CSE 333
Lecture 18 -- server sockets

Hal Perkins
Department of Computer Science & Engineering
University of Washington
Administrivia

Exercise covering client-side programming posted late yesterday, due Monday before class

Next exercise covers today’s server-side code. Post today or wait until Monday? (Due Wed. in either case)

HW4 out after class, due last Wednesday of the quarter (+ late days if you have them)
Today

Network programming

- server-side programming
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” or “in6addr_any” -- 0.0.0.0 or :: (i.e., all 0’s)

- 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 (also handles IPv4 clients on POSIX systems)
- a local IP address
  - the special IP address INADDR_ANY (“0.0.0.0”) means “all local IPv4 addresses of this host”
  - use in6addr_any (instead of INADDR_ANY) for IPv6
- a local port number
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.
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
Before we go...

hw4 demo
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 ‘\n’, not just ‘\n’

```
GET / HTTP/1.0\r\nHost: www.foo.com\r\nConnection: close\r\n\r\n```

CSE333 lec 18 networks.3 // 08-07-15 // Perkins
See you on Wednesday!