EECS 22L: Software Engineering Project in C Language

Lecture 9

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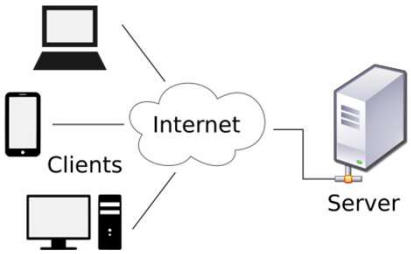
Lecture 9: Overview

- Project 2 Technical Discussion and Advise
  - Client-server software architecture
- Discussion on Socket Communication
  - Client-server example
  - Blocking I/O communication
  - Multiplexing multiple connections
  - Clock server example

Project 2: Software Architecture

- Client-Server Software Architecture
  - Software applications communicating via the Internet



Source: David Vignoni (LGPL, wikipedia.org)

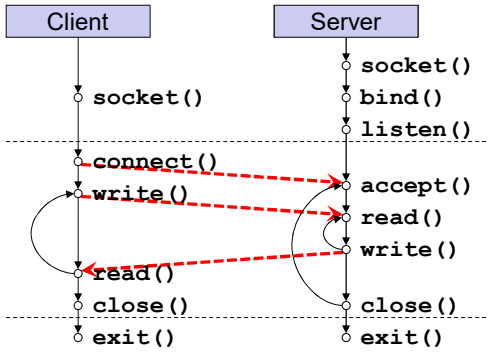
  - Server: provides a service function to one or more clients
  - Client: initiates requests for service
  - Internet: communication network to exchange messages

Project 2: Client-Server Communication

- Discussion on Socket Communication
  - Sockets Tutorial
    - **`http://www.linuxhowtos.org/C_C++/socket.htm`**
    - **`http://www.linuxhowtos.org/data/6/client.c`**
    - **`http://www.linuxhowtos.org/data/6/server.c`**
  - Reference: Linux manual pages
    - **`man socket`**
    - **`man select`**
    - **`man select_tut`**
  - Extended client-server example:
    `~eecs22/SocketTutorial.tar.gz`
    - **`client2.c`**
    - **`server2.c`**
    - ➢ This example can handle only one client at a time, others have to wait for their turn to connect

Project 2: Client-Server Communication

- Discussion on Socket Communication
  - Sequence Diagram for client-server example



  - This simple example can handle only one client at a time, others have to wait for their turn to connect (they are blocked)
  - *Blocking communication* can stall both the client and the server!

Project 2: Client-Server Architecture

- Communication Example: *Initial* Chat App
  - Client: `Hello!`
  - Server: `ERROR invalid message "Hello!"`
  - Client: `CREATE_ACCOUT Albert Einstein AE`
  - Server: `OK AE = Albert Einstein`
  - Client: `GET CONTACTS AE`
  - Server: `OK IN = Isaac Newton, NT = Nikola Tesla`
  - Client: `SEND_MESSAGE NT Hello Nikola, how are you?`
  - Server: `OK`
  - Client: `RECEIVE_MESSAGES`
  - Server: `OK NT="I'm fine, thanks!", END_OF_MESSAGES`

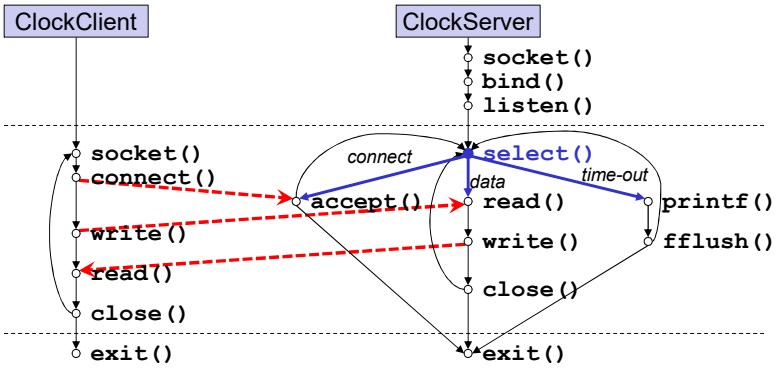
Avoid a possibly long delay for the other client to respond!

Project 2: Client-Server Architecture

- Discussion on Socket Communication
  - Handling multiple active client connections
    - Option 1: Parallel/concurrent (asynchronous) I/O
      - Use multiple processes (**`fork()`**) or threads (**`pthread_create()`**)
      - Requires Operating System (OS) knowledge (i.e. EECS 111), and very careful programming to avoid race-conditions and deadlocks
    - Option 2: Synchronous I/O multiplexing
      - Wait on multiple I/O requests, handle them first-come-first-served (FCFS)
      - Function **`select()`** monitors multiple file descriptors, with timeout option
  - ➢ Multiplexing multiple connections with **`select()`**
  - Clock server example: **`~eecs22/ClockServer.tar.gz`**
    - **`ClockServer.c`**
    - **`ClockClient.c`**
    - **`Makefile, README`**
  - ➢ Online demonstration!

Project 2: Client-Server Architecture

- Multiplexing multiple client connections with **`select()`**
  - ClockServer example: **`~eecs22/ClockServer.tar.gz`**



  - ➢ Wait simultaneously to connect, to transfer data, or for time-out!
  - ➢ Keep sequential execution short
  - ➢ Limit client-server interaction to one request at a time