Code Inspection Checklist

- Variables
  - Meaningful names?
  - Named constants instead of hard-coded numbers
  - Are read-only variables declared const?
  - Are all variables used?
- Functions
  - Meaningful names
  - Are all parameters used?

Code Inspection Checklist (cont.)

- Correctness
  - Parentheses and brackets properly matched?
  - Switch cases all end in break? Have default?
- Initialization
  - For all variables before use
- Loops
  - All terminate?
  - Do break and continue statements work correctly?
  - Are loop control variables modified in loop body?

Code Inspection Checklist (cont.)

- Dynamic allocation
  - All allocations properly deallocated?
- Pointers
  - Can a NULL pointer be dereferenced?
- Comments
  - Are comments appropriate?
  - Do comments accurately describe the code?
- Defensive programming
  - Are checks made for divide by zero, invalid data, etc.?

Code Walkthroughs or Reviews

- Less formal than inspections
- Typically fewer people involved
- Discussions of alternatives are allowed
  - Even encouraged

Software Engineering

COEN 174

Ron Danielson

Testing and Quality Assurance

Chapter 10

Objectives

- Understand why quality is essential in software engineering
- Know basic techniques for testing software, including test coverage
- Understand basic techniques for software validation and verification

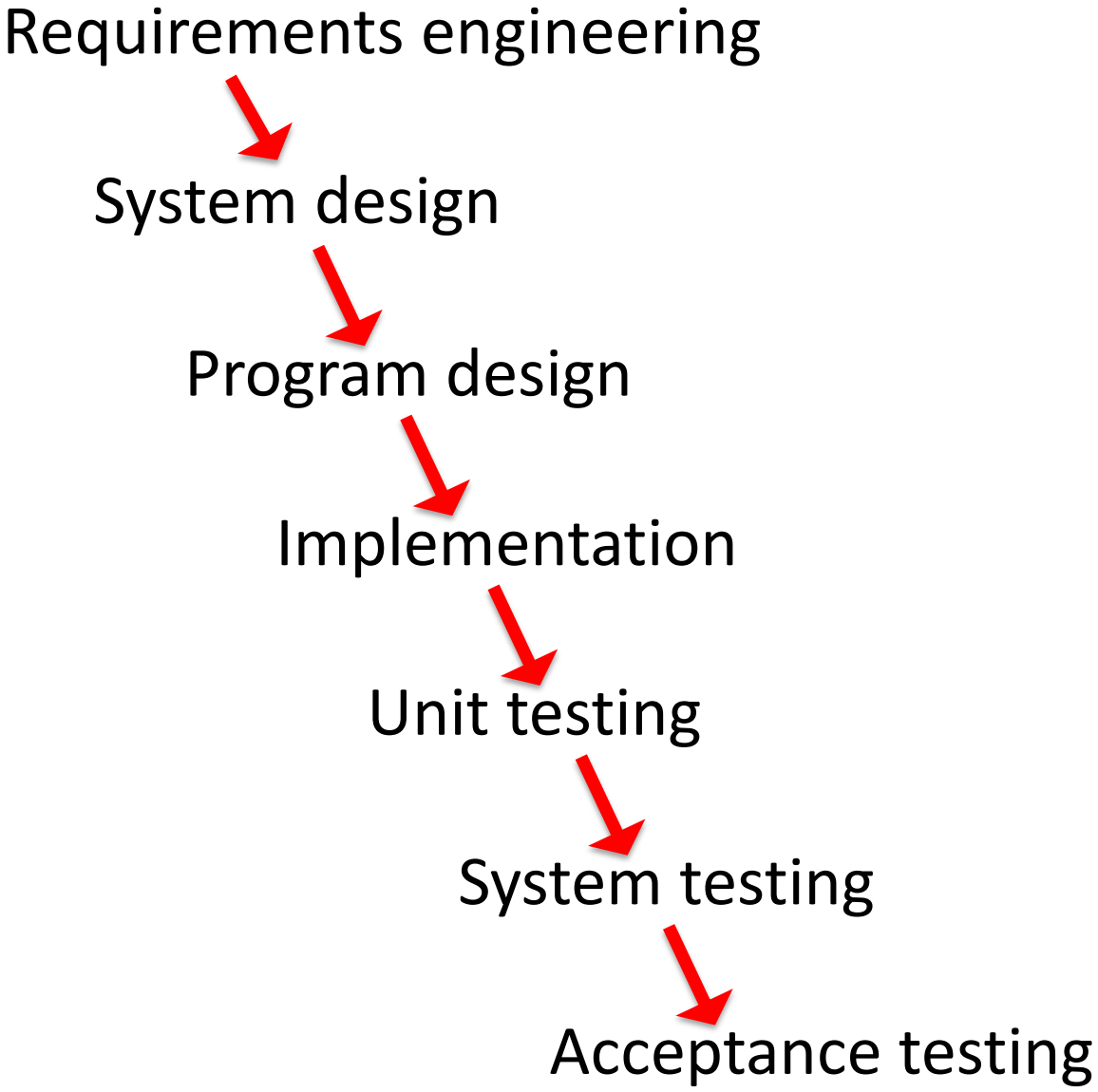
Ensuring Quality

- **Quality Assurance**: actions to **measure** and **improve** quality in a ***product*** and a ***process***
  - Most large SW development organizations have separate QA organizations that do more elaborate levels of testing
- **Quality Control**: actions to **validate** and **verify** the quality of a product
  - By detecting faults and fixing the defects

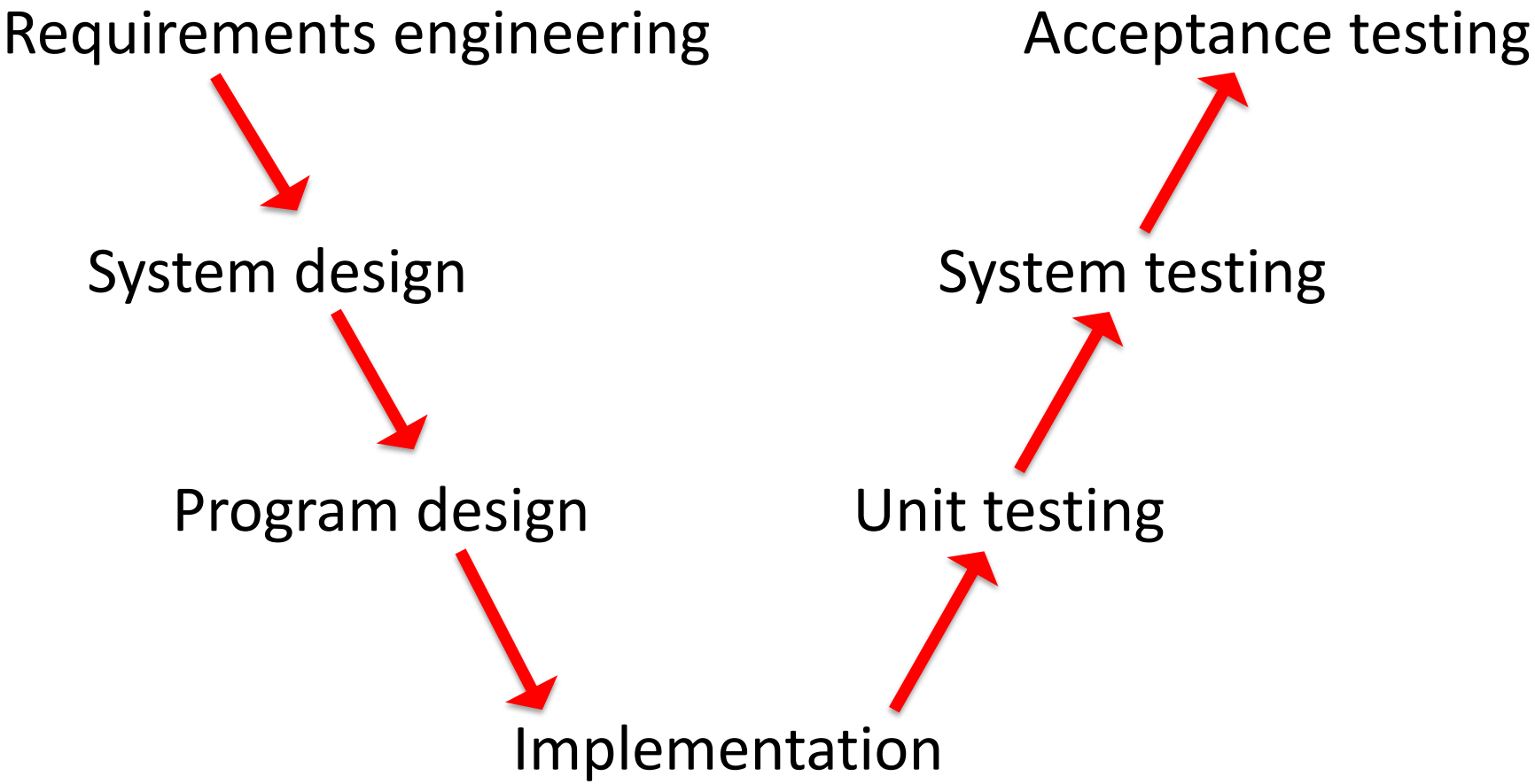
What Is Software Quality

- Traditionally two measures
  - Conforms to requirements
  - Serves the purpose for which the SW is intended
- **Verification** is checking conformance
  - Did SW evolve properly from requirements
    - i.e., does the SW work correctly?
  - Verified against design and written specification
- **Validation** is checking that software meets user requirements
  - Was the correct system built?
  - Validated with client

SE Process


Requirements engineering
System design
Program design
Implementation
Unit testing
System testing
Acceptance testing

SE Process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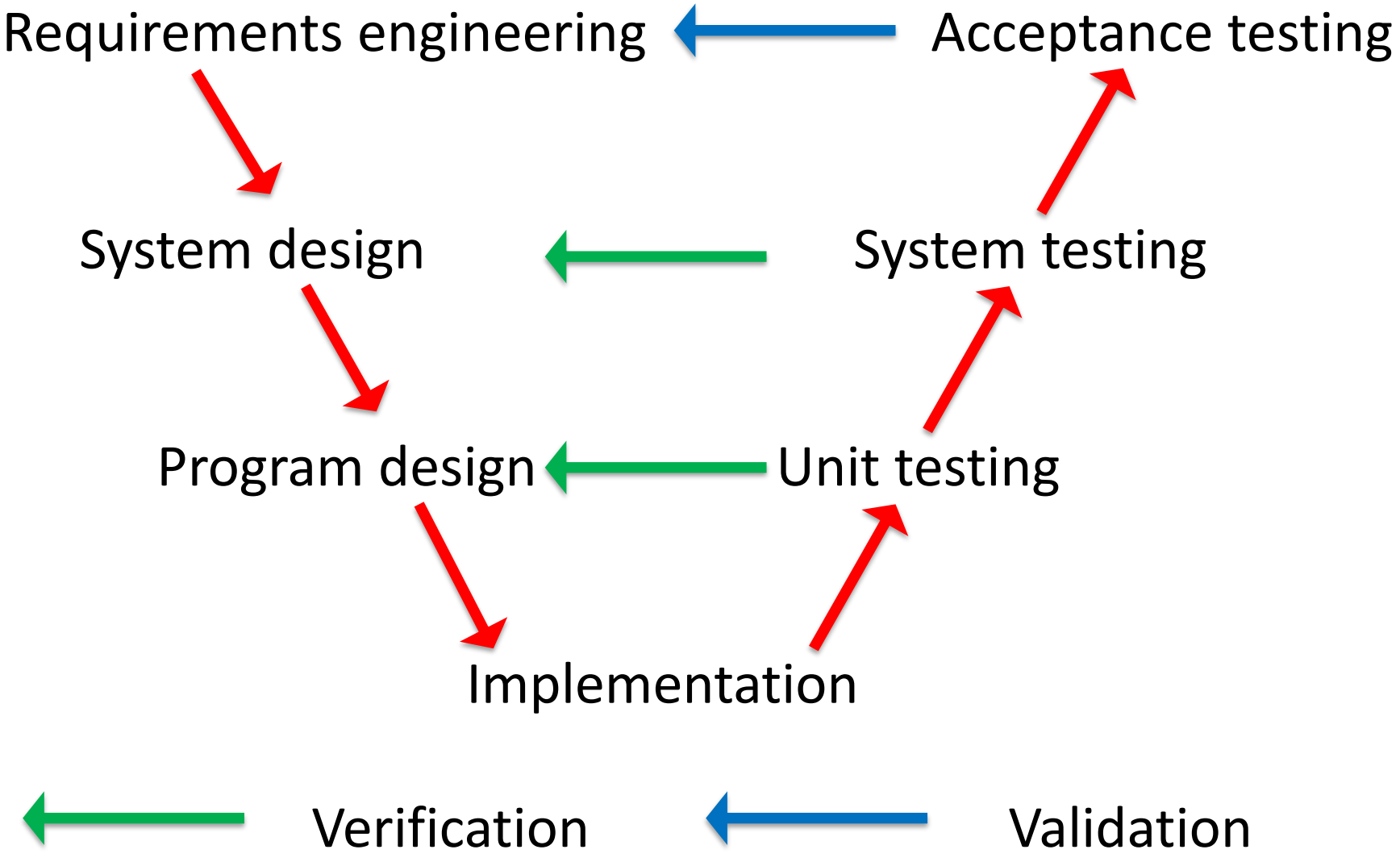

Requirements engineering
Acceptance testing
System design
System testing
Program design
Unit testing
Implementation
Verification
Validation

Verification vs. Validation

- Verification: Did we **build the product right**?
- Validation: Did we **build the right product**?

Lack of Quality

- Caused by errors
- **Fault** or **defect** is a condition that may cause a failure
  - Caused by errors made by SEs
  - Error may be in code
  - Error may be in requirements, or in design documents
- A **failure** is the inability of a system to perform as required by the specification
- **Severity** of a fault or failure is determined by the consequences
- **Priority** of a fault or failure is determined by importance of finding a fix

Finding Errors

- **Testing** is running code *in a controlled environment* to check that it behaves correctly
  - Often easiest, usually most common, only dynamic way to find errors
- Formally prove software is correct
- Static analysis
  - Informal reviews
  - Walkthroughs
  - Technical reviews
  - Inspections

increasing formality

Testing

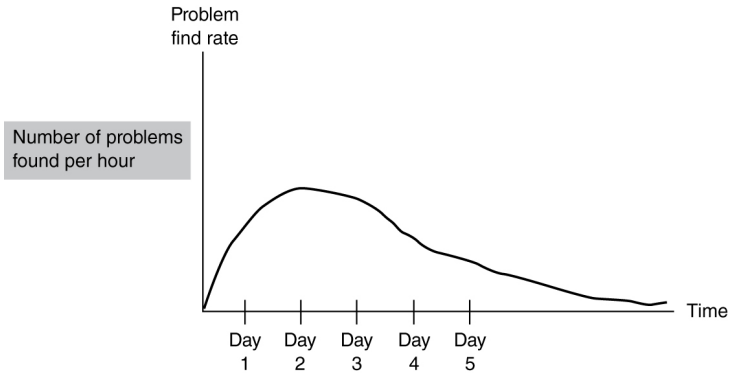
- Testing is an activity performed to
  - Find faults
    - Can't prove there are no faults since exhaustive testing is impossible
      - Test finding roots of quadratic equation $ax^2 + bx + c$
      - For 32-bit integer values, 1 test/ns, 2.5 trillion years
  - Assess product quality
    - Fewer errors found implies higher quality
    - Quality of test cases significant factor in accuracy of this assessment
- Test early, test often

Testing (cont.)

- Levels of testing
  - **Unit** (single methods, procedures, modules, …)
  - **Functional** (multiple units as a functional unit)
  - **Component** (multiple functions)
  - **Integration/system** (all components together)
- Who does testing
  - Programmers (unit)
  - Testers/QA staff (integration/system)
  - Users (alpha and beta)
  - Clients (acceptance)

Testing (cont.)

- When to stop testing
  - When all test cases have been passed
  - When all errors have been found
  - When error detection levels out



  - Based on fault seeding
    - Embed known errors in software product
    - At any point, percentage of seeded errors found is an estimate for percent of real errors found

Testing (cont.)

- Other criteria for stopping testing
  - Tester can't find error in N minutes
  - **Nominal**, **boundary**, and **out-of-bounds** tests run error-free
  - When agreed checklist of test types has been completed
  - When time scheduled for testing expires