

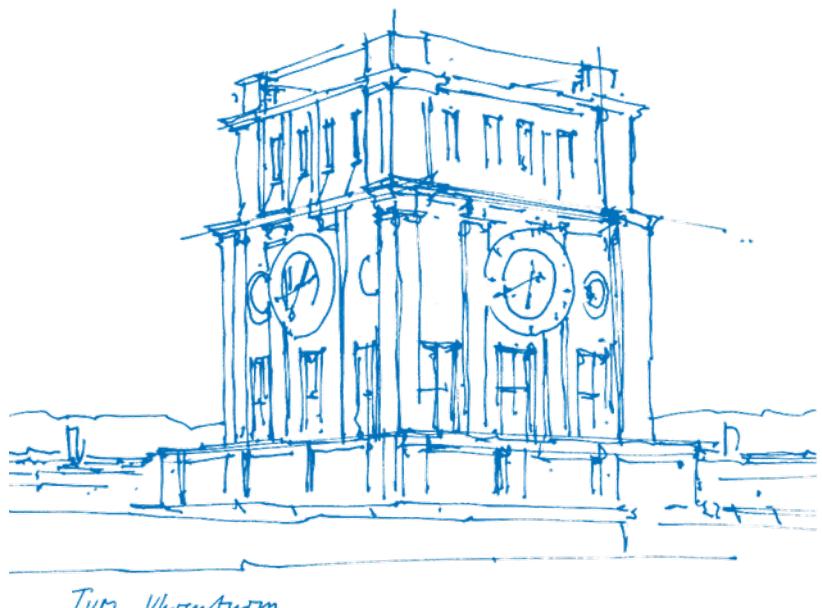
# Parallel Programming Tutorial - #pragma omp the 1<sup>st</sup>

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May 20, 2020



# 📢 Public Service Announcements

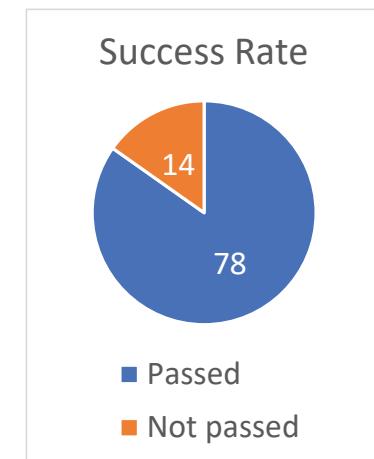
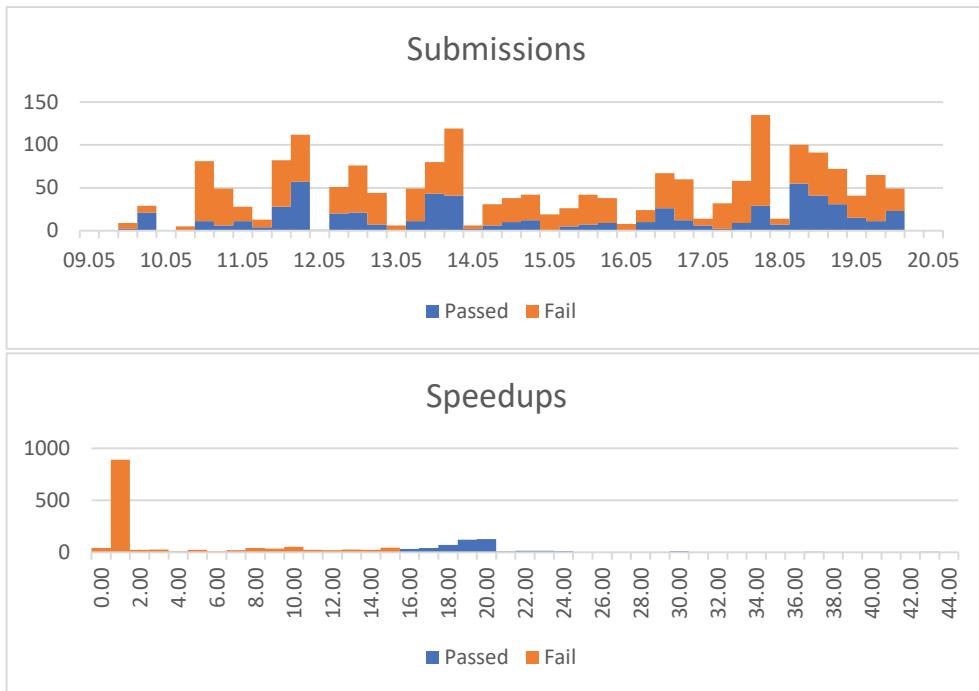
- Next week's lecture is a **live** guest lecture on Monday at 10:15.
  - Topic: OpenMP Architecture Review Board and SIMD
- Lots of incoming requests and suggestions. Keep them coming.
- The previous exercise suffered from numerical problems. We hope to fix this in the coming exercises by giving you tolerances where appropriate.

# Review: Previous exercise

## Some common issues

- Exit code 139 → segmentation fault
  - Possible causes: Lack of synchronization, memory overruns, placing too much data on the stack
- Reproducing a run on your local system
  - Copy the relevant seed from the submission server and input it to your program

# Review: Previous exercise



# Moodle Exercise

## Moodle Quiz

If you have any more questions on lecture or exercise content,  
please write us and we will cover them after the break.

```
#pragma omp executive summary
```

- Know your common constructs
- Know your scheduling and data sharing
- Be able to analyze and interpret dependencies

## Content Questions

This is a placeholder.

<insert your question here>

I'm not reiterating theory this week unless you ask me to.

#omp

This is a placeholder.

<insert your question here>

I'm not reiterating theory this week unless you ask me to.

## Assignment 2: “Stormy Seas (Captain Sparrow’s Return to Port Royal)”

# Assignment: Stormy Seas



**Figure 1:** “You are, without doubt, the worst pirate I have ever heard of.” “Ah, but you have heard of me.”

# Assignment: Stormy Seas



[Figure 1:](#) “You are, without doubt, the worst pirate I have ever heard of.” “Ah, but you have heard of me.”



[Figure 2:](#) Not exactly the best place to die.

# Assignment: Stormy Seas



[Figure 1:](#) "You are, without doubt, the worst pirate I have ever heard of." "Ah, but you have heard of me."



[Figure 2:](#) Not exactly the best place to die.



[Figure 3:](#) The harbormaster might have something to say about this.

# Explanation: Stormy Seas

## Part 1: Simulate waves

- A typical stencil code.
- Wave heights are stored in a 2D grid as floats  $\in [0, 1]$ .
- The new wave height is calculated from 4 neighbors in each step.

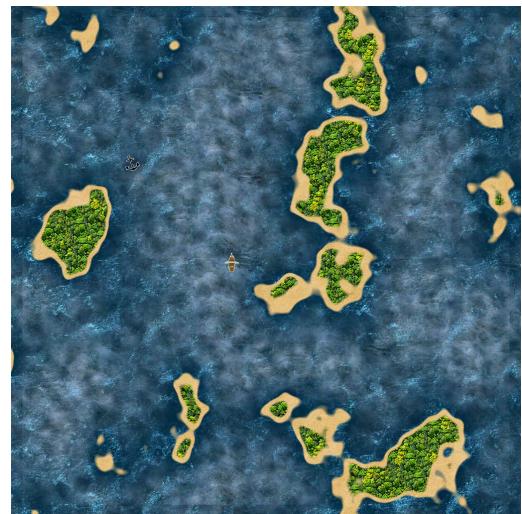


Figure 4: High waves are marked in white

# Explanation: Stormy Seas

## Part 2: Find shortest path for Captain Jack to Port Royal

- In each time step, the Jolly Mon can move 1 space in a cardinal direction (north/east/south/west) or along a diagonal (NE, SE, SW, NW). Alternatively, it can just stay where it is.
- The Jolly Mon can never be in a position with wave heights  $\geq \text{SHIP\_THRESHOLD}$ .
- Exception: The Jolly Mon can always be at its starting position, no matter the current wave height.
- A pirate has no time to dawdle, so take the shortest path observing the constraints.
- Output the earliest simulation frame  $t$  that Captain Jack can arrive at Port Royal, or “no solution” if he cannot arrive in time.



Figure 5: A short path to the destination observing constraints (in green)

# Assignment: Stormy Seas

Your job: Bring Captain Jack safely back to Port Royal.



Figure 6: The harbormaster might have something to say about this.

## Tips

- Access to the entire machine, want speedup of 8x.
- You can swap out any of the algorithms (even the `readInput` utility function). Just copy them to your submission file.
- You only need to output the time step in which Jack arrives at Port Royal.
- Our machine has two NUMA domains, so think a little about data locality (first-touch).

# Assignment: Stormy Seas

Your job: Bring Captain Jack safely back to Port Royal.



Figure 7: The harbormaster might have something to say about this.

## More tips

- Multiple different problems solved in each run.
- The wave simulation has fewer dependencies to be taken care of when parallelizing.
- Try to find irrelevant calculations that can be eliminated.
- Extra: Visualization output (Using `-v` flag)
  - Requires `ffmpeg` to be available on your path (check by typing `ffmpeg` on the terminal).
- Absolute tolerance in path length: 2

# What we covered today

- Review of the current assignment homework.
- `#pragma omp do magic`
- New exercise: Stormy Seas.
- Make sure to take advantage of our Homework Q&A sessions if you are having problems