

CS3300 Introduction to Software Engineering

# Lecture 16: Black-Box Testing

Dr. Nimisha Roy ▶ [nroy9@gatech.edu](mailto:nroy9@gatech.edu)

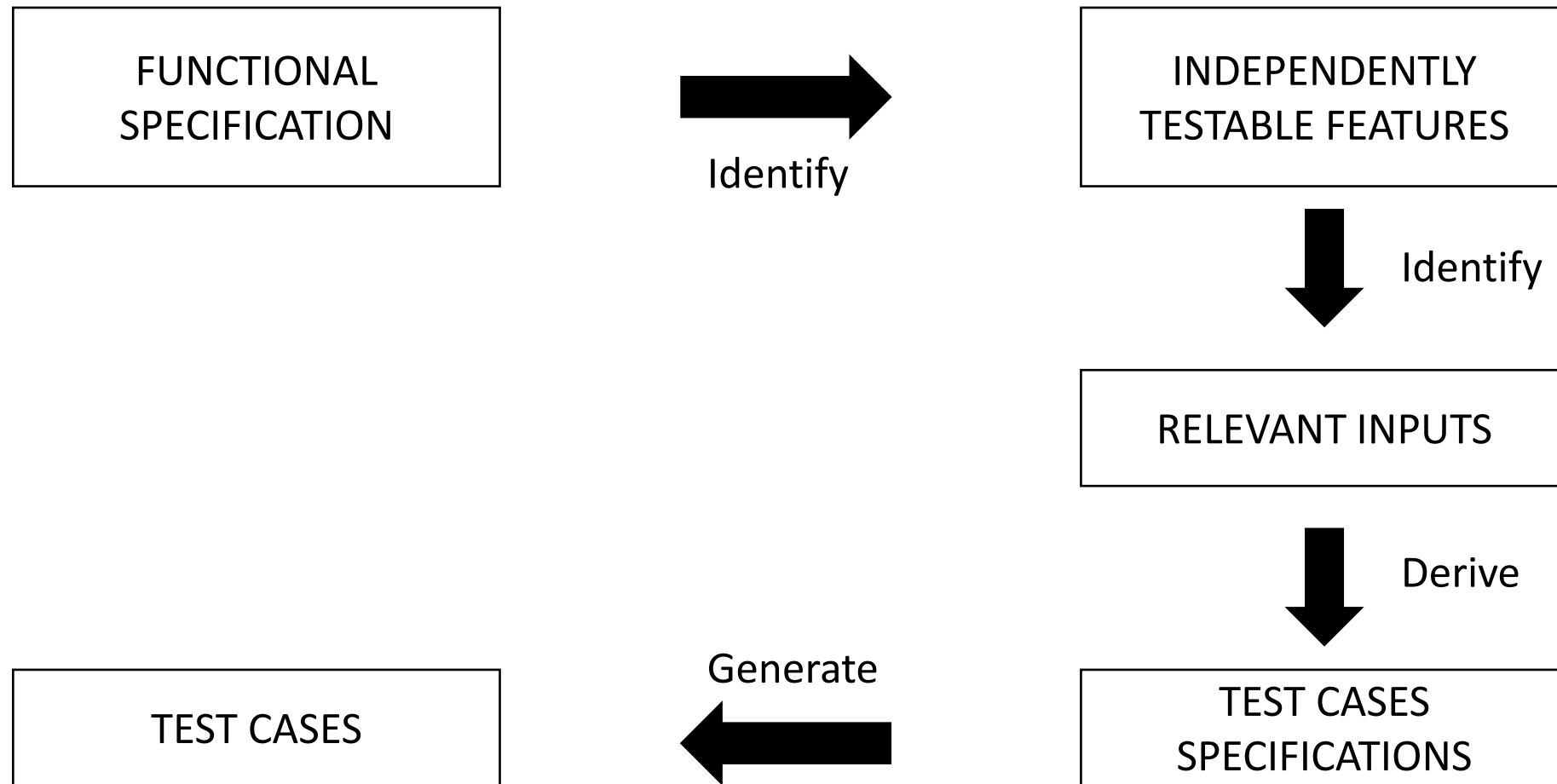
# Black- Box Testing



## Advantages

- Focus on the domain
- No need for the code
  - Early test design
  - Prevents the highly occurring scenario of no-time-for-testing
- Catches logic defects
- Applicable at all granularity levels

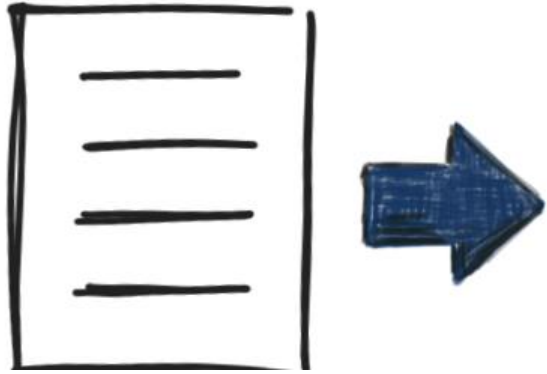
# A systematic Functional-Testing Approach



Decoupling; Automated Sub-tasks; Monitor testing process

# A systematic Functional-Testing Approach

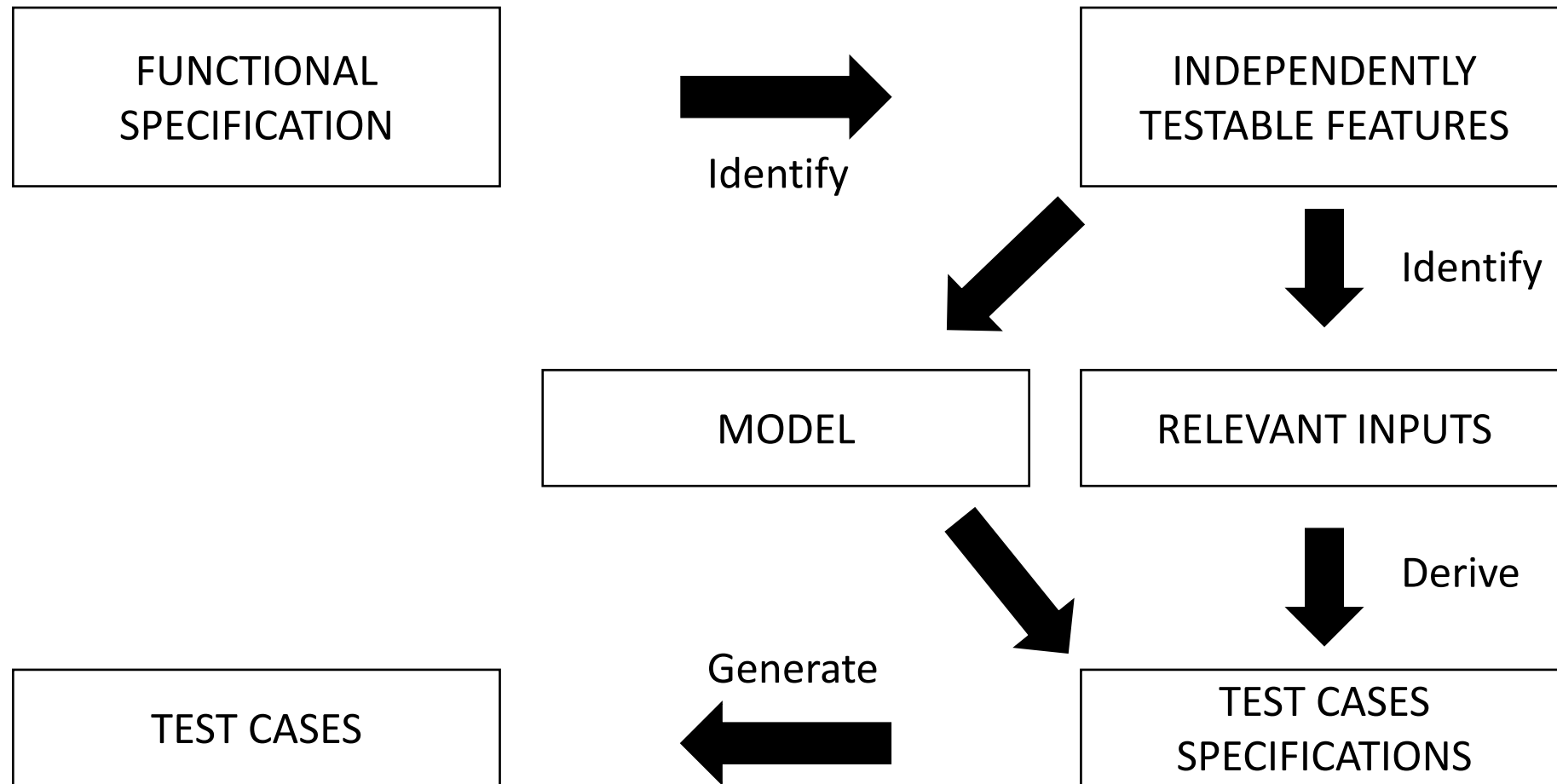
## The Category-Partition Method



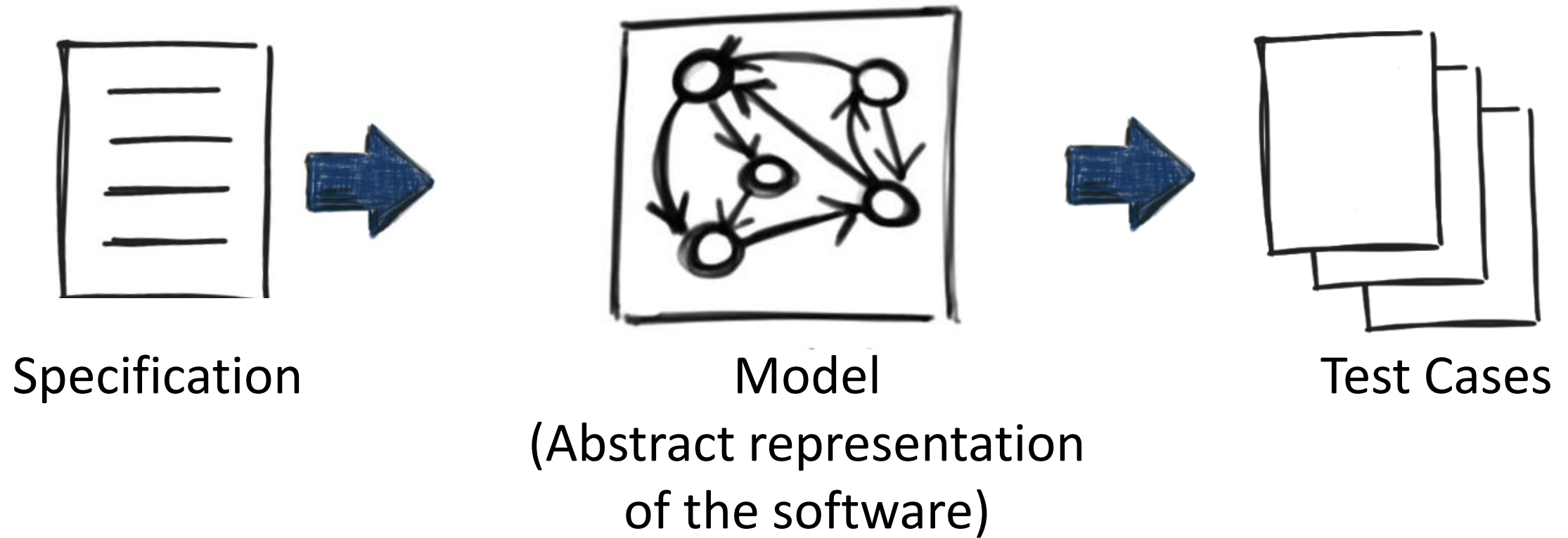
Functional  
Specification

1. Identify independently testable features
2. Identify Categories (characteristic features of input)
3. Partition Categories into choices (interesting values – boundary values)
4. Identify constraints among choices (PROPERTY---- IF, ERROR, SINGLE)
5. Produce/Evaluate test case specifications (Produce test frames, can be automated using TSLGenerator)
6. Generate test cases from test case specifications (by instantiating)

# Model-Based Testing



# Model-Based Testing

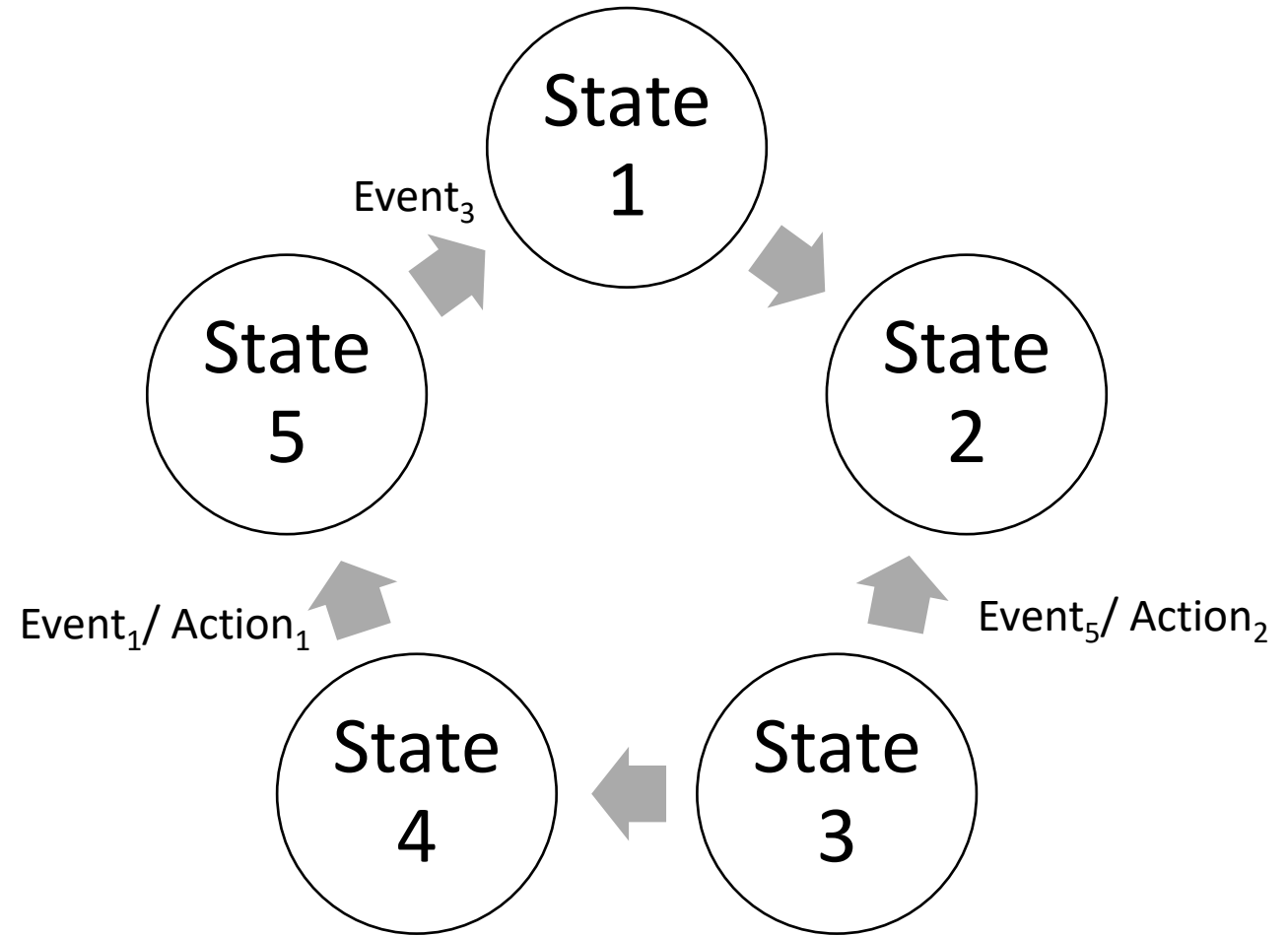


# Finite State Machines (FSM)

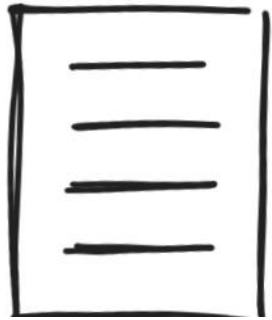
Nodes = States

Edges = Transitions

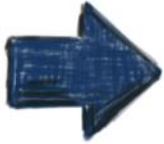
Edge Labels =  
Events/Actions



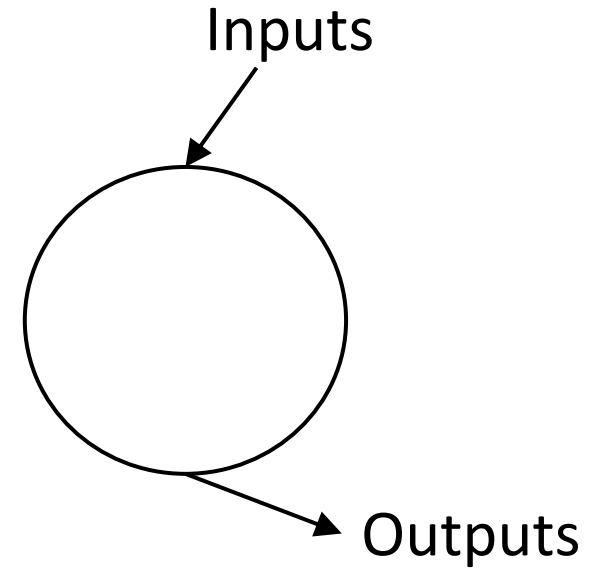
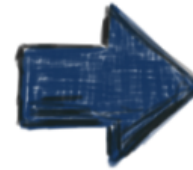
# Building an FSM



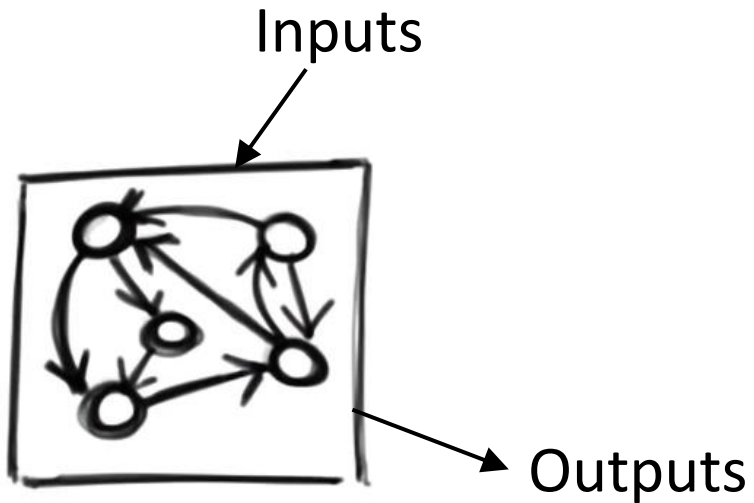
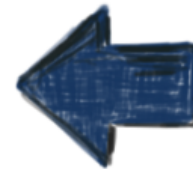
Specification



Identify System's  
Boundaries, and  
Input and Output

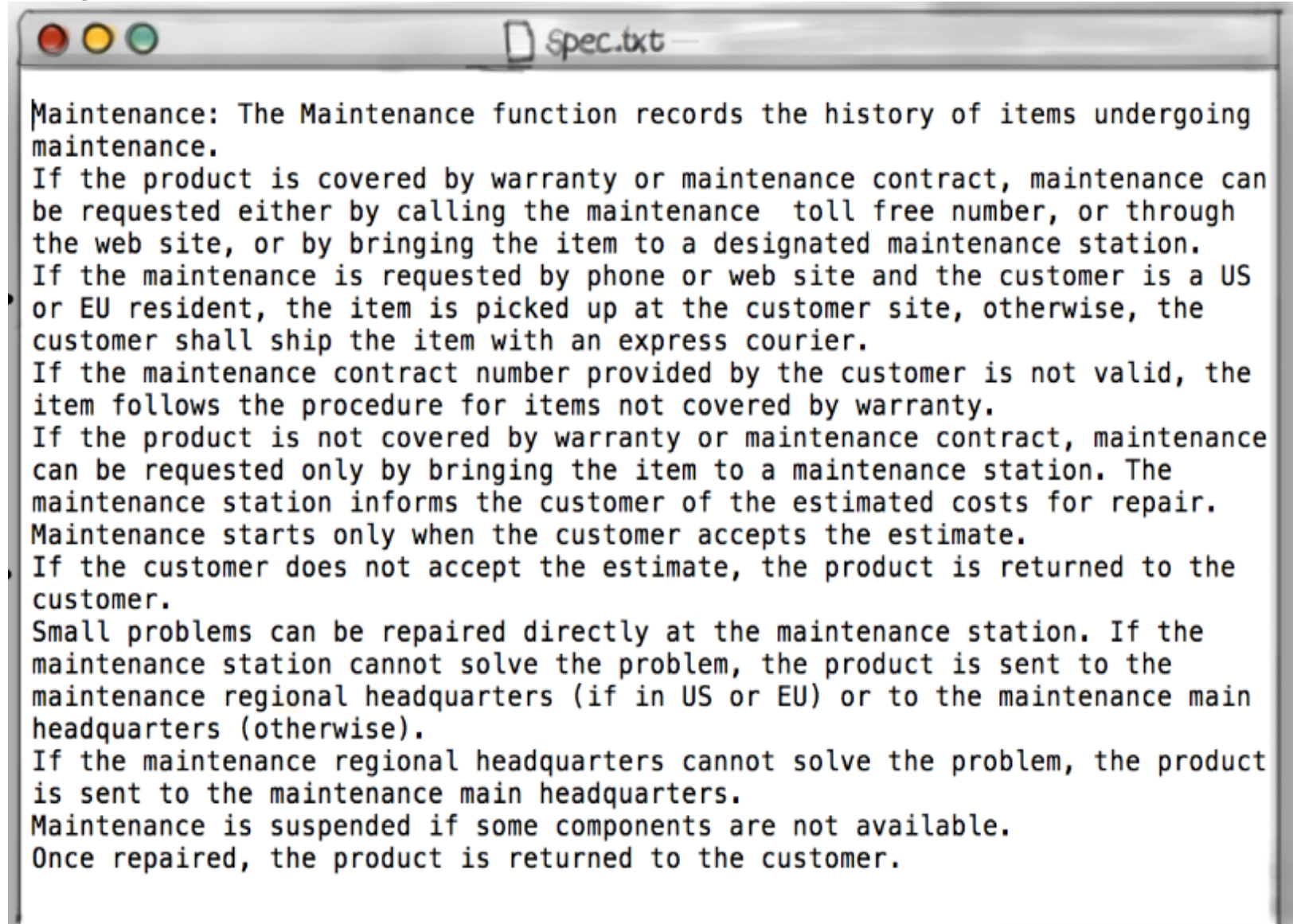


Identify relevant  
states and  
transitions



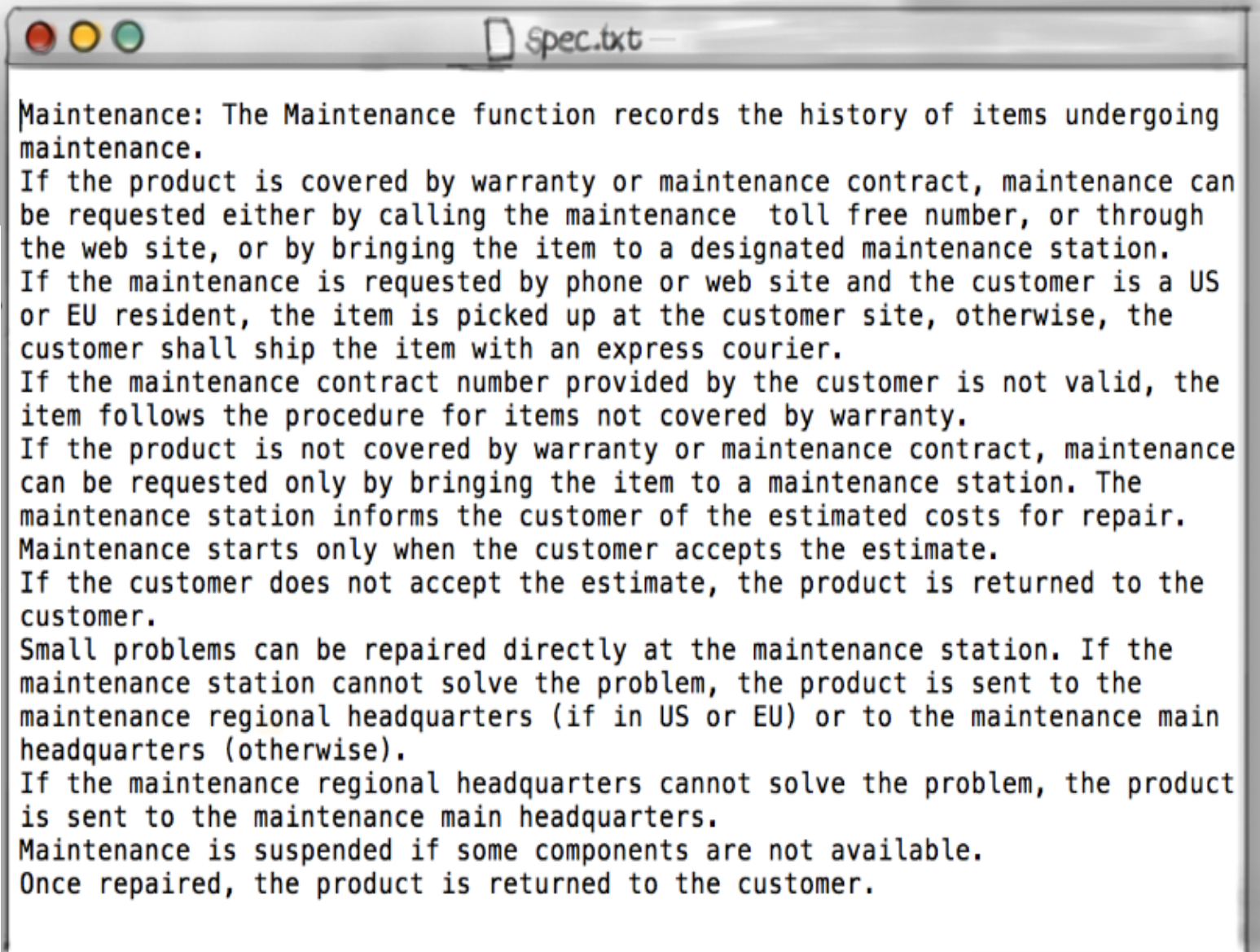


# From an Informal Specification...



# From an Informal Specification...

Multiple  
choices here ↘



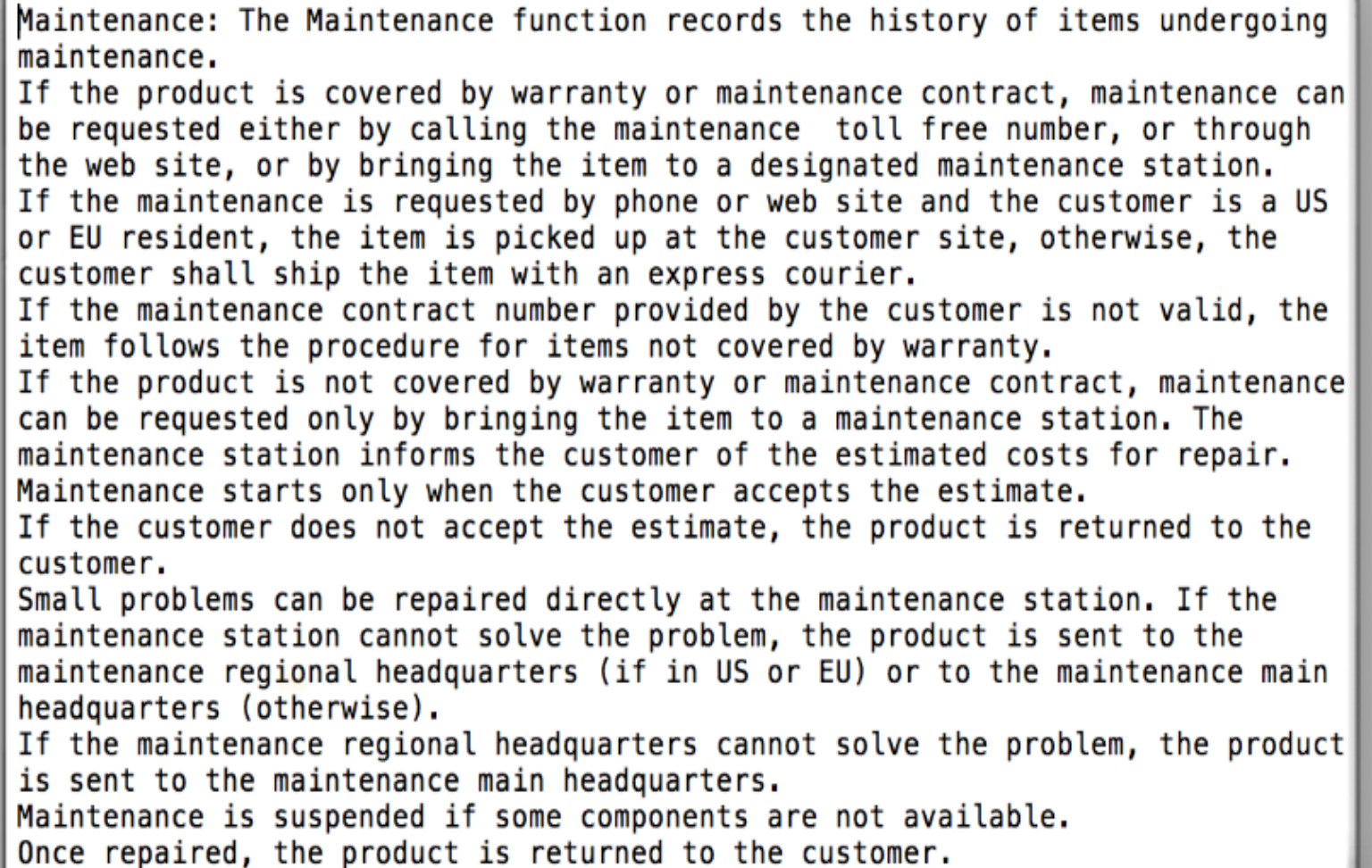
```
Spec.txt

Maintenance: The Maintenance function records the history of items undergoing
maintenance.
If the product is covered by warranty or maintenance contract, maintenance can
be requested either by calling the maintenance toll free number, or through
the web site, or by bringing the item to a designated maintenance station.
If the maintenance is requested by phone or web site and the customer is a US
or EU resident, the item is picked up at the customer site, otherwise, the
customer shall ship the item with an express courier.
If the maintenance contract number provided by the customer is not valid, the
item follows the procedure for items not covered by warranty.
If the product is not covered by warranty or maintenance contract, maintenance
can be requested only by bringing the item to a maintenance station. The
maintenance station informs the customer of the estimated costs for repair.
Maintenance starts only when the customer accepts the estimate.
If the customer does not accept the estimate, the product is returned to the
customer.
Small problems can be repaired directly at the maintenance station. If the
maintenance station cannot solve the problem, the product is sent to the
maintenance regional headquarters (if in US or EU) or to the maintenance main
headquarters (otherwise).
If the maintenance regional headquarters cannot solve the problem, the product
is sent to the maintenance main headquarters.
Maintenance is suspended if some components are not available.
Once repaired, the product is returned to the customer.
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# From an Informal Specification...

Multiple  
choices here ↘

Determine  
the next step →



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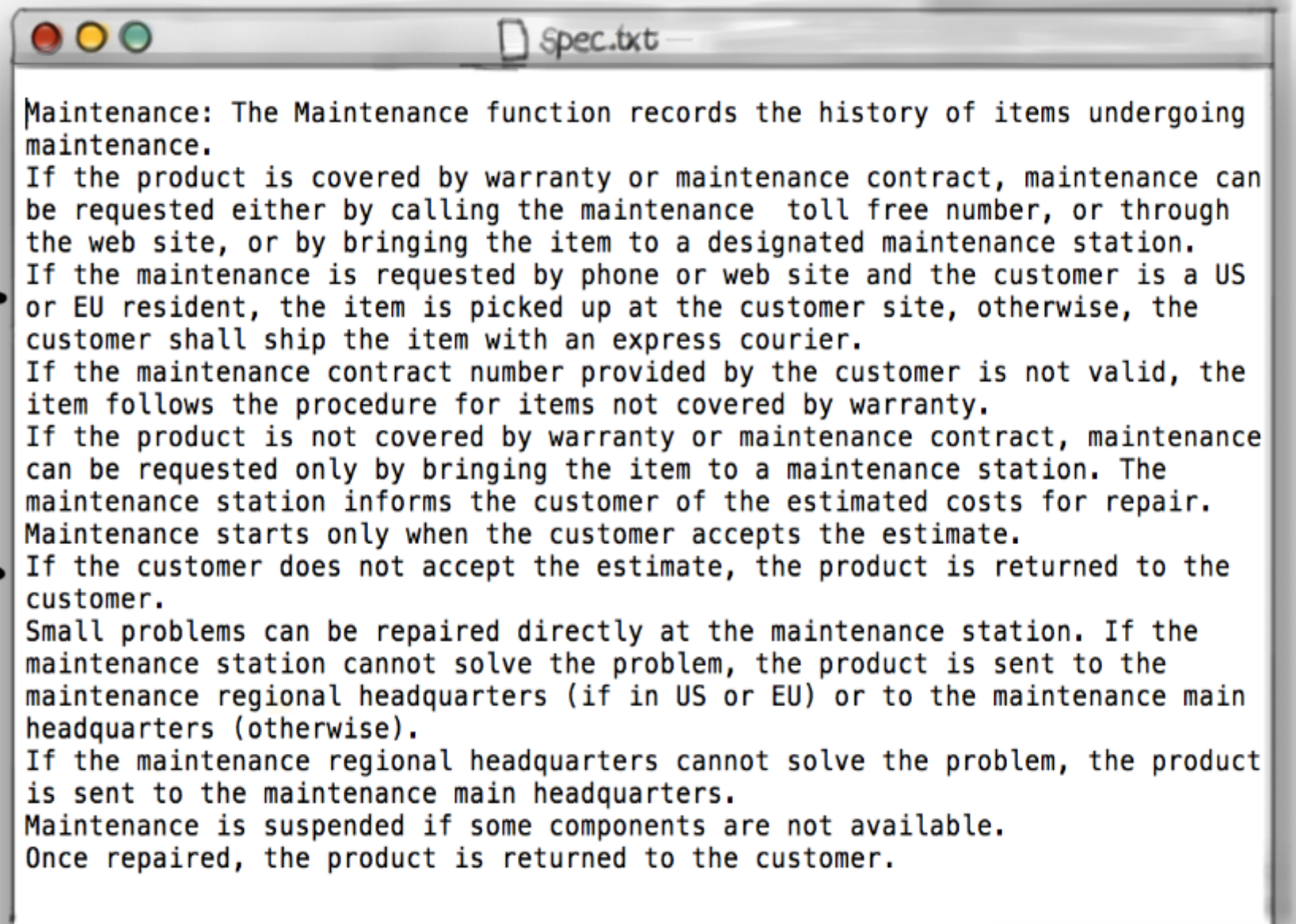


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Multiple  
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Determine  
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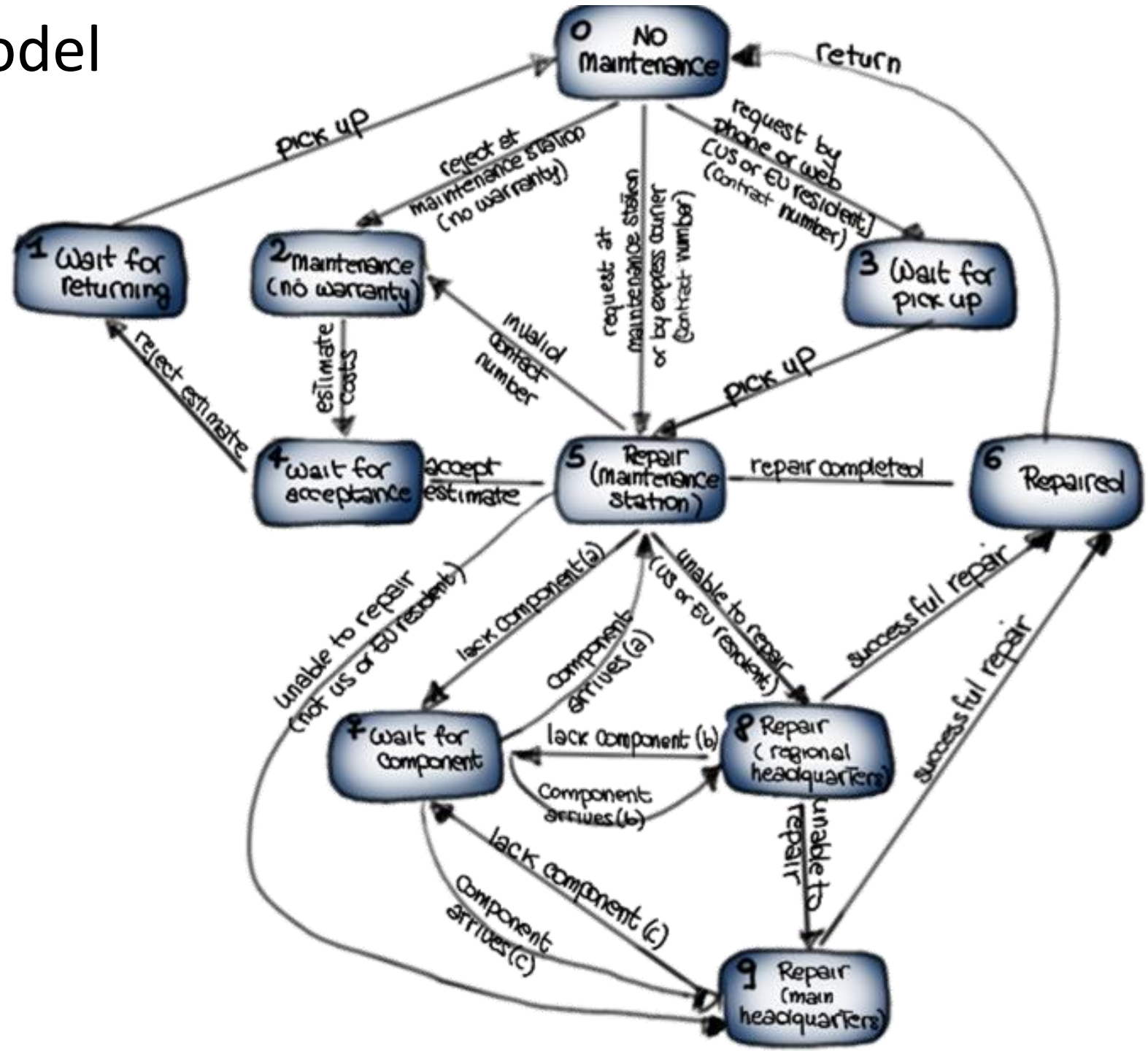
and so on



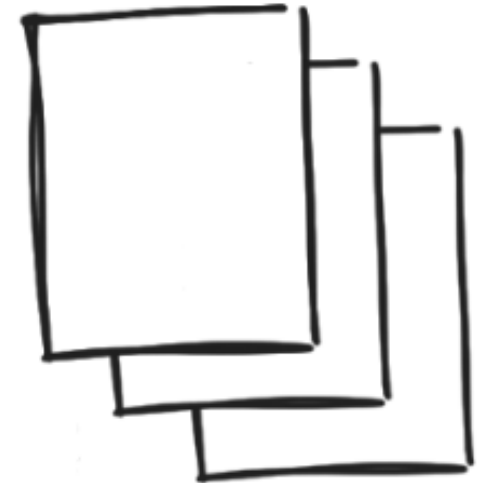
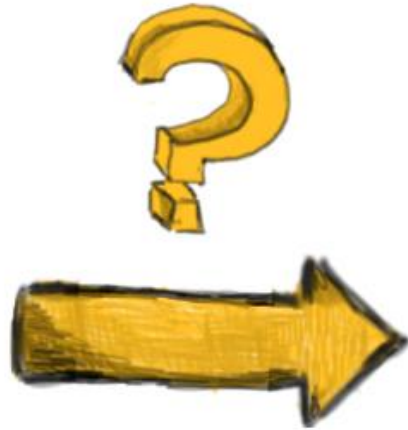
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```

... To a Finite State Model



# Finite State Model to a Set of Test Cases

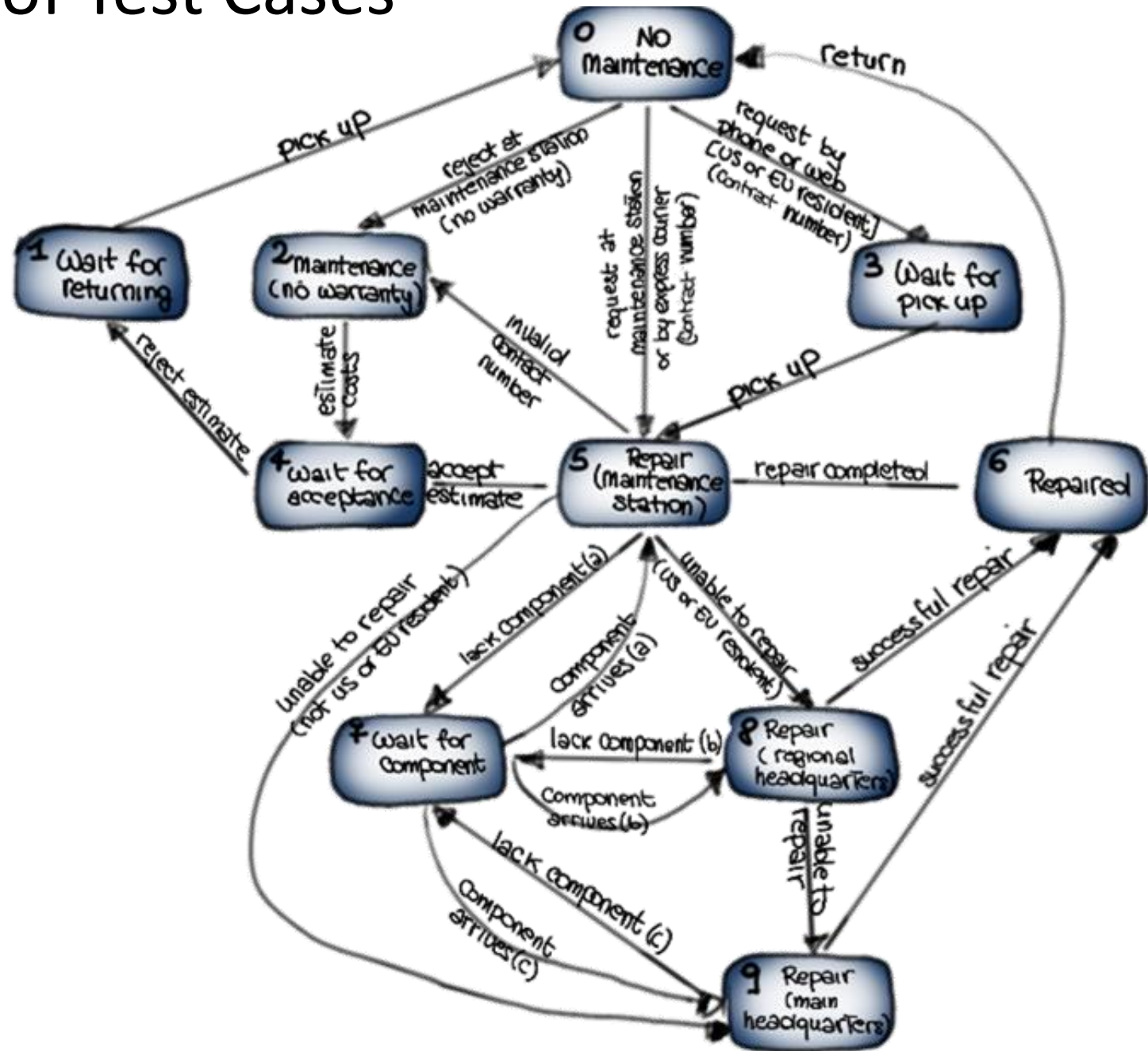


Test Cases

# Finite State Model to a Set of Test Cases

Cover the behaviors represented by the state machine.

- Cover all the states
- Or Identify paths in state machine that go through all states in the machine



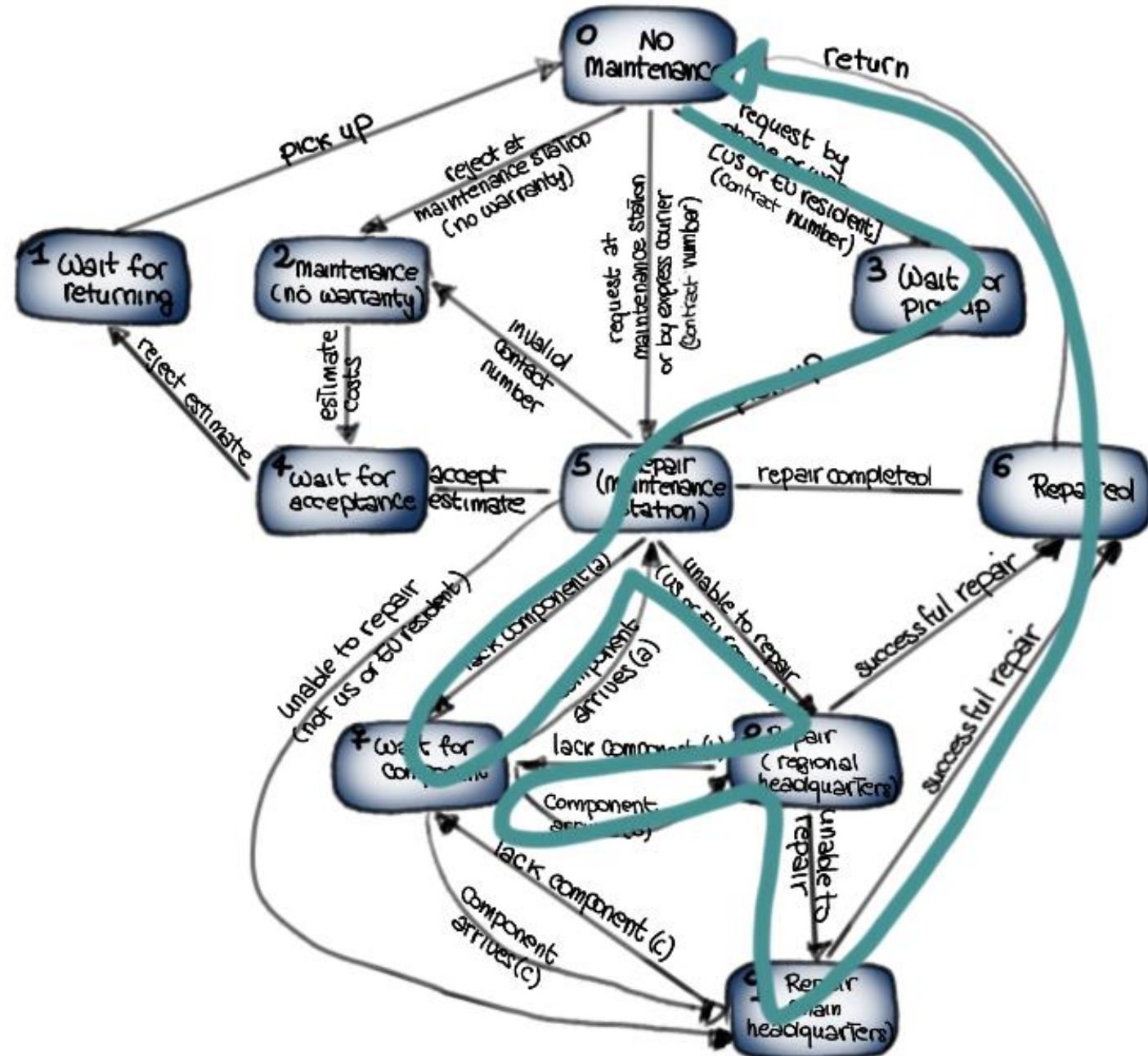


# Finite State Model to a Set of Test Cases

Cover the behaviors represented by the state machine.

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TC1:  $\Phi$ , 3, 5, 7, 5, 8, 7, 8, 9, 6,  $\Phi$





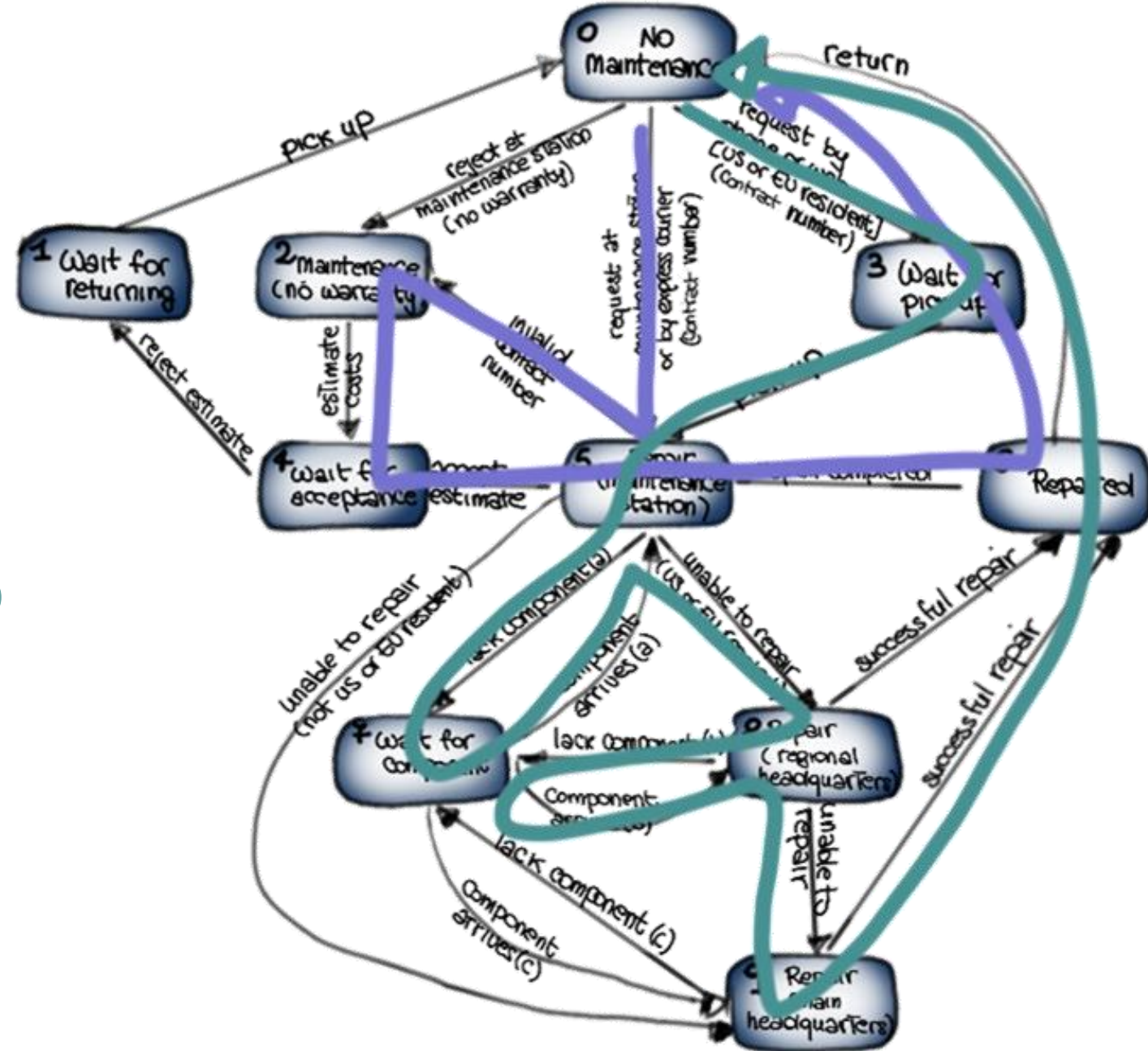
# Finite State Model to a Set of Test Cases

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TC2:  $\Phi$ , 5, 2, 4, 5, 6,  $\Phi$



# Finite State Model to a Set of Test Cases

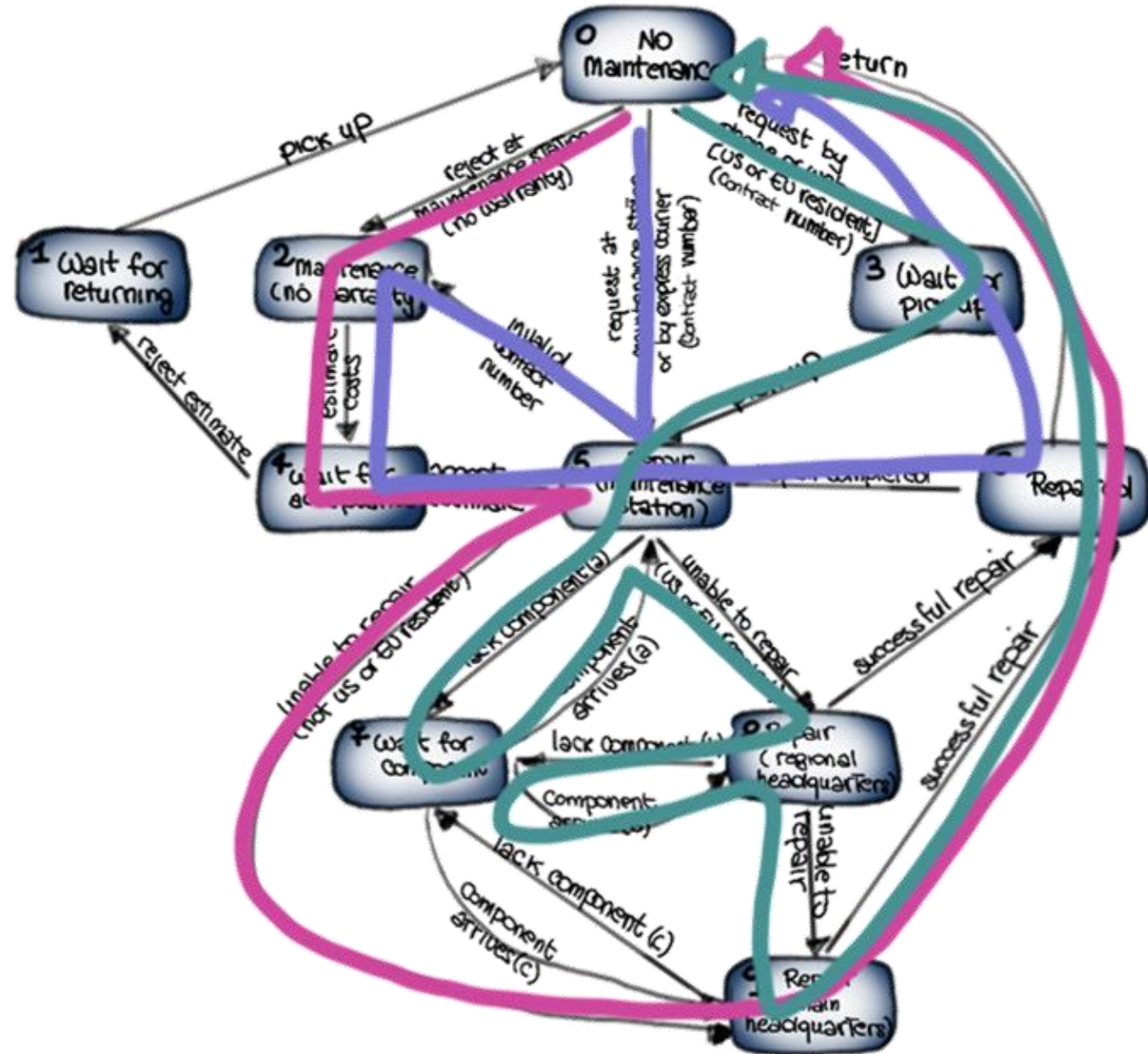
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TC2:  $\Phi$ , 5, 2, 4, 5, 6,  $\Phi$

TC3:  $\Phi$ , 2, 4, 5, 9, 6,  $\Phi$





# Finite State Model to a Set of Test Cases

Cover the behaviors represented by the state machine.

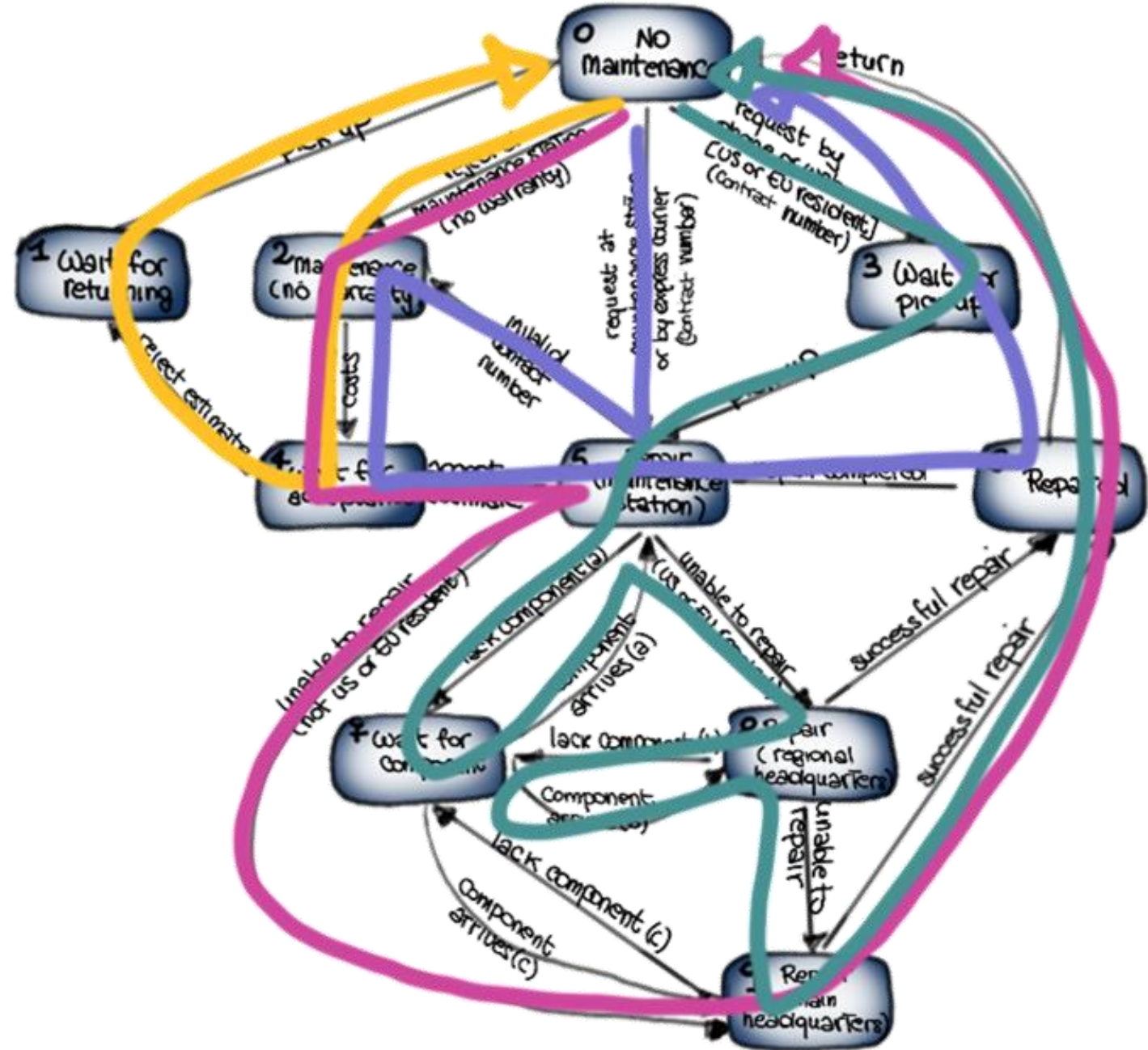
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- Or Identify paths in state machine that go through all states in the machine
- Or cover all transitions

TC1:  $\Phi$ , 3, 5, 7, 5, 8, 7, 8, 9, 6,  $\Phi$

TC2:  $\Phi$ , 5, 2, 4, 5, 6,  $\Phi$

TC3:  $\Phi$ , 2, 4, 5, 9, 6,  $\Phi$

TC4:  $\Phi$ , 2, 4, 1,  $\Phi$



# Finite State Model to a Set of Test Cases

Cover the behaviors represented by the state machine.

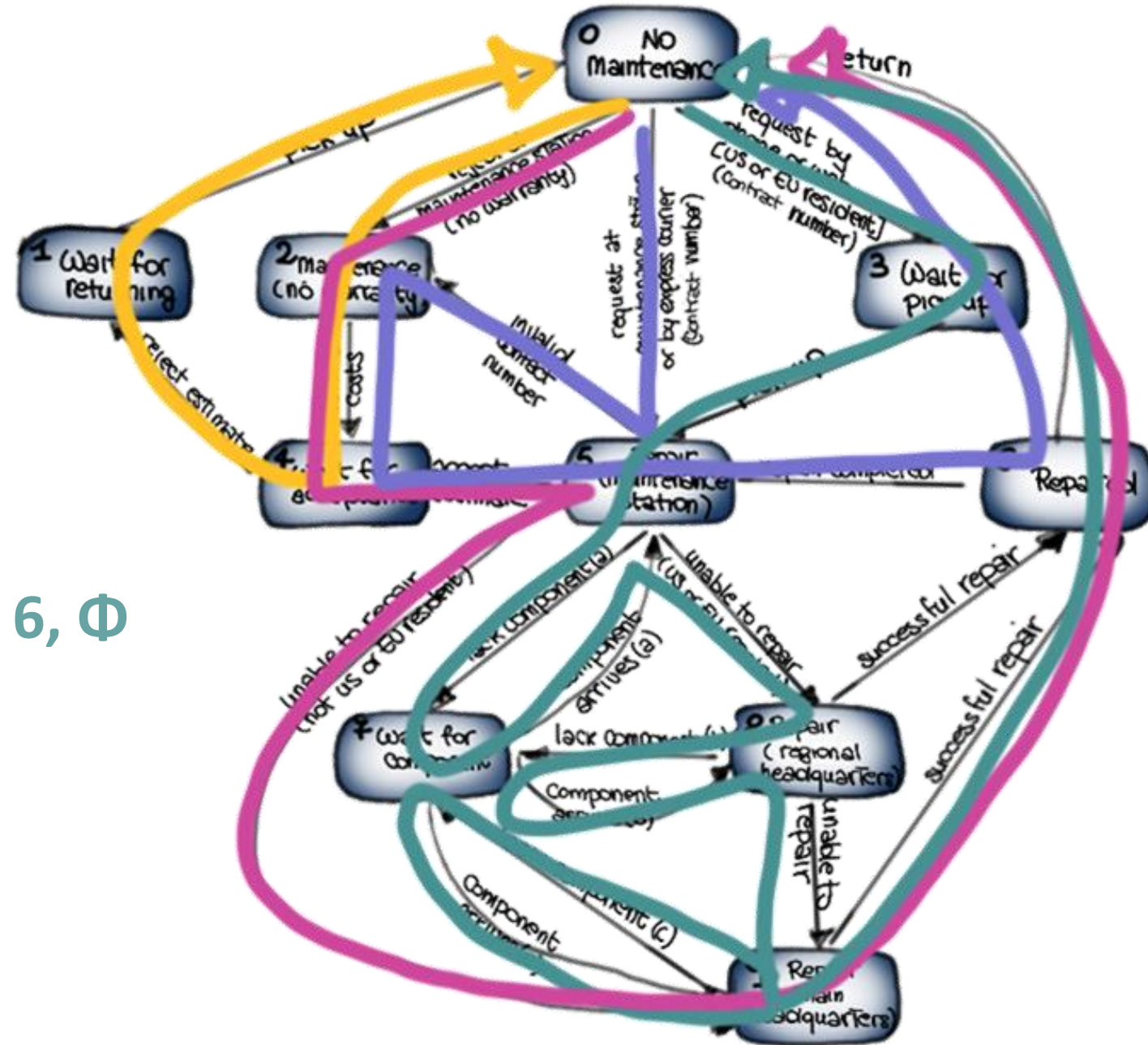
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TC4:  $\Phi$ , 2, 4, 1,  $\Phi$





# Finite State Model to a Set of Test Cases

Cover the behaviors represented by the state machine.

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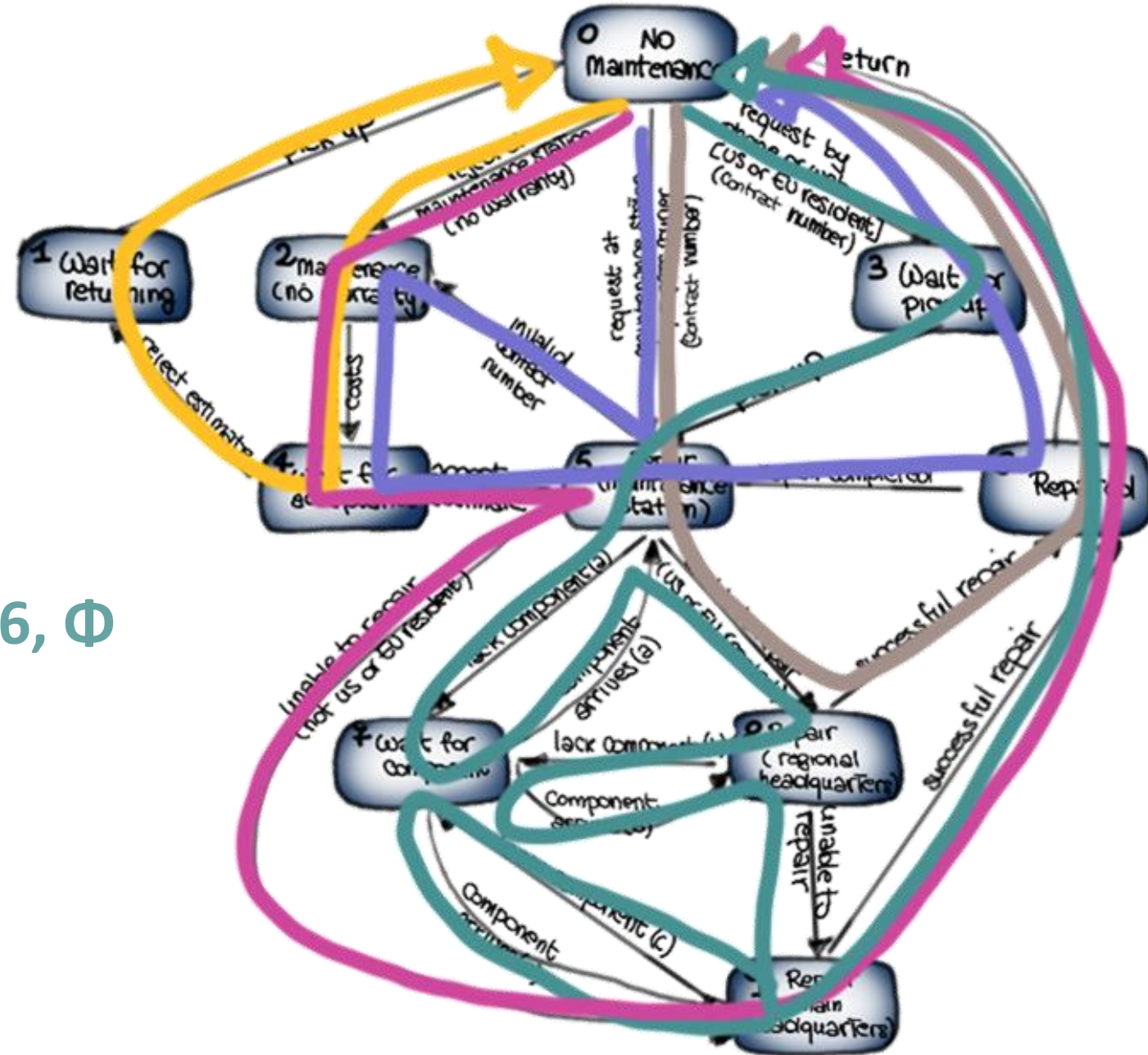
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TC3:  $\Phi$ , 2, 4, 5, 9, 6,  $\Phi$

TC4:  $\Phi$ , 2, 4, 1,  $\Phi$

TC5:  $\Phi$ , 5, 8, 6,  $\Phi$



# Some Considerations

## Applicability

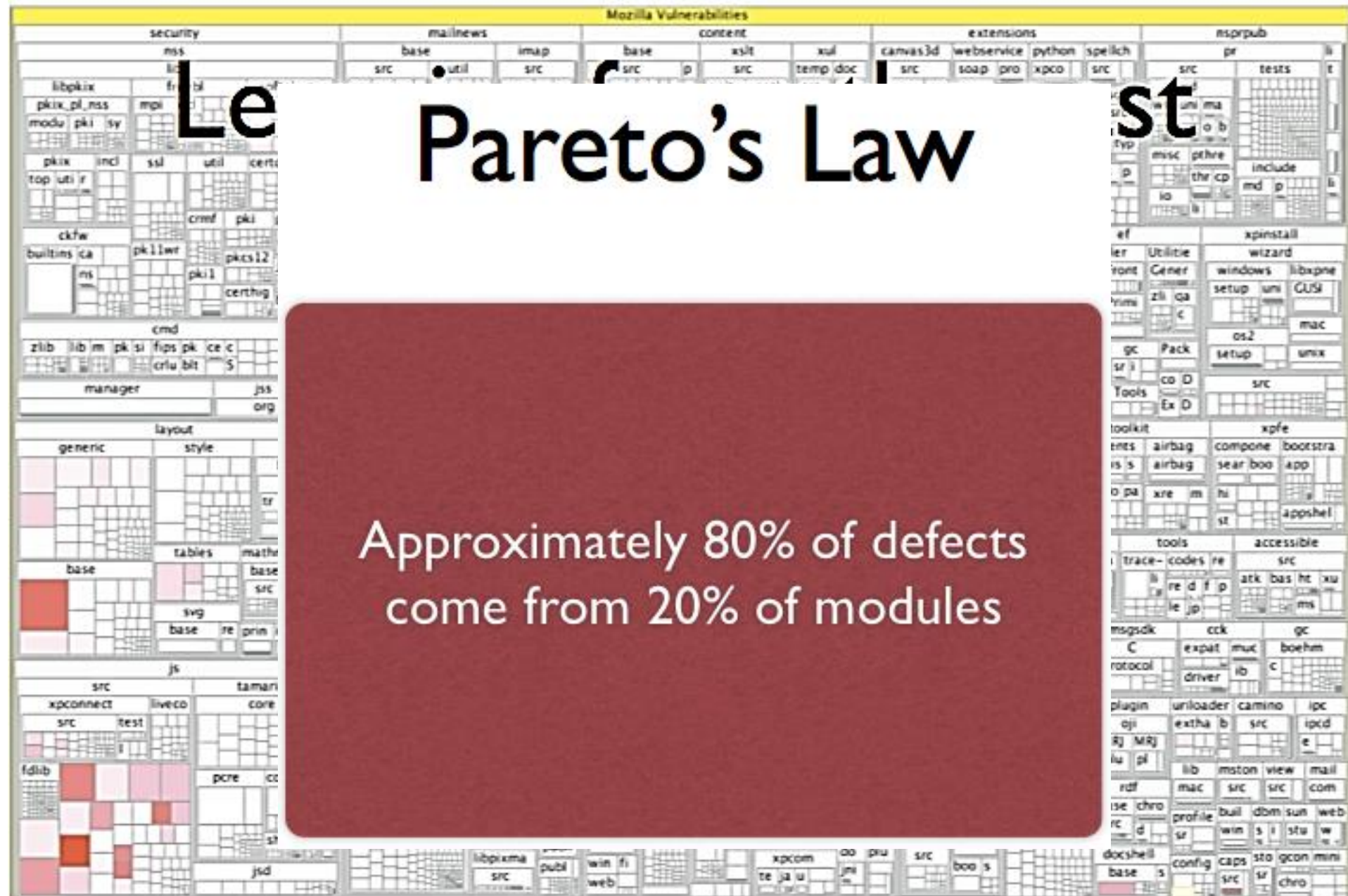
- Very General Approach
- In UML, state machine are readily available

## Abstraction is key

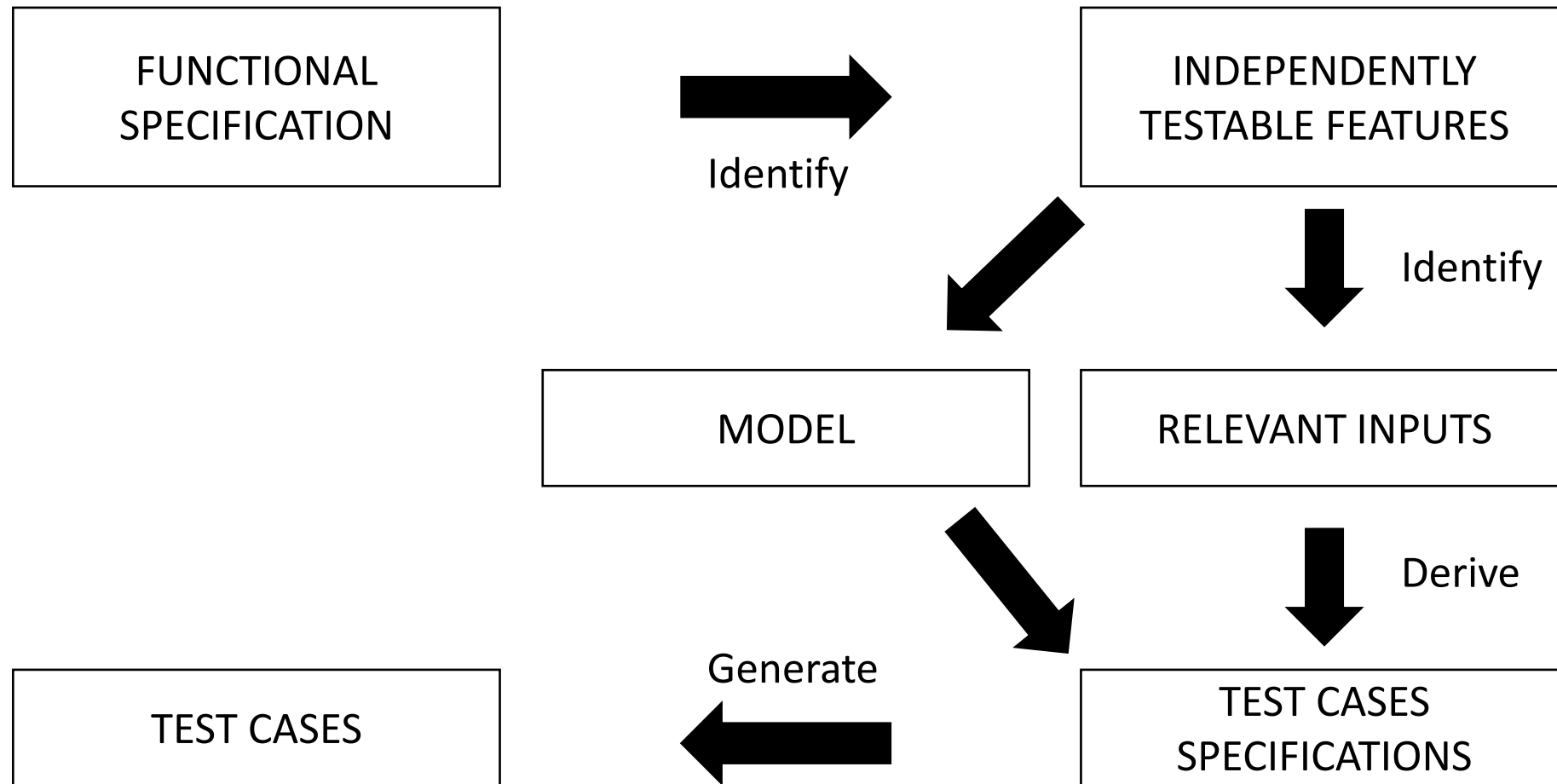
## Many other approaches

- Decision tables
- Flow graphs
- Historical Models
- ...

# Historical models



# Black-Box Testing



Decoupling; Automated Sub-tasks; Monitor testing process



# Industry Standards Today

- Many techniques of Black Box Testing
  - 2 important techniques discussed in class- Category partition & Model based testing
- Automating Black-Box Testing is very important
- Tools popular in Industry:
  - [UFT \(Unified Testing Tool\)](#)
    - designed for automated regression, and functional testing.
    - widely used by many big companies like Microsoft, IBM, Apple
    - difficult to use on GUI-rich browser-based applications.
  - [Selenium WebDriver](#)
    - designed as a language-independent automated black-box testing tool (open source)
    - most popular open-source solution for web application functional and regression testing
    - recording and playing back scripts, exporting and importing test cases from one language to another, debugging capabilities, and creating custom commands
  - [Watir](#) (Ruby), [Ranorex Studio](#) (commercial solution), [SilkTest](#), [Squish](#)
- AI in Testing – gaining popularity