

Universidad Nacional de San Agustín

Data bases

UMTG: a toolset to automatically generate system test cases from use case specifications

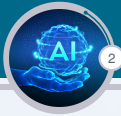
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2021



UMTG

Definition
Workflow



UMTG, a toolset that generates executable system test cases by exploiting the behavioural information implicitly described in use case specifications [1].

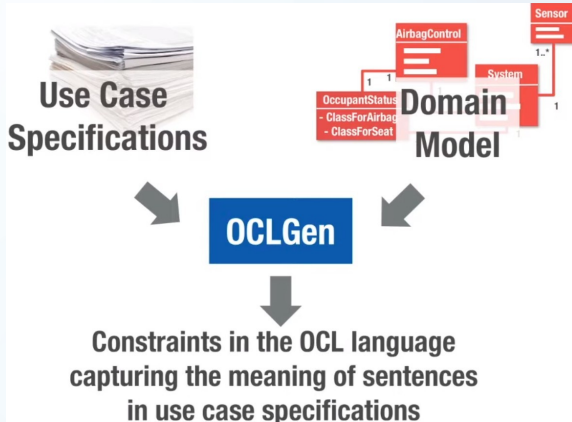
UMTG generates OCL constraints for:

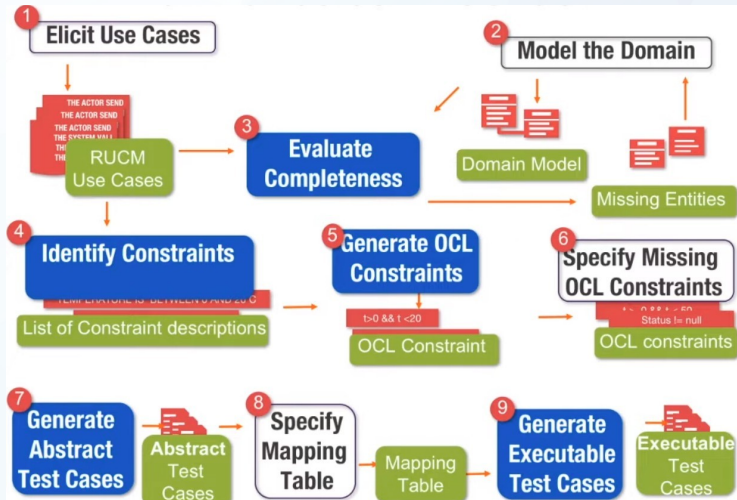
- ▶ Use case preconditions.
- ▶ Postconditions.
- ▶ Conditional steps.

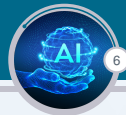


Table: Examples of OCL constraints.

Constraint	OCL Equivalent
The age of a person is not negative	context Person inv: self.age >=0
A Person has 2 parents at max	context Person inv: self.parents->size()<=2
The system sets the occupancy status to empty	BodySense.allinstances()->forAll(i i.occupancyStatus = Occu- pancy::Empty)







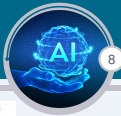
	ID	[RUCM]
UCS-1 BoSe III RUCM - SIMF		
1 UCS: BodySense III AUDI		
1.1 Use Case: Identify	8224	1 UCS: BodySense III AUDI MLB ev0 - Normal operation
1.1.1 Brief Description	8225	1.1 Use Case: Identify Initial Occupancy Status of a Seat
1.1.2 Precondition	8226	1.1.1 Brief Description
1.1.3 Primary Actor	8227	The system identifies the initial occupancy status for airbag control.
1.1.4 Secondary Actor	8228	1.1.2 Precondition
AirbagControlUnit	8229	The system has been initialized.
1.1.5 Dependency	8741	1.1.3 Primary Actor
1.1.6 Generalization	8742	IgnitionResetButton
N/A	8743	1.1.4 Secondary Actors
1.1.7 Basic Flow	8744	AirbagControlUnit, SeatSensor
1.1.8 Specific Alternative	8745	1.1.5 Dependency
1.1.9 Bounded Alternative	8746	INCLUDE USE CASE Self Diagnosis, INCLUDE USE CASE Classify Occupancy Status
1.2 Use Case: Self Diagnosis	8747	1.1.6 Generalization
1.3 Use Case: Classify	8748	N/A
1.3.1 Brief Description	8238	1.1.7 Basic Flow
1.3.2 Precondition	8239	1. The system REQUESTS weight FROM the SeatSensor.
1.3.3 Primary Actor	8240	2. INCLUDE USE CASE Self Diagnosis.
1.3.4 Secondary Actor	8241	3. INCLUDE USE CASE Classify Occupancy Status.
1.3.5 Dependency	8739	4. The system VALIDATES THAT no error is detected.
1.3.6 Generalization	8243	5. The system SENDS the occupant class TO AirbagControlUnit.
1.3.7 Basic Flow	8246	Postcondition: The occupant class has been sent to AirbagControlUnit.
1. The system REQUESTS weight FROM the SeatSensor.	8257	1.1.8 Specific Alternative Flow
2. INCLUDE USE CASE Self Diagnosis.		
3. INCLUDE USE CASE Classify Occupancy Status.		
4. The system VALIDATES THAT no error is detected.		
5. The system SENDS the occupant class TO AirbagControlUnit.		
Postcondition: The occupant class has been sent to AirbagControlUnit.		

Figure: RUCM Use Case Specification in IBM DOORS.



```
22
23
24@= /*
25  *OCLs for guard conditions:
26  */
27-- the weight on seat is above 20 kg
28 inv Weight_On_Seat_Is_Above_20_Kg:BodySenseSystem.allInstances()->forAll(i | i.itsSeatSensor.
29
30-- the temperature is between 0 and 45 c
31 inv Temperature_Is_Between_0_And_45_C:BodySenseSystem.allInstances()->forAll(i | i.itsTemper
32
33-- the SeatSensor is valid
34 inv Seat_Sensor_Is_Valid:BodySenseSystem.allInstances()->forAll(i | i.itsSeatSensor.seatStati
35
36-- the TemperatureSensor is valid
37 inv Temperature_Sensor_Is_Valid:BodySenseSystem.allInstances()->forAll(i | i.itsTemperatureSe
38
39-- the seat is not empty
```

Figure: OCL constraints generated by UMTG.



```
!# CoveredModulePath = /FSE-Demo/Use Case Specifications/UCS-1 BoSe III RUCM - SIMPLIFIED
!# CoveredFlowID = 8238, 8579, 8516
# The system has been initialized.
# The system REQUESTS weight FROM the SeatSensor.
# The system sets MeasurementDeviceError to not detected.
# The system REQUESTS TemperatureSensorStatus FROM the TemperatureSensor.
# [TRUE] The system VALIDATES THAT the TemperatureSensor is valid.
# The system REQUESTS SeatStatus FROM the SeatSensor.
# [TRUE] The system VALIDATES THAT the SeatSensor is valid.
# Postcondition: There is no MeasurementDeviceError detected.
# The system REQUESTS temperature FROM the TemperatureSensor.
# The system sets TemperatureError to not detected.
# [TRUE] The system VALIDATES THAT the temperature is between 0 and 45 c.
# [TRUE] The system VALIDATES THAT the seat is not empty.
# [TRUE] The system VALIDATES THAT the weight on seat is above 20 kg.
# The system sets occupant class to adult.
# Postcondition: The adult occupant class has been derived.
# [TRUE] The system VALIDATES THAT no error is detected.
# The system SENDS the occupant class TO AirbagControlUnit.
# Postcondition: The occupant class has been sent to AirbagControlUnit.
```

```
<SET>    BodySenseSystem.initialized = True
```

```
<INPUT>  SeatSensor.weight = 64
```

```
<INPUT>  TemperatureSensor.TemperatureSensorStatus = HWStatus_Valid
```

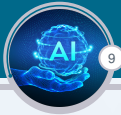
```
<INPUT>  SeatSensor.SeatStatus = HWStatus_Valid
```

```
<CHECK>  There_is_no_MeasurementDeviceError_detected
```

Figure: Abstract test cases.

Workflow

Mapping table



Microsoft Excel - Mapping.csv

File Edit View Insert Format Tools Data Window Help

Type a question for help

100% Arial 10

	D4	Reset Power T = {-f INIT_TIME_AIRBAG}	
	A	Read Occupant Status D1 = {OCC_ADULT}; D2 = A0h; D3 = 80h; D4 = F8h; D5 = 00h	
1	<SET>	BodySenseSystem.initialized = True	Reset Power Time=INIT TIME
2	<INPUT>	SeatSensor.weight = ('d*')	Set BUS Channel = (RELAY_SEAT_WEIGHT); Value = (\$1)
3	<INPUT>	TemperatureSensor.temperature = (-?d*)	Set BUS Channel = (RELAY_TEMPERATURE); Value = (\$1)
4	<CHECK>	(The_adult_occupant_class_has_bee <MERGE>	Reset
5	<MESSAGE>		
6	<MESSAGE>		
7	<MESSAGE>	Control_Request(Service_ID=('w*'))	
8	<INPUT>	TemperatureSensor.TemperatureSensorStatus = HWStatus	Set BUS Channel = (RELAY_TEMPERATURE_SENSOR); Status
9	<SET>	BodySenseSystem.voltage = ('d*')	Set BUS Channel = (RELAY_VOLTAGE); Value = (\$1)
10	<INPUT>	SeatSensor.SeatStatus = HWStatus_Invalid	Set BUS Channel = (RELAY_SEAT_SENSOR); Status = (ERROR
11	<CHECK>	The_VoltageError_has_been_detected	Reset
12	<CHECK>	The_SeatSensorError_has_been_detected	Reset
13	<CHECK>	The_classification_filter_has_been_reset	LIN Read MsgID = 20h D1 = 52h; D2 = 01h; D3 = (DEFAULT_F
14	<CHECK>	The_TemperatureRangeError_has_been_detected	Reset
15	<CHECK>	The_TemperatureSensorError_has_been_detected	Reset
16	<CHECK>	(The_child_occupant_class_has_bee <MERGE>	Reset
17	<CHECK>	(The_empty_occupant_class_has be <MERGE>	Reset
18	<CHECK>	The_error_occupant_class_has_been_sent_to_AirbagControl	Reset
19			
20			

Ready

Figure: Mapping table.



"New Test" current 2.0 (1.0) in /FSE-Demo/System Test Cases (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools User UMTG Help

View/Develop View All level

	ID	New Test Description	Input Values	Expected Value
1 Definitions For Prop				
2 Test Cases				
2.1 Test Case - 0				
2.2 Test Case - 1				
2.3 Test Case - 2				
2.4 Test Case - 3				
2.5 Test Case - 4				
2.6 Test Case - 5				
2.7 Test Case - 6				
2.8 Test Case - 7				
2.9 Test Case - 8	TCC9 546	<SET> BodySenseSystem.initialized = True		
2.10 Test Case - 9	TCC9 547	Reset Power	Time=INIT TIME	
2.11 Test Case - 10	TCC9 548	<INPUT> SeatSensor.weight = 29		
	TCC9 549	Set BUS	Channel = {RELAY_SEAT_W EIGHT} Value = {29}	
	TCC9 550	<INPUT> TemperatureSensor.temperature = 48		
	TCC9 551	Set BUS	Channel = {RELAY_TEMPER ATURE} Value = {48}	
	TCC9 552	<CHECK> The_TemperatureRangeError_has_been_detected		
	TCC9 553	Reset Power	T = {-f TIME_STD_DET_ STARTUP}	

Figure: Test case.



- [1] C. Wang, F. Pastore, A. Goknil, L. C. Briand, and Z. Iqbal, “Umtg: a toolset to automatically generate system test cases from use case specifications,” in *Proceedings of the 2015 10th Joint Meeting on Foundations of Software Engineering*, 2015, pp. 942–945.

