KIN+CARTA
Create

NORTHERN TRUST

IMMERSE

Mutation Testing

[July] [2020]

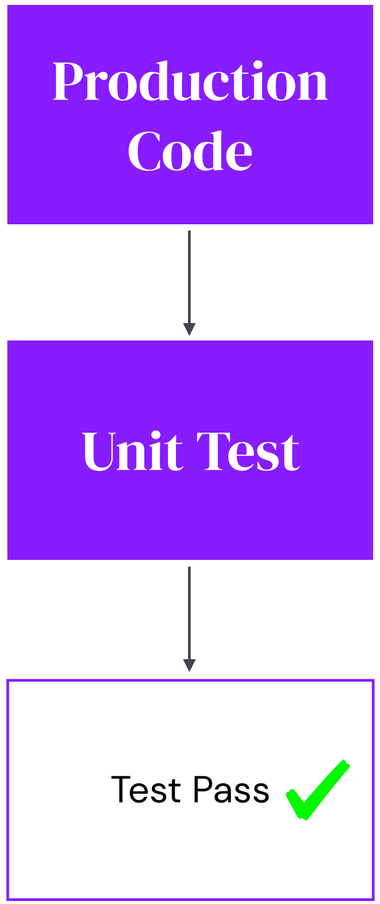
Contents

Motivation

- Unit Tests are not a guarantee of quality
- Code Coverage metrics can have gaps
  - Poor tests can still exhibit good coverage
  - Coverage can be inflated with tests without corresponding quality improvements (i.e. domain classes)

Are there ways to better evaluate the quality of unit tests?

What is Mutation Testing?



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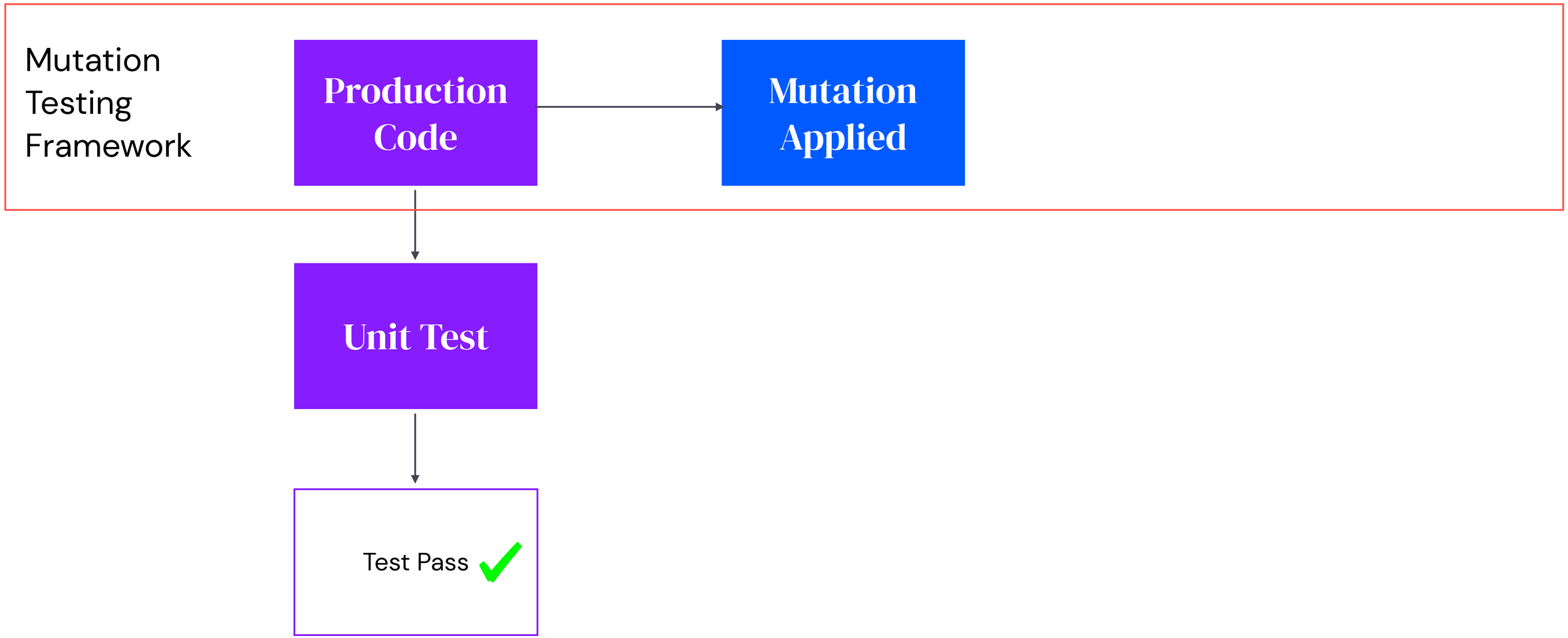

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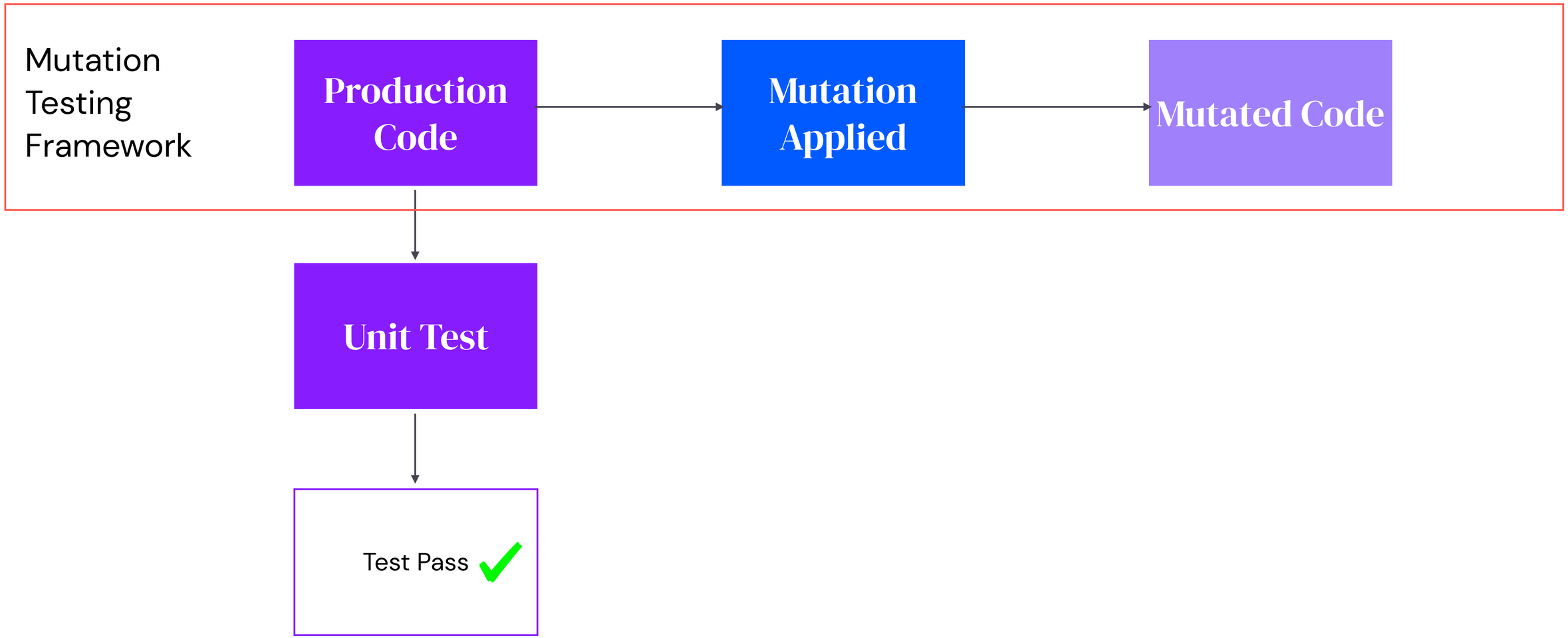

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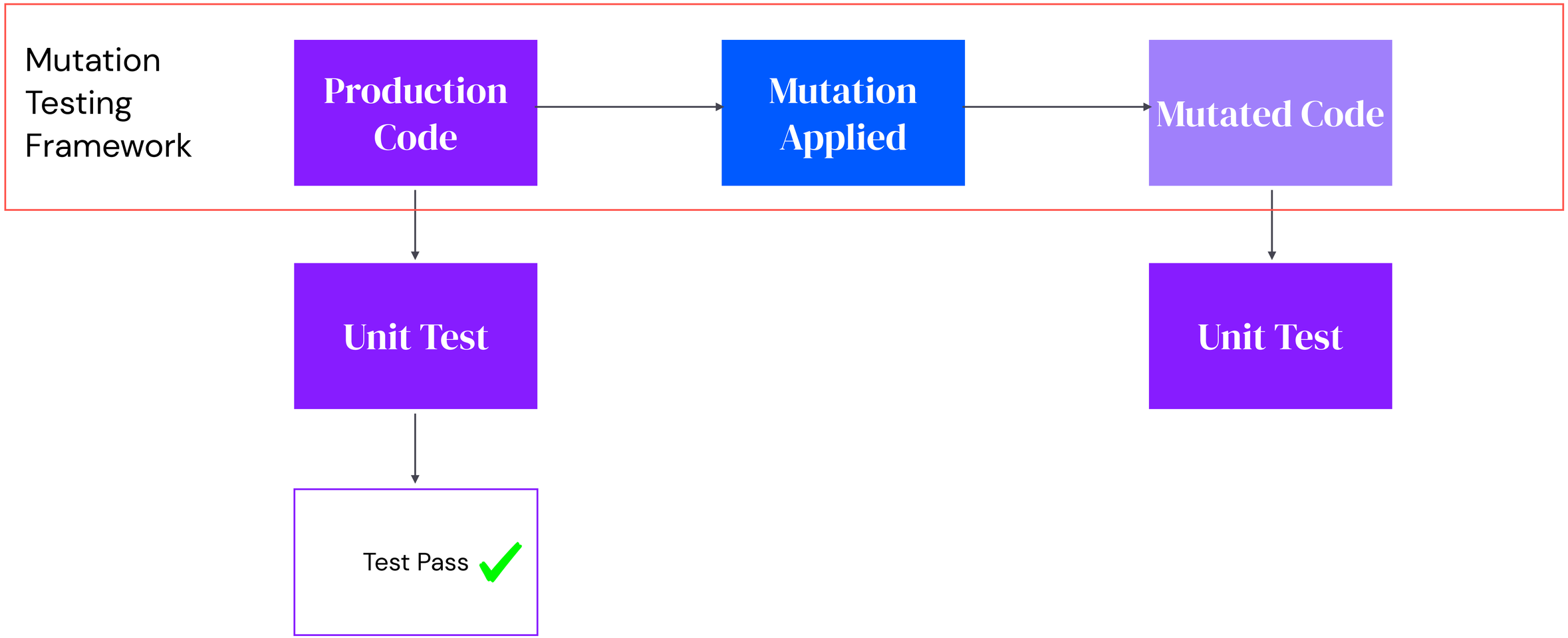

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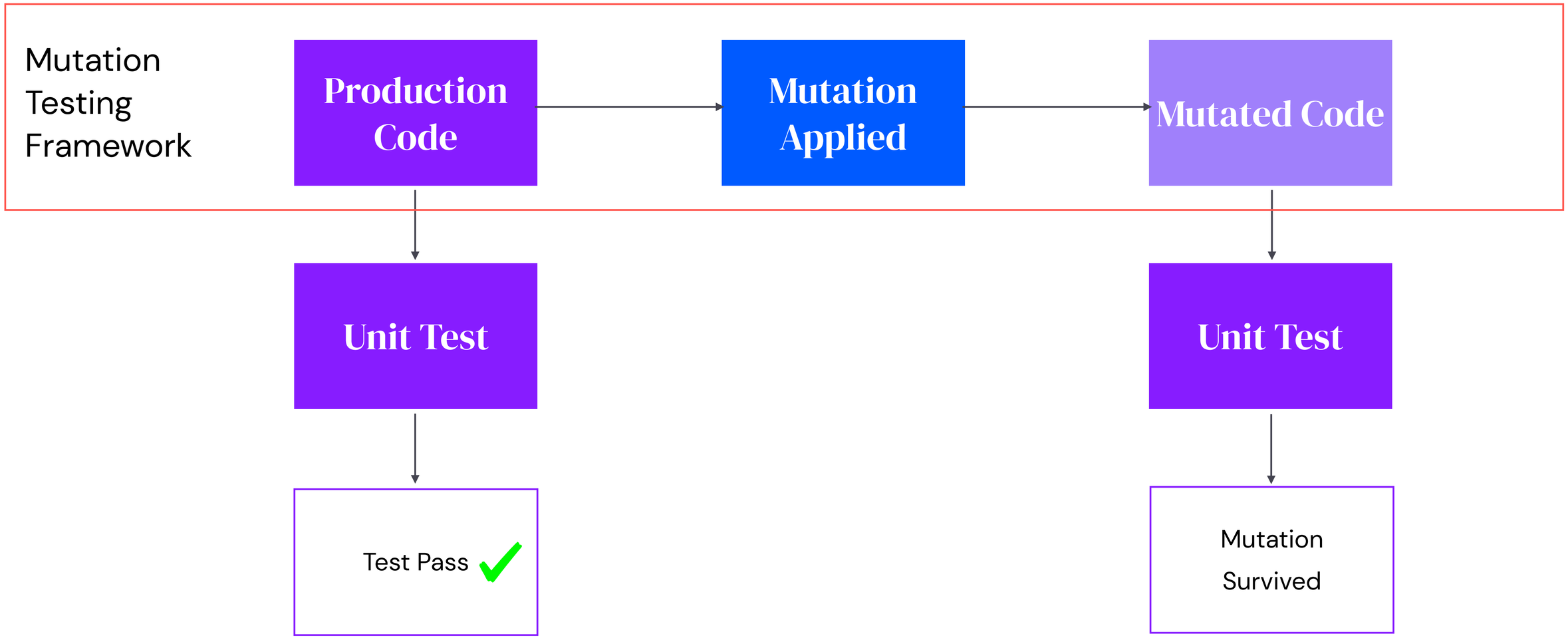

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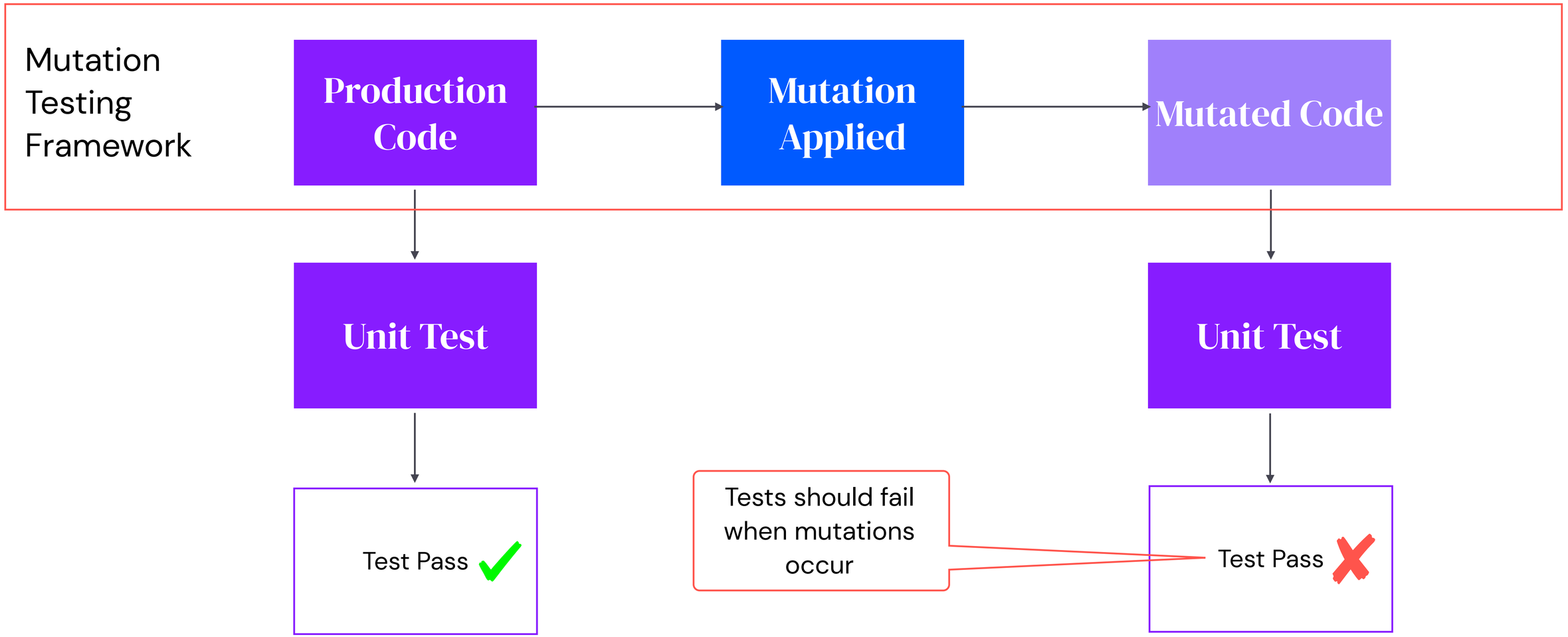

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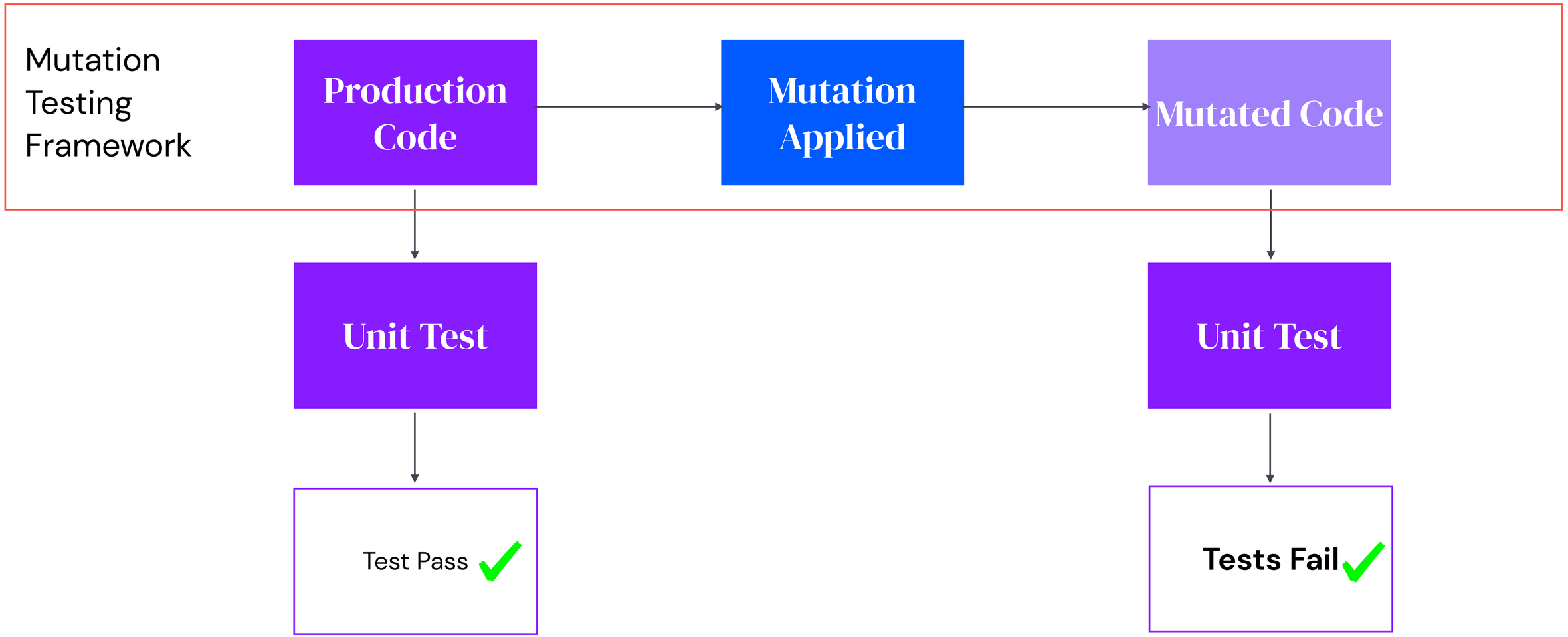

Examples of Mutations

Mutation Type	Original Code	Mutated Code
Conditional	`if (x > y) {…}`	`if (x <= y) {…}`
Arithmetic	`x + y`	`x - y`
Return	`return true;`	`return false;`

Non-Void	`public void doSomething();`
	`…`
	`public void doAnother() {`
	`  doSomething();`
	`  return true;`
	`}`
		`public void doSomething();`
		`…`
		`public void doAnother() {`
		`  return true;`
		`}`

Demo

https://github.com/jnedum/mutation-testing-demo

Libraries

- PITest (http://pitest.org/)
  - Java based
  - Only major maintained version for JDK
  - Well-supported Gradle Plugin
  - Kotlin support through 3rd party projects
- Stryker (https://stryker-mutator.io/)
  - Leading framework for JS, .NET
- MutPy (https://pypi.org/project/MutPy/)
  - Leading framework for Python
  - Many alternatives exist (Cosmic Rays, MutMut)

Summary

Benefits of Mutation Testing

- Ensures test quality
- Can be easily run within CI pipeline
- Validates quality of tests even in cases where coverage is good
- Catches tests not covering boundary conditions well
- Automates aspects of test quality, lessens load on manual review
- Particularly well-suited for environments without pull requests

Drawbacks of Mutation Testings

- Computationally expensive - can take a long time to run
  - PITest offers threading to run tests in parallel
- Mutations grow exponentially with code
  - PITest allows you to choose mutators at runtime
  - Works better on microservices than monoliths