



Coding: Best Practices & Tools

Towards painless programming for researchers

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Better practices in coding: why?

Better practices in coding: why?

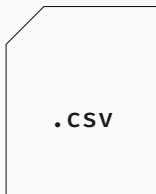
Instead of imagining that our main task is to instruct a computer what to do, let us concentrate rather on explaining to human beings what we want a computer to do.

— D. Knuth

Editors & IDEs

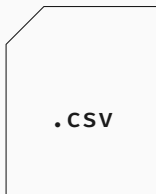
File types in research

File types in research

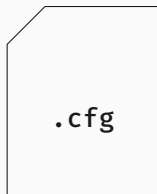


data

File types in research

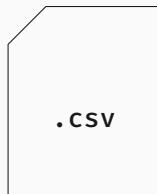


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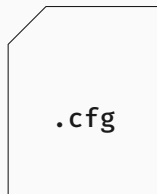


config

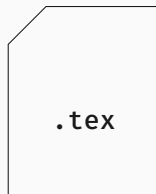
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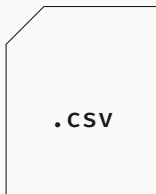


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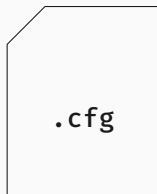


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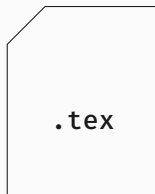
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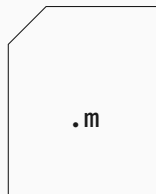
data



config

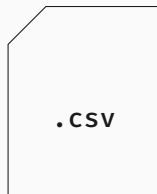


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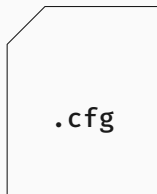


code

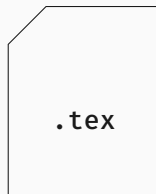
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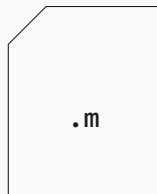
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config



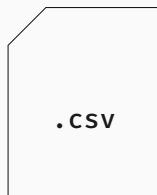
\LaTeX



code

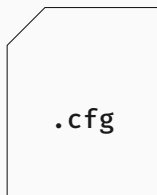
These are all **text files**...

File types in research



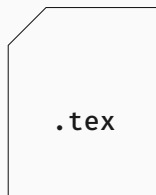
.csv

data



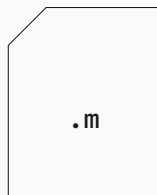
.cfg

config



.tex

LaTeX



.m

code

These are all **text files**...
...let's use **a good text editor**!

What makes a text editor *good*?

A good text editor has to be...

- Invisible
- Intelligent
- Customizable
- Extensible

All the fuss about Vlm and GNU Emacs

- Pros**
 - learn once, use forever
 - available everywhere
 - (im)proved with time
- Cons**
 - at the beginning, intimidating

Characteristics

- It's not a text editor, it's a Lisp interpreter
- Highly context-dependent behavior

Characteristics

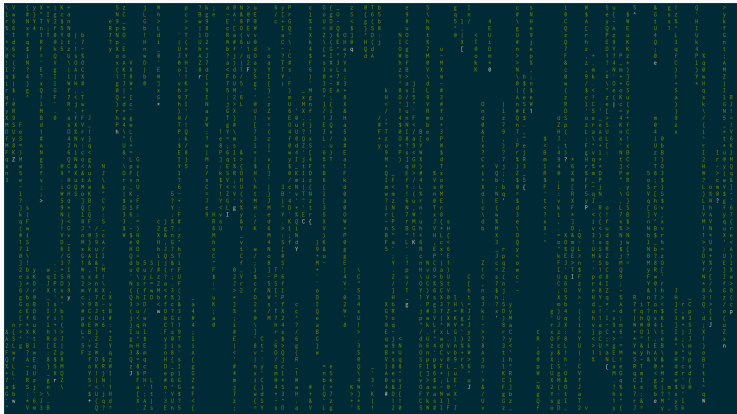
- It's not a text editor, it's a Lisp interpreter
- Highly context-dependent behavior

How to get started

1. use it as a regular text editor
2. customize according to need
3. extend it using packages

Editors: VIm

What people think it is...



Editors: VIm

What it does actually look like

[illegible]

Characteristics

- Command line or GUI
- Modal (one mode per class of action: edition, displacement, selection, etc...)
- Based on shortcuts and commands
- Fully customizable through plugin or embedded language
- Painless integration with any standard UNIX toolchain

Where to start

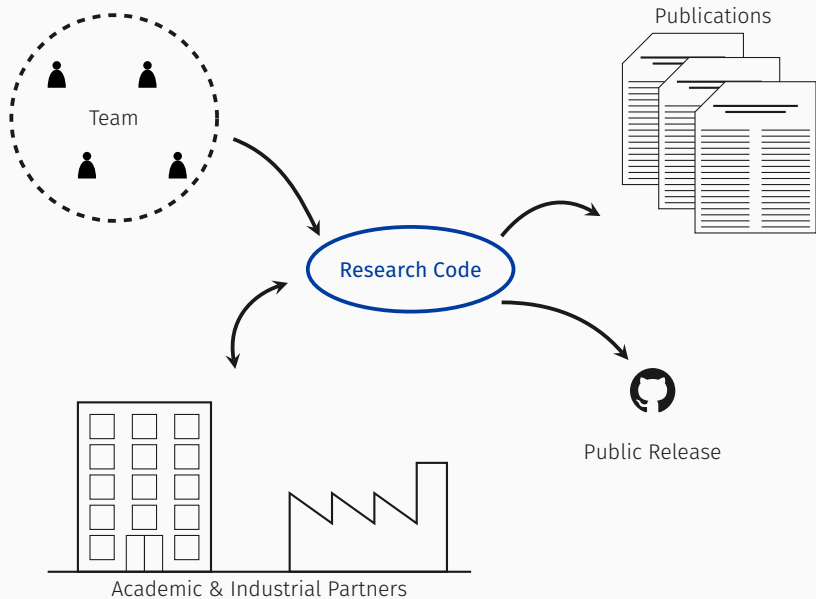
- `http://vim-adventures.com/ & $ vimtutor`
- `http://vimcasts.org/`
- `https://vimebook.com/en`

Multi-platform, open-source and actively maintained

- Atom atom.io
- Light Table lighttable.com
- Sublime Text sublimetext.com

Versioning for fun and profit

Contribution to a research code



We need to **edit** files every single day.

We need to **collaborate on** files every single day.

We need to **review** files every single day.

We need to **explore** files every single day.

We need to **share** files every single day.

We need a reliable versioning system!

Versioning for fun and profit

The old old way : name it, zip it, mail it

The first versioning attempts traditionally rely on 3 pillars:

- Naming conventions
- Regular backups
- Careful data management

Versioning: the old old way

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- Naming conventions
- Regular backups
- Careful data management

“C’mon, I even mailed myself the latest version:
how could this go wrong?”

Versioning: the old old way






Awesome_project





Versioning: the old old way

- 📁 Awesome_project
- 📁 Awesome_project_2






Versioning: the old old way

-  Awesome_project
-  Awesome_project_2
-  Awesome_project_backup







Versioning: the old old way

-  Awesome_project
-  Awesome_project_2
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Versioning: the old old way

-  Awesome_project
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-  Awesome_project_test
-  Awesome_project_test
-  Awesome_project_backup_2
-  Awesome_project_idea_sunday










Versioning: the old old way

-  Awesome_project
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-  Awesome_project_test
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-  Awesome_project_publi









Versioning: the old old way

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-  Awesome_project_idea_sunday
-  Awesome_project_publi
-  Awesome_project_publi_fix

Versioning: the old old way





-  Awesome_project
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-  Awesome_project_publi
-  Awesome_project_publi_fix
-  Awesome_project_not_good

Versioning: the old old way

-  Awesome_project
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Versioning: the old old way

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...

Plus, this does not behave well when scaling things up...

- How to handle team-work?
- Modification conflicts: what to do?
- No continuous time travel
- ...and a lot more issues

Versioning for fun and profit

The new old way : {Drop,}Box and Changelogs

The Cloud: one more step towards real-time collaboration!

- Free & paid plans
- Auto-sync even for big files
- Team notifications
- Mobile access to files
- A carefully maintained changelog *may* keep track of changes

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But...

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- Mobile access to files
- A carefully maintained changelog *may* keep track of changes

But... does the "Cloud" really share the spirit that drives research?

*These and other features may require our systems to
access, store and scan Your Stuff.*

— DropBox TOS

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— Box TOS

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— Google TOS

What about iCloud?

*Apple reserves the right at all times to determine whether Content is appropriate and in compliance with this Agreement, and may pre-screen, **move, refuse, modify and/or remove** Content at any time, without prior notice and in its sole discretion [...]*

— iCloud TOS

Terms of Service: chosen moments

What about iCloud?

*However, by submitting or posting such Content on areas of the Service that are accessible by the public or other users with whom you consent to share such Content, you grant Apple a worldwide, royalty-free, non-exclusive license to **use, distribute, reproduce, modify, adapt, publish, translate, publicly perform and publicly display** such Content on the Service solely for the purpose for which such Content was submitted or made available, without any compensation or obligation to you.*

— iCloud TOS

Versioning for fun and profit

The badass way: **git**

Versioning: the badass way

git was built to handle huge projects, like the Linux kernel:

- distributed (everyone has a full copy)
- efficient (only changes are transferred)
- commit-wise versioning
- supporting branches (new ideas in a enclosed space) and tagging
- potentially server-less & self-hostable
- simultaneous modifications & smart merging
- usable through GUI (tig, gitk, tortoise-git & others) or command-line

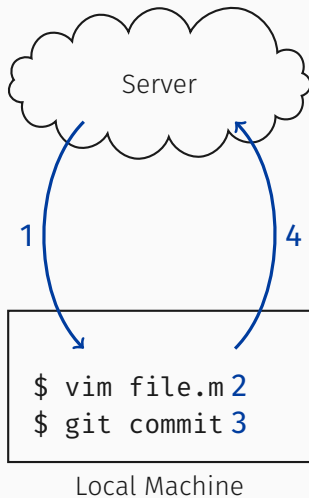
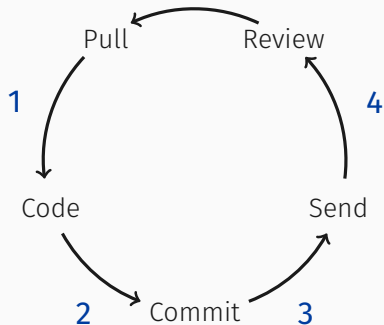
Versioning: the badass way

Concerning commits...

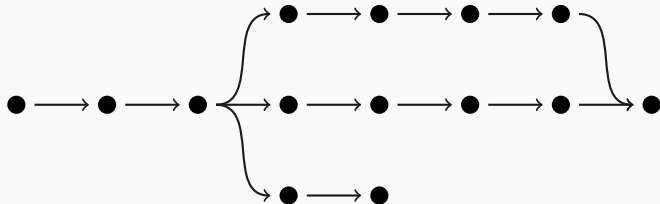
18ab98fc...	Unique (SHA1) identifier
Deletes Harkonnens	Changes Summary
Leto Atreides <leto@atreides.ar>	Committer & Author
Dec. 25 2015 21:42:21	Date & Time
- - + - - + +	Per-file additions/deletions
file doc.tex new file mode 10644 file stuff.sh old mode 100644 new mode 100755	Mode changes & file additions/deletions

All the needed information is here!

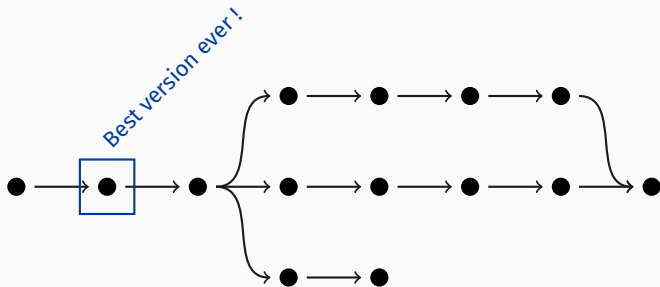
Versioning: the badass way



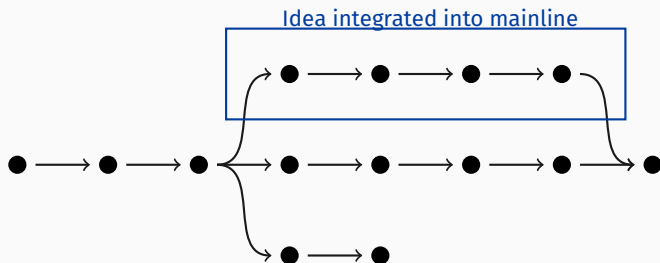
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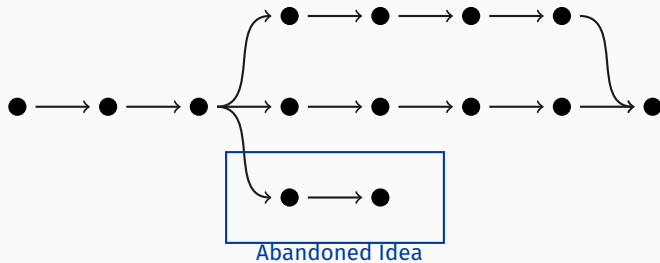
Versioning: the badass way



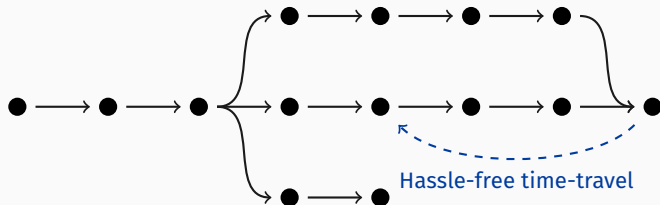
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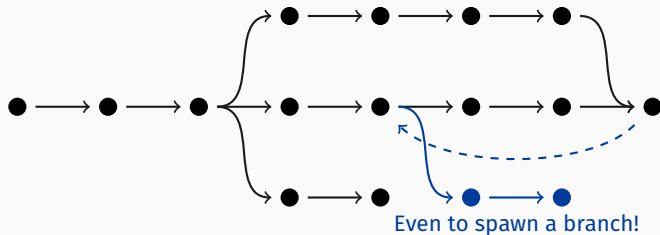
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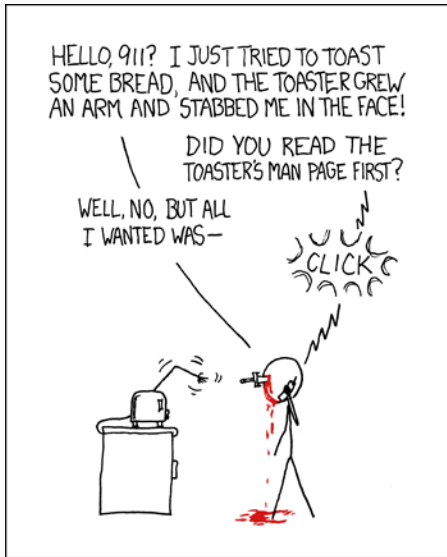
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Versioning: the badass way



Documentation



Before using a program, it's good to know:

- **what** it does
- **how** it does it
- **why** it does it like that

Before using a program, it's good to know:

- **what** it does
- **how** it does it
- **why** it does it like that

Code tells you **how**.

Documentation tells you the rest.

Internal

- comments
- self-documenting code

External

- separate manual
- referenced material

Internal documentation: comments

Begin every file with a comment

- say what the code should do
- describe how to use the file

A MATLAB example

```
function [h,a] = pythagoras(c1,c2)
% pythagoras -- computes the hypotenuse and the area of
% right-angled triangle
%
% Inputs: c1 - length of the first cathetus [m]
%        c2 - length of the second cathetus [m]
% Outputs: h - length of the hypotenuse [m]
%         a - area of the triangle [m^2]
%
% Example: [hypo,area] = pythagoras(3,4)
```

- Explain **why**
- Close to code they refer to
- If updating the code, **update the comments**
- Avoid them if unnecessary

What is “unnecessary”

What feels obvious to you when writing the code may not be obvious to someone else, or even to you at a future time.

A MATLAB example

```
%  ** USELESS COMMENT **
```

```
% compute the mean value of every column of A
```

```
B = mean(A,1);
```

```
%  ** USEFUL, bsxfun may be obscure! **
```

```
% divide every column of A by the column vector v
```

```
B = bsxfun(@rdivide,A,v);
```

When commenting...

- ...a library, say **what** it does
`% This toolbox computes PSDs.`
- ...a function, say **how** it does it
`% PSD estimate using Welch's method.`
- ...a line, say **why** it does it that way
`\% bsxfun is faster than a for loop`

*Programs must be written for people to read,
and only incidentally for machines to execute.*

*— Structure and interpretation
of computer programs*

- Aim at writing code that does not need comments
- Use meaningful, non-ambiguous variable names

Quality internal documentation can be used to automatically generate external documentation.

A MATLAB example

`publish()` code publishing tool included in MATLAB

More useful tools

Doxygen doc-generator supporting multiple languages

Sphinx doc-generator built for the Python project

rtfd.org free web-service for hosting documentation

What's next?

We couldn't fit it all in... so here is the rest:

Github Public Git server for free software (paid plans exist) with webpage publishing service (good to host the homepage of a project).

Agility Project management methods centered on human relations more than on tools and processes. See Kanban or Scrum for an introduction.

TDD & BDD Test- & Behavior Driven Development. Coding paradigms focusing on certain aspects (reliability & spec. compliance). Useful to scale from a research PoC to a distributed software.

Questions?

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