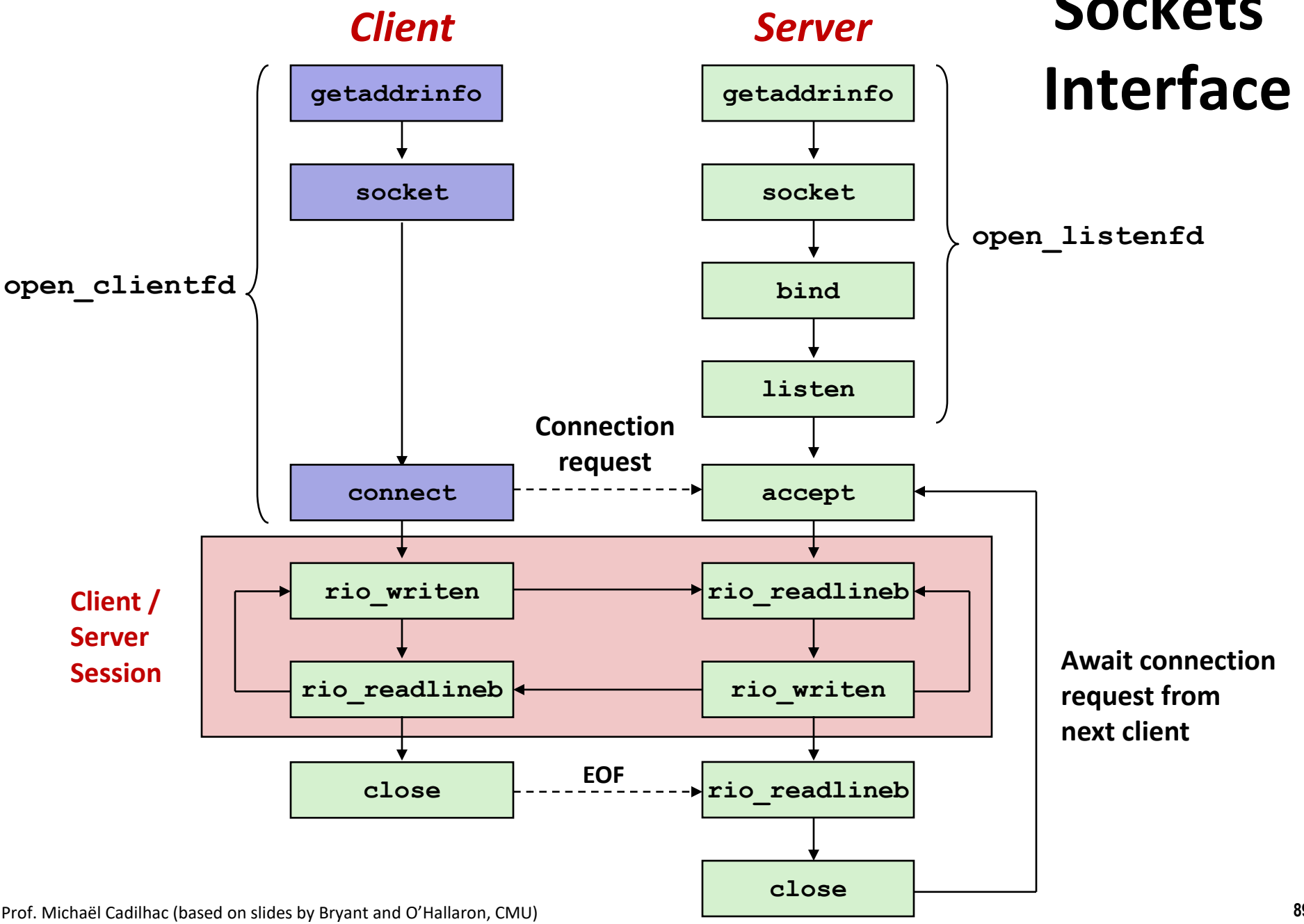
Network Programming:

Basic client/server application:

3. Sockets helper:

`open_{clientfd,listenfd}`

Sockets Interface



Sockets Helper: `open_clientfd`

- Establish a connection with a server

```
int open_clientfd(char *hostname, char *port) {
  int clientfd;
  struct addrinfo hints, *listp, *p;

  /* Get a list of potential server addresses */
  memset(&hints, 0, sizeof(struct addrinfo));
  hints.ai_socktype = SOCK_STREAM;  /* Open a connection */
  hints.ai_flags = AI_NUMERICSERV;  /* …using numeric port arg. */
  hints.ai_flags |= AI_ADDRCONFIG;  /* Only use supported IPvX */
  Getaddrinfo(hostname, port, &hints, &listp);
```

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- We don't specify `hints.ai_family`

Sockets Helper: `open_clientfd` (cont)

```
    /* Walk the list for one that we can successfully connect to */
    for (p = listp; p; p = p->ai_next) {
        /* Create a socket descriptor */
        if ((clientfd = socket(p->ai_family, p->ai_socktype,
                               p->ai_protocol)) < 0)
            continue; /* Socket failed, try the next */

        /* Connect to the server */
        if (connect(clientfd, p->ai_addr, p->ai_addrlen) != -1)
            break; /* Success */
        Close(clientfd); /* Connect failed, try another */
    }

    /* Clean up */
    Freeaddrinfo(listp);
    if (!p) /* All connects failed */
        return -1;
    else    /* The last connect succeeded */
        return clientfd;
}
```

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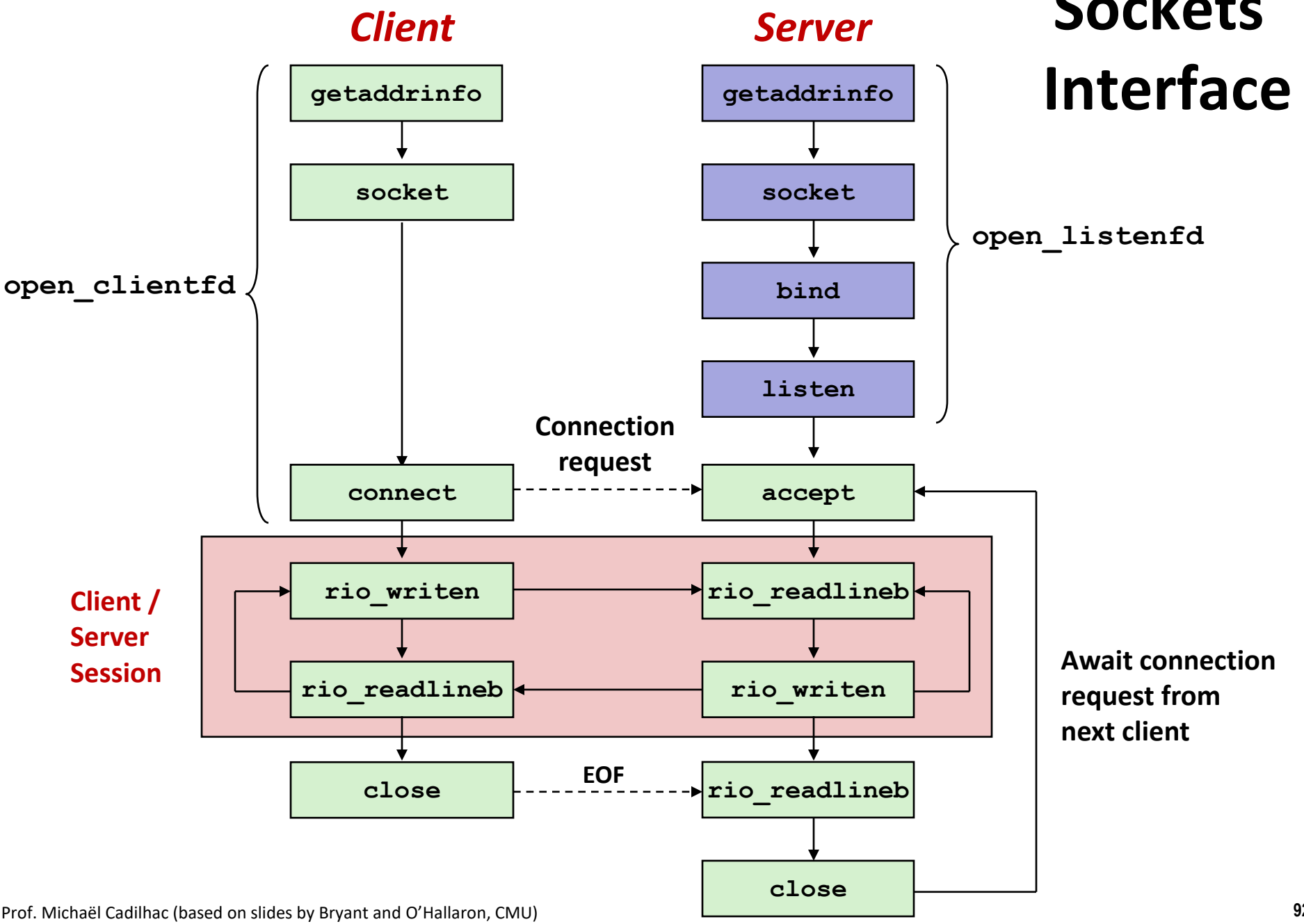
Sockets Interface



Sockets Helper: `open_listenfd`

- Create a listening descriptor that can be used to accept connection requests from clients.

```
 int open_listenfd(char *port)
{
    struct addrinfo hints, *listp, *p;
    int listenfd, optval=1;

    /* Get a list of potential server addresses */
    memset(&hints, 0, sizeof(struct addrinfo));
    hints.ai_socktype = SOCK_STREAM;             /* Accept connect. */
    hints.ai_flags = AI_PASSIVE | AI_ADDRCONFIG; /* …on any IP addr */
    hints.ai_flags |= AI_NUMERICSERV;            /* …using port no. */
    Getaddrinfo(NULL, port, &hints, &listp);
```

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- **`AI_PASSIVE` + First arg == `NULL`, implies:**
  - Returned socket suitable for binding a socket that will accept connections
  - Returned socket address has wildcard address (`INADDR_ANY`).

Sockets Helper: `open_listenfd` (cont)

```
/* Walk the list for one that we can bind to */
for (p = listp; p; p = p->ai_next) {
    /* Create a socket descriptor */
    if ((listenfd = socket(p->ai_family, p->ai_socktype,
                           p->ai_protocol)) < 0)
        continue;  /* Socket failed, try the next */

    /* Eliminates "Address already in use" error from bind */
    Setsockopt(listenfd, SOL_SOCKET, SO_REUSEADDR,
               (const void *)&optval , sizeof(int));

    /* Bind the descriptor to the address */
    if (bind(listenfd, p->ai_addr, p->ai_addrlen) == 0)
        break; /* Success */
    Close(listenfd); /* Bind failed, try the next */
}
```

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Sockets Helper: `open_listenfd` (cont)

```
    /* Clean up */
    Freeaddrinfo(listp);
    if (!p) /* No address worked */
        return -1;

    /* Make it a listening socket ready to accept conn. requests */
    if (listen(listenfd, LISTENQ) < 0) {
        Close(listenfd);
        return -1;
    }
    return listenfd;
}
```

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Sockets Helper: `open_listenfd` (cont)

```
    /* Clean up */
    Freeaddrinfo(listp);
    if (!p) /* No address worked */
        return -1;

    /* Make it a listening socket ready to accept conn. requests */
    if (listen(listenfd, LISTENQ) < 0) {
        Close(listenfd);
        return -1;
    }
    return listenfd;
}
```

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- **Key point:** `open_clientfd` and `open_listenfd` are both independent of any particular version of IP.