Software Engineering Basics

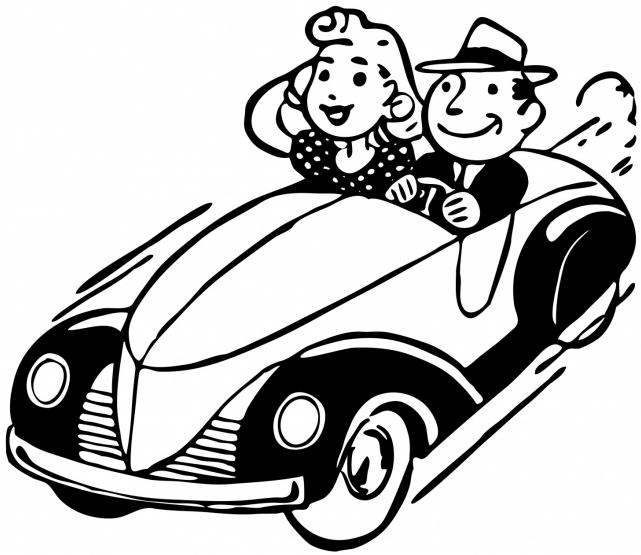
Martin Thoma

14. August 2018

Intended Audience

Software is written by people with different backgrounds and strengths. Not everybody has a Software Engineering background. Those slides should help you to get the basics.

Alice and Bob



- Project: Build self-driving car
- Alice is in the US, Bob in Germany

Project structure

- bin
- docs
- awesome_project
- tests
- setup.py
- tox.ini

✚ `$ grep -rnIi foobar`

Details on my blog.

git workflow

1. `$ git clone repostory.git`
2. `$ git add filename`
3. `$ git commit`
4. `$ git push`

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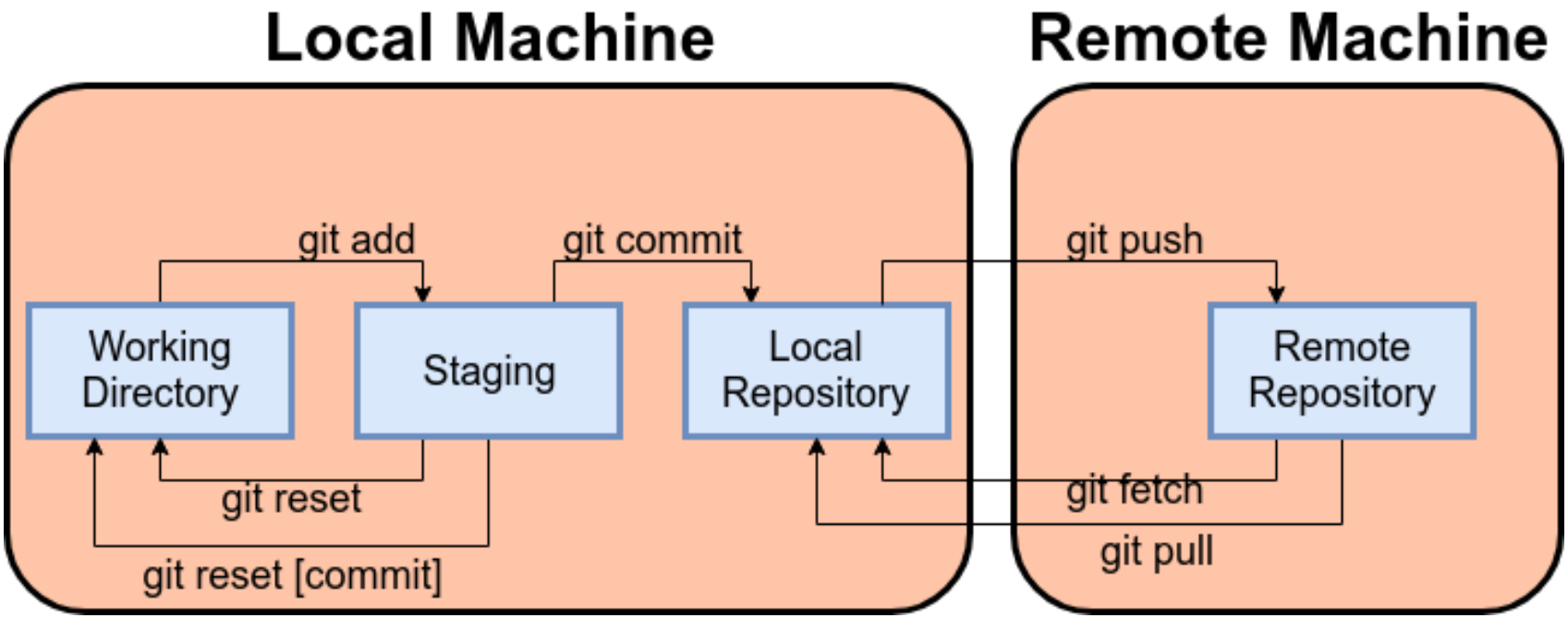


Version Control: git

[master] 3d131ee feature 1 - Alice <alice@xyz.com>

[master] f2e99ab feature 2 - Bob <bob@xyz.com>

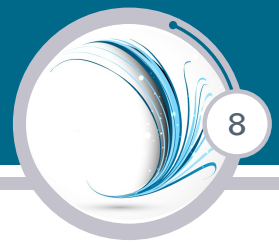
[master] bb32da6 feature 3 - Alice <alice@xyz.com>

[master] 354b9f1 feature 4 - Alice <alice@xyz.com>

git log


```
commit 204f2c82a5bd7379b66d351130917ec0012ec4fb
Merge: 175dab397 f7f6c7d4a
Author: Pauli Virtanen <pav@iki.fi>
Date:   Sun Aug 12 14:23:38 2018 +0000

    Merge pull request #9127 from andyfaff/disablegmpy

    CI: try disabling gmpy assert

commit 175dab3978031c30c2ec7f1da641069bcca6cc4a
Merge: 1536d17cc e677a2bb8
Author: Ilhan Polat <ilhanpolat@gmail.com>
Date:   Sun Aug 12 13:27:44 2018 +0200

    Merge pull request #9131 from akahard2dj/DOC_scipy.optimize.tutorial_typo.Quetzalcohuatl

    DOC: Correct the typo in scipy.optimize tutorial page

commit 1536d17cc7a741e329e1a2a85bbe3d5fd508ebed
Merge: b87690987 9a94b31da
Author: Pauli Virtanen <pav@iki.fi>
Date:   Sat Aug 11 22:40:46 2018 +0000

    Merge pull request #9129 from eric-wieser/no-bare-except

    BUG: Do not catch and silence KeyboardInterrupt/SystemExit

    Bare excepts are only correct when trying to capture and forward exceptions - in all other

    This only touches the code that is user-facing, not any of the tooling or tests.
```

git blame




```
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  196)     >>> y6 = gaussian_filter1d(x, 6)
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  197)     >>> plt.plot(x, 'k', label='original data')
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  198)     >>> plt.plot(y3, '--', label='filtered, sigma=3')
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  199)     >>> plt.plot(y6, ':', label='filtered, sigma=6')
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  200)     >>> plt.legend()
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  201)     >>> plt.grid()
582ae6d284 scipy/ndimage/filters.py   (Martin Thoma           2017-04-23 18:37:59 +0200  202)     >>> plt.show()
ca465a651f Lib/ndimage/Lib/filters.py (Ed Schofield           2006-03-18 13:52:58 +0000  203)     """
ca465a651f Lib/ndimage/Lib/filters.py (Ed Schofield           2006-03-18 13:52:58 +0000  204)     sd = float(sigma)
19eff1c3fb scipy/ndimage/filters.py   (Thouis (Ray) Jones     2012-06-05 10:29:22 +0200  205)     # make the radius of the filter equal to truncate standard deviations
19eff1c3fb scipy/ndimage/filters.py   (Thouis (Ray) Jones     2012-06-05 10:29:22 +0200  206)     lw = int(truncate * sd + 0.5)
a83a5dd741 scipy/ndimage/filters.py   (Jaime Fernandez del Rio 2016-03-13 21:25:34 +0100  207)     # Since we are calling correlate, not convolve, revert the kernel
a83a5dd741 scipy/ndimage/filters.py   (Jaime Fernandez del Rio 2016-03-13 21:25:34 +0100  208)     weights = _gaussian_kernel1d(sigma, order, lw)[::-1]
ca465a651f Lib/ndimage/Lib/filters.py (Ed Schofield           2006-03-18 13:52:58 +0000  209)     return correlate1d(input, weights, axis, output, mode, cval, 0)
```

git status


```
moose@pc07 ~/GitHub/LaTeX-examples/presentations/software-engineering-basics master git status
On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        new file:   Feathergraphics/1.pdf
        new file:   Feathergraphics/2.pdf
        new file:   Makefile
        new file:   beamercolorthemeFeather.sty
        new file:   beamerinnerthemeFeather.sty
        new file:   beamerouterthemeFeather.sty
        new file:   beamerthemeFeather.sty
        new file:   feather.tex
        new file:   graphics/car.jpg
        new file:   graphics/git-2-fixes.png
        new file:   graphics/git-simple.png
        new file:   graphics/gitgrpah.html
        new file:   software-engineering-basics.tex

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   ../../documents/book-minimal/book-minimal.pdf
        modified:   software-engineering-basics.tex

Untracked files:
  (use "git add <file>..." to include in what will be committed)

        ../../documents/letter-dsgvo/
```

We read code MUCH more often than we write it.

Problem: Dirty commit history due to bugs / fixes

[master] 5e5f8c8 feature 1 - Alice <alice@xyz.com>

[master] 1bff507 fix feature 1 - Alice <alice@xyz.com>

[master] ae89eb5 fix feature 1 - #2 - Alice <alice@xyz.com>

[master] c1bcc99 now it is really fixed - Alice <alice@xyz.com>

[master] db3bcda feature 2 - Bob <bob@xyz.com>

Auto formatting

- PRs should not be about simple code style

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- Choose one style guide and stick to it

Auto formatting

- PRs should not be about simple code style
- Choose one style guide and stick to it
- Trailing spaces are just noise - make your editor remove them automatically.

The Zen of Python, by Tim Peters (1)

Beautiful is better than ugly.
Explicit is better than implicit.
Simple is better than complex.
Complex is better than complicated.
Flat is better than nested.
Sparse is better than dense.
Readability counts.
Special cases aren't special enough to break the rules.
Although practicality beats purity.
Errors should never pass silently.
Unless explicitly silenced.

The Zen of Python, by Tim Peters (2)

In the face of ambiguity, refuse the temptation to guess.
There should be one– and preferably only one –obvious way to do it.
Although that way may not be obvious at first unless you're Dutch.
Now is better than never.
Although never is often better than *right* now.
If the implementation is hard to explain, it's a bad idea.
If the implementation is easy to explain, it may be a good idea.
Namespaces are one honking great idea – let's do more of those!

commit messages

- Can I understand what the commit was about?

cleanup, fixed bug, new feature, ...

commit messages

- Can I understand what the commit was about?
- Use prefixes

- BUG: bug fix
- DEV: development tool or utility
- DOC: documentation
- ENH: Enhancement, a new feature
- MAINT: Maintenance task
- REL: release
- STY: Stylistic change
- TST: addition or modification of tests

Source: Scipy Development Workflow

commit messages

- Can I understand what the commit was about?
- Use prefixes
- Mention issues

- See issue #123
- Closes issue #123

commit squashing

Commit squashing
Making multiple commits in a row become one

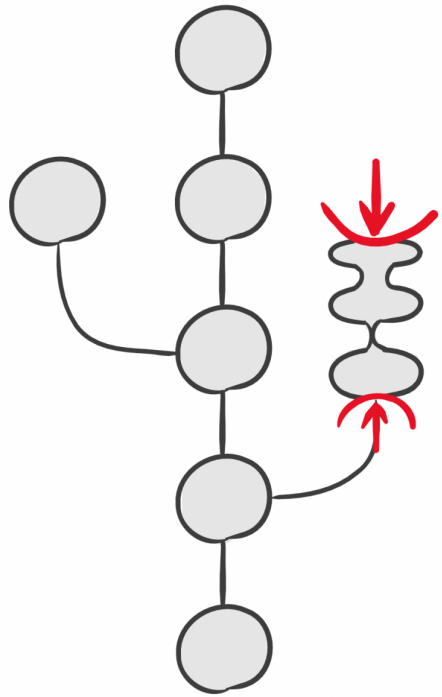


Image source:
stevenschwenke.de

git merge

[master] 02ddb49 ENH: feature 1 - Alice <alice@xyz.com>

[master] cb0fc5e ENH: feature 2 - Alice <alice@xyz.com>

[master] a0e98b6 ENH: feature 3 - Alice <alice@xyz.com>

[feature] d8ff19b ENH: feature 4 - Alice <alice@xyz.com>

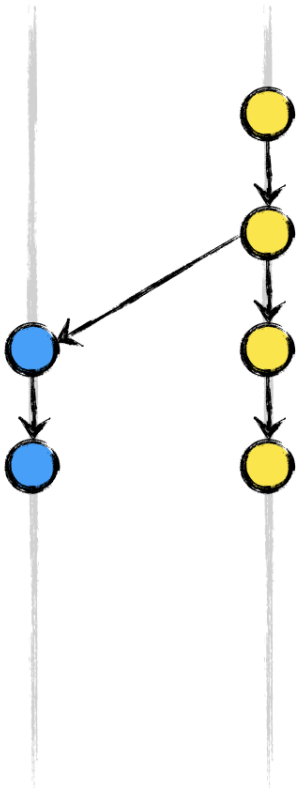
[feature] 166f7b5 ENH: feature 4 - fix 1 - Alice <alice@xyz.com>

[feature] 71fcfc0 ENH: feature 4 - fix 2 - Alice <alice@xyz.com>

[master] b9248de Merge branch `feature` into `master` - Sergio Flores <saxo-guy@epic.com>

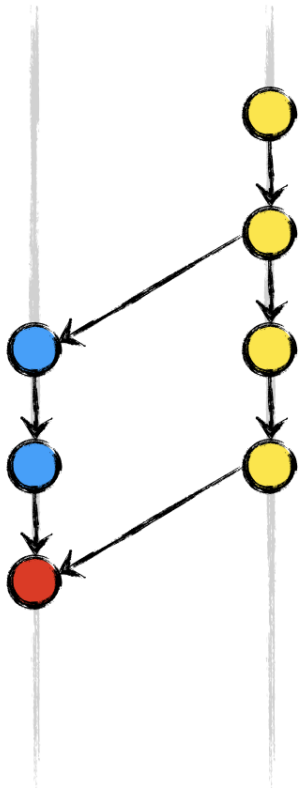
git merge vs git rebase

feature/login develop



```
$ git merge develop
```

feature/login develop



```
$ git rebase develop
```

feature/login develop

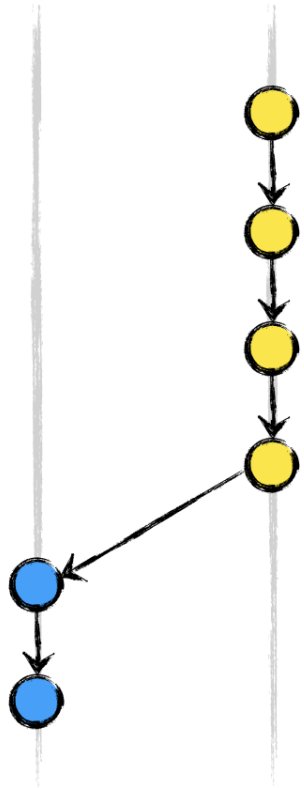


Image source: Jeff Kreeftmeijer

Logic Bugs: Functions and McCabe


```
1  from math import ceil
2
3  def f(n=1000000):
4      roundUp = lambda n, prime: int(ceil(float(n) / prime))
5
6      arr = [True] * n
7      arr[0] = False
8      arr[1] = False
9      primeList = []
10
11     for curr in range(2, n):
12         if not arr[curr]:
13             continue
14         primeList.append(curr)
15         for multiplicant in range(2, roundUp(n, curr)):
16             arr[multiplicant * curr] = False
17     return primeList
```

Logic Bugs: Names


```
4  def round_up(n, prime):
5      return int(ceil(float(n) / prime))
6
7
8  def get_primes_below_n(n=1000000):
9      is_prime_table = [True] * n
10     is_prime_table[0] = False
11     is_prime_table[1] = False
12     prime_list = []
13
14     for current_number in range(2, n):
15         if not is_prime_table[current_number]:
16             continue
17         prime_list.append(current_number)
18         for multiplicant in range(2, round_up(n, current_number)):
19             is_prime_table[multiplicant * current_number] = False
20     return prime_list
```

Logic Bugs: Doctests!


```
8  def get_primes_below_n(n=1000000):
9      """
10     Get a list of all primes below n.
11
12     Parameters
13     ----------
14     n : int
15
16     Returns
17     -------
18     prime_list : list
19
20     Examples
21     --------
22     >>> get_primes_below_n(10)
23     [2, 3, 5, 7]
24     """
```

Falsehood Data Scientists Beliefes

(1) Floating point numbers always look like this: 1.23456 or 0.000004577 or 12345.467765.

Falsehood Data Scientists Beliefes

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- Scientific notation: `4.577E-5` or `1.2345467765E4`

Falsehood Data Scientists Beliefes

(1) Floating point numbers always look like this: 1.23456 or 0.000004577 or 12345.467765.

- Scientific notation: `4.577E-5` or `1.2345467765E4`
- German decimal format: `1,23456` or `0,000004577`

Falsehood Data Scientists Beliefes

(2.1) Country names have an unique representation

Falsehood Data Scientists Beliefes

(2.1) Country names have an unique representation
“Germany” vs “Deutschland”

Falsehood Data Scientists Beliefes

(2.2) Country names have an unique representation in English

Falsehood Data Scientists Beliefes

(2.2) Country names have an unique representation in English
“United Kingdom” vs “UK”

Falsehood Data Scientists Beliefes

(2.3) Country names have an unique unabreviated representation in English

Falsehood Data Scientists Beliefes

(2.3) Country names have an unique unabreviated representation in English
“United Kingdom” vs “Great Britain” vs “England”

Falsehood Data Scientists Beliefes

(2.3) Country names have an unique unabreviated representation in English

Solution:

Use/Demand **ISO 3166-1 alpha-3 country codes** everywhere

Falsehood Data Scientists Beliefes

(3) Data is clean

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No.

Falsehood Data Scientists Beliefes

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No.

- User database: Birth date in the year 3.

Falsehood Data Scientists Beliefes

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No.

- User database: Birth date in the year 3.
- User database: Active user who is more than 90 years old.

Falsehood Data Scientists Beliefes

(3) Data is clean
No.

- User database: Birth date in the year 3.
- User database: Active user who is more than 90 years old.
- User database: User who is younger than 6.

Falsehood Data Scientists Beliefes

(4) Time has no beginning and no end

Falsehood Data Scientists Beliefes

(4) Time has no beginning and no end
Unix Time Stamp: Seconds since 1st of January, 1970. Stored in unsigned int.

Falsehood Data Scientists Beliefes

(4) To avoid the Year-2038 problem, I can store `YYYY-mm-dd HH:MM:ss`

Falsehood Data Scientists Beliefes

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- Python's strftime directives

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- Python's strftime directives
- Timezones

Falsehood Data Scientists Beliefes

(4) To avoid the Year-2038 problem, I can store `YYYY-mm-dd HH:MM:ss`

- Python's strftime directives
- Timezones
- Whenever possible, store the timezone and use **ISO 8601**: `2012-04-23T18:25:43.511+02:30` (reasons)

Falsehood Data Scientists Beliefes

(5) The (physical) unit of a column / an API can be guessed.

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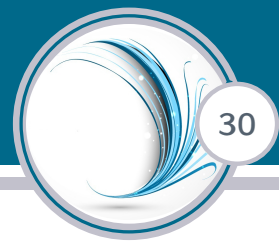
- See if the distribution / quantiles are reasonable

Falsehood Data Scientists Beliefes

(5) The (physical) unit of a column / an API can be guessed.

- Clarify it
- See if the distribution / quantiles are reasonable
- Internally, use unit library Pint

See also



- git
  - meld: Tool for diff and merge (`$ git mergetool`)
  - A successful Git branching model
- Debugging Python with ipdb and Sypder - starting at 4:00
- cprofile: Check where code improvements are effective
- David Goldberg: What Every Computer Scientist Should Know About Floating-Point Arithmetic
- Testing with Python
- Logging with Python
- UML: Sequence diagrams, Flow charts (e.g. Dia or draw.io)
- Balsamiq: Draft an UI
- Web: REST basics