Building a Web Server

Network System Calls

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socket

```
int socket(
    int domain,
    int type,
    int protocol
)
```

socket() creates an endpoint for communication and returns a file descriptor that refers to that endpoint.

bind

```
int bind(
    int sockfd,
    struct sockaddr *addr,
    socklen_t addrlen
)
```

When a socket(2) is created with socket, it exists in a name space (address family) but has no address assigned to it. bind() assigns the address specified by addr to the socket referred to by the file descriptor sockfd.

struct sockaddr_in

```
struct sockaddr {
  uint16_t  sa_family;
  uint8_t   sa_data[14];
};
```

```
struct sockaddr_in {
  uint16_t  sin_family;
  uint16_t  sin_port;
  uint32_t  sin_addr;
  uint8_t   __pad[8];
}
```

struct sockaddr_in

```
struct sockaddr_in {
  uint16_t  sin_family;
  uint16_t  sin_port;
  uint32_t  sin_addr;
  uint8_t   __pad[8];
}
```

```
struct sockaddr_in addr = {
  AF_INET,
  htons(80),
  {inet_addr("127.0.0.1")},
  {0}
};
```

MEMORY

```
0000555555554000  02 00 00 50 7f 00 00 01 | ...P....
0000555555554008  00 00 00 00 00 00 00 00 | ........
0000555555554010  00 00 00 00 00 00 00 00 | ........
...               ...
0000555555555000  00 00 00 00 00 00 00 00 | ........
0000555555555008  00 00 00 00 00 00 00 00 | ........
0000555555555010  00 00 00 00 00 00 00 00 | ........
0000555555555018  00 00 00 00 00 00 00 00 | ........
...               ...
00007fffffffe000  00 00 00 00 00 00 00 00 | ........
00007fffffffe008  00 00 00 00 00 00 00 00 | ........
00007fffffffe010  00 00 00 00 00 00 00 00 | ........
```

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0000555555554000  02 00 00 50 7f 00 00 01 | ...P....
0000555555554008  00 00 00 00 00 00 00 00 | ........
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...               ...
0000555555555000  00 00 00 00 00 00 00 00 | ........
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0000555555555018  00 00 00 00 00 00 00 00 | ........
...               ...
00007fffffffe000  00 00 00 00 00 00 00 00 | ........
00007fffffffe008  00 00 00 00 00 00 00 00 | ........
00007fffffffe010  00 00 00 00 00 00 00 00 | ........
```

listen

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

listen() marks the socket referred to by sockfd as a passive socket, that is, as a socket that will be used to accept incoming connection requests using accept(2).

accept

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

The accept() system call is used with connection-based socket types (SOCK_STREAM, SOCK_SEQPACKET). It extracts the first connection request on the queue of pending connections for the listening socket, sockfd, creates a new connected socket, and returns a new file descriptor referring to that socket.

Steps to Accept TCP/IP Network Connections

PROCESS	
PID PPID	42 1
Real User ID Effective User ID Saved User ID	1000 1000 1000
FD 0 FD 1 FD 2 FD 3 FD 4 ... FD 1024	/dev/pts/1 /dev/pts/1 /dev/pts/1
555555554000-555555555000 r--p /bin/program 555555555000-555555556000 r-xp /bin/program ... 7ffff7da6000-7ffff7dc8000 r--p /lib/.../libc.so.6 7ffff7dc8000-7ffff7f40000 r-xp /lib/.../libc.so.6 ... 7fffffde000-7ffffffff000 rw-p [stack]	

Steps to Accept TCP/IP Network Connections

```
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 3
```

PROCESS	
PID PPID	42 1
Real User ID Effective User ID Saved User ID	1000 1000 1000
FD 0 FD 1 FD 2 FD 3 FD 4 ... FD 1024	/dev/pts/1 /dev/pts/1 /dev/pts/1 **socket:[31337]**
555555554000-555555555000 r--p /bin/program 555555555000-555555556000 r-xp /bin/program ... 7ffff7da6000-7ffff7dc8000 r--p /lib/.../libc.so.6 7ffff7dc8000-7ffff7f40000 r-xp /lib/.../libc.so.6 ... 7fffffffde000-7ffffffff000 rw-p [stack]	

Steps to Accept TCP/IP Network Connections

```
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 3
bind(3,
     {sa_family=AF_INET,
      sin_port=htons(80),
      sin_addr=inet_addr("0.0.0.0")},
     16)                                 = 0
```

PROCESS	
PID PPID	42 1
Real User ID Effective User ID Saved User ID	1000 1000 1000
FD 0 FD 1 FD 2 FD 3 FD 4 ... FD 1024	/dev/pts/1 /dev/pts/1 /dev/pts/1 socket:[31337]

```
555555554000-555555555000 r--p  /bin/program
555555555000-555555556000 r-xp  /bin/program
...
7ffff7da6000-7ffff7dc8000 r--p  /lib/.../libc.so.6
7ffff7dc8000-7ffff7f40000 r-xp  /lib/.../libc.so.6
...
7fffffffde000-7ffffffff000 rw-p  [stack]
```

Steps to Accept TCP/IP Network Connections

```
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 3
bind(3,
     {sa_family=AF_INET,
      sin_port=htons(80),
      sin_addr=inet_addr("0.0.0.0")},
     16)                                 = 0
listen(3, 0)                             = 0
```

PROCESS	
PID PPID	42 1
Real User ID Effective User ID Saved User ID	1000 1000 1000
FD 0 FD 1 FD 2 FD 3 FD 4 ... FD 1024	/dev/pts/1 /dev/pts/1 /dev/pts/1 socket:[31337]

```
555555554000-555555555000 r--p  /bin/program
555555555000-555555556000 r-xp  /bin/program
...
7ffff7da6000-7ffff7dc8000 r--p  /lib/.../libc.so.6
7ffff7dc8000-7ffff7f40000 r-xp  /lib/.../libc.so.6
...
7fffffde000-7ffffffff000 rw-p  [stack]
```

Steps to Accept TCP/IP Network Connections

```
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 3
bind(3,
     {sa_family=AF_INET,
      sin_port=htons(80),
      sin_addr=inet_addr("0.0.0.0")},
     16)                                 = 0
listen(3, 0)                             = 0
accept(3, NULL, NULL)                    = 4
```

PROCESS	
PID PPID	42 1
Real User ID Effective User ID Saved User ID	1000 1000 1000
FD 0 FD 1 FD 2 FD 3 FD 4 ... FD 1024	/dev/pts/1 /dev/pts/1 /dev/pts/1 socket:[31337] **socket:[31338]**

```
555555554000-555555555000 r--p  /bin/program
555555555000-555555556000 r-xp  /bin/program
...
7ffff7da6000-7ffff7dc8000 r--p  /lib/.../libc.so.6
7ffff7dc8000-7ffff7f40000 r-xp  /lib/.../libc.so.6
...
7fffffffde000-7ffffffff000 rw-p  [stack]
```