

ELE 491

Senior Design Project Proposal

These slides are loosely based on the book Design for Electrical and Computer Engineers by Ford and Coulston. I have used the sources referenced in the book freely and without re-attribution. Please see the book for full source attribution



ELE 491

Senior Design Project Proposal

Class 11 – Test

Test

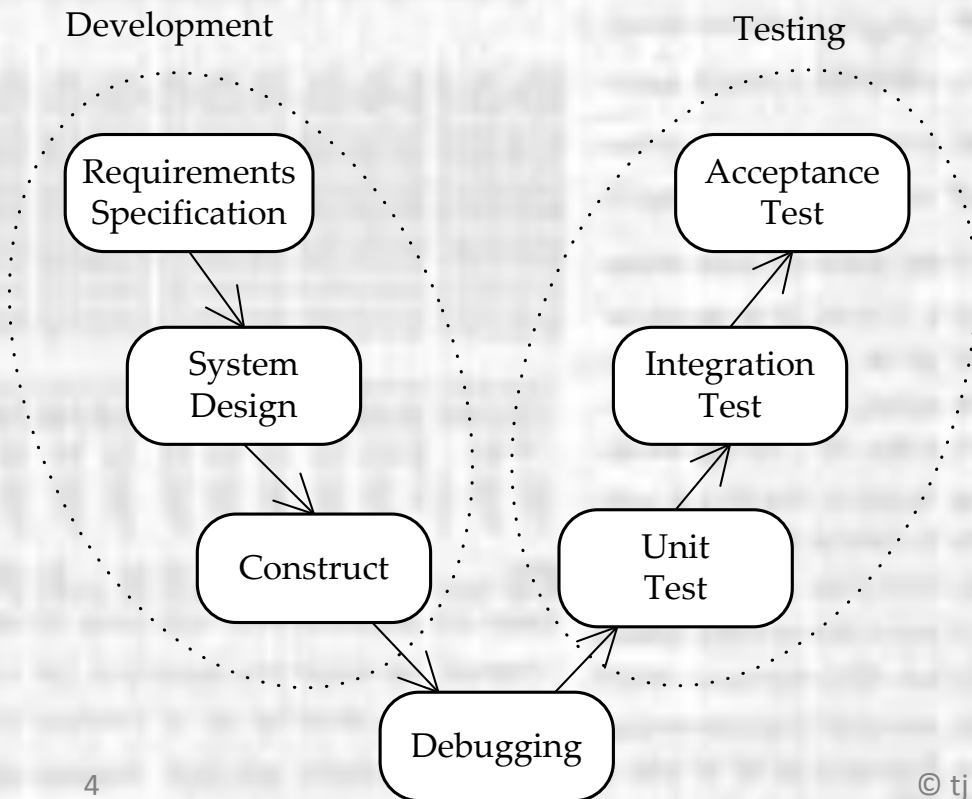
Overview

- Why Test
 - Uncover design errors
 - Validate specifications
 - Debug
 - Can provide independent verification
 - Design and test done by different people / organizations

Test

Overview

- When to Test
 - All through the design process
 - Concept tests
 - Block tests
 - Module tests
 - Integration tests
 - System tests
 - Final test
 - Acceptance testing



Test

Overview

- Who Tests
 - Designers
 - Test engineers
 - Quality engineers
 - Customers
 - Standards organizations
 - Regulatory agencies

Test

Methodologies

- Various Types of Testing Methodologies

- Black Box

- No knowledge of internals
- Test to spec
 - Input A \rightarrow output 1
 - Input B \rightarrow output 2
- Common when the blocks are abstracted

- White Box

- Utilize knowledge of internal construction
- E.g.

Internal node F (digital) is set by inputs A,B,C such that $F = A+B+C$
F then drives “other” circuitry

To test the “other” circuitry need only exercise input A

To test node F, need only pick 1 path through the “other” circuitry

Test

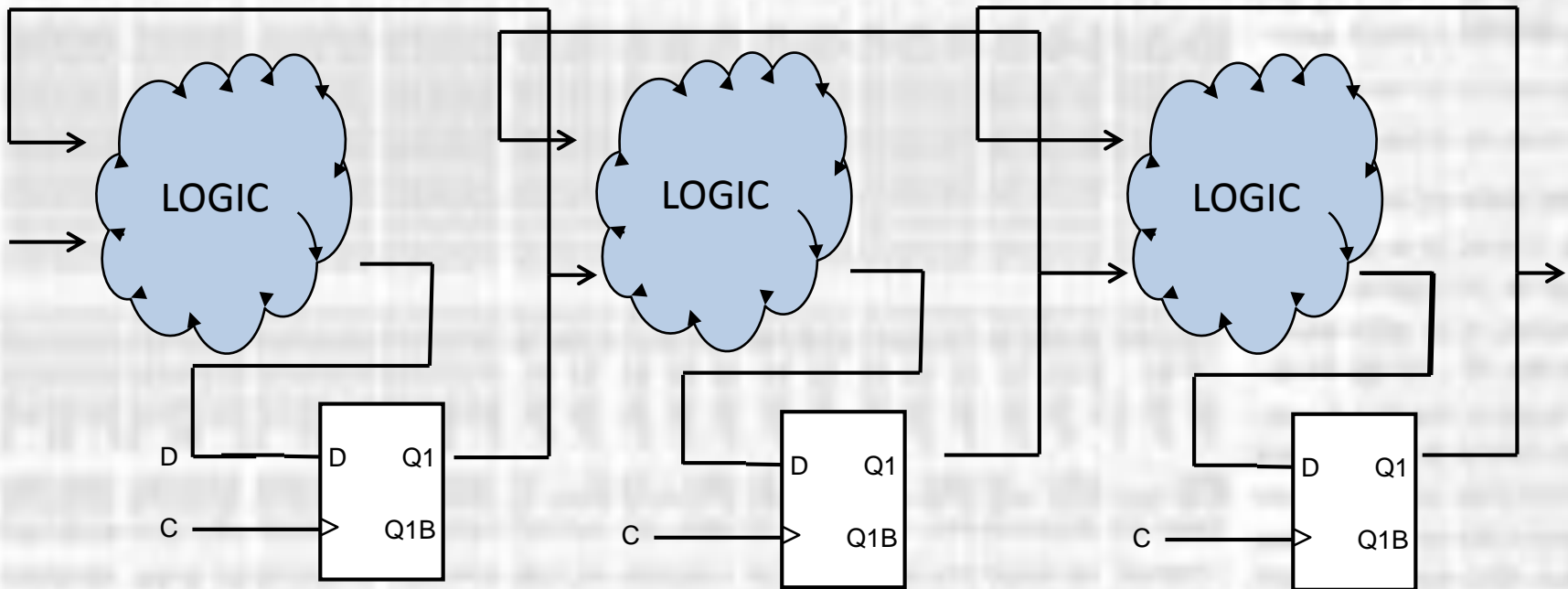
Methodologies

- Design for Test
 - Controllability
 - Ability to set the value of internal nodes in the design
 - Extra inputs (test inputs or secondary inputs)
 - Bypass circuitry
 - Special state circuitry
 - Break a feedback loop and force unity forward gain
 - Observability
 - Ability to see the value of internal nodes in the design
 - Extra outputs (test outputs or secondary outputs)
 - Bypass circuitry
 - Reverse path testing

Test

Methodologies

- Design for Test
 - Example – Scan Chain

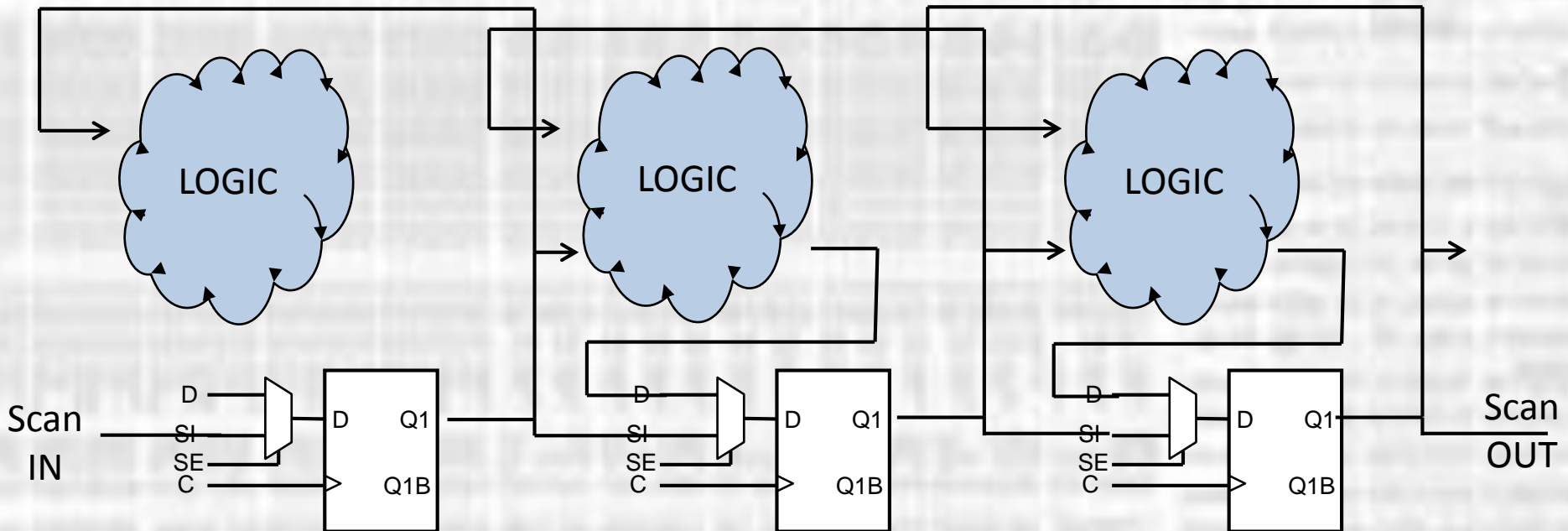
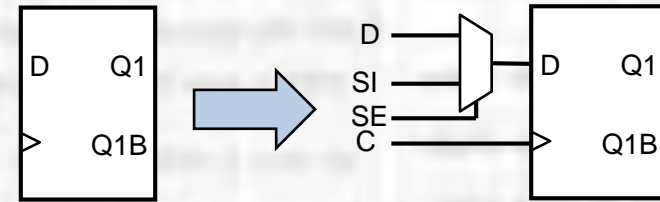


Test

Methodologies

- Design for Test

- Example – Scan Chain



Test

Methodologies

- Various Types of Tests
 - Exhaustive
 - Every possible input, over temp, voltage, process, ...
 - Corner
 - Choose extremes to run tests – influenced by design knowledge
 - High voltage, low temp, high frequency, ...
 - Low voltage, high temp, low frequency, ...
 - Functional
 - Validate function at nominal temperature, voltage, frequency, ...
 - Parametric
 - Test a given parameter across a range of temperatures, voltages, frequencies, ...

Test

Methodologies

- Test Case Properties
 - Accurate
 - Economical
 - Repeatable
 - Traceable
 - To a specification or functional requirement
 - Non-harmful
 - The system must be able to return to a known acceptable state

Test

Test Types

- Debug
 - Device not working as expected – Why?
 - Bohrbugs
 - Repeatable error
 - Same test case, inputs, output
 - Heisenbugs
 - Somewhat random
 - Notorious for pointing to the wrong place
 - Debugging is highly iterative
 - If stuck – seek a second opinion

Test

Test Types

- Unit
 - Complete test of a block or module
 - Suite of tests that verify all each piece of functionality/specification
 - Typically used to verify the design
 - For module completion
 - For higher level integration
 - Focus on test coverage
 - All paths
 - All cases
 - All conditions

Test

Test Types

- Integration
 - Test final system or subsystems of modules/blocks
 - Verify interfaces working correctly
 - Verify higher level functional and parametric performance
- Focus on test coverage
 - All Interfaces
 - All block level paths
 - All cases
 - All conditions

Test

Test Types

- Manufacturing
 - Final product test to supplier acceptance criteria
 - Verify product will work correctly
 - Detect potential early failure units
 - Heavy use of guard-banding
 - Temp
 - Voltage
 - Frequency
 - Focus on efficiency (\$)

Test

Test Types

- Acceptance
 - Final system test to customer acceptance criteria
 - Verify full system working correctly
 - Often a joint supplier / customer effort
 - Includes one time and manufacturing tests

Test Summary

- Good Designs
 - Account for testability from the start
 - Include extra circuitry to:
 - Improve observability
 - Improve controllability
 - Reduce production test time
- Good Designers
 - Respect the test process
 - Test early and often

In Class Activity