Test-Driven Development in Practice

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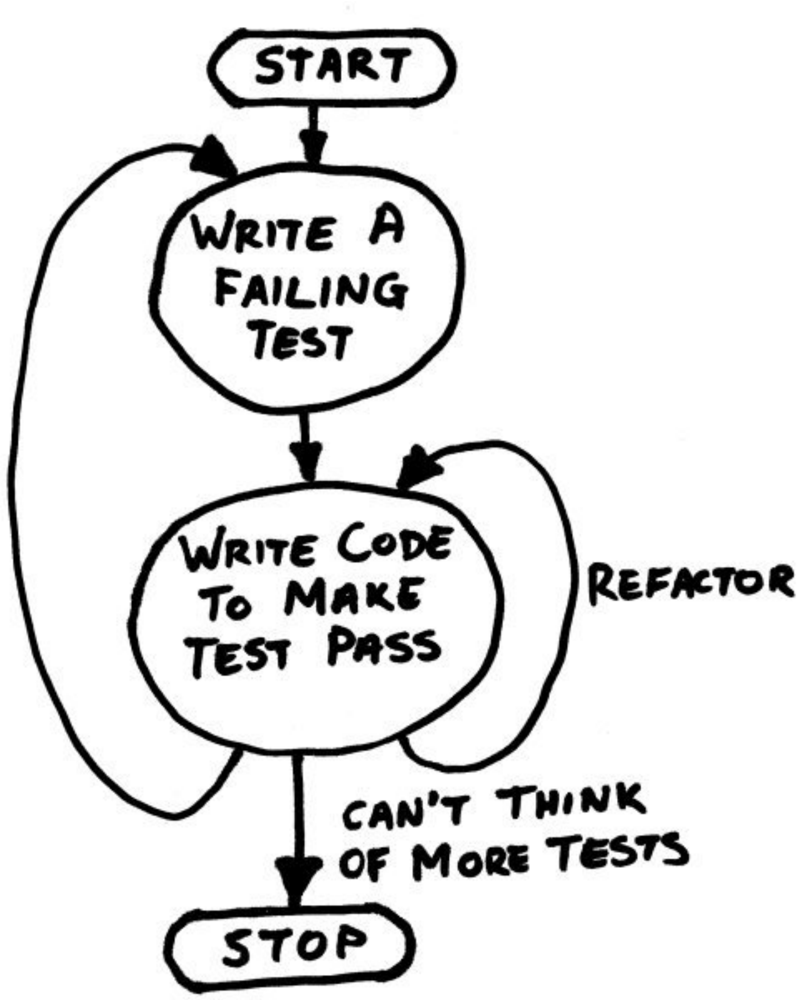
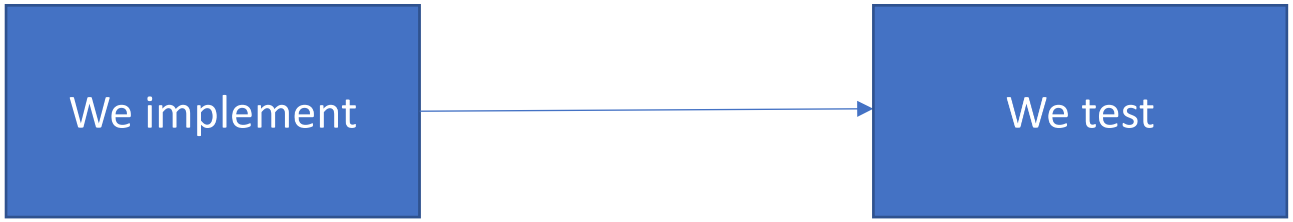


That’s how we currently do!



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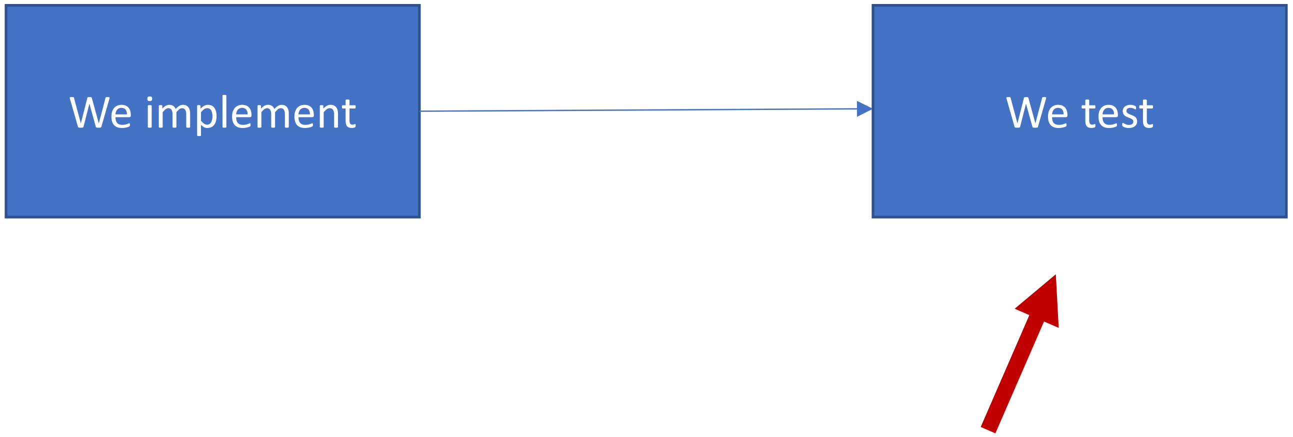
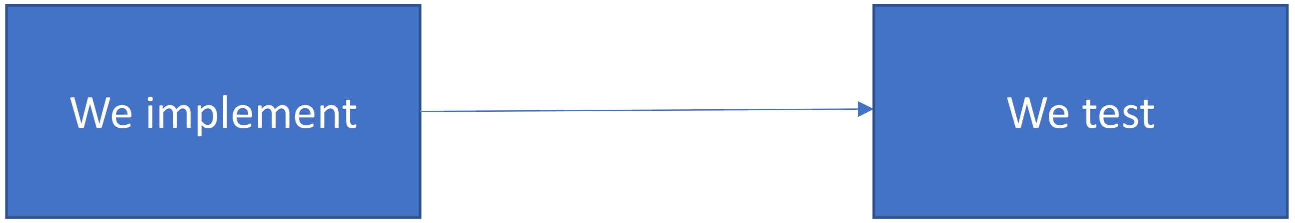


What do we miss if we do testing later?
… VERY VERY late?

Can we test first?



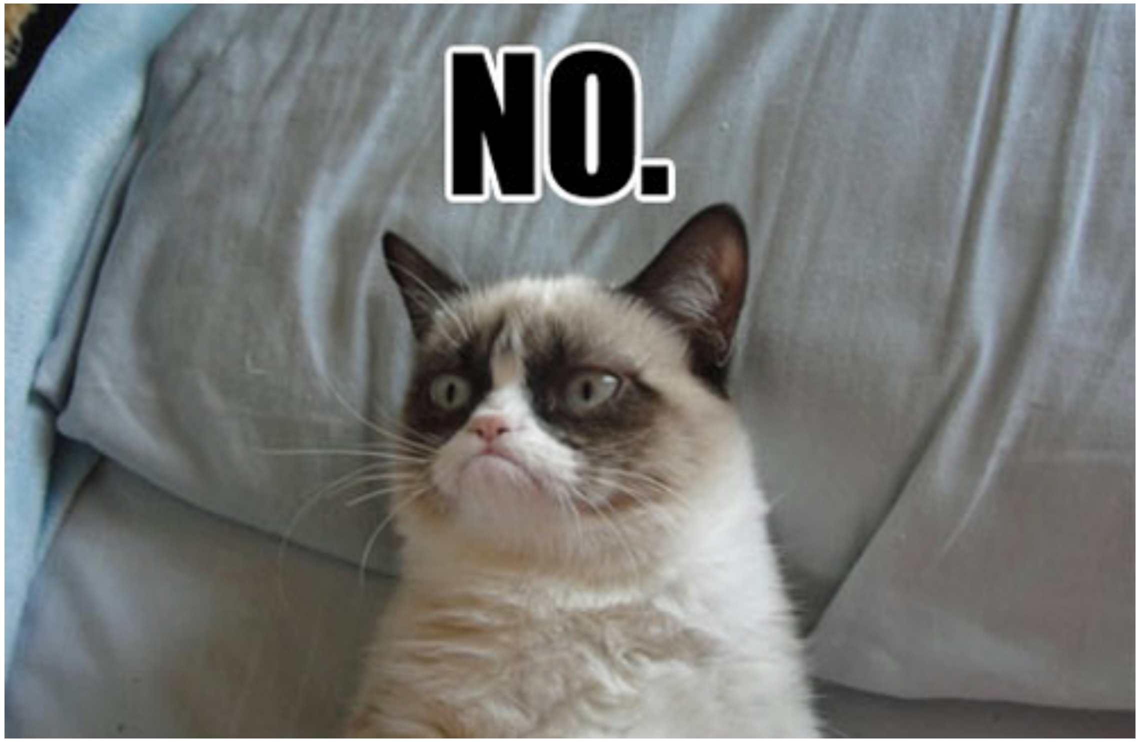
How?

- We think about a test.
- We write the test.
- We implement the code …
- **In the simplest way we can.**

Let’s try!

- Roman Numerals
- Receives a string, converts to integer
  - ”I” -> 1
  - ”III” -> 3
  - ”VI” -> 6
  - ”IV” -> 4
  - ”XVI” -> 16
  - ”XIV” -> 14

Are you happy with this code?



Baby steps

- *Simplicity:* We should do the simplest implementation that solves the problem, start by the simplest possible test, …

- Do not confuse *being simple* with *being innocent*.
  - Kent Beck states in his book: *”Do these steps seem too small to you? Remember, TDD is not about taking teensy tiny steps, it’s about being able to take teensy tiny steps. Would I code day-to-day with steps this small? No. But when things get the least bit weird, I’m glad I can.”*

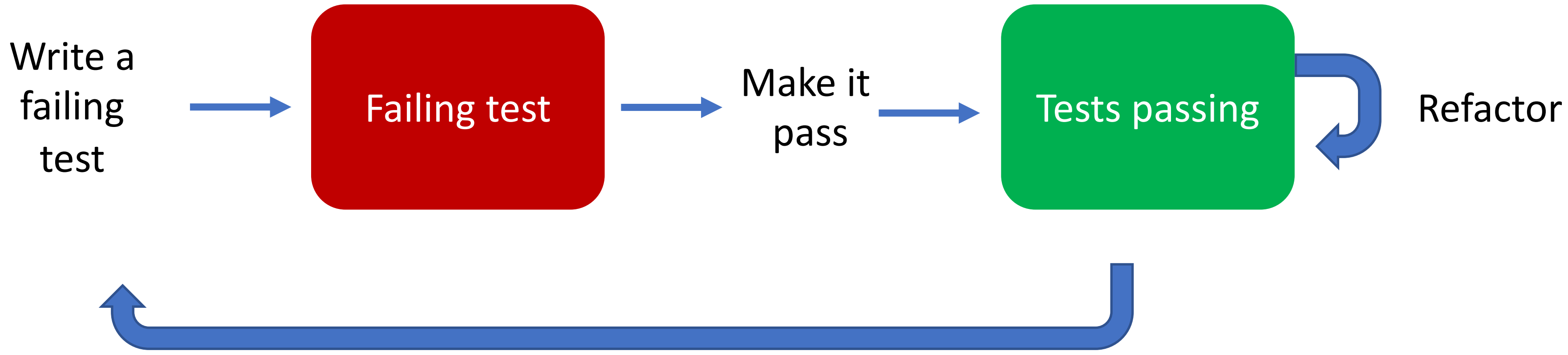
Refactor!

- In many opportunities, we are so busy making the test pass that we forget about writing good code.

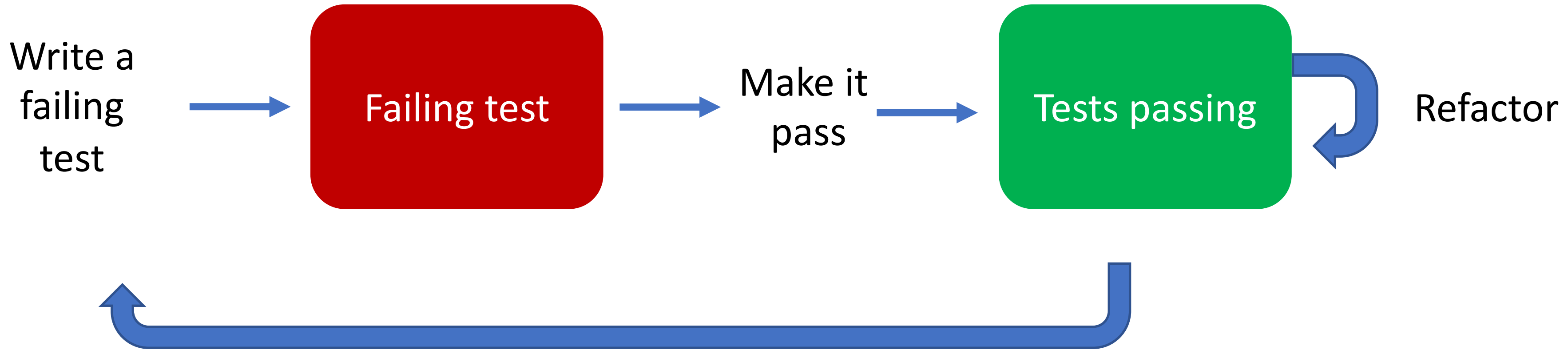
- After the test is green, you can refactor.
  - Good thing is that, after the refactoring, tests should still be green.
- Refactoring can be at low-level or high-level.
  - Low-level: rename variables, extract methods.
  - High-level: change the class design, class contracts.

Let’s do some refactor and continue!

The TDD cycle



The TDD cycle



What are the advantages?

Focus on the requirements

- Starting by the test means **starting by the requirements**.
- It makes us think more about:
  - what we expect from the class.
  - how the class should behave in specific cases.
- We do not write ”useless code”
  - Go to your codebase right now. How much code have you written that is never used in real world?

Controlling your pace

- Having a failing test, give us a clear focus: **make the test pass**.
- I can write whenever test I want:
    - If I feel insecure, I can write a simpler test.
    - If I feel safe, I can write a more complicated test.
    - If there’s something I do not understand, I can take a tiny baby step.
    - If I understand completely, I can take a larger step.

Test from the requirements

- Starting from the test means starting from the requirements. Meaning your **tests derive from the requirements**, and not from existing code.
- If you follow the idea of always having tests, you do not need to test afterwards.
  - Your code is tested already!

It’s our first client!

- The test code is the **first client** of the class you are constructing.
  - Use it to your advantage.

- What can you get from the client?
  - Is it hard to make use of your class?
  - Is it hard to build the class?
  - Is it hard to set up the class for use (pre conditions)?
  - Does the class return what I want?

Testable code

- TDD makes you think about tests from the beginning.
  - This means you will be enforced to **write testable classes**.
- We discussed it before: a testable class is also an easy-to-use class.

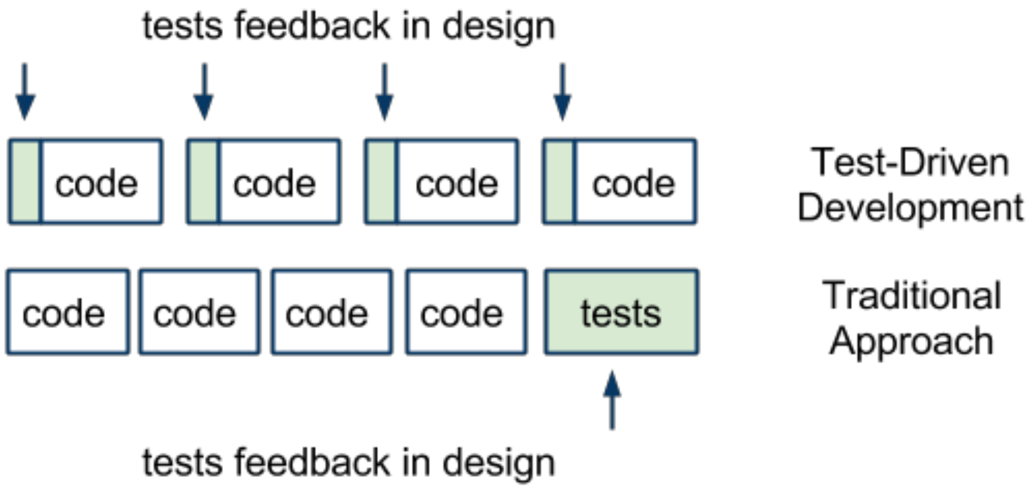
- Some people call TDD as *Test-Driven Design.*

Tests as a *draft*

- Changing your class design **is cheaper** when done at the beginning.
- Use your tests as a *draft*: play with the class; if you don’t like the class design, change it.
    - Remember: the test is your first client.

Faster feedback

- You are writing tests frequently. This means you will find the problem sooner.
- Tests at the end also work. But maybe the feedback is just too late.



Controllability

- Tests make you **think about managing dependencies from the beginning**.
- If your class depends on too many classes, testing gets harder.
    - You should refactor.

Listen to your test

- The test may reveal design problems.
- You should **”listen to it”.**

- Too many tests?
  - Maybe your class does too much.
- Too many mocks?
  - Maybe your class is too coupled.
- Complex set up before calling the desired behavior?
  - Maybe rethink the pre-conditions.

Is it really effective?

- 50% more tests, less time debugging [5].
- 40-50% less defects, no impact on productivity [6].
- 40-50% less defects in Microsoft and IBM products [12].
- Better use of OOP concepts [13].
- More cohesive, less coupled [15].

Janzen, D., Software Architecture Improvement through Test-Driven Development. Conference on Object Oriented Programming Systems Languages and Applications, ACM, 2005.
Maximilien, E. M. and L. Williams. Assessing test-driven development at IBM. IEEE 25th International Conference on Software Engineering, Portland, Orlando, USA, IEEE Computer Society, 2003.
Nagappan, N., Bhat, T. Evaluating the efficacy of test- driven development: industrial case studies. Proceedings of the 2006 ACM/IEEE international symposium on Empirical software engineering.
Janzen, D., Saiedian, H. On the Influence of Test-Driven Development on Software Design. Proceedings of the 19th Conference on Software Engineering Education & Training (CSEET'06).
Steinberg, D. H. The Effect of Unit Tests on Entry Points, Coupling and Cohesion in an Introductory Java Programming Course. XP Universe, Raleigh, North Carolina, USA, 2001.

Is it?

- No difference in code quality [Erdogmus et al., Müller et al.]
- Siniaalto and Abrahamsson: The differences in the program code, between TDD and the iterative test-last development, were not as clear as expected.

Erdogmus, H., Morisio, M., et al. On the effectiveness of the test-first approach to programming. IEEE Transactions on Software Engineering 31(3): 226 – 237, 2005.
Müller, M. M., Hagner, O. Experiment about test-first programming. IEE Proceedings 149(5): 131 – 136, 2002.
Siniaalto, Maria, and Pekka Abrahamsson. "Does test-driven development improve the program code? Alarming results from a comparative case study." *Balancing Agility and Formalism in Software Engineering*. Springer Berlin Heidelberg, 2008. 143-156.

Is it?

- *”The practice of test-driven development does not drive directly the design, but gives them a safe space to think, the opportunity to refactor constantly, and subtle feedback given by unit tests, are responsible to improve the class design”*.
- *“The claimed benefits of TDD may not be due to its distinctive test-first dynamic, but rather due to the fact that TDD-like processes encourage fine-grained, steady steps that improve focus and flow.”*

Aniche, M., & Gerosa, M. A. (2015). Does test-driven development improve class design? A qualitative study on developers’ perceptions. *Journal of the Brazilian Computer Society*, *21*(1), 15.
Fucci, D., Erdogmus, H., Turhan, B., Oivo, M., & Juristo, N. (2016). A Dissection of Test-Driven Development: Does It Really Matter to Test-First or to Test-Last?. *IEEE Transactions on Software Engineering*.

Practical advice on TDD

- Keep a ”test list”.
- Refactor both production and test code.
- Always see the test failing.
- Stop and think.

TDD 100% of the time?

- No silver bullet! ☺
- Maurício: I do not use TDD 100% of the times. I let my experience tell me when I need it.
  - However, I **always** write tests and I **never** spend too much time only with production code.

Summary

- The TDD cycle is about writing a failing test, make it pass, refactor.
- TDD brings many advantages: focus on the requirements, rhythm, fast feedback, and testability thinking.
- Doing tests is more important than TDD.
- TDD is not a silver bullet.