

# CSE 333

## Lecture 22 -- wrapup

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# Administrivia

Final exam Wednesday, 2:30-4:20

Topic list and old exams on the web

Anything all quarter is possible, but biased toward 2nd half

Last minute Q&A Tuesday, 4:30, GUG 218

So what have we been doing  
for the last 10 weeks?

?

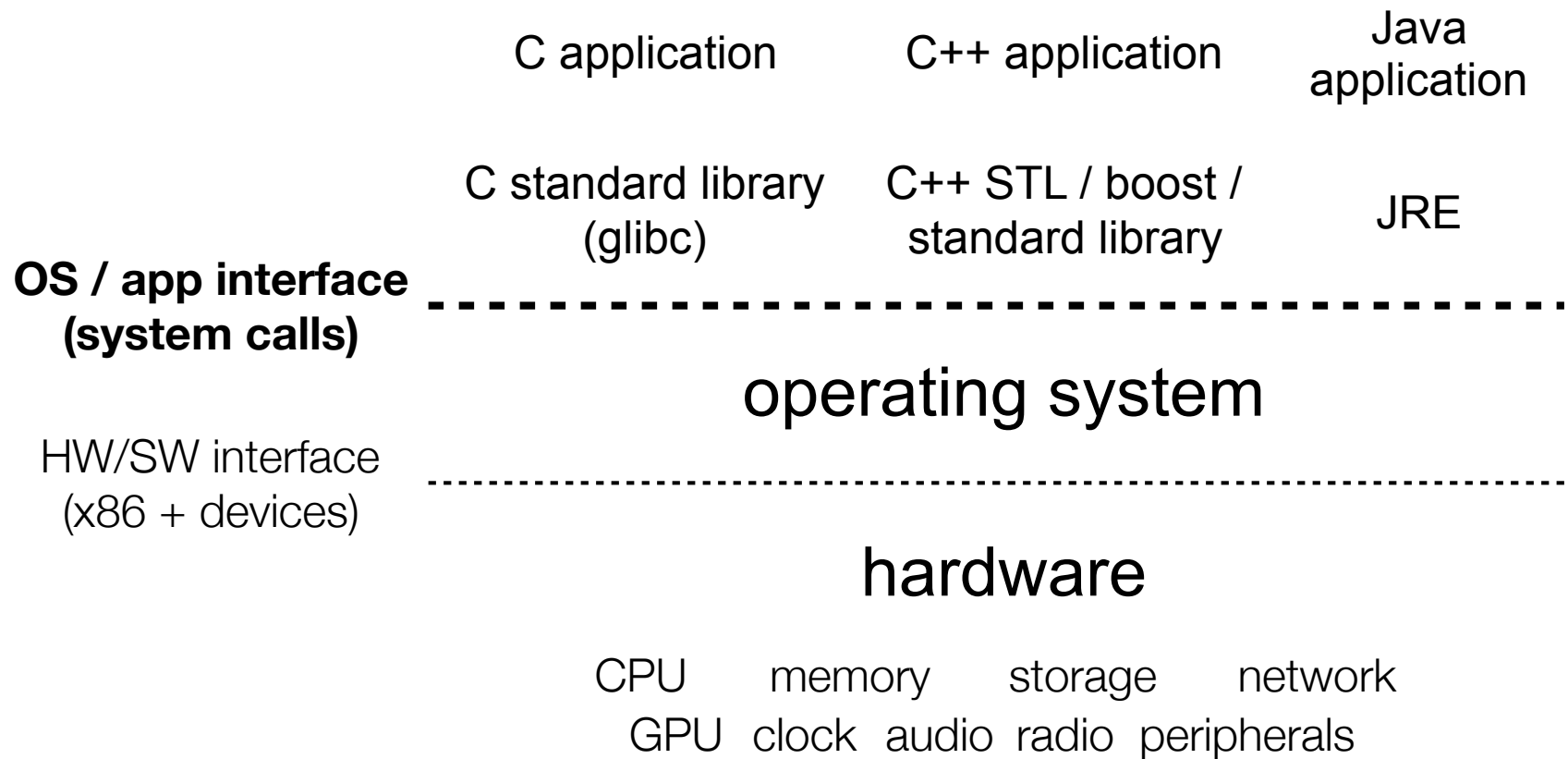
# Course goals

Explore the gap between

Intro: the computer is a magic appliance that runs programs

CSE 351: the computer is a stupid appliance that executes really, really simple instructions (really fast)

# Course map: 100,000 foot view



# Goals

## Skills

Programming closer to the hardware: C/C++

Disciplined design, testing, debugging

## Knowledge

OS interface and semantics, languages, some networking

A deep(er) understanding of “the layer below”

*quiz: when is the data safely on disk after a write? Actually received over the network? How many copies are made along the way?*

# Main topics

C Programming, tools, and workflow

Memory management

System interfaces and services (files, etc.)

C++ : the 800-lb gorilla of programming languages

“better C” + classes + STL + smart pointers + ...

Networking basics: TCP/IP, sockets, ...

Drilling deeper...

# The C/C++ Ecosystem

System layers: C/C++, libraries, operating system

Building programs

cpp: #include, #ifndef, and all that

compiler (cc1): source → .o

loader (ld): .o + libraries → executable



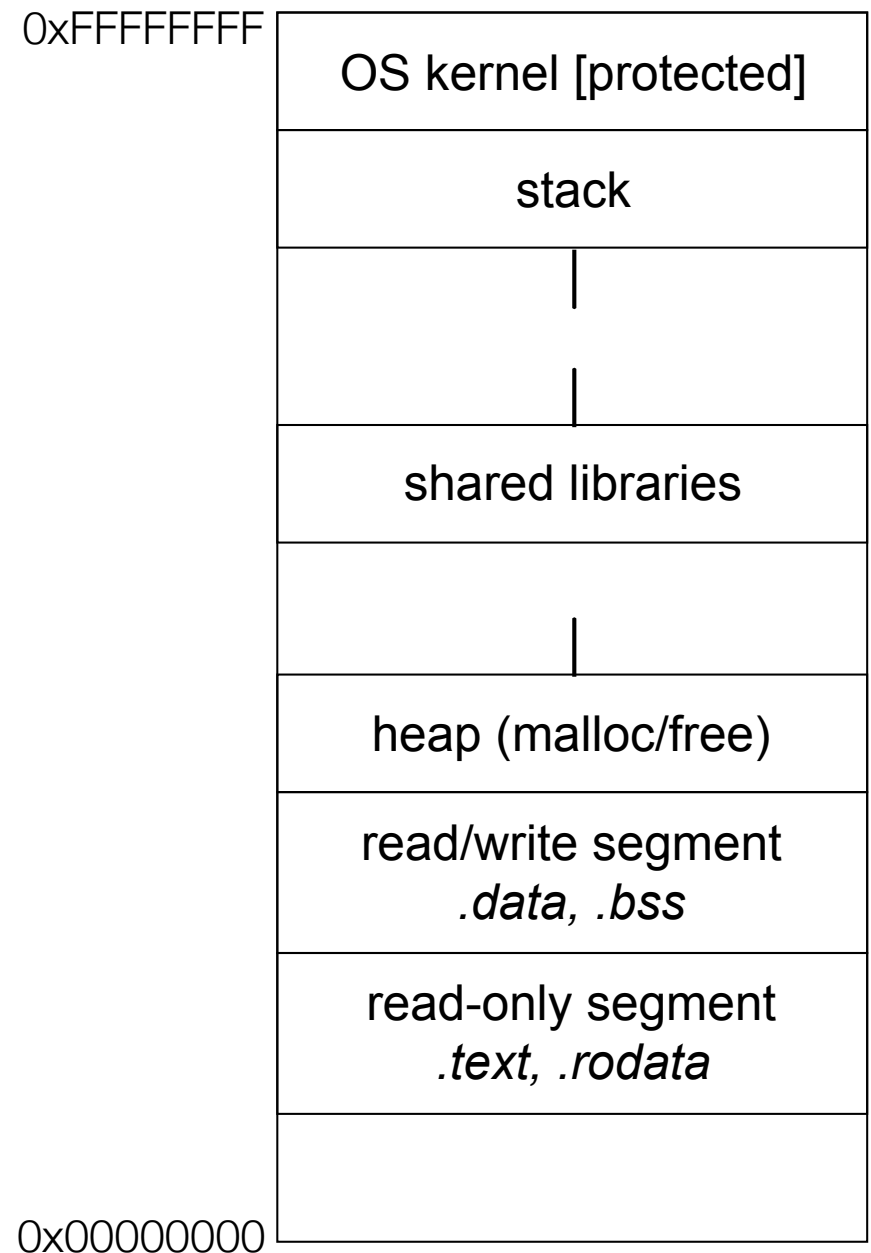
# Program execution

What's a process?

Address space

Thread(s) of execution

Environment (arguments, open files, ...)



# C language

## Structure of C programs

Header files and implementations; declaration vs definition

Internal vs external linkage

Standard types and operators (scalars including things like `uint64_t`, structs, arrays, typedef, etc.)

Functions: defining, using, execution model

Standard libraries and data structures (strings, streams, ...)

C standard library, system calls, and how they are connected

Handling errors in a language without exception handling

return codes, `errno`, and friends

# Memory

Object *scope* and *lifetime* (static, automatic, dynamic)

Pointers and associated operators ( &, \*, ->, [ ] )

Using pointers for call-by-reference as well as linked data

Dynamic memory allocation (malloc/free; new/delete)

Who is responsible for dynamic memory & what happens if not done right (dangling pointers, memory leaks, ...)

Tools: debuggers (gdb), monitors (valgrind), ...

Most important tool: thinking(!)

# C++ (and C++11)

A “better C”

Type-safe streams and memory mgmt (new, delete, delete[ ]), etc.

References and const

C with classes (and objects)

Constructors, copy constructor, destructor, assignment

Subclasses and inheritance

Dynamic vs static dispatch & why it matters, virtual functions, vtables

Pure virtual functions and abstract classes

C++ casts - what are they and why so many (compared to C)?

# Templates, STL, and smart ptrs

Templates: parameterized classes and functions

- How the idea is similar to Java generics and what's different

- How C++ implements templates (expansion)

STL: basics = vector, list & map containers and iterators

- Copy semantics

Smart pointers: unique, shared, and weak

- Reference counting, resource management

Using class hierarchies with STL

- Pointer vs value semantics, assignment slicing

# Networking

Layered protocol model, particularly TCP and IP

What they do, how they are related, how they differ

Network addressing and protocols: IP addresses, DNS, IPv4, IPv6, ports

Application protocols: where HTTP fits in the scheme

# Network Programming

## Client side

1. get IP address / port
2. create socket
3. **connect** socket to server
4. **read** / **write** data
5. **close** socket

## Server side

1. get IP address / port
2. create socket
3. **bind** socket to address / port
4. indicate that socket is a **listener**
5. **accept** connection from client
6. **read** / **write** data
7. **close** socket

# Concurrency

## Why?

- Better resource utilization
- Better throughput

## Processes

- Heavyweight, isolated, created by cloning: `fork()`

## Threads

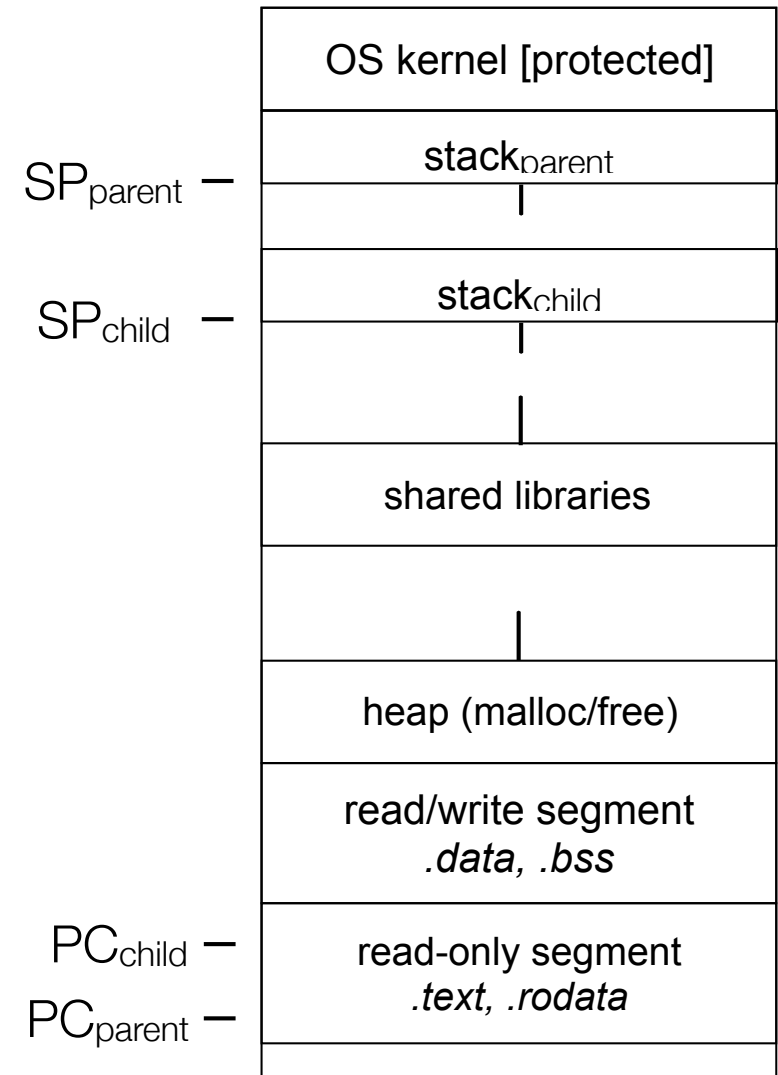
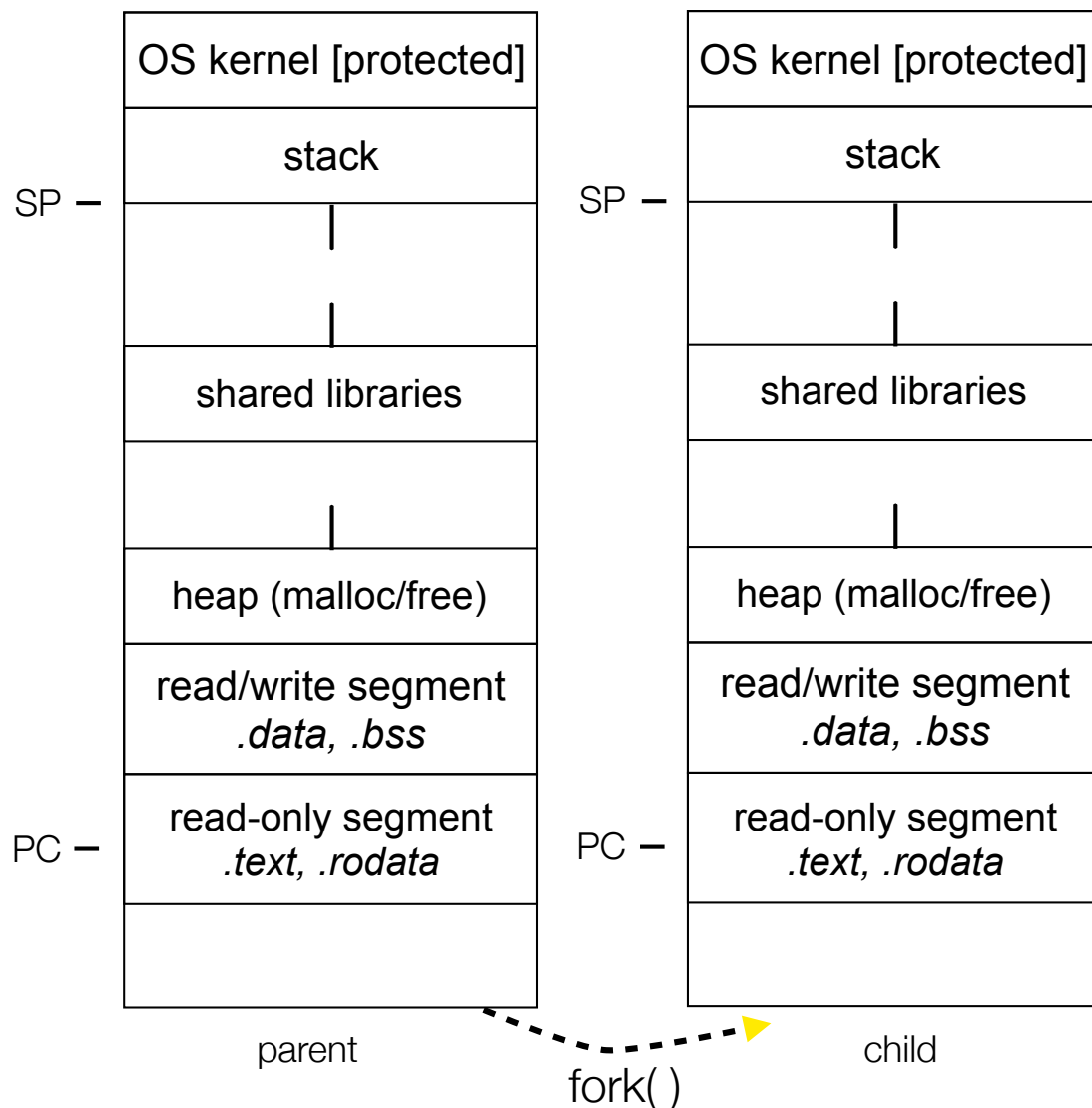
- Lightweight, share address space, `pthread`s

## Synchronization (particularly threads)

- What are the main issues?



# Processes vs threads on one slide



# Phew! That's it!!

But that's a lot!!!

Studying for the exam

- Review lecture slides, assignments, exercises

- Try some of the end-of-lecture problems for practice

- Look at old exams and topic list on the web

  - Try the old exam questions first, before looking at answers

- Study groups! Ask questions / trade ideas on the discussion board! Ask course staff questions!

The goal is learning and mastery

# That's it (almost)

But first, ...

This doesn't happen without great help!  
Thanks!!

Course staff:

Phillip Dang

Renshou Gu

Josh Nazarian

Joshua Rios

Bruce Wen

Reid Zhang

# One more thing...

## Course evals

Constructive feedback (positive we hope, but negative when called for) is what helps us get better

Please fill out online before it closes

Congratulations and good luck on the exam!!

You've learned a lot – go out and build great things!!!

See you Wednesday!