CSE 333 Section 8

Client-Side Networking

Logistics

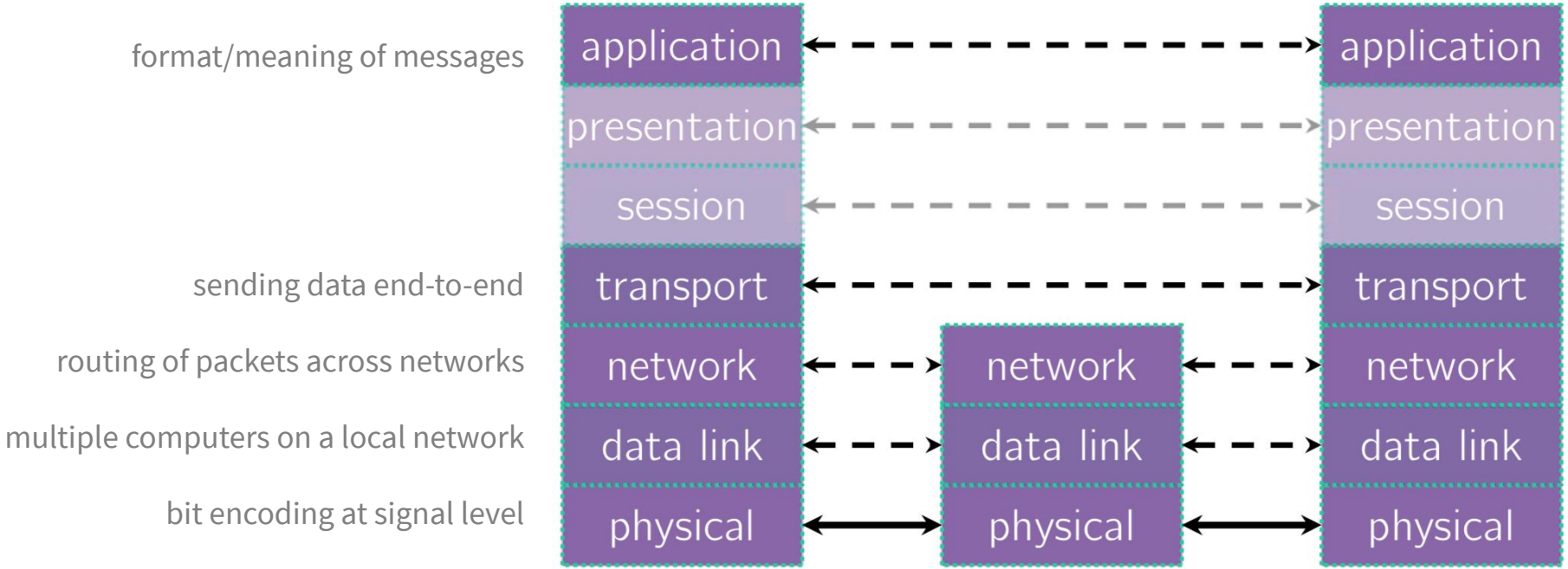
Due TODAY:

- Homework 3 (@9:00 pm)

Due Monday:

- Exercise 15 (@11:00 am)

Computer Networks: A 7-ish Layer Cake



Exercises 1 & 2

Exercises 1 & 2

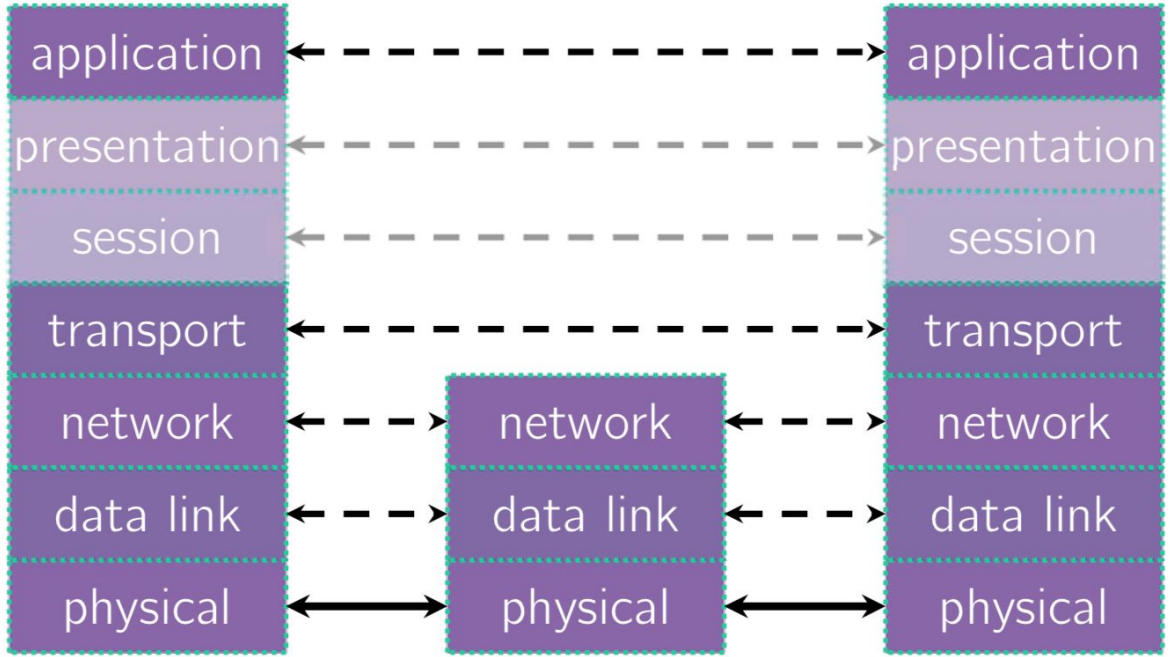
format/meaning of messages

sending data end-to-end

routing of packets across networks

multiple computers on a local network

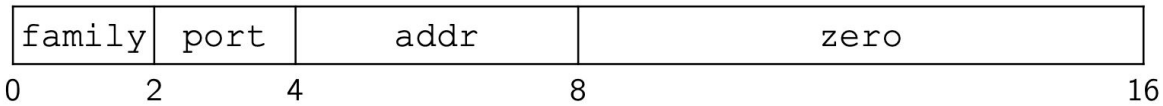
bit encoding at signal level



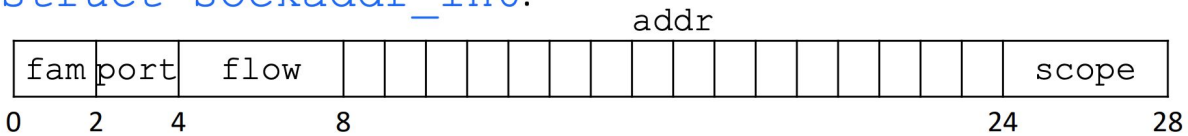
Sockets

- Just a file descriptor for network communication
- Types of Sockets
  - Stream sockets (TCP)
  - Datagram sockets (UDP)
- Each socket is associated with **a port number** and **an IP address**
  - Stored in network byte order (big endian)

`struct sockaddr_in`:

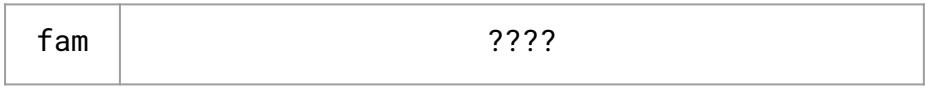


`struct sockaddr_in6`:



Sockets

struct sockaddr (pointer to this struct is used as parameter type in system calls)



....

struct sockaddr_in (IPv4)

16

struct sockaddr_in6 (IPv6)

28

struct sockaddr_storage

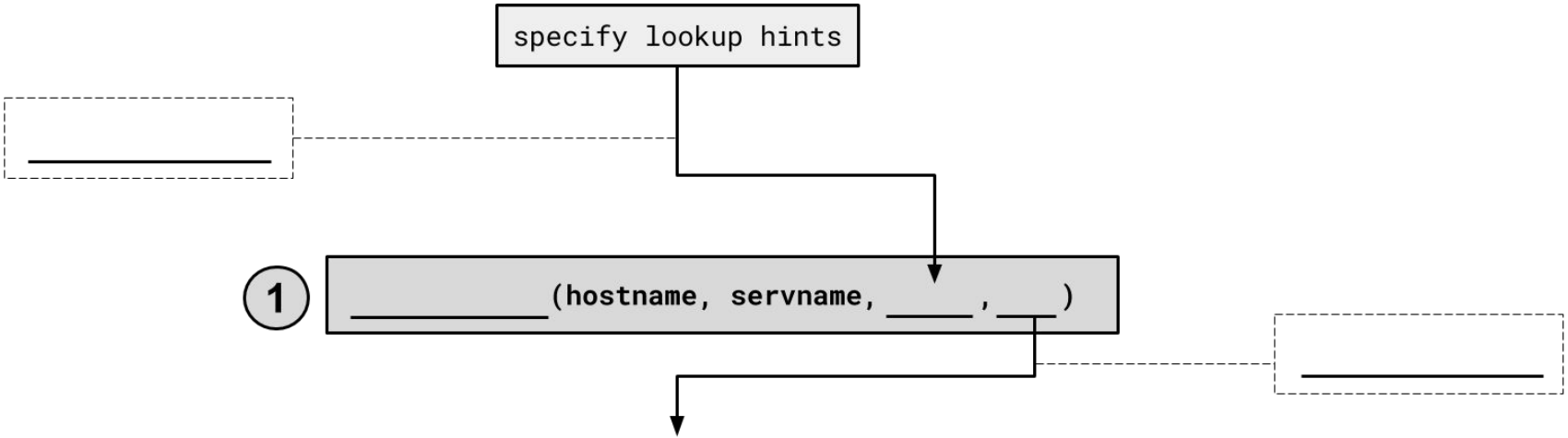
Big enough to hold either

Big Endian and Little Endian

- **N**etwork Byte Order (Big Endian)
  - The most significant byte is stored in the highest address
- **H**ost byte order
  - Might be big or little endian, depending on the hardware
- To convert between orderings, we can use
  - `uint32_t htonl (uint32_t hostlong);`
  - `uint32_t ntohl (uint32_t hostlong);`

Exercise 3

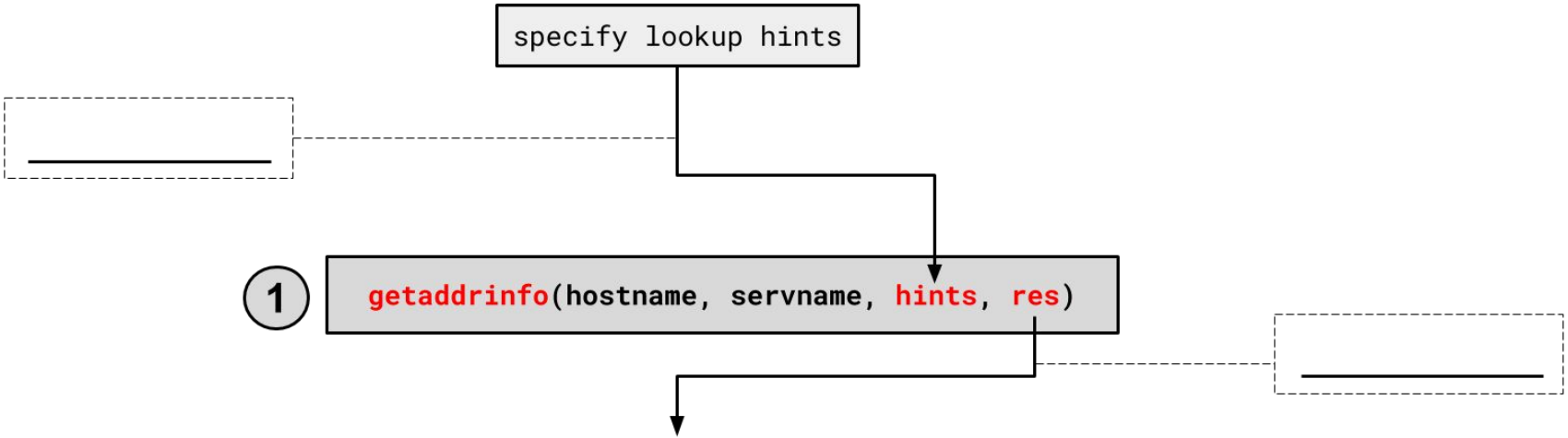
1.



1. getaddrinfo()

```
int getaddrinfo(const char *hostname,
                const char *service,
                const struct addrinfo *hints,
                struct addrinfo **res);
```

- Performs a **DNS Lookup** for a hostname



1. getaddrinfo()

```
int getaddrinfo(const char *hostname,
                const char *service,
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```
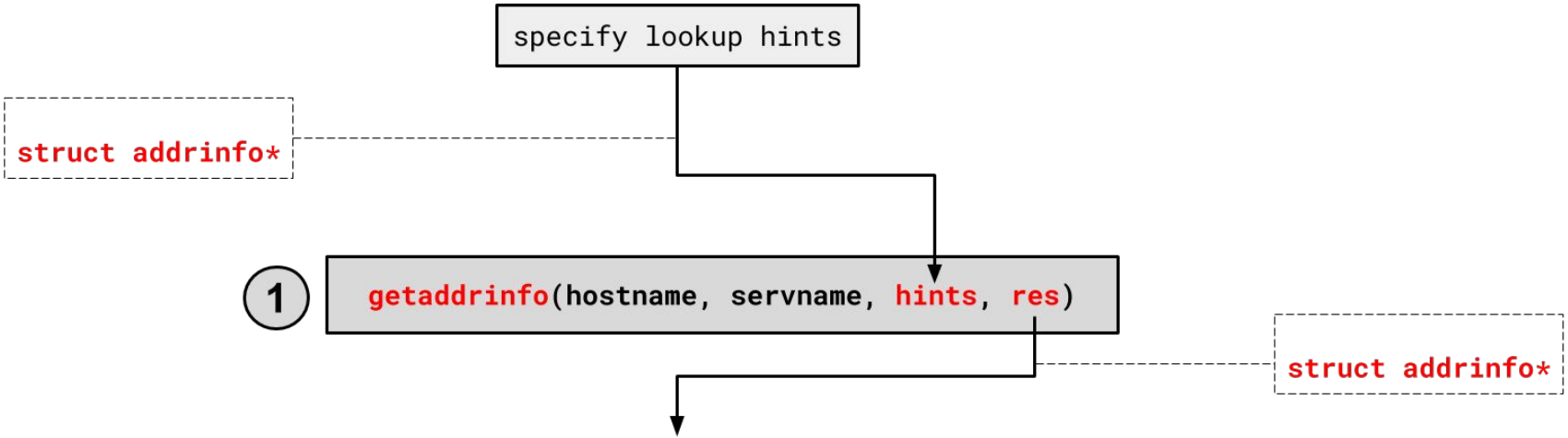

- Performs a **DNS Lookup** for a hostname
- Use “hints” to specify constraints (`struct addrinfo *`)
- Get back a linked list of `struct addrinfo` results



1. getaddrinfo() - Interpreting Results

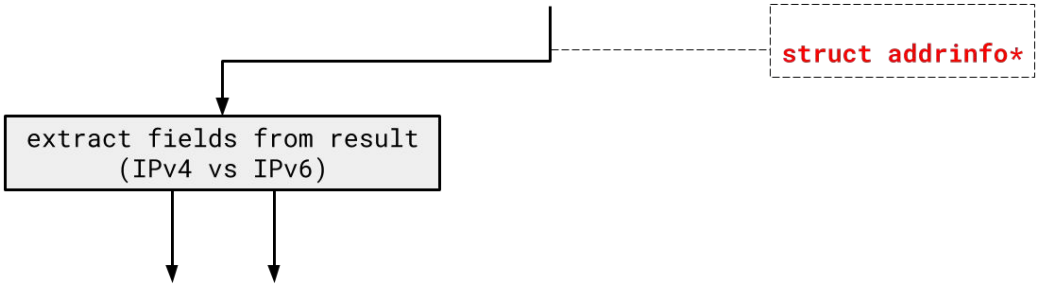
```
struct addrinfo {
    int ai_flags; // additional flags
    int ai_family; // AF_INET, AF_INET6, AF_UNSPEC
    int ai_socktype; // SOCK_STREAM, SOCK_DGRAM, 0
    int ai_protocol; // IPPROTO_TCP, IPPROTO_UDP, 0
    size_t ai_addrlen; // length of socket addr in bytes
    struct sockaddr* ai_addr;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

- `ai_addr` points to a `struct sockaddr` describing the socket address

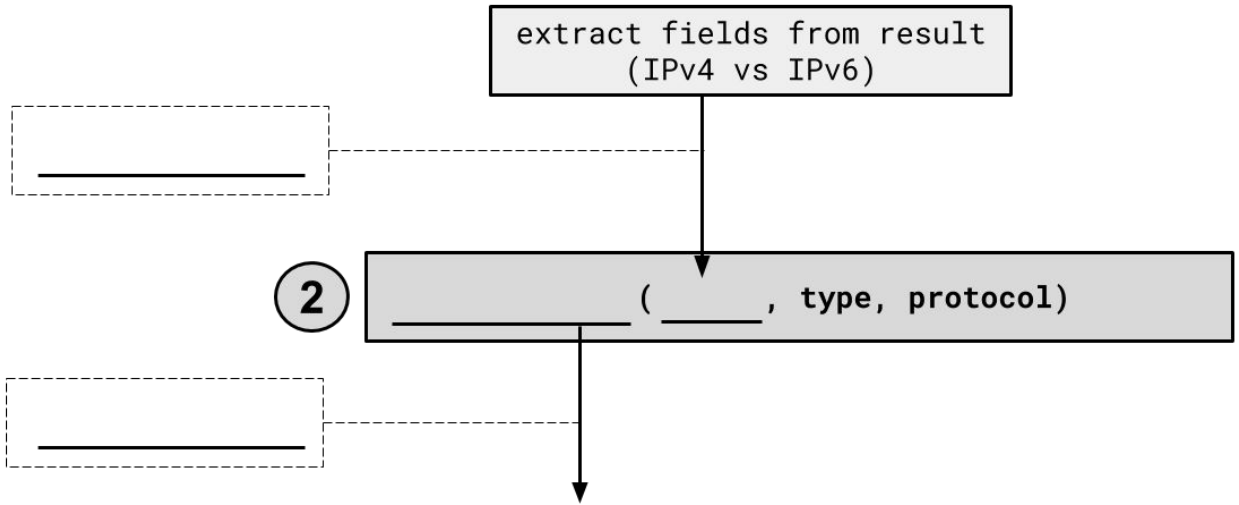
1. getaddrinfo() - Interpreting Results

With a `struct sockaddr*`:

- The field `sa_family` describes if it is IPv4 or IPv6
- Cast to `struct sockaddr_in* (v4)` or `struct sockaddr_in6* (v6)` to access/modify specific fields
- Create a `struct sockaddr_storage` to make a space big enough for either



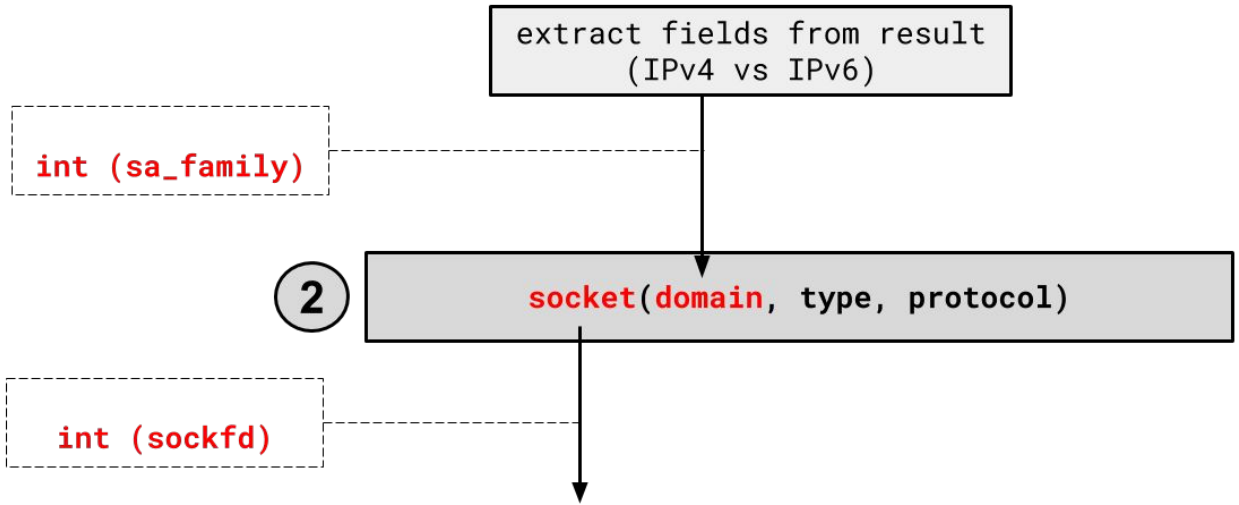
2.



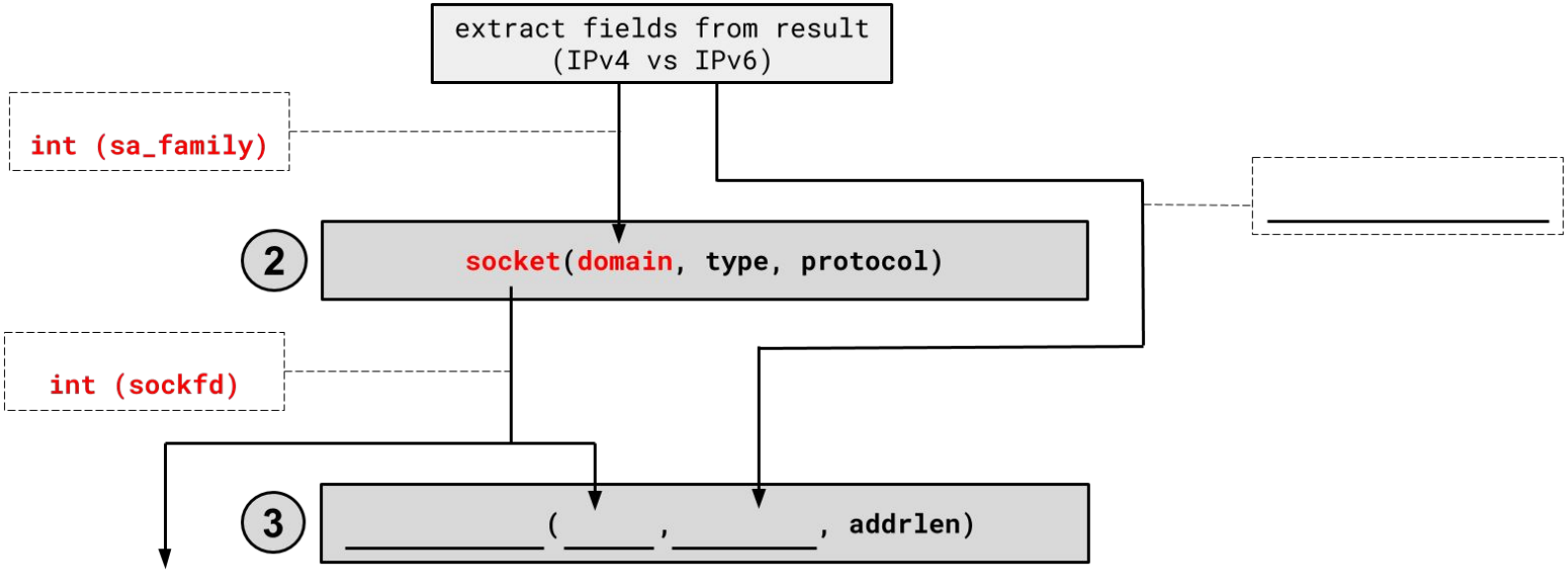
2. socket()

```
int socket(int domain,     // AF_INET, AF_INET6
           int type,       // SOCK_STREAM (TCP)
           int protocol); // 0
```

- Creates a “raw” socket, ready to be bound
- Returns file descriptor (`sockfd`) on success, `-1` on failure



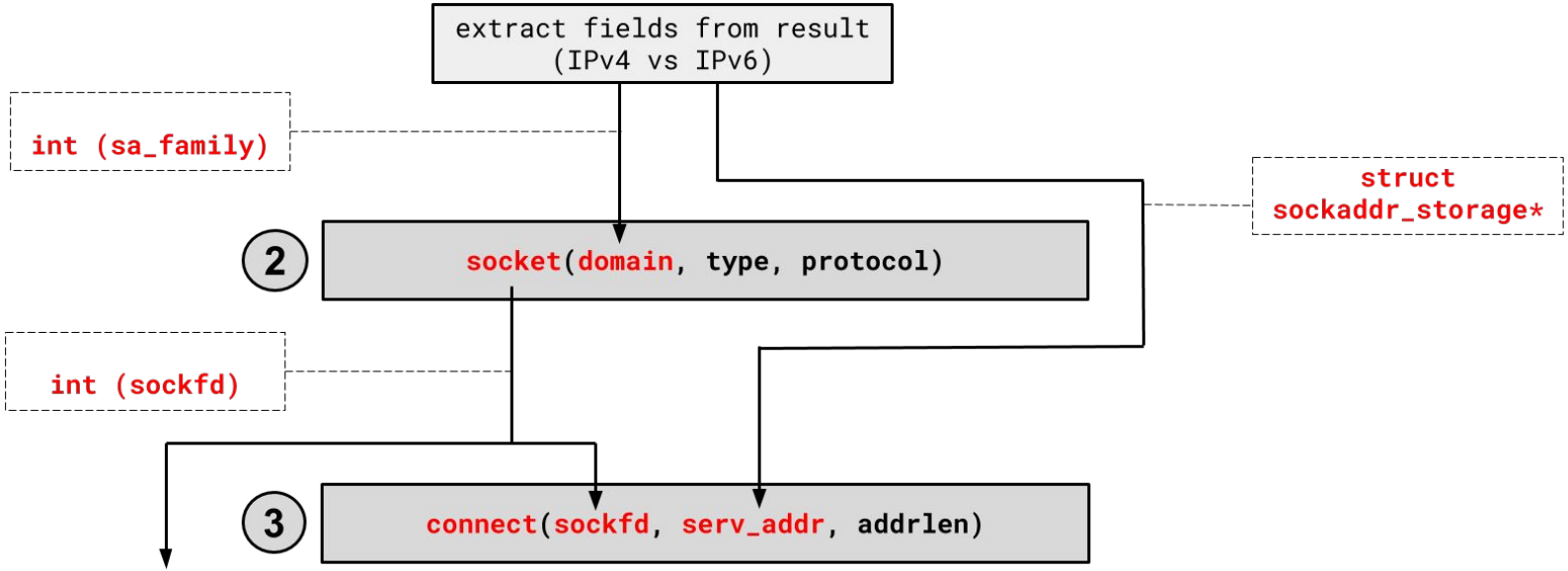
3.


extract fields from result
(IPv4 vs IPv6)
int (sa_family)
2
socket(domain, type, protocol)
int (sockfd)
3
_____(_____,_____, addrlen)

3. connect()

```
int connect (int sockfd,                          // from 2
             const struct sockaddr *serv_addr, // from 1
             socklen_t addrlen);      // size of serv_addr
```

- Connects an available socket to a specified address
- Returns 0 on success, -1 on failure



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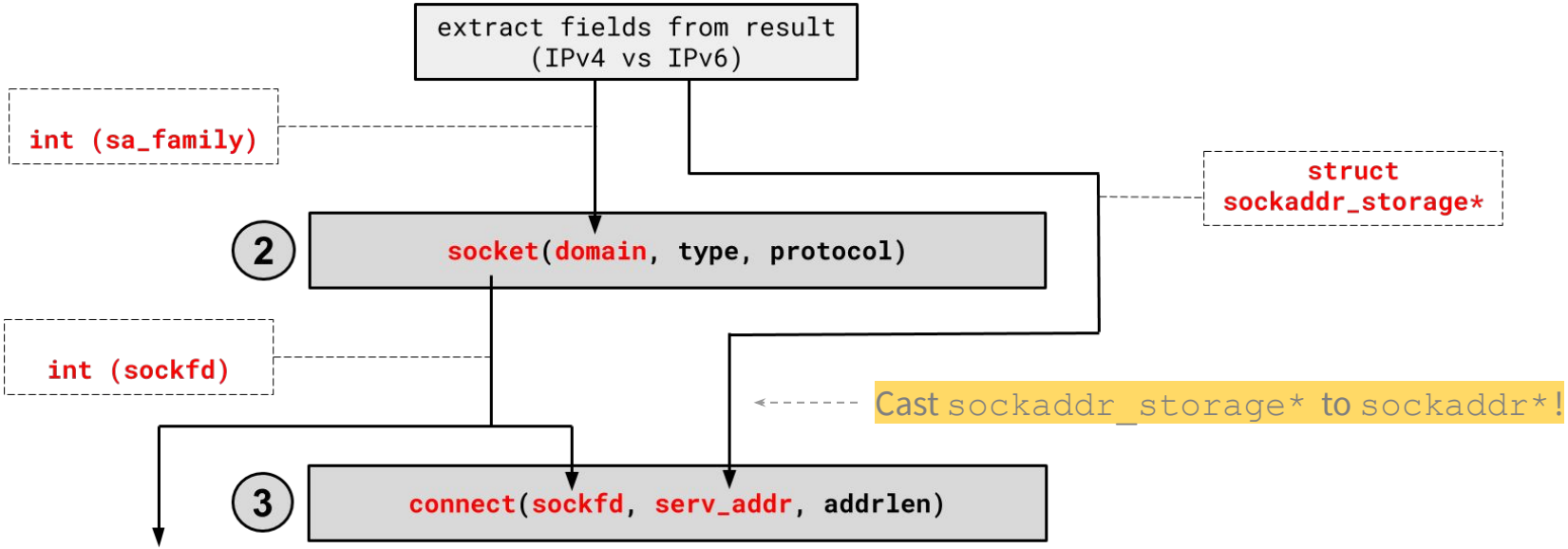

4. read/write and 5. close

- Thanks to the file descriptor abstraction, use as normal!
- `read` from and `write` to a buffer, the OS will take care of sending/receiving data across the network
- Make sure to `close` the fd afterward