

Homework 4

Editors

Solutions

Submission Instructions

Submit this assignment on [Gradescope](#). You may find the free online tool [PDFescape](#) helpful to edit and fill out this PDF. You may also print, handwrite, and scan this assignment.

Optional Readings

Interrupting Developers and Makers vs Managers

In lecture we spent a little time talking about the mental model of programmers. As computer science grows, there is a growing body of research and wisdom in how to maximize the efficacy of individual programmers. One of the key revelations is that programming is a creative process. It requires time to “page in” what you are working on. As a result, even small interruptions (read: text messages) can be far more costly than you may realize.

<http://thetomorrowlab.com/2015/01/why-developers-hate-being-interrupted/>
Why developers hate being interrupted, by Derek Johnson at The Tomorrow Lab.

<http://www.paulgraham.com/makersschedule.html>
Maker’s Schedule, Manager’s Schedule, by Paul Graham, co-founder of Y Combinator.

Once you are in a job environment and meetings become a regular thing, one of the best tricks I learned is to schedule a few 4-hour meetings with yourself throughout the week. It both prevents others from interrupting you (your calendar shows you as busy) and lets you mentally prepare for a good, reliable work session. (A similar alternative, some find [pomodoro](#) helpful)

Software Engineering in the Real World

<http://blogs.msdn.com/b/peterhal/archive/2006/01/04/509302.aspx>
What Do Programmers Really Do Anyway?, by Peter Hallam, then-Microsoft Developer

Why is 5 times more time spent modifying code than writing new code? The answer is that new code becomes old code almost instantly. Write some new code. Go for coffee. All of sudden you’ve got old code.

This post gives a nice perspective on what enterprise software engineering is really like. School projects are misleading. Rarely in life will you be faced with a spec and a blank text file. Far more often you are building on or improving something that came before you and will exist long after you.

<http://www.joelonsoftware.com/articles/fog0000000069.html>
Things You Should Never Do, Part I, by Joel Spolsky

It’s harder to read code than to write it.

Building on the previous, rarely in life are you handed a spec and a blank text file, often in life you are handed a spec and a pile of (seemingly) spaghetti code that does at least some of it. This article discusses the hidden value of the built-up institutional knowledge and the high value of working code.

When was the last time you saw a hunt-and-peck pianist? -Jeff Atwood, co-founder of Stack Overflow and Discourse.
Some extras on the [value of being a good typist](#) and [ditching the mouse for the keyboard](#).

1 Trying out some of the fancy features

People often complain about how difficult the simple things are using text-based text editors. Indeed, Notepad (or TextEdit) make changing some text and saving a file very easy. In this question we explore some of the things that Notepad (and nano, and gedit, and Microsoft Word...) cannot do.

I encourage you to play around with things as you work through this question. The intent is to expose you to features you may not have been aware of along with some context for why they are useful.

There are many things to try here. **For credit on this question, you only need to choose any 5.** That said, I encourage you to try all of these.

For this question, you may choose vim or Emacs, whichever you are more comfortable with.

I'll present solutions in blue for vim, and in red for Emacs.

To start, grab copies of two files full of code:

```
# Examples from http://web.mst.edu/~price/cs53/code_example.html
wget http://web.mst.edu/~price/cs53/fs11/workDecider.cpp
wget http://web.mst.edu/~price/cs53/KatsBadcode.cpp
```

1. Sometimes you will come across some ugly code. Your editor can help make it better. Open `KatsBadcode.cpp`. Among other issues, the really bad tabbing makes this hard to read.

Describe how to automatically fix the whitespace for the whole file.

```
gg=G (gg-go to top of file, = re-indent from here to, G-the end of the file)
C-x h <tab> or C-x h C-M-\ and as a courtesy to your collaborators,
give M-x delete-trailing-whitespace a go
```

2. Editing one file is nice, but often it's really useful to compare files side-by-side (source and headers, spec and implementation).

Describe the command sequence to create another window side-by-side with your current window, switch to it, and then open a file in that window.

```
:split [filename] (or :vsplit), Ctrl-W + (W or arrow)
C-x 4 f <filename> or more manually C-x 3 (or C-x 2), C-x o, C-x C-f <filename>
```

Try playing around with these two views, copy/paste code between them, bind them so they scroll together, resize them, add more splits.

3. Editors also have pretty nice integration with compilation tools. With `KatsBadcode.cpp` open, try typing `:make KatsBadcode` in vim or `M-x compile<enter>make KatsBadcode` in Emacs.¹

First cool thing that happened: Yes, you can run `make` *without* any Makefile anywhere. We'll cover how that happened during build-system week.

Building `KatsBadcode.cpp` will fail with several errors.

Describe how to navigate between compilation errors automatically.

```
:cn, :cp
C-x `, M-g p or M-x next-error, M-x previous-error
```

4. While C-style languages support `/* block comments */`, others such as Python have no block comments and require you to put a `#` at the beginning of every line.

Describe how to efficiently comment out a large block of Python code.

```
Ctrl-v, highlight range, Shift-i, #, Escape
C-space, highlight range, M-;
```

¹ Descriptions of Emacs commands are usually written as `C-c` or `M-x`, which mean "Ctrl+C" or "Meta+x" respectively. Meta is often mapped to the escape and/or alt key, `M-x` means press Escape and then `x` or hold alt and press `x`.

5. (This one is actually about the terminal emulator): The normal keyboard shortcuts to copy/paste are Ctrl-C and Ctrl-V. These do not work in the terminal, however.

Explain what Ctrl-C does in a terminal.

In a terminal, Ctrl-C sends the signal SIGKILL to the foreground process (whoa, wordy!).

Breaking that down, normally when you write programs, your program asks the operating system for input events. If a user types "hello", your program doesn't see it until it calls `cin` (on the flip side, if your program calls `cin` before the operating system has anything to send it (before the user has typed anything), then your program is put to sleep by the operating system until there is data available).

Sometimes, however, the operating system needs to send an *asynchronous* message to your program, that is it needs to send a message that your program didn't ask for. In unix, *signals* are the mechanism that deliver these messages. One such asynchronous message is the kill signal (SIGKILL), which is usually understood to mean that the user wants your program to exit. If your program does not implement a *signal handler* (special function) and register it to catch SIGKILL, then the operating system will kill your program automatically (this is why Ctrl-C will kill the programs you write).

Many programs will install handlers, however, to *catch* the signal and do something different with it. For example, try hitting Ctrl-C when running vim, what happens? Ctrl-Z also sends a signal, SIGSTOP. This signal is special in that it *cannot be caught*. When a program receives a SIGSTOP signal, it is immediately suspended. This can be a useful way to bail out of a program (such as ed) that Ctrl-C isn't killing and you can't figure out how to stop. Note the program is **not** dead (yet), but you can kill a stopped program to remove it completely.

Describe how to copy/paste using the keyboard in a terminal.

Ctrl-Shift-C and Ctrl-Shift-V

6. The default cut/copy/paste(/put/yank/kill) operations do not put text in the system clipboard (that is you cannot copy/paste into/from other applications). **Describe how to copy/paste a region of text to/from the system clipboard using your text editor.**

Use "+" to select the system clipboard register (+), that is "+yy to copy the current line, or "+p to paste

A freebie because it basically works already, Copy M-w, Paste C-y - however, I couldn't find an obvious way to make it work in -nw mode, which could cause issues if something spawns emacs without a window.

7. Many times you have a repetitive task that you need to do say 10 or 20 times. It's too short to justify writing a script or anything fancy, but it's annoying to type the same thing over and over again. As example, reformatting the staff list to a nice JSON object:

```

                                staff = [
Pannuto,Pat                      {"first": "Pat", "last": "Pannuto"},
Darden,Marcus                    {"first": "Marcus", "last": "Darden"},
Terwilliger,Matt                 {"first": "Matt", "last": "Terwilliger"},
Chojnacki,Alex                   {"first": "Alex", "last": "Chojnacki"},
                                ]

```

Editors support the record and reply of *macros*. With macros, you can start recording, puzzle out how to turn one line into the other, and then simply replay it for the rest. As a general rule, do not bother trying to be optimal or efficient, just find anything that works. Try starting with the column on the left and devising a macro to turn it into the column on the right.

Describe how to record and replay a macro. (you do not need to include the contents of your macro)

qq, <commands>, q (to stop recording), @q to replay (note the second q is a register, so you could also do qa and @a)

(my macro): yyps^M^[i{"first": ^[A,^[kddpkJli"last": ^[A]^[0f:lli"^[wwi"^[f:lli"^[\${i"^[kJ0j

C-x (, <commands>, C-x) , C-x e to replay

(my macro): <tab> "first" <space> C-right C-f C-space C-right
C-w C-left " C-y ", <space> "last": <space> " C-right "

8. Similar to how `~/ .bashrc` configures your shell, a `~/ .vimrc` or `~/ .emacs` file² can configure how your editor behaves. Here are some excerpts from the staff's configuration files:

```
.vimrc:
set number      " double-quote means comment in vimscript; this turns on line numbers
map ; :        " this line and the next makes ; act like : so that you don't have to
noremap ;; ;   " hit shift all the time, typing ";" will act as ";" used to

.emacs:
; line numbers - in Emacs, ; means a comment
(global-linum-mode t)
(setq linum-format "%d ")
; Changes all yes/no questions to y/n type
(fset 'yes-or-no-p 'y-or-n-p)
```

Add something useful not listed above to your editor's configuration file. Describe what you added and why.

```
" Show whitespace characters
" helps notice bad tabbing and eliminates trailing whitespace characters
set list
set listchars=tab:. ,trail:.

;set return go to newline and indent
(global-set-key (kbd "RET") 'newline-and-indent)

; m-x compile scrolls automatically
(setq compilation-scroll-output 'first-error)

; show trailing whitespace
(setq-default show-trailing-whitespace t)
; delete trailing whitespace on save
(add-hook 'before-save-hook 'delete-trailing-whitespace)

; enable better package manager
(require 'package)
(add-to-list 'package-archives
'("marmalade" . "http://marmalade-repo.org/packages/"))
(add-to-list 'package-archives
'("melpa" . "http://melpa.org/packages/") t)
(package-initialize)
; M-x install-package or M-x package-list-packages
```

9. Some final little things

- (a) Editors understand balanced `()`'s and `{}`'s. Describe how to jump from one token to its match, such as from the opening `{` on line 29 of `KatsBadcode` to its partner `}` on line 58.

Simply type `%`

`C-M-right`, `C-M-left`

- (b) Now imagine if you are editing code and you determine you can remove an `if` block, for example removing the `if` on line 28 of `KatsBadcode` and running its body unconditionally. You need to fix the indentation level of all 20 lines of the body.

Describe how to change the indentation level of a block of code.

Select the region (`Shift-V`), hit `<` (or `3<` for three in, etc)

`C-u - 20 C-x <tab>`

² These files do not exist by default, you have to create them.

- (c) Sometimes it's useful to run quick little commands. For example, your code needs to read from a file, but you can't remember if it's called `sample_data.txt` or `sampleData.txt`.
Describe how to run 'ls' directly from within your editor.

```
:!ls
```

```
M-! ls or M-x shell-command
```

2 Remote work

One thing that can make life very convenient is learning how to work on remote machines. CAEN has a large number of machines available for students to use remotely, at login.engin.umich.edu. Let's check that out.

ssh is the **secure shell** program, and is used to securely log in to remote machines.

Run `ssh login.engin.umich.edu` to log into a CAEN machine. Take a look around, this is the same login environment and home directory as if you had sat down at a physical CAEN machine.

Use `vim` or `emacs` to create a file called `test.txt` on CAEN. Put some text in it, save, and quit.

Now try to run `gedit test.txt`.

What error do you get? Why?

```
** (gedit:30002): WARNING **: Could not open X display
```

```
(gedit:30002): Gtk-WARNING **: cannot open display:
```

Graphical applications in Linux connect to a *display server* called **X11**, commonly just called **X**. It's X that is responsible for hosting a *window manager*, which is thing that lets a bunch of application windows all share the same screen.

Because the machine you've logged into doesn't have a screen, there is no display server running, so `gedit` has nowhere to render itself, hence this error.

One really cool thing about how X is designed: unlike OS X or Windows, programs that are running on one physical machine can display their window on a different physical machine, this is called X forwarding.

Close your ssh session (log out of the terminal, either by typing `exit` or pressing `Ctrl-d` at an empty prompt). Then log in again with the additional `-X` flag to ssh: `ssh -X login.engin.umich.edu`.

Now try running `gedit test.txt` – great! Only, now you cannot do anything else in that terminal.

How can you keep using this terminal without killing the gedit session that is already running?

How should you launch gedit so that you can still use the terminal?

(Hint: remember we talked about shell job control a few weeks ago)

You can keep using `gedit` by suspending it by pressing `Ctrl-z` and then backgrounding it by running `bg`.

You can run `gedit` in the background when you first start it up by adding an ampersand to the end of the command, like this:

```
gedit &
```

These job control features are part of `bash`, though most shells include similar if not identical commands.

Try running a more graphically intensive program, such as the `eclipse` IDE or `matlab`. How does it compare to sitting at a physical CAEN machine? How does it compare to using VNC to log into CAEN? (And how good is your Internet connection right now ;) ?)

You may also find the **secure copy** program, `scp`, useful for moving files between your machine and the remote machine. Assuming you have the file 'test.txt' on your local machine,

```
scp test.txt login.engin.umich.edu:
```

will copy the file to CAEN. Note the trailing colon, this is what tells `scp` to copy to a remote machine.

You can also specify a path on one or both machines. Assuming that you have the folder 'inhomeoncaen' on your CAEN account and 'local' in the current directory of your machine,

```
scp login.engin.umich.edu:inhomeoncaen/test.txt local/
```

will the file `test.txt` from CAEN to your machine.

scp operates just like cp, that is, you have to pass the `-r` flag if you want to copy a directory, such as

```
scp -r project1 login.engin.umich.edu:classes/eecs280/
```

(There's no question on scp, just a tool for you to play with)