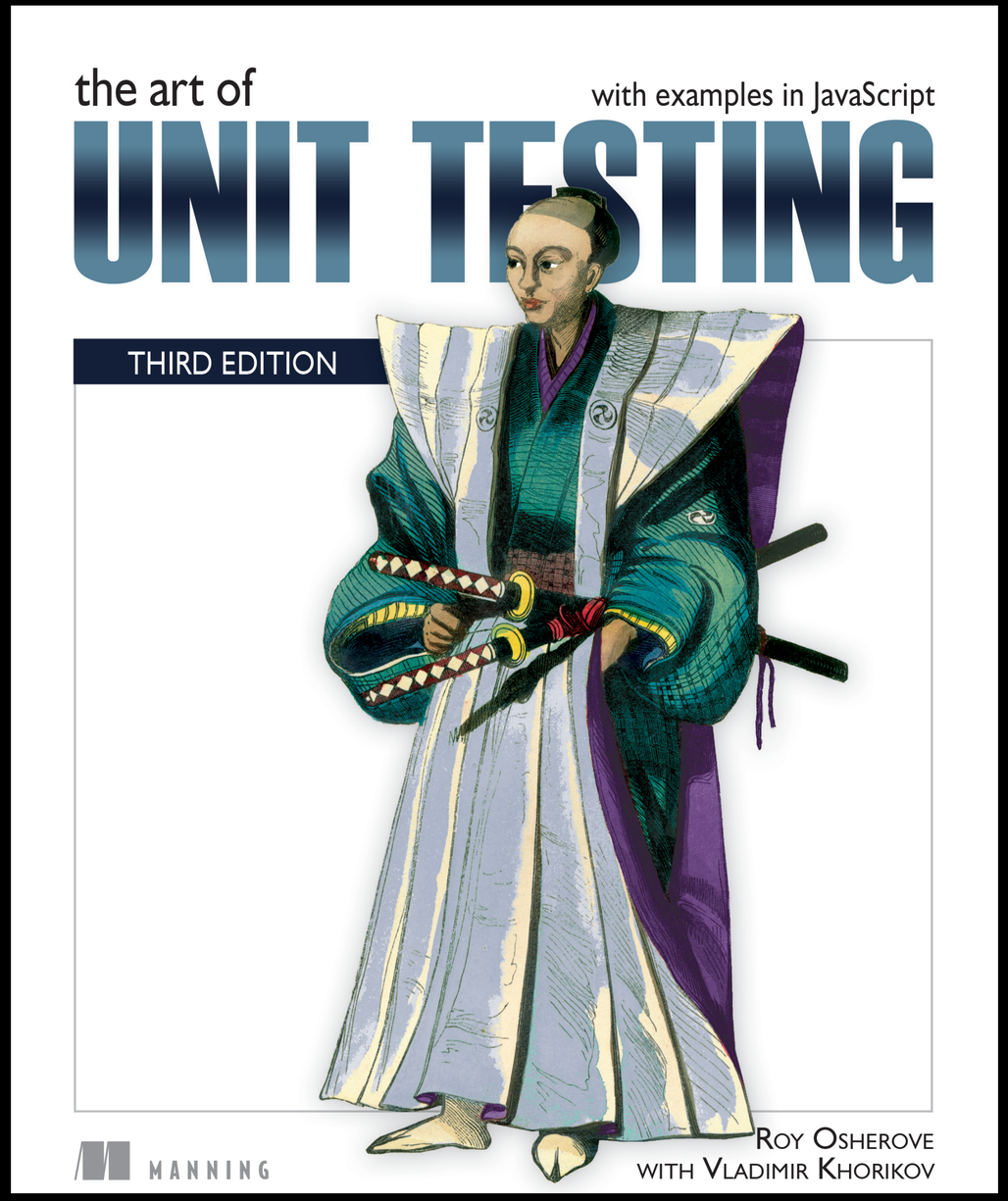
The Art of Unit Testing

The Art of Unit Testing

Study Group in Gogoro



WebConf 2024

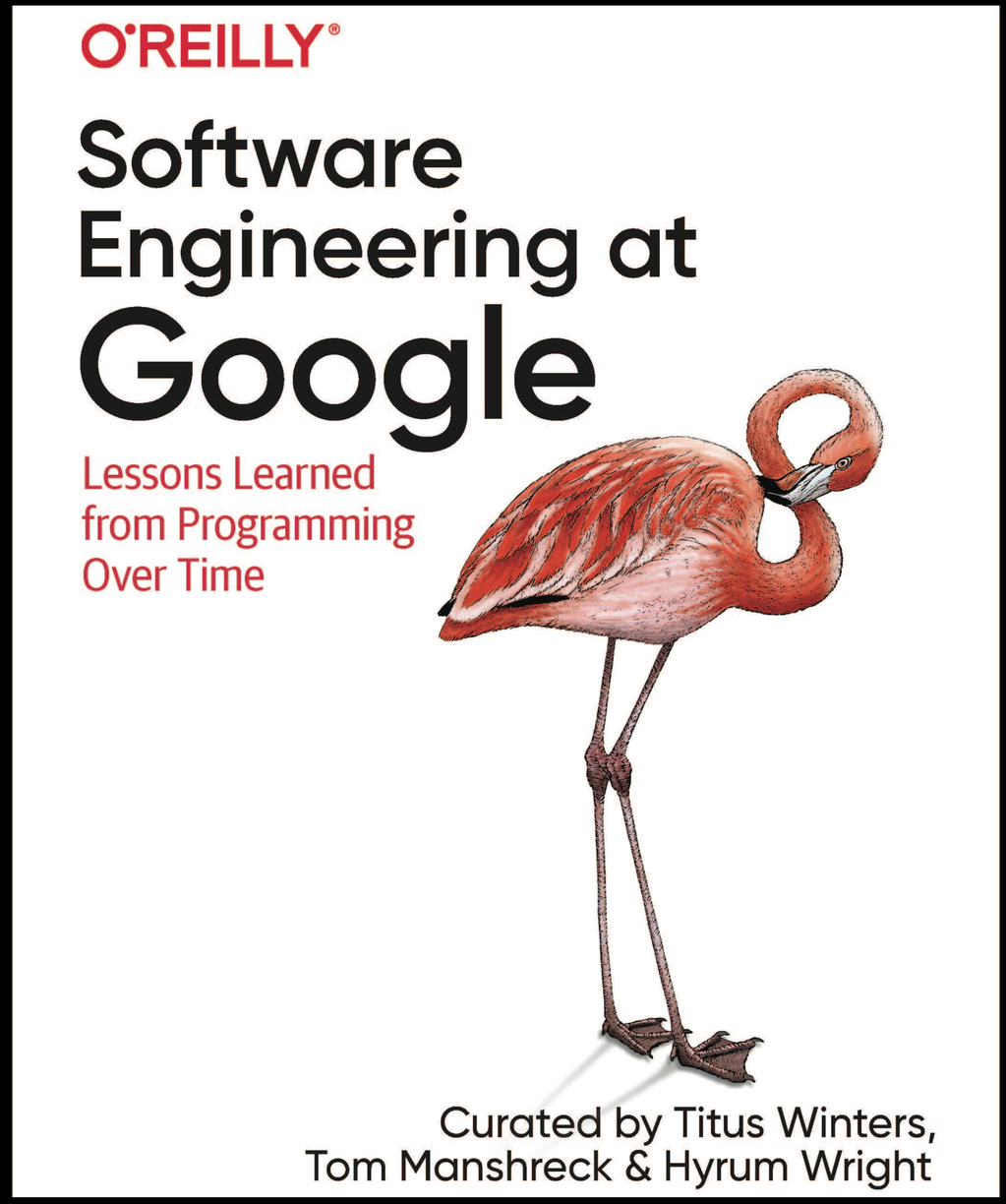
Flexible Front-end Testing

The Art of Unit Testing

- The Story of Google Web Server
- Test Pyramid
- 12 Concepts

The Story of Google Web Server

Software Engineering at Google



The Story of Google Web Server

Google Web Service

GWS v9.0

GWS v10.0 ❌

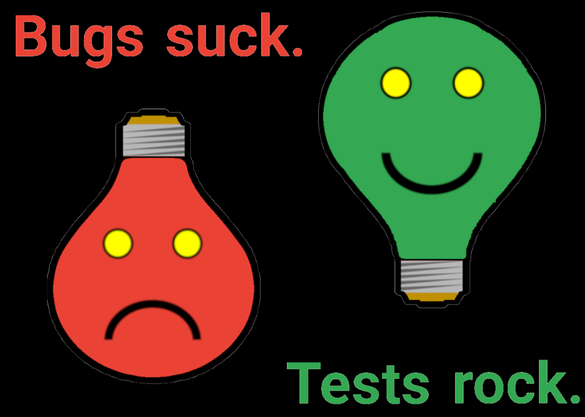
Rollback

Unit testing
for new feature ✅

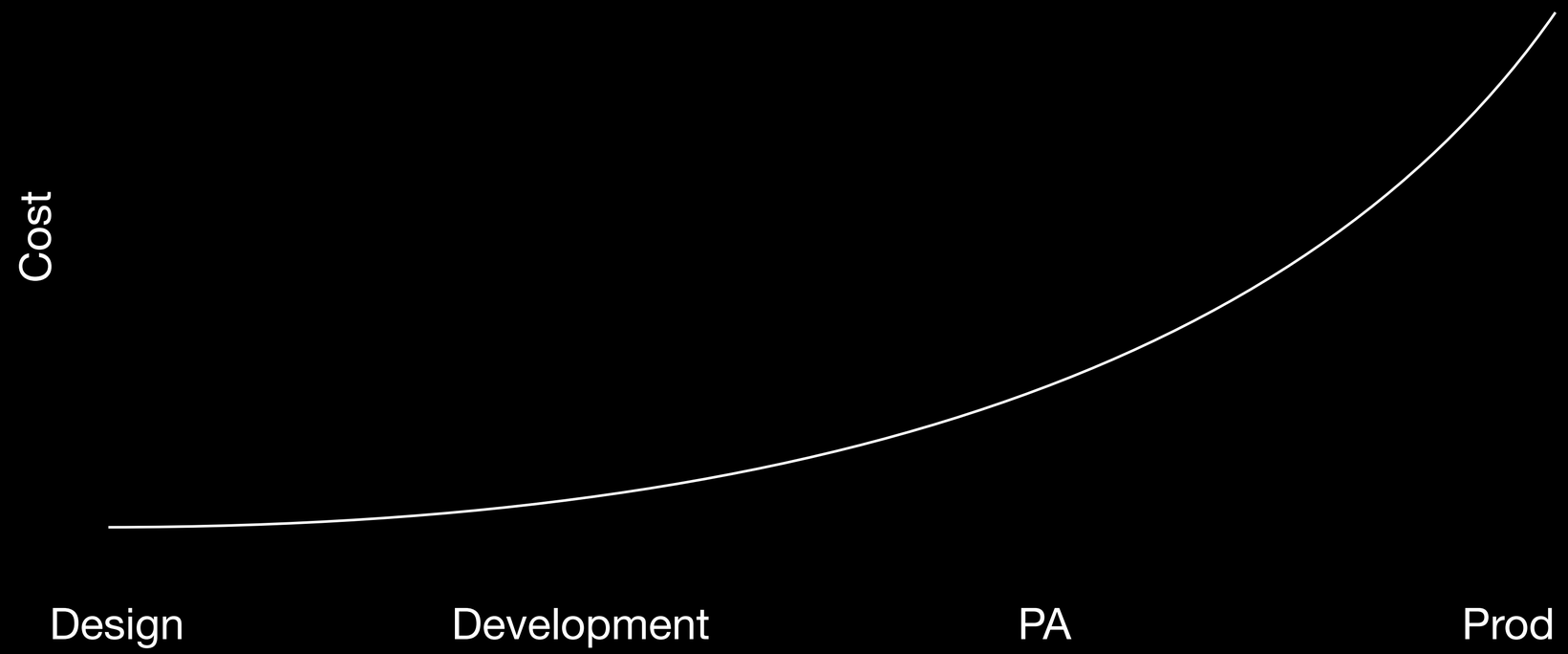
You can’t rely on programmer ability alone to avoid product defects

Reshape Google's engineering culture.

- Orientation Classes
- Test Certified
- Testing on the Toilet
  - Google Testing Blog



Shift Left



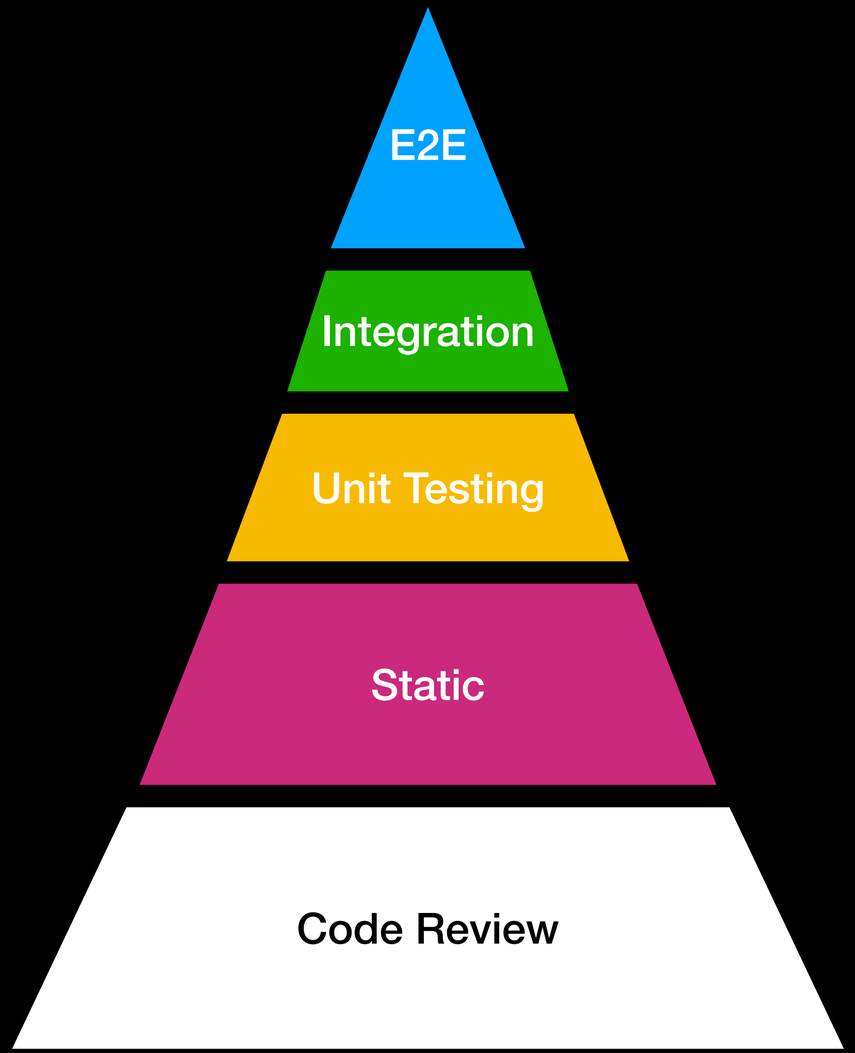
Beyoncé Rule

“If you liked it, then you shoulda put a test on it.”

Other tiers of testing

- Performance testing
- Visual Testing
- Security testing
- Localization testing
- Privacy testing

Test Pyramid



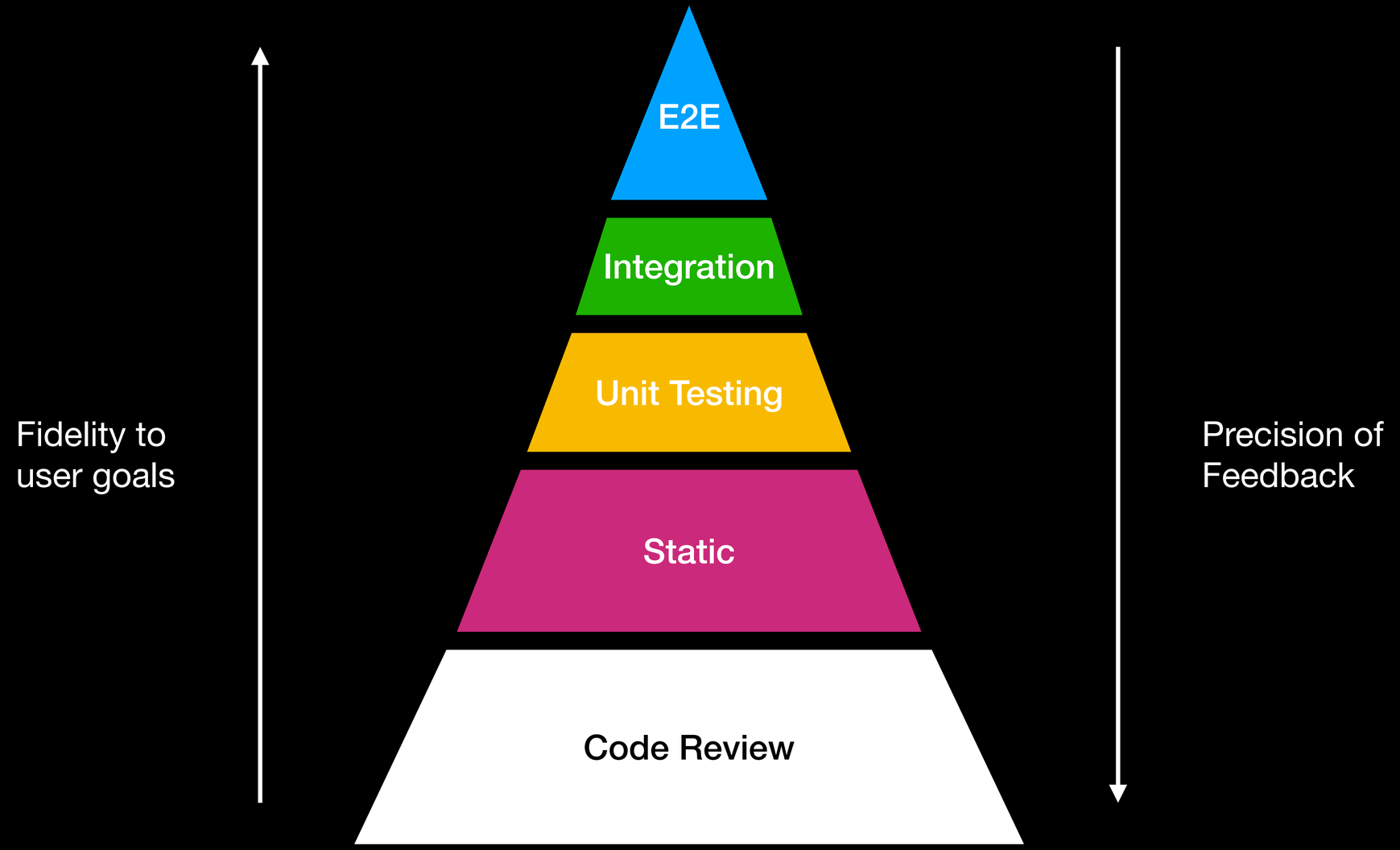
- Browser
- App

- Dependency
- API

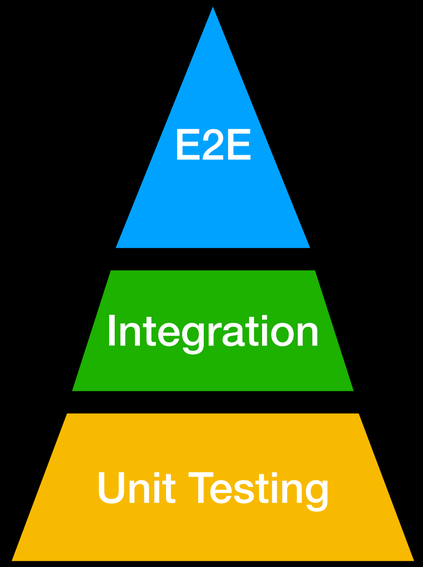
- Unit Test
- Components

- ESLint
- TypeScript
- SonarQube

Test Pyramid



Test Pyramid in Overdue Page



- Overdue UI
- Playwright Codegen

- Payment API Endpoint
- POST api/my/bill/:billId/pay

- getInvoiceMonths()
- <PaymentMethodModal />

Playwright Codegen

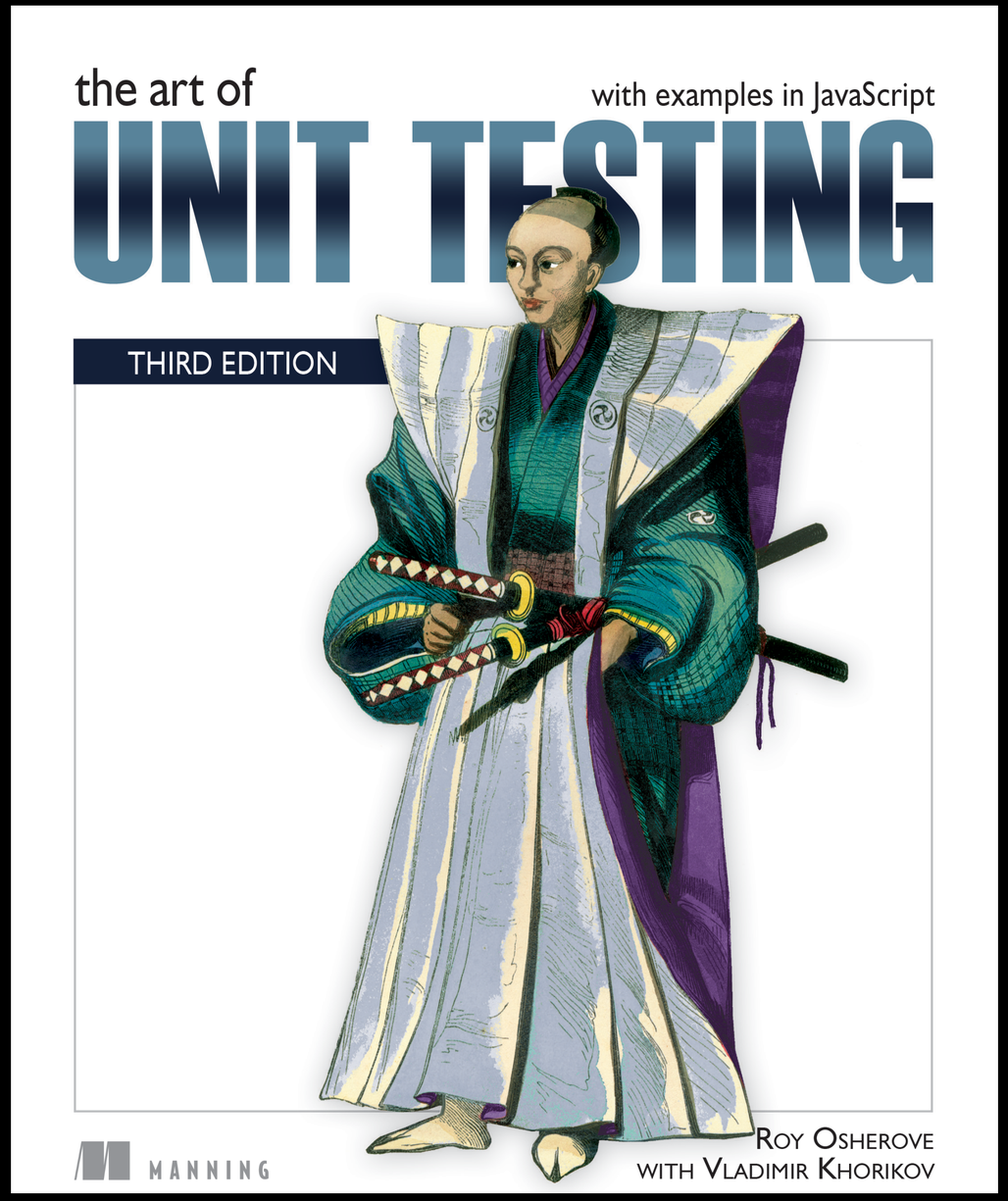
Generate tests for you as you perform actions in the browser

Swagger Codegen

Generate API integration tests
from Swagger

The Art of Unit Testing

12 Concepts



The Art of Unit Testing

- Readability
- Maintainability
- Trust
- Design and Process

Readability

If we can’t read it, then it’s hard to maintain, hard to debug,
and hard to know what’s wrong

Avoiding logic in unit tests

If you have any of the following inside a unit test, your test contains logic

- switch, if, or else statements
- foreach, for, or while loops
- Concatenations (+ sign, etc.)
- try, catch

Flow control in unit tests ❌

```
it('should display current time whenever', () => {
  const timeDisplay = new TimeDisplay();

  const result = timeDisplay.getFormatTime();

  const date = new Date();
  let expectedTime = "It's ";
  if (date.getHours() === 0 && date.getMinutes() <= 1) {
    expectedTime += 'midnight';
  } else if (date.getHours() === 12 && date.getMinutes() === 0) {
    expectedTime += 'noon';
  } else {
    expectedTime += `${date.getHours()}:${date.getMinutes()}`;
  }
  expectedTime += '.';
  expect(result).toBe(expectedTime);
});
```

Remove logic in unit tests

```
it('should display current time whenever', () => {
  jest.useFakeTimers().setSystemTime(new Date('2025-02-17 00:00:00'));
  const timeDisplay = new TimeDisplay();

  const result = timeDisplay.getFormatTime();

  expect(result).toBe("It's midnight.");
  jest.clearAllTimers();
});
```

Loop in unit tests ❌

```
it('should pass the valid email list', () => {
  const validEmailList = [
    'simple@example.com',
    'very.common@example.com',
    'disposable.style.email.with+symbol@example.com',
    'other.email-with-hyphen@example.com',
    'fully-qualified-domain@example.com',
    'CAPITAL@example.com',
  ];

  validEmailList.forEach((email) => {
    expect(isValidEmail(email)).toBe(true);
  });
});
```

it.each(case) for same pattern test cases

```
it.each([
  'simple@example.com',
  'very.common@example.com',
  'disposable.style.email.with+symbol@example.com',
  'other.email-with-hyphen@example.com',
  'fully-qualified-domain@example.com',
  'CAPITAL@example.com',
])('should pass when email is %s', (email) => {
  expect(isValidEmail(email)).toBe(true);
});
```

Complex test causes problems

- The test is harder to read and understand
- The test is hard to recreate
- The test is more likely to have a bug or to verify the wrong thing

DRY vs DAMP

- DRY: Don’t Repeat Yourself
- DAMP: Descriptive and Meaningful Phrases

DAMP: Descriptive and Meaningful Phrases

```
it('should stop task progress', () => {
  const task = new Task();
  task.setTitle('Do the laundry');
  task.setStatus('inProgress');
  task.setAssigneeId(1);

  task.stopProgress();

  expect(task.status).toBe('open');
  expect(task.assigneeId).toBeNull();
});

it('should finish task', () => {
  const task = new Task();
  task.setTitle('Do the laundry');
  task.setStatus('inProgress');
  task.setAssigneeId(1);

  task.finish();

  expect(task.status).toBe('closed');
  expect(task.assigneeId).toBe(1);
});
```

DRY: Don’t Repeat Yourself

```
const createTask = (title, status, assigneeId) => {
  const task = new Task();
  task.setTitle(title);
  task.setStatus(status);
  task.setAssigneeId(assigneeId);
  return task;
};

it('should stop task progress', () => {
  const task = createTask('Do the laundry', 'inProgress', 1);

  task.stopProgress();

  expect(task.status).toBe('open');
  expect(task.assigneeId).toBeNull();
});

it('should finish task', () => {
  const task = createTask('Do the laundry', 'inProgress', 1);

  task.finish();

  expect(task.status).toBe('closed');
  expect(task.assigneeId).toBe(1);
});
```

beforeEach() and scroll fatigue ❌

```
let task = null;
beforeEach(() => {
  task = new Task();
  task.setTitle('Do the laundry');
  task.setStatus('inProgress');
  task.setAssigneeId(1);
});

it('should stop task progress', () => {
  task.stopProgress();

  expect(task.status).toBe('open');
  expect(task.assigneeId).toBeNull();
});

it('should finish task', () => {
  task.finish();

  expect(task.status).toBe('closed');
  expect(task.assigneeId).toBe(1);
});
```

Maintainability

If maintaining the test or production code is painful because of the tests, our lives will become a living nightmare

How often should we change a test after writing it?

It never needs to change
unless the requirements under test change

Don’t change the test again as

- Refactor the system
- Fix bugs
- Add new features

Strive for Unchanging Tests

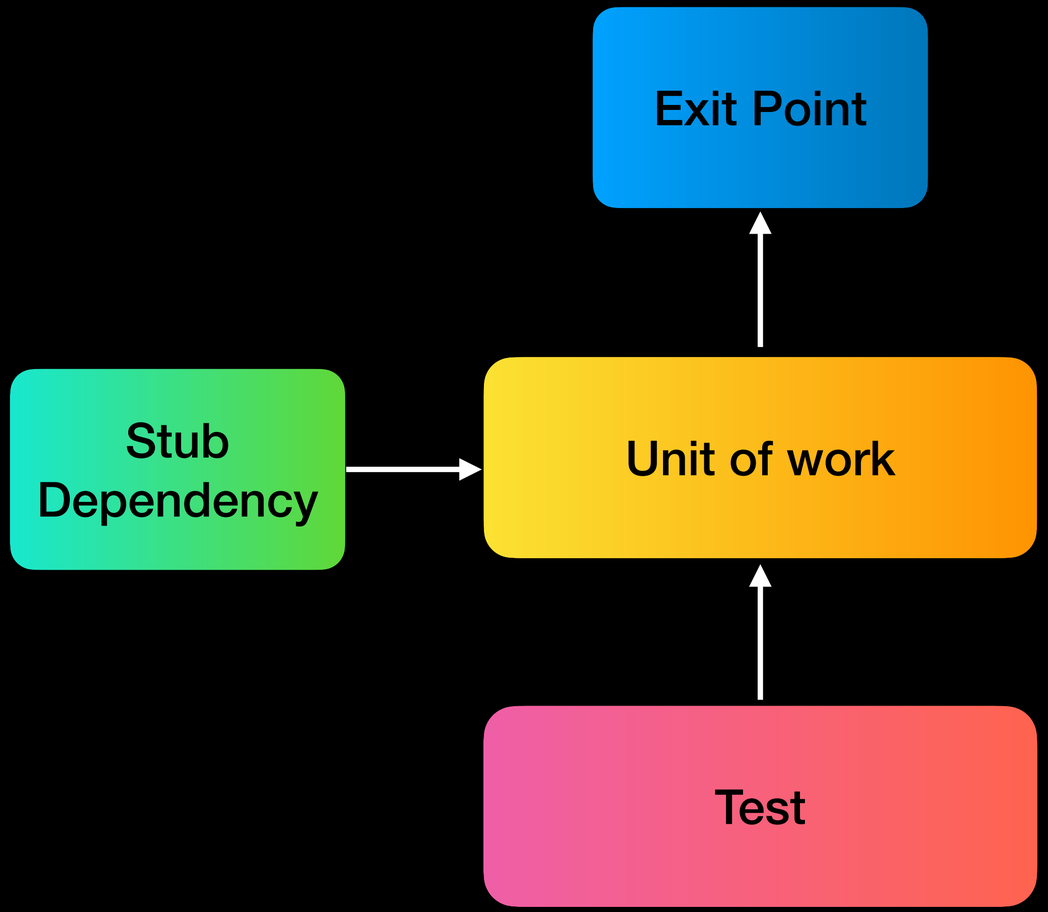
- Avoid testing private or protected methods
- Avoid over specification
- Avoid interaction testing

Avoid over specification

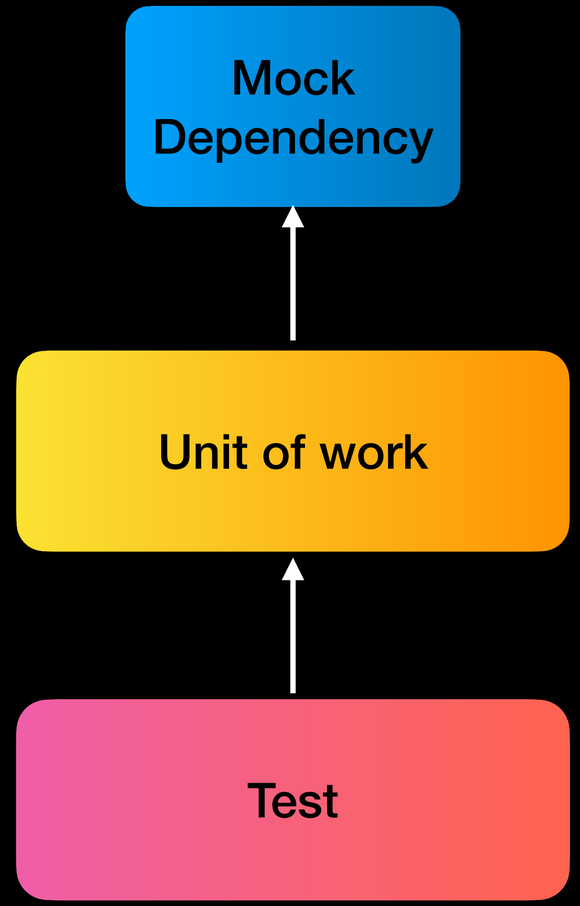
```
<button
  id="main"
  class="btn btn-large"
  name="submission"
  role="button"
  data-testid="submit"
>
  Submit
</button>
```

```
// ❌ Highly subject to change
cy.get('.btn.btn-large')

// ‼️ Highly subject to change
cy.contains('Submit')

// 👍 Isolated from all changes
cy.contains('input:button.submit')
cy.get('[data-testid="submit"]')
```

Stub


Exit Point
Stub Dependency
Unit of work
Test

Mock


Mock Dependency
Unit of work
Test

Stub and Mock

Difference	Stub	Mock
Dependency	Incoming	Outgoing
Count	>= 1	Only one for maintainability
Assertion	❌	✅
Example	Time	Logger

Interaction testing ❌

```
it('should call requestApplePay after clicking Apple Pay', async () => {
  const requestApplePay = jest.fn();
  const mockApplePayAvailable = {
    requestApplePay,
  };
  server = startMirage({}, 'test');
  useApplePay.mockImplementation(() => mockApplePayAvailable);
  const { user } = myGogoroRender(
    <PaymentMethodComponent isPayOpen bill={bill} />,
    State
  );
  const applePay = screen.getByTestId('apple-pay');

  await act(async () => user.click(applePay));

  expect(requestApplePay).toHaveBeenCalledWith(bill);
});
```

Test state, not interactions

```
it('should popup payment success modal after apple pay success', async () => {
  const mockApplePaySuccess = {};
  useApplePay.mockImplementation(() => mockApplePaySuccess);
  server = startMirage({}, 'test');

  myGogoroRender(<PaymentMethodComponent isPayOpen />, State);

  expect(
    await screen.findByText('my-plan:bill.pay-success')
  ).toBeInTheDocument();
});
```

Trust

If we don’t trust the results of our tests when they fail, we’ll start manually testing again, losing all the time benefit the tests are supposed to provide

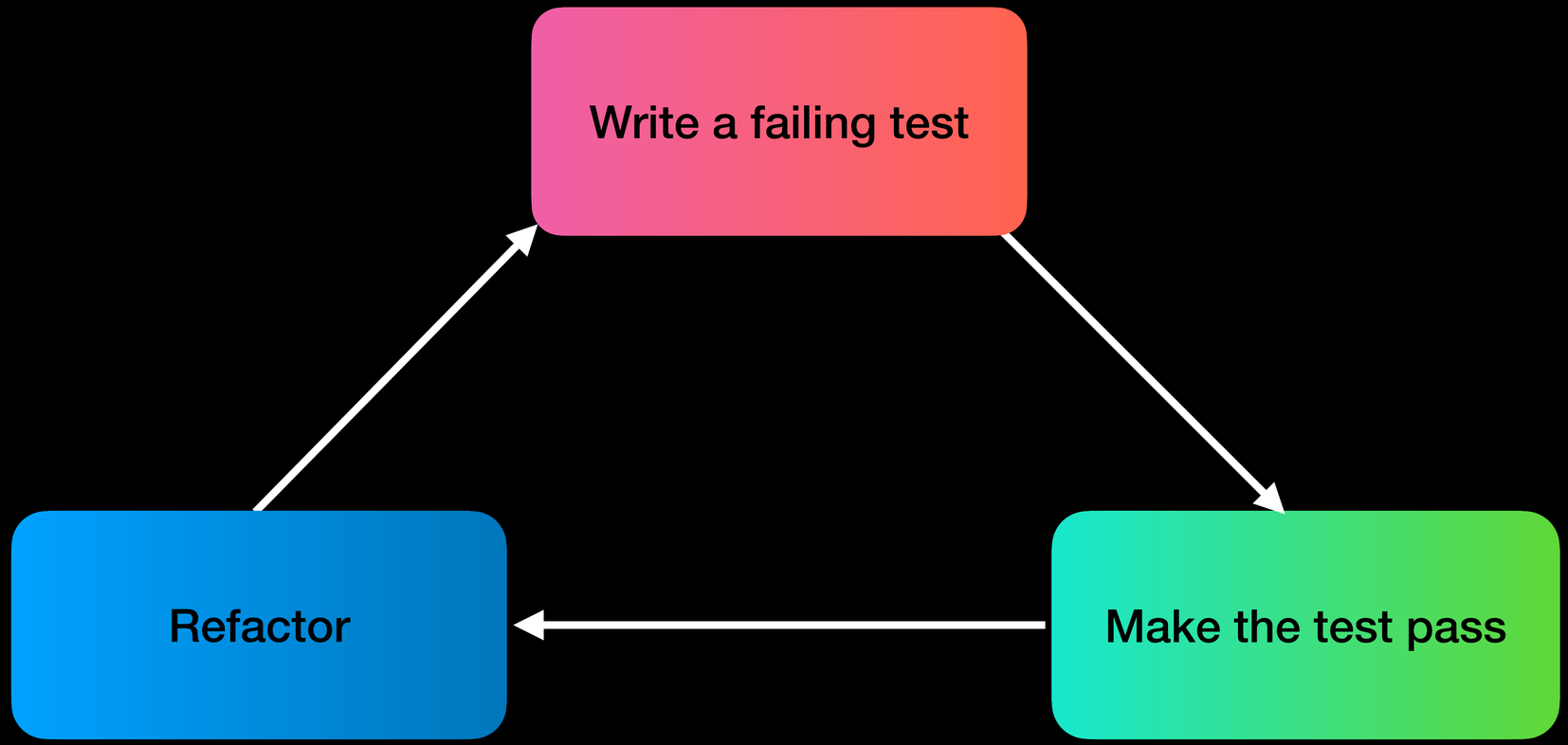
You might not trust a test if

- It fails and you’re not worried
- You feel like it’s fine to ignore the results of this test
- It passes and you are worried
- You still feel the need to manually debug or test
- You skip your tests

TDD

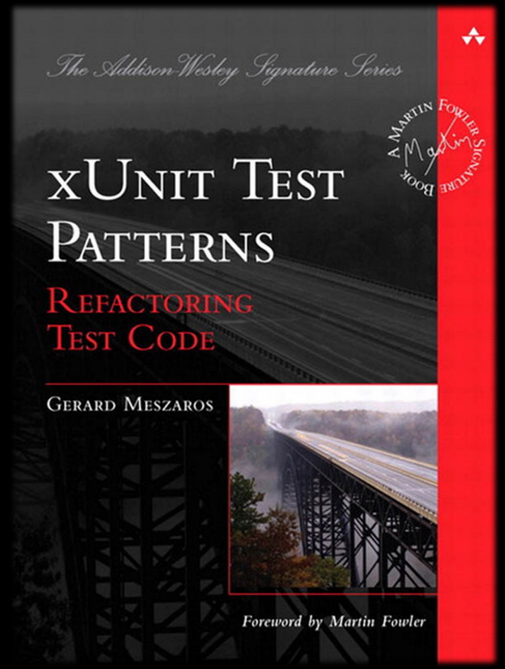
- it fails when it should and it passes when it should
- Use TDD to give AI more context and hint

TDD with AI



Test Smells

- Hard-to-Test Code
- Fragile Test
- Test Code Duplication
- Test Logic in Production
- Erratic Test
- Obscure Test
- Conditional Test Logic
- Slow Tests

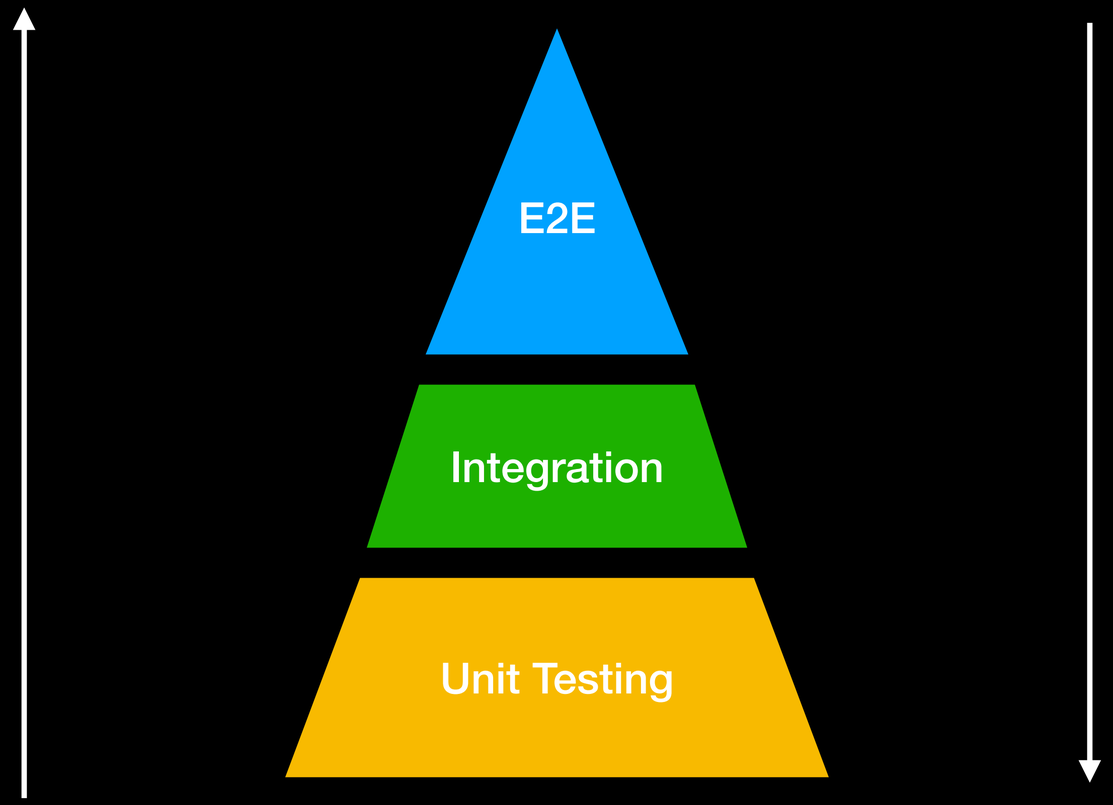


Design and Process

- Developing a testing strategy with PA team
- Integrating unit testing into the organization

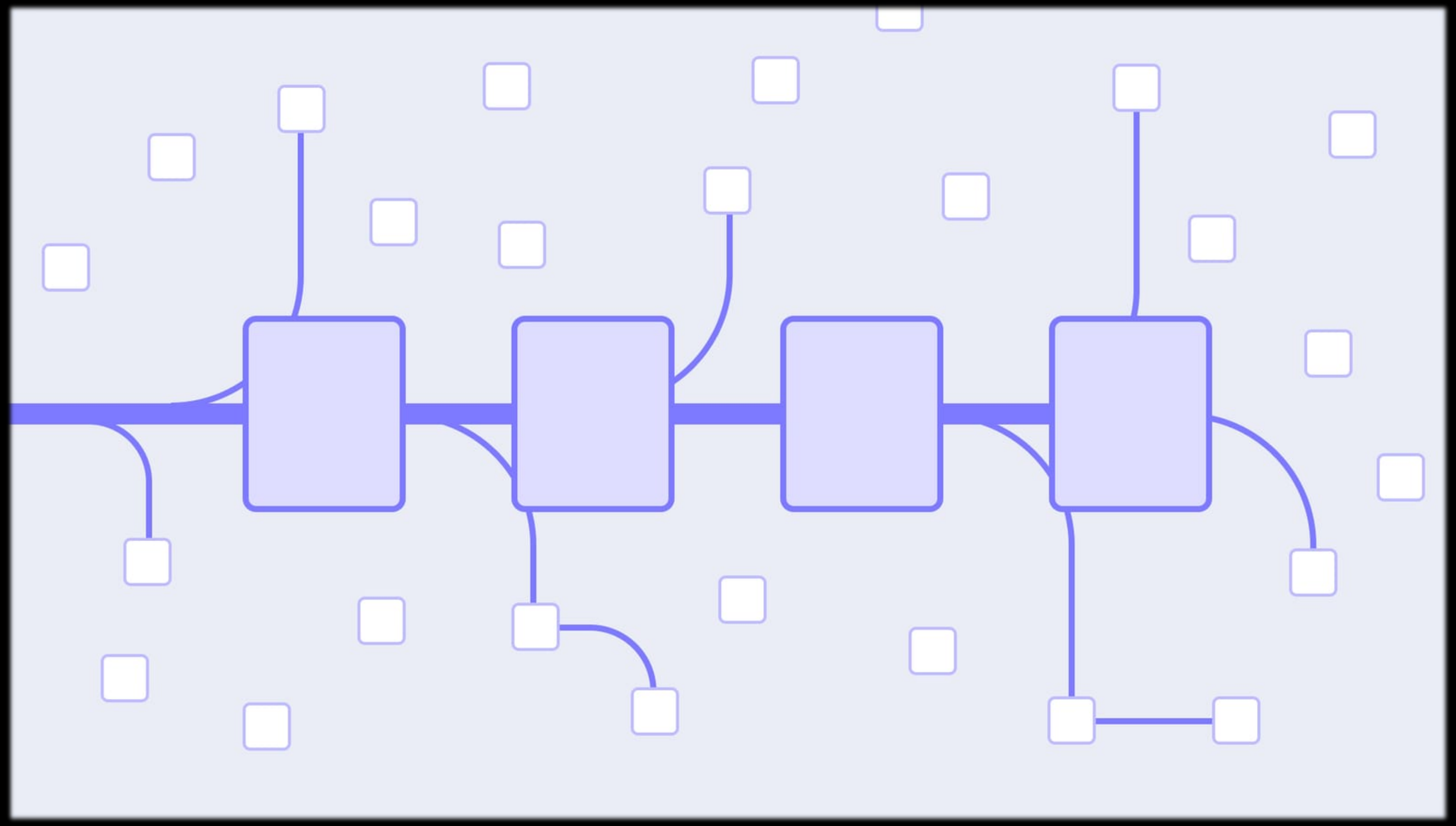
Developing a testing strategy with PA team

- Slow
- Flaky
- Real
- Complex



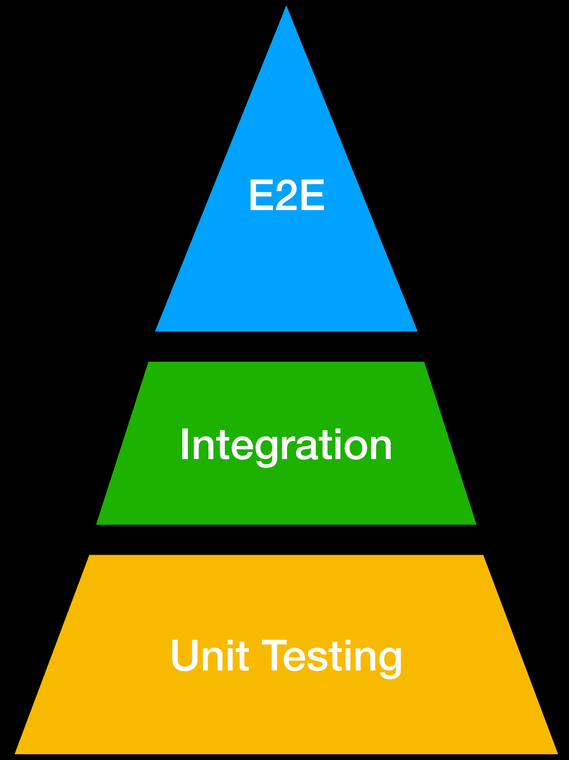
- Fast
- Stable
- Fake
- Easy

Prevent overlap testing



Maintenance

- Review failed test cases
- Trace issues from large system
- Another CI pipeline for flaky testing



Integrating unit testing into the organization

We have lots of code without tests: Where do we start?

80% of bugs are found in 20% of the code.

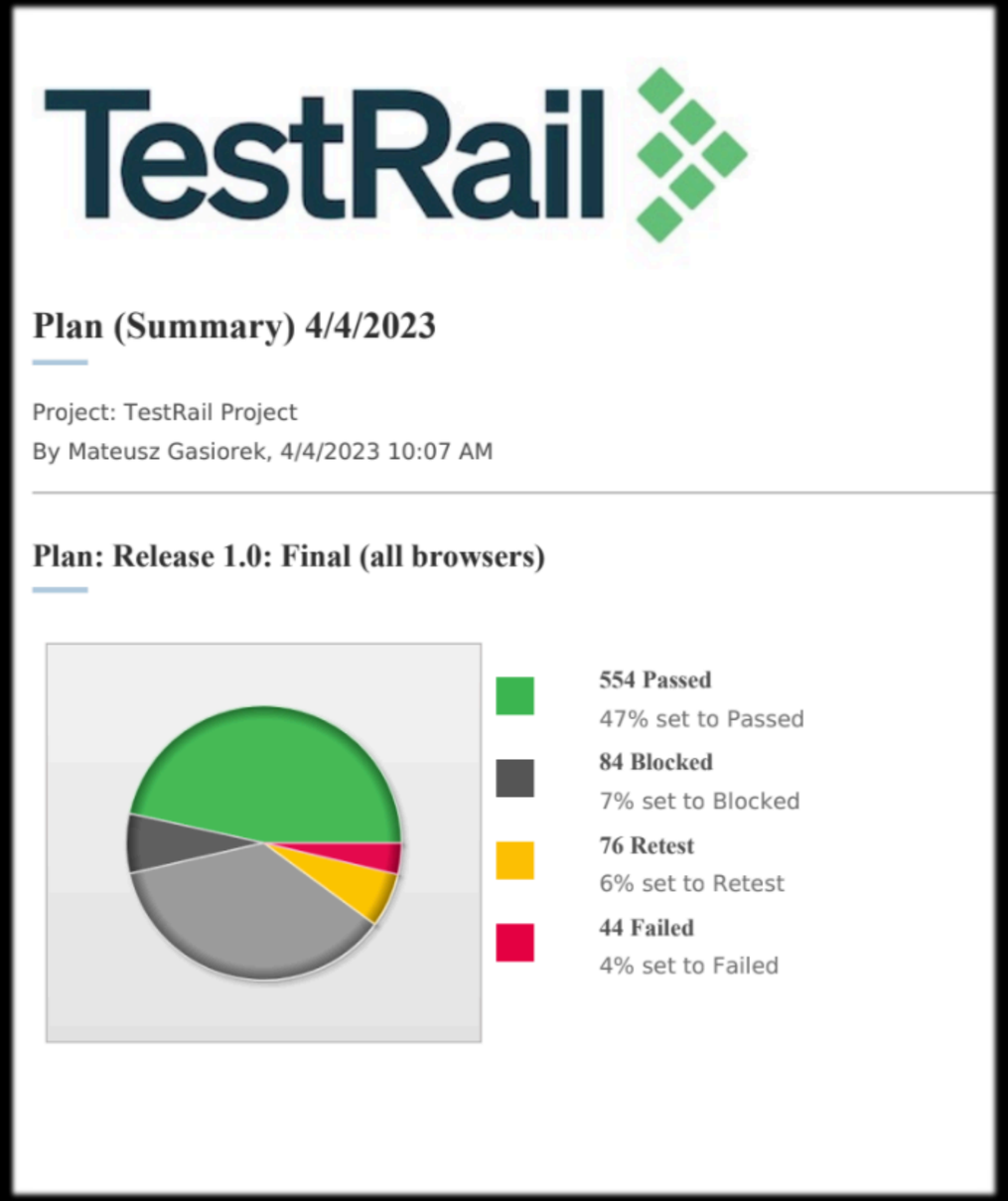
Find the code that has the most problems and test them

Easy-First Strategy

Test Feasibility: Logical complexity, Dependency level and Priority

Make Progress Visible

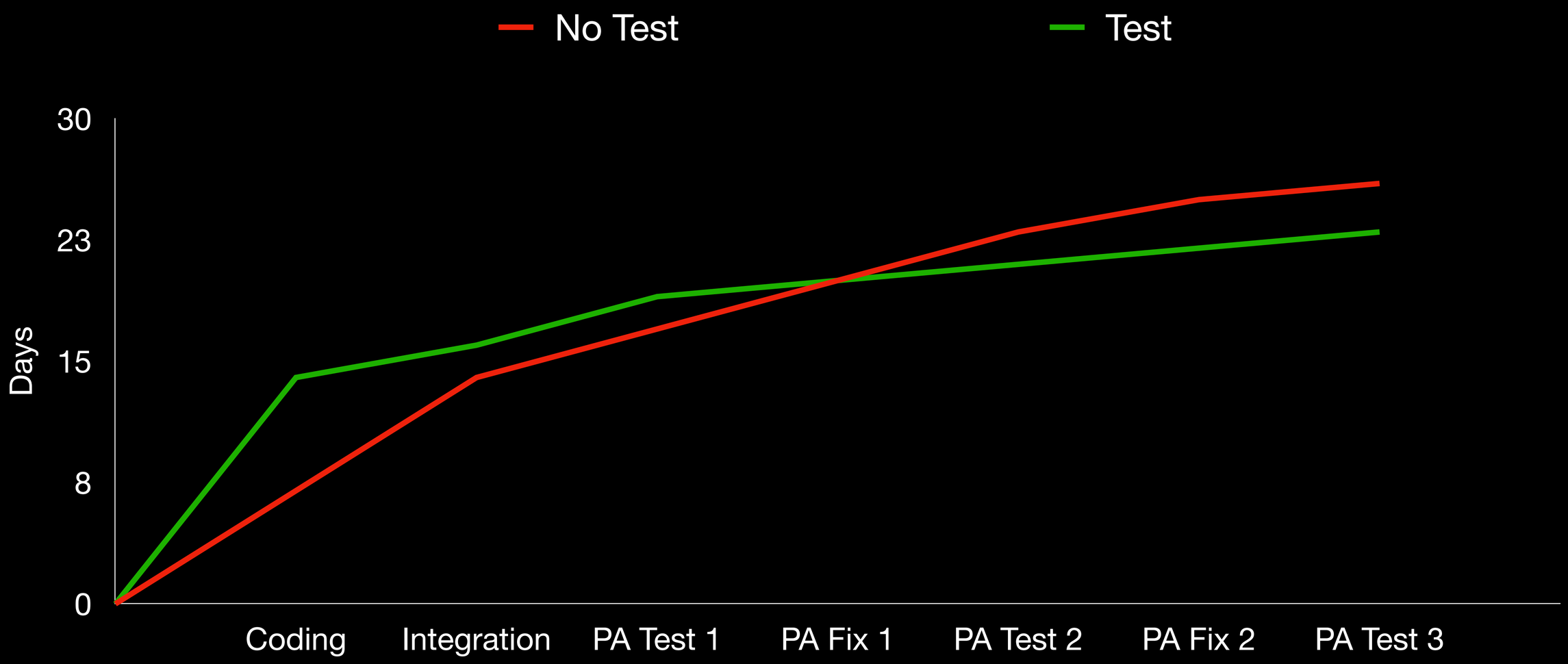
Code coverage is **NOT** quality



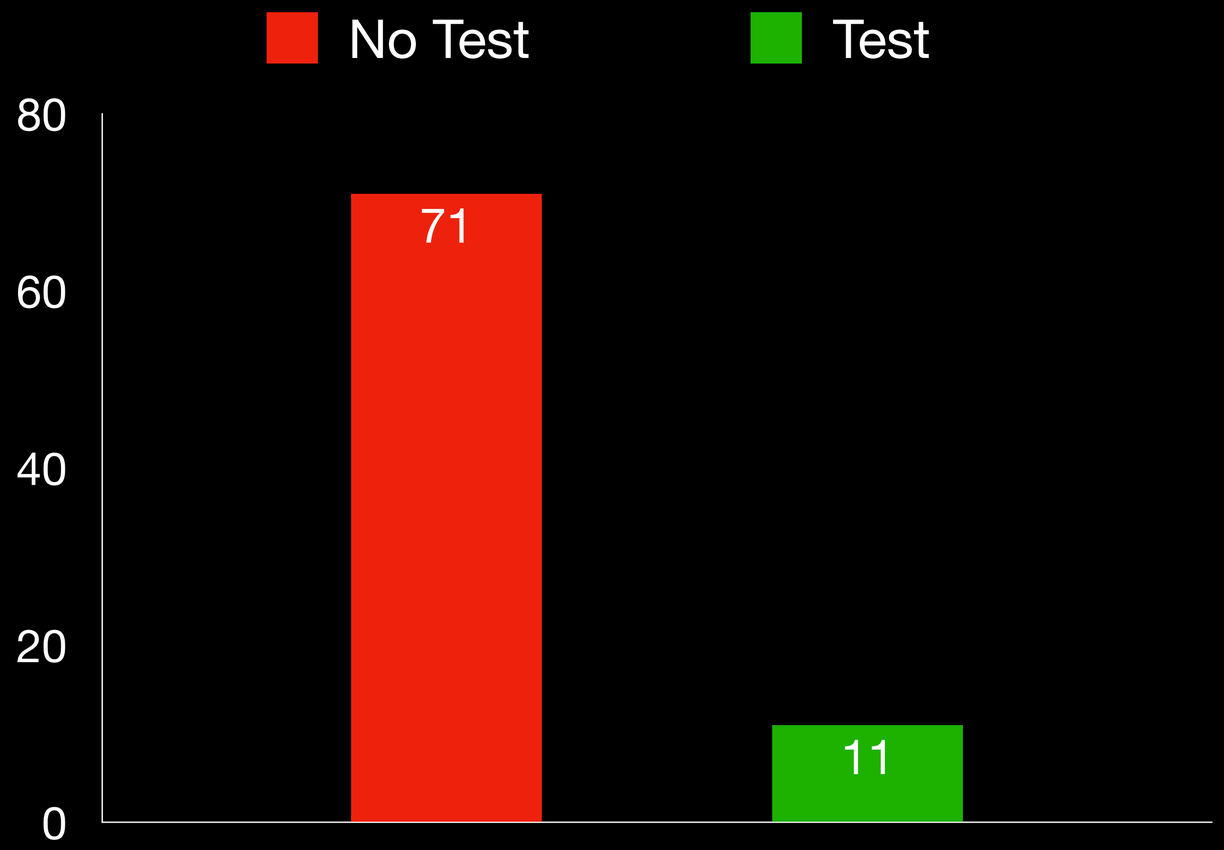
Create metrics and follow the trends

- Bugs found in production
- Deployment frequency
- The amount of time it takes a feature request to get into production
- Time to restore service
- Engineering confidence

Team progress with test and without test



Bugs found in production



Team progress with test and without test

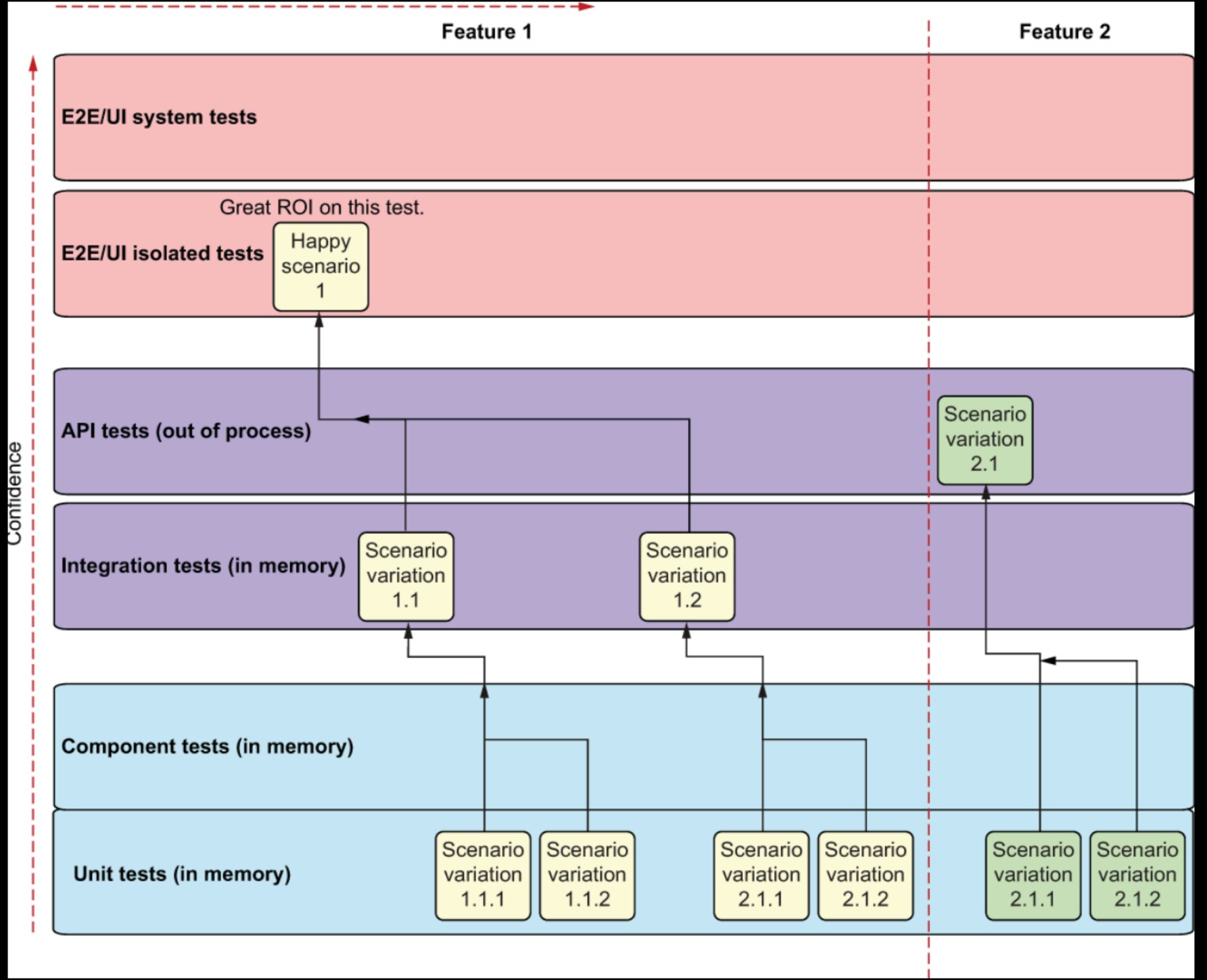
Stage	No Test	Test
Coding	7 days	14 days
Integration	7 days	2 days
Testing and bug fixing	Testing, 3 days Fixing, 3 days Testing, 3 days Fixing, 2 days Testing, 1 day, Total 12 days	Testing, 3 days Fixing, 1 day Testing, 1 days Fixing, 1 day Testing, 1 day, Total, 7 days
Overall Release Time	26 days	23 days
Bugs found in production	71	11

Reshape Gogoro engineering culture.

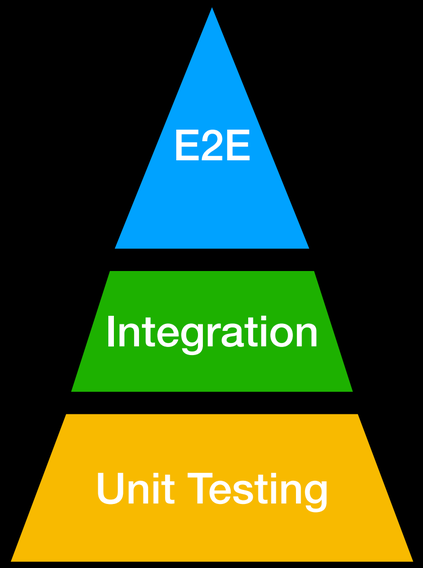
- Develop a testing strategy with PA team
- Create metrics and follow the trends
- Add integration and e2e testing in sprint

Action

Develop a testing strategy with PA team


Feature 1
Feature 2
E2E/UI system tests
Great ROI on this test.
E2E/UI isolated tests
Happy scenario 1
API tests (out of process)
Scenario variation 2.1
Integration tests (in memory)
Scenario variation 1.1
Scenario variation 1.2
Component tests (in memory)
Unit tests (in memory)
Scenario variation 1.1.1
Scenario variation 1.1.2
Scenario variation 2.1.1
Scenario variation 2.1.2
Scenario variation 2.1.1
Scenario variation 2.1.2
Confidence

Test pyramid with PA team

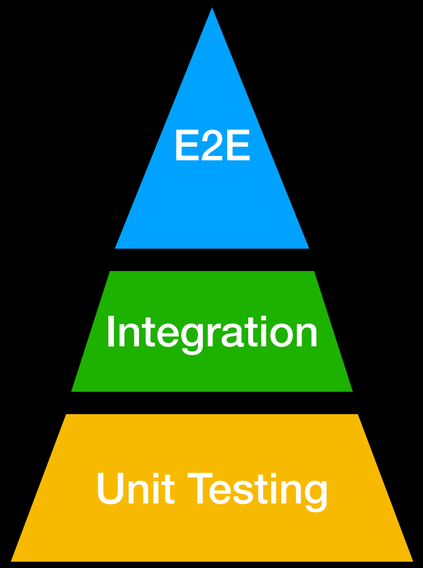


- PA + RD
- 10%

- PA + RD
- 20%

- RD
- 70%

Test pyramid and test framework



- Pytest
- Playwright, Cypress

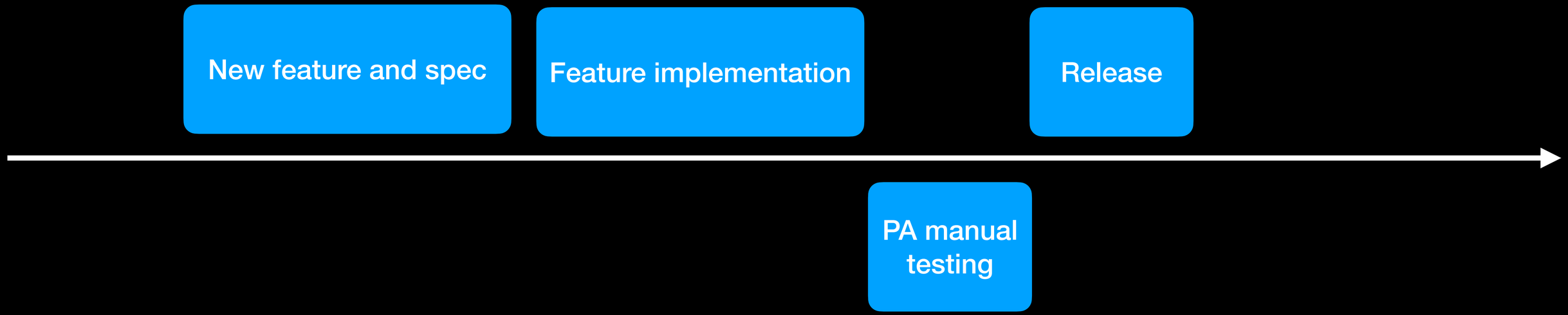
- Pytest
- Supertest

- Jest
- Vitest

Pilot project and feature

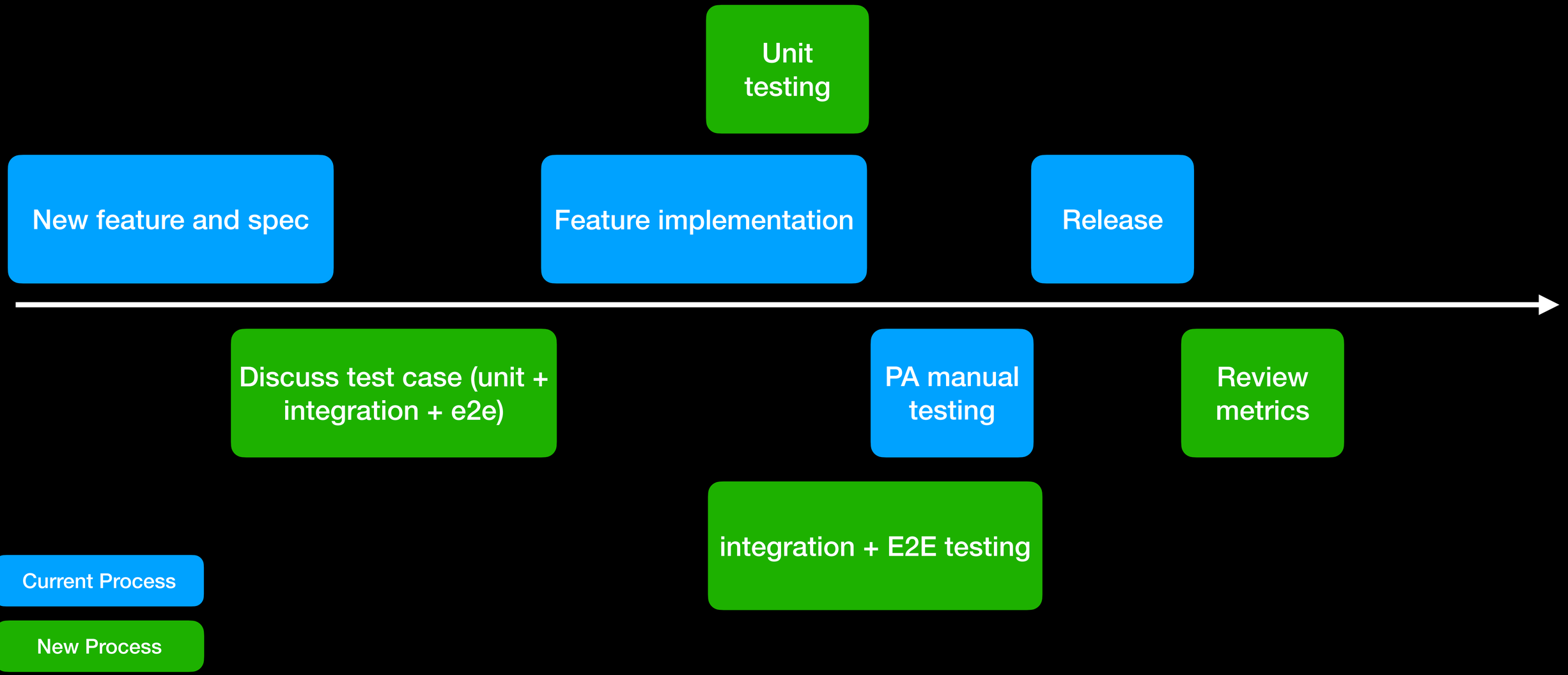
- MyGogoro, invoice
- MyPocket, wallet password retry 5 times
- BD/CD, Invoice

Current Flow

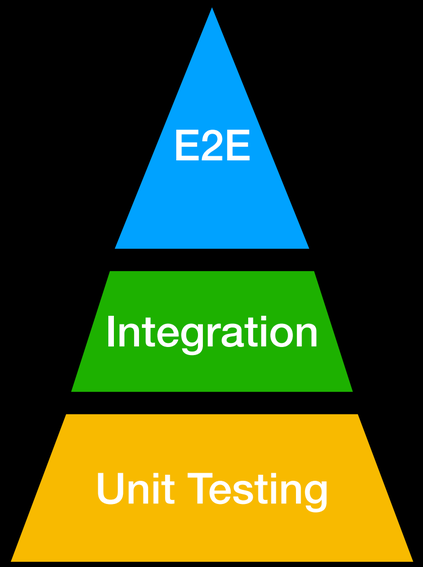


Current Process

Working Flow

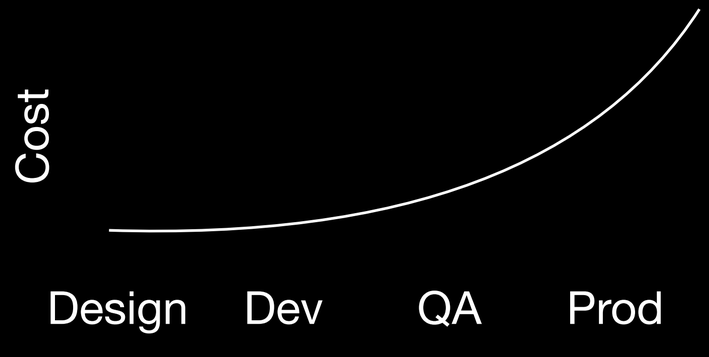


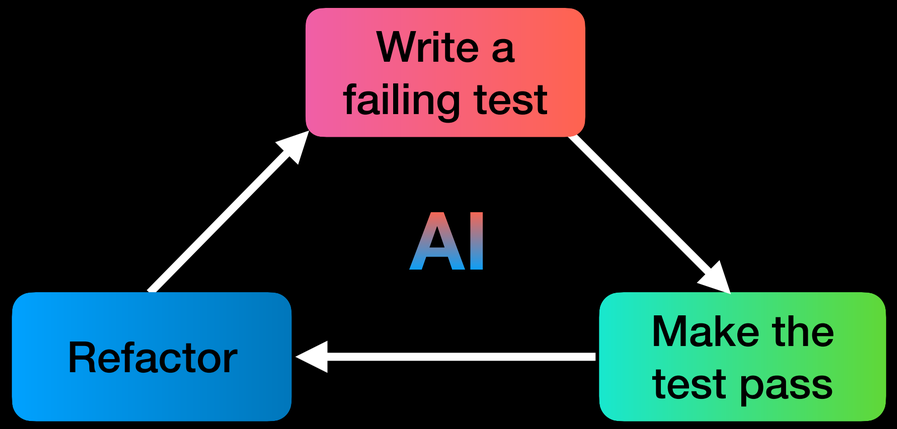
Playwright Codegen



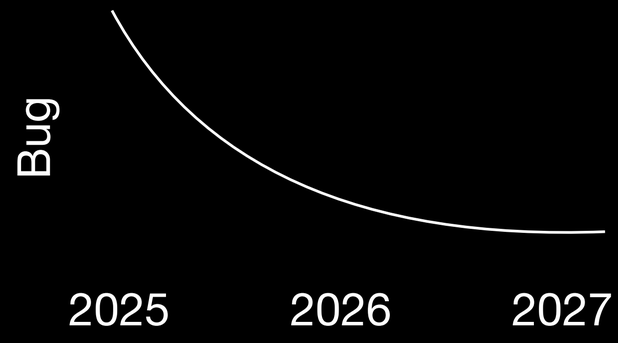
- Readability
- Maintainability
- Trust
- Design and Process

Shift Left





Visible Progress



Reference

- 如何撰寫具彈性的測試程式 | 2024 WebConf Taiwan
- Component testing in Storybook
- Test Smells
- Software Engineering at Google, Testing Overview
- Google Testing Blog
- The Art of Unit Testing, Third Edition

Q & A

Thank you for listening