

krajanba & apoltora
Project Proposal

[Web page link for the project](#)

TITLE: Locks

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URLs:

Intro website:

<https://apoltora0.wixsite.com/locks>

Project Proposal tab:

<https://apoltora0.wixsite.com/locks/project-proposal>

SUMMARY: Summarize your project in no more than 2-3 sentences. Describe what you plan to do and what parallel systems you will be working with.

Using micro-benchmarks to compare and contrast the consequences of different locks, we will be rigorously testing a set of locks (namely test and set, test and test and set, queue, ticket, etc.) and observing some metrics like their latency, interconnect traffic, scalability, storage cost and fairness and measuring how each compares. The micro-benchmarks will be very simple so that the focus remains on the locks.

BACKGROUND: If your project involves accelerating a compute-intensive application, describe the application or piece of the application you are going to implement in more detail. This description need only be a few paragraphs. It might be helpful to include a block diagram or pseudocode of the basic idea. An important detail is what aspects of the problem might benefit from parallelism and why?

We will use simple micro-benchmarks of code that test various types of lock implementations. An example of a simple micro-benchmark is:

```
lock(&is_lock);
```

```
x++;
```

```
unlock(&is_lock);
```

Locks are invaluable for parallelism so that threads may run in parallel while avoiding any race conditions that may occur so that we guarantee the correctness of execution. Also at the same time we need to avoid any possible deadlocks and try to minimize starvation of threads due to locks.

THE CHALLENGE: Describe why the problem is challenging. What aspects of the problem might make it difficult to parallelize? In other words, what do you hope to learn by doing the project?

This problem is challenging because while we test parallelism we need to ensure correctness in lock placement. While we want to test locks and compare the results of certain locks with others, we need to be consistent in our tests (such that we are doing similar micro-benchmarks) and tools we use for profiling. Examining these differences, we consider why we see the differences that we do and attribute it to certain qualities about one lock over another. Another challenge is there are cases where the lock is obtained by a thread but the thread stays idle. Are there ways to regain the lock from this thread? Also trying to implement locks in assembly is something that we are going to learn as we have only used functions from libraries to implement locks until now.

RESOURCES: Describe the resources (type of computers, starter code, etc.) you will use. What code base will you start from? Are you starting from scratch or using an existing piece of code? Is there a book or paper that you are using as a reference (if so, provide a citation)? Are there any other resources you need, but haven't figured out how to obtain yet? Could you benefit from access to any special machines?

We will be running our tests on psc and on ghc. We will create several different micro-benchmarks from scratch. We also plan to use tools like perf for observing cache misses for these micro-benchmarks. We will be referencing our class slides as well as looking at online research papers.

We haven't found any papers yet but hope to find them soon. We will also like to have guidance on useful research papers and any specific places to look for assembly implementations of locks which may be helpful to us. Also, we would like to have guidance on what other kinds of locks there are (apart from the ones in slides) and what they should hypothetically behave like.

GOALS AND DELIVERABLES: Describe the deliverables or goals of your project. This is by far the most important section of the proposal!

Separate your goals into what you **PLAN TO ACHIEVE** (what you believe you must get done to have a successful project and get the grade you expect) and an extra goal or two that you **HOPE TO ACHIEVE** if the project goes really well and you get ahead of schedule, as well as goals in case the work goes more slowly. It may not be possible to state precise performance goals at this time, but we encourage you to be as precise as possible. If you do state a goal, give some justification of why you think you can achieve it. (e.g., I hope to speed up my starter code 10x, because if I did it would run in real-time.)

Our goal is to demonstrate the pros and cons of some locks over others. We would like to observe and measure the metrics like latency, cache misses, scalability, storage cost and fairness for different lock implementations. After writing micro benchmarks, if time permits we may test the locks on bigger workloads also. By bigger workloads we mean that when the critical section gets significantly bigger (more lines of code) than our micro-benchmarks. We hope to see that the locks have a lot of differences, and there is a benefit to using some over others depending on the circumstance. In the same way if we are lagging behind in schedule then we may reduce the number of lock implementations or number of tests accordingly.

These goals are tentative but maybe subject to changes based on instructor's feedback or when a new idea pops up as we make progress in our project.

If applicable, describe the demo you plan to show at the poster session (Will it be an interactive demo? Will you show an output of the program that is really neat? Will you show speedup graphs?). Specifically, what will you show us that will demonstrate you did a good job?

We will show different micro-benchmarks with lock implementations measuring different factors to see which locks are more ideal than the other in a certain situation. This will likely mean that we will have small sections of the poster representing those micro-benchmarks, where ideally we can have a graph/table comparison of the behaviour of different locks.

If your project is an analysis project, what are you hoping to learn about the workload or system being studied? What question(s) do you plan to answer in your analysis?

We plan to answer questions like, will lock “x” cause starvation, will lock “y” cause a lot of interconnect traffic, etc. It’s a thorough analysis which provides the pros and cons of different lock implementations.

PLATFORM CHOICE: Describe why the platform (computer and/or language) you have chosen is a good one for your needs. Why does it make sense to use this parallel system for the workload you have chosen?

We have decided to write code in assembly as we can directly plug in the assembly instructions related to locks. We will use pthreads for spawning threads and that can really use any system, so we consider using ghc for consistency with the course, and also psc to take advantage of its high core count where we can run many more threads at once to start seeing contention, overhead, fairness, etc. all really tested.

SCHEDULE

Week 1: 10/31 - 11/6

Figure out which micro-benchmarks we want to use, and which locks we would like to test. Begin writing the micro-benchmarks.

Week 2: 11/7 - 11/13

Microbenchmarks for lock implementation 1

Week 3: 11/14 - 11/20

Microbenchmarks for lock implementation 2

Week 4: 11/21 - 11/27

11/22 Milestone Report due at 9AM

Microbenchmarks for lock implementation 3

Week 5: 11/28 - 12/04

Microbenchmarks for lock implementation 4

Week 6: 12/05-12/10

Doing tests on all the implementations, making comparisons and compiling the results.
Implementing more locks or more tests if we have more time.

12/09 Final Report due

12/10 Poster Session