CSE 333 Section 9 - Servers, netcat and boost

Welcome back to section! We're glad that you're here :)

Step-by-step Server-Side Networking

Step 1. Figure out what IP address and port to use for the server. (`getaddrinfo()`)

```
// returns 0 on success, negative number on failure
int getaddrinfo(const char *hostname,    // hostname to lookup
           const char *servname,         // service name
           const struct addrinfo *hints, // desired output
      (optional)
           struct addrinfo **res);       // results structure

struct addrinfo {
     int ai_flags;              // additional flags
     int ai_family;             // AF_INET, AF_INET6, AF_UNSPEC
     int ai_socktype;                // SOCK_STREAM, SOCK_DGRAM, 0
     int ai_protocol;                // IPPROTO_TCP, IPPROTO_UDP, 0
     size_t ai_addrlen;         // length of socket addr in bytes
     struct sockaddr* ai_addr;  // pointer to socket addr
     char* ai_canonname;        // canonical name
     struct addrinfo* ai_next;  // can have linked list of records
}
```

Step 2. Create a socket. (`socket()`)

```
// returns file descriptor on success, -1 on failure (errno set)
int socket(int domain,          // AF_INET, AF_INET6, etc.
           int type,            // SOCK_STREAM, SOCK_DGRAM, etc.
           int protocol);       // usually 0
```

Step 3. Bind the socket to an IP address for the server. (`bind()`)

```
// returns 0 on success, -1 on failure (errno set)
int bind(int sockfd,                  // fd from step 2
         struct sockaddr *serv_addr,    // socket addr from step 1
         socklen_t addrlen);          // size of serv_addr
```

Step 4. Mark the socket as "passive", one that listens for incoming connections. (`listen()`)

```
// returns 0 on success, -1 on failure (errno set)
int listen(int sockfd,   // fd from step 2
           int backlog); // max amount of pending connections.
                         // Usually just use SOMAXCONN
```

Step 5. .Accepts an incoming connection & provides information on the connection (`accept()`)

```
// returns a file descriptor that handles the connection to a
// specific client connection, -1 on failure (errno set)
int accept(int listen_fd,             // fd from step 2
        struct sockaddr *client_addr, // output param for client
info
        socklen_t addrlen);               // size of client_addr
```

Step 6. Transfer data through the accepted socket. (`read()` and `write()`)

```
// returns amount read, 0 for EOF, -1 on failure (errno set)
ssize_t read(int fd, void *buf, size_t count);

// returns amount written, -1 on failure (errno set)
ssize_t write(int fd, void *buf, size_t count);
```

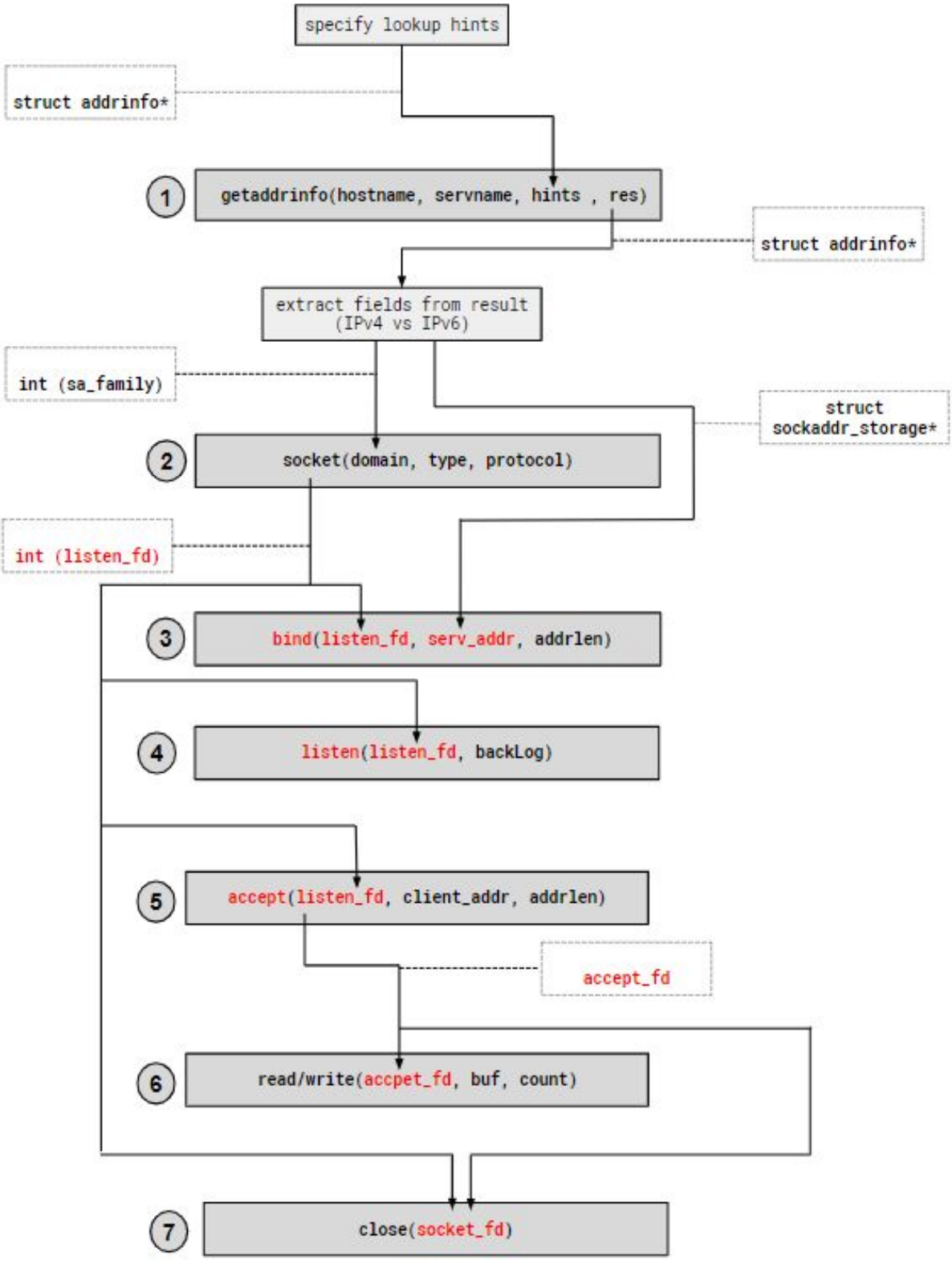
These are the same POSIX calls used for files, so remember to deal with partial reads/writes!

Step 7. Close the listen and accept sockets when done. (`close()`)

```
// returns 0 for success, -1 on failure (errno set)
int close(int fd);
```

Exercise 1 (Diagram on the next page)

Fitting the Pieces Together. The diagram on the next page depicts the basic skeleton of a C++ program for server-side networking, with arrows representing the flow of data between them. Fill in the names of the functions being called, and the arguments being passed. Then, for each arrow in the diagram, fill in the type and/or data that it represents.


specify lookup hints
struct addrinfo*
1
getaddrinfo(hostname, servname, hints , res)
struct addrinfo*
extract fields from result
(IPv4 vs IPv6)
int (sa_family)
struct
sockaddr_storage*
2
socket(domain, type, protocol)
int (listen_fd)
3
bind(listen_fd, serv_addr, addrlen)
4
listen(listen_fd, backLog)
5
accept(listen_fd, client_addr, addrlen)
accept_fd
6
read/write(accpet_fd, buf, count)
7
close(socket_fd)

Boost Library

Exercise 1

Write a function that takes in a string that contains words separated by whitespace and returns a vector that contains all of the words in that string, in the same order as they show up, but with no duplicates. Ignore all leading and trailing whitespace in the input string.

Example:
`RemoveDuplicates(" Hi I'm sorry  jon sorry hi hihi  hi hi     ")` should return the vector `["Hi", "I'm", "sorry", "jon", "hi", "hihi"]`

```
// There are other and better ways to solve this, but this
// solution uses only things from the final exam reference sheet
vector<string> RemoveDuplicates(const string& input){
  string copy(input);
  boost::algorithm::trim(copy);
  std::vector<string> components;
  boost::split(components, copy, boost::is_any_of(" \t\n"),
                                 boost::token_compress_on);
  std::vector<string> result;
  for (size_t i = 0; i < components.size(); ++i) {
    bool unique = true;
    for (size_t j = 0; j < i && unique; ++j) {
      unique &= components[i] != components[j];
    }
    if (unique) {
      result.push_back(components[i]);
    }
  }
  return result;
}
```

```
// Alternate Solution
vector<string> RemoveDuplicates(const string& input) {
  string copy(input);
  boost::algorithm::trim(copy);
  vector<string> components;
  boost::split(components, copy, boost::is_any_of(" \t\n"),
                                 boost::token_compress_on);
  set<string> aux;
  vector<string> res;
  for (auto comp : components) {
    if (aux.find(comp) == aux.end()) {
      res.push_back(comp);
      aux.insert(comp);
    }
  }
  return res;
}
```