Section 5

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Section Today

- Administrative stuff
- ~~Homework 1 recap~~ ☹
- Homework 2 questions
- Project and homework tips
- Semaphores and Monitors (continued)

Administrative Stuff

- Project groups!
  - Please PLEASE work in pairs ☺
  - Please email me if your space is not set up by 11:59 pm tonight (Thu Feb 2nd)
  - Subversion spaces are in `/projects/instr/12wi/cse451`
  - Use Tortoise SVN to access

    `svn+ssh://<CSEnetID>@attu.cs.washington.edu/projects/instr/12wi/cse451/<groupname>`

More Administrative Stuff

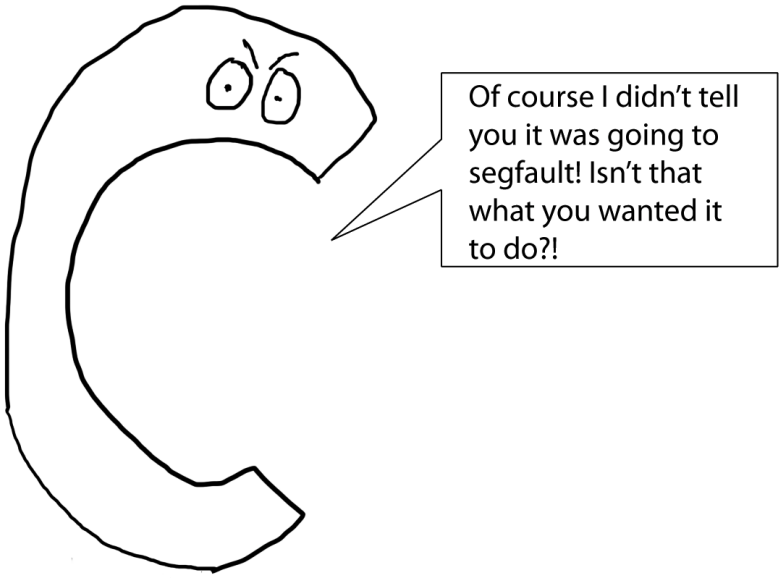
- Anonymous Feedback Form
  - https://catalyst.uw.edu/umail/form/ericwu/3969
- Class mailing list forthcoming…

Homework 2 Questions

- Exercise 2
  - A **standard** Round Robin queue places **unique** TCB pointers in the queue.
- Exercise 5
  - If you were to write code for wait() and signal(), how would you do it?
  - DO NOT actually write code. (Pseudo-code is fine.)
- Other questions?

Project and Homework Advice

- Skills for managing and working on large projects
- How to go about designing your projects and homework solutions



Borrowed from http://worldgnat.wordpress.com/2010/11/12/angry-c-is-angry/

Debugging

- Print to console generously
  - Print out variables, static text for conditionals, sanity checks, etc.
  - Be sure to flush the buffer immediately after printing!
- Sometimes debuggers lie
  - Return to the first point
- Use assertions
  - Bugs only occur in code that has already executed.

Debugging (continued)

- Differentiate between linker and compiler errors.
  - Linker errors are from bad names and symbols.
  - Compiler errors are everything in between.
- Make sure your types are defined before you use them!
- Check for misspellings and copy existing code to see if linking works.

Common Project Problems

- “Error occurred in a file that I didn’t edit.”
  - Likely meant you corrupted a variable or wrote to a bad memory address.
- “Code hangs…”
  - In project 3, likely a deadlock.
- Any others?

Project and Homework Design

- Design with the user in mind!
  - But who is the user?

Project and Homework Design

- Design with the user in mind!
  - But who is the user?
- Design for other hackers
  - If someone wanted to modify your code, would it be easy to do?
  - Does it belong in a file, class, or function that makes sense?
  - Is your code redundant?

Project and Homework Design

- Design with the user in mind!
  - But who is the user?
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  - If someone wanted to modify your code, would it be easy to do?
  - Does it belong in a file, class, or function that makes sense?
  - Is your code redundant?
- Design for the client
  - Is the design optimized for performance and space? Does it matter?

Semaphores

- Covered in lecture and section
  - Questions?

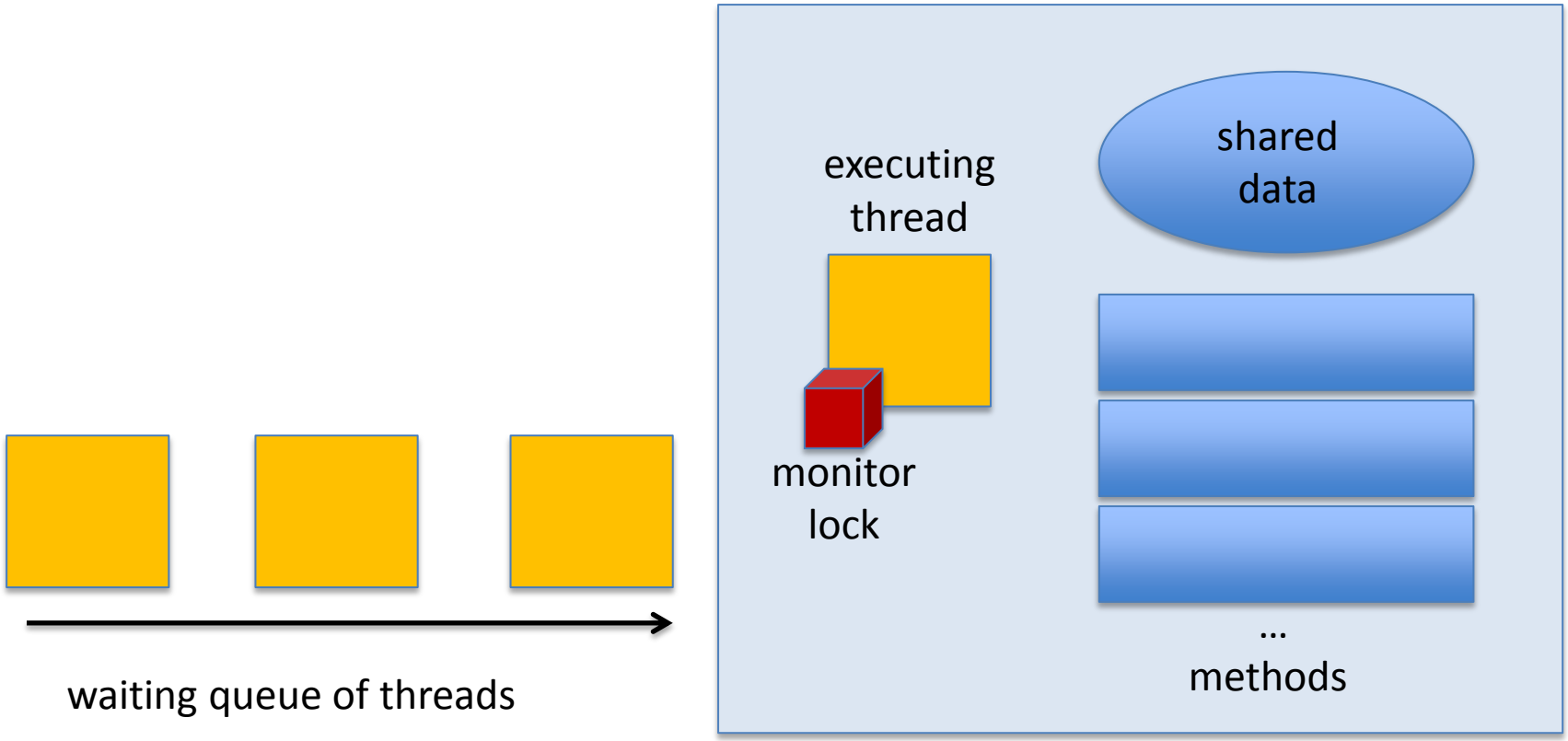
Monitors

- These are programming language constructs
  - Essentially a class defined by a language
    - Contains methods, shared variables, etc.
    - Synchronization is automatically added into the superclass, API, or encapsulating code

How do monitors work?

- Use a lock to ensure only one thread can enter the monitor at a time.
  - Let's call this lock the **monitor lock.**
- Use condition variables to control thread behavior inside the monitor.

Monitors in a Picture



Condition Variables

- Synchronization primitives used in monitors
- They use wait() and signal()
  - Similar, but **not** the same purpose as semaphores wait() and signal()!

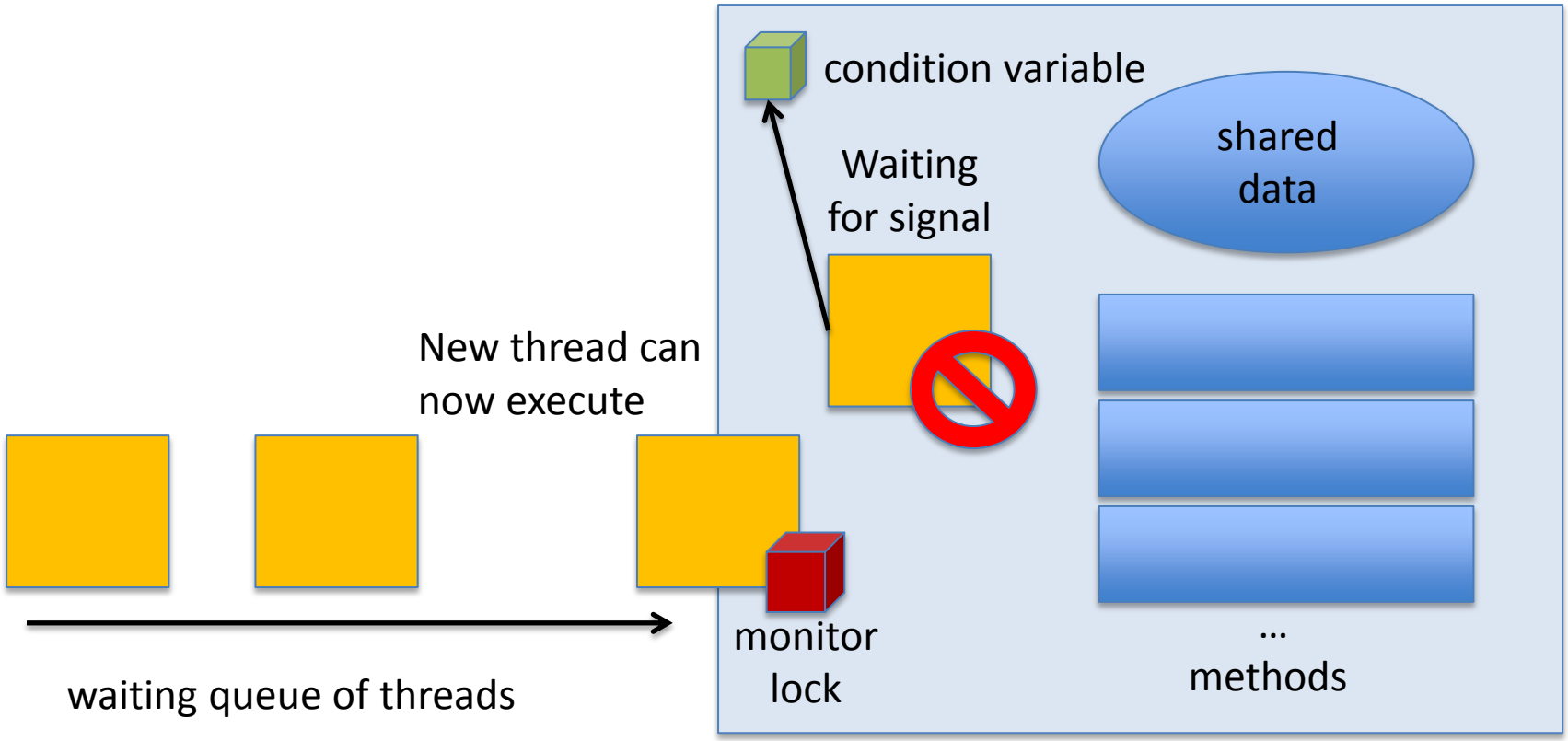
Condition Variables

- wait(**condition**)
  - Puts current thread on the waiting queue for **condition**.
- signal(**condition**)
  - Wakes up at most one thread from the waiting queue corresponding to **condition**.
- broadcast(**condition**)
  - Wakes up all threads on waiting queue corresponding to **condition**.

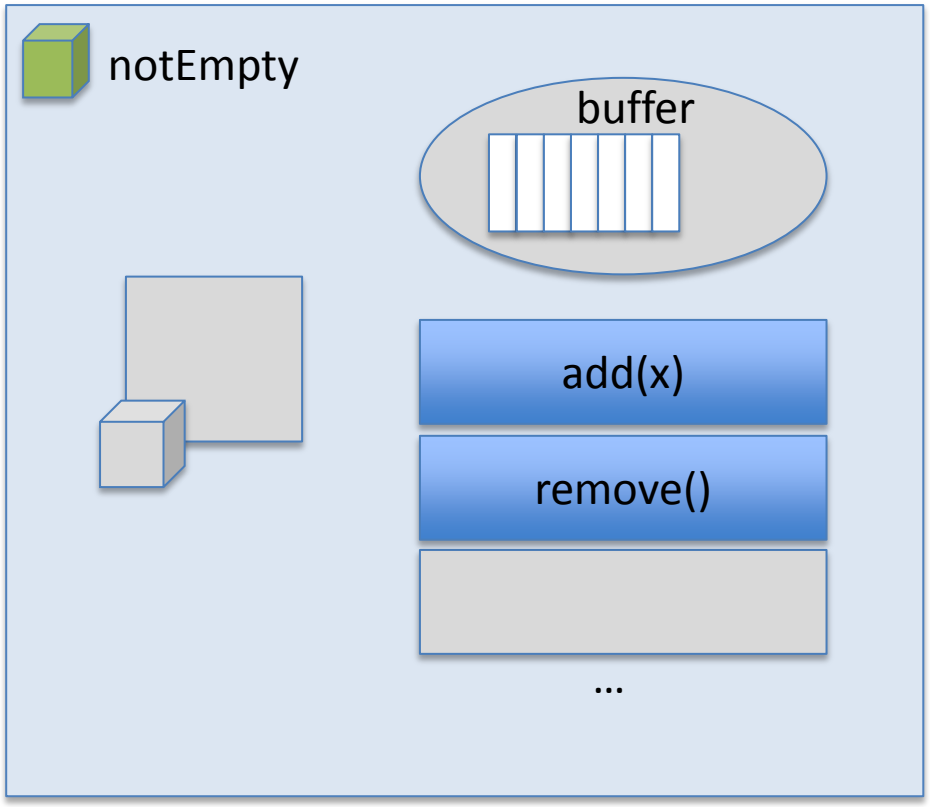
But… wait()!

- Upon entering the monitor, the thread acquires the monitor lock.
- If the thread calls wait(), it must release the monitor lock.
  - Why?

After the Executing Thread calls wait()



Example: unbounded buffer

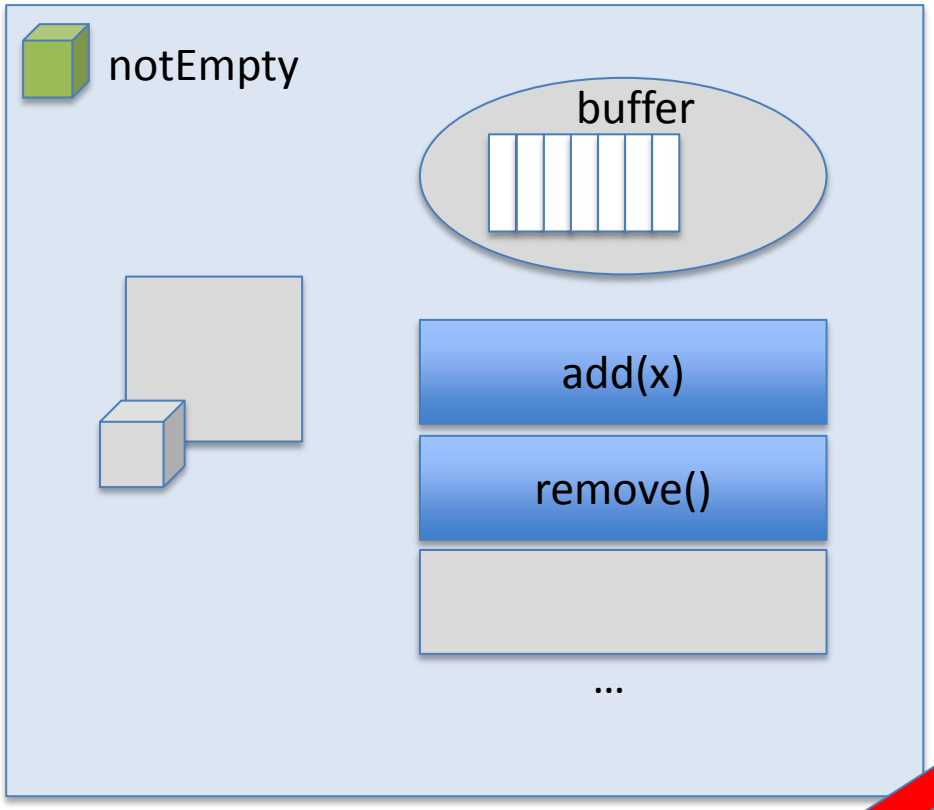



```
Monitor {
        private queue buffer;
        condition notEmpty;

        add(x) {
                buffer.add(x);
                signal(notEmpty);
        }

        remove() {
                if (buffer.empty()) {
                        wait(condition variable);
                        // current thread stops
                }
                // buffer should be
                // non-empty here
                buffer.remove()
        }
```

Monitor Scheduling Choices

- Hoare: signal(**condition**) means
  - Run waiter immediately
- Mesa: signal(**condition**) means
  - Waiter is made ready, but signaler continues

Revisit example: Hoare or Mesa?

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Monitors by Design

- Which is better: Hoare or Mesa?
- What do we get from monitors? What don't we get?

Monitors by Design

- Which is better: Hoare or Mesa?
- What do we get from monitors? What don't we get?
- Why don't monitors resolve deadlocks?
- How to guarantee no deadlocks? Is it possible?