

CSE 333

Lecture 15 -- server sockets

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Administrivia

HW3 out later this week

We will have 2 exercises this week

- today's is due on Friday, as it is a little more involved

Midterm grading bonanza is tomorrow

- back on Wednesday

More administrivia

Cody's office hours are moved to Thursday for this week only

- Thursday, 1:30pm-3:20pm, in CSE022

Today

Network programming

- server-side programming

Remember from client sockets

We had a client open a TCP connection to a server using the sockets API

- there were five steps:
 1. figure out the address and port to which to connect
 2. create a socket
 3. connect the socket to the remote server
 4. read and write data using the socket
 5. close the socket

Servers

Pretty similar to clients, but with additional steps

- there are seven steps:
 1. figure out the **address and port** on which to listen
 2. create a **socket**
 3. **bind** the socket to the address and port on which to listen
 4. indicate that the socket is a **listening** socket
 5. **accept** a connection from a client
 6. **read** and **write** to that connection
 7. **close** the connection

Accepting a connection from a client

Step 1. Figure out the address and port on which to listen.

Step 2. Create a socket.

Step 3. **Bind** the socket to the address and port on which to listen.

Step 4. Indicate that the socket is a **listening** socket.

Servers

Servers can have multiple IP addresses

- “multihomed”
- usually have at least one externally visible IP address, as well as a local-only address (127.0.0.1)

When you bind a socket for listening, you can:

- specify that it should listen on all addresses
 - by specifying the address “INADDR_ANY” -- a.k.a. 0.0.0.0
- specify that it should listen on a particular address

bind()

The “bind()” system call associates with a socket:

- an address family
 - ▶ AF_INET: IPv4
 - ▶ AF_INET6: IPv6
- a local IP address
 - ▶ the special IP address INADDR_ANY (also known as “0.0.0.0”) means “all local IP addresses of this host”
- a local port number

listen()

The “listen()” system call tells the OS that the socket is a listening socket to which clients can connect

- you also tell the OS how many pending connections it should queue before it starts to refuse new connections
 - ▶ you pick up a pending connection with “accept()”
- when listen returns, remote clients can start connecting to your listening socket
 - ▶ you need to “accept()” those connections to start using them

Server socket, bind, listen

see server_bind_listen.cc

Accepting a connection from a client

Step 5. **Accept** a connection from a client.

Step 6. `read()` and `write()` to the client.

Step 7. `close()` the connection.

accept()

The “accept()” system call waits for an incoming connection, or pulls one off the pending queue

- it returns an active, ready-to-use socket file descriptor connected to a client
- it returns address information about the peer
 - ▶ use `inet_ntop()` to get the client’s printable IP address
 - ▶ use `getnameinfo()` to do a **reverse DNS lookup** on the client

Server accept, read/write, close

see server_accept_rw_close.cc

Something to note...

Our server code is not concurrent

- single thread of execution
- the thread blocks waiting for the next connection
- the thread blocks waiting for the next message from the connection

A crowd of clients is, by nature, concurrent

- while our server is handling the next client, all other clients are stuck waiting for it

Exercise 1

Write a program that:

- creates a listening socket, accepts connections from clients
 - ▶ reads a line of text from the client
 - ▶ parses the line of text as a DNS name
 - ▶ does a DNS lookup on the name
 - ▶ writes back to the client the list of IP addresses associated with the DNS name
 - ▶ closes the connection to the client

Exercise 2

Write a program that:

- creates a listening socket, accepts connections from clients
 - ▶ reads a line of text from the client
 - ▶ parses the line of text as a DNS name
 - ▶ connects to that DNS name on port 80
 - ▶ writes a valid HTTP request for “/”
 - see next slide for what to write
 - ▶ reads the reply, returns the reply to the client

Exercise 2 continued

Here's a valid HTTP request to server `www.foo.com`

- note that lines end with `'\r\n'`, not just `'\n'`

```
GET / HTTP/1.0\r\n
Host: www.foo.com\r\n
Connection: close\r\n
\r\n
```

See you on Friday!