SOCKET PROGRAMMING

CPSC 441 - Tutorial 2

Winter 2018

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WHAT IS A **SOCKET**?

- The application wants to **send** and **receive** data via network
  - A web browser
- An **interface** is needed to pass data between the **application** (layer) and the **network** (layer)

SOCKET **TYPES**

TCP SOCKET

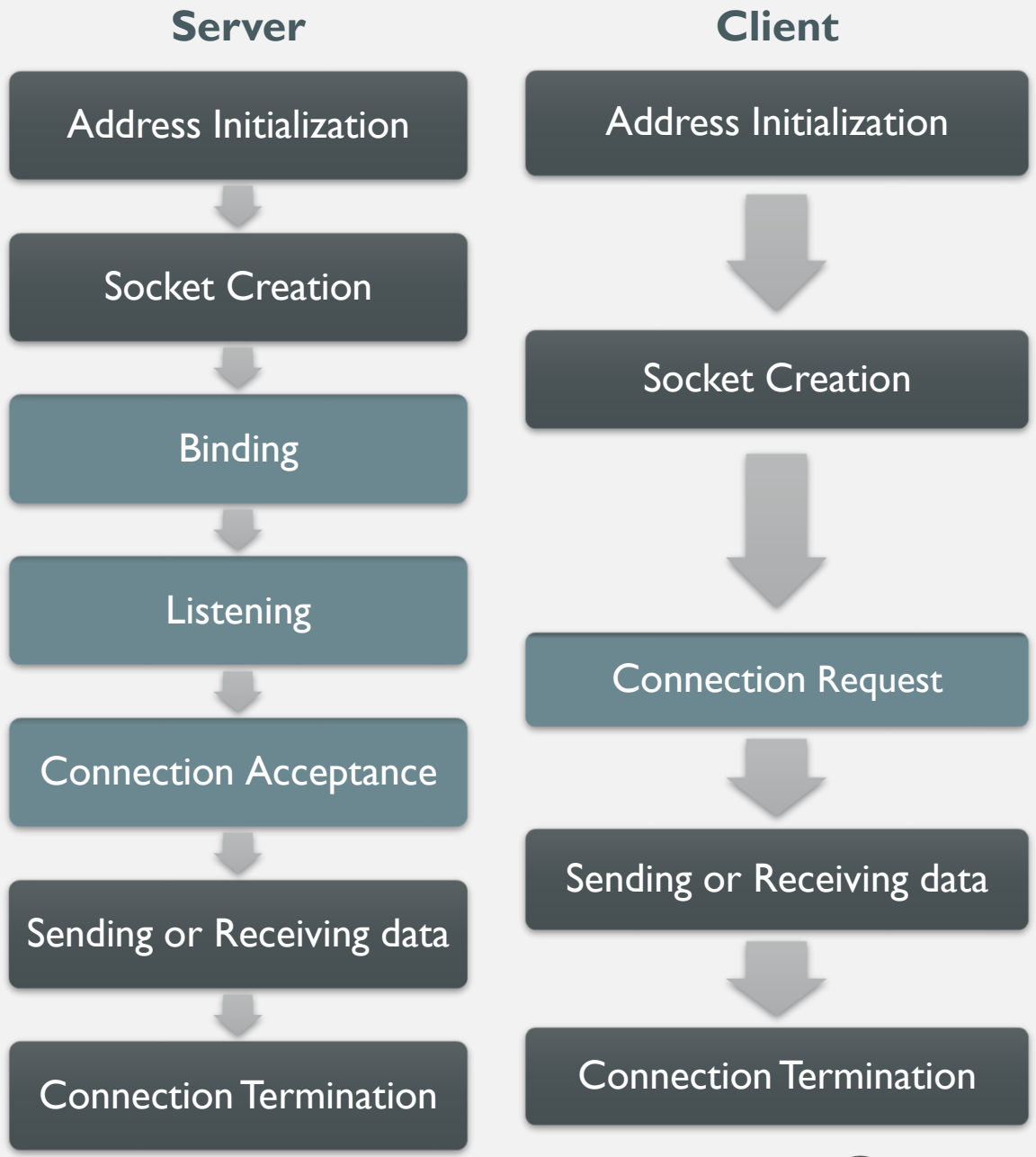
- Type: SOCK_STREAM
- Reliable delivery
- In-order guaranteed
- Connection-oriented
- Bidirectional

UDP SOCKET

- Type: SOCK_DGRAM
- Unreliable delivery
- No order guaranteed
- No notion of "connection" – application destination for each packet
- Can send or receive

SOCKET **PROGRAMMING PROCESS** IN **C**

- Two sides of socket programming:
  - **Server** side
  - **Client** side
- Proxy is **both** server & client



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ADDRESS INITIALIZATION

```
struct sockaddr_in{
    short sin_family;
    u_short sin_port;
    struct in_addr sin_addr;
    char sin_zero[8];
}
```

- **sin_family**: specifies the address family – e.g. AF_INET
- **sin_port**: specifies the port number – 0 to 65535
- **sin_addr**: specifies the IP address
- **sin_zero**: unused

```
1.  struct sockaddr_in address;
2.  memset(&address, 0, sizeof(address));
3.  address.sin_family = AF_INET;
4.  address.sin_port = htons(port);
5.  address.sin_addr.s_addr = htonl(INADDR_ANY)
```

- **address**: the variable that you define for initializing the sockaddr_in
- **memset()**: initialize the address to zero
- **AF_INET**: corresponds to IPv4 protocol as communication domain
- **htons()**: convert 16-bit host-byte-order (little endian) to network-byte-order (big endian)
- **htonl()**: convert 32-bit host-byte-order (little endian) to network-byte-order (big endian)
- **INADDR_ANY**: any IP address on the local machine

SOCKET CREATION

```
1.  int mysocket1;
2.  mysocket1 = socket(AF_INET, SOCK_STREAM, 0);
3.  if(mysocket1 == -1){
4.      printf("socket() call failed");
5.  }
```

- **socket**(domain, type, protocol)
  - **domain**: communication domain – integer
  - **type**: socket type – SOCK_STREAM or SOCK_DGRAM
  - **protocol**: network protocol – 0 is default (TCP)
  - other parameters: rarely used

- **mysocket1**: socket descriptor (sockid) – integer
- **AF_INET**: corresponds to IPv4 protocol as communication domain
- **SOCK_STREAM**: TCP socket type
- **0**: TCP network protocol

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BINDING (**SERVER ONLY**)

```
1.  int status;
2.  status = bind(mysocket1, (struct sockaddr *)
3.  &address, sizeof(struct sockaddr_in));
4.  if(status==-1){
5.      prinf("bind() call failed");
6. }
```

- **bind**(sockid, &addrport, size)
  - **sockid**: socket descriptor - integer
  - **addrport**: the IP address and port number of the machine stored in `sockaddr struct`
  - **size**: the size of the `sockaddr struct`

- **status**: error status of `bind()` function
  - `-1` if bind failed
  - `>0` if bind succeed
- **mysocket1**: previously created socket
- `(struct sockaddr *)&address`: reference of initialized server address struct casted to `sockaddr struct` pointer
- `sizeof(struct sockaddr_in)`: size of `sockaddr_in struct`

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LISTENING (**SERVER ONLY**)

```
1.  int status;
2.  status = listen(mysocket1,5);
3.  if(status==-1){
4.      printf("listen() call failed");
5.  }
```

- **`listen`**`(sockid, queuelen)`
  - **`sockid`**: socket descriptor - integer
  - **`queuelen`**: the number of active participants that can wait for a connection

- **`status`**: error status of `listen()` function
  - `-1` if bind failed
  - `>0` if bind succeed
- **`mysocket1`**: previously created socket
- **`5`**: five participants can wait for a connection if the server is busy

CONNECTION REQUEST (**CLIENT ONLY**)

```
1.  int status;
2.  status = connect(mysocket1, (struct sockaddr
    *)&address, sizeof(struct sockaddr_in));
3.  if(status==-1){
4.      printf("connect() call failed");
5.  }
```

- **connect**(sockid, &addr, addrlen)
  - **sockid**: socket descriptor - integer
  - **addr**: address of server which is stored in `struct sockaddr`
  - **addrlen**: size of `addr`

Note that connect process is **blocking** and waits for the server to accept the connection

- **status**: error status of `connect()` function
  - `-1` if bind failed
  - `>0` if bind succeed
- **mysocket1**: previously created socket
- `(struct sockaddr *)&address`: reference of initialized server address struct casted to `sockaddr struct` pointer
- `sizeof(struct sockaddr_in)`: size of `sockaddr_in struct`

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CONNECTION ACCEPTANCE (SERVER ONLY)

```
1.  int mysocket2;
2.  mysocket2 = accept(mysocket1, NULL, NULL);
3.  if(mysocket2 == -1){
4.      printf("accept() call failed");
5.  }
```

- **accept**(sockid, &addr, addrlen)
  - **sockid**: listening socket descriptor - integer
  - **addr**: address of active participant will be stored in addr in struct sockaddr format
  - **addrlen**: size of addr

Note that accept process is **blocking** and waits for connection before returning

- **mysocket1**: listening socket descriptor (sockid) – integer
- **mysocket1**: new socket descriptor for accepted connection – integer
- If you don't want to store clients you can use **NULL** as the second and third parameters of the accept() function

SEND AND RECEIVE

- **send**(sockid, &buff, len, flags)
  - **sockid**: socket descriptor – integer
  - **buff**: buffer to be transmitted
  - **Len**: length of buffer (in bytes) – integer
  - **flags**: special options, usually set to 0 – integer
- **recv**(sockid, &buff, len, flags)
  - **sockid**: socket descriptor – integer
  - **buff**: stores received bytes
  - **Len**: length of buffer (in bytes) – integer
  - **flags**: special options, usually set to 0 – integer

```
1.  int count;
2.  char snd_message[100] = {"hello"};
3.  char rcv_message[100];
4.  count = send(mysocket2, snd_message, 5, 0);
5.  if(count == -1){
6.      printf("send() call failed.")
7.  }
8.  count = recv(mysocket2, rcv_message, 100, 0);
9.  if(count == -1){
10.     printf("recv() call failed.")
11. }
```

- **mysocket1**: the socket that holds the established connection
- **5**: the length of **snd_message** which is equal to number of characters in "hello"
- **100**: the maximum length for **rcv_message** is used here

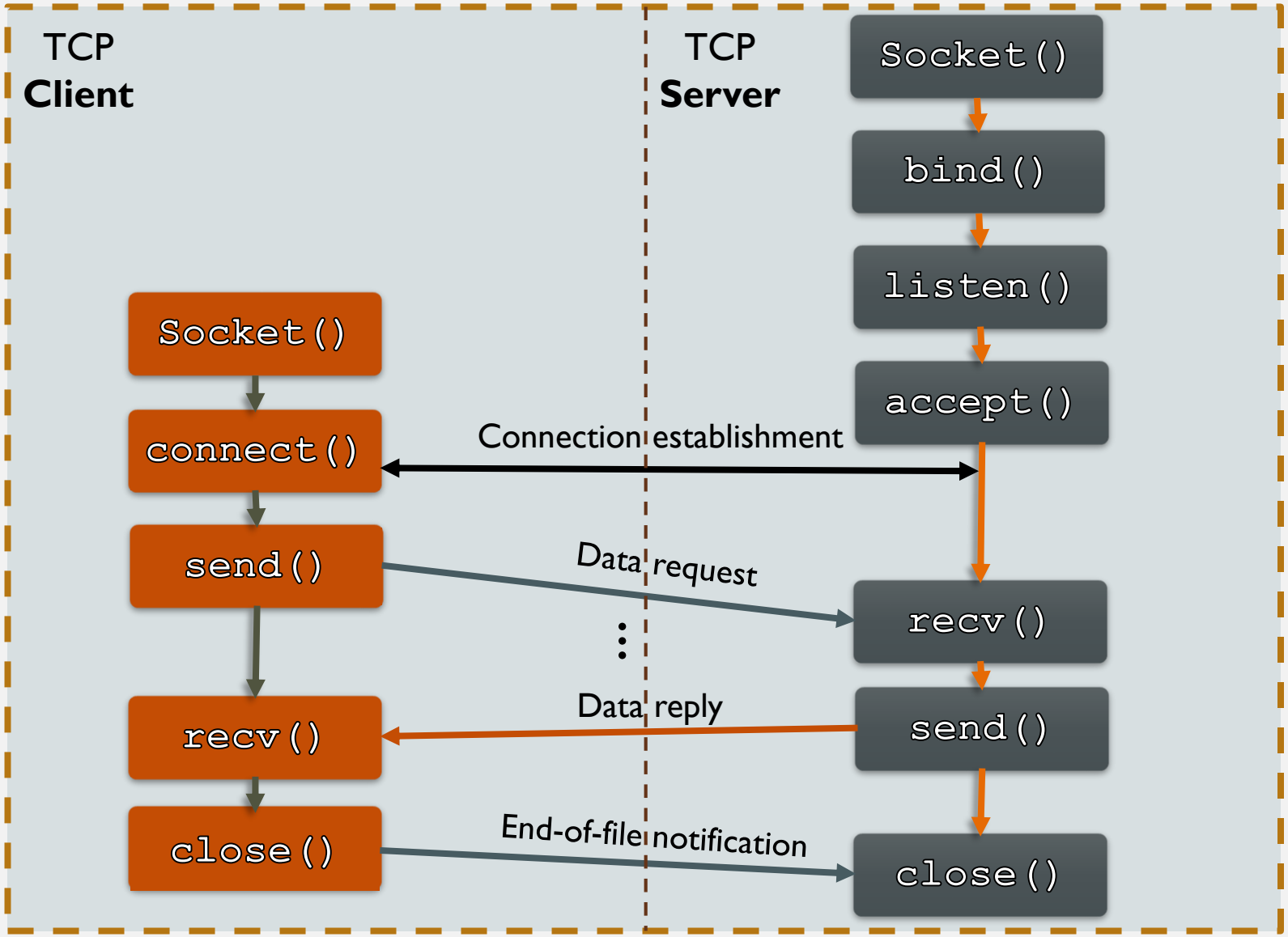
CONNECTION TERMINATION

- **close**(sockid)
  - **sockid**: listening socket descriptor – integer
  - Closing the socket will close the connection and the port used by it will be freed up

Always close the socket after you are done using it

```
1.  close(mysocket2);
2.  close(mysocket1);
```

SERVER AND CLIENT **INTERACTIONS**



ASSIGNMENT 1