



CS4514 (B03) HELP Session 1

Introduction to Network Programming (v1.2)

Speaker: Mingzhe Li





Outline

- Project 1 Overview
- Unix Network Programming
- Program Debugging
- Project Turnin
- How to get help

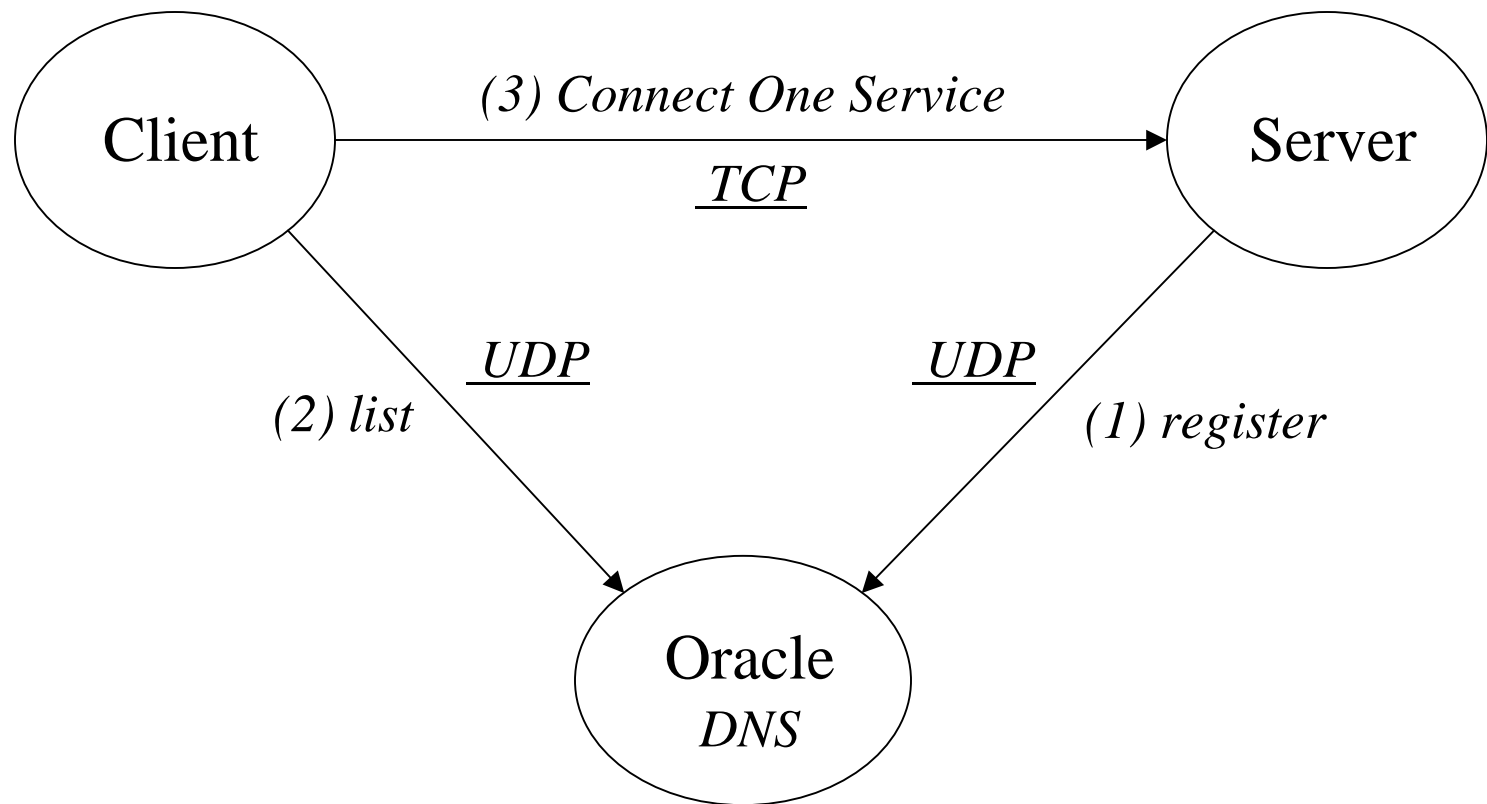


CS4514 Project1

- Your programs should compile and work on ccc.wpi.edu computers. Those systems are running Linux.
- [Netoracle](#) is running on ccc3.wpi.edu only.
- Programs will be done in **C** or **C++**
- If your program is developed in another platform you should **test** the software on **ccc** before turning in the assignment.
- Make sure you have the correct **#include** in your program.
- We have registered a couple of services in oracle that can be used to debug your client.



Project 1 Communication Model





Project 1 missions (in handout)

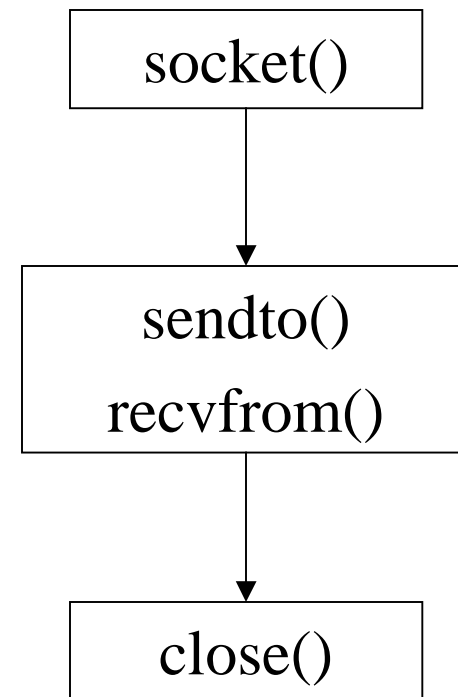
- **Client:**
 1. Waiting on user's commands.
 2. List all services registered on netoracle.
 3. Connect to service using the transport address returned from netoracle.

- **Server:**
 1. Register service to netoracle.
 2. Waiting for connections and providing service.



UDP Transmission (Client)

- Stevens (Page 212)
 - Connectionless
 - Specify transport address every time you send/recv data
 - Unreliable Protocol
 - Data lost, bit errors
 - Stevens (Page 216)
 - Simple UDP echo client
 - Lenon page78 (robust)





Example: UDP Client

```
struct hostent *hp;           /* /usr/include/netdb.h */
struct sockaddr_in server;    /* /usr/include/netinet/in.h */
int sd, lserver = sizeof( server );

/* prepare a socket */
if ( (sd = socket( AF_INET, SOCK_DGRAM, 0 )) < 0 ) {
    perror( strerror(errno) );
    exit(-1);
}
```



Example: UDP Client (Continued)

```
/* prepare server address */
```

```
bzero( (char*)&server, sizeof(server) );
```

```
server.sin_family = AF_INET;
```

```
server.sin_port = htons( SERVER_PORT ); //endian convert
```

```
if ( (hp = gethostbyname(SERVER_NAME)) == NULL) {
```

```
    perror( strerror(errno) );
```

```
    exit(-1);
```

```
}
```

```
bcopy( hp->h_addr, (char*)&server.sin_addr, hp->h_length);
```




Example: UDP Client (Continued)

```
/* prepare your message */
```

```
...
```

```
/* send/receive data */
```

```
sendto( sd, sBuf, data_size, 0, (struct sockaddr*)&server,  
        lserver );
```

```
recvfrom( sd, rBuf, MAXLEN, 0, (struct sockaddr*)&server,  
          &lserver );
```

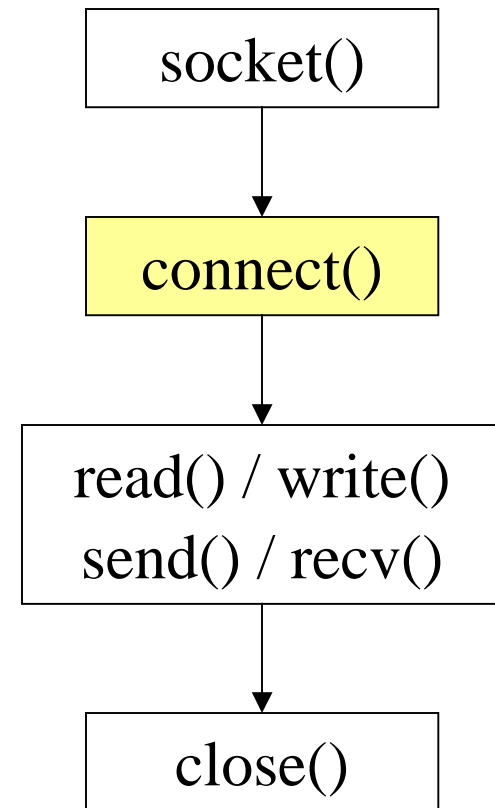
```
/* close socket */
```

```
close( sd );
```



TCP Connection (Client)

- Stevens (Page 86)
 - Connection Oriented
 - Specify transport address once at connection
 - Use File Operations
 - read() / write()
 - Reliable Protocol





Example: TCP Client

```
int sd;
struct hostent *hp;          /* /usr/include/netdb.h */
struct sockaddr_in server;  /* /usr/include/netinet/in.h */

/* prepare a socket */
if ( (sd = socket( AF_INET, SOCK_STREAM, 0 )) < 0 ) {
    perror( strerror(errno) );
    exit(-1);
}
```



Example: TCP Client (Continued)

```
/* prepare server address */
```

```
bzero( (char*)&server, sizeof(server) );
```

```
server.sin_family = AF_INET;
```

```
server.sin_port = htons( SERVER_PORT );
```

```
if ( (hp = gethostbyname(SERVER_NAME)) == NULL) {
```

```
    perror( strerror(errno) );
```

```
    exit(-1);
```

```
}
```

```
bcopy( hp->h_addr, (char*)&server.sin_addr, hp->h_length);
```



Example: TCP Client (Continued)

```
/* connect to the server */
```

```
if (connect( sd, (struct sockaddr*) &server, sizeof(server) ) < 0 ) {  
    perror( strerror(errno) );  
    exit(-1);  
}
```

```
/* send/receive data */
```

```
while (1) {  
    read/write();  
}
```

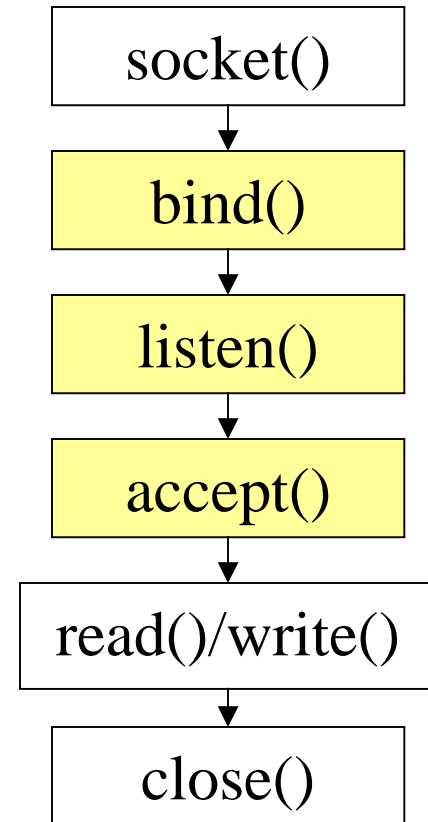
```
/* close socket */
```

```
close( sd );
```



TCP Connection (Server)

- Stevens (Page 86)
 - Bind transport address to socket
 - Listen to the socket
 - Accept connection on a new socket





Example: TCP Server

```
int sd, nsd;  
struct sockaddr_in server; /* /usr/include/netinet/in.h */  
  
sd = socket( AF_INET, SOCK_STREAM, 0 );  
  
bzero( (char*)&server, sizeof(server) );  
server.sin_family = AF_INET;  
server.sin_port = htons( YOUR_SERVER_PORT );  
server.sin_addr.s_addr = htonl( INADDR_ANY );
```



Example: TCP Server (Continued)

```
bind( sd, (struct sockaddr*) &server, sizeof(server) );
```

```
listen( sd, backlog );
```

```
while (1) {
```

```
    nsd = accept( sd, (struct sockaddr *) &client, sizeof(client) );
```

```
    read()/write();
```

```
    close( nsd );
```

```
}
```

```
close( sd );
```




Some Useful System Calls

- **Gethostbyname**: map hostname to IP addr
struct hostent ***gethostbyname**(char *name)
- **Getservbyname**: look up service name given
struct servent ***getservbyname**(const char *servname,
const char *protocol)
- **Gethostname**: get own hostname
int **gethostname**(char *name, size_t len)
- **Getsockname**: map sd to socket addr
int **getsockname**(int sd, struct sockaddr *sa, size_t *lsa)



Oracle Commands (om struct)

■ Find a service:

```
serv.ver = verCur;  
serv.cmd = cmdGet;  
serv.uid = ?;  
serv.sbServ = ?;
```

■ Register a service:

```
serv.ver = verCur;  
serv.cmd = cmdPut;  
serv.uid = ?;  
serv.sbServ = ?;  
serv.sbDesc = ?;  
serv.sa = ?
```

■ Clear a service:

```
serv.ver = verCur;  
serv.cmd = cmdClr;  
serv.uid = ?;  
serv.sbServ = ?;
```



Oracle Commands

- enum cmd {
cmdErr, /* An error occurred. See sbDesc for details */
cmdGet, /* Get the address of a service */
cmdAckGet, /* ACK for cmdGet message */
cmdEnd, /* Last response to a cmdGet message */
cmdPut, /* Register a new service */
cmdAckPut, /* ACK for cmdPut message */
cmdClr, /* Unregister a service */
cmdAckClr /* ACK for cmdClr message */
- };



Oracle Communication Example

```
int sd;
struct sockaddr_in sa;    // you can use gethostbyname() and
                          // getservbyname() to get sa in your project.

struct om sendMsg, recvMsg;
size_t lom = sizeof(struct om);

sendMsg.ver = verCur;
sendMsg.cmd = cmdGet;

sendto( sd, (void *)&sendMsg, lom, 0, (struct sockaddr *) &sa, lsa );
recvfrom( sd, (void *)&recvMsg, lom, 0, (struct sockaddr *) &sa, &lsa );

// you can also use connect()/send()/recv() for UDP connection, for more
// information -- use “man connect”, “man send” and “man recv”
```



UNIX Programming

- Some functions that you may need:
 - bind
 - listen
 - accept
 - select
 - sendto/send
 - recvfrom/recv
 - gethostbyname
 - getservbyname
 - gethostname
 - getsockname
 - fork
 - strlen, strtok



Other resources

- Use man pages for help on a particular command or function (Give the section number).

> man sendto

> man 2 bind //show bind(2)

- Internet: Beej's Guide to Network Programming

<http://www.ecst.csuchico.edu/~beej/guide/net/>



UNIX Debugging

- GDB -- GNU Project Debugger
- Compile program with `-g` flag
 - `g++ -g -o program program.cc`
 - `gcc -g -o program program.c`
- `gdb program {core}`
 - set args (command arguments)
 - run, where, list, step, break
 - continue inspect, help, quit
- Can examine specific data in program



UNIX Debugging (Continued)

- There are many more options use “help” to learn more.
- Also look at “man gdb”.
- This will be useful to find out where a program crashes or seg faults.
- You can set breakpoints to stop at specific line or function.
- You can set specific data values in program.



Turnin Your Files

■ Turnin Command

- mkdir proj1
- cp * proj1 /* copy all your files to submit to proj1 directory */
- tar -czf proj1.tgz proj1
- /cs/bin/turnin submit cs4514 proj1 proj1.tgz

■ Files should include

- All source code (including a Makefile)
- A documentation file (include your compile command if you don't offer a Makefile)
- A result script showing the running result
- Any custom include files that you used, including oracle.h if you have not used
`#include "/cs/cs4514/pub/lib/oracle.h"`



HELP

- Bring printouts to office hours.
- Email to TA mailing list with questions.
- You CAN email a specific TA or SA, but do not expect immediate results, better to use the TA mailing list.
- We do have a class mailing list that could be used as a last resort.