unrolling): 1.334307
unrolling_16 Time: 0.028148
Speedup (16-way unrolling): 0.600647
unrolling_64 Time: 0.034136
Speedup (64-way unrolling): 0.495284
anwar@DESKTOP-OUT68RN:~$  gcc -O0 lastsize.c -o lastsize
anwar@DESKTOP-OUT68RN:~$ ./lastsize
size = 16777216
normal Time: 0.017337
unrolling_4 Time: 0.013057
Speedup (4-way unrolling): 1.327794
unrolling_8 Time: 0.013053
Speedup (8-way unrolling): 1.328200
unrolling_16 Time: 0.029310
Speedup (16-way unrolling): 0.591505
unrolling_64 Time: 0.034200
Speedup (64-way unrolling): 0.506930
anwar@DESKTOP-OUT68RN:~$  gcc -O0 lastsize.c -o lastsize
anwar@DESKTOP-OUT68RN:~$ ./lastsize
size = 16777216
normal Time: 0.018763
unrolling_4 Time: 0.013568
Speedup (4-way unrolling): 1.382886
unrolling_8 Time: 0.014044
Speedup (8-way unrolling): 1.336015
unrolling_16 Time: 0.031189
Speedup (16-way unrolling): 0.601590
unrolling_64 Time: 0.035921
Speedup (64-way unrolling): 0.522341
anwar@DESKTOP-OUT68RN:~$  gcc -O0 lastsize.c -o lastsize
anwar@DESKTOP-OUT68RN:~$ ./lastsize
size = 16777216
normal Time: 0.017450
unrolling_4 Time: 0.013065
Speedup (4-way unrolling): 1.335630
unrolling_8 Time: 0.012979
Speedup (8-way unrolling): 1.344480
unrolling_16 Time: 0.028906
Speedup (16-way unrolling): 0.603681
unrolling_64 Time: 0.033658
Speedup (64-way unrolling): 0.518450
anwar@DESKTOP-OUT68RN:~$
```

I well put the code in text file with submission.

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