Quality Assurance of Large C++ Projects

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Developer at Microsoft (Hyper-V) in the past

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Quality Assurance

Quality Assurance vs Quality Control

Focus on **quality of processes**	Finding defects **in ready product**
Proactively **preventing defects**	Reactively **identify defects**

Goal of Quality Assurance

Improve development processes so that defects do not arise when the product is being developed

Relative Effectiveness of Quality Techniques

Quality Technique	Average Rate of Found Defects
Informal design reviews	35%
Formal design inspections	55%
Informal code reviews	25%
Formal code inspections	60%
Modeling or prototyping	65%
Personal desk-checking of code	40%
Unit test	30%
New function (component) test	30%
Integration test	35%
Regression test	25%
System test	40%
Low-volume beta test (<10 sites)	35%
High-volume beta test (>1,000 sites)	75%

Only combination of techniques can assure 95% and higher quality

General Principle of Software Quality

Improving quality reduces development costs

Coding Standards

Importance of Coding Standards

- Impossible to build a complex system without standardization
- Share experience from the industry and your project
- Make code look and behave uniformly
- Use only the “safest” subset of the C++ Language

Available Standards and Guidelines for C++

C++ Core Guidelines by Bjarne & Co

High Integrity C++ Coding Standard

Google C++ Style Guide

Sutter, Alexandrescu: C++ Coding Standards

… and many more

Make your Guidelines extensible. Support by the Dev Team

Automating Guideline Checking

Automate guideline checking as a pre-commit hook for the changeset

No unchecked code in the repository!

cpplint.py – regex-based tool for Google C++ Style Guide

Guideline Checker Tool – available with VS 2015 for C++ Core Guidelines

★ clang-tidy – clang-based tool for C++ Core Guidelines, Google C++ Style Guide, *and your own checks!*

Code Reviews

Code Review: Best Practices

Integrate review with your issue tracking system

Prefer pre-commit reviews if possible

Independent review by 2 people increase ratio of found defects

Code Review Systems

Review Board

Gerrit for Git

Crucible by Atlassian

… and many more

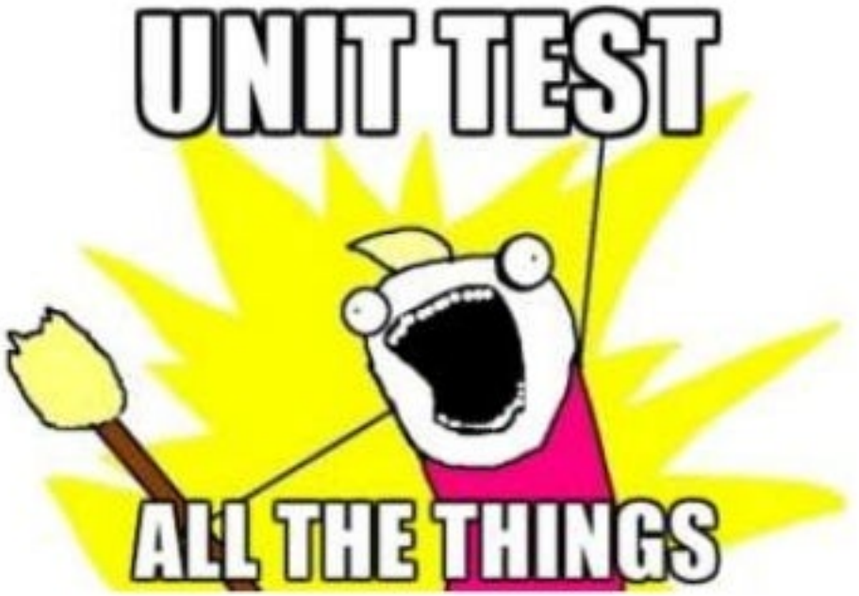
Code Review Checklist

1. Does the code implement requirements spec?
2. Is the code compliant with the Coding Standards?
3. Does the code change any existing functionality?
4. Are all non-success scenarios handled?
5. ...

Unit Testing

Unit Testing Ideology

- *Design code to be testable: Test-Driven Development*
- *Integrate unit tests into your project build process (as a post-build event)*
- *Aim for 100% coverage*



Unit Testing Frameworks

Boost.Test

CppUnit

Google Test

CxxTest

… and more: check out Comparison of C++ unit testing frameworks

Static Code Analysis

Static Code Analysis Basics

Your C++ Compiler:

1. Use max warning level
2. Use built-in static analysis checks (e.g. -Weffc++ for gcc)

Run static analysis as a build or pre-commit step

Static Code Analysis Tools

Cppcheck

PVS Studio

Coverity

Copy-paste detectors (e.g. CPD)

… check out Static Code Analysis Tools for C++

Code Coverage

Code Coverage Tools

lcov for *NIX

OpenCPPCoverage for Windows

Use coverage for Unit Test runs

Intrusive Dynamic Verification

Runtime Verification Tools

Application Verifier / Driver Verifier for Windows

Address Sanitizer / Memory Sanitizer / Thread Sanitizer (clang)

Undefined Behavior Sanitizer

Valgrind / Helgrind / Massif

Memory leaks: UMDH, LeakDiag

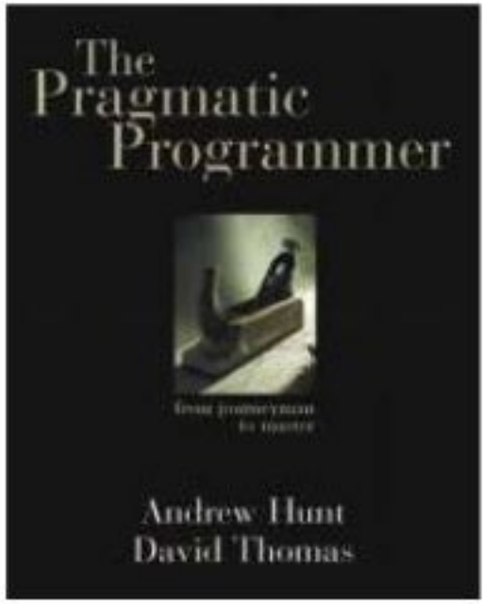
Non-intrusive Dynamic Verification

Assertive Programming (Programming by contract)

If it can't happen, use assertions to ensure that it won't

Leave assertions turned on in production code (except for when it affects performance)

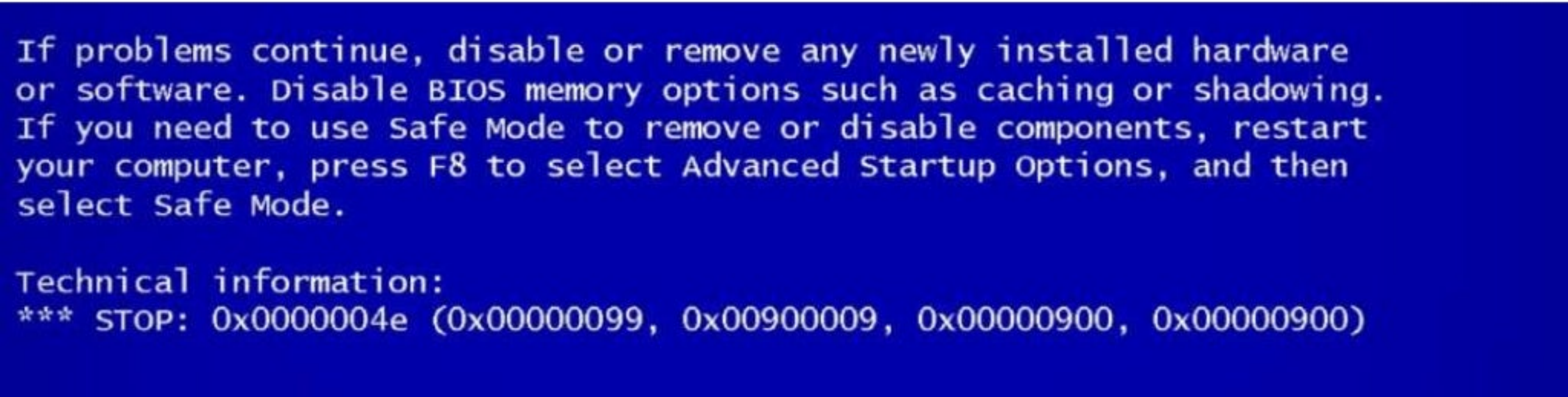
Collect and analyze assertions



Crash Dump Reporting/Analysis System

Collect and analyze crash dumps from test labs and from production

Check out Crash Dump Collection and Analysis System talk



Continous Integration

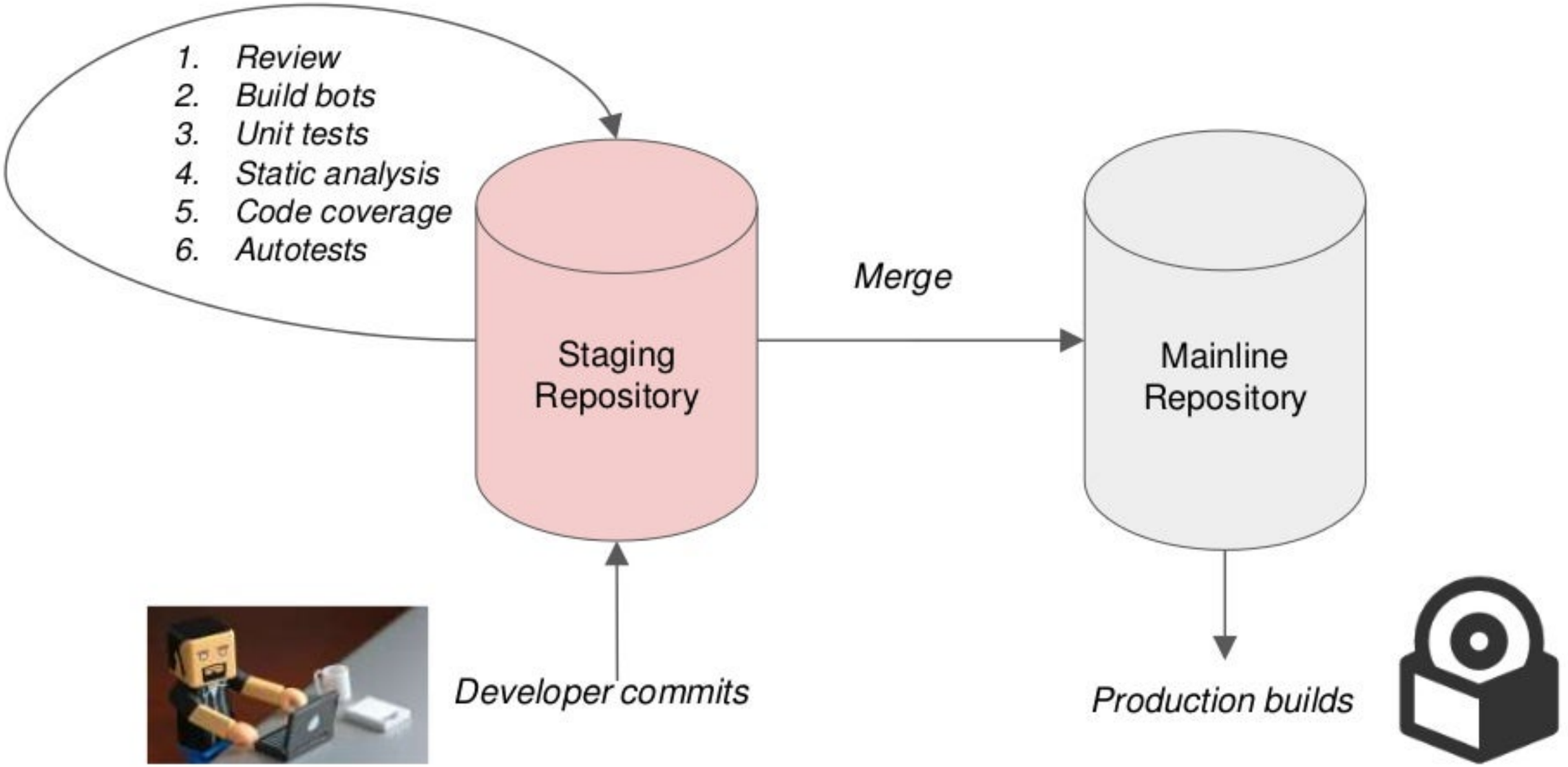
Continuous Integration Tools

TeamCity: *3 agents for free*

Jenkins

Team Foundation Server

Staging Repository



“Free” Lunch

Thanks! Questions?

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