TCP Sockets Programming

- Creating a *passive mode* (server) socket.
- Establishing an application-level *connection*.
- send/receive data.
- Terminating a connection.

Creating a TCP socket

```
int socket(int family,int type,int proto);

int sock;
sock = socket( PF_INET,
               SOCK_STREAM,
               0);
if (sock<0) { /* ERROR */ }
```

Binding to well known address

```
int mysock;
struct sockaddr_in myaddr;

  mysock = socket(PF_INET,SOCK_STREAM,0);
  myaddr.sin_family = AF_INET;
  myaddr.sin_port = htons( 80 );
  myaddr.sin_addr = htonl( INADDR_ANY );

  bind(mysock, (sockaddr *) &myaddr,
          sizeof(myaddr));
```

Establishing a passive mode TCP socket

Passive mode:

– Address already determined.

– Tell the kernel to accept incoming connection requests directed at the socket address.
  - ***3-way handshake***

– Tell the kernel to queue incoming connections for us.

`listen()`

```
int listen( int sockfd, int backlog);
```

`sockfd` is the TCP socket (already bound to an address)

`backlog` is the number of incoming connections the kernel should be able to keep track of (queue for us).

`listen()` returns -1 on error (otherwise 0).

Accepting an incoming connection.

- Once we call **`listen(),`** the O.S. will queue incoming connections
  - – Handles the 3-way handshake
  - – Queues up multiple connections.

- When our application is ready to handle a new connection, we need to ask the O.S. for the next connection.

`accept()`

```
int accept( int sockfd,
            struct sockaddr* cliaddr,
            socklen_t *addrlen);
```

`sockfd` is the passive mode TCP socket.

`cliaddr` is a pointer to *allocated* space.

`addrlen` is a *value-result* argument

- must be set to the size of **`cliaddr`**
- on return, will be set to be the number of used bytes in **`cliaddr`**.

`accept()` return value

`accept()` returns a new socket descriptor (small positive integer) or -1 on error.

After **`accept`** returns a new socket descriptor, I/O can be done using the **`read()`** and **`write()`** system calls.

`read()` and **`write()`** operate a little differently on sockets (vs. file operation)!

Terminating a TCP connection

- Either end of the connection can call the **`close()`** system call.
- If the other end has closed the connection, and there is no buffered data, reading from a TCP socket returns 0 to indicate EOF.

Client Code

- TCP clients can call **`connect()`** which:
  - takes care of establishing an endpoint address for the client socket.
    - don't need to call bind first, the O.S. will take care of assigning the local endpoint address (TCP port number, IP address).
  - Attempts to establish a connection to the specified server.
    - ***3-way handshake***

connect()

```
int connect( int sockfd,
            const struct sockaddr *server,
            socklen_t addrlen);
```

`sockfd` is an already created TCP socket.

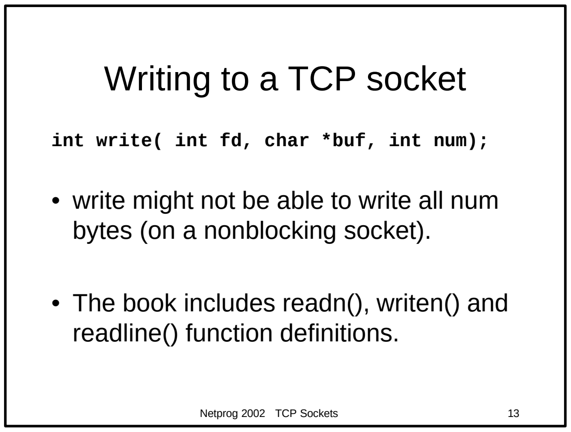
`server` contains the address of the server (IP Address and TCP port number)

`connect()` returns 0 if OK, -1 on error

Reading from a TCP socket

```
int read( int fd, char *buf, int max);
```

- By default **`read()`** will block until data is available.
- reading from a TCP socket may return less than max bytes (whatever is available).
- You must be prepared to read data 1 byte at a time!



Writing to a TCP socket

```
int write( int fd, char *buf, int num);
```

- write might not be able to write all num bytes (on a nonblocking socket).
- The book includes readn(), writen() and readline() function definitions.

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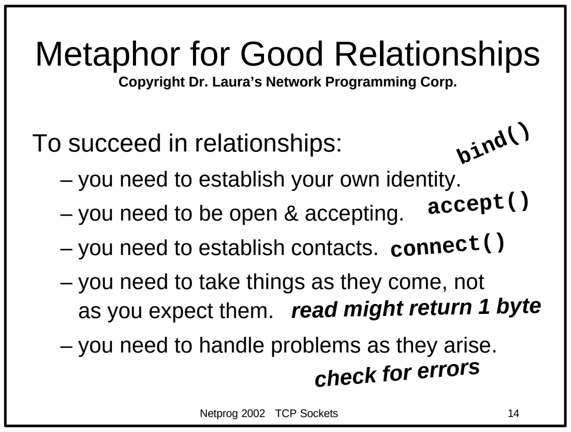

Metaphor for Good Relationships

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To succeed in relationships:

- you need to establish your own identity. **`bind()`**
- you need to be open & accepting. **`accept()`**
- you need to establish contacts. **`connect()`**
- you need to take things as they come, not as you expect them. ***read might return 1 byte***
- you need to handle problems as they arise. ***check for errors***

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