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**CS 589 – Final Project**

**Acknowledgements:**

I would like to thank **Prof. Bogdan Korel**, Teaching Assistants **Praneeth Thota** and **Berk** for your continuous support and guidance in the entire course work and for this project to get into a good shape.

**Introduction:**

This documentation comprises of the designing and execution of test cases which are been well taught and implemented in our course work. The key testing strategies involved are 2-pair transition testing, covers all the in and out flow of a particular state in an Extended Finite State Model(EFSM), Ghost Transition testing, covers all the negative scenarios of a particular state in EFSM, Multiple Condition Testing, covers all the possible combinations of a complex predicate branches in every method.

Theother implementations in this project included are testing individual methods through driver methods written which are used as stubs for testing purpose. The key test drivers in this project are main(), showAll(), currentState() which displays the current values retained by the class object created.

1. **2-Pair State Transition Testing**

From the given EFMS the following are the 2 pair state transitions derived

* S0 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T0, T5, T3, T13, T14 | T1, T15 | (T0, T1) (T0, T15)  (T5, T1) (T5, T15)  (T3, T1) (T3, T15)  (T13, T1) (T13, T15)  (T14, T1) (T14, T15) |

* S1 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T1 | T2, T6 | (T1, T2) (T1, T6) |

* S2 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T2 | T3, T4 | (T2, T3) (T2, T4) |

* S3 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T4, T6 | T5, T7, T8 | (T4, T5) (T4, T7) (T4, T8)  (T6, T5) (T6, T7) (T6, T8) |

* S4 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T7, T8 | T9 | (T7, T9) (T8, T9) |

* S5 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T9, T10 | T10, T11, T12 | (T9, T10) (T9, T11) (T9, T12)  (T10, T10) (T10, T11) (T10, T12) |

* S6 :

|  |  |  |
| --- | --- | --- |
| **Incoming Transitions** | **Outgoing Transitions** | **Transition Pairs** |
| T11, T12 | T13, T14 | (T11, T13) (T11, T14)  (T12, T14) (T12, T14) |

**Test Cases:**  The following are the test which covers the above mentioned transition pair combinations

|  |  |  |
| --- | --- | --- |
| **Test Case#** | **Transitions Covered** | **Test Case** |
| Test#1 | (T0, T1) (T1, T6)  (T6, T5) (T5, T15) | Activate 15 20 Start PayCash 15 Cancel TurnOff |
| Test#2 | (T0, T1) (T1, T2)  (T2, T3) (T3, T5) | Activate 15 20 Start PayCredit Reject TurnOff |
| Test#3 | (T0, T1) (T1, T6)  (T6, T7) (T7, T9)  (T9, T11) (T11, T13)  (T13, T15) | Activate 15 20 Start PayCash 20 Regular SartPump StopPump Receipt TurnOff |
| Test#4 | (T0, T1) (T1, T6)  (T6, T7) (T7, T9)  (T9, T11) (T11, T14)  (T14, T15) | Activate 15 20 Start PayCash20 Regular StartPump StopPump NoReceipt TurnOff |
| Test#5 | (T0, T1) (T1, T6)  (T6, T8) (T8, T9)  (T9, T11) (T11, T13)  (T13, T15) | Activate 15 20 Start PayCash 25 Super StartPump StopPump Receipt TurnOff |
| Test#6 | (T0, T1) (T1, T6)  (T6, T8) (T8, T9)  (T9, T12) (T12, T14)  (T14, T15) | Activate 15 20 Start PayCash 15 Super StartPump PumpGallon NoReceipt TurnOff |
| Test#7 | (T0, T1) (T1, T6)  (T6, T7) (T7, T9)  (T9, T10) (T10, T11)  (T11, T13) | Activate 15 20 Start PayCash 20 Regular StartPump PumpGallon StopPump Receipt TurnOff |
| Test#8 | (T0, T1) (T1, T6)  (T6, T7) (T7, T9)  (T9,T10)(T10,12)  (T12, T13) (T13, T15) | Activate 15 20 Start PayCash 20 Regular StartPump PumpGallon PumpGallon Receipt TurnOff |
| Test#9 | (T0, T1) (T1, T2)  (T2, T4) (T4, T5)  (T5, T5) | Activate 15 20 Start PayCredit Approved Cancel TurnOff |
| Test#10 | (T0, T1) (T1, T2)  (T2, T4) (T4, T7)  (T7, T9) (T9, T11)  (T11, T14) (T14, T1)  (T1, T2) (T2, T3) (T3, T15) | Activate 15 20 Start PayCredit Approved Regular StartPump StopPump NoReceipt Start PayCredit Reject TurnOff |
|  |  |  |
| Test#11 | (T0, T1) (T1, T2)  (T2, T4) (T4, T8)  (T8, T9) (T9, T10)  (T10, T10) (T10, T11)  (T11, T13) (T13, T1)  (T1, T2) (T2, T3)  (T3, T15) | Activate 15 20 Start PayCredit Approved Super StartPump PumpGallon PumpGallon StopPump Receipt Start PayCredit Reject TurnOff |
| Test#12 | (T0, T1) (T1, T2)  (T2, T4) (T4, T5)  (T5, T1) (T1, T2)  (T2, T3) (T3, T1)  (T1, T6) (T6, T5)  (T5, T15) | Activate 15 20 Start PayCredit Approved Cancel Start PayCredit Reject Start PayCash Cancel TurnOff |
| Test#13 | (T0, T15) | Activate 10 15 TurnOff |

1. **Ghost Transition Testing**

The following are the test cases which are pulled for ghost transitions at each transition state

|  |  |  |
| --- | --- | --- |
| **Test Case#** | **Transition State** | **Test Case** |
| Test#1 | S0 | Activate 10 15 Activate 10 15 PayCredit Reject Approved Cancel PayCash 10 Regular Super StartPump PumpGallon StopPump Receipt NoReceipt TurnOff |
| Test#2 | S1 | Activate 10 15 Start Activate 5 10 Start Reject Approved Cancel Regular Super StartPump PumpGallon StopPump Receipt NoReceipt PayCredit Reject TurnOff |
| Test#3 | S2 | Activate 10 15 Start PayCredit Activate 5 5 Start PayCredit Cancel PayCash Regular Super StartPump PumpGallon StopPump Reveipt No Receitp Approved Cancel TurnOff |
| Test#4 | S3 | Activate 10 15 Start PayCredit Approved Activate 5 5 Start PayCredit Approved PayCash 10 StartPump PumpGallon StopGallon Receipt NoReceipt Cancel TurnOff |
| Test#5 | S4 | Activate 10 15 Start PayCredit Approved Super Activate 5 5 Start PayCredit Approved Super Reject Cancel PayCash 10 Regular PumpGallon StopPump Receipt NoReceipt StartPump StopPump NoReceipt TurnOff |
| Test#6 | S5 | Activate 10 15 Start PayCredit Approved Super StartPump Activate 10 15 Start PayCredit Reject Approved Cancel PayCash 10 Regular Super StartPump Receipt NoReceipt StopPump Receipt TurnOff |
| Test#7 | S6 | Activate 10 15 Start PayCredit Approved Super StartPump StopPump Activate 5 5 Start PayCredit Reject Approved Cancel PayCash Regular Super StartPump PumpGallon StopPump NoReceipt TurnOff |

1. **Multiple Condition Testing:**

The following are the test cases drawn for all the methods involved in the class file provided.

* + **Activate()**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test # | S==-1 | a>0 | b>0 | Test Case |
| Test#1 | T | T | T | Activate 4 5 TurnOff |
| Test#2 | T | T | F | Activate 4 -5 TurnOff |
| Test#3 | T | F | T | Activate -4 5 TurnOff |
| Test#4 | T | F | F | Activate -4 -5 TurnOff |
| Test#5 | F | T | T | Activate 4 5 Activate 4 5 TurnOff |
| Test#6 | F | T | F | Activate 4 -5 Activate 4 -5 TurnOff |
| Test#7 | F | F | T | Activate -4 5 Activate -4 5 TurnOff |
| Test#8 | F | F | F | Activate -4 -5 Activate -4 -5 TurnOff |

* **Start ()**

|  |  |  |
| --- | --- | --- |
| Test# | S == 0 | Test Case |
| Test#9 | T | Activate 10 15 Start PayCredit Reject TurnOff |
| Test#10 | F | Activate 10 15 Start PayCredit Start Reject TurnOff |

* **PayCredit()**

|  |  |  |
| --- | --- | --- |
| Test# | S == 1 | Test Case |
| Test#11 | T | Activate 10 15 Start PayCredit Reject TurnOff |
| Test$12 | F | Activate 10 15 Start PayCredit Reject PayCredit TurnOff |

* **Reject()**

|  |  |  |
| --- | --- | --- |
| Test# | S == 2 | Test Case |
| Test#13 | T | Activate 10 15 Start PayCredit Reject TurnOff |
| Test$14 | F | Activate 10 15 Reject TurnOff |

* **Cancel**

|  |  |  |
| --- | --- | --- |
| Test# | S == 3 | Test Case |
| Test#15 | T | Activate 10 15 Start PayCredit Approved Cancel TurnOff |
| Test$16 | F | Activate 10 15 Cancel TurnOff |

* **Approved**

|  |  |  |
| --- | --- | --- |
| Test# | S == 2 | Test Case |
| Test#17 | T | Activate 10 15 Start PayCredit Approved Cancel TurnOff |
| Test$18 | F | Activate 10 15 Approved TurnOff |

* **PayCash(int c)**

|  |  |  |  |
| --- | --- | --- | --- |
| Test# | S == 1 | C > 0 | Test Case |
| Test#19 | T | T | Activate 10 15 Start PayCash 10 Cancel TurnOff |
| Test#20 | T | F | Activate 10 15 Start PayCash -10 Cancel TurnOff |
| Test#21 | F | T | Activate 10 15 PayCash 10 TurnOff |
| Test$22 | F | F | Activate 10 15 PayCash -10 TurnOff |

* **Regular**

|  |  |  |
| --- | --- | --- |
| Test# | S == 3 | Test Case |
| Test#23 | T | Activate 10 15 Start PayCash 10 Regular StartPump StopPump NoReceipt TurnOff |
| Test$24 | F | Activate 10 15 Regular TurnOff |

* **Super**

|  |  |  |
| --- | --- | --- |
| Test# | S == 3 | Test Case |
| Test#25 | T | Activate 10 15 Start PayCredit Super StartPump StopPump NoReceipt TurnOff |
| Test$26 | F | Activate 10 15 Super TurnOff |

* **StartPump**

|  |  |  |
| --- | --- | --- |
| Test# | S == 4 | Test Case |
| Test#27 | T | Activate 10 15 Start PayCash 10 Super StartPump StopPump NoReceipt TurnOff |
| Test$28 | F | Activate 10 15 StartPump TurnOff |

* **PumpGallon (s == 5)**

|  |  |  |
| --- | --- | --- |
| Test# | S == 5 | Test Case |
| Test#29 | T | Activate 10 15 Start PayCash 10 Super StartPump PumpGallon NoReceipt TurnOff |
| Test#30 | F | Activate 10 15 PumpGallon TurnOff |

* **PumpGallon ((w == 1) || ((cash >= price \* (G + 1)) && (w == 0)))**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test# | w == 1 | ((cash >= price \* (G + 1) | w == 0 | Test Case |
| Test# | T | T | T | Not Executable |
| Test# | T | T | F | Not Executable |
| Test# | T | F | T | Not Executable |
| Test#31 | T | F | F | Activate 10 15 Start PayCard Approved Regular StartPump PumpGalon StopPump NoReciept TurnOff |
| Test#32 | F | T | T | Activate 10 15 Start PayCash 15 Regular StartPump PumpGalon NoReciept TurnOff |
| Test# | F | T | F | Not Executable |
| Test#33 | F | F | T | Activate 10 15 Start PayCash 5 Regular StartPump PumpGalon NoReciept TurnOff |
| Test# | F | F | F | Not Executable |

* **PumpGallon ((w == 0) || cash < price \* (G + 1))**

|  |  |  |  |
| --- | --- | --- | --- |
| Test# | w == 0 | cash < price \* (G + 1) | Test Case |
| Test#34 | T | T | Activate 10 15 Start PayCredit 15 Regular StartPump PumpGalon NoReciept TurnOff |
| Test# | T | F | Not Executable |
| Test# | F | T | Not Executable |
| Test# | F | F | Not Executable |

* **PumpGallon ((w == 0) && (total < cash))**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test#** | **w == 0** | **total < cash** |  |
| Test#65 | T | T | Activate 10 15 Start  PayCash 10 Regular StartPump StopPump NoReciept TurnOff |
| Test#66 | T | F | Activate 10 15 Start  PayCash 20 Regular StartPump StopPump NoReciept TurnOff |
| Test# | F | T | Not Executable |
| Test# | F | F | Not Executable |

* **StopPump (S == 5)**

|  |  |  |
| --- | --- | --- |
| **Test#** | **S == 5** | **Test Case** |
| Test#35 | T | Activate 10 15 Start PayCredit Approved Regular StartPump PumpGalon StopPump NoReciept TurnOff |
| Test#36 | F | Activate 10 15 StopPump TurnOff |

* **StopPump ((w == 0) && (total < cash))**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test#** | **w == 0** | **total < cash** |  |
| Test#43 | T | T | Activate 10 15 Start PayCredit Approved Regular StopPump NoReciept TurnOff |
| Test#44 | T | F | Not Executable |
| Test# | F | T | Not Executable |
| Test# | F | F | Activate 10 15 Start PayCredit Approved Super StartPump StopPump NoReciept TurnOff |

* **NoReceipt**

|  |  |  |
| --- | --- | --- |
| Test# | S == 6 | Test Case |
| Test#37 | T | Activate 10 15 Start PayCredit Approved Regular StartPump PumpGalon StopPump NoReciept TurnOff |
| Test#38 | F | Activate 10 15 NoReciept TurnOff |

* **Receipt**

|  |  |  |
| --- | --- | --- |
| Test# | S == 6 | Test Case |
| Test#39 | T | Activate 10 15 Start PayCredit Approved Regular StartPump PumpGalon StopPump Reciept TurnOff |
| Test#40 | F | Activate 10 15 Reciept TurnOff |

* **TurnOff**

|  |  |  |
| --- | --- | --- |
| Test# | S == 0 | Test Case |
| Test#41 | T | Activate 10 15 TurnOff |
| Test#42 | F | Activate 10 15 Start TurnOff PayCredit Reject TurnOff |

**Conclusion:**

The course work and the project implementation of this course gave me enough exposure and also lot of learning scope such as transition pair testing, multiple branch condition testing, Ghost Transition Testing, Testing individual methods by implementing test drivers for the methods specified in the class file. The implementations included in this project are purely done by me based on the knowledge gained during the course.