Assignment #3—Off The Beaten `$PATH`

Due: February 6, 2023 at 11:59pm

This assignment consists of three different components:

1. **You will modify your `$PATH` variable, shell prompt, and add aliases**
2. **You'll get some practice using the networking tools we learned about in Lecture 7**
3. **You'll run a small server that our grading machine will connect to**

We expect this assignment to take 1-3 hours depending on your proficiency level with the tools. If you find yourself unproductively stuck or unproductively struggling, ask on Ed and/or go to office hours!

Part I: Customizing Your Environment Variables (1 point)

In Lecture 4: Shell Scripting, we saw how to write a shell script and make it executable from anywhere on the computer. Imagine you have a shell script called `hello.sh` that simply prints `Hello`. You create the script inside of a folder called `CS45` on your Desktop. (The folder would thus have a path of `~/Desktop/CS45`.) Given the script is located inside of the `CS45` folder, you can only run it from within that folder. Let's change that!

To make hello.sh script executable from anywhere on your machine, you will want to move it somewhere that is recognized by your `$PATH` environment variable. Whenever you type a command in the shell prompt (i.e. the command `grep`), your computer searches every folder inside of your `$PATH` environment variable to see if any of those folders have an executable by the name of the command you typed in (i.e. an executable by the name `grep`). For example, here is a sample `$PATH` environment variable:

```
Unset
/Library/Frameworks/Python.framework/Versions/3.11/bin:/opt/local/bin:/
opt/local/sbin:/opt/homebrew/bin:/opt/homebrew/sbin:/usr/local/bin:/usr
/bin:/bin:/usr/sbin:/sbin:/Library/Apple/usr/bin
```

When you type in `grep`, your computer first searches inside of `/Library/Frameworks/Python.framework/Versions/3.11/bin` to see if it finds an executable by the name of `grep`. If it doesn't find it there, it would then search inside of `/opt/local/bin` . It would then search inside of `/opt/local/bin`, and so forth.

To check what paths are currently set on your computer, you can run `echo $PATH` at the command line prompt.

Let's create a new `bin` folder that belongs to the user who is currently signed in (presumably you!) A `bin` folder is short for a binary folder, which, as the name suggests, contains binary files

(executable files) for programs that you might want to run. This new `bin` folder will allow us to store any of the local binary files that should be accessible anywhere on the computer for the current user.

Step 1: Creating A Bin Folder

First, you will want to navigate to your home directory using `cd ~`. Once you are in your home directory, you will want to make a new folder called `bin` using `mkdir bin`. Next, you will want to enter this new directory using `cd`. We will need the absolute path of this directory for Step 3. To get the absolute path of your newly-created `bin` folder, you should run `pwd` inside `~/bin`.

Step 2: Finding Your Shell

Your next task is to find out what shell you are running. You can normally do this by running `ps -p $$`. Your output may look something like the following:

```
Unset
karel@karel-computer bin % ps -p $$
  PID TTY           TIME CMD
25466 ttys001    0:00.32 -zsh
```

Step 3: Adding the Path

Now that you have your local `bin` folder (`~/bin`) and your shell, you will need to update (or make!) the config file specific to your shell:

- If you are using a `zsh` shell, your config file will be `.zshrc`
- If you are using a `bash` shell, your config file will `.bashrc`
- If you are using a `tcsh` shell, your config file will be `.tcshrc`

To check if you already have an existing config file, you should navigate back to your home directory (`~`) and then run `ls -a` (which will list all hidden files, such as your configuration files). If you don't have the right configuration file for your shell, you can just create the file using `touch <NAME_OF_FILE>` (i.e. `touch .zshrc` for a `zsh` shell).

Once you have your configuration file, you will want to open it and the following line, replacing `NEW_PATH` with the full path you discovered in Step 1 using `pwd`:

```
Unset
export PATH=$PATH:<INSERT_NEW_PATH>
```

In other words, if your path from step 1 was `/Users/karel/bin`, then your line inside of your config file would read `export PATH=$PATH:/Users/karel/bin`

Congratulations! You've successfully added a new path to your environment. You should now test out your new powers by creating a script called hello (you can drop the .sh ending as we will be turning the script into a command). The script should simply echo `Hello` along with your name. Make sure it has a valid shebang line so your computer knows how to run it! You can create the script in any directory you choose. Once you have created your script, turn it into an executable by running `chmod +x hello`

Now you will want to move the script to `~/bin`. You can do so by running `mv hello ~/bin/`. You should now be able to say hello to yourself at any time of day, from anywhere on the computer!

In addition to modifying your path variable, there are other useful configurations that we will guide you through. Let's work on implementing the following two configurations:

- Adding colors to your ls command
- Customizing your shell prompt

Adding Colors to ls

To add colors for `ls`, you will want to add an alias for `ls` that changes the standard `ls` command to an `ls` command with colors. The way to do this will depend on which shell you are using.

If you are on macOS, you should add the following two lines to your `.bashrc` or `.zshrc` file:

```
Unset
export CLICOLOR=1
alias ls='ls -G'
```

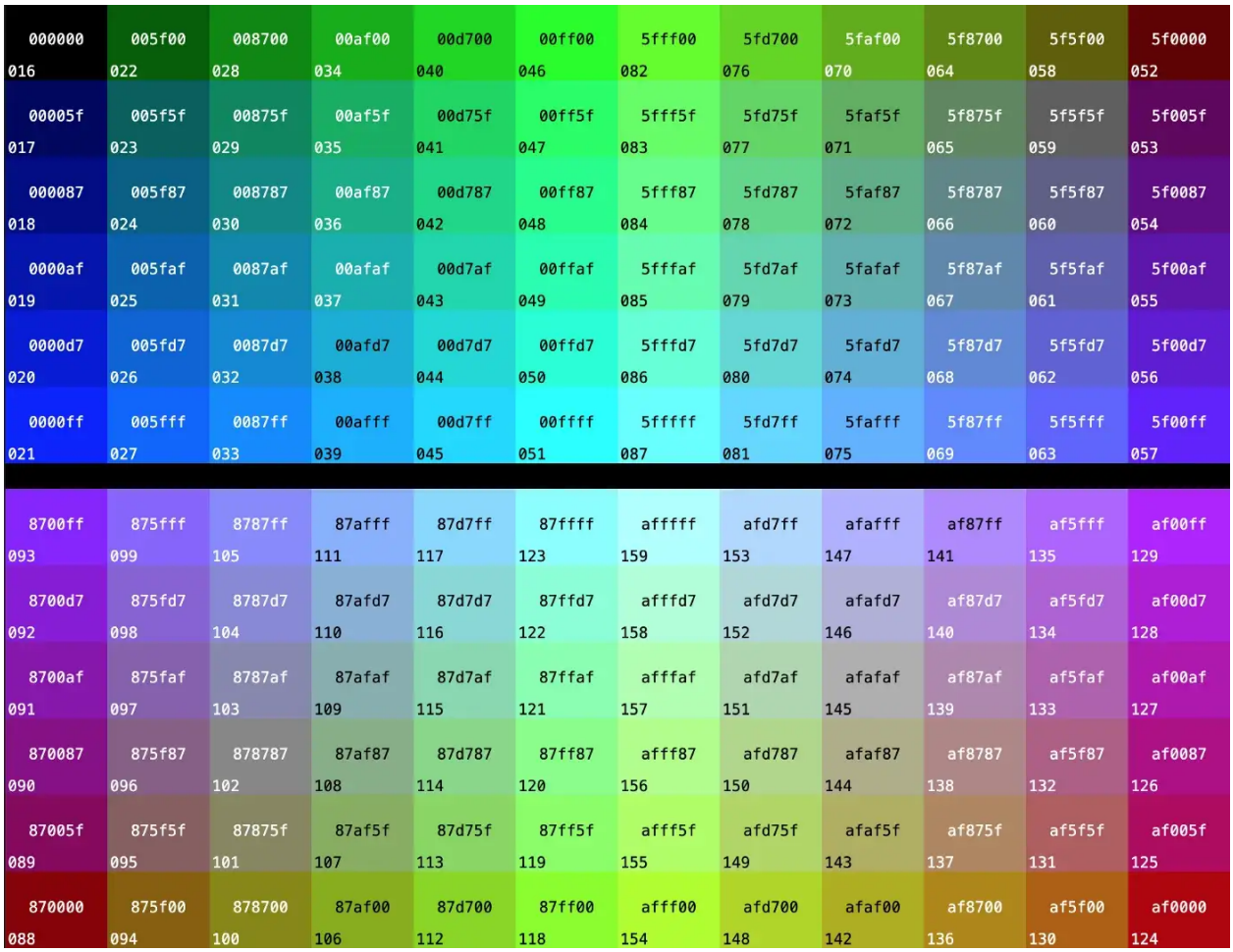
If you are using Linux or Windows (WSL), you should add the following line to your `.bashrc` or `.zshrc` file:

```
Unset
alias ls="ls --color=auto"
```

Customizing Your Shell Prompt

Now we will customize our shell prompt by adding colors to it and modifying what contents it has. Though we will leave it up to you as to what customization you would like to include, we have also provided a sample customization with CS45 themed-colors.

If you are using a `zsh` shell, you should use `zsh` guidelines for customizing your prompt. Here is a tool to build a `zsh` prompt. You can also use the chart below to choose `zsh` colors.



If you'd like to use our CS45-themed shell prompt, you should add the following line to your `.zshrc` file:

```
Unset
PROMPT='%B%F{75}%n%f@%b%F{88}%m%f:%~ %# '
```

If you are using a `bash` shell, you can also customize your shell. You will need to use `bash` specific syntax. You can easily customize your prompt using this tool. If you'd like to use our CS45-themed shell prompt, you should add the following line to your `.bashrc` file:

```
Unset
PS1="\[$(tput bold)\]\[\033[38;5;75m\]\u\[$(tput sgr0)\]@\[$(tput
sgr0)\]\[\033[38;5;88m\]\h\[$(tput sgr0)\]: \w \\$\[$(tput sgr0)\] "
```

For students who have access to the myth machines, we also recommend adding an alias for `ssh`-ing into the myth machines. (This part is not graded as not all students have access to the myth machines.) While you won't be able to have it automatically enter your password into `ssh` (for security reasons, ssh requires a human to type in the password), it'll at least reduce the tedium of typing "ssh $SUNET@myth.stanford.edu" over and over again.

Note: *If you are using another shell and we didn't include specific instructions here, reach out to us! We are happy to help.*

For this part of the assignment, you should submit your configuration file (e.g. `.bashrc`, `.zshrc`, etc).

Part II: Networking Short Answers (1 point)

In this part of the assignment, you'll be exploring some of the networking tools we learned about in Lecture 7 to get some information about your computer's networking environment. Make sure to install the software for Lecture 7! Note that for the commands below, if your computer uses Windows, you should use the Windows commands (even if you're inside WSL!)

(1) Network Interfaces & IP Addresses

To start, let's take a look at what network interfaces your computer has. On Windows, you can run the command `ipconfig.exe`, on macOS you can use `ifconfig`, and on linux you can use `ip addr`. This will list all the network devices your computer has available!

1.1 Using the command above, redirect its output into a file called `interfaces.txt`.

1.2 Look inside the output in `interfaces.txt`. Write the name of the interface that appears to be your wireless connection into a file called `wifi_interface.txt`

1.3 Look inside the output of `interfaces.txt`. Find and write your local IP address inside a file called `local_ip.txt`.

(2) Routes

Let's take a look at the routing table your computer is using. On Windows, you can run the command `route.exe print -4`, on macOS you can use `netstat -nrf inet`, and on linux you can use `ip -4 route`

2.1 Using the command above, redirect its output into a file called `routes.txt`

2.2 Look inside the output in `routes.txt`. Find the default route (this is the address of the router that's connecting you to the rest of the internet!) and put its IP address in `default_route.txt`.

(3) Traceroute

Let's see what path it takes to get to a server hosted in another country (in this case, we'll be connecting to a website that gives information about a town in Japan)! On Windows, you can use the command `tracert.exe www.town.okutama.tokyo.jp`, on Linux you can use `traceroute -I --resolve-hostnames www.town.okutama.tokyo.jp`,[1] and on macOS you can use `traceroute -I www.town.okutama.tokyo.jp` Note that these commands may take a while to complete. If you have trouble with these commands, please let us know on Ed as soon as possible!

3.1 Using the commands above, pass them to a special program called `tee` which lets you redirect output to a file ***and see it on your terminal at the same time!*** *The output of your command should go to a file called `traceroute.txt`. For example:*

```
tracert.exe www.town.okutama.tokyo.jp | tee traceroute.txt
traceroute -I --resolve-hostnames www.town.okutama.tokyo.jp | tee traceroute.txt
traceroute -I www.town.okutama.tokyo.jp | tee traceroute.txt
```

3.2 How many hops did it take to get to the destination server? Put the number into a file `hops.txt`, or write "the traceroute didn't complete" if it wasn't able to find the destination within 64 hops.

3.3 Which hop number do you think was the last hop inside Stanford's campus? Put the number in `last_stanford_hop.txt`

3.4 Which hop do you think is the first server you see that's located in Japan (if any)? Place your answer and justification in `jump.txt`

Part III: Running a Small Server (1 point)

In Lecture 7: Introduction to Computer Networking, we learned all about how information travels from one computer to another. In this part of the assignment, you'll get some practice running your own development server over the network. Make sure to install the software for Lecture 7!

⚠️ Note that this part of the assignment will expose parts of your computer to the internet. Please ensure that you follow the commands below in a **new, empty directory** to avoid exposing unwanted or private information. ⚠️

[1] This is for the `inetutils-traceroute` package , which is the version listed on the software page. There's a few different programs named `traceroute`, so make sure you're using the right one!

In a **new directory**, create a new file called `sunet.txt` that contains your SUNet ID (the part before your email!):

```
Unset
mkdir my_server_directory
cd my_server_directory
echo "Your SUNet Here" > sunet.txt
```

Then, you'll want to start your server. First, open a Python server as before:

```
Unset
python3 -m http.server --bind localhost 8080 &
```

We want to also publish the server to the internet using `ngrok`; the `&` at the end of the command above instructs the shell to **immediately place your server into the background** without needing to suspend it first. Neat!

Finally, let's publish it on `ngrok`. Make sure to install it first and follow the instructions to set up your account!

```
Unset
ngrok config add-authtoken <your authtoken here>

ngrok http 8080
```

Open up a new terminal window to create a file called `server_url.txt` and copy/paste the URL that ngrok gives you into the file. Then, submit it to Gradescope (keeping your computer open, localtunnel running, and Python HTTP server running)–our autograder will connect to your server and verify that your `sunet.txt` file matches your SUNet in Gradescope.

If you need to resubmit your assignment, make sure the server is running and the URL in `server_url.txt` is up-to-date—otherwise our autograder won't be able to connect to your computer.

Feedback Survey (0.5 points)

Once you have completed the assignment, you can earn an additional 0.5 points by completing our anonymous feedback survey. Given this is the first offering of the course, we want to collect as much feedback as possible to improve the course in the future. You can complete the survey here. Once you complete the survey, you will receive a completion code which you should place in a text

file named `survey.txt`. The survey is anonymous so submitting the completion code is the only way to verify that you completed the survey. *Please do not share this code with anyone, as that would constitute a breach of the honor code.*

Submitting Your Assignment

Once you have finished this assignment, you will need to upload your files to Gradescope. Make sure to upload all files to the Assignment 3 submission page. You should also upload `survey.txt` if you completed the survey.

You can submit all necessary files by running the following command, replacing `<CONFIG_FILE>` with the configuration file for your shell.

```
Unset
# Run this command in your assignment directory:
zip -jv assign3_submission.zip ./server_url.txt ./survey.txt
./interfaces.txt ./wifi_interface.txt ./local_ip.txt ./routes.txt
./default_route.txt ./traceroute.txt ./hops.txt ./last_stanford_hop.txt
./jump.txt ~/<CONFIG_FILE>
```

Once you have created a zip file, you can upload it to Gradescope. Make sure your server is running and available at the URL specified in the `server_url.txt` file while the autograder is running.

All files must have the same name as specified above.