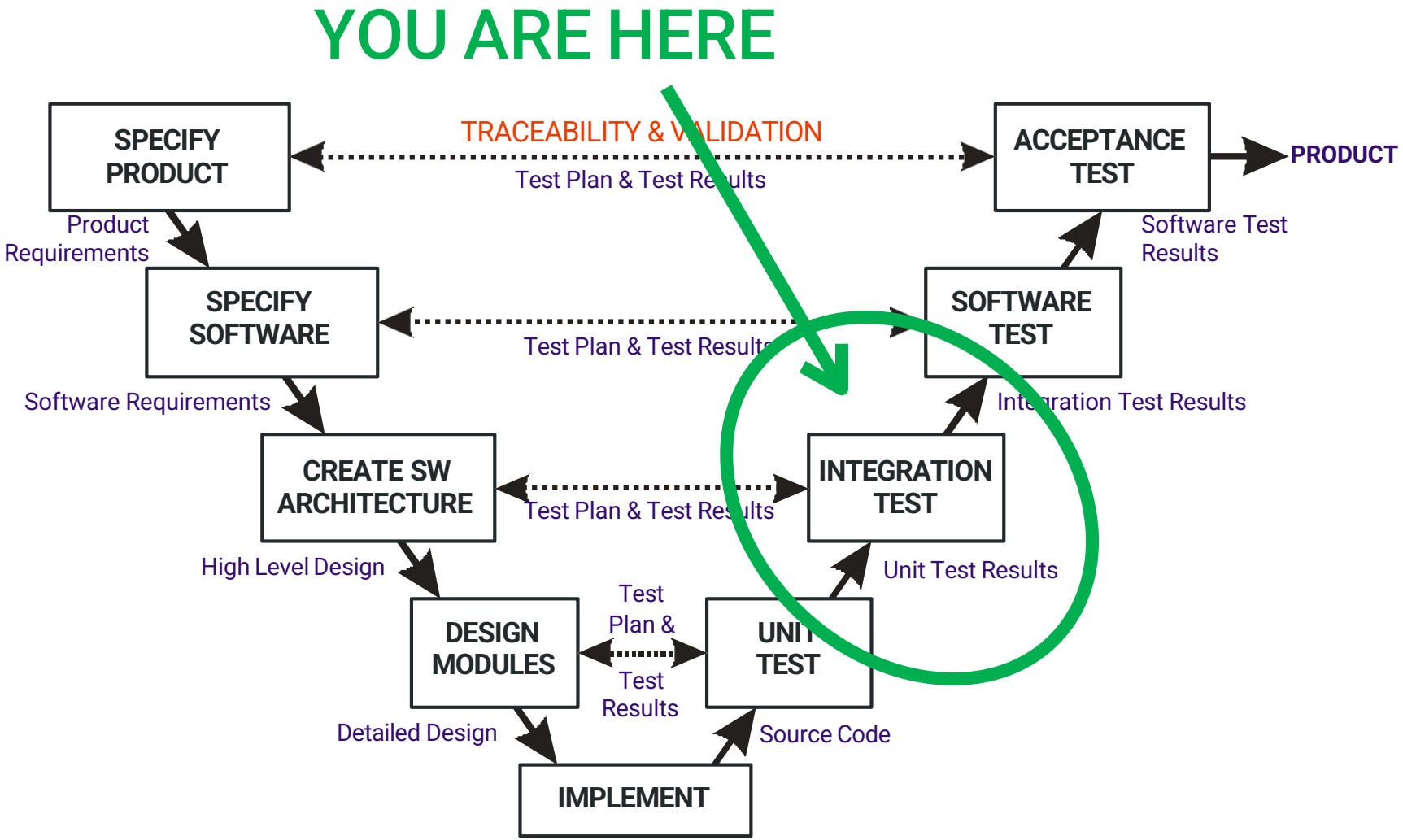
Integration Testing

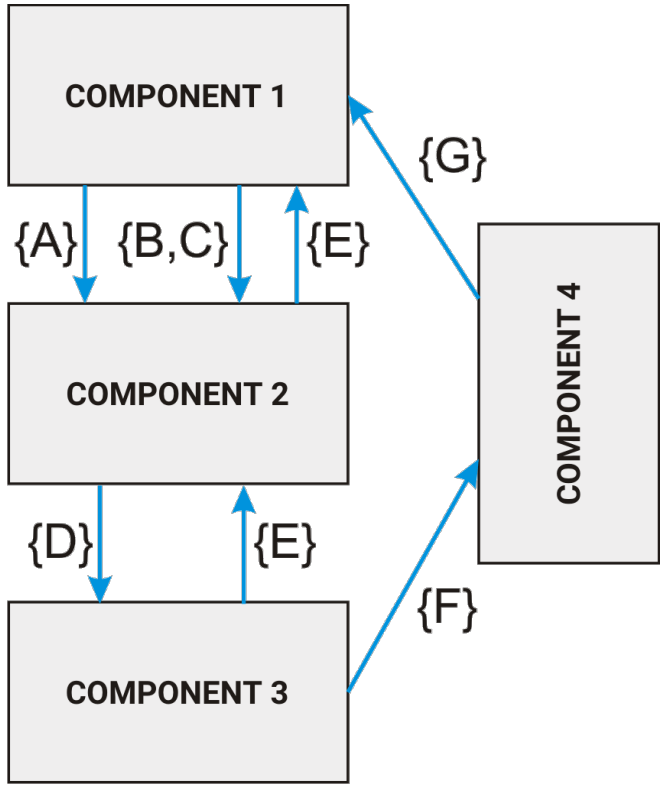
“It's hard enough to find an error in your code when you're looking for it; it's even harder when you've assumed your code is error-free.”

– Steve McConnell


YOU ARE HERE
SPECIFY PRODUCT
TRACEABILITY & VALIDATION
Test Plan & Test Results
ACCEPTANCE TEST
PRODUCT
Product Requirements
Software Test Results
SPECIFY SOFTWARE
Test Plan & Test Results
SOFTWARE TEST
Software Requirements
Integration Test Results
CREATE SW ARCHITECTURE
Test Plan & Test Results
INTEGRATION TEST
High Level Design
Unit Test Results
Test Plan &
DESIGN MODULES
Test Results
UNIT TEST
Detailed Design
Source Code
IMPLEMENT

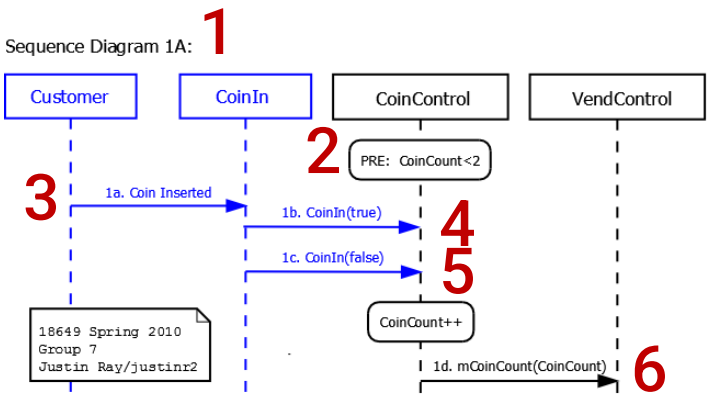
Integration Testing

- Anti-Patterns:
  - Skipping straight to system test
  - No traceability from integration test to High Level Design
  - Integration test “pass” criterion based on system function, not interfaces
- Testing component integration:
  - Exercise all component interfaces
    - Correct responses to input sequences?
    - Handle all types of data on interfaces?
  - Ensure modules match HLD, including SDs
    - Assume unit test has vetted each component
    - Concentrate on component interactions



Integration Test Approach To SDs

- **Exercise all interfaces**
  - All inputs result in correct outputs
  - Every component interface exercised
    - With all relevant values
    - With all relevant timing & sequencing
  - Use SDs and HLD info drive testing
    - Pass/fail: does it match SD?
- **Integration test coverage:**
  - All arcs on all SDs exercised?
  - Off-nominal behaviors tested?
    - Invalid sequencing and extraneous inputs?
    - Extraneous outputs?

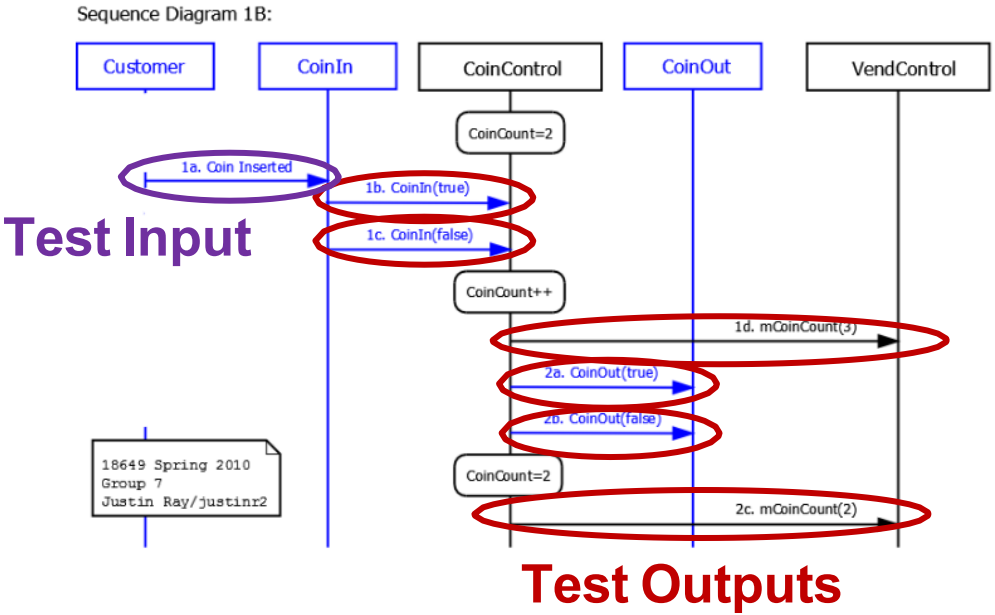


Integration Test IT-1a:

1. Initialize modules
2. Test setup: CoinCount to zero
3. Insert coin (1a)
4. Observe CoinIn(true) (1b)
5. Observe CoinIn(false (1c)
6. Observe mCoinCount == 1 (1d)

Tracing Integration Tests to SDs

- Observe module interactions
  - Set up test
    - Meet SD preconditions
  - Feed input arc(s) to modules
  - Observe intermediate arcs
  - Observe output arcs
  - Find a way to observe documented side effects (e.g., final CoinCount)



- Integration test "pass" is <u>not</u> just based on final output
  - Do all the arcs appear in expected sequence?
  - Is timing appropriate?

Integration Tests and Messaging

- Interfaces often look like “messages”
  - Categorical values (enums)
  - Data structures
  - Network packets
- Integration testing should exercise “message” structure
  - All types of messages
  - Valid and invalid field values
  - Timing, exception handling
    - e.g., bad checksum, bad sequence number
- HLD will have the message dictionary
  - Defines message types, formats, etc.
  - Accompanied by a validation test suite

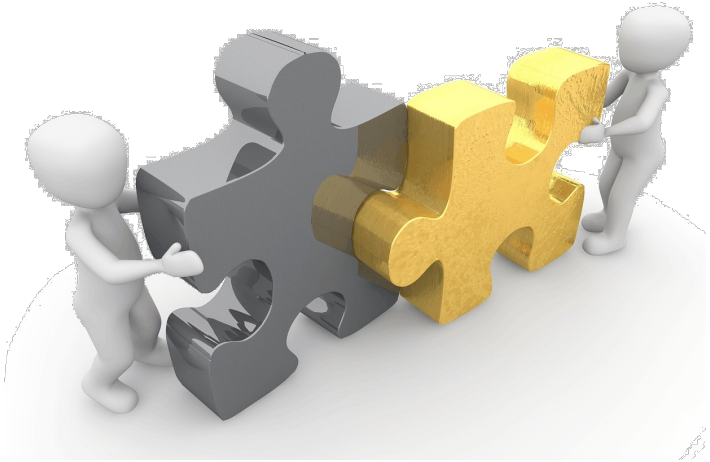
Mode 01 [edit]

PID (hex)	PID (Dec)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
00	0	4	PIDs supported [01 - 20]				Bit encoded [A7..D0] == [PID $01..PID $20] See below
01	1	4	Monitor status since DTCs cleared. (Includes malfunction indicator lamp (MIL) status and number of DTCs.)				Bit encoded. See below
02	2	2	Freeze DTC				
03	3	2	Fuel system status				Bit encoded. See below
04	4	1	Calculated engine load	0	100	%	$\frac{100}{255}A$ (or $\frac{A}{2.55}$)
05	5	1	Engine coolant temperature	-40	215	°C	$A - 40$

OBDii Parameter ID message dictionary (CAN Network Messages)
[https://en.wikipedia.org/wiki/OBD-II_PIDs]

Integration Test Best Practices

- Trace Integration tests to HLD
  - Exercise all arcs on every SD
  - Cover all modules; all interfaces
  - Cover all message types and fields



- Integration test pitfalls
  - System testing alone misses system integration edge cases
    - Sometimes a misbehaving system appears to work at system test
    - Can be difficult to exercise off-nominal SDs at system level
  - If you skip HLD, you can’t trace Integration Tests back to design

Solutions that might fix the problem without breaking anything

Essential

Hoping This Works

O RLY?

@ThePracticalDev

Disclaimer

This lecture contains materials from:

- Philip Koopman - CMU