

# Test Design Techniques

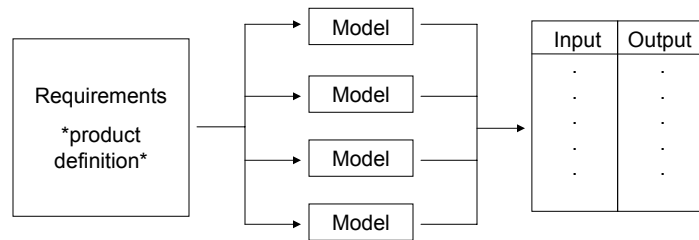
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GLSEC, 26 October 2006

## Overview

- What is test design and why do we care?
- Common test design strategies
- Using resulting models
  - Define tests
  - Requirements analysis
  - Estimate schedules
  - Test prioritization
  - Test documentation

## Test Design Progression



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## Test Planning Progression

- Transform the requirements\*
  - Make lists of every possible attribute
  - Make tables whenever possible
  - Make graphs whenever possible
- Identify test cases
- Reduce number of tests
- Decide which tests must be executed

\* generic term for "product definition"

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# Requirements Modeling

- Some common requirements modeling methods
  - Decision Tables
  - Use Case
  - State Transition Diagrams
  - Classification Trees

# Decision Tables

## Decision Tables

- Record complex business rules
- Document internal design
- Useful when specification has many If-Then-Else statements

## Decision Tables

- Set of conditions
- Rules: All combinations of input values
- Resulting action based on applying rule
  - Depend on values of conditions; not order in which conditions are evaluated
- Merge rules whose resulting actions are identical

## Decision Tables

	Rule 1	Rule 2	...	Rule 2 <sup>n</sup>
Condition 1				
Condition 2				
...				
Condition n				
Action a				
Action b				
Action c				
...				

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## Testing Decision Tables

- Create at least one test case for each rule
- Conditions are the input
- Actions are the expected outcome

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# Example

- Prepare credit card statement
  - IF customer has non-zero balance
    - THEN calculate finance charge
  - IF customer missed a payment in last 12 months
    - THEN finance charge is at high rate
  - IF previous payment was late
    - THEN calculate late payment fee
  - IF customer signed up for bonus rebate plan
    - THEN calculate cash rebate

Decision Table – example 1

	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6	Rule 7	Rule 8	Rule 9	Rule 10	Rule 11	Rule 12	Rule 13	Rule 14	Rule 15	Rule 16	
c o n d i t i o n	account shows credit or zero balance	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	
	customer missed a payment in last 12 months	F	F	F	F	T	T	T	T	T	T	T	F	F	F	F	
	previous payment was sent late	F	F	T	T	F	F	T	T	F	F	T	T	F	F	T	T
	customer signed up for bonus rebate plan	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T
a c t i o n	calculate finance charge at regular rate												X	X	X	X	
	calculate finance charge at high rate								X	X	X	X					
	calculate late payment fee										X	X			X	X	
	calculate cash back rebate amount													X		X	

### Decision Table – example 2

		Rule 1-8	Rule 9-10	Rule 11-12	Rule 13	Rule 14	Rule 15	Rule 16
condition	account shows credit or 0 balance	T	F	F	F	F	F	F
	customer missed a payment in last 12 months	--	T	T	F	F	F	F
	previous payment was sent late	--	F	T	F	F	T	T
	customer signed up for bonus rebate plan	--	--	--	F	T	F	T
action	calculate finance charge at regular rate				X	X	X	X
	calculate finance charge at high rate		X	X				
	calculate late payment fee			X			X	X
	calculate cash back rebate amount					X		X

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### Decision Table – example 3

		Rule 1-8	Rule 9-10	Rule 11-12	Rule 13	Rule 14	Rule 15	Rule 16
condition	account shows credit or 0 balance	T	F	F	F	F	F	F
	customer missed a payment in last 12 months	--	T	T	F	F	F	F
	previous payment was sent late	--	F	T	F	F	T	T
	customer signed up for bonus rebate plan	--	--	--	F	T	F	T
action	calculate finance charge	none	high	high	regular	regular	regular	regular
	calculate late payment fee			yes			yes	yes
	calculate cash back rebate amount					yes		yes

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# Use Cases

# Use Cases

- Accomplish a goal within the system
  - End-to-end transaction
  - Often from the end user perspective
  - Test individual transactions
- Identify relationship between key participants and components

# Use Case Notation

- Notation has many components
- Of interest to testers
  - Use Case identifier
  - Preconditions
  - Success/Failed End Condition
  - Trigger
  - Main Success Scenario
  - Extensions

*Go to  
Sample Use Cases*

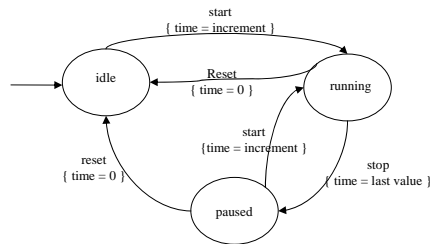
# State Machines

# State Machine

- Useful when specs provided as state machine (state transition diagram)
- Useful to model input which must be entered in a defined order
- Test transitions between states by creating events that lead to transitions

# State Transition Diagram Example

Stopwatch example



# State Transition Table – 1 initial

Event → ↓ State	START	STOP	RESET
Idle	Running {Time = increment value}	?	?
Running	?	Paused { Time = last value }	Idle { Time = 0 }
Paused	Running { Time = increment value }	?	Idle { Time = 0 }

## State Transition Table – 1 filled

Event → ↓ State	START	STOP	RESET
Idle	Running {Time = increment value}	Idle { Time = 0 }	Idle { Time = 0 }
Running	Running {Time = increment value}	Paused { Time = last value }	Idle { Time = 0 }
Paused	Running { Time = increment value }	Paused { Time = last value }	Idle { Time = 0 }

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## State Transition Table - 2

Current State	Event	Action	Next State
Idle	START	Time = increment value	Running
Idle	STOP	Time = 0	Idle
Idle	RESET	Time = 0	Idle
Running	START	Time = increment value	Running
Running	STOP	Time = last value	Paused
Running	RESET	Time = 0	Idle
Paused	START	Time = increment value	Running
Paused	STOP	Time = last value	Paused
Paused	RESET	Time = 0	Idle

State transition diagram information and test cases all in one chart

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# Classification Trees

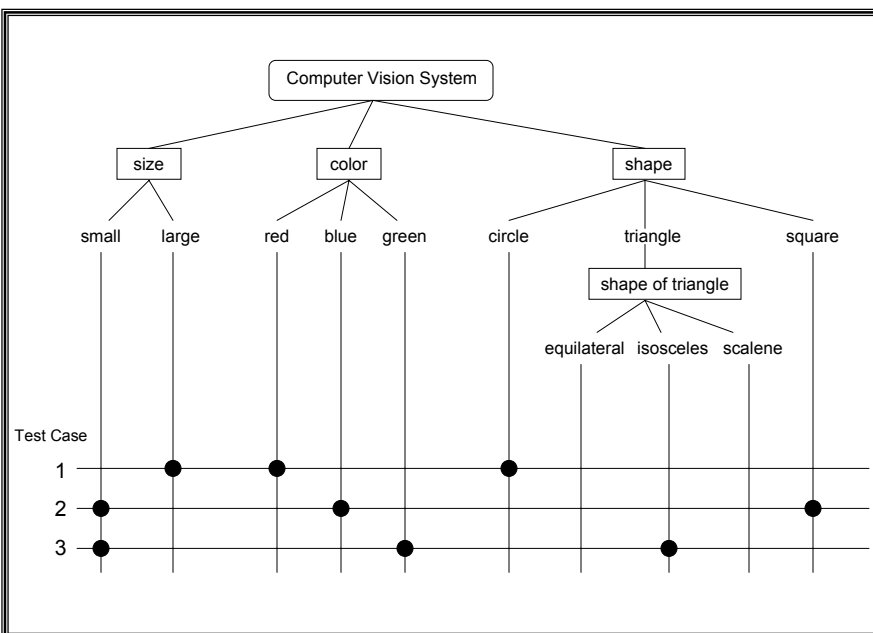
## Classification Tree Method

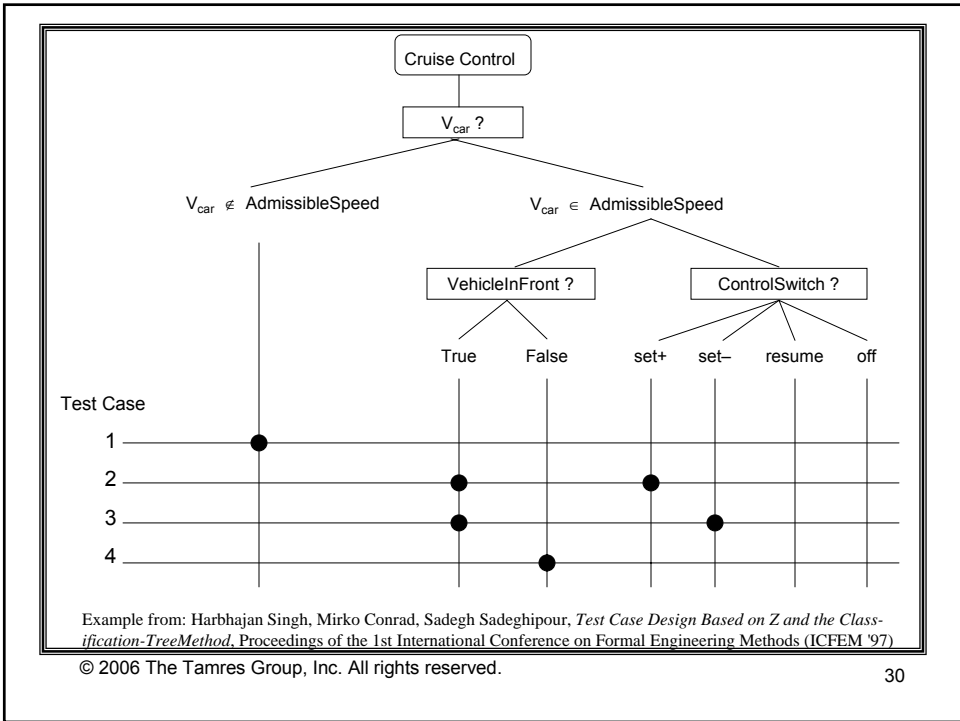
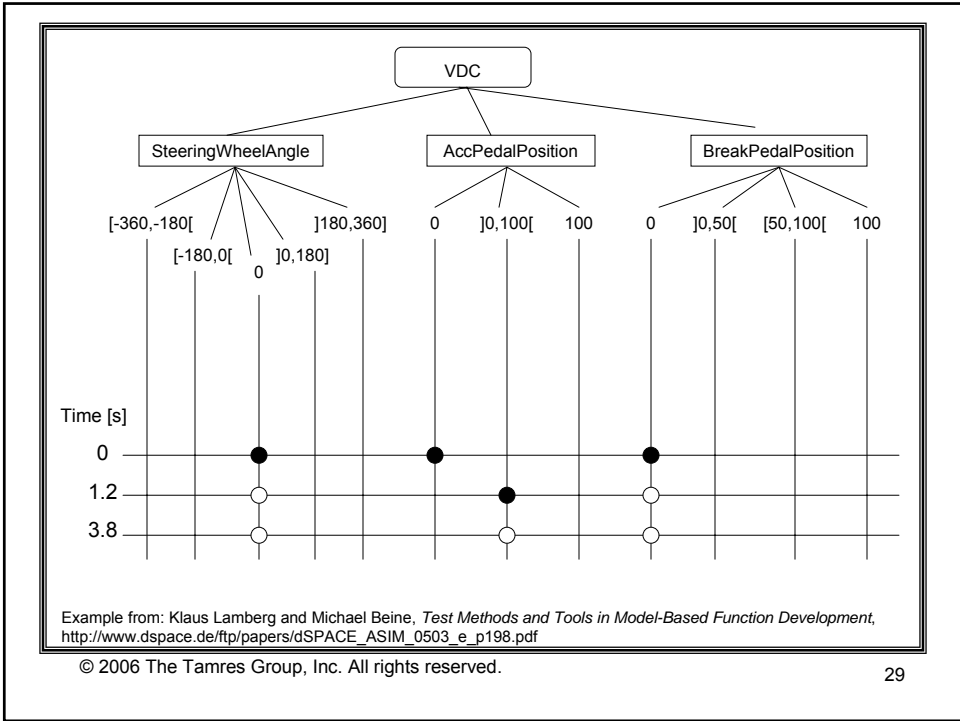
- Developed by Daimler-Benz Research
- Test case design tool using a black-box approach (based on the functional specification)
- Based on Category Partitioning

# CTM Example

- Computer Vision System
  - inputs are various building blocks
  - aspects are size, color, and shape of a block
    - Size: small, large
    - Color: red, green, blue
    - Shape: circle, triangle, square

Example from: Grochtmann, Matthias. *Test Case Design Using Classification Trees*. Proceedings of STAR '94, 8-12 May 1994, Washington, DC.  
[www.systematic-testing.com/documents/star1994.pdf](http://www.systematic-testing.com/documents/star1994.pdf)





## Classification Tree Editor

- Tool that supports
  - Design of classification tree
  - Definition of test cases in the table area
  - Hierarchies and structure of large trees
  - Creation of automated test cases
  - Documentation of test cases
    - In tree/table format
    - Generate text version

## Classification Tree Editor

- Free download available at [www.systematic-testing.com](http://www.systematic-testing.com)

# Congratulations!

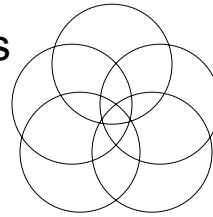
You have a model

## Is it good?

- Characteristics of a good model
  - Useful
  - Communication tool
  - Focus on content

If you have to *explain* the model,  
it's not a good model

- Which approach to use?
  - Experience, comfort level
  - Follow requirements format
  - Problem space
  - If you're stuck, change models
- Each design method provides
  - Unique tests
  - Duplicate tests



## Working with the models

- Schedule estimation
- Test documentation shortcut
- Prioritize tests
- Record executed tests

## Schedule Estimation

- Estimate number of test cases or test scenarios
  - Often create more tests during test execution
  - Tend to underestimate number of tests
- Estimate approximate effort to run tests
  - Allow for environment setup, tools, etc.

## For More Information

- Tamres, Louise. *Introducing Software Testing*. Addison-Wesley, 2002.

# Thank You

If you have any questions, contact me at

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