Programming: The Next Step

Presentations

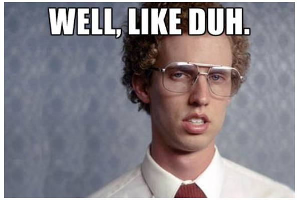
3 minutes, brief feedback afterwards

Feedback focus

- is the topic clear?
- are the user/software perspective thought through well enough to start coding?
- is the project manageable, well-focused?
- are there unforeseen obstacles?
- can you think of more efficient design choices?
- (are the possible extensions worthwhile?)

Beneficial feedback

- ask questions for clarification
- give constructive / encouraging feedback
- keep it personal ("I think the project could benefit…, because I feel that…")
- try to make it very specific
- compliments on great ideas are helpful too



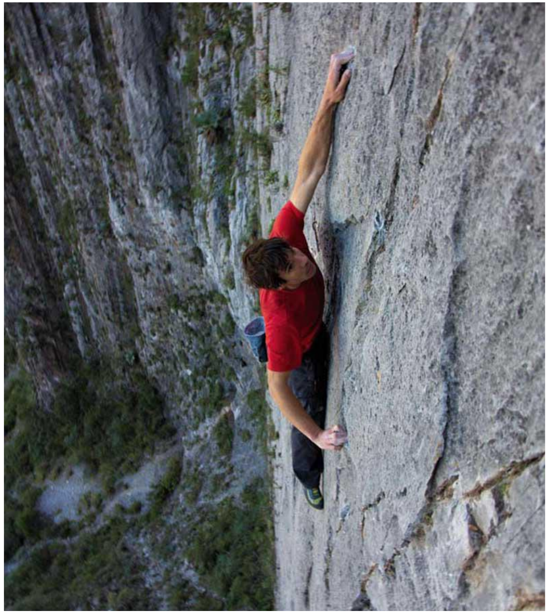
Today

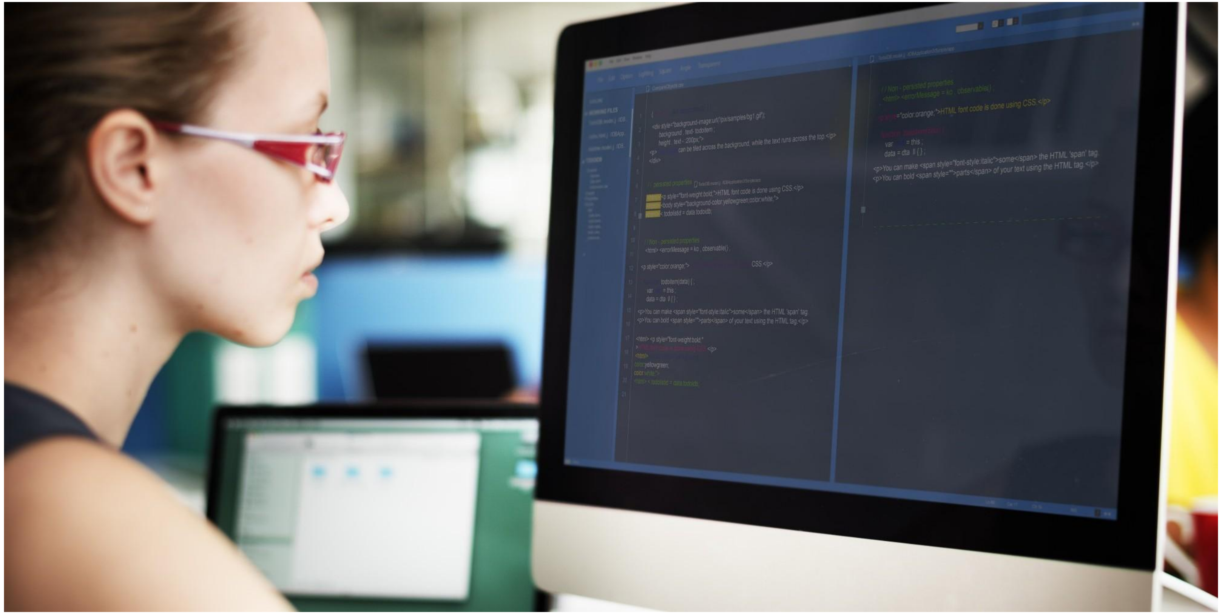
Programming Superpowers

1. Independence
2. Coding style
3. Documentation
4. Version control
5. Testing
6. Having fun

(today, maybe next week)

~~Independence~~ Free Solo





https://youtu.be/Phl82D57P58

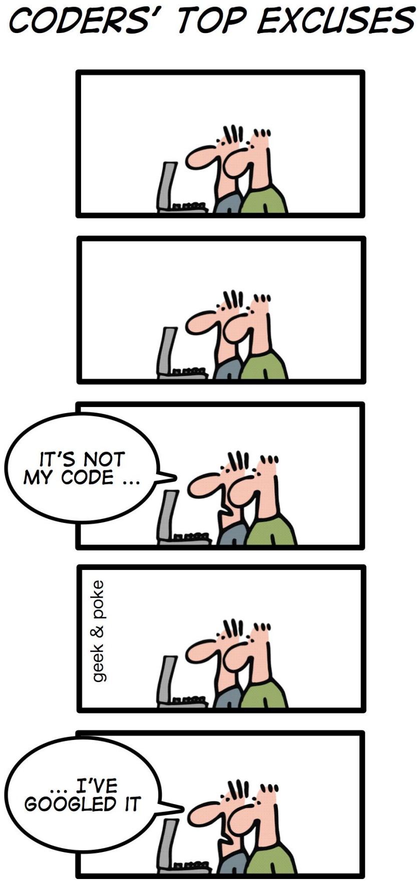
Independence

Resources / documentation

- R: ?*package*; vignette("*package*")
- Python: documentation (2 vs 3)
- Presentation: help resources

Search

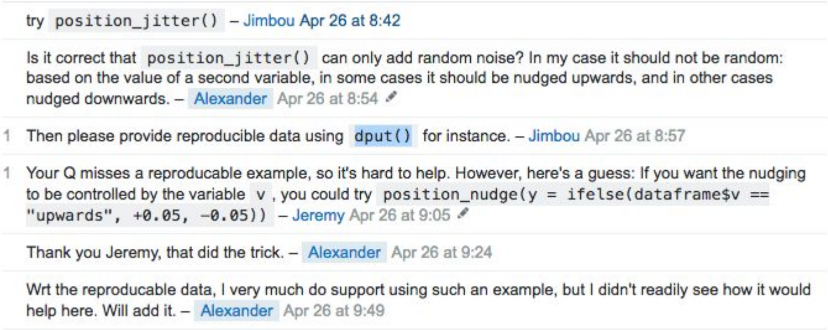
- How to Google effectively (!)
- Stack Overflow
  - [*tag*]: [r][python][python-2.7][python-3.*x*][*package*]
  - *-exclude*
  - “*exact phrase*”



Independence

Ask

- your peers
- stackoverflow for most languages (read tips in link)
- neurobs for presentation
- provide a reproducible example (e.g., reprex)
- 2 hours supervision



try `position_jitter()` – Jimbou Apr 26 at 8:42

Is it correct that `position_jitter()` can only add random noise? In my case it should not be random: based on the value of a second variable, in some cases it should be nudged upwards, and in other cases nudged downwards. – Alexander Apr 26 at 8:54

1 Then please provide reproducible data using `dput()` for instance. – Jimbou Apr 26 at 8:57

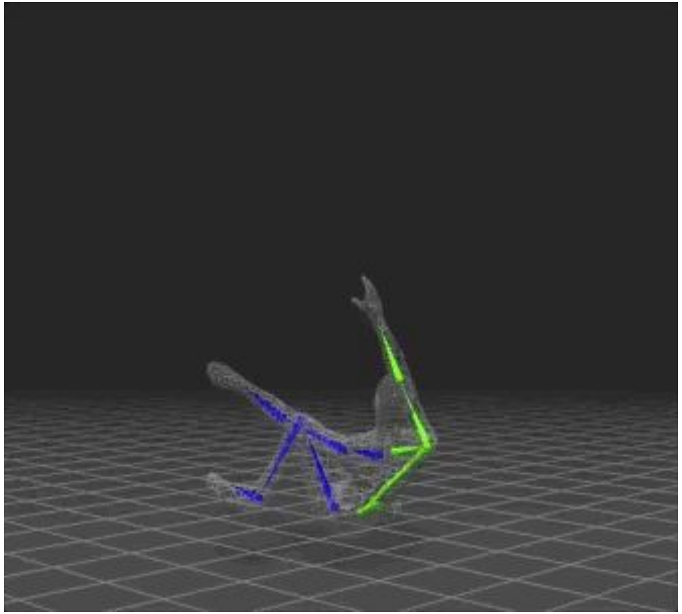
1 Your Q misses a reproducable example, so it's hard to help. However, here's a guess: If you want the nudging to be controlled by the variable `v`, you could try `position_nudge(y = ifelse(dataframe$v == "upwards", +0.05, -0.05))` – Jeremy Apr 26 at 9:05

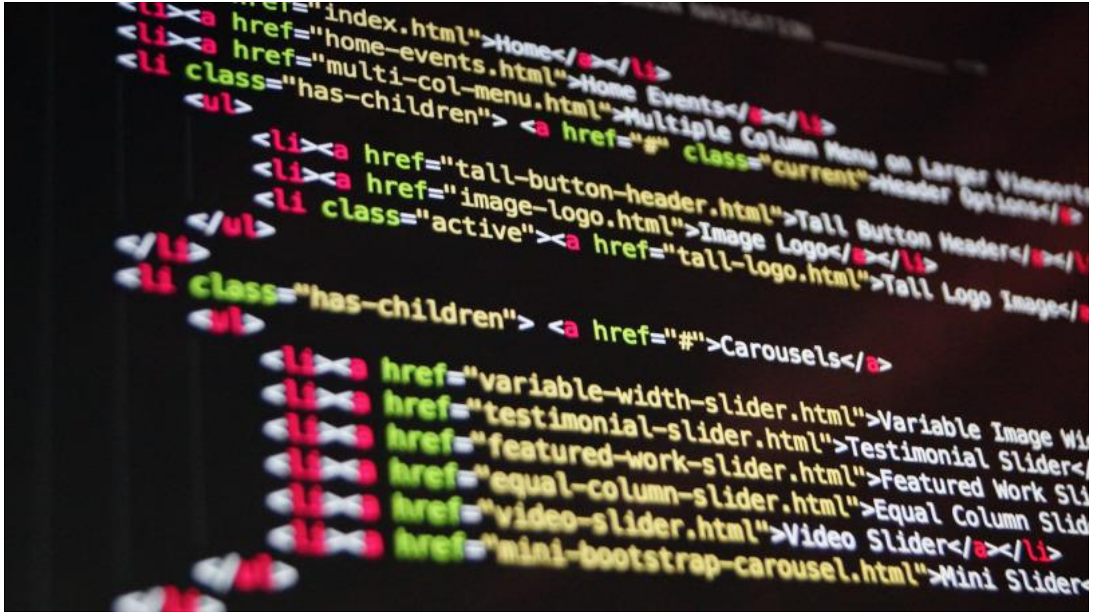
Thank you Jeremy, that did the trick. – Alexander Apr 26 at 9:24

Wrt the reproducable data, I very much do support using such an example, but I didn't readily see how it would help here. Will add it. – Alexander Apr 26 at 9:49

Take-away: (1) research your question (2) make it specific (3) most problems have been solved before: find and learn (4) if not: make sure others will learn from it

~~Coding Style~~ Efficiency



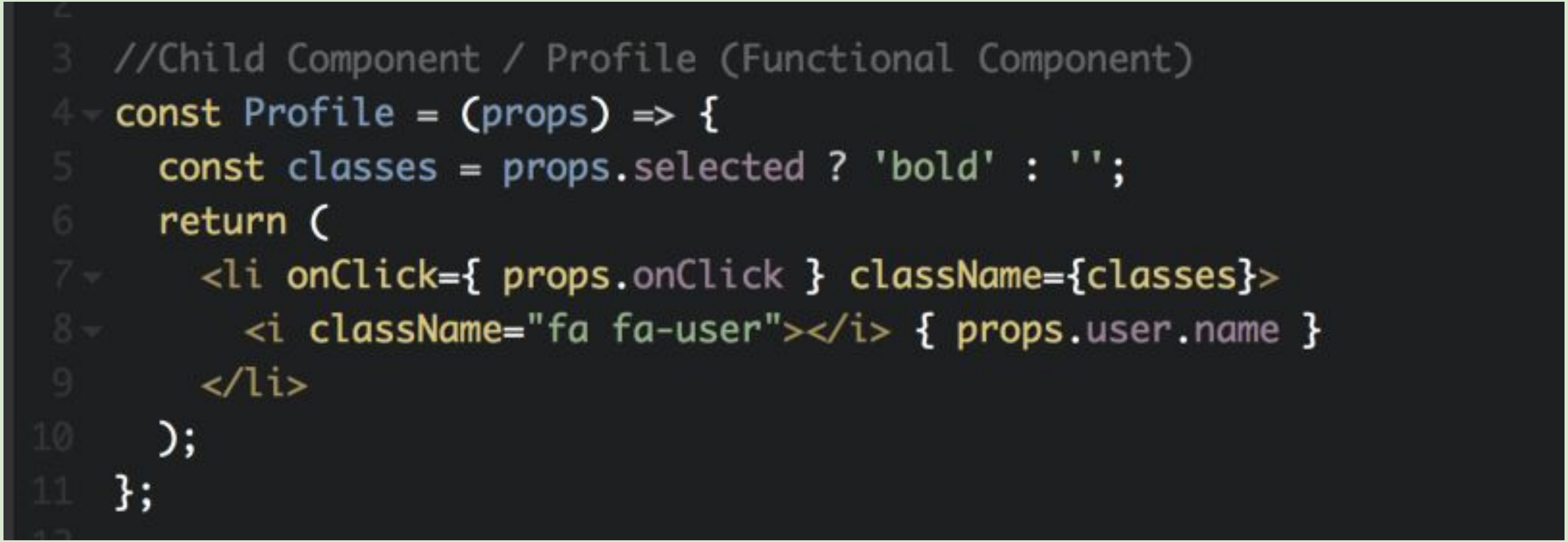


```
<li><a href="index.html">Home</a></li>
<li><a href="home-events.html">Home Events</a></li>
<li><a href="multi-col-menu.html">Multiple Column Menu on Larger Viewport
<li class="has-children"> <a href="#" class="current">Header Options</a>
  <ul>
    <li><a href="tall-button-header.html">Tall Button Header</a></li>
    <li><a href="image-logo.html">Image Logo</a></li>
    <li class="active"><a href="tall-logo.html">Tall Logo Image</a
  </ul>
</li>
<li class="has-children"> <a href="#">Carousels</a>
  <ul>
    <li><a href="variable-width-slider.html">Variable Image Wi
    <li><a href="testimonial-slider.html">Testimonial Slider</
    <li><a href="featured-work-slider.html">Featured Work Sli
    <li><a href="equal-column-slider.html">Equal Column Slid
    <li><a href="video-slider.html">Video Slider</a></li>
    <li><a href="mini-bootstrap-carousel.html">Mini Slider
  </ul>
```

Coding Style

```
~]?=)"+K+"*(?:'((?:\\\\.|[^\\\\'])*)'|\"((?:\\\\.|[^\\\\\"])*)\"|("+L+"))|)"+K+"*\\]",N=":("+L+")(?:\\((('((?:\\\\.|[^\\\\'])*)'|\"((?:\\\\.|[^\\\\\"])*)\")|((?:\\\\.|[^\\\\()[\\]]|"+M
+")*)|.*)\\)|)",O=new RegExp(K+"+","g"),P=new RegExp("^"+K+"+|((?:^|[^\\\\])(?:\\\\.)*)"+K+"+$","g"),Q=new RegExp("^"+K+"*,"+K+"*"),R=new RegExp("^"+K+"*([>+~]|"+K+")"+K+"*"),S=new
RegExp("="+K+"*([^\\]'\"]*?)"+K+"*\\]","g"),T=new RegExp(N),U=new RegExp("^"+L+"$"),V={ID:new RegExp("^#("+L+")"),CLASS:new RegExp("^\\.("+L+")"),TAG:new RegExp("^("+L+"|
[*])"),ATTR:new RegExp("^"+M),PSEUDO:new RegExp("^"+N),CHILD:new RegExp("^:(only|first|last|nth|nth-last)-(child|of-type)(?:\\("+K+"*(even|odd|(([+-]|)(\\d*)n|)"+K+"*(?:([+-]|)"+K+"*(\
\d+)|))"+K+"*\\)|)","i"),bool:new RegExp("^(?:"+J+")$","i"),needsContext:new RegExp("^"+K+"*[>+~]|:(even|odd|eq|gt|lt|nth|first|last)(?:\\("+K+"*((?:-\\d)?\\d*)"+K+"*\\)|)(?=[^-]|
$)","i")},W=/^(?:input|select|textarea|button)$/i,X=/^h\d$/i,Y=/^[^{]+\{\s*\[native \w/,Z=/^(?:#([\w-]+)|(\w+)|\.([\w-]+))$/,$=/[+~]/,_=new RegExp("\\\\([\\da-f]{1,6}"+K+"?|("+K
+")|.)","ig"),aa=function(a,b,c){var d="0x"+b-65536;return d!==d||c?b:d<0?String.fromCharCode(d+65536):String.fromCharCode(d>>10|55296,1023&d|56320)},ba=/([\0-\x1f\x7f]|^-?\d)|^-$|[^
\0-\x1f\x7f-\uFFFF\w-]/g,ca=function(a,b){return b?"\0"===a?"\ufffd":a.slice(0,-1)+"\\"+a.charCodeAt(a.length-1).toString(16)+" ":"\\"+a},da=function(){m()},ea=ta(function(a){return
a.disabled===!0&&("form"in a||"label"in a)},{dir:"parentNode",next:"legend"});try{G.apply(D=H.call(v.childNodes),v.childNodes),D[v.childNodes.length].nodeType}catch(fa)
{G={apply:D.length?function(a,b){F.apply(a,H.call(b))}:function(a,b){var c=a.length,d=0;while(a[c++]=b[d++]);a.length=c-1}}}function ga(a,b,d,e){var
f,h,j,k,l,o,r,s=b&&b.ownerDocument,w=b?b.nodeType:9;if(d=d||[],"string"!=typeof a||!a||1!==w&&9!==w&&11!==w)return d;if(!e&&((b?b.ownerDocument||b:v)!==n&&m(b),b=b||n,p)){if(11!
==w&&(l=Z.exec(a)))if(f=l[1]){if(9===w){if(!(j=b.getElementById(f)))return d;if(j.id===f)return d.push(j),d}else if(s&&(j=s.getElementById(f))&&t(b,j)&&j.id===f)return d.push(j),d}
else{if(l[2])return G.apply(d,b.getElementsByTagName(a)),d;if((f=l[3])&&c.getElementsByClassName&&b.getElementsByClassName)return G.apply(d,b.getElementsByClassName(f)),d}if(c.qsa&&!
A[a+" "]&&(!q||!q.test(a))){if(1!==w)s=b,r=a;else if("object"!==b.nodeName.toLowerCase()){(k=b.getAttribute("id"))?
k=k.replace(ba,ca):b.setAttribute("id",k=u),o=g(a),h=o.length;while(h--)o[h]="#"+k+" "+sa(o[h]);r=o.join(","),s=$.test(a)&&qa(b.parentNode)||b}if(r)try{return
G.apply(d,s.querySelectorAll(r)),d}catch(x){}finally{k===u&&b.removeAttribute("id")}}}return i(a.replace(P,"$1"),b,d,e)}function ha(){var a=[];function b(c,e){return a.push(c+"
")>d.cacheLength&&delete b[a.shift()],b[c+" "]=e}return b}function ia(a){return a[u]=!0,a}function ja(a){var b=n.createElement("fieldset");try{return!!a(b)}catch(c){return!1}
finally{b.parentNode&&b.parentNode.removeChild(b),b=null}}function ka(a,b){var c=a.split("|"),e=c.length;while(e--)d.attrHandle[c[e]]=b}function la(a,b){var
c=b&&a,d=c&&1===a.nodeType&&1===b.nodeType&&a.sourceIndex-b.sourceIndex;if(d)return d;if(c)while(c=c.nextSibling)if(c===b)return-1;return a?1:-1}function ma(a){return function(b){var
c=b.nodeName.toLowerCase();return"input"===c&&b.type===a}}function na(a){return function(b){var c=b.nodeName.toLowerCase();return("input"===c||"button"===c)&&b.type===a}}function oa(a)
{return function(b){return"form"in b?b.parentNode&&b.disabled===!1?"label"in b?"label"in b.parentNode?b.parentNode.disabled===a:b.disabled===a:b.isDisabled===a||b.isDisabled!==!
a&&ea(b)===a:b.disabled===a:"label"in b&&b.disabled===a}}function pa(a){return ia(function(b){return b=+b,ia(function(c,d){var
e,f=a([],c.length,b),g=f.length;while(g--)c[e=f[g]]&&(c[e]=!(d[e]=c[e]))})})}function qa(a){return a&&"undefined"!=typeof a.getElementsByTagName&&a}
c=ga.support={},f=ga.isXML=function(a){var b=a&&(a.ownerDocument||a).documentElement;return!!b&&"HTML"!==b.nodeName},m=ga.setDocument=function(a){var b,e,g=a?a.ownerDocument||
a:v;return g!==n&&9===g.nodeType&&g.documentElement?(n=g,o=n.documentElement,p=!f(n),v!==n&&(e=n.defaultView)&&e.top!==e&&(e.addEventListener?e.addEventListener("unload",da,!
1):e.attachEvent&&e.attachEvent("onunload",da)),c.attributes=ja(function(a){return a.className="i",!a.getAttribute("className")}),c.getElementsByTagName=ja(function(a){return
a.appendChild(n.createComment("")),!a.getElementsByTagName("*").length}),c.getElementsByClassName=Y.test(n.getElementsByClassName),c.getById=ja(function(a){return
o.appendChild(a).id=u,!n.getElementsByName||!n.getElementsByName(u).length}),c.getById?(d.filter.ID=function(a){var b=a.replace(_,aa);return function(a){return
a.getAttribute("id")===b}},d.find.ID=function(a,b){if("undefined"!=typeof b.getElementById&&p){var c=b.getElementById(a);return c?[c]:[]}}):(d.filter.ID=function(a){var
b=a.replace(_,aa);return function(a){var c="undefined"!=typeof a.getAttributeNode&&a.getAttributeNode("id");return c&&c.value===b}},d.find.ID=function(a,b){if("undefined"!=typeof
b.getElementById&&p){var c,d,e,f=b.getElementById(a);if(f){if(c=f.getAttributeNode("id"),c&&c.value===a)return[f];e=b.getElementsByName(a),d=0;while(f=e[d+
+])if(c=f.getAttributeNode("id"),c&&c.value===a)return[f]}return[]}}),d.find.TAG=c.getElementsByTagName?function(a,b){return"undefined"!=typeof b.getElementsByTagName?
b.getElementsByTagName(a):c.qsa?b.querySelectorAll(a):void 0}:function(a,b){var c,d=[],e=0,f=b.getElementsByTagName(a);if("*"===a){while(c=f[e++])1===c.nodeType&&d.push(c);return d}
return f},d.find.CLASS=c.getElementsByClassName&&function(a,b){if("undefined"!=typeof b.getElementsByClassName&&p)return b.getElementsByClassName(a)},r=[],q=[],
(c.qsa=Y.test(n.querySelectorAll))&&(ja(function(a){o.appendChild(a).innerHTML="<a id='"+u+"'></a><select id='"+u+"-\r\\' msallowcapture=''><option selected=''></option></
select>",a.querySelectorAll("[msallowcapture^='']").length&&q.push("[*^$]="+K+"*(?:''|\"\")"),a.querySelectorAll("[selected]").length||q.push("\\["+K+"*(?:value|"+J
+")"),a.querySelectorAll("[id~="+u+"-]").length||q.push("~="),a.querySelectorAll(":checked").length||q.push(":checked"),a.querySelectorAll("a#"+u+"+*").length||q.push(".#.+
[+~]")}),ja(function(a){a.innerHTML="<a href='' disabled='disabled'></a><select disabled='disabled'><option/></select>";var
b=n.createElement("input");b.setAttribute("type","hidden"),a.appendChild(b).setAttribute("name","D"),a.querySelectorAll("[name=d]").length&&q.push("name"+K+"*[*^$|!~]?="),2!
==a.querySelectorAll(":enabled").length&&q.push(":enabled",":disabled"),o.appendChild(a).disabled=!0,2!
==a.querySelectorAll(":disabled").length&&q.push(":enabled",":disabled"),a.querySelectorAll("*,:x"),q.push(",.*:")})),(c.matchesSelector=Y.test(s=o.matches||o.webkitMatchesSelector||
o.mozMatchesSelector||o.oMatchesSelector||o.msMatchesSelector))&&ja(function(a){c.disconnectedMatch=s.call(a,"*"),s.call(a,"[s!='']:x"),r.push("!=",N)}),q=q.length&&new
RegExp(q.join("|")),r=r.length&&new RegExp(r.join("|")),b=Y.test(o.compareDocumentPosition),t=b||Y.test(o.contains)?function(a,b){var c=9===a.nodeType?
a.documentElement:a,d=b&&b.parentNode;return a===d||!(!d||1!==d.nodeType||!(c.contains?c.contains(d):a.compareDocumentPosition&&16&a.compareDocumentPosition(d)))}:function(a,b)
{if(b)while(b=b.parentNode)if(b===a)return!0;return!1},B=b?function(a,b){if(a===b)return l=!0,0;var d=!a.compareDocumentPosition-!b.compareDocumentPosition;return d?d:
(d=(a.ownerDocument||a)===(b.ownerDocument||b)?a.compareDocumentPosition(b):1,1&d||!c.sortDetached&&b.compareDocumentPosition(a)===d?a===n||a.ownerDocument===v&&t(v,a)?-1:b===n||
b.ownerDocument===v&&t(v,b)?1:k?I(k,a)-I(k,b):0:4&d?-1:1)}:function(a,b){if(a===b)return l=!0,0;var c,d=0,e=a.parentNode,f=b.parentNode,g=[a],h=[b];if(!e||!f)return a===n?-1:b===n?
1:e?-1:f?1:k?I(k,a)-I(k,b):0;if(e===f)return la(a,b);c=a;while(c=c.parentNode)g.unshift(c);c=b;while(c=c.parentNode)h.unshift(c);while(g[d]===h[d])d++;return d?
la(g[d],h[d]):g[d]===v?-1:h[d]===v?1:0},n):n},ga.matches=function(a,b){return ga(a,null,null,b)},ga.matchesSelector=function(a,b){if((a.ownerDocument||a)!
```

Coding Style

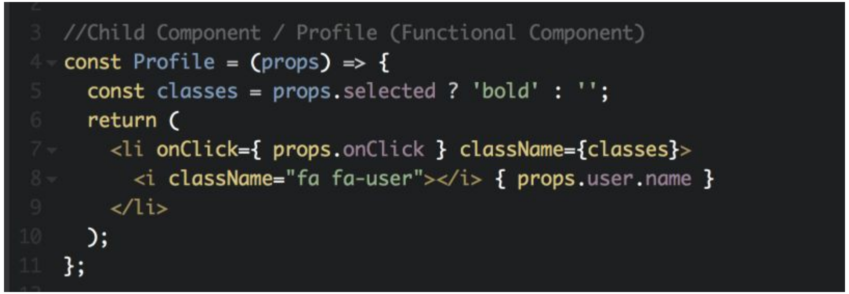


```
//Child Component / Profile (Functional Component)
const Profile = (props) => {
  const classes = props.selected ? 'bold' : '';
  return (
    <li onClick={ props.onClick } className={classes}>
      <i className="fa fa-user"></i> { props.user.name }
    </li>
  );
};
```

Coding Style

Principles

- hierarchy: use tabs to represent internal structure
- modularity & chunking: make reusable code that serves a single purpose
- consistency: choose a style and stick to it
- framing: comment your code



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    </li>
  );
};
```

Reasons

- less mistakes
- easier to spot mistakes
- easier collaboration
- easier for others to help you
- more efficient in the long run
- open science

Coding Style: Style Guides

R

- Hadley Wickham, Google, formatR

NetLogo

- Official style

Python

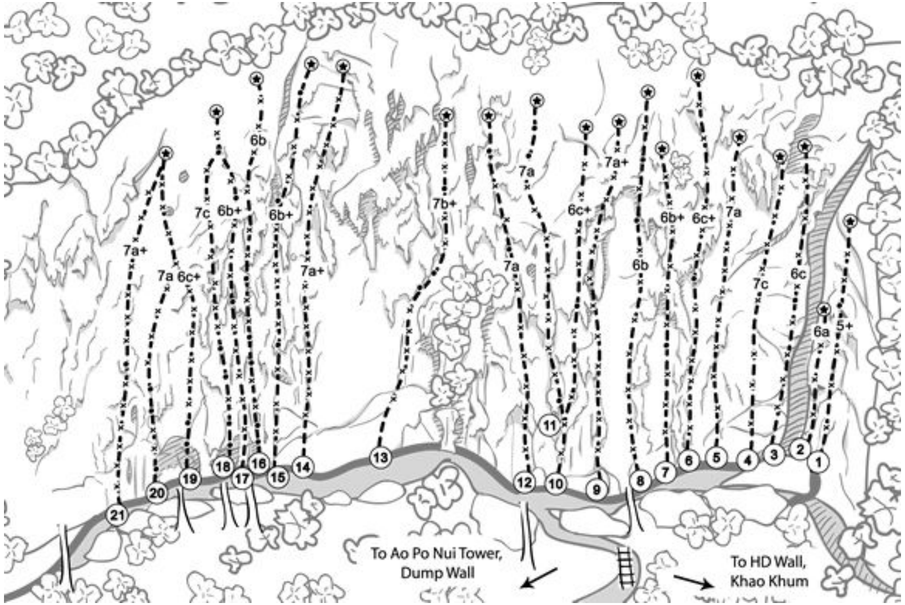
- PEP-8, PEP-8 tutorial

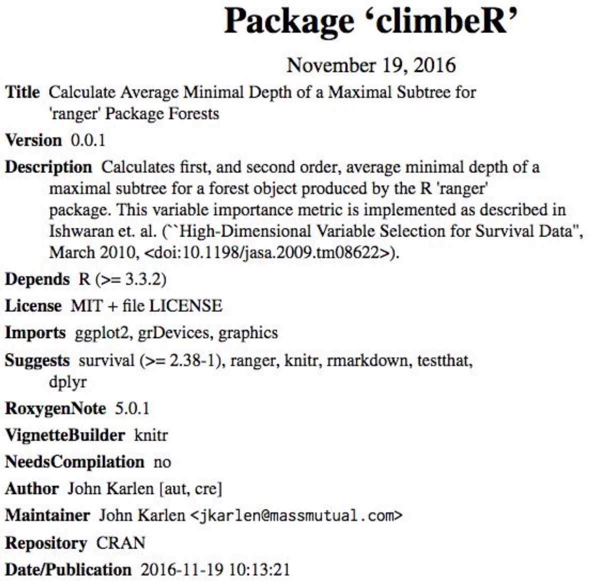
Presentation

- Ask Jasper for tips

Take-away: use a consistent style that matches a preferred style in your language

~~Documentation~~ Topo





Package ‘climbeR’

November 19, 2016

Title Calculate Average Minimal Depth of a Maximal Subtree for 'ranger' Package Forests

Version 0.0.1

Description Calculates first, and second order, average minimal depth of a maximal subtree for a forest object produced by the R 'ranger' package. This variable importance metric is implemented as described in Ishwaran et. al. (``High-Dimensional Variable Selection for Survival Data'', March 2010, <doi:10.1198/jasa.2009.tm08622>).

Depends R (>= 3.3.2)

License MIT + file LICENSE

Imports ggplot2, grDevices, graphics

Suggests survival (>= 2.38-1), ranger, knitr, rmarkdown, testthat, dplyr

RoxygenNote 5.0.1

VignetteBuilder knitr

NeedsCompilation no

Author John Karlen [aut, cre]

Maintainer John Karlen <jkarlen@massmutual.com>

Repository CRAN

Date/Publication 2016-11-19 10:13:21

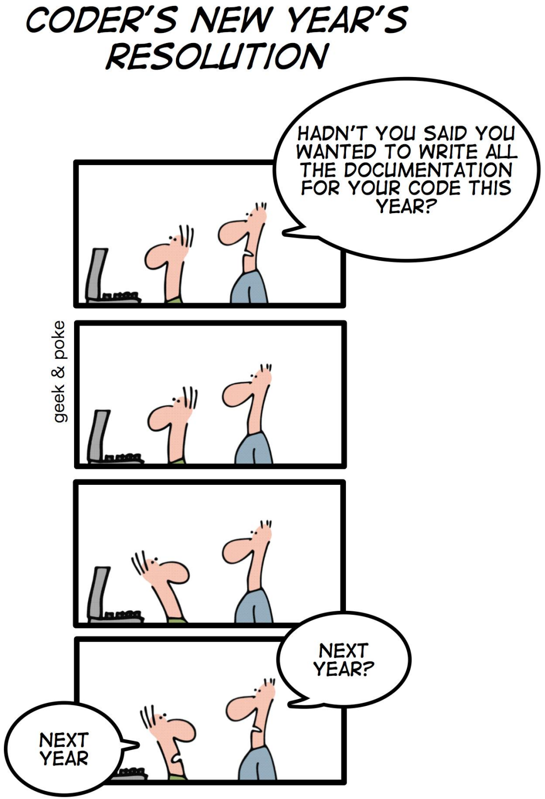
Documentation

Three reasons

Because you forget

Because you want others to use it

Because you forget


CODER'S NEW YEAR'S RESOLUTION
HADN'T YOU SAID YOU WANTED TO WRITE ALL THE DOCUMENTATION FOR YOUR CODE THIS YEAR?
geek & poke
NEXT YEAR?
NEXT YEAR

Documentation (code-intensive)

Commenting

r

# python

# presentation

; netlogo

Literate computing

R Notebook (R)

Jupyter Notebook (over 40 languages)

Take-away: comment your code extensively

Documentation (text-intensive)

Literate programming

R vignette: try *vignette("dplyr")*

(more on literate programming and computing)

Manual

R documentation

Python documentation

Look through some manuals

And you can build a website...

Take-away: (1) be aware of different ways to document your code, and the different goals of documentation (2) imitate the documentation style that is preferred in your language

Version Control

Reasons

Document the *changes*

(Re)store versions

Compare versions

Automatic backup

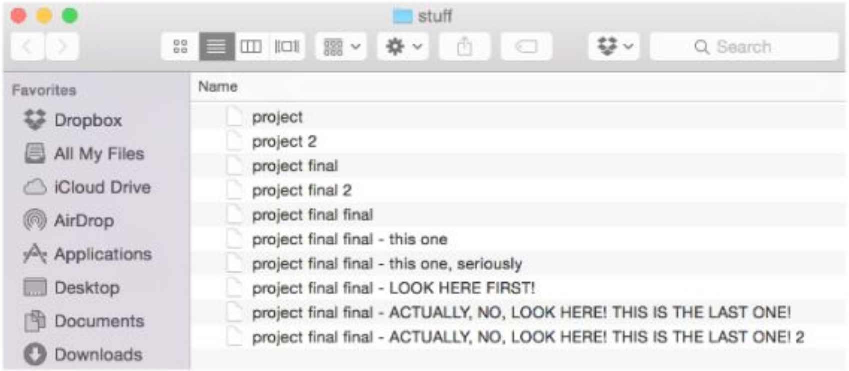
Collaboration

GitHub

Online service for Git (version control software)

Many additional features

Let’s check it out

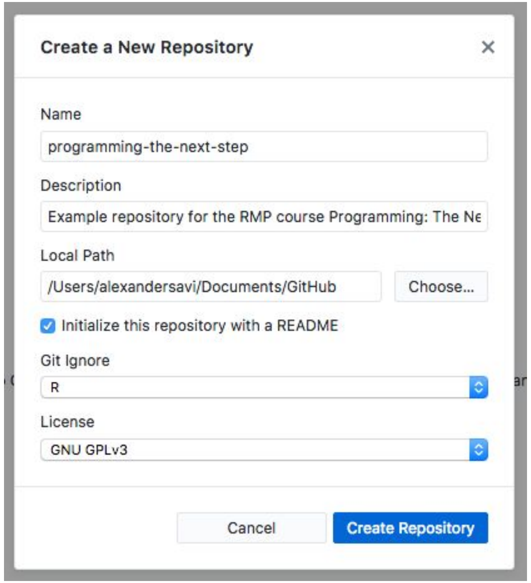


project
project 2
project final
project final 2
project final final
project final final - this one
project final final - this one, seriously
project final final - LOOK HERE FIRST!
project final final - ACTUALLY, NO, LOOK HERE! THIS IS THE LAST ONE!
project final final - ACTUALLY, NO, LOOK HERE! THIS IS THE LAST ONE! 2

DOGHOUSEDIARIES

Version Control: GitHub Desktop

Create repository



Create a New Repository

Name

programming-the-next-step

Description

Example repository for the RMP course Programming: The Ne

Local Path

/Users/alexandersavi/Documents/GitHub

☑ Initialize this repository with a README

Git Ignore

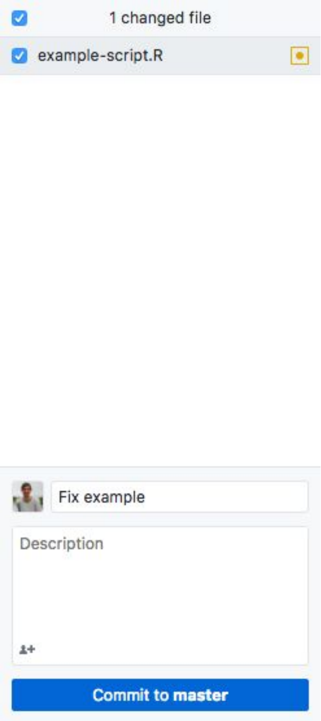
R

License

GNU GPLv3

What is Git Ignore?

Commit



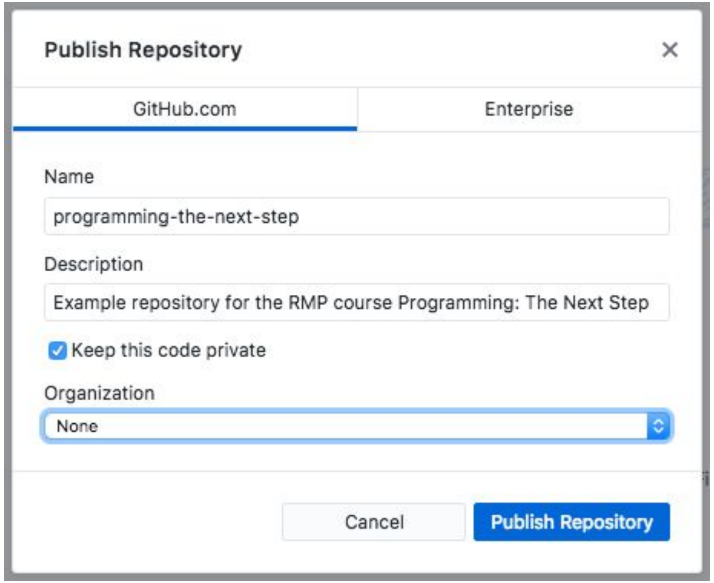
☑ 1 changed file

☑ example-script.R

Fix example

Description

Publish



Publish Repository

Name

programming-the-next-step

Description

Example repository for the RMP course Programming: The Next Step

☑ Keep this code private

Organization

None

Version Control: Become a Pro

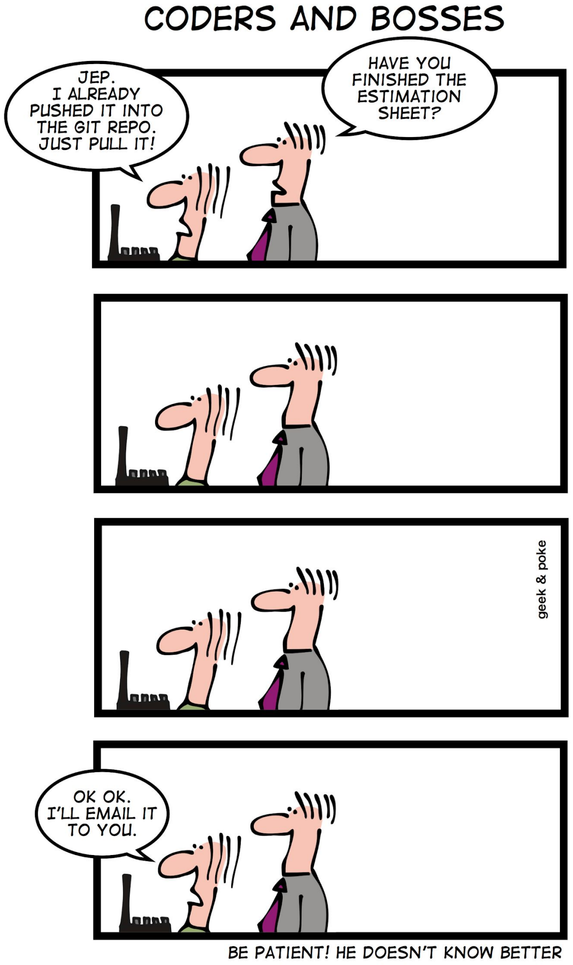
Git

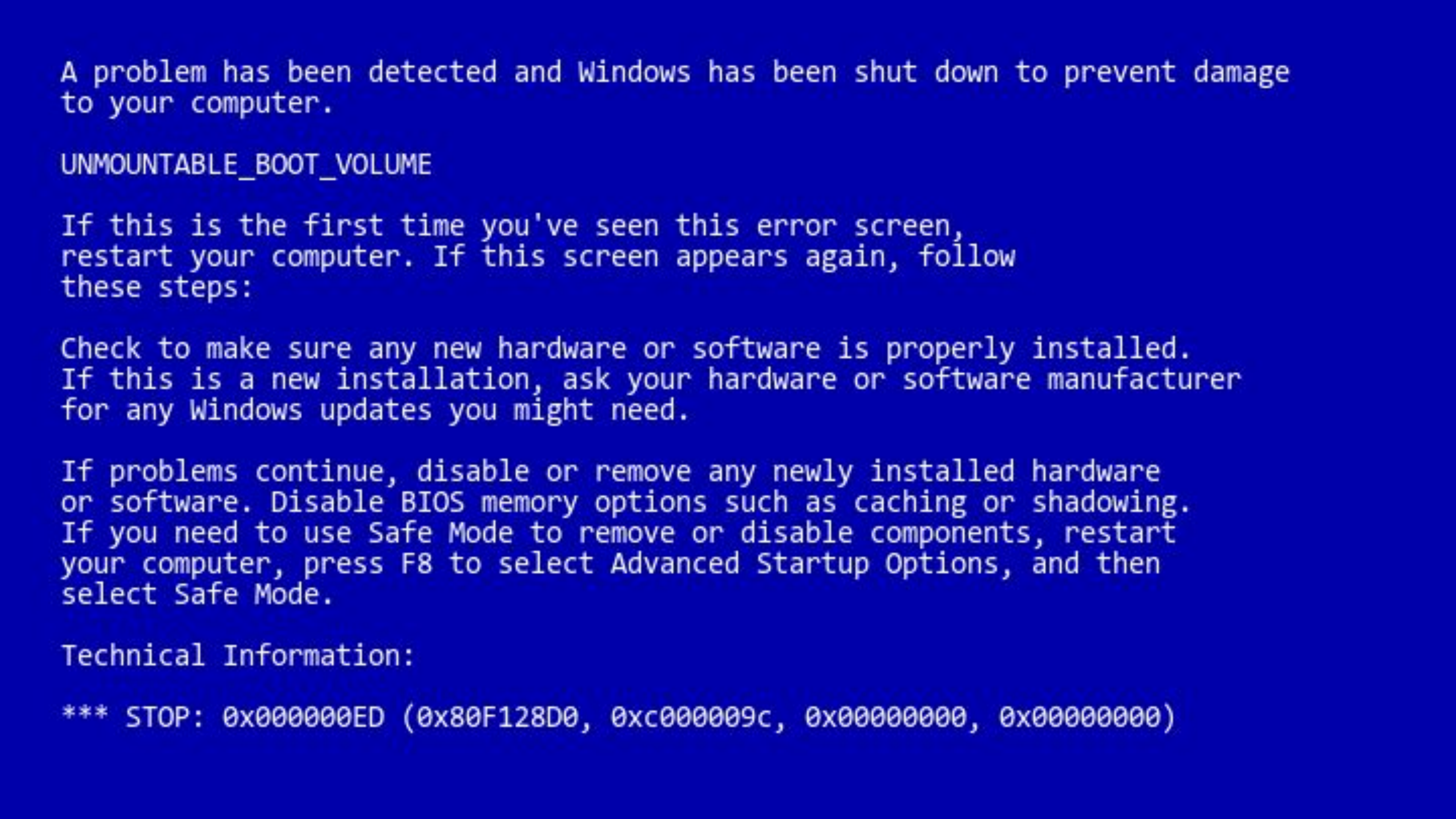
- Use it from the terminal (guide)
- Use it from the terminal (tutorial)
- Read the book
- Learn about workflows

GitHub

- Use it on GitHub.com (guide)
- Use it from the terminal (tutorial)
- Work with GitHub Desktop

Take-away: get some experience with setting up a Git/GitHub workflow, and get familiar with Git basics


CODERS AND BOSSES
HAVE YOU FINISHED THE ESTIMATION SHEET?
JEP. I ALREADY PUSHED IT INTO THE GIT REPO. JUST PULL IT!
geek & poke
OK OK. I'LL EMAIL IT TO YOU.
BE PATIENT! HE DOESN'T KNOW BETTER



```
A problem has been detected and Windows has been shut down to prevent damage
to your computer.

UNMOUNTABLE_BOOT_VOLUME

If this is the first time you've seen this error screen,
restart your computer. If this screen appears again, follow
these steps:

Check to make sure any new hardware or software is properly installed.
If this is a new installation, ask your hardware or software manufacturer
for any Windows updates you might need.

If problems continue, disable or remove any newly installed hardware
or software. Disable BIOS memory options such as caching or shadowing.
If you need to use Safe Mode to remove or disable components, restart
your computer, press F8 to select Advanced Startup Options, and then
select Safe Mode.

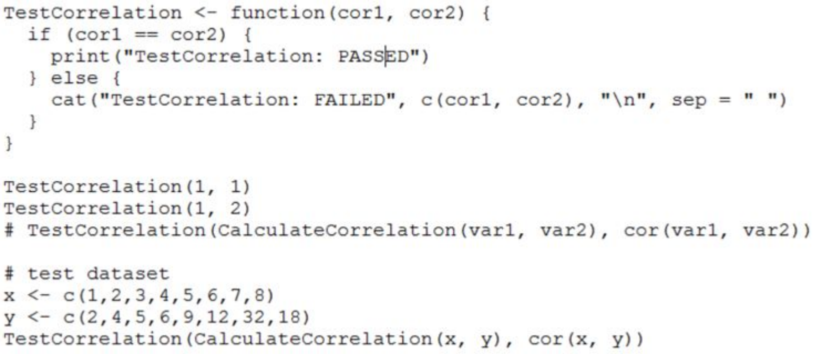
Technical Information:

*** STOP: 0x000000ED (0x80F128D0, 0xc000009c, 0x00000000, 0x00000000)
```

Unit Testing

1. Work with small units (e.g, a function).
2. What should the unit do?
3. Create the unit.
4. Create a test for the unit.

Compare with external ground truth:



```
TestCorrelation <- function(cor1, cor2) {
  if (cor1 == cor2) {
    print("TestCorrelation: PASSED")
  } else {
    cat("TestCorrelation: FAILED", c(cor1, cor2), "\n", sep = " ")
  }
}

TestCorrelation(1, 1)
TestCorrelation(1, 2)
# TestCorrelation(CalculateCorrelation(var1, var2), cor(var1, var2))

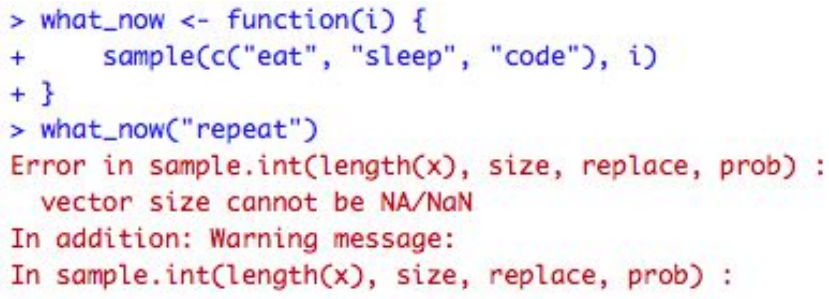
# test dataset
x <- c(1,2,3,4,5,6,7,8)
y <- c(2,4,5,6,9,12,32,18)
TestCorrelation(CalculateCorrelation(x, y), cor(x, y))
```

Or verify each step:

- use *print()* in a loop
- verify a single case, before going over all cases
- use *set.seed()* to see whether things change when they shouldn’t

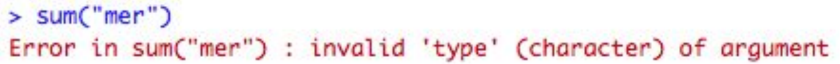
Error Provision

First try to break your code

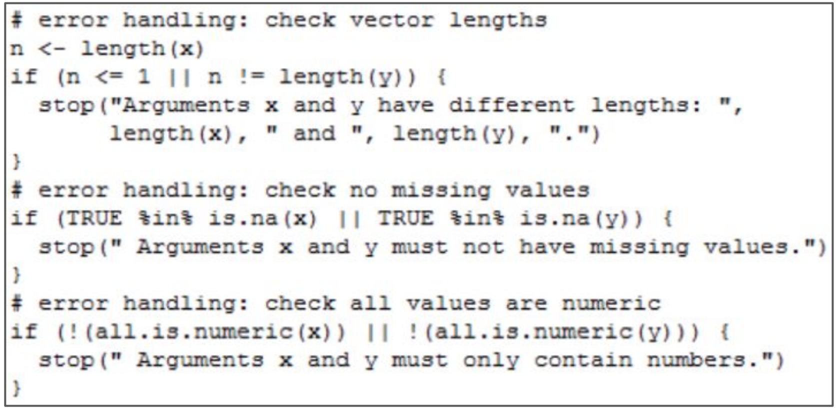


```
> what_now <- function(i) {
+     sample(c("eat", "sleep", "code"), i)
+ }
> what_now("repeat")
Error in sample.int(length(x), size, replace, prob) :
  vector size cannot be NA/NaN
In addition: Warning message:
In sample.int(length(x), size, replace, prob) :
```

Then provide meaningful details



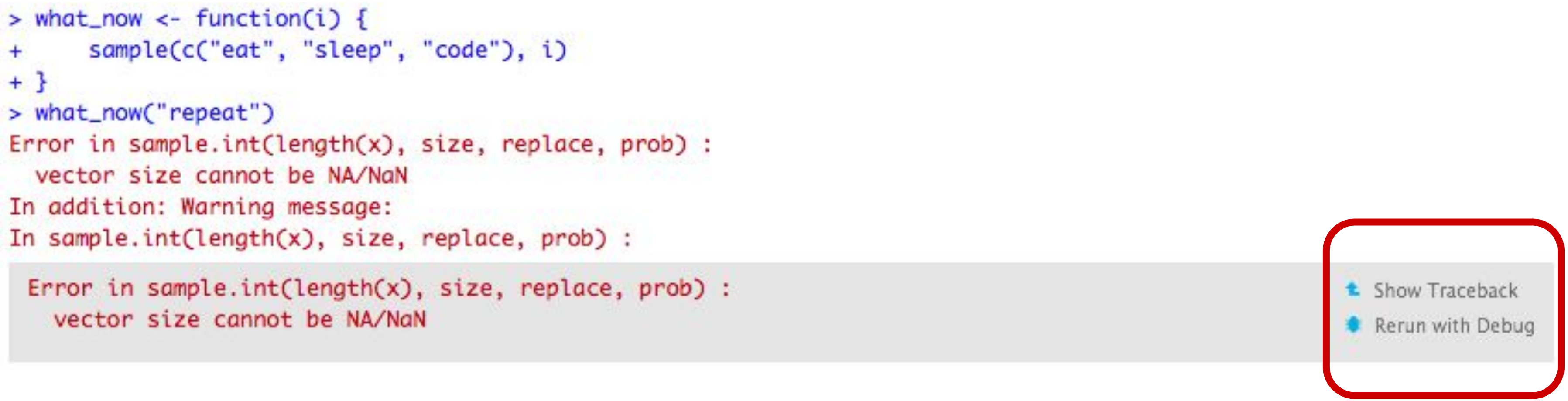
```
> sum("mer")
Error in sum("mer") : invalid 'type' (character) of argument
```



```
# error handling: check vector lengths
n <- length(x)
if (n <= 1 || n != length(y)) {
  stop("Arguments x and y have different lengths: ",
       length(x), " and ", length(y), ".")
}
# error handling: check no missing values
if (TRUE %in% is.na(x) || TRUE %in% is.na(y)) {
  stop(" Arguments x and y must not have missing values.")
}
# error handling: check all values are numeric
if (!(all.is.numeric(x)) || !(all.is.numeric(y))) {
  stop(" Arguments x and y must only contain numbers.")
}
```

Debugging

RStudio



```
> what_now <- function(i) {
+     sample(c("eat", "sleep", "code"), i)
+ }
> what_now("repeat")
Error in sample.int(length(x), size, replace, prob) :
  vector size cannot be NA/NaN
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In sample.int(length(x), size, replace, prob) :
```

```
Error in sample.int(length(x), size, replace, prob) :
  vector size cannot be NA/NaN
```

Alpha Testing

Think your program is unbreakable? Let others have a try!

We'll do it in class!

Bug report

For each bug specify

- the steps to reproduce
  - description of what went wrong (user perspective)
  - when relevant: systems specs where error occurred (OS, browser)
- what you expected to see
- what you saw instead
  - provide a screenshot

Pro tip: GitHub uses Issues for this

Having Fun

Hide an easter egg

Try programmer humor

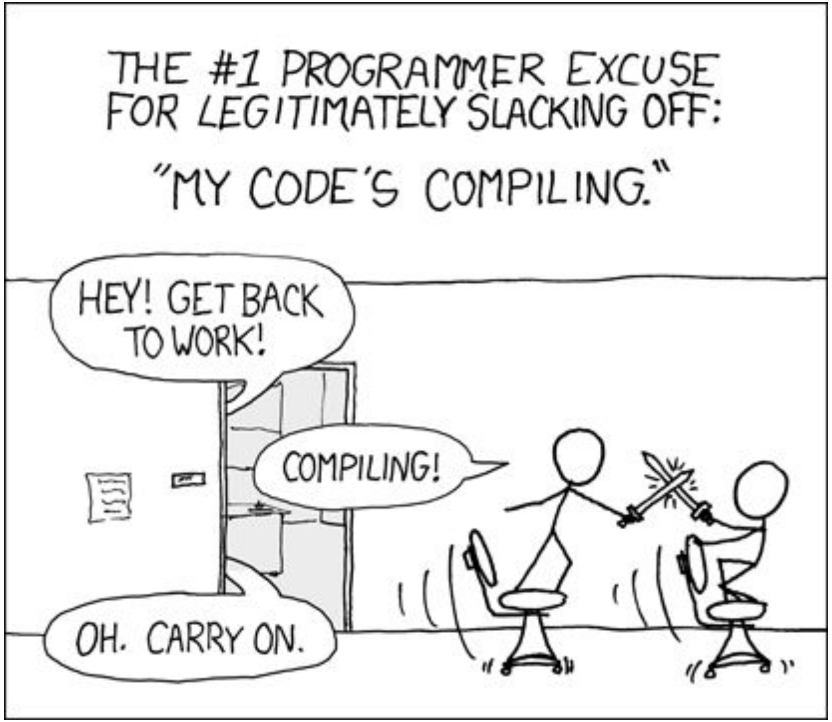
Take a break

Learn to juggle

Solve or suggest a computer-puzzle

Sit together

Break your neighbor's code



Presentation

Extend shared presentation.

Use 2 slides (show, don’t tell):

1. Superpowers
    a. Version control: how do you keep track of changes/versions?
    b. Coding style: what’s your style?
    c. *Documentation: how do you make sure you and others can understand your code?*
2. Progress
    a. Past: what have you done so far?
    b. Future: what’s next?

Present next week in 2 minutes.

Questions?

Happy coding!