
LAB 9

CS 361: Systems Programming / Spring 2023

Description

In this lab session, you will explore function select to perform multiplexed I/O.

Please read this document carefully and follow the instructions on the last section to complete this lab session. When you answered all the questions, please show your work to the TA.

Guide

1. Accept the invitation for Lab 9 on Github classroom: <https://classroom.github.com/a/5DHPgVYi>
2. Import the Github repository created to your machine using vscode, as explained in Assignment 0
3. Make sure that you can launch a terminal inside vscode via menus: Terminal > New Terminal
4. Read this guide and answer the questions as they appear. You should answer a total of 11 questions.

Errata

- When Lecture 16 refers to `FD_CLEAR`, it means `FD_CLR`
- When Lecture 16 refers to `fdset`, it means `fd_set`

Function select

Function `select` was thoroughly covered in Lecture 16. Please open the slides for Lecture 16, as you will be using them throughout this lab. Function `select`'s API is:

```
int select(int nfds, fd_set * readfds, fd_set * writefds, fd_set * errorfds, struct timeval *restrict, timeout);
```

Lecture 16 covers the meaning of each argument in detail. It also covers the return value. Please revise those slides now.

Question 1: List and describe the first 3 arguments of function `select`?

Question 2: What does function `select` return?

FD_ macros

Arguments of function select have type `fd_set`, which you can manipulate using the following macros:

```
FD_ZERO(fd_set* s)
FD_SET(int fd, fd_set* s)
FD_CLR(int fd, fd_set * s)
FD_ISSET(int fd, fd_set * s)
```

Lecture 16 covers each macro in detail. Please revise those slides now.

Question 3: What does each macro `FD_` do?

Question 4: Open `lab9-1.c` and inspect that file. Describe what it does in your own words.

Question 5: Run `make` to compile `lab9-1.c` into executable `lab9-1`.

Choose a 5-digit port and pass it as argument: `./lab9-1 <PORT>`

In another **two** terminals, run command `telnet 127.0.0.1 <PORT>`

You should have **three** terminals open by now.

Does any program terminate?

Question 6: After Q5, Write “Hello” and press enter on the first telnet terminal. What does `lab9-1` print?

Question 7: After Q6, write “Goodbye” and press enter on the second telnet terminal. What does `lab9-1` print?

Question 8: Repeat Q5, and write “Goodbye” and press enter on the second telnet terminal. What does `lab9-1` print?

Question 9: After Q8, write “Hello” on the first telnet terminal. What does `lab9-1` print?

Question 10: Use `select` before accepting and/or reading from any connected client, to ensure lab9-1 does not block accepting and reading from sockets.

You know you succeeded when lab9-1 prints “Hello” or “Goodbye” immediately, whichever happens first.

Lecture 16 has code examples about how to use `select`.

Use `select` first in the loop.

You need to add variables before the while loop, and use `FD_` macros to set them, as explained in the code shown in Lecture 16.

Edit each `if` to only enter if the respective socket is ready. Use the `fd_set` that you passed to `select` together with the `FD_` macros.

What changes did you perform on lab9-1.c ?

Question 11: How would you change Q10’s answer to also account for writing to clients?

Extra / Optional

Can you modify lab9-1 such that it works for an unbounded number of clients, not just two?

Grading

Show your UIC card to the TA when you enter the lab, or type your UIN on the chat when joining remotely. Stay in the session until you show your work, or until the TA announces that the lab is over.

- You have to remain present for the whole lab to get attendance, which you can then use to resubmit Assignment 4.
- You can leave early after showing your work to the TA (answers to all questions). In this case, you will get a 5% bonus in Assignment 4.