Principles of Software Construction: Objects, Design, and Concurrency

Software Engineering for Teams

Charlie Garrod **Chris Timperley**

Administrivia

- Homework 4c due today
  - Up to 75% of points lost on Homework 4a can be recovered by submitting revised design documents
- Homework 5 coming soon
  - Team signup sheet will be posted to Piazza today
  - Team signup deadline is next Tuesday
- Midterm in class next Thursday
  - Review session with Shruti and Alice
    Next Wednesday, 6-8pm, Hamerschlag B131* *(provisional)*
    There will be pizza! :-)

Intro to Java

Git, CI

UML

Static Analysis

Performance

GUIs

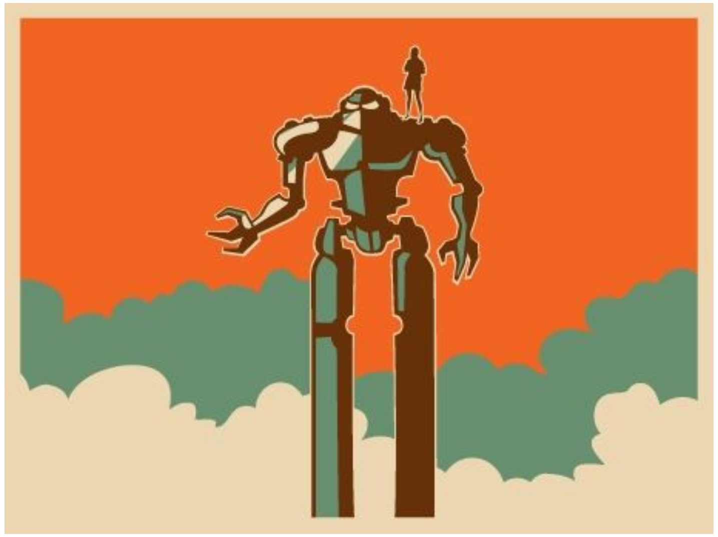
GUIs

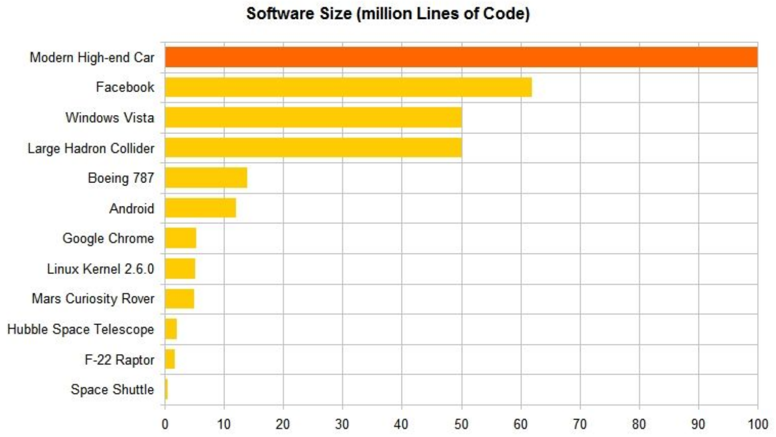
More Git

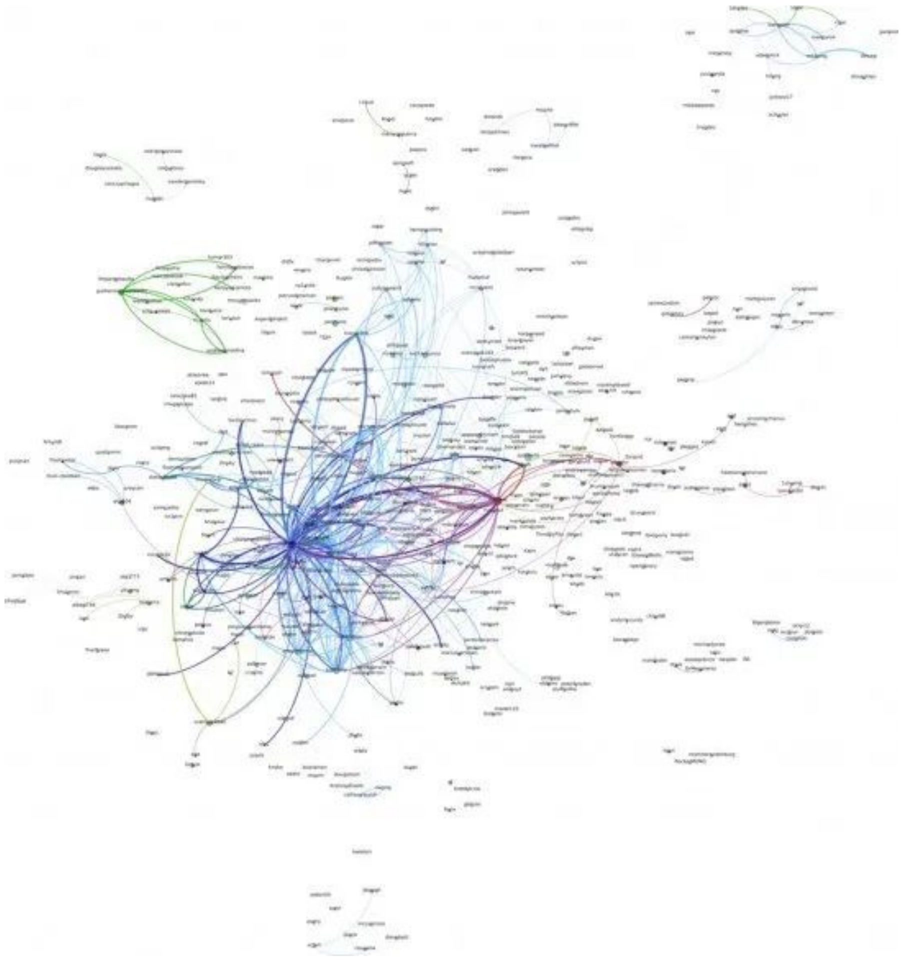
Design

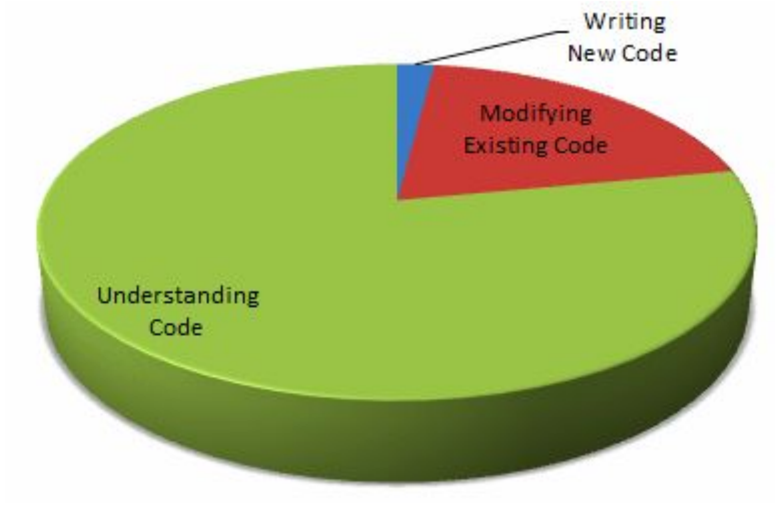
Part 1: Design at a Class Level	Part 2: Designing (Sub)systems	Part 3: Designing Concurrent Systems
Design for Change: Information Hiding, Contracts, Unit Testing, Design Patterns	Understanding the Problem	Concurrency Primitives, Synchronization
Design for Reuse: Inheritance, Delegation, Immutability, LSP, Design Patterns	Responsibility Assignment, Design Patterns, GUI vs Core, Design Case Studies	Designing Abstractions for Concurrency
	Testing Subsystems	
	Design for Reuse at Scale: Frameworks and APIs	

Software engineering is inherently collaborative









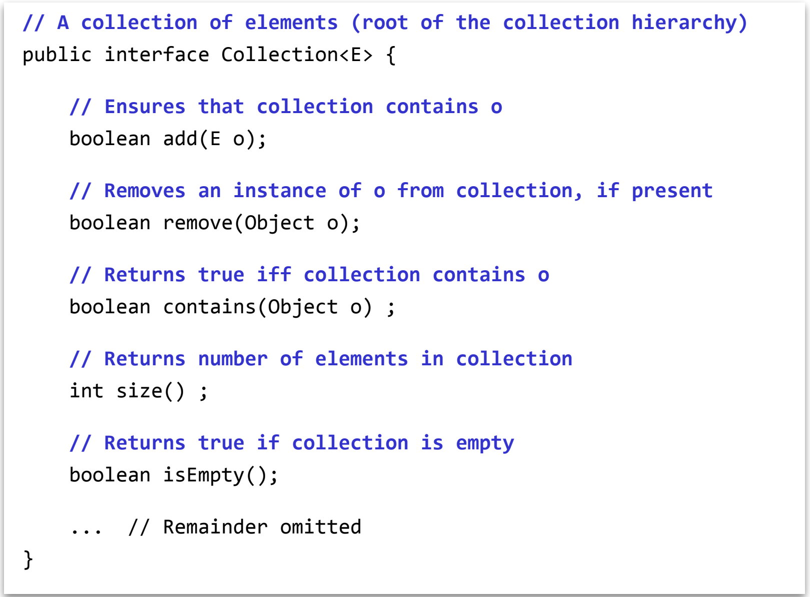
"Understanding code is by far the activity at which professional developers spend most of their time."

Peter Hallam, C# language design team

https://blog.codinghorror.com/when-understanding-means-rewriting/

Design as communication

APIs, code, and documentation are the language that we use to **communicate** the intent of our software to other developers.



```
// A collection of elements (root of the collection hierarchy)
public interface Collection<E> {

    // Ensures that collection contains o
    boolean add(E o);

    // Removes an instance of o from collection, if present
    boolean remove(Object o);

    // Returns true iff collection contains o
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    int size() ;

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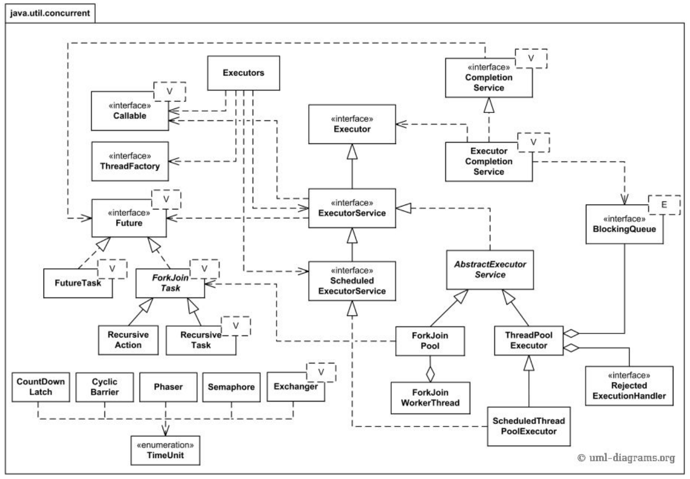
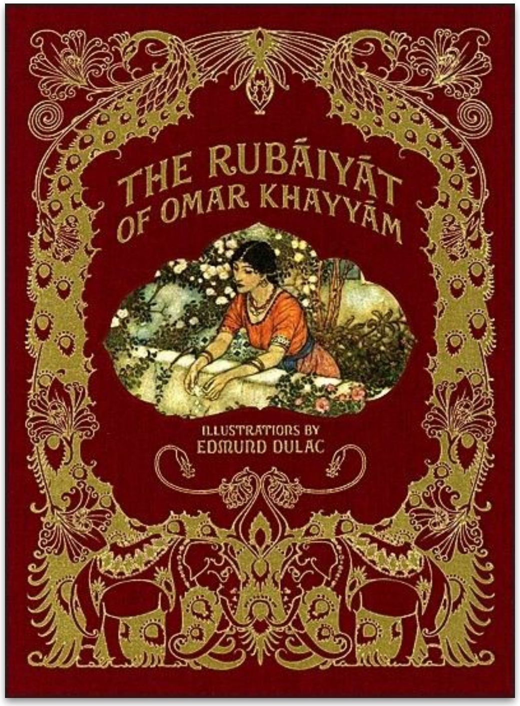


https://www.uml-diagrams.org/examples/java-7-concurrent-executors-uml-class-diagram-example.png

When we get it right, code can read like poetry or a novel you don’t want to put down. But when we get it wrong, code can be □□□□□□.



The group project will give you valuable experience of tackling real-world design and engineering challenges

- You have to write code that is understandable
- You have to work with other people's APIs and code
- You have to read and understand other people's code
  - It's not enough for your code to produce the right result
- You will have to collectively make design decisions
- You will learn much more about good design

You will communicate within a team to develop plugins.
You will also communicate with other teams to use plugins.

Our goal is to transform you from a programmer to an engineer.

Outline

- Group dynamics
- Tools and processes for software teams

Challenges of working as a team: Aligning expectations

- How do we make decisions?
  - Are you a *laissez-faire* or *by-the-book* person?
- ...

Challenges of working as a team: Aligning expectations

- How do we make decisions?
  - Are you a *laissez-faire* or *by-the-book* person?
- How do we divide the work?
  - Who should do what task?
  - Should team members be responsible for certain components?
  - How do we ensure a fair allocation of work?
- Does the group share the same goals and incentives?
  - Bad things can happen when these are misaligned!
- What happens when work isn't done?
  - How will you make sure that the group stays on track?
- When do team members like to get work done?
  - Are they night owls or early birds? (Be honest!)
- What other commitments do your team members have?
- Where will you get the work done?
  - Will you work in the same location? Remotely? Asynchronously?
- ...

Team roles: You will probably have more than one

- **Facilitator:** Moderates team discussion and keeps the group on task.
- **Recorder:** Takes notes summarizing team discussions and **decisions**, and keeps all necessary records.
- **Timekeeper:** Keeps the group aware of time constraints and deadlines and makes sure meetings start on time.
- **Devil's Advocate:** Raises counter-arguments and (constructive) objections; introduces alternative explanations and solutions.
- **Innovator:** Encourages imagination and contributes new and alternative perspectives and ideas.
- **Harmonizer:** Strives to create a positive team atmosphere.
- **Prioritizer:** Makes sure group focuses on most important issues and does not get caught up in unimportant details.

Running an effective meeting: Before the meeting

- Prepare an agenda
  - Beware of meetings without an agenda!
- Figure out a regular meeting slot
  - If there is no agenda, cancel the meeting (longer notice is better)
  - Make sure that your meeting has a clear cut-off time
- Determine a convenient place to meet
  - Minimum distractions; laptop space; whiteboards
- Be organised and prepared

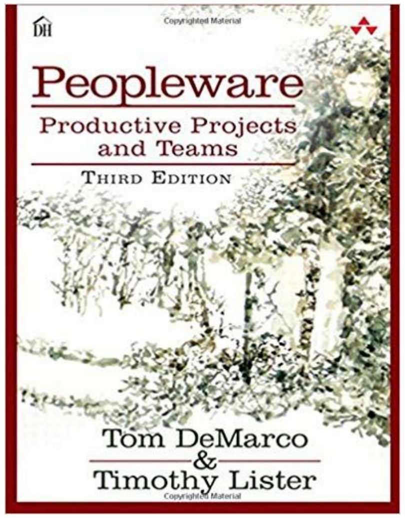
Running an effective meeting: During the meeting

- At the start of the meeting, follow up on items from the previous meeting and *briefly* review status.
- At the end of the meeting, summarise the decisions that were made, the issues to be resolved, and the work to be done.
  - Agree on what each team member needs to do by the next meeting.
  - Set an agenda for the next meeting.
- Every meeting should produce an artifact.
  - The recorder should maintain minutes of the meeting.
  - A copy of the minutes should be sent to each team member.
  - Consider using a shared Google Drive or similar.

Aside: The importance of *flow*

"Unfortunately, you can't turn on flow like a switch. **It takes a slow descent into the subject, requiring 15 minutes or more of concentration before the state is locked in.** During this immersion period, you are particularly sensitive to noise and interruption. **A disruptive environment can make it difficult or impossible to attain flow."**

— Peopleware, Third Edition, Chapter 10



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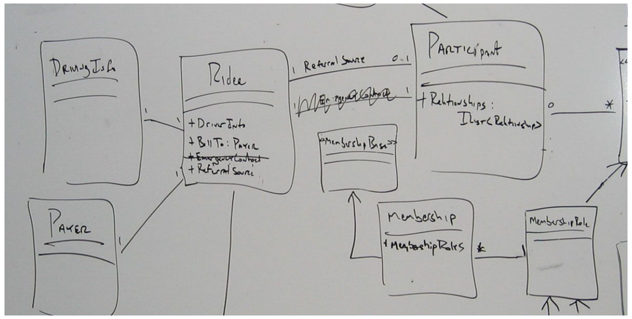
Outline

- Group dynamics
- Tools and processes for software teams
  - Identifying and assigning tasks
  - Collaborative development via GitHub
  - Testing strategies

Design the API



Basic Process:

(1) Determine minimal feature set
(2) Draw UML on the whiteboard.
(3) Sketch out your API on paper
(4) Write example code
(5) Review
(6) Repeat

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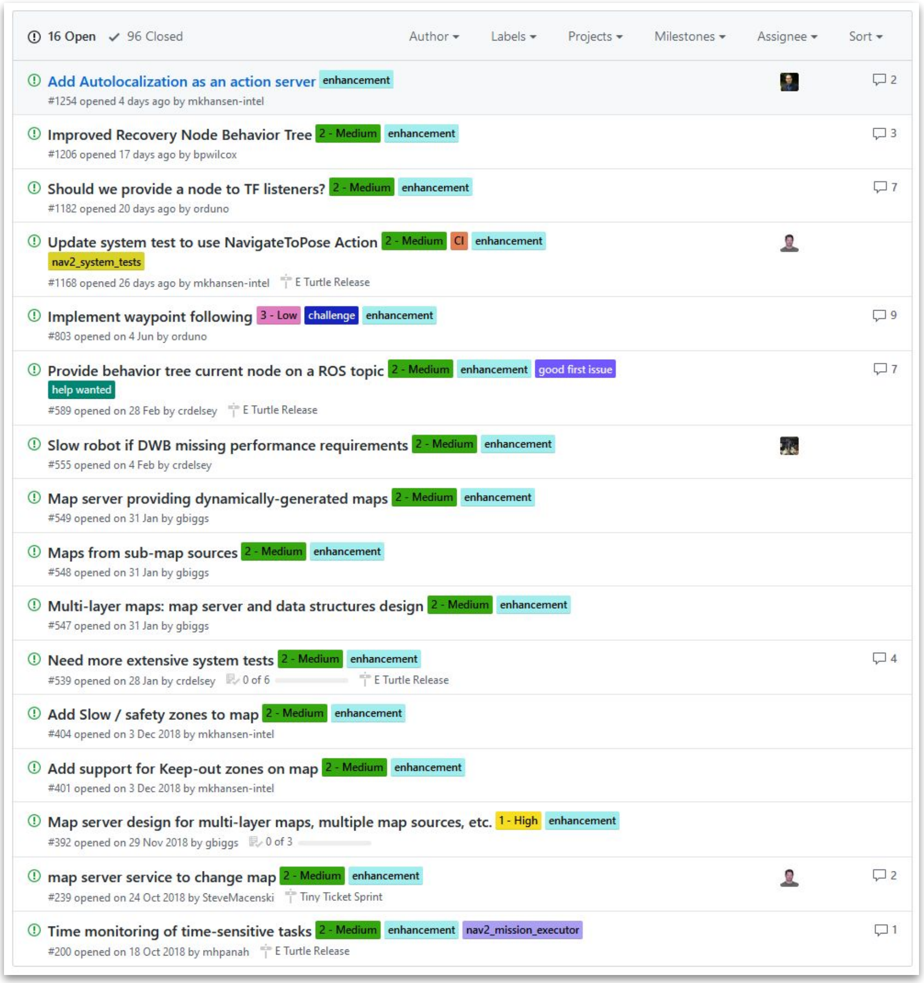
Break up tasks into GitHub Issues



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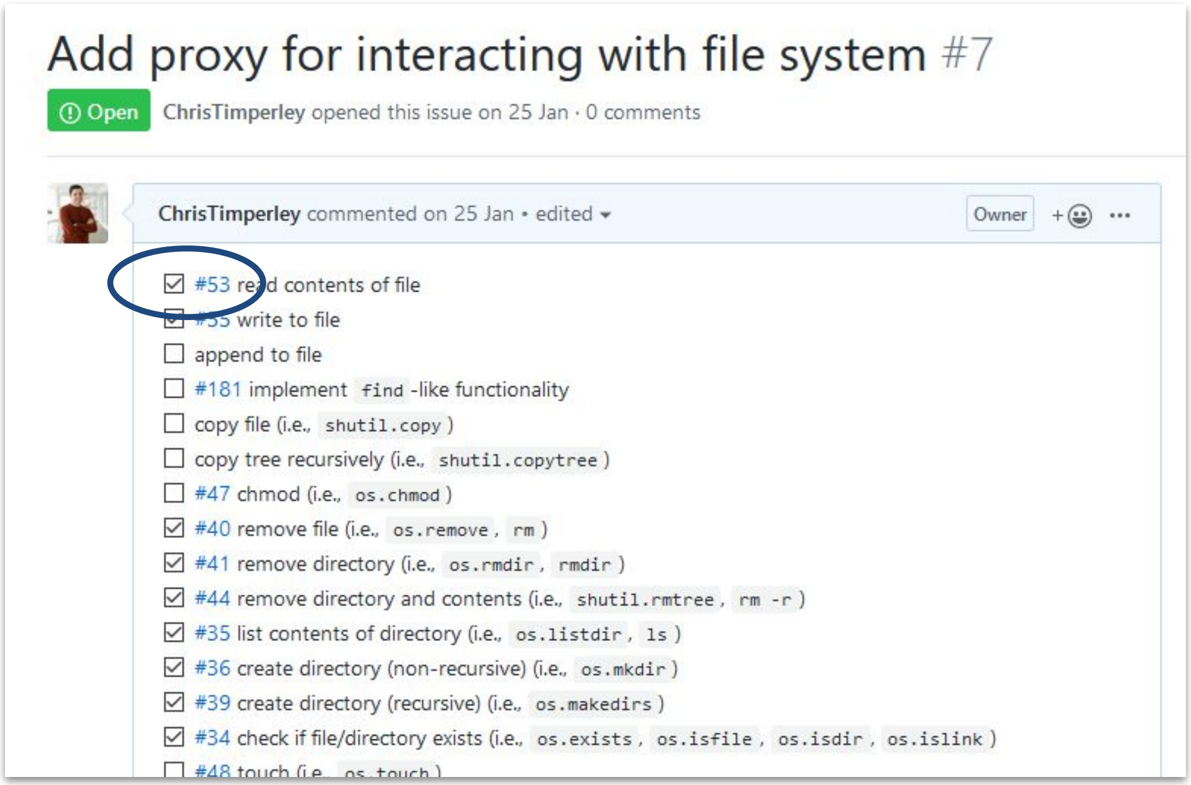
Issues can represent both tasks and bugs that need to be fixed.

Issues should be:

- a *reasonable* chunk of work
- focused and cohesive

Is an issue too big? Break it up!



Add proxy for interacting with file system #7

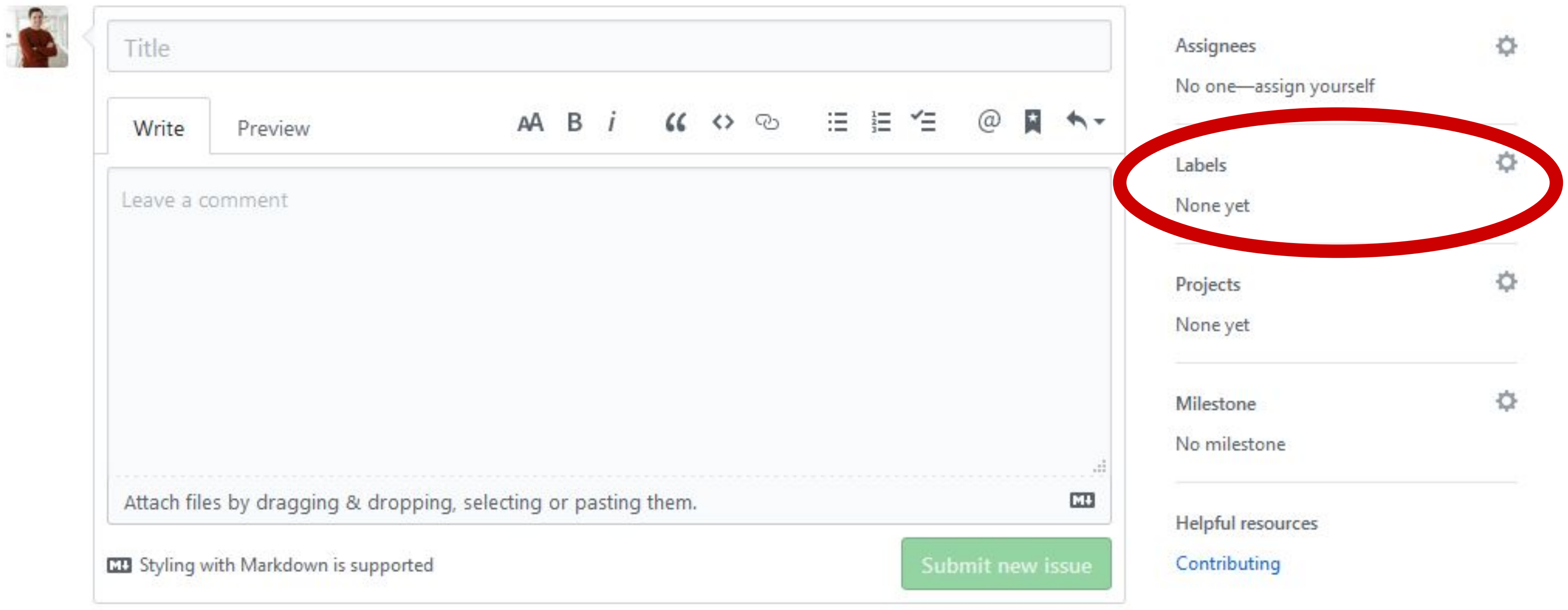
Open ChrisTimperley opened this issue on 25 Jan · 0 comments

ChrisTimperley commented on 25 Jan • edited

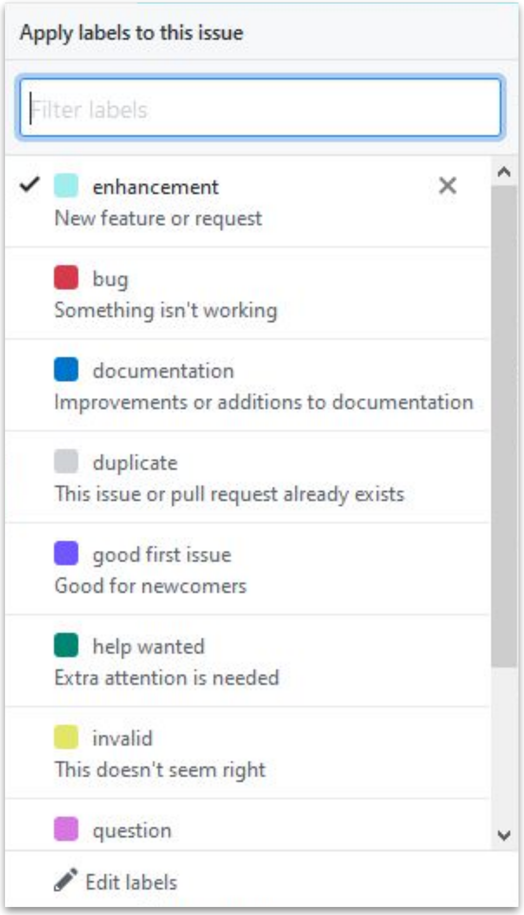
Owner

- [x] #53 read contents of file
- [x] #55 write to file
- [ ] append to file
- [ ] #181 implement `find` -like functionality
- [ ] copy file (i.e., `shutil.copy`)
- [ ] copy tree recursively (i.e., `shutil.copytree`)
- [ ] #47 chmod (i.e., `os.chmod`)
- [x] #40 remove file (i.e., `os.remove` , `rm`)
- [x] #41 remove directory (i.e., `os.rmdir` , `rmdir`)
- [x] #44 remove directory and contents (i.e., `shutil.rmtree` , `rm -r`)
- [x] #35 list contents of directory (i.e., `os.listdir` , `ls`)
- [x] #36 create directory (non-recursive) (i.e., `os.mkdir`)
- [x] #39 create directory (recursive) (i.e., `os.makedirs`)
- [x] #34 check if file/directory exists (i.e., `os.exists` , `os.isfile` , `os.isdir` , `os.islink`)
- [ ] #48 touch (i.e., `os.touch`)

Break up tasks into GitHub Issues



Use labels to indicate priority and differentiate bugs from features


Apply labels to this issue

Filter labels

✓ 🟦 enhancement ✕
New feature or request

🟥 bug
Something isn't working

🟦 documentation
Improvements or additions to documentation

⬜ duplicate
This issue or pull request already exists

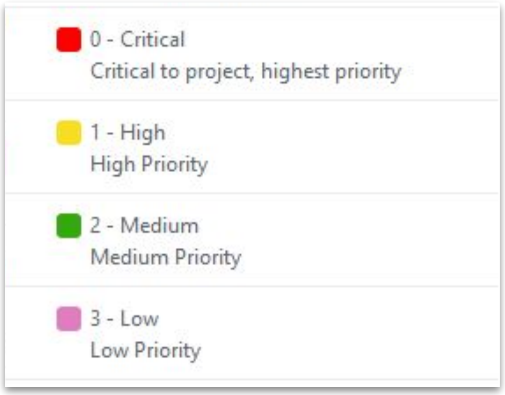
🟪 good first issue
Good for newcomers

🟩 help wanted
Extra attention is needed

🟨 invalid
This doesn't seem right

🟪 question

Edit labels

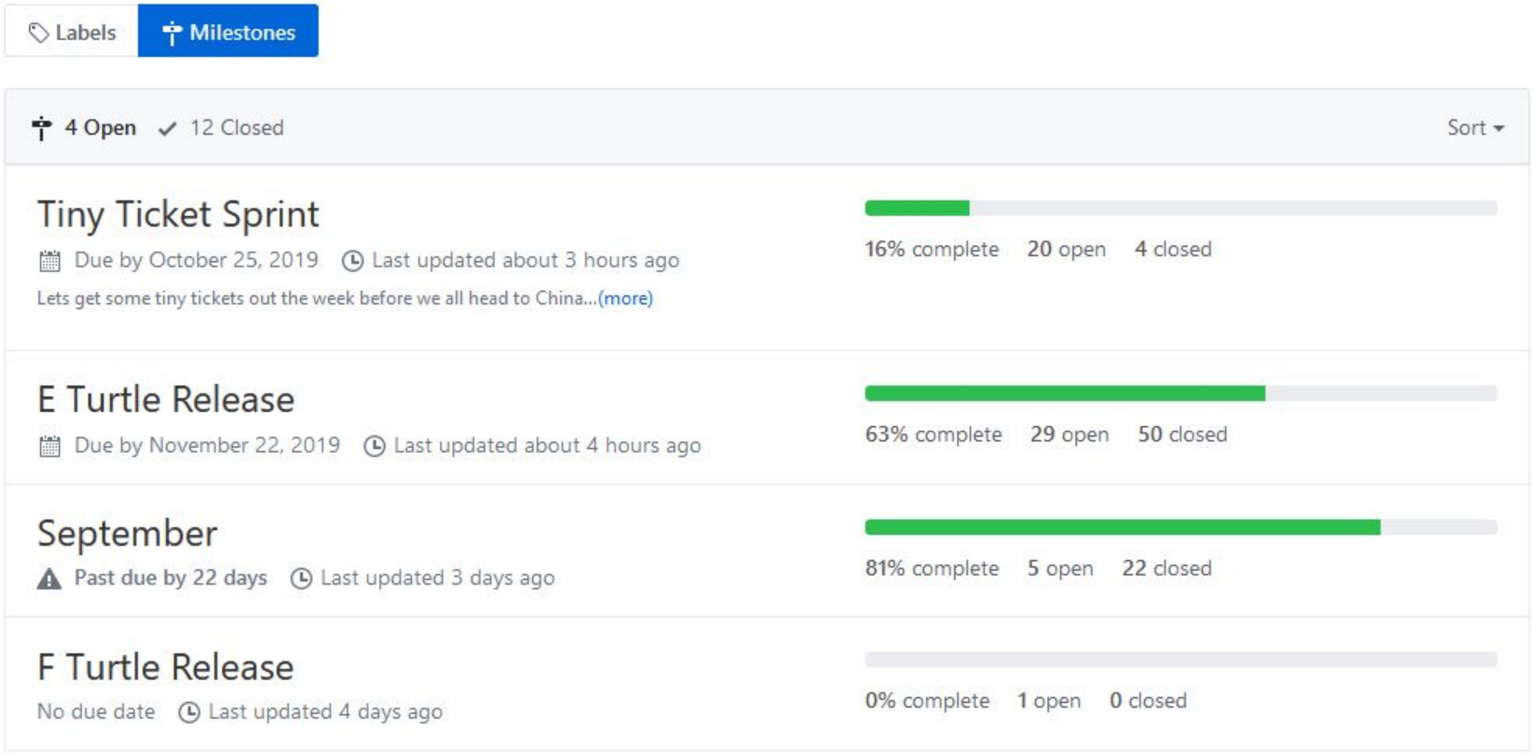

🟥 0 - Critical
Critical to project, highest priority

🟨 1 - High
High Priority

🟩 2 - Medium
Medium Priority

🟪 3 - Low
Low Priority

Consider using milestones (e.g., HW5a, HW5b)



4 Open ✓ 12 Closed

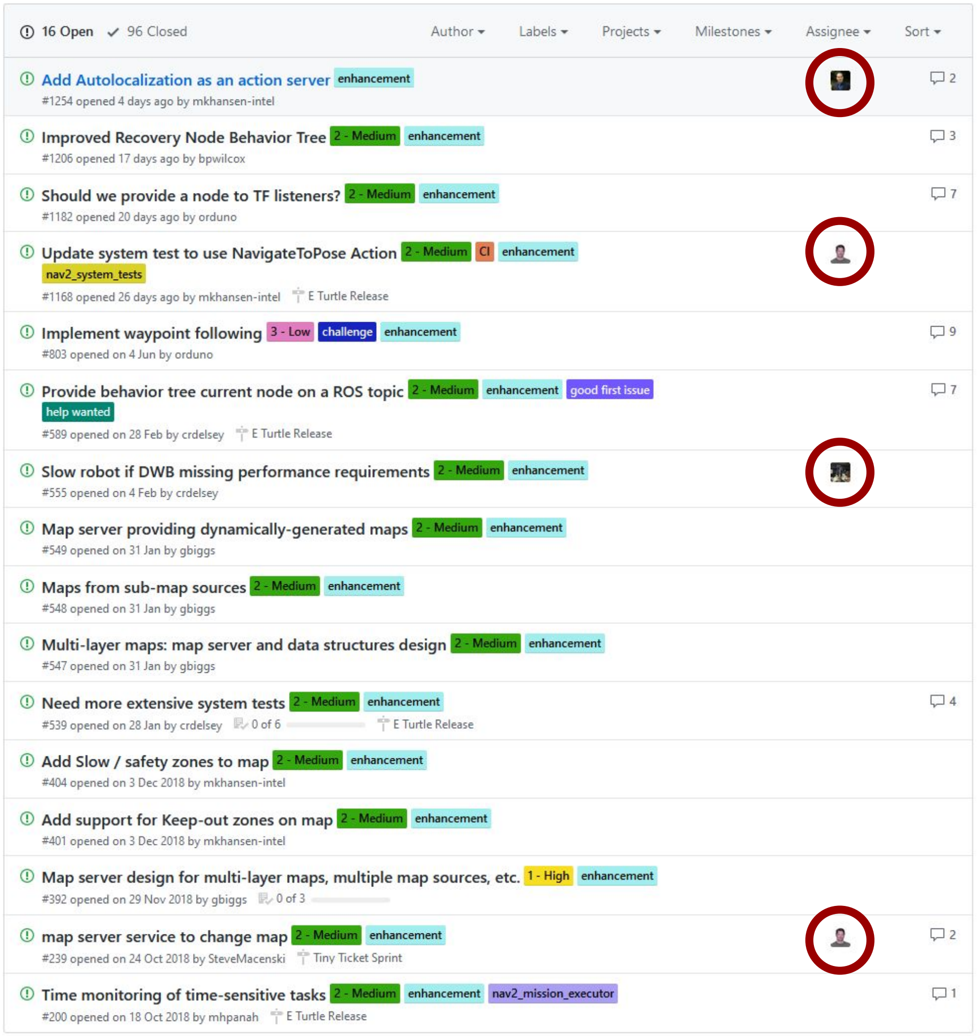
Tiny Ticket Sprint
Due by October 25, 2019 · Last updated about 3 hours ago
Lets get some tiny tickets out the week before we all head to China...(more)
16% complete · 20 open · 4 closed

E Turtle Release
Due by November 22, 2019 · Last updated about 4 hours ago
63% complete · 29 open · 50 closed

September
Past due by 22 days · Last updated 3 days ago
81% complete · 5 open · 22 closed

F Turtle Release
No due date · Last updated 4 days ago
0% complete · 1 open · 0 closed

Now what?



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Assigning issues to team members

- How do we assign issues to team members?
  - Split the issues equally?
  - Are all issues equally important and time consuming?
  - Should one person deal with all X-related matters?
- Unfair assignment can create resentment and bad dynamics.
  - Most of the time this happens, it's unintentional!
  - Software engineers are *really* lousy at effort estimation.

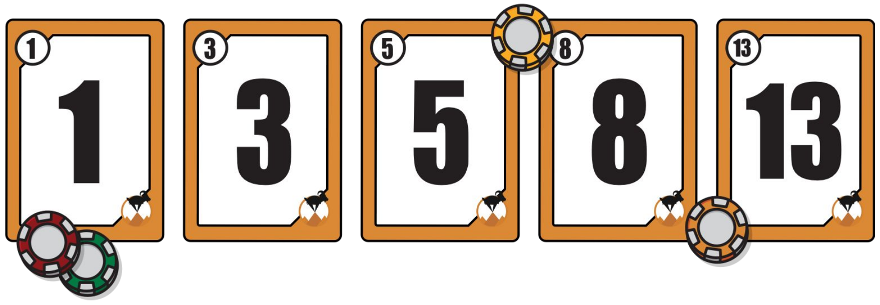
https://jignashadesai.files.wordpress.com/2017/01/uneven.jpg

Beware: Humans aren’t good at estimating effort!

Hofstadter's Law: It always takes longer than you expect, even when you take into account Hofstadter's Law.
— *Douglas Hofstadter, Gödel, Escher, Bach: An Eternal Golden Braid*

The first 90 percent of the code accounts for the first 90 percent of the development time. The remaining 10 percent of the code accounts for the other 90 percent of the development time.
— Tom Cargill, Bell Labs

Use planning poker to estimate effort



https://www.mountaingoatsoftware.com/agile/planning-poker

When should we assign issues?

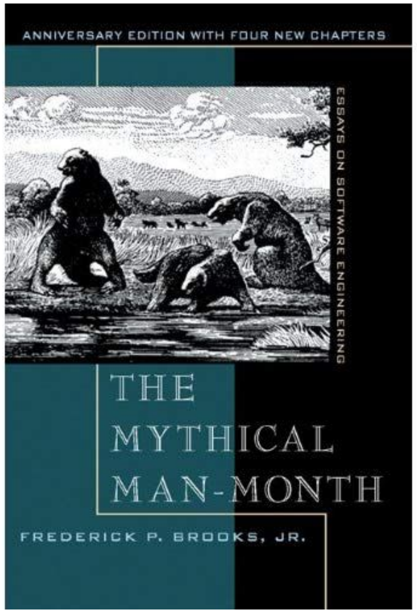
- No hard-and-fast rule.
- Self-assignment can be okay, and may be necessary.
- **Need to maintain checks and balances! Review issue assignment during meetings.**

https://acumagnet.files.wordpress.com/2018/02/809316fe-2d30-4da7-92a1-18e6021efc03-4063-000003860964ea7d_tmp.jpg

How does a large software project get to be one year late?

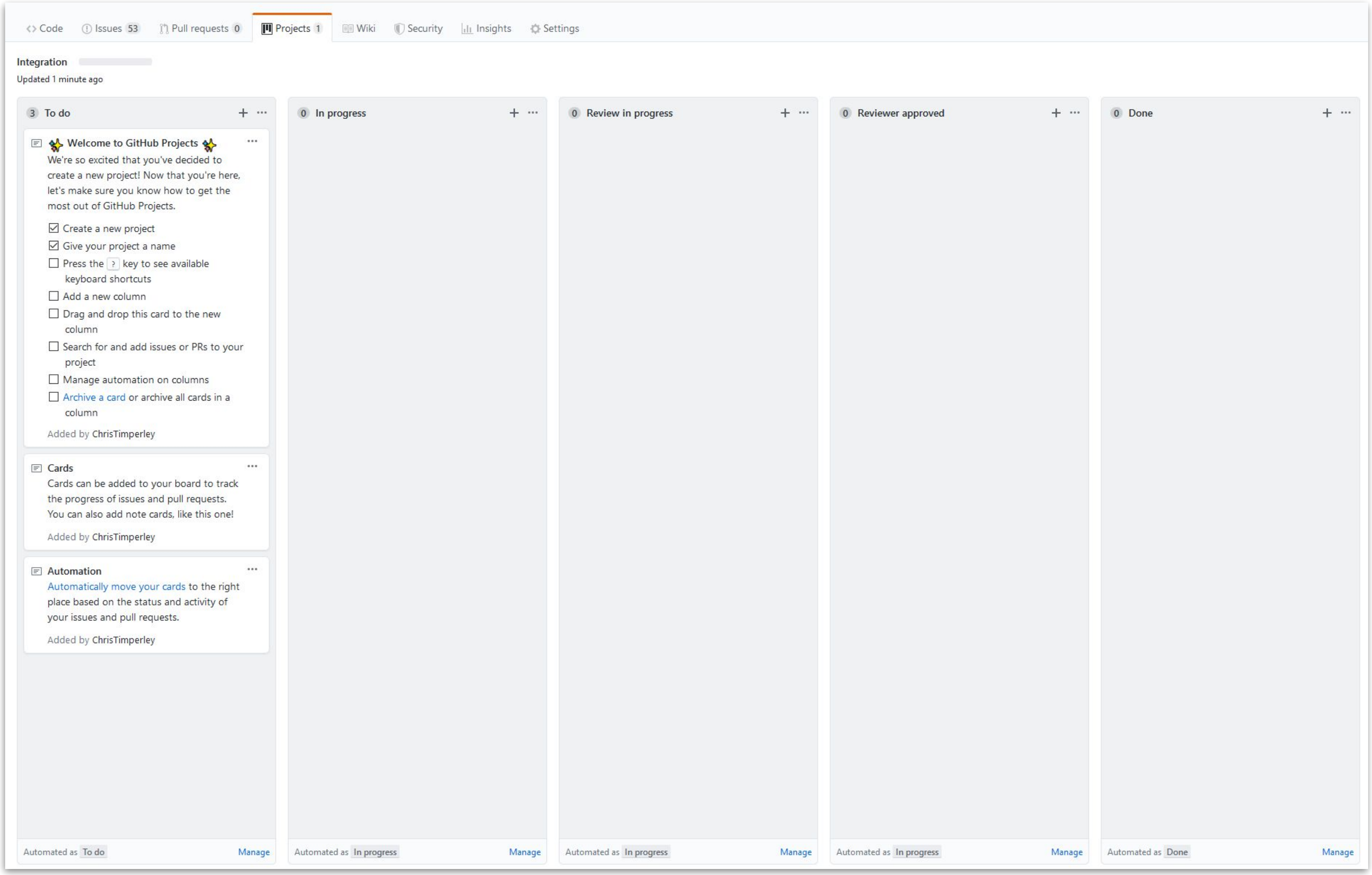
One day at a time.

— Fred Brooks, *The Mythical Man-Month*


ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS
ESSAYS ON SOFTWARE ENGINEERING
THE MYTHICAL MAN-MONTH
FREDERICK P. BROOKS, JR.

https://en.wikipedia.org/wiki/The_Mythical_Man-Month

Use a simple Kanban board to measure progress



<> Code | Issues 53 | Pull requests 0 | Projects 1 | Wiki | Security | Insights | Settings

Integration
Updated 1 minute ago

3 To do

Welcome to GitHub Projects
We're so excited that you've decided to create a new project! Now that you're here, let's make sure you know how to get the most out of GitHub Projects.

- [x] Create a new project
- [x] Give your project a name
- [ ] Press the ? key to see available keyboard shortcuts
- [ ] Add a new column
- [ ] Drag and drop this card to the new column
- [ ] Search for and add issues or PRs to your project
- [ ] Manage automation on columns
- [ ] Archive a card or archive all cards in a column

Added by ChrisTimperley

Cards
Cards can be added to your board to track the progress of issues and pull requests. You can also add note cards, like this one!
Added by ChrisTimperley

Automation
Automatically move your cards to the right place based on the status and activity of your issues and pull requests.
Added by ChrisTimperley

Automated as To do — Manage

0 In progress
Automated as In progress — Manage

0 Review in progress
Automated as In progress — Manage

0 Reviewer approved
Automated as In progress — Manage

0 Done
Automated as Done — Manage

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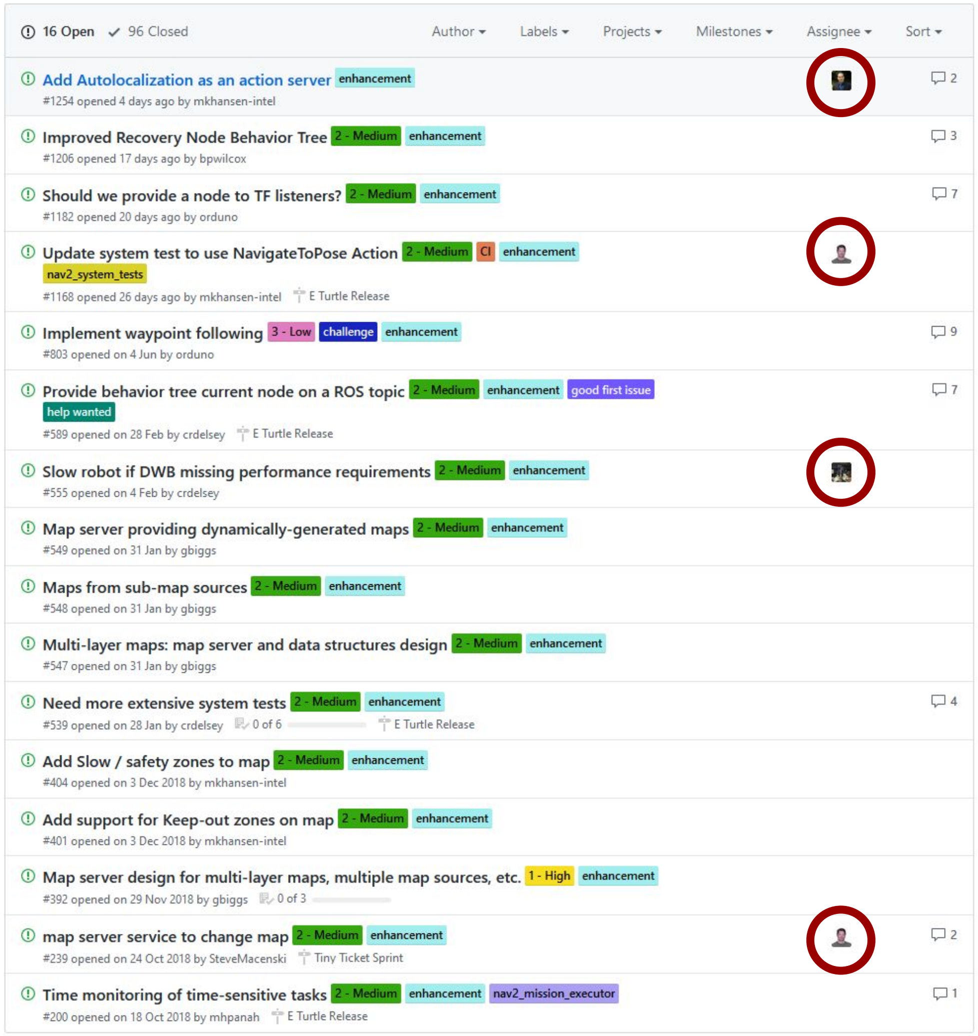
Tackling the issues



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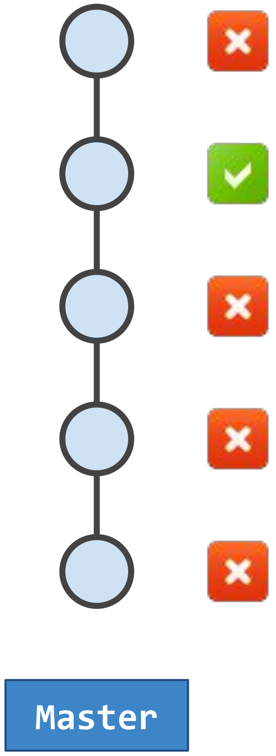
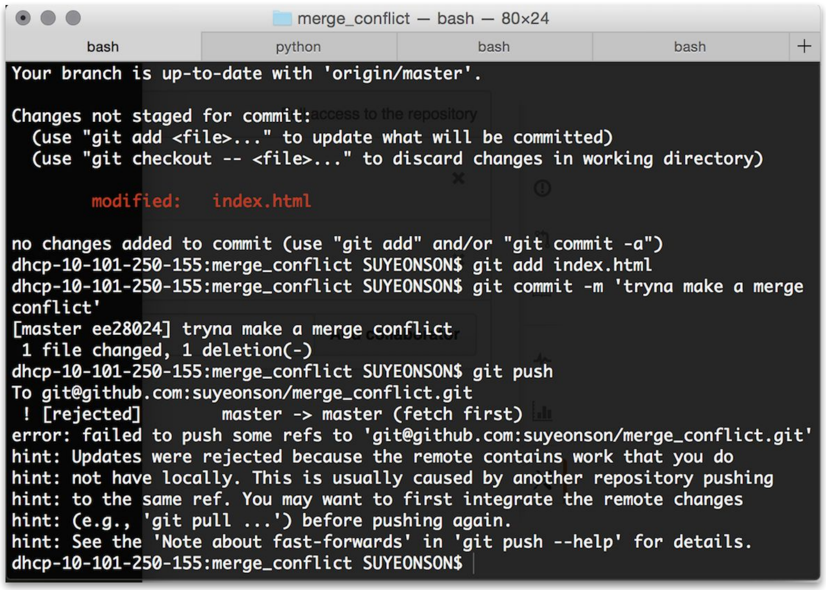
Single-branch development doesn't scale to teams





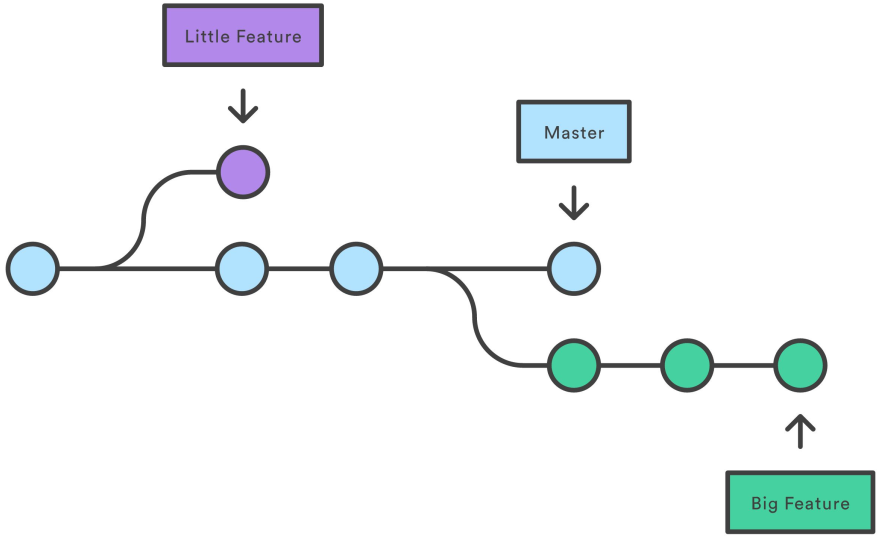
```
Your branch is up-to-date with 'origin/master'.

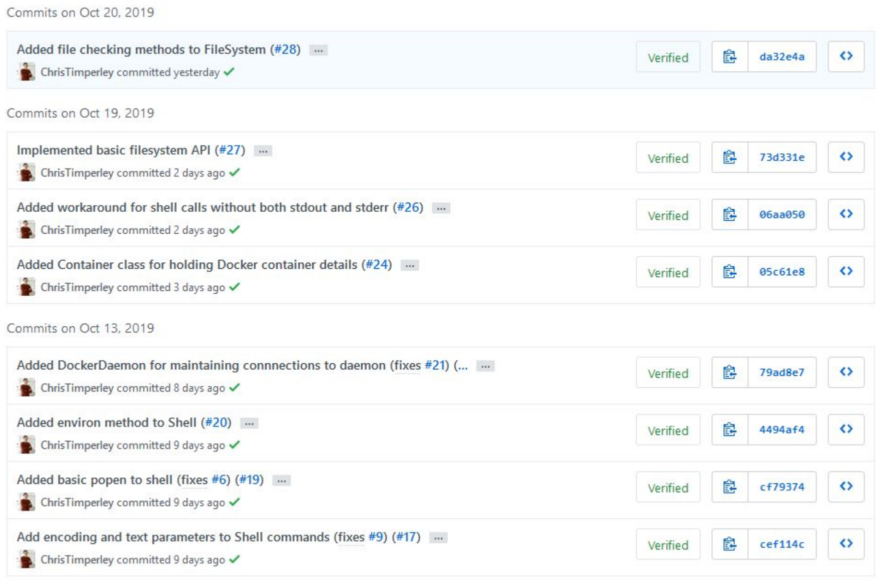
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   index.html

no changes added to commit (use "git add" and/or "git commit -a")
dhcp-10-101-250-155:merge_conflict SUYEONSON$ git add index.html
dhcp-10-101-250-155:merge_conflict SUYEONSON$ git commit -m 'tryna make a merge
conflict'
[master ee28024] tryna make a merge conflict
 1 file changed, 1 deletion(-)
dhcp-10-101-250-155:merge_conflict SUYEONSON$ git push
To git@github.com:suyeonson/merge_conflict.git
 ! [rejected]        master -> master (fetch first)
error: failed to push some refs to 'git@github.com:suyeonson/merge_conflict.git'
hint: Updates were rejected because the remote contains work that you do
hint: not have locally. This is usually caused by another repository pushing
hint: to the same ref. You may want to first integrate the remote changes
hint: (e.g., 'git pull ...') before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
dhcp-10-101-250-155:merge_conflict SUYEONSON$
```

Use simple **branch-based development**




Commits on Oct 20, 2019

Added file checking methods to FileSystem (#28) …
ChrisTimperley committed yesterday ✓ — Verified — da32e4a

Commits on Oct 19, 2019

Implemented basic filesystem API (#27) …
ChrisTimperley committed 2 days ago ✓ — Verified — 73d331e

Added workaround for shell calls without both stdout and stderr (#26) …
ChrisTimperley committed 2 days ago ✓ — Verified — 06aa050

Added Container class for holding Docker container details (#24) …
ChrisTimperley committed 3 days ago ✓ — Verified — 05c61e8

Commits on Oct 13, 2019

Added DockerDaemon for maintaining connnections to daemon (fixes #21) (… …
ChrisTimperley committed 8 days ago ✓ — Verified — 79ad8e7

Added environ method to Shell (#20) …
ChrisTimperley committed 9 days ago ✓ — Verified — 4494af4

Added basic popen to shell (fixes #6) (#19) …
ChrisTimperley committed 9 days ago ✓ — Verified — cf79374

Add encoding and text parameters to Shell commands (fixes #9) (#17) …
ChrisTimperley committed 9 days ago ✓ — Verified — cef114c

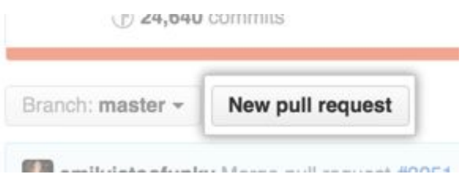
Create a new branch for each feature.

- allows parallel development
- no dealing with half-finished code
- no merge conflicts!

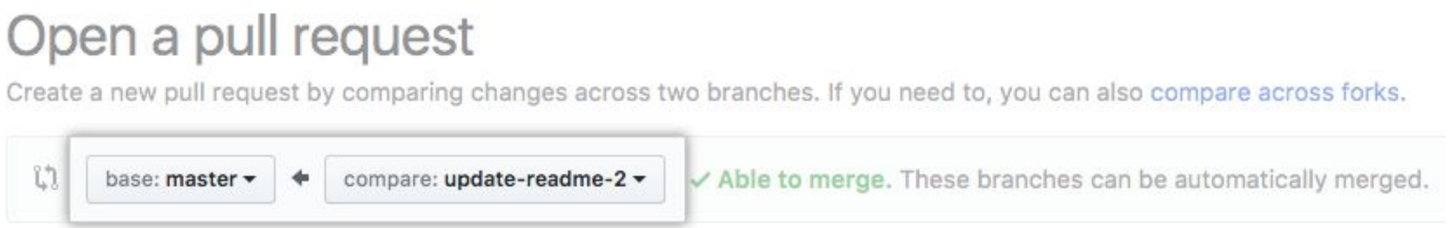
Every commit to "master" should pass your CI checks.

build passing

Use GitHub **pull requests** to review and merge changes



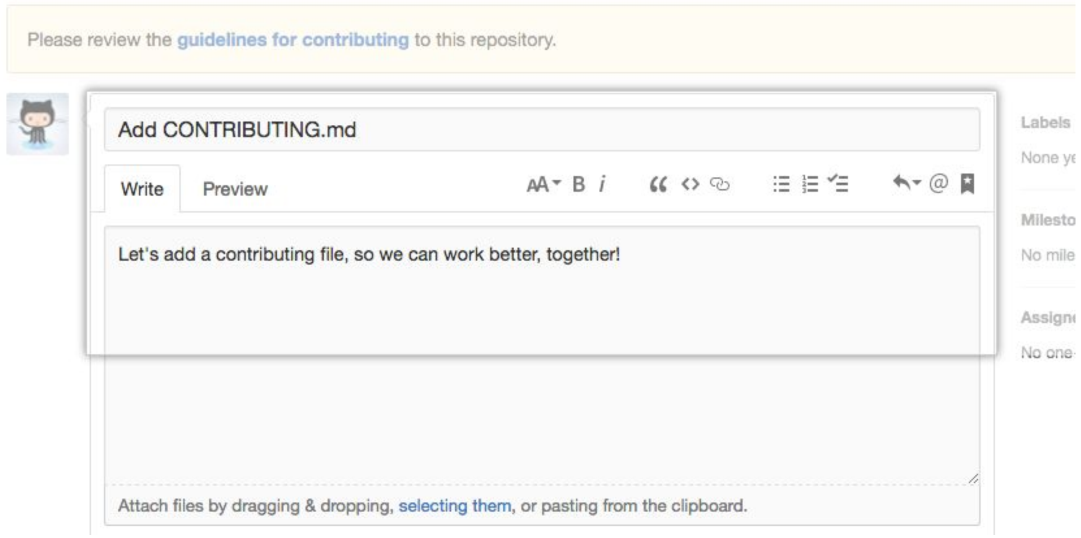
24,640 commits



Open a pull request

Create a new pull request by comparing changes across two branches. If you need to, you can also compare across forks.

✓ Able to merge. These branches can be automatically merged.



Please review the guidelines for contributing to this repository.

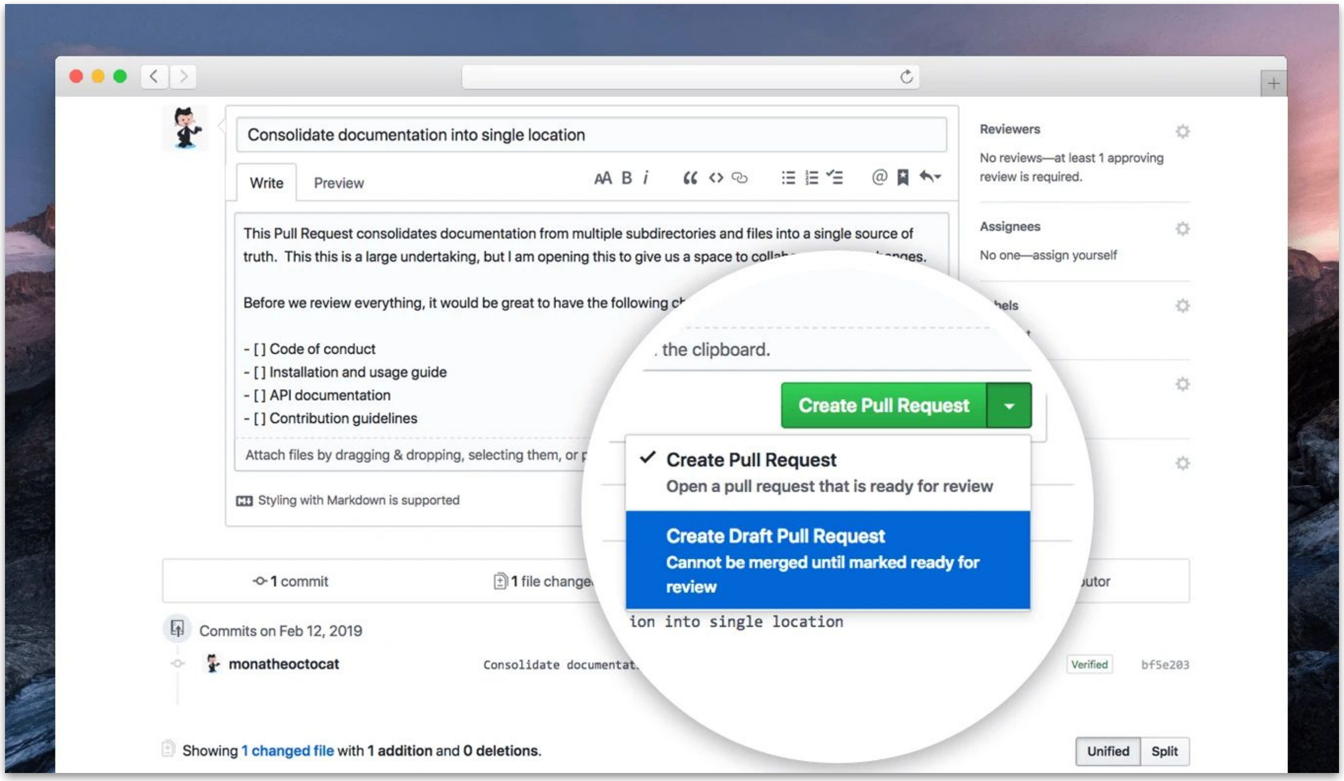
Add CONTRIBUTING.md

Let's add a contributing file, so we can work better, together!

Attach files by dragging & dropping, selecting them, or pasting from the clipboard.

https://help.github.com/en/github/collaborating-with-issues-and-pull-requests/creating-a-pull-request

Aside: You can also create **draft pull requests**



Consolidate documentation into single location

This Pull Request consolidates documentation from multiple subdirectories and files into a single source of truth. This this is a large undertaking, but I am opening this to give us a space to collab

Before we review everything, it would be great to have the following ch

- [] Code of conduct
- [] Installation and usage guide
- [] API documentation
- [] Contribution guidelines

Write
Preview
Attach files by dragging & dropping, selecting them, or p
Styling with Markdown is supported
Reviewers
No reviews—at least 1 approving review is required.
Assignees
No one—assign yourself
. the clipboard.
Create Pull Request
✓ Create Pull Request
Open a pull request that is ready for review
Create Draft Pull Request
Cannot be merged until marked ready for review
1 commit
1 file change
Commits on Feb 12, 2019
monatheoctocat
Consolidate documentation into single location
Verified
bf5e203
Showing 1 changed file with 1 addition and 0 deletions.
Unified
Split

Makes it easier for others to see progress without interrupting your workflow!

https://github.blog/2019-02-14-introducing-draft-pull-requests/

You’ve created your Pull Request. Now what?

Jared Palmer

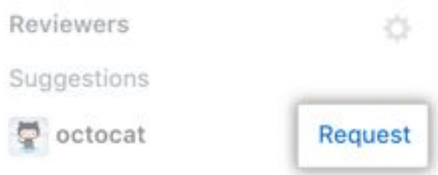
@jaredpalmer

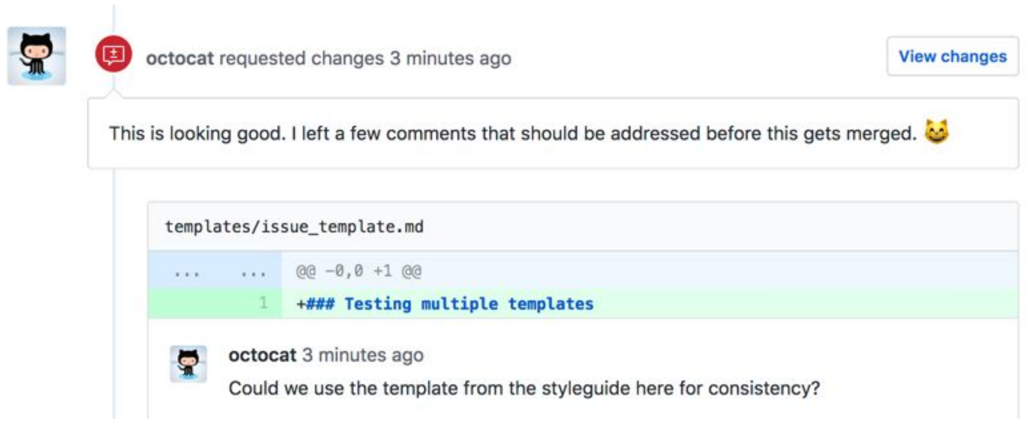
When you merge your own pull request

6:05 AM · 24 Jun 19 · Twitter for iPhone

Doing PRs

Better: Ask your teammates to review your pull request!



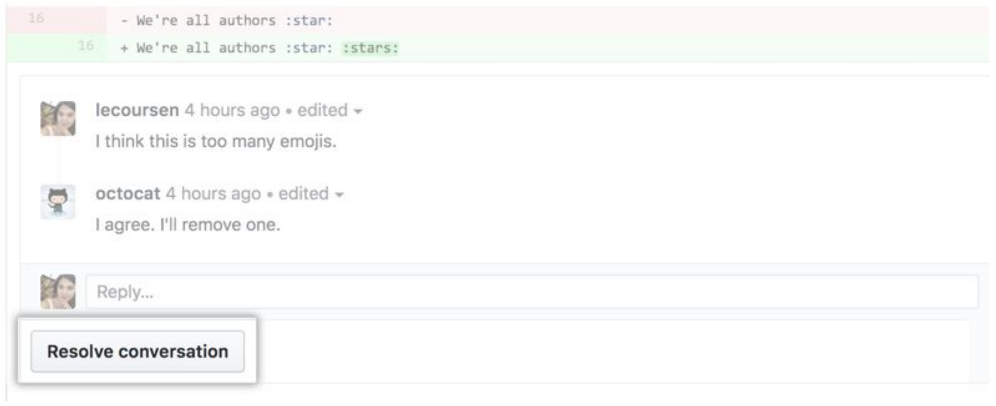


octocat requested changes 3 minutes ago

This is looking good. I left a few comments that should be addressed before this gets merged. 😺

```
templates/issue_template.md
...   ...   @@ -0,0 +1 @@
          1 +### Testing multiple templates
```

octocat 3 minutes ago
Could we use the template from the styleguide here for consistency?



```
16     - We're all authors :star:
    16 + We're all authors :star: :stars:
```

lecoursen 4 hours ago • edited
I think this is too many emojis.

octocat 4 hours ago • edited
I agree. I'll remove one.

https://help.github.com/en/github/collaborating-with-issues-and-pull-requests/about-pull-request-reviews

Tips for Code Review: Preparing your code for review

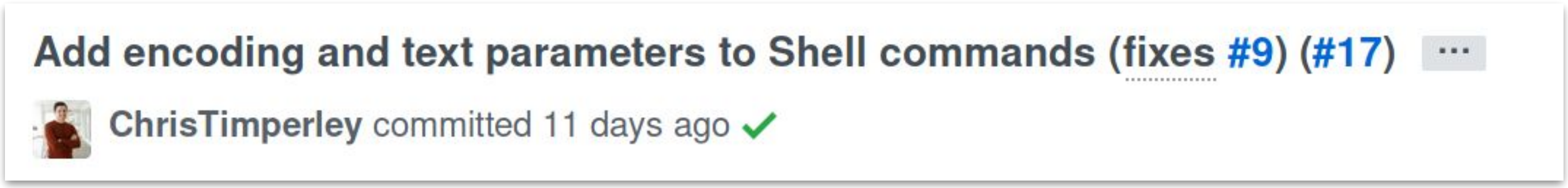
1. **Keep your changes small and cohesive**
   - Large pull requests (PRs) are tedious and difficult to review.
   - Try to avoid fixing multiple issues in one PR.
2. **Check your code before you submit your pull request**
   - Is the code readable? Do I need to add any comments?
   - Is the Travis build passing? If not, fix it.
   - Make life easier for the reviewer — things will move faster! :-)
3. **Don’t get too attached to your code**
   - You may have to change things. Don’t take it personally.
   - Be open to feedback — you’ll become a better engineer.

Tips for Code Review: Reviewing code

1. **Agree the purpose of review**
   - At a minimum, to see that the code is correct and tested.
   - Check for style, consistency, naming, etc.
2. **Be considerate**
   - Don't review the author; review the code
3. **Provide constructive criticism**
   - Identify the *potential* issues and provide suggestions
   - If there's any doubt, ask for clarification -- you may be wrong.
   - Don't pass off your own opinions as fact
4. **Don't change the pull request yourself**
   - At that point, you're no longer a reviewer.
5. **Establish timeliness expectations**
   - How long should the PR author wait to receive a review?

https://alterconf.com/talks/unlearning-toxic-behaviors-code-review-culture
https://css-tricks.com/code-review-etiquette/

Bonus tip: Automatically close issues in commits/PRs


Add encoding and text parameters to Shell commands (fixes #9) (#17) ···

ChrisTimperley committed 11 days ago ✓

Use any of the following words:

- close #N, closes #N, closed #N
- fix #N, fixes #N, fixed #N
- resolve #N, resolves #N, resolved #N

Outline

- Group dynamics
- Tools and processes for software teams
  - Identifying and assigning tasks
  - Collaborative development
  - Testing strategies

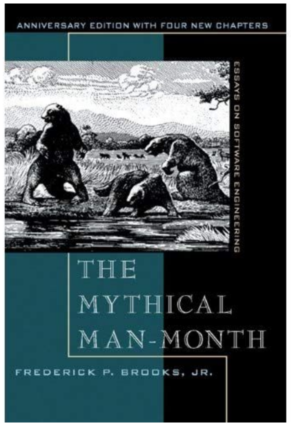
Devise a testing strategy for your team

- Who should write tests?
  - The person responsible for the implementation?
  - Someone else?
- When should tests be written? When will tests be written?
  - Smaller issues = fewer tests
  - Write blackbox tests before implementation
  - Write additional whitebox tests before submitting a pull request
- Consider using mocks and (basic) dependency injection
  - Allow coupled components to be unit tested
  - Allows developers to work in parallel

https://site.mockito.org/

Summary

- Identify and discuss risks within your team
  - Get to know your teammates, and agree on your process
- Tools and services like Git, GitHub, and Trello can improve your engineering process and help your team work more effectively!
  - Some process is better than no process.
  - Use this advice as a set of guidelines; discover what works well for your team -- everyone is different.
- Check out the books below for much more on this topic!


ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS
ESSAYS ON SOFTWARE ENGINEERING
THE MYTHICAL MAN-MONTH
FREDERICK P. BROOKS, JR.