Program Structures & Algorithms

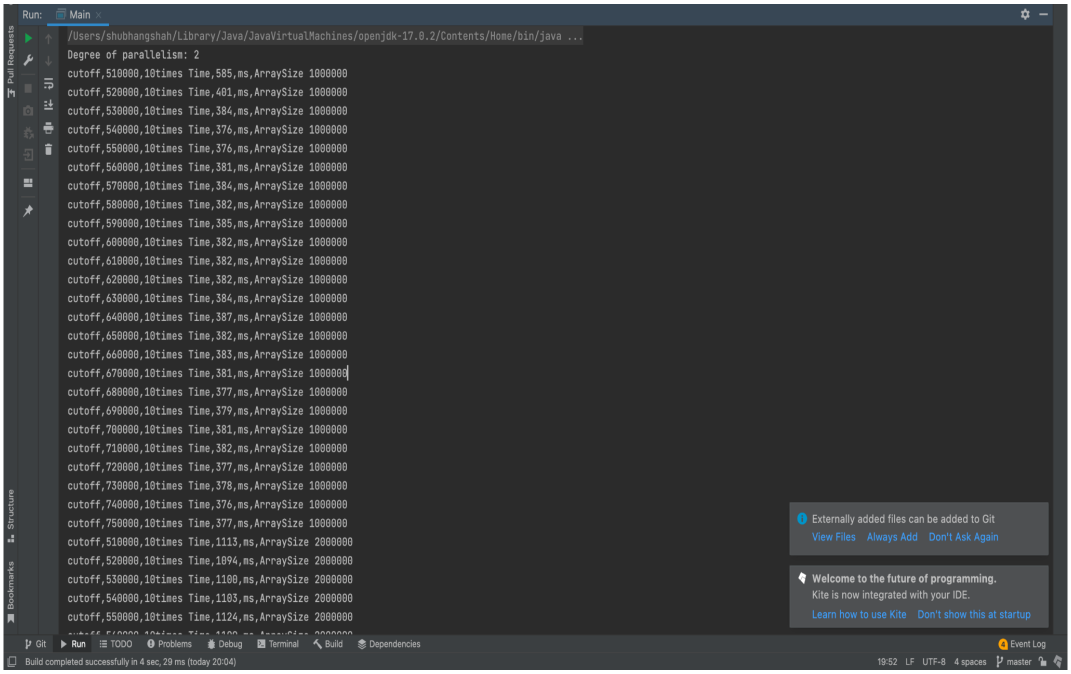
Spring 2022

Assignment No. 4

Name: Shubhang Shah

(NUID): 002111376

- ## Task
  - Implement multithreading in Main.java and ParaSort.java
  - Develop multithreading support in Main.java. The following constraints were put in place
    - Thread counts are decided with doubling method
    - Cutoff and Array size values are also varying
  - Determine the relationship between the cut-off and time
  - Done graph plotting for multiple scenarios
- ## Output screenshot
  - Evidence to show multiple number of thread output



```
/Users/shubhangshah/Library/Java/JavaVirtualMachines/openjdk-17.0.2/Contents/Home/bin/java ...
Degree of parallelism: 2
cutoff,510000,10times Time,585,ms,ArraySize 1000000
cutoff,520000,10times Time,401,ms,ArraySize 1000000
cutoff,530000,10times Time,384,ms,ArraySize 1000000
cutoff,540000,10times Time,376,ms,ArraySize 1000000
cutoff,550000,10times Time,376,ms,ArraySize 1000000
cutoff,560000,10times Time,381,ms,ArraySize 1000000
cutoff,570000,10times Time,384,ms,ArraySize 1000000
cutoff,580000,10times Time,382,ms,ArraySize 1000000
cutoff,590000,10times Time,385,ms,ArraySize 1000000
cutoff,600000,10times Time,382,ms,ArraySize 1000000
cutoff,610000,10times Time,382,ms,ArraySize 1000000
cutoff,620000,10times Time,382,ms,ArraySize 1000000
cutoff,630000,10times Time,384,ms,ArraySize 1000000
cutoff,640000,10times Time,387,ms,ArraySize 1000000
cutoff,650000,10times Time,382,ms,ArraySize 1000000
cutoff,660000,10times Time,383,ms,ArraySize 1000000
cutoff,670000,10times Time,381,ms,ArraySize 1000000
cutoff,680000,10times Time,377,ms,ArraySize 1000000
cutoff,690000,10times Time,379,ms,ArraySize 1000000
cutoff,700000,10times Time,381,ms,ArraySize 1000000
cutoff,710000,10times Time,382,ms,ArraySize 1000000
cutoff,720000,10times Time,377,ms,ArraySize 1000000
cutoff,730000,10times Time,378,ms,ArraySize 1000000
cutoff,740000,10times Time,376,ms,ArraySize 1000000
cutoff,750000,10times Time,377,ms,ArraySize 1000000
cutoff,510000,10times Time,1113,ms,ArraySize 2000000
cutoff,520000,10times Time,1094,ms,ArraySize 2000000
cutoff,530000,10times Time,1100,ms,ArraySize 2000000
cutoff,540000,10times Time,1103,ms,ArraySize 2000000
cutoff,550000,10times Time,1124,ms,ArraySize 2000000
```

Externally added files can be added to Git

Welcome to the future of programming.
Kite is now integrated with your IDE.

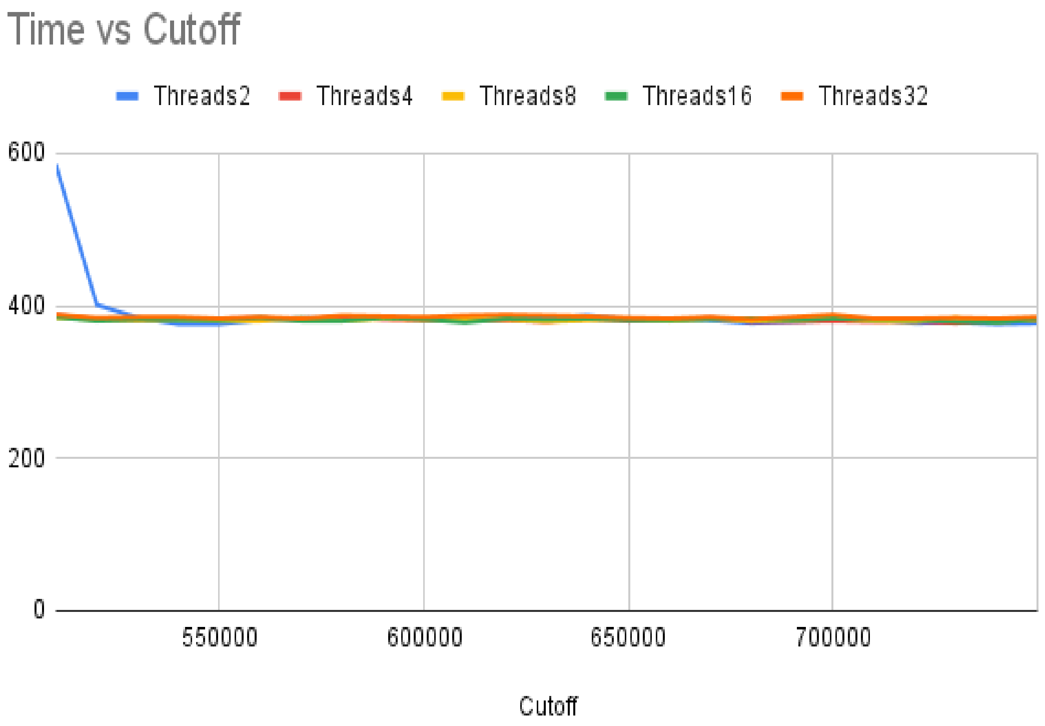
Build completed successfully in 4 sec, 29 ms (today 20:04)

- ## Relationship Conclusion
  - A standard plot of cutoff vs time for varying number of threads. Below attached graphs shows that the number of threads is not a contributor.

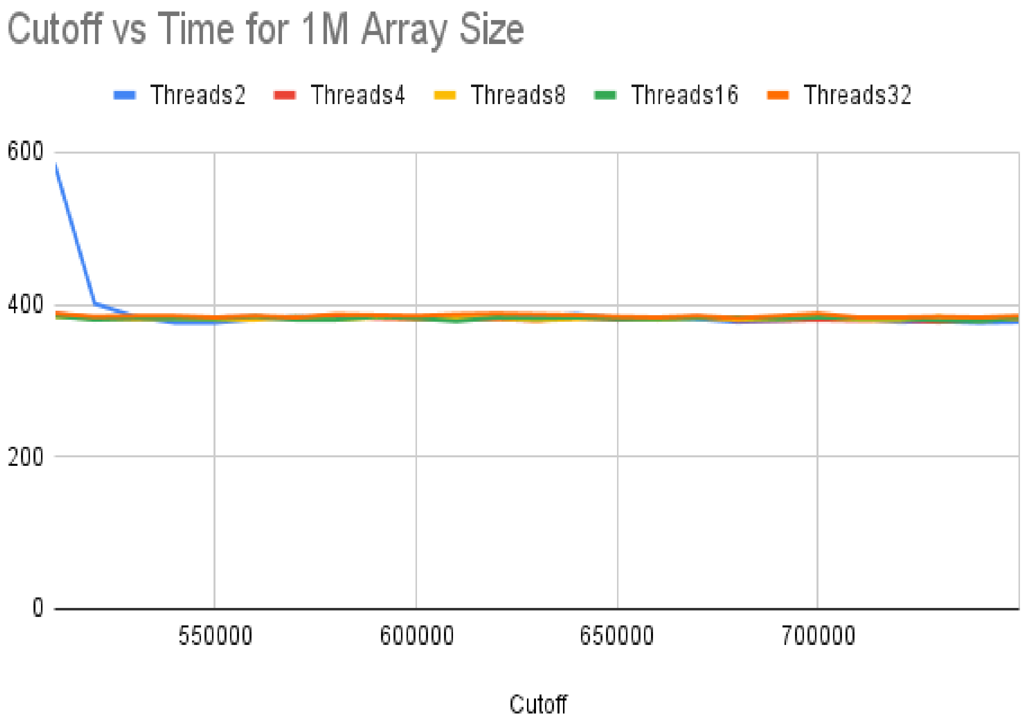
- Increasing the number of threads beyond 8 had no significant improvement in efficiency of sorting.
- Based on graphs, we can conclude that the cutoff should be between N/4 and N/8.
- Also, the graph shows that the thread value should lie between 8 or 16.

- **Evidence / Graph**

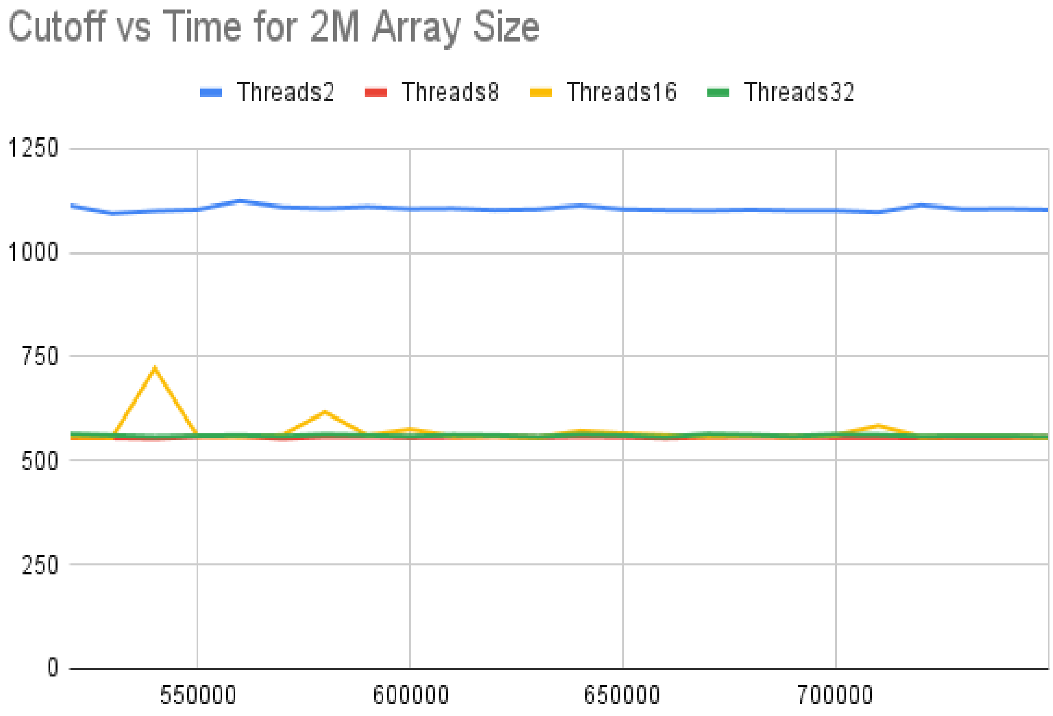
  - Graphical representation of time vs cutoff



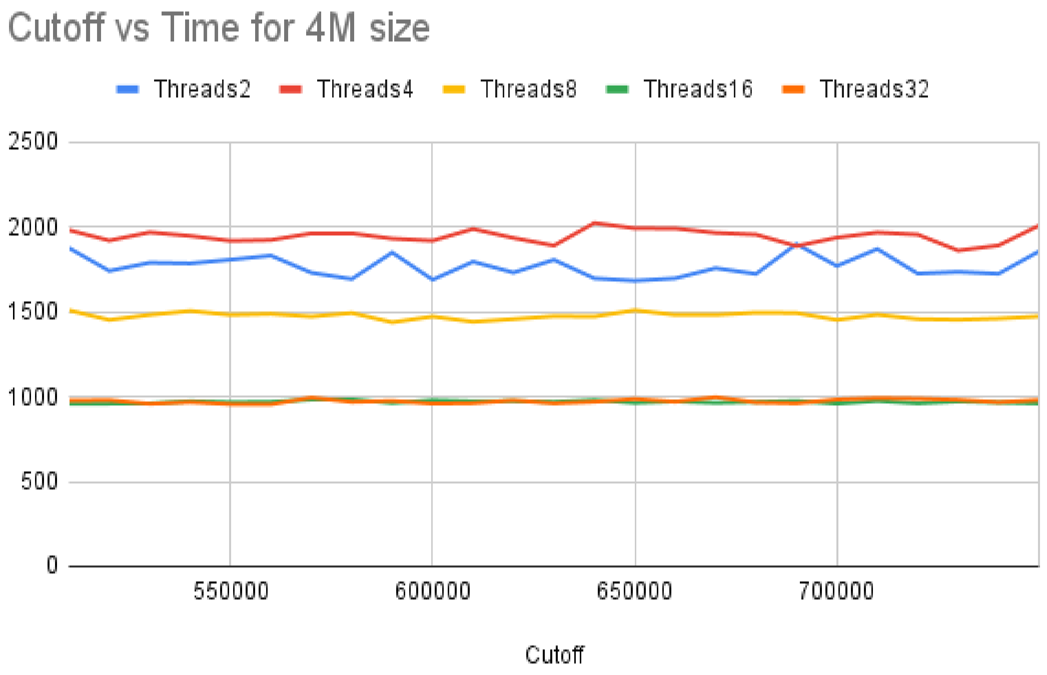
- Graphical representation of time vs cutoff for array size 1M



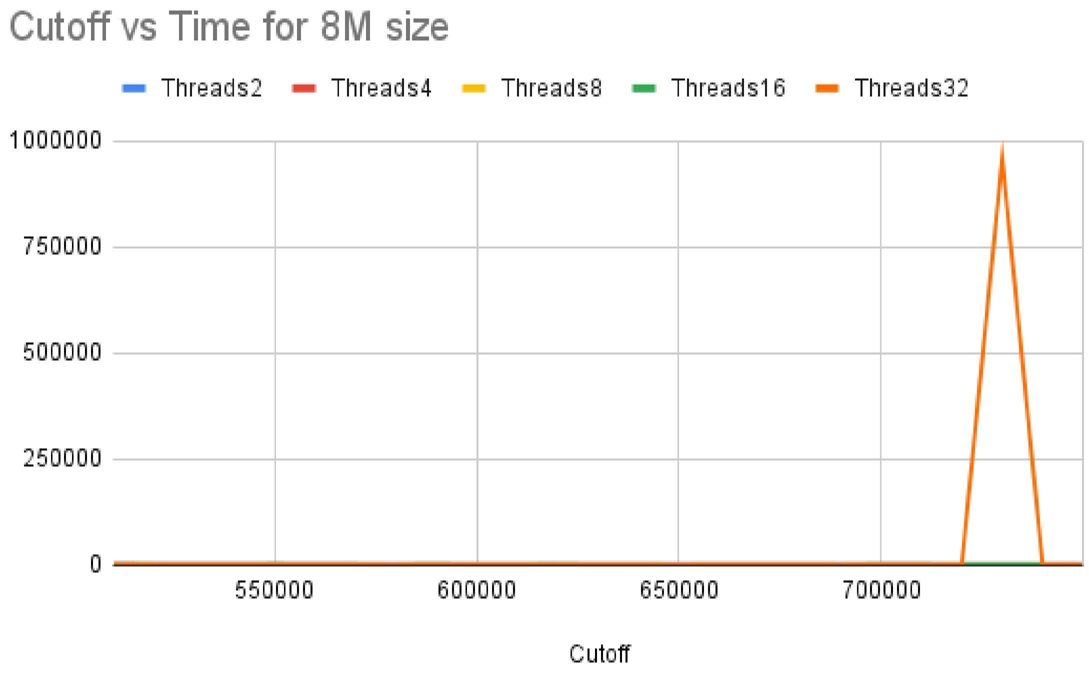
- Graphical representation of time vs cutoff for array size 2M



- Graphical representation of time vs cutoff for array size 4M



- Graphical representation of time vs cutoff for array size 8M


Cutoff vs Time for 8M size
Threads2
Threads4
Threads8
Threads16
Threads32
Cutoff