Software Testing

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Overview

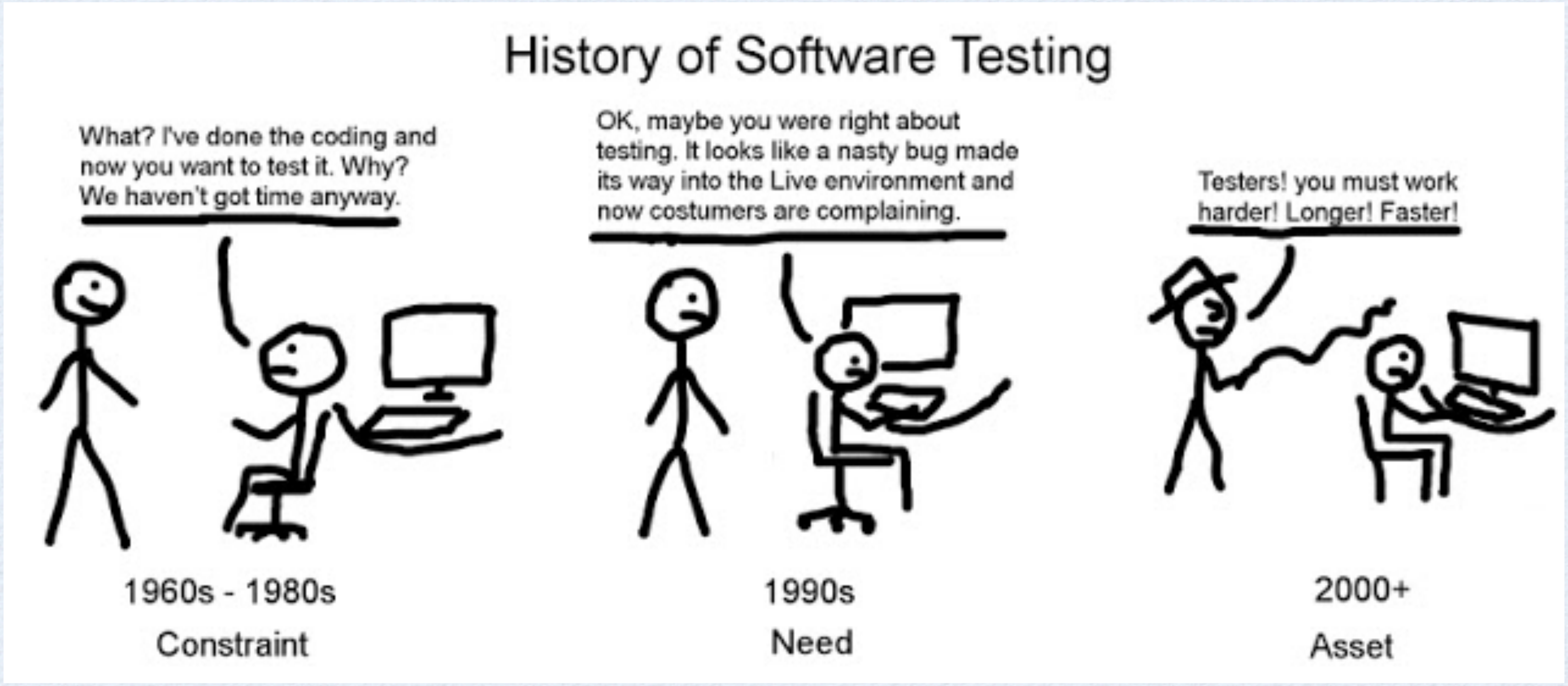
Breakpoints (sorry!)

- What is testing?
- Types of test
- The curse of dimensionality as applied to test
- Reducing the test load
- Automated test

Standard Software Lifecycle

$$\begin{tikzcd}
\text{Requirements} \arrow[dr] & & & & & \\
& \text{Design} \arrow[dr] & & & & \\
& & \text{Implementation} \arrow[dr] & & & \\
& & & \text{Integration} \arrow[dr] & & \\
& & & & \text{Deployment} \arrow[dr] & \\
& & & & & \text{Maintenance}
\end{tikzcd}$$

Software Testing


History of Software Testing
What? I've done the coding and now you want to test it. Why? We haven't got time anyway.
OK, maybe you were right about testing. It looks like a nasty bug made its way into the Live environment and now costumers are complaining.
Testers! you must work harder! Longer! Faster!
1960s - 1980s
Constraint
1990s
Need
2000+
Asset

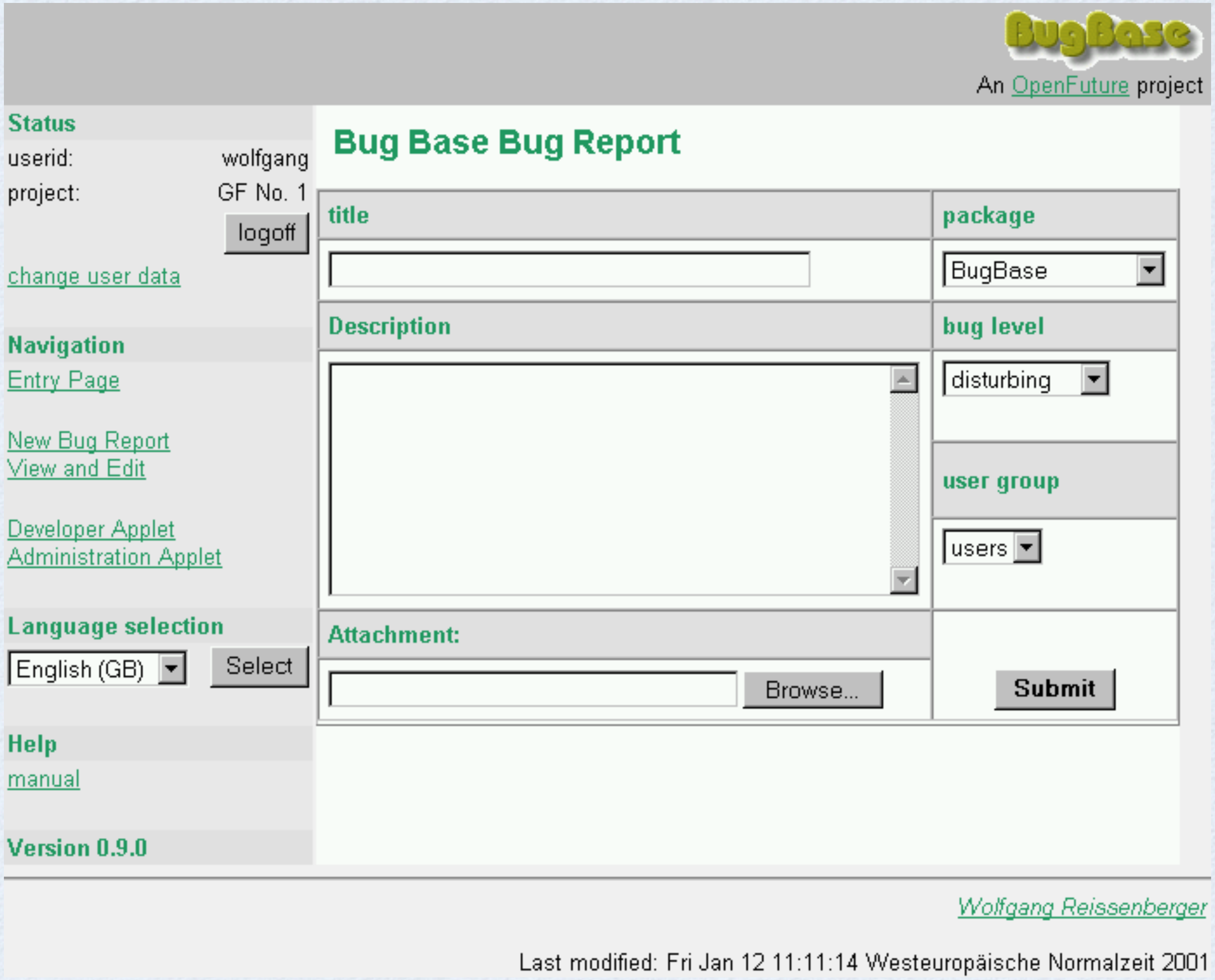
- What is a test?
- Specified by a test case
  - outlines the steps taken to perform the required test
  - expected output of the test
- Outputs are:
  - bug reports - formal description of a defect
  - validation - approval that the software can progress to next development stage

A Test Suite Document

[typically done with a pen!!!]

Test Case ID	Description	Pass/ Fail
2.1.1	Entry with a blank First Name results in an error message being displayed saying The First Name must be filled in.	
2.1.2	The First Name field will accept a maximum of 50 characters	
2.1.3	If more than 50 characters are entered in The First Name field an error message will be displayed saying "The First Name field will not accept more than 50 characters."	
2.1.4	Entry with numbers in The First Name field shall result in an error message being displayed saying "The First Name field will not accept numbers."	
2.1.4	First Name field will accept the character: "-".	

Bug Reports



BugBase

An OpenFuture project

Status

userid:	wolfgang
project:	GF No. 1

logoff

change user data

Navigation

Entry Page

New Bug Report
View and Edit

Developer Applet
Administration Applet

Language selection

English (GB) Select

Help

manual

Version 0.9.0

Bug Base Bug Report

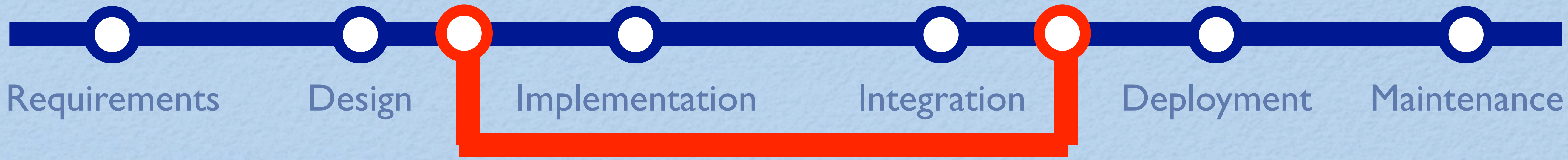
title	package
	BugBase
Description	**bug level**
	disturbing
	user group
	users
Attachment:	
Browse...	Submit

Wolfgang Reissenberger

Last modified: Fri Jan 12 11:11:14 Westeuropäische Normalzeit 2001

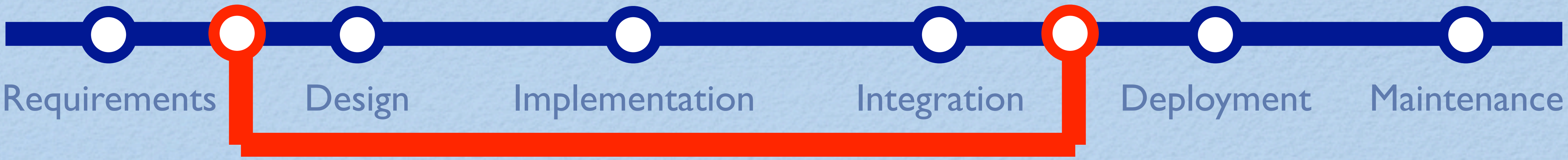
Unit Testing

- **Input:**
  - The functional specification of an individual unit
- **Output:**
  - Simple pass / fail
- **Performed by:**
  - Typically a developer
- **Frequency:**
  - Informally can be more than once per day
  - Formally depends on implementation schedule



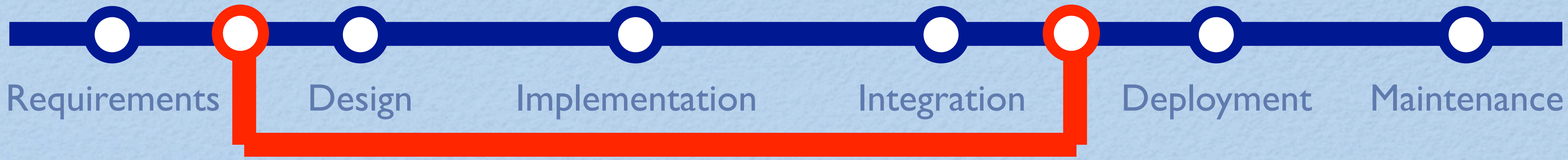
Integration Testing

- **Input:**
  - The functional specification of the product
- **Output:**
  - Bug Reports
  - Sign-off for system test if performed at the end of an ***increment***
- **Performed by:**
  - The development team
- **Frequency:**
  - Formally on a weekly / bi-weekly basis



System Testing

- **Input:**
  - The requirements specification of the product
- **Output:**
  - Sign off for Acceptance Test
  - Formal Bug Reports
- **Performed by:**
  - A professional tester
- **Frequency:**
  - Once per development increment (typically for every full, working version of the code base)



Acceptance Testing

- **Input:**
  - Specific use cases of the product
- **Output:**
  - Sign off for product release
  - Formal Bug Reports
- **Performed by:**
  - A professional tester or a member of the Quality Assurance Department
- **Frequency:**
  - Once per version release (more if there is a failure)

Jargon

- ***Regression Testing***
  - This refers to any testing designed to catch new defects introduced into existing, working code by adding new functionality
  - Important part of integration testing
  - Important part of system testing
    - New versions
    - Patch releases

Jargon

- ***White Box Testing***
  - Sometimes called “clear box”, “glass box”, “transparent box” or “structural testing”
  - Tests the designed structure and interactions of functional code blocks
  - Requires knowledge of the internals of the system
- ***Black Box Testing***
  - Black box testing treats the product as a finished system, with no knowledge of the internal workings.
  - Effectively testing from the user’s perspective

Exercise

- For the key testing types:
  - System
  - Unit
  - Integration
- Identify if they require white box, black box or both types of testing

Why White Box Test?

- If we can black box test everything, why bother white box testing?

Curse of Dimensionality

- A test is like a search, methodically running through scenarios looking for mistakes
- One input with 10 values = 10 tests
- Two inputs with 10 values = 100 tests
- Three inputs with 10 values = 1000 tests
- If you tested everything the company would go bust before V0.1!

Reducing the Search Space

- If we test a multiplication function, should we test it can multiply any two integers?
  - A 32 bit integer can hold any number from -2147483648 to 2147483647
  - 18446744073709551616 tests... for a multiplication
    - Practical?
    - Useful?

Reducing the Search Space

- Where can a multiplication fail?
  - Sign problems
  - 0
  - Limits
- Practical tests
  - ++, -+. +-. –
  - +0, 0+, -0, 0-
  - Max * Max

} 9 tests

Test Reduction Strategies

- Boundary testing
  - Failures often occur at the transition points
    - Valid and invalid
    - Signed and unsigned
    - Zero

Test Reduction Strategies

- Limits testing
  - Failure at the limits of memory
    - Buffer overflow
    - Numerical overflow / Underflow

Test Reduction Strategies

- Partition testing
  - Requires an understanding of the software's requirements
  - Partitions the search space based on an understanding of its operation

Other Types of Testing

- Load Testing
  - Useful for networked or real-time software
  - Add more clients, requests etc and check service degredation
    - London Ambulance Service

Other Types of Testing

- Stress Testing
  - For pure software, similar to load testing, but involves pushing the system to failure
  - For hardware / software systems involves high shock loads and electrical limits to find the points of failure

Other Types of Testing

- Security Testing
  - Increasingly important
  - Relates to limits and boundary testing
  - Sometimes involves “white-hat hackers”

Harnesses and Automated Tests

- There can still be a prohibitively large number of tests
- Is automation the answer?

Harnesses and Automated Test

- Test harnesses typically enable automated test
- They are usually software-only environments, which:
  - Simulate the physical components of a physical system
  - Simulate external services and programs for networked systems

Automated Test Systems

- Automated test systems can be hardware and software systems
- They typically allow tests to be written and designed in scripting languages
- BE VERY CAREFUL

Example System

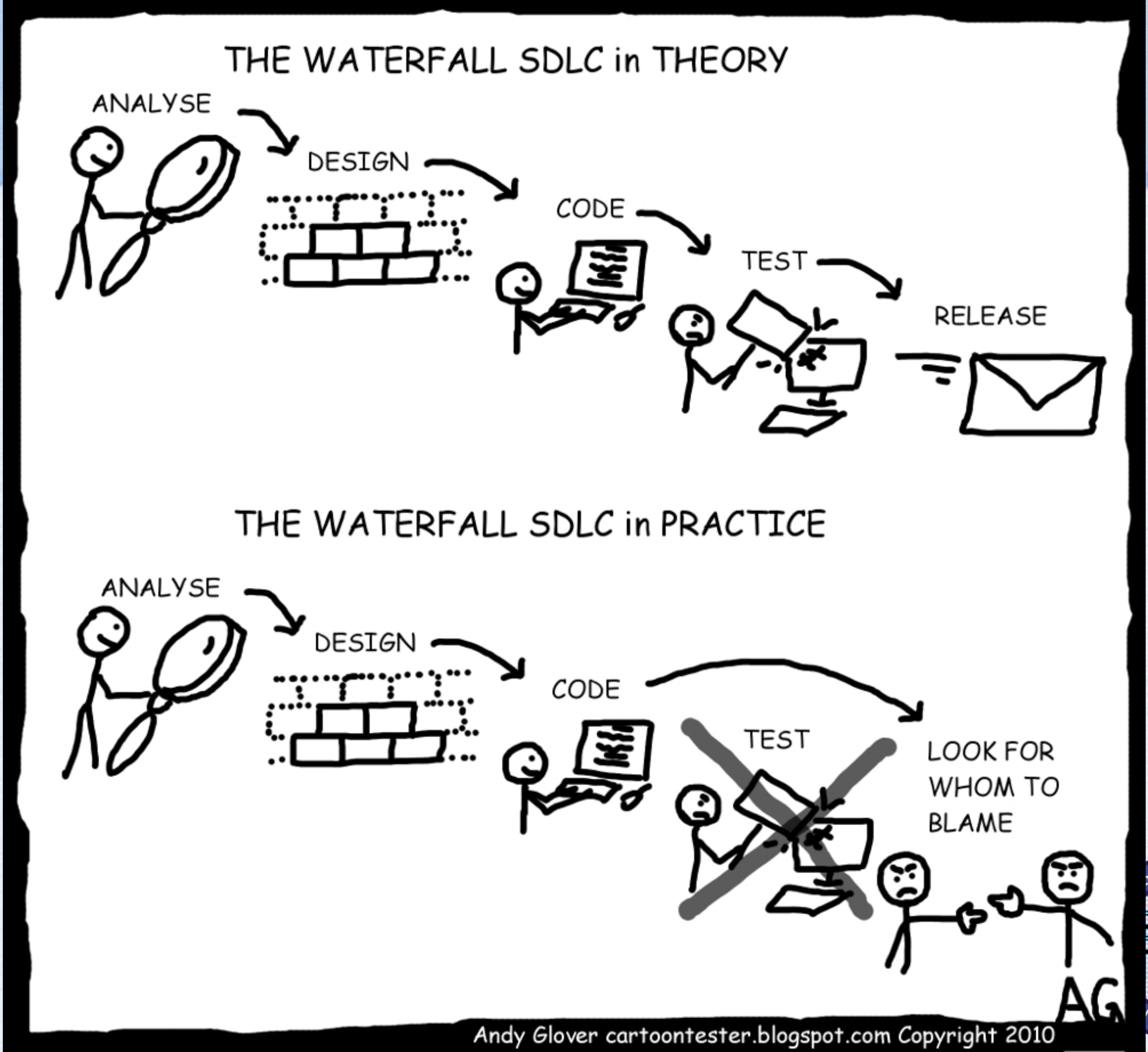
- A motor controller should take 10 seconds to ramp a motor from 0 to 100 Hz

Example Test Script

```
StopMotor();

A = speed();

RunMotor(100);

Wait(10000);

B= Speed ();


If (A==0) && (B==100)

   PASS
```

Better Script

```
StopMotor();
RunMotor(100);
while(speed < 100) {
  A= Speed ();
  t = time();
  output(t,A);
}
```


THE WATERFALL SDLC in THEORY
ANALYSE
DESIGN
CODE
TEST
RELEASE
THE WATERFALL SDLC in PRACTICE
ANALYSE
DESIGN
CODE
TEST
LOOK FOR WHOM TO BLAME
AG
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Summary

- Testing is a varied and important discipline
- Testing is a vital part of the development lifecycle
- It simply isn't possible to do exhaustive testing
- Even limited testing requires automation
- Be careful!