QA Introduction

Quality Assurance, Testing and Test Automation

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Table of Contents

Software Quality Assurance

Introduction

Software Quality Assurance (QA)

- What is "**software quality assurance**" (**SQA**)?
  - Software quality assurance aims to **assure** that the **software** is **bug free** (behaves as expected)
  - Defects are reported and tracked through a **bug tracking system**
  - Performed by the Quality Assurance engineers (**QA engineers**)
- Most of the QA work is **software testing**
  - **Manual** testing (click and check the results)
  - **Automated** testing (QA automation)
- Continuous integration and delivery (**CI/CD pipeline**)

The QA Role and Its Responsibilities

Quality Assurance (QA) Engineer's Role

- **QA engineers** ensure the **software quality**
- Plan and execute **testing activities**
  - **Test** the software, its functionality, UX and usability, etc.
  - Create **test plans**, design **test cases**, **execute tests**
  - Develop and execute **test automation** scripts
- **Report** and **track bugs** and their lifecycle
  - Perform **regression testing** when bugs are resolved
- Track the **development process** and its quality
  - Review the **requirements**, **design** and **code**
  - Build and monitor **CI/CD pipeline**, track QA **metrics**

What is a Database?

- A **database** is a collection of data, organized to be easily accessed, managed and updated
- Modern databases are managed by **Database Management Systems** (DBMS)
  - Define database **structure**, e.g. tables, collections, columns, relations, indexes
  - Create / Read / Update / Delete data (CRUD operations)
  - Execute **queries** (filter / search data)

QA Job Ads

Live Demo

https://calendly.com/pages/jobs/details?gh_jid=4698556002
https://www.indeed.com/viewjob?jk=534ebdec45075857
https://www.linkedin.com/jobs/view/1949370301

Defects, Bugs, Issues

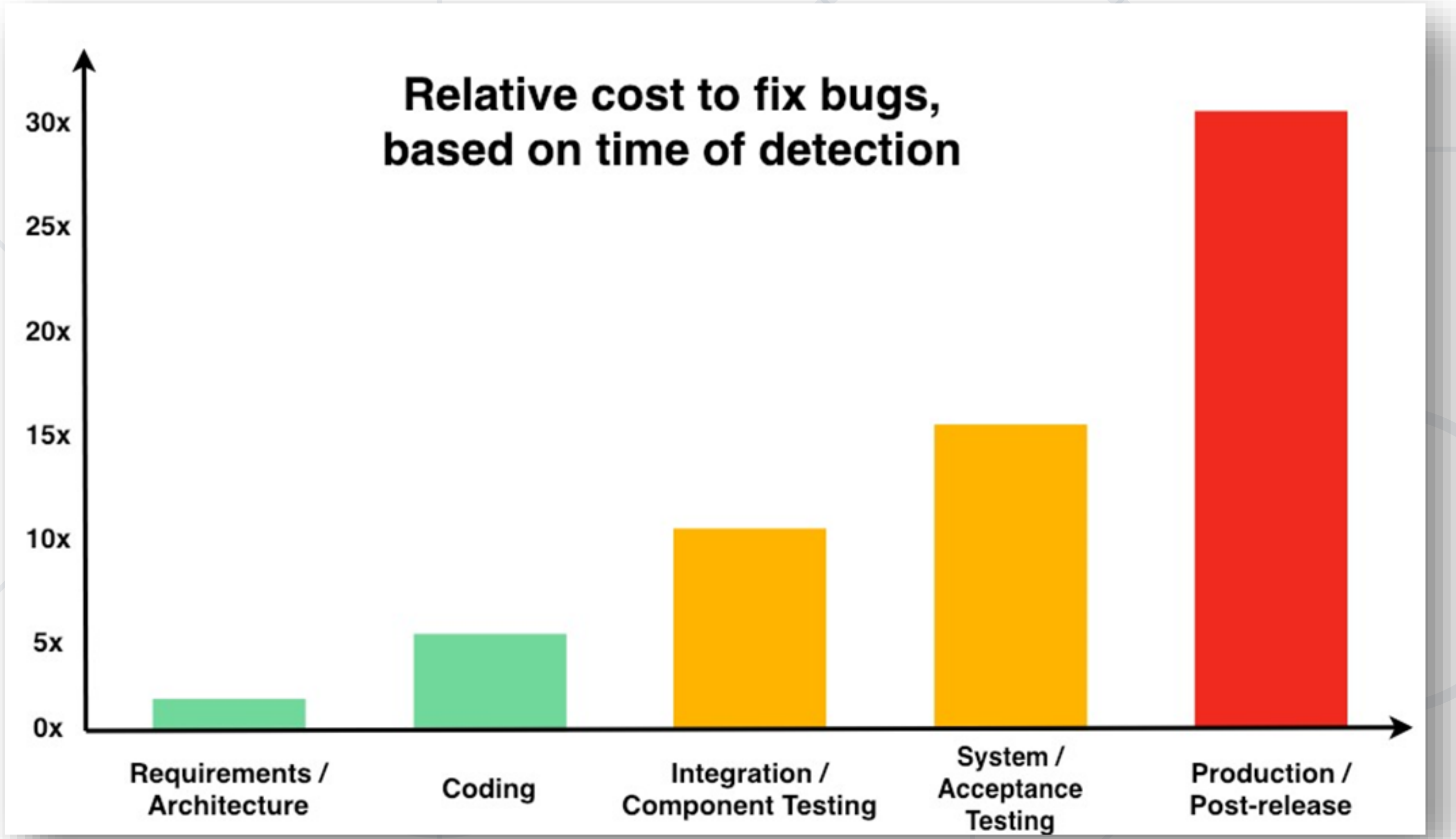
Issue Tracking Systems

Software Defects

- Humans can make **errors** (mistakes)
- Errors produce **defects**
  - **Defects** are **bugs** in the program code, or mistakes in the **requirements** / **design** / other
- If a **defect** is executed, it might cause a **failure**:
  - Fail to do what it should do / do wrong thing
- **QA** / **software testing** aims to find the **defects**
  - **Automated testing** and **CI/CD** reduce the defects

The Cost of Software Defects

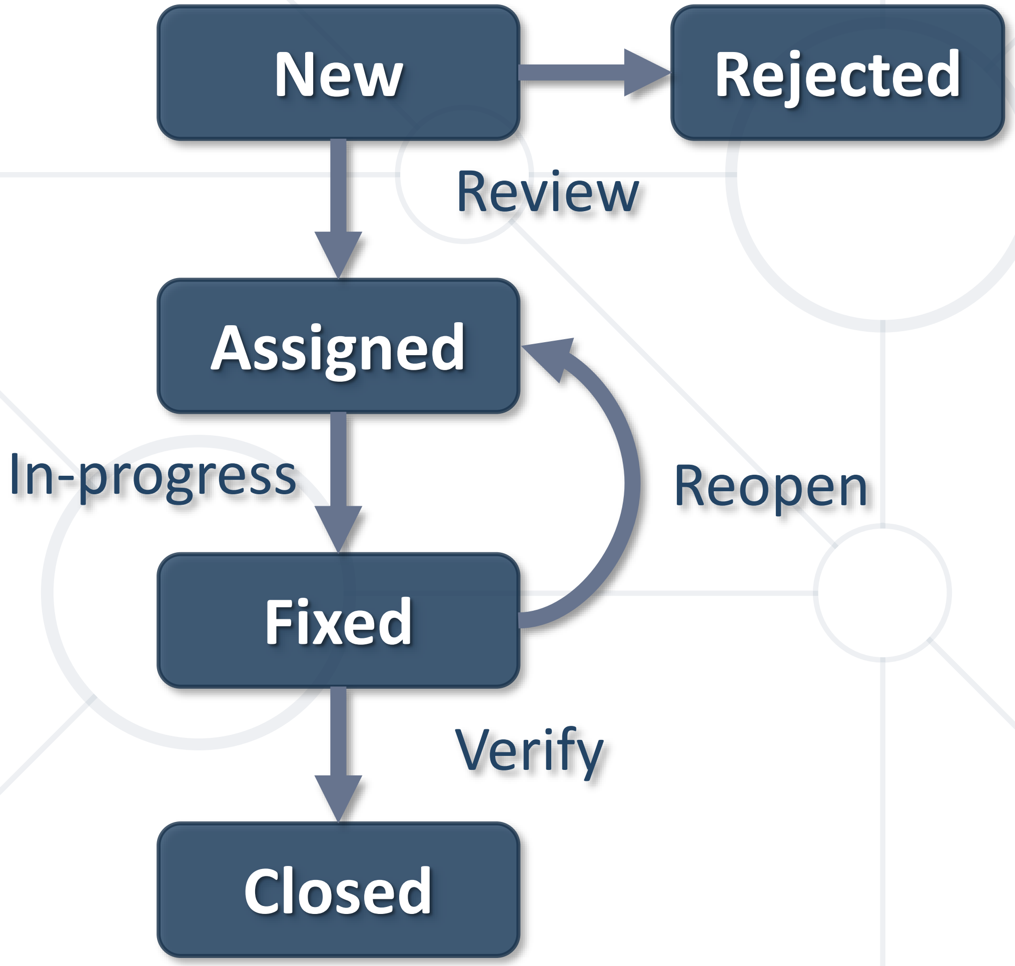
- Defects **cost less** when found **earlier**



- Agile practices (like CI/CD) find defects earlier

Bug Tracking and Issue Lifecycle

- Software defects / bugs / problems / issues
  - Are tracked in **issues trackers** (bug trackers)
- **QA engineers** manage the issue lifecycle
- Issue **lifecycle**
  - New → Assign / Reject → Fix → Verify → Close / Reopen



Issues

- **QAs** report, describe and **track issues** in an issue tracker
- **Issues** hold the following information
  - Title and description (with steps to reproduce)
  - State: open / closed
  - Status: new / assigned / rejected / fixed / verified
  - Priority: low, medium, high, critical
  - Assigned team members
  - Discussion / comments

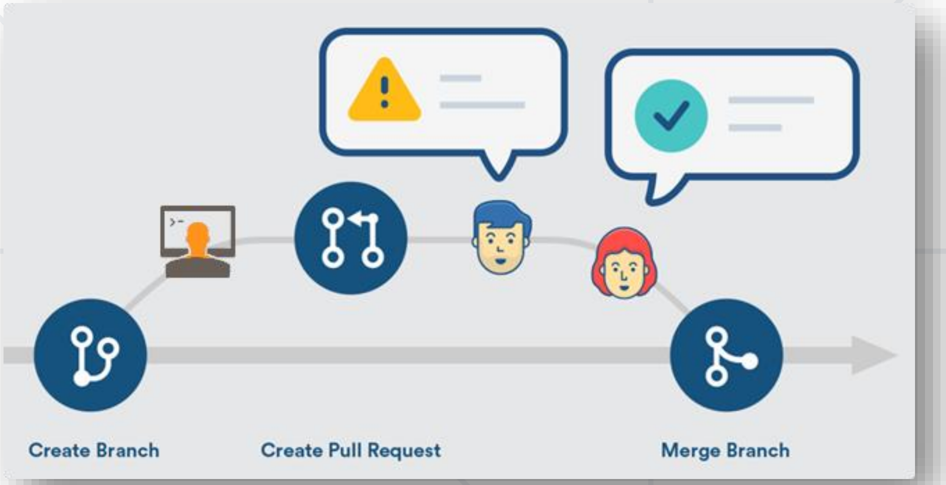
Issue Tracker

Live Demo

https://github.com/twbs/bootstrap/issues
https://github.com/twbs/bootstrap/issues/31392
https://github.com/twbs/bootstrap/issues/31459

Typical Flow for Handling an Issue

1. An **issue** is logged by someone
2. A developer is **assigned** to fix it
3. A **new branch** is created for the fix
4. The developer makes **changes and fixes** in this branch (writes code, commits changes, pushes the changes)
5. When ready, the developer sends a **pull request**
6. Other developers **review** / **comment** / **approve**
7. The changes are **merged** in the upstream branch



Pull Request Merge

Live Demo

https://github.com/twbs/bootstrap/pull/31396

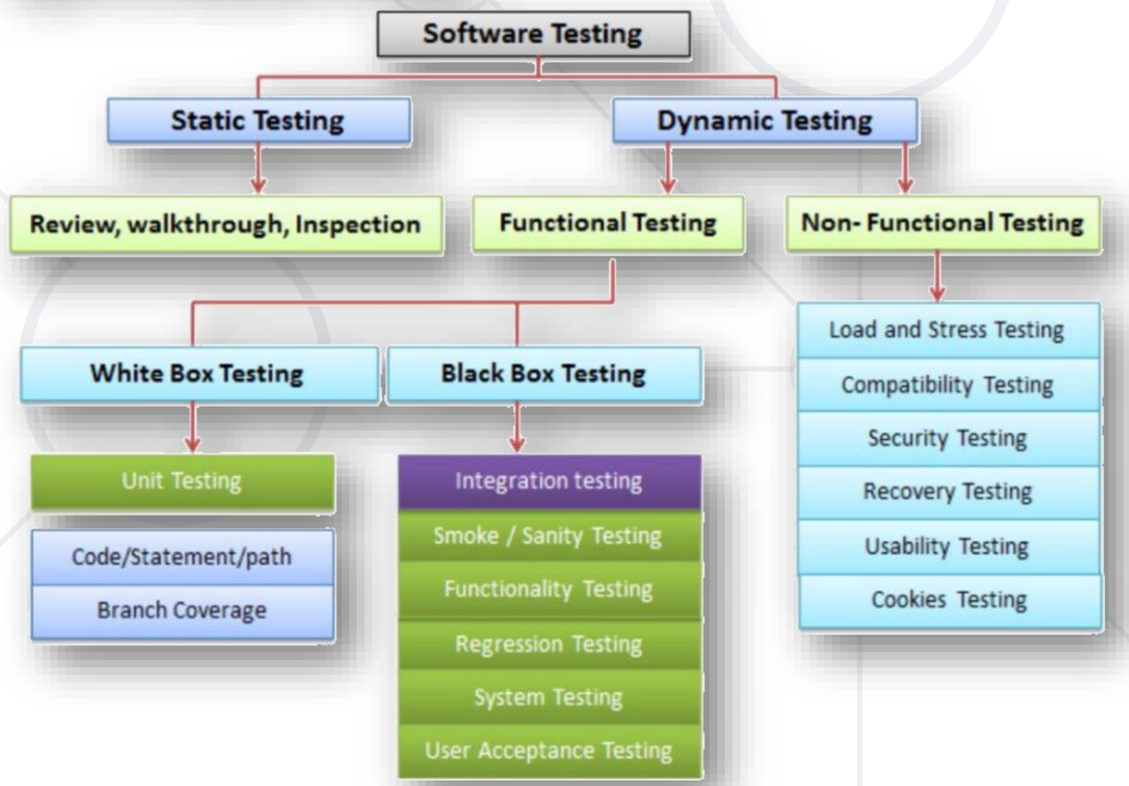
Software Testing

Test Types and Test Levels

Software Testing and Test Types

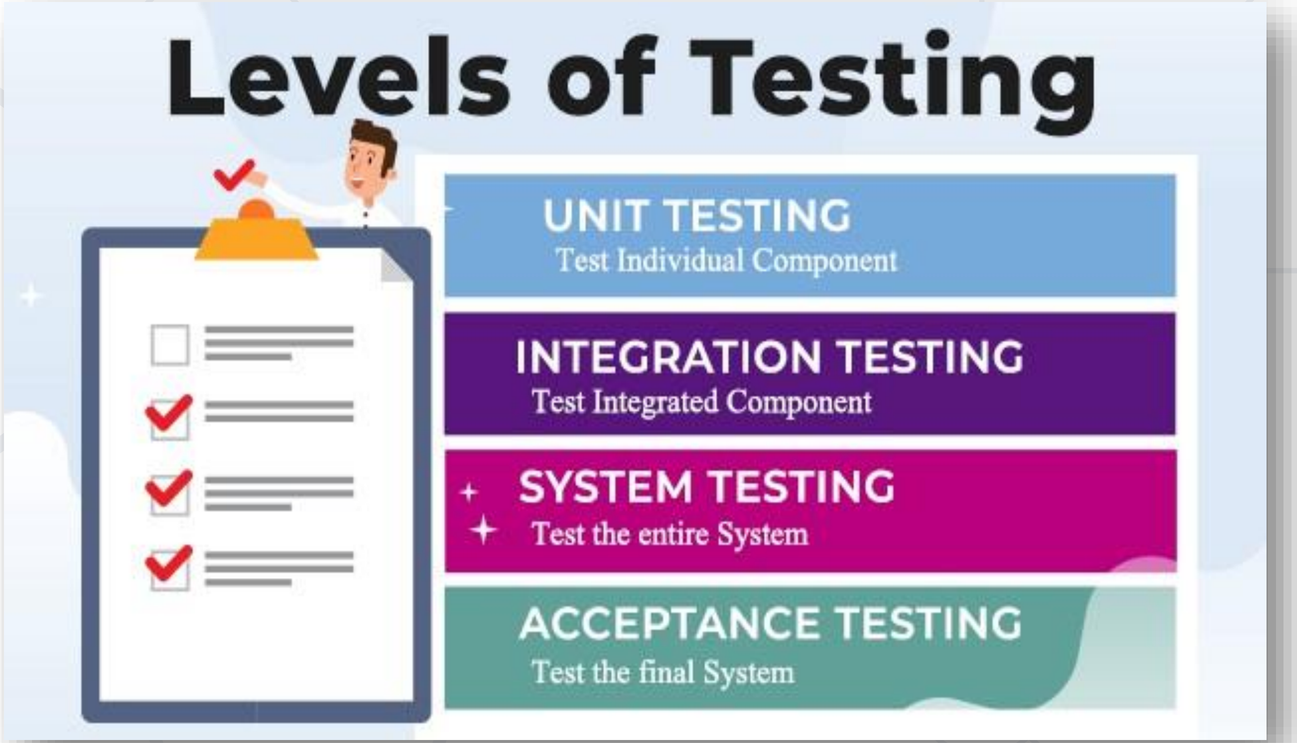
- Testing checks whether software **conforms to the requirements**, aims to **find defects**
- Types of software tests
  - Functional and non-functional
  - Black-box and white-box tests, regression tests
  - Stress tests, load tests, UX and usability tests, security tests
  - Manual vs. automated tests

Types of Software Testing:

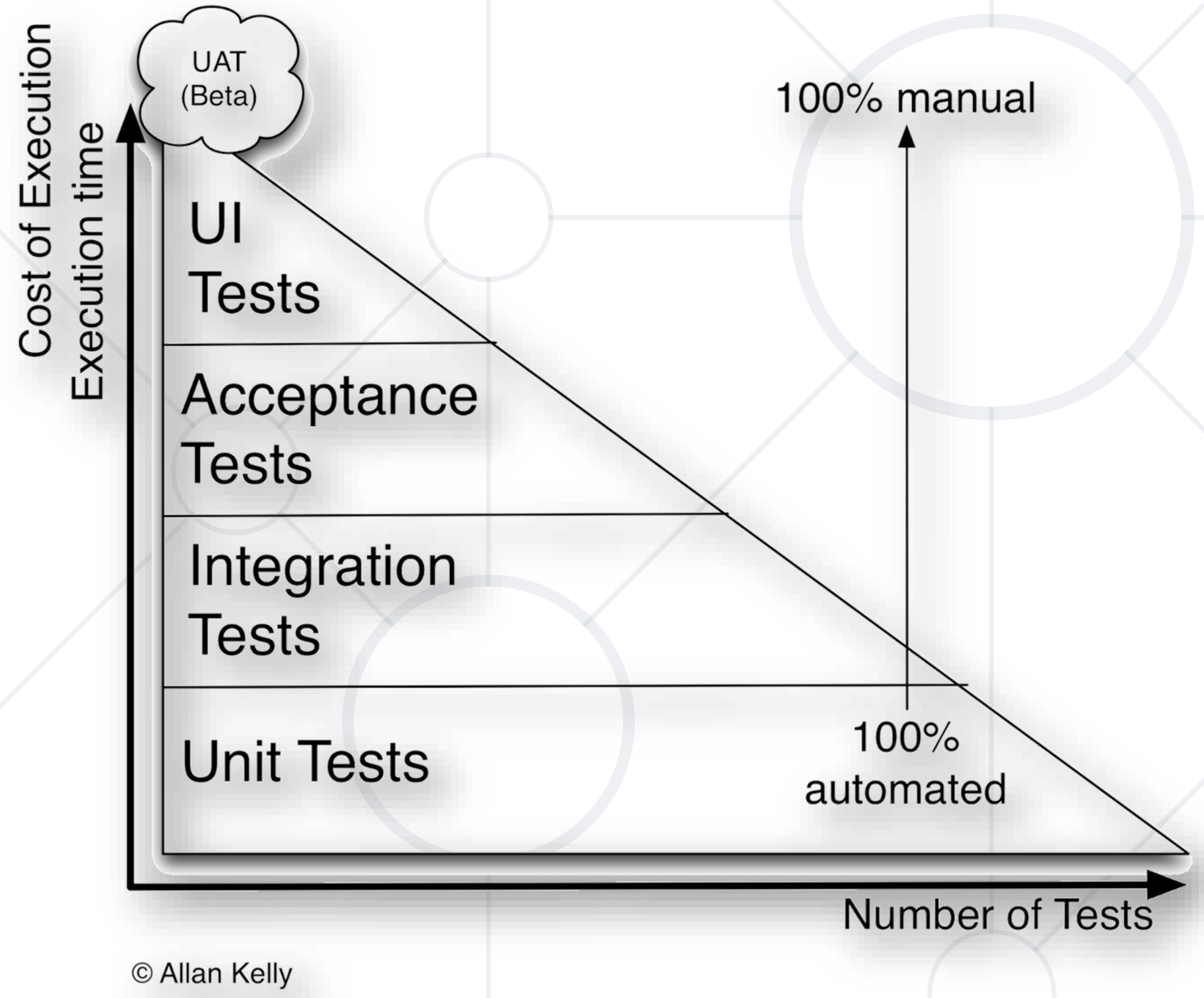


Test Levels

- **Unit tests**
  - Test single component
  - Automated by developers
- **Integration tests**
  - Test interaction between components
- **System tests** / **acceptance tests**
  - Test the entire system

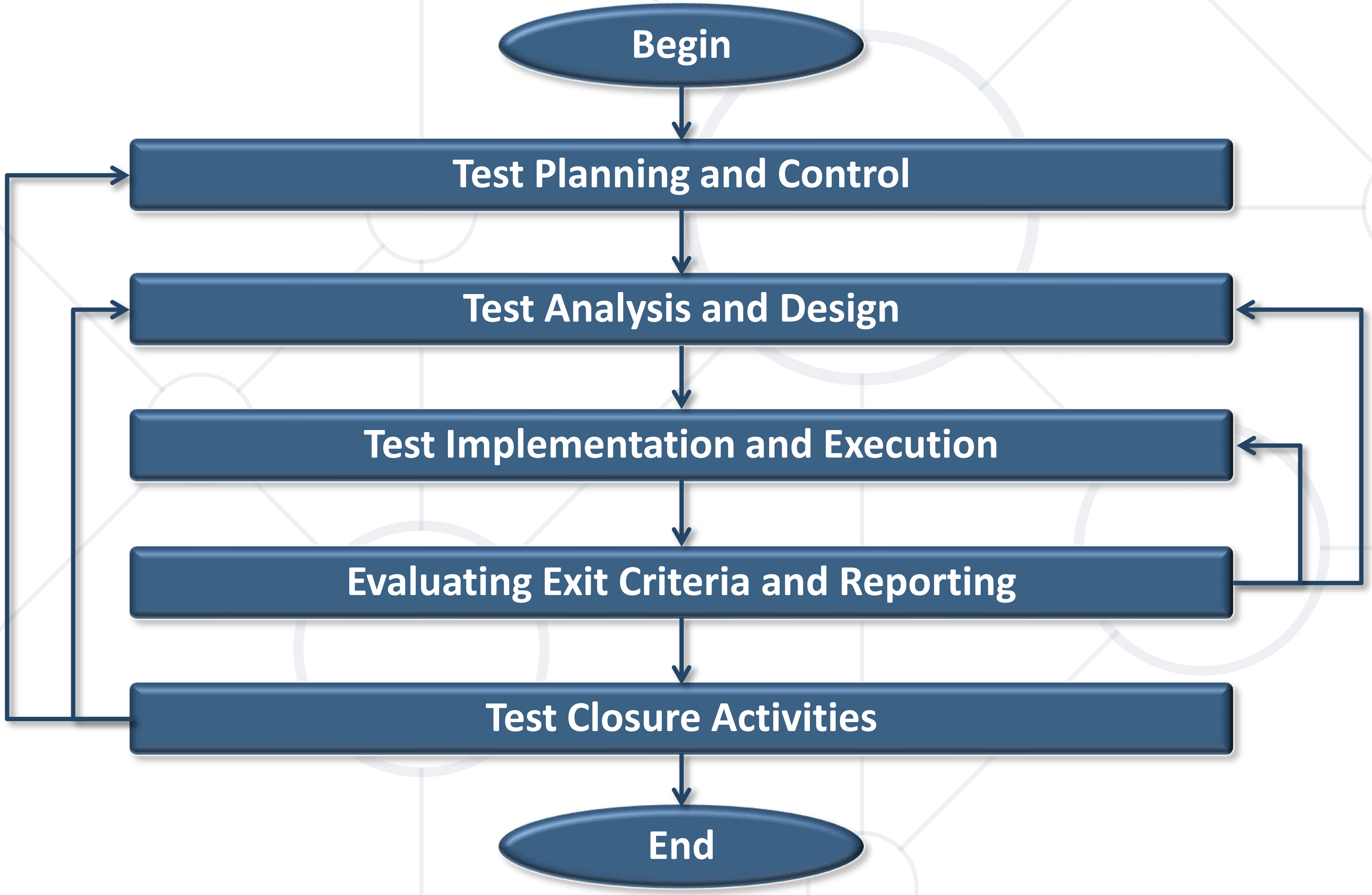


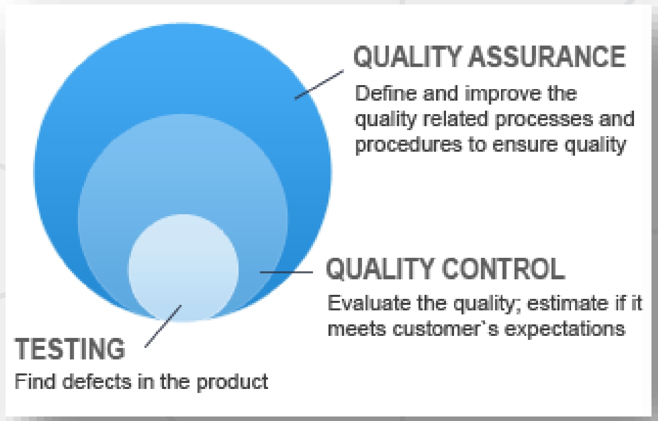
The Testing Triangle



- **Unit tests**: fully automated
- **Integration tests**: fully automated
- **System tests** / **acceptance tests**: partially automated
- **UI / UX tests**: mostly manual

Test Process and Test Activities


Begin
Test Planning and Control
Test Analysis and Design
Test Implementation and Execution
Evaluating Exit Criteria and Reporting
Test Closure Activities
End


QUALITY ASSURANCE
Define and improve the quality related processes and procedures to ensure quality
QUALITY CONTROL
Evaluate the quality; estimate if it meets customer`s expectations
TESTING
Find defects in the product

The Software Testing Process

- Test **planning**
  - Establish **test strategy** and **test plan**
  - What to test, how to test, when, test scenarios
- Test **development**
  - Test procedures, test scenarios, test cases, test scripts, test automation
- Test **execution** and reporting
- Defect tracking / **issue tracking**

Test Plan, Test Scenarios and Test Cases

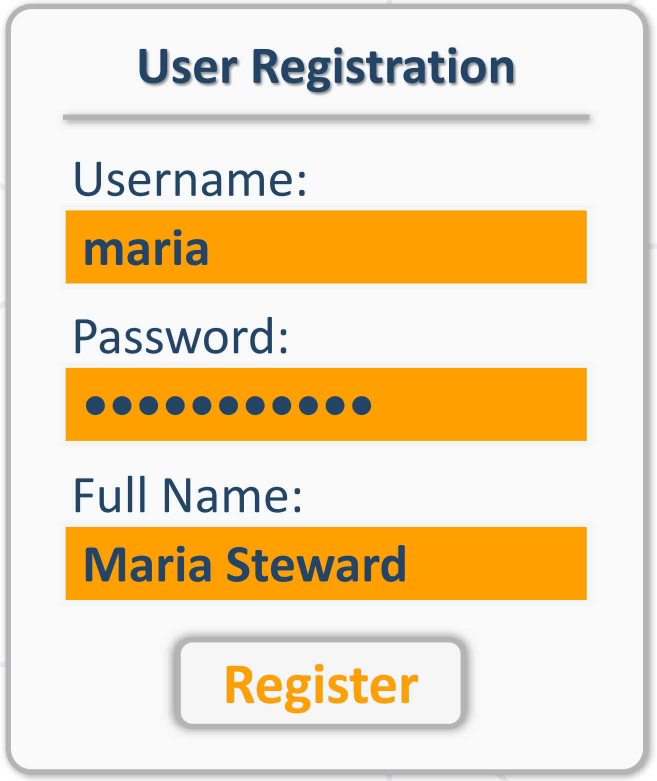
- The test plan describes how tests will be performed
  - List of QA and test activities to be performed to ensure **meeting the quality requirements** (more or less formal)
  - Features to be tested (scenarios), test cases, testing approach, test schedule, acceptance criteria
- Test scenarios and test cases
  - Test scenarios – stories to be tested
  - Test cases – tests of certain function
  - Each test scenario is covered by several test cases

Test Case

- Sequence of **steps** to check the **correct** behavior
- At **least two cases** to fully test certain scenario
  - A positive test
  - A negative test
- Test cases consist of
  - Title
  - Steps to follow
  - Expected result

Test Scenarios and Test Cases – Example

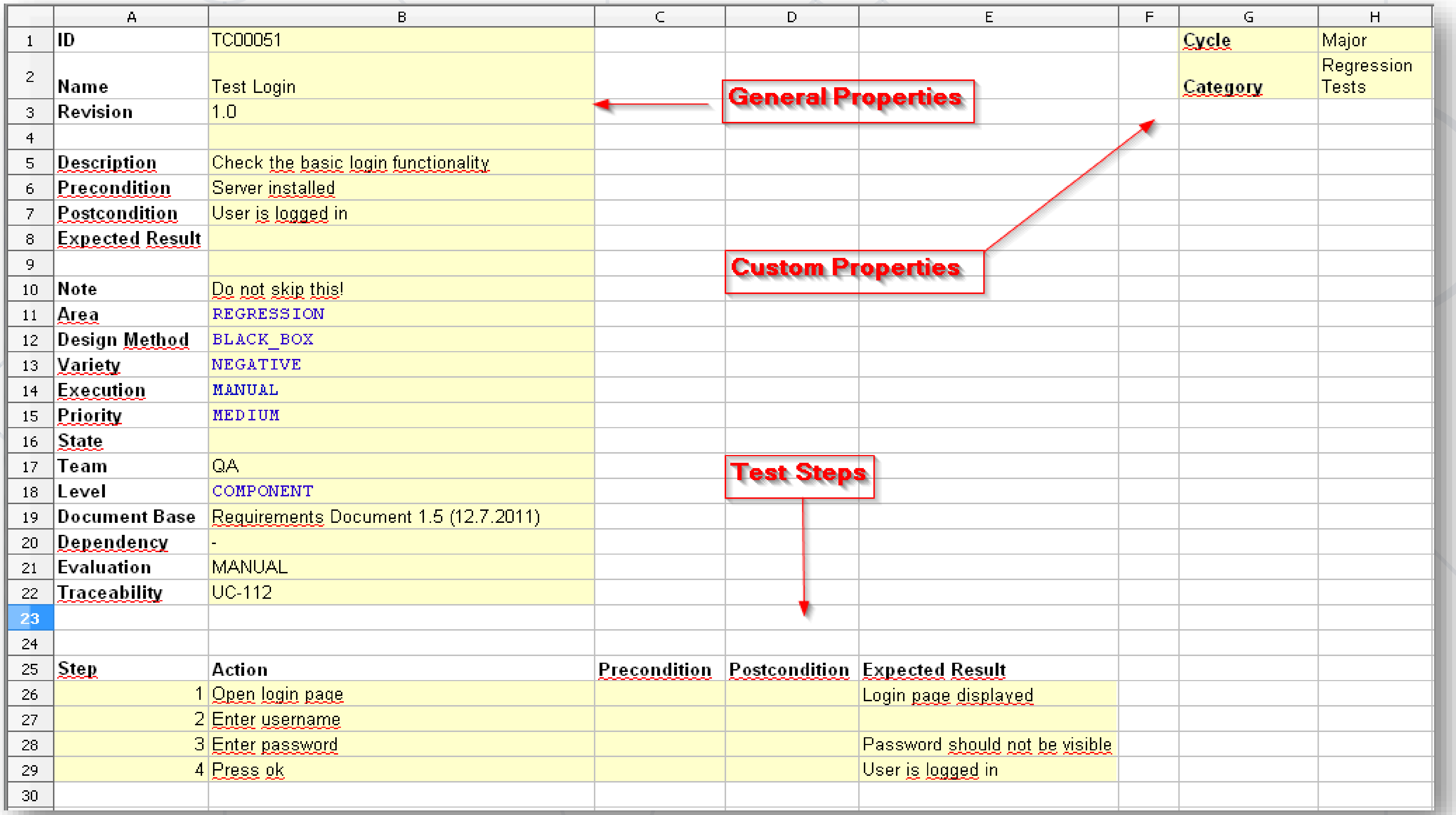
- Sample **test scenario**
  - User registration
- **Test cases** for this scenario
  - Non-existing username → success
  - Duplicated username → error
  - Empty username or password → error
  - Too long username → error
  - Invalid characters in username / password → error



User Registration

Username:	maria
Password:	●●●●●●●●●●●●
Full Name:	Maria Steward

Test Case – Formal Example



	A	B	C	D	E	F	G	H
1	ID	TC00051					Cycle	Major
2	Name	Test Login					Category	Regression Tests
3	Revision	1.0						
4								
5	Description	Check the basic login functionality						
6	Precondition	Server installed						
7	Postcondition	User is logged in						
8	Expected Result							
9								
10	Note	Do not skip this!						
11	Area	REGRESSION						
12	Design Method	BLACK_BOX						
13	Variety	NEGATIVE						
14	Execution	MANUAL						
15	Priority	MEDIUM						
16	State							
17	Team	QA						
18	Level	COMPONENT						
19	Document Base	Requirements Document 1.5 (12.7.2011)						
20	Dependency	-						
21	Evaluation	MANUAL						
22	Traceability	UC-112						
23								
24								
25	Step	Action	Precondition	Postcondition	Expected Result			
26	1	Open login page			Login page displayed			
27	2	Enter username						
28	3	Enter password			Password should not be visible			
29	4	Press ok			User is logged in			
30								

Test Plan

Live Demo

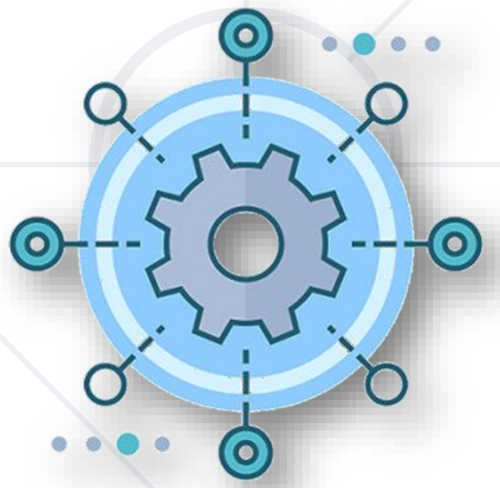
https://melodic.cloud/wp-content/uploads/2019/01/D5.06-Test-Strategy-and-Environment.pdf
https://www.smartdcc.co.uk/media/3609/testing-approach-document-for-june-2020-release_v03-clean.pdf

Test Automation

Unit Testing, Integration Testing, Mocha, Selenium

Test Automation

- **Test automation** is important part of software development
- Test automation is done at many levels
  - **Unit tests**: written by developers
  - **Integration tests**: written by devs and QAs
  - **UI tests**: written by QAs
- **Test automation tools** record and execute recorded tests
  - Testing **frameworks** (JUnit, NUnit, Mocha, …)
  - Automated testing **tools** (Selenium, Appium, Sikuli)
  - **Web** testing, **API** testing, **mobile** testing

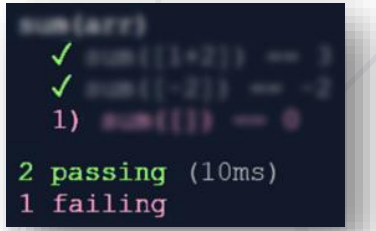


Test Automation Engineers

- **Test automation engineers** (software developers in test)
  - **Developers** with **QA** automation specialization
  - **Technical** skills: coding, OOP, Web technologies, front-end, back-end, databases, services and APIs, software engineering, etc.
  - **QA** skills: testing frameworks and test automation tools
  - **DevOps** skills: containers, cloud, CI/CD pipeline
  - Logical thinking and problem-solving skills
  - Planning and organizational skills
  - Attention to details

Unit Testing

- **Unit test** == a piece of code that tests specific functionality in certain software component (unit)



```
sum(arr)
  ✓ sum([1+2]) == 3
  ✓ sum([-2]) == -2
  1) sum([]) == 0

2 passing (10ms)
1 failing
```

```
function testSum() {
  if (sum([1, 2]) != 3)
    throw "1+2 != 3";
  if (sum([-2]) != -2)
    throw "-2 != -2";
  if (sum([]) != 0)
    throw "empty sum != 0";
}
```

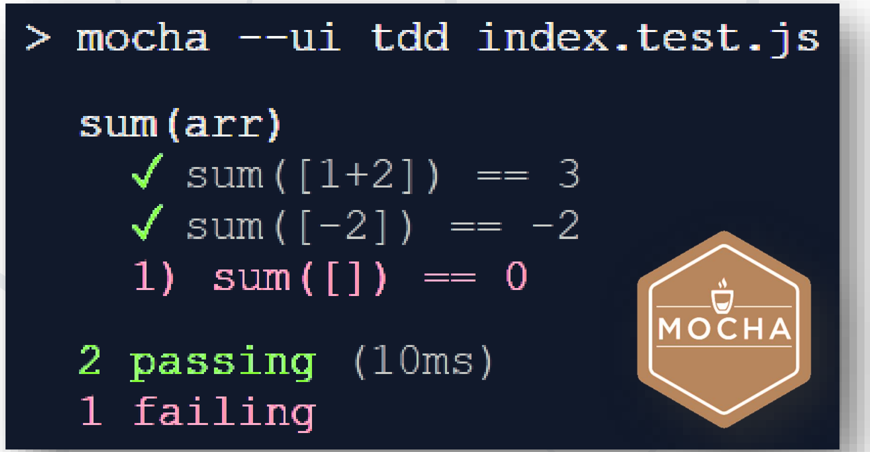
```
function sum(arr) {
  let sum = 0;
  for (let item of arr)
    sum += item;
  return sum;
}
```

Unit Testing Framework

- **Unit testing frameworks** simplify unit testing and reporting
  - Example: **Mocha** JS testing framework

```
const assert = require('assert');

suite('sum(arr)', function() {
  test('sum([1+2]) == 3', function() {
    assert.equal(sum([1, 2]), 3); });
  test('sum([-2]) == -2', function() {
    assert.equal(sum([-2]), -2); });
  test('sum([]) == 0', function() {
    assert.equal(sum([]), 0); });
});
```



```
> mocha --ui tdd index.test.js

  sum(arr)
    ✓ sum([1+2]) == 3
    ✓ sum([-2]) == -2
    1) sum([]) == 0

  2 passing (10ms)
  1 failing
```

Unit Testing with Mocha

Live Demo

https://repl.it/@nakov/mocha-unit-test-example-js

Integration Testing

- **Integration testing** test several units (components) together
  - Aims to expose faults in the **interaction between integrated units**
  - Example: test user registration + data access services + database storage (check whether the new user is stored in the DB)
- **Unit testing** vs. **integration testing**
  - Integration testing tests the interaction between several units
  - Unit testing tests a single unit (component)
- Integration testing is implemented by:
  - Testing framework + test stubs / mocks

Integration Testing with Mocha

Live Demo

https://repl.it/@nakov/MVC-app-integration-tests-example-mocha
https://github.com/nakov/MVC-app-integration-tests-example-mocha/actions

Web Testing Automation and Selenium

- **System testing** tests the entire system:
  - e.g., front-end (UI logic) + back-end (business logic) + database
- Example: automated system testing for Web apps
  - Auto deploy the Web app in a **testing environment** (e.g. Docker)
  - Execute **UI test scenarios** (e.g. fill and submit forms, then check for the inserted / modified data)
- **Selenium** automates testing of Web apps
  - Automates the Web browser: test recording + asserts + execution

Web Testing with Selenium

Live Demo

https://repl.it/@nakov/selenium-webdriver-example

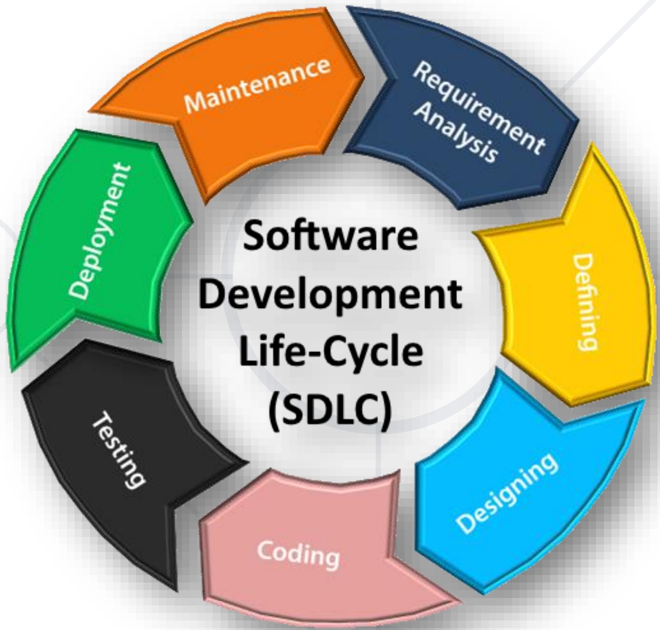
The CI/CD Pipeline

Continuous Integration and Continuous Delivery

Software Development Lifecycle (SLDC)

- **Software engineering** is not just coding!
- The **SDLC** includes the following activities:
  - **Requirements** analysis
  - Software **design**
  - **Construction**
  - **Testing**
  - **Release**
  - **Maintenance**

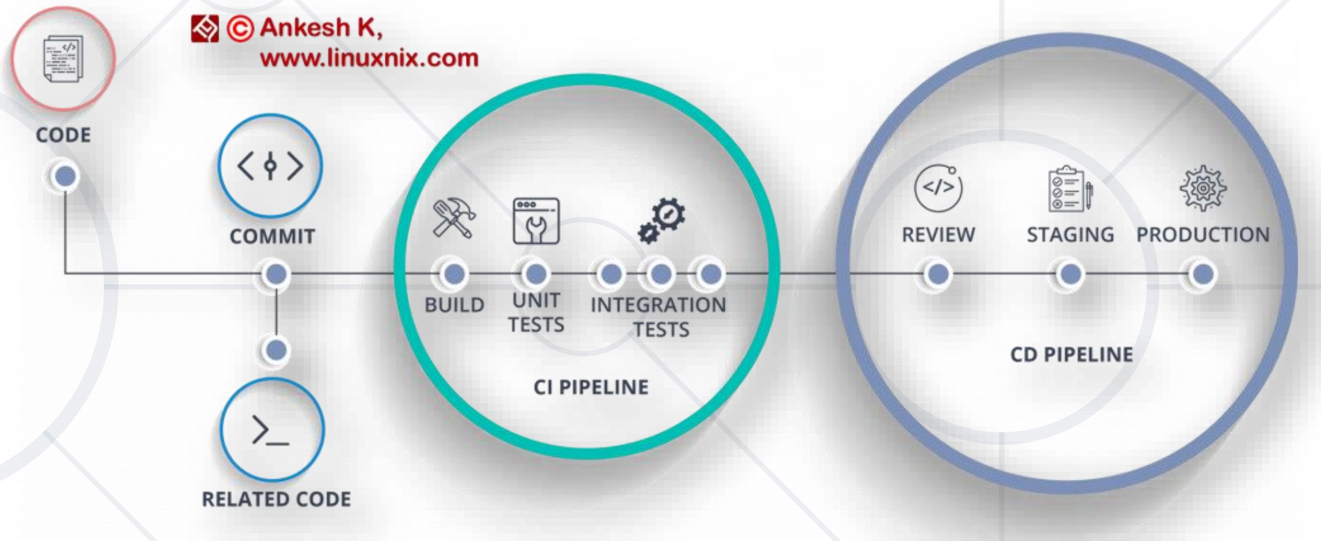
Software project **management**



- **Development processes** (Waterfall / Scrum /Kanban) define workflow and key practices

CI/CD Pipeline

- **CI/CD pipeline**
  - Continuously integrate and release new features
- **Continuous integration** (**CI**)
  - Write code, test and integrate it in the product
- **Continuous delivery** (**CD**)
  - Continuously release new features
- **QAs** maintain and monitor the CI/CD pipeline



GitHub Actions

CI/CD Pipeline with GitHub Actions

Live Demo

https://github.com/fireship-io/fireship.io/runs/924075545

https://github.com/dotnet-architecture/eShopOnWeb/runs/930547025

https://github.com/github/covid19-dashboard/runs/923863536

https://github.com/nakov/MVC-app-integration-tests-example-mocha/actions

Summary

- QA engineers ensure the **software quality**: testing, reporting and process
- Plan and execute **testing activities**
- Design **test cases** and execute **tests**
- Write **test automation** scripts
- Report **bugs** and track their lifecycle
- Build and monitor **CI/CD** pipeline

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