

Acceptance Test Driven Development



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Acceptance Test Driven Development

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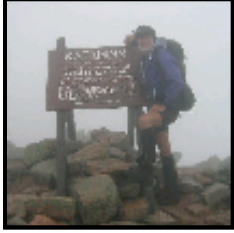
Objectives

- Acceptance test driven development can help customer /developer communication
- Table-driven requirements can reduce ambiguity over free text
- Tables can be the tests
- Requirements are tests / tests are requirements
 - What are your requirements (tests) for this session?

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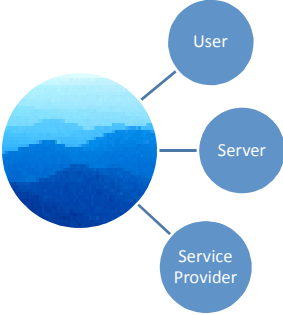
- Fellow Consultant
- OOA&D, Design Patterns, Lean, Agile, Scrum, Test-Driven Development
- Author *Prefactoring*, 2006 Jolt Award Winner
- Author *Interface Oriented Design*
- Over 1/3 century of software development experience

*No code goes in till the test goes on.
A journey of two thousand miles begins with a single step.*

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Acceptance Tests

- Acceptance Tests:
 - User's point of view
 - External view of system
- Examine externally visible effects
 - Inputs and outputs
 - State changes
 - External interfaces




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Types of Tests

- User Acceptance
 - Provided by end user / customer
 - May be just “happy path” or obvious scenarios
- Completeness
 - All exceptional conditions
 - Complete End-To-End

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Acceptance Tests As Tables


- Functional tables
 - Business logic
 - Workflow
- Quality metric tables
 - Performance
 - Scalability
- Tables can show
 - Rules themselves
 - Examples of rules

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Tables

- Tables can be executed with
 - FIT/FITNESS
 - Automation tool (e.g. QTP)
 - Other
- Discovery
 - Filling out tables may bring to light suppressed premises
 - *Unstated requirements or assumptions*

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Types of tests

- Given this input, is the output this value?
- When user does this, does the state change to that new state?
- When this event occurs, does the appropriate action occur?

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Types of Answers

- Idempotent – same answer all the time
- State dependent
- Time dependent
- Highly data dependent



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Table Evaluation


- Remove redundant redundancy
- Business domain terms
- Specific, easy to diagnose
- Avoid lots of input and output columns
 - Break into smaller tables
- Shared between customer unit and developer unit
- Automatable (part of continuous build)


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Warning

- Acceptance tests and tables are not a substitute for interactive communication
- They can provide focus for that communication.

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**Input / Output
Example**

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Input and Output Example

- Demonstrate
 - Dependence on Input Values
 - Limits on Input Values
- Input Temperature in Celsius, Output Temperature in Fahrenheit
- Dependence question:
 - 0 C → 32 F
 - 100 C → 212 F
- Limit questions:
 - -253.16 C → -459.4 F (absolute zero 0 K)
 - -253.161 C → What should it do?

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Input and Output Example (continued)


Celsius	Fahrenheit	Notes
0	32	
100	212	Needed?
-253.16	-459.4	Precision?
-253.161	Error	Below 0 Kelvin

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Conversion Example


- As an accountant, I need to convert a set of amounts that are in different currencies to a total in a common currency
- Answers are time dependent
 - Exchange rates
 - How often exchange rates updated

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Currency Conversion Table

Currency To/ Currency From	EUR	USD	SWF
EUR	1.0	1.5	.91
USD	.67	1.0	.75
SWF	1.1	1.35	1.0


Input	Output Currency	Output Amount
5 EUR	USD	7.5 USD
7.5 USD	EUR	5 EUR
5 EUR + 10 USD	USD	17.5 USD
5 EUR + 10 USD	EUR	11.67 EUR
5 EUR + 10 USD + 10 SWF	USD	??
5 EUR + 5 EUR	USD	??

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Table Drives Questions

- Questions
 - What to do with “round-off”?
 - Example: Tax program income/expense not match balance sheet
 - Are the conversions symmetric
 - e.g. $USD \rightarrow EUR == 1 / (EUR \rightarrow USD)$
 - Should amounts be individually converted
 - or should amounts in currency be totaled before conversion?

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Sudoku

- Sudoku
 - Input Table
 - Output Table
- Tables for
 - Is there only one Output?
 - Is there no Output?
 - How much time does it take to achieve an output?

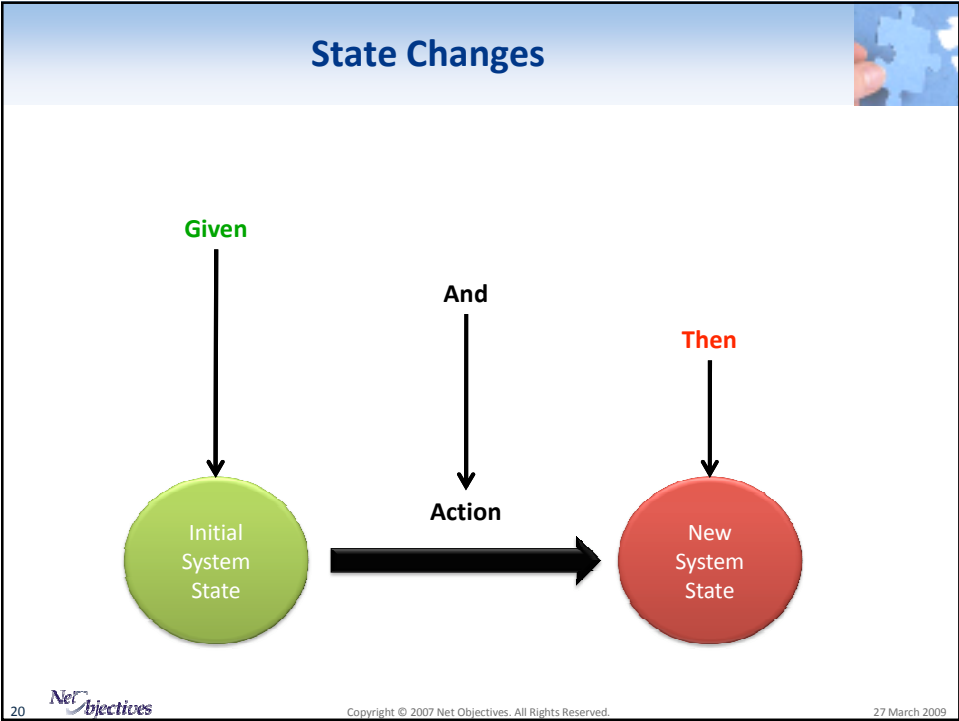
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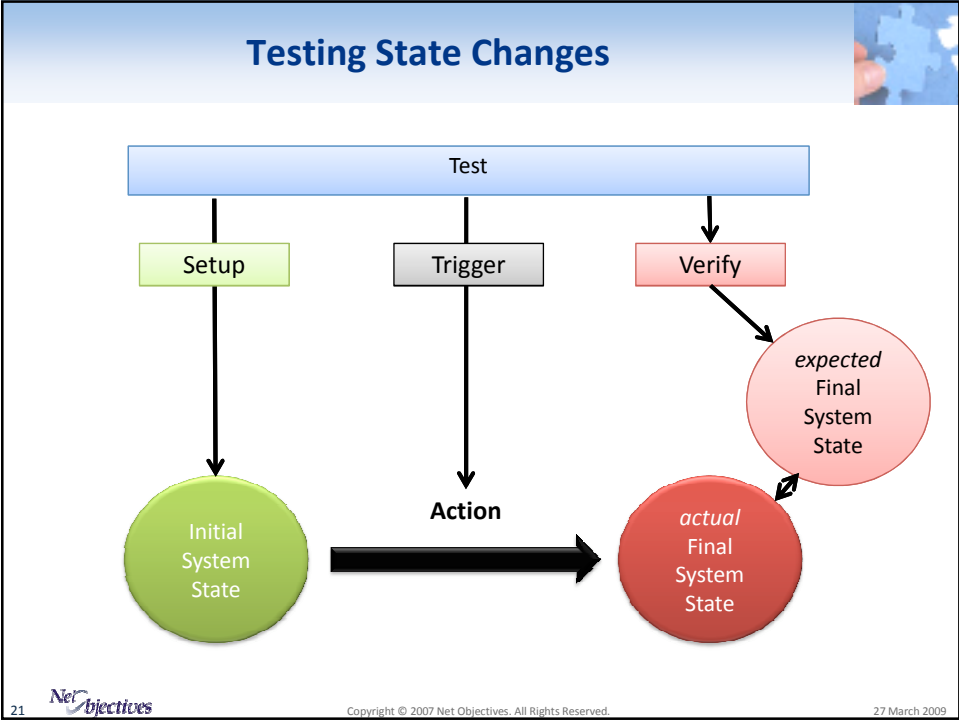
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Test Anatomy

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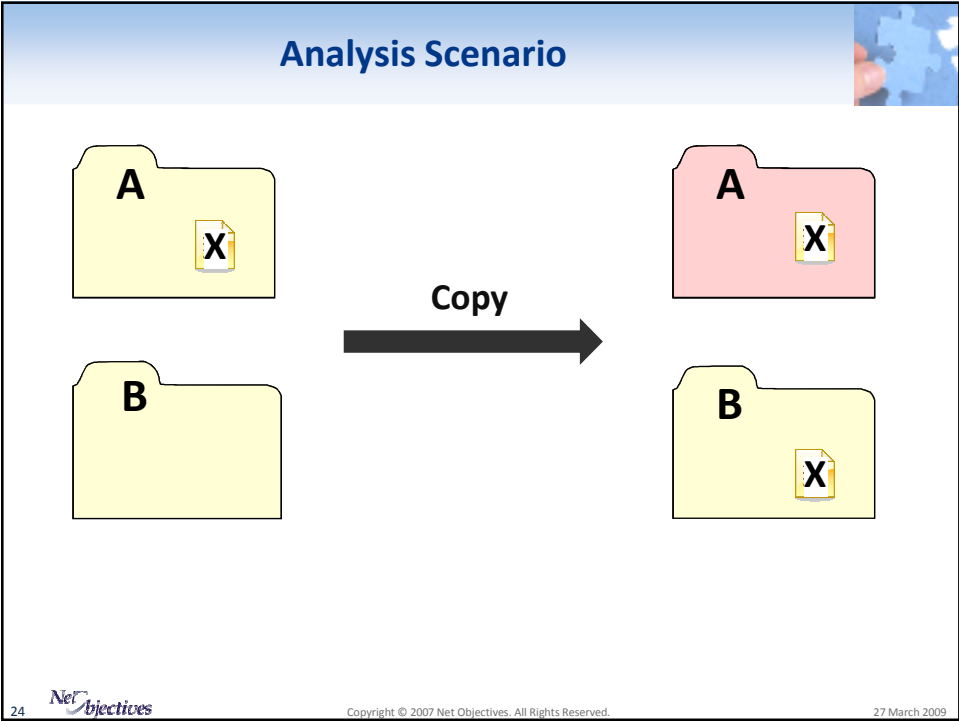
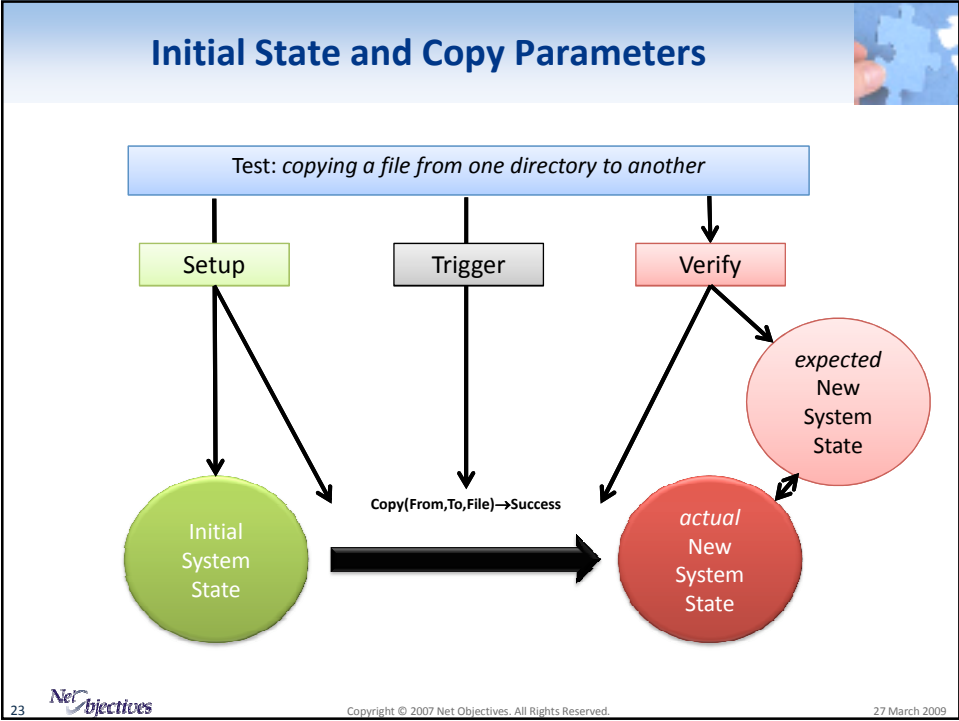


Exercise

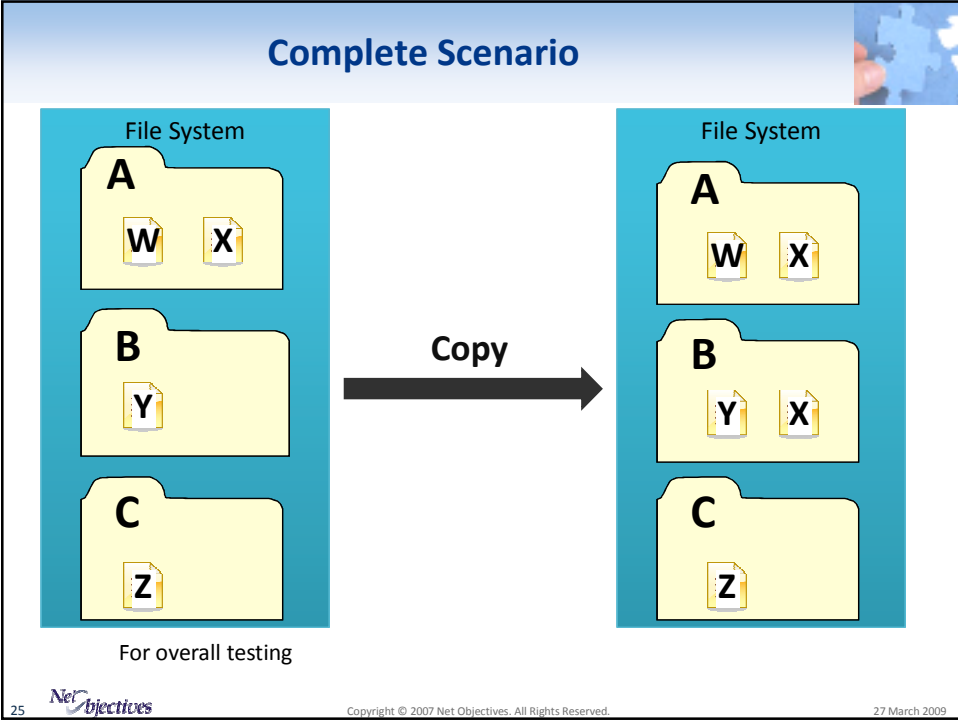
- Write questions (tests) for:
“copying a file from one directory to another”

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Copying Table Example

Source Directory Contains	Destination Directory Contains	Copy File	Destination Directory Contains?	Content Comparison?	Notes
X, Y, Z	A, B, C	X	A,B,C,X	(Destination.X == Source.X)	Standard copy
X, Y, Z	A,B,C,X	X	A,B,C,X	(Destination.X == Source.X)	X overwritten
X, Y, Z	A,B,C,X	X	A,B,C,X	(Destination.X == Destination.X)	X not overwritten

What about modification date and other attributes?
Make more columns

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First Example

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A Business Rule Example

If Customer Rating is Good and the Order Total is less than or equal \$10.00,
Then do not give a discount,
Otherwise give a 1% discount.

If Customer Rating is Excellent,
Then give a discount of 1% for any order.

If the Order Total is greater than \$50.00,
Then give a discount of 5%.

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Business Rule Table

Discount		
Order total	Customer rating	Discount percentage?
10.00	Good	0.0
10.01	Good	1.0
50.01	Good	1.0
.01	Excellent	1.0
50.00	Excellent	1.0
50.01	Excellent	5.0

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A Little Code

```
class Discount extends fit.ColumnFixture {
    public double orderTotal;
    public CustomerRating customerRating;
    public double discountPercentage()
    {
        // Calls the method that computes
        // the discount and returns the discount
        return computeDiscount
            (orderTotal, customerRating);
    }
};
```

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Business Rule Table

Discount		
Order total	Customer rating	Discount percentage?
10.00	Good	0.0
10.01	Good	1.0
50.01	Good	Expected 1.0 Actual 5.0
.01	Excellent	1.0
50.00	Excellent	1.0
50.01	Excellent	5.0


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Business Rule Table With Formatting

Order total	Customer rating	Discount percentage?
\$10.00	Good	0.0%
\$10.01	Good	1.0%
\$50.01	Good	!0%
\$.01	Excellent	1.0%
\$10.00	Excellent	1.0%
\$50.01	Excellent	5.0 %

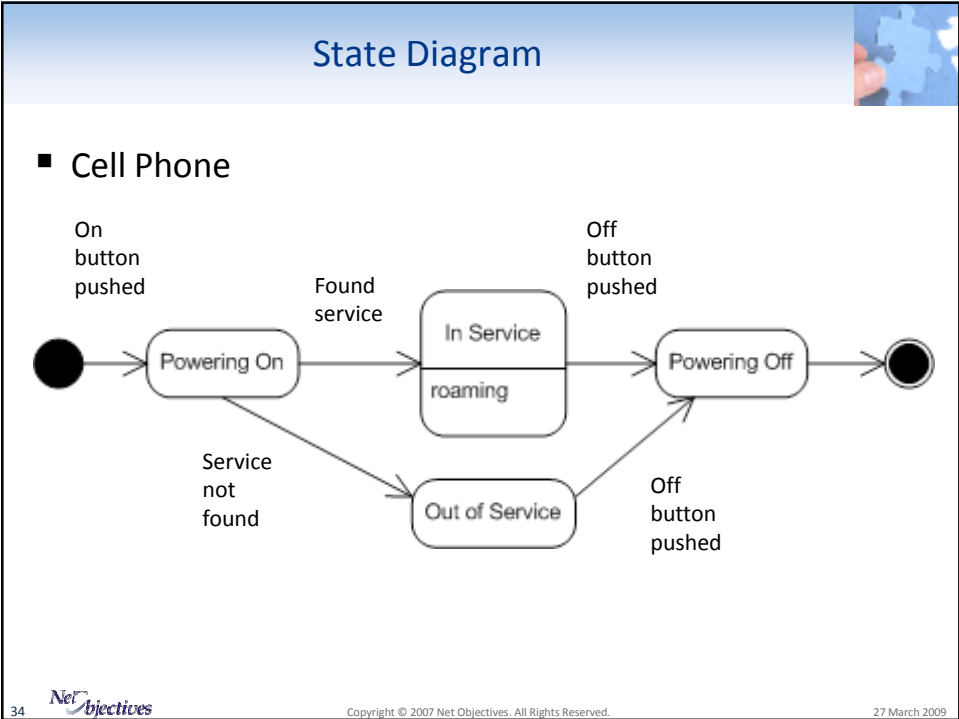
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Example Of State


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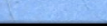
State Table

State/Event	On Button Pushed	Service Found	Service Not Found	Off Button Pushed
Initial	Powering On			
Powering On		In Service	Out of Service	
In Service				Powering Off
Out of Service				Powering Off

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Example Contributions

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Retirement Contribution Example

- Requirement

The system shall match incoming retirement contribution files with bank deposits. If the total on the contribution files matches the bank deposit, the corresponding funds shall be purchased.
- Exceptions ?


```

graph TD
    RP[Retirement Plan] --> P[Process]
    BD[Bank Deposit] --> P
    CF[Contribution File] --> P
    P --> F[Funding]
          
```

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Setup Tables

PlanID = XYZ	
Name	Fund
George	WildEyedStocks
Sam	GovernmentBonds
Bill	UnderTheMattress

PlanID	Bank Routing Number	Account Number
XYZ	111-11-11111	12345678

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Inputs

401K Contributions	PlanID=XYZ
Name	Amount
George	5000
Sam	1000
Bill	500

Bank Deposit		
Routing Number	Account Number	Amount
111-11-11111	12345678	6500

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Output Table

Expected Output		
Funding	PlanID = XYZ	
Name	Fund	Amount
George	WildEyedStocks	5000
Sam	GovernmentBonds	1000
Bill	UnderTheMattress	500

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Contribution States

Contribution State	Meaning
Received	Contribution File received
Awaiting Match	Waiting for Bank Deposit
Purchase Funds	Matched Bank Deposit, buy funds
Begin Exception Processing	Bank Deposit received, but incorrect

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State Transitions


Contribution State	Event	New State	Notes
Initial	Received data	Received	
Received	Data check is bad	EditProcessing	
Received	Data check is good	Awaiting Match	
Awaiting Match	Matched exactly	Purchase Funds	Matching on entry and ½ hour before close
Awaiting Match	Discrepancy in match	BeginExceptionProcessing	
AwaitingMatch	Matching time exceeded	BeginExceptionProcessing	
Purchase Funds	One minute prior to market close	Awaiting Confirmation	Enter order for funds


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Deposit States

Deposit State	Event	New State
Initial	Data received	Received
Received	Data check is bad	Edit Processing
Received	Data check is good	Awaiting Match
Awaiting Match	MatchedExactly	Matched

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Example Email

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Email Validation

- Requirement
 - Reject invalid emails
 - Improperly formed ones
 - Ones from “anonymous sites”

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Original Table


Email	Valid	Reason
<u>George@sam.com</u>	Y	
George@george@same.com	N	Two @
<u>George@hotmail.com</u>	N	Banned domain
<u>George@iamoutogetyou.com</u>	N	Banned domain
.George@sam.com	N	Invalid name
George@samcom	N	Invalid domain
George+Bill@sam.com	Y	
... and many more		

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Format Validation

Email	Valid?	Name?	Domain?
X@Y	Y	X	Y
XY	N	DNC	DNC
XY@XY@XY	N	DNC	DNC

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Name Validation


- The Name (actually the local-part) must only contain:
 - Uppercase and lowercase English letters (a-z, A-Z)
 - Digits 0 through 9
 - Period (.) provided that it is not the first nor last character, nor may it appear two or more times consecutively.
 - Characters ! # \$ % & ' * + - / = ? ^ _ ` { | } ~
- Maximum size is 64 characters

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Name Valid Characters

Characters	Valid
a-z	Y
A-Z	Y
0-9	Y
! # \$ % & ' * + - / = ? ^ _ ` { } ~	Y
.	Y (if not first, last or two consecutive)
Anything else (maybe list)	N

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Valid Name Examples

Name	Valid?	Reason
George	Y	
George..a	N	Period appears twice in a row
George^	N	Character not allowed
.George	N	Period first
George.	N	Period last

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Domain Validation

- Domains
 - Maximum 255 characters
 - Periods separate parts of domain
 - There must be at least a top level domain and a second level domain

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Domain Character Validation


Character	Valid	Notes
a-z	Y	
.	Y	Must have at least one Cannot be first or last character
-	Y	
0-9	Y	
Anything else	N	

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Domain Validation

Domain	Top Level Domain	Second Level Domain	Third Level Domain	Valid	Notes
A.B.C	C	B	A	Y	
Z				N	Must have at least one period
B.C	C	B		Y	
A.B.C.D	D	C	B	Y	Fourth Level is A
Z.				N	Cannot end in period
.Z					Cannot begin with period


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Disallowed Domain

Domain	Reason
Hotmail.com	Anonymous mail
Imouttogetyou.com	Spam source

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Example Complex Business Rule

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Complex Business Rule

Field One	Field Two	Field Three	Field Four	Result
> 20	< 50 or blank	>=100	Y	Allow
Otherwise or blank	DNC	DNC	DNC	Disallow
DNC	Otherwise	DNC	DNC	Disallow
DNC	DNC	Otherwise or blank	DNC	Disallow
DNC	DNC	DNC	N or blank	Disallow



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Complex Business Rule

Field One	Result
> 20	Allow
Blank	Disallow
Otherwise	Disallow

Field Three	Result
>=100	Allow
Blank	Disallow
Otherwise	Disallow

Field Two	Results
< 50	Allow
Blank	Allow
Otherwise	Disallow

Field Four	Result
Y	Allow
N	Disallow
Blank	Disallow
Otherwise	??

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Complex Business Rule

Field One	Field Two	Field Three	Field Four	Result ?
Allow	Allow	Allow	Allow	Allow
Disallow	DNC	DNC	DNC	Disallow
DNC	Disallow	DNC	DNC	Disallow
DNC	DNC	Disallow	DNC	Disallow
DNC	DNC	DNC	Disallow	Disallow

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**Example
High Availability**

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High Availability System

- If a server goes down, switch any applications running on it to the alternative server. If the alternate server does not have the capacity for all the applications, then run the applications based on priority order. Then email or text message the system administrator, based on his or her preference, that the additional applications cannot be run.

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Servers and Applications

ServerName	Capacity - Application
Freddy	5
Fannie	3

Application	Priority
CEO's Pet	100
MP3 Download	99
Lost Episode Watching	98
External Web	50
Internal Web	25
Payroll	10

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Events Handling

Server	Applications
Freddy	CEO's Pet, External Web, Internal Web, Payroll
Fannie	Lost Episode Watching, MP3 Download

Event	Servers Remaining ?	Applications Running ?	Action ?
Freddy Goes Down	Fannie	CEO's Pet, Lost Episode Watching, MP3 Download	Send event alert "Freddy down"
Fannie Goes Down	Freddy	CEO's Pet, Lost Episode Watching, MP3 Download, External Web, Internal Web,	Send event alert "Fannie down"

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May discover new concepts or principles

Event Alerts

Event Alert	Text ID	Email	Action?
Email	DNC	Ab@e.com	Send mail to AB@e.com
Text Message	123	DNC	Send text to 123


Event Alert	Email	Response	Action?
Email	AB@e.com	Mail sent	None
Email	AB@e.com	Mail not deliverable	Audible alarm???

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And Another Condition

Server	Applications
Fannie	CEO's Pet, Lost Episode Watching, MP3 Download

Event	Servers Remaining	Action?
Fannie Goes Down	None	Send event alert "Help"

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**Not An Ending,
But a Beginning**

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Objective Review

- Our objectives were:
 - Acceptance test driven development can help customer unit/developer unit communication
 - Table-driven requirements can reduce ambiguity
 - Requirements are tests / tests are requirement
- Did we meet your tests?
 - If not, what else needs to be done?

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