Recitation 12: ProxyLab Part 1

Instructor: TA(s)

Outline

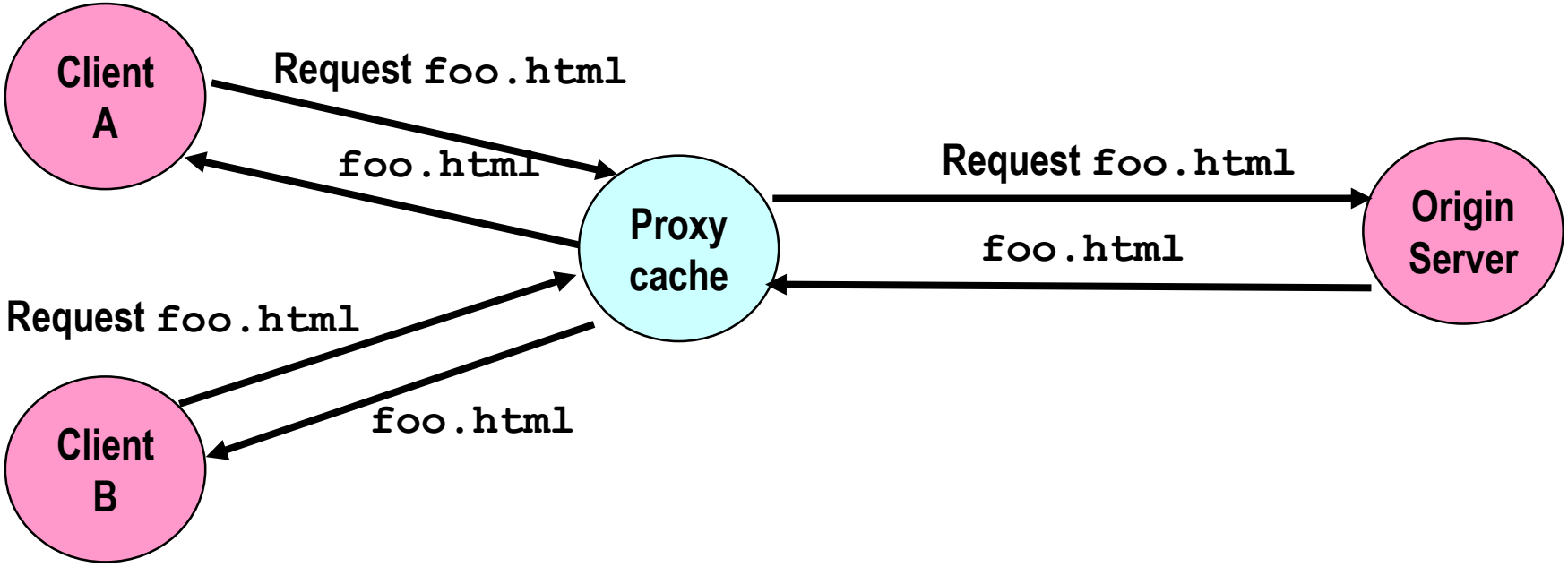
- Proxies
- Networking
- Networking Demos

Proxy Lab

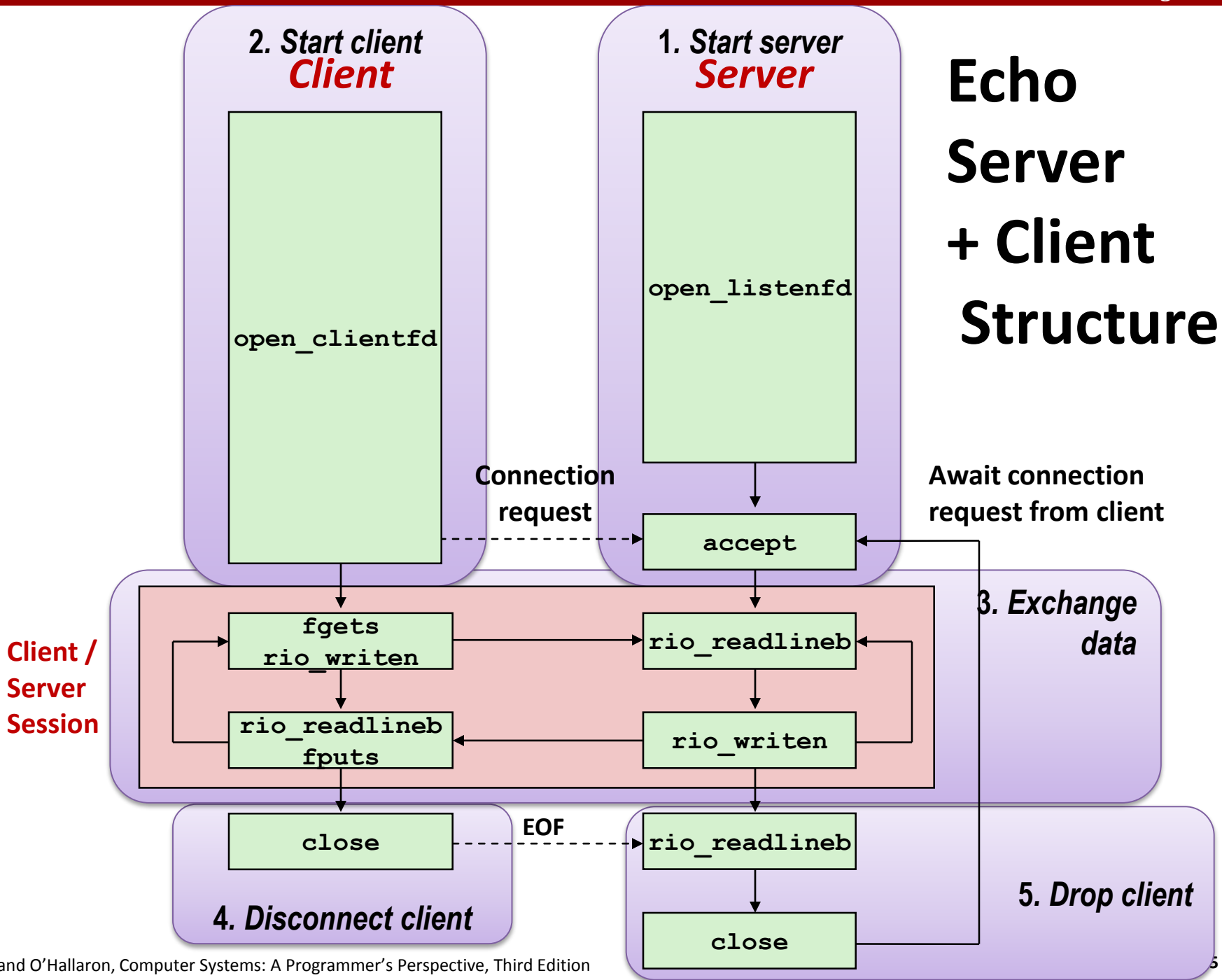
- **There are no grace days / late submissions**
  - 8% of final grade
- **You are submitting an entire project**
  - Modify the makefile
  - Split source file into separate pieces
- **Submit regularly to verify proxy builds on Autolab**
- **Your proxy is a server, it should not crash!**

Why Proxies?

- **Proxies are both clients and servers**
- **Can perform useful functions as requests and responses pass by**
  - Examples: Caching, logging, anonymization, filtering, transcoding



Echo Server + Client Structure



Transferring HTTP Data

If something requests a file from a web server,

- **how does it know that the transfer is complete?**

A) It reads a NULL byte.
B) The connection closes.
C) It reads a blank line.
D) The HTTP header specifies the number of bytes to receive.
E) The reading function receives EOF.

Telnet Demo

- **Telnet is valuable for manually testing your proxy**
  - What are valid requests to web servers?
  - What do valid replies look like?

- **Connect to a shark machine**
- `$ telnet www.cs.cmu.edu 80`

```
GET /~213/recitations/rec12.html HTTP/1.0 <press enter>
<press enter>
```

Echo Demo

- See the instructions written in the telnet results to set up the echo server. Get someone nearby to connect using the echo client.
- What does echoserver output?

Echo Demo

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- What does echoserver output? (Sample output:)

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$ ./echoserver 10101
Accepted connection from hammerheadshark.ics.cs.cmu.edu:46422
hammerheadshark.ics.cs.cmu.edu:46422 sent 6 bytes
Disconnected from hammerheadshark.ics.cs.cmu.edu:46422
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Server listening port

Client host

Client port

Echo Demo

- **Look at echoclient.c**
  - Opens a connection to the server
  - Reads/writes from the server
- **Look at echoserver output**
  - Why is the printed client port different from the server's listening port?

Echo Demo

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  - Opens a connection to the server
  - Reads/writes from the server
- **Look at echoserver output**
  - Why is the printed client port different from the server's listening port?
  - Server opens **one** "**listening**" port
    - Incoming clients connect to this port
  - Once server **accepts** a connection, it talks to client on a **different** "**ephemeral**" port

Echo Demo

- Try to connect two clients to the same server.
- What happens?

Echo Demo

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- **What happens?**
  - Second client has to wait for first client to finish!
  - Server doesn't even accept second client's connection
  - Where/why are we getting stuck?

Echo Demo

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- **What happens?**
  - Second client has to wait for first client to finish!
  - Server doesn't even accept second client's connection
  - Where/why are we getting stuck?
- **Because we're stuck in echo() talking to the first client, echoserver can't handle any more clients**
- **Solution: multi-threading**

Echo Server Multithreaded

- **How might we make this server multithreaded?**
  (Don't look at echoserver_t.c)

```
while (1) {
    // Allocate space on the stack for client info
    client_info client_data;
    client_info *client = &client_data;

    // Initialize the length of the address
    client->addrlen = sizeof(client->addr);

    // Accept() will block until a client connects to the port
    client->connfd = Accept(listenfd,
            (SA *) &client->addr, &client->addrlen);

    // Connection is established; echo to client
    echo(client);
}
```

Echo Server Multithreaded

- **View the code in echoserver_t.c**
- **Nominate one student in class to run the echoserver_t**
  - Have several others connect to it

Echo Server Multithreaded

- **echoserver_t.c isn't too different from echoserver.c**
  - To see the changes: `diff echoserver.c echoserver_t.c`
- **Making your proxy multithreaded will be very similar**
- **However, don't underestimate the difficulty of addressing race conditions between threads!**
  - Definitely the hardest part of proxylab
  - More on this next time...

Reminders

- **Read the writeup**
- **Start early**
  - Remember, no late submissions
  - Come to office hours this week, before it gets crowded!
- **Work incrementally and take breaks**