A Tool to generate unit tests

UNICA

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Abstract

The agent-based representation of the economic model is made by a lot of functions that we need to be sure that it are working properly. The smallest function for an agent could be considered the transition function, this function allows the agent to act and to communicate with the others agents. The correct operation of all transition functions is a necessary condition for the correct functioning of the entire system. The best way to test small parts of the system is the unitary test provided with a tool that collect all units in one o more suits and able to run automatically. We present a tool that provide an automatic way to write and run a collection of suites generating code from a collection of a suites, where each suite is described by a specified markup language.

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1 Introduction

1.1 The unit-test generator tool:basics ideas

The agent-based representation of the economic model is made by a lot of functions that we need to be sure that it are working properly. The smallest function for an agent could be considered the transition function, this function allows to the agent acting and communicating with the others agents. The correct operation of all transition functions is a necessary condition for the correct functioning of the entire system. The best way to test small parts of the system is the unitary test provided with a tool that collect all units in one o more suits and able to run automatically. In a system is large it is a good practice to divide the system in modules, which have to be tested with an automatic tool respecting the modular organization. In order to do this specific ...

The rules that is following satisfy the lexical-grammar definition that we have defined before:

2 General description

The automatic tool to run unitary test run a collection of suites, where each suite contain a collection of unitary tests. Each suite is related basically to a module maintaining the preexistent subdivision, but it is possible to build more suites for a single module, for example we can write three suites for the financial market regarding each agents that act in the financial market, so we will have a better subdivision. The set of the suites is collected in a xml file, this file allows to configure the system and group the suites.

2.1 The configuration file

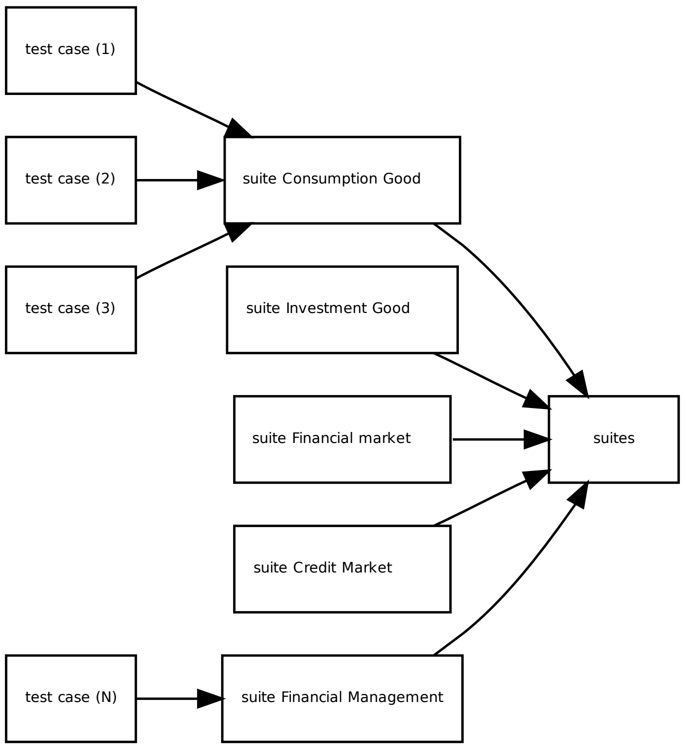
The set of the suites of the entire model are grouped by a configuration file, this file are used to configure the paths of each suite and the path of the model. This file is placed in the top of model in the same folder that contains the model description. The previous code describes the configuration of the testing for the eurace model, it contains two fondamental tags that are following:

- the tag **modelPath**, associate the system of test to the FLAME agent model;
- the tag **suitePath**, it allows to add a new suite associating its path.

2.2 The suite

The suite is described by a file, this file has the extension .xml and has to be placed in the linked module, in the same folder of the associated sub-module. The suite is identified by a name and is characterized by a collection of unitary tests. The agent model is set with a list of constants that need to be specified. The composition and elements of a suite is opened with the tag called **suite** and its specification is characterized by the following tags:

- the tag **name**: this tag specified the suite name, this name must be unique in the system.



```
<suites>
<modelPath>eurace_model.xml</modelPath>
<suitePath>FINANCIAL_UG/suite.xml</suitePath>
<suitePath>Government_GREQAM/suite.xml</suitePath>
<suitePath>Cons_Goods_UNIBI/suite.xml</suitePath>
</suites>
```

Figure 1: the configuration file suites.xml

```
<constants>
<firm_planning_horizon>10</firm_planning_horizon>
<seed>10000</seed>
</constants>
```

Figure 2: the constants definition

- the tag **constants**,this tag contain the values of each costants. We must specify only the constanst that are used in the collection of test-cases, this definition is explained with more details in the next paragraph.
- the tag **unittest**: this tag open the unit-test specification and it could be written more times , each time that we have to define a test-case.

2.2.1 constants

The tag constant permit to open a tree that speciefies the values of the constants which are defined in the related agent model. Moreover, there are a set of contants that can be defined only in the system of test, as an example the the *seed* and the *current_day*. The *seed* is a particular and fondamental constants useful to set the seed of the random number generator. The current_day is the present day of a calendar, this constants is useful because more functions could change depending of the day of the calendar. The constants are defined as the example figure 2.2.1. The example show the value association of two constants , the constants named *firm_planning_horizon* e the constants *seed*.

2.3 The unit test

A unit test is specified with the tag unittest and permit to define a test case. More test-case could be written for a particulare function, writing more fixture in order to fill the greater part of cases. A complete verification of a program or a simple part of a program at any stage in the life cycle can be obtained by performing the test process for every element of the domain. If each instance succeeds, the program is the program is verified; otherwise,an error has been found. This testing method is known as exhaustive testing and is the technique that will guarantee the validity of a program. Unfortunately, this technique is not practical. Frequently, functional domains are infinite, or even if finite, sufficiently large to make the number of required test instances infeasible. In order to reduce this potentially infinite exhaustive testing process to a feasible testing process, we must find criteria for choosing representative elements from the functional domain. The subset of elements chosen for use in a testing process is called a test data set (test set for short). Thus the crux of the testing problem is to find an adequate test set, one large enough to span the domain and yet small enough that the testing process can be performed for each element in the set. The unit test is set by the following items:

- the **name of the test**. This name has to be unique in the system.
- the **name of the transition function** that will has to be tested.

- the name of the owner of the transition function. This part specifies the type of agent (for example Household or Firm) that are subject to the test.
- the **declarative part**. This part is important because it specifies how the assertion parts have to be built .
- the **fixture**.
- the **expected values**.

2.3.1 The declarative part

The declarative part specifies the variables and messages that are subject to assertions. This part is opened with the tag called *declaration* and contains a list of variables and a list of messages. The list of variables The following code shows an example of a typical declarative part:

```
<declaration>
<variables>
 <variable>
     <type>Asset_array</type>
     <name>assetsowned</name>
 </variable>
<variable>
     <type>Order_array</type>
     <name>pendingOrders</name>
 </variable>
</variables>
<messages>
<message>
  <name>order</name>
</message>
</messages>
</declaration>
```

The xml code above shows two variables and a messages that are subject to assertion. The **test_generator** tool generate three types of assertion: the first assertion is related to the *assetsowned*, the second to *pending_orders* and finally the third is related to the *order* message.

2.3.2 The fixture

The fixture is a set of memory variables and input messages, initialized to proper values, used as repeatable input data for the tests. Each time a test case is run, its fixture is reinitialized, because previous tests might have corrupted the fixture, making the test fail not due to errors in the code, but to wrong test data. By defining a fixture, you decide what you will and won't test for. A complete set of tests for a transition function will have many fixtures, each of which will be used by many tests, in many ways. This part is opened with the tag called **fixture** and contains a list of the initialization values of agent's variables and a list of the initialization values of messages. The following code shows an example of a typical fixture part:

```
<fixture>
<Household>
<id>1</id>
<assetsowned>{{1,10,100}}</assetsowned>
<pendingOrders>{{1,50,90,1}}</pendingOrders>
</Household>
<messages>
<order_status>{{1,1,110,1}}</order_status>
</messages>
</fixture>
```

2.3.3 The expected values

A Test Case stimulates a Fixture and checks for expected results. If the tests are unsuccessful, they have to provide helpful information about the kind of error and about his location, the system that launch the test shows a summary of all test belonging from all suite. To this purpose, the framework is endowed with standard checking functions (Checks) able to test Boolean conditions and to report automatically the results and the system state in the case of failure. The checks need an expected state of the agent and the expected output messages. The expected values part is opened with the tag called **expected_states** and contains a list of the expected values of agent's variables and a list of the expected values of output messages. The following code shows an example of a typical fixture part:

```
<expected_states>
<Household>
<id>1</id>
<assetsowned>{{1,10,100}}</assetsowned>
</Household>
</expected_states>
```

The xml code above shows two agent's variables that are the expected state of the Household. The expected_state parts don't contain a list of expected messages because the related transition function don't involve any output message.

3 Quick start guide

Here is a set of steps for setting up and generate C code of unit test and run the test automatically . Details and instructions for a more thorough tour of **test_generator** features, including installing, validating, and using the performance evaluation tools, are given in the following sections.

3.1 Downloading

The first step is to download the test_generator and install any necessary files. It needs the libxml and CUnit library that have to be installed properly, we send to the appendix for more details . The way to get test_generator is to use the repository at the address http://ccpforge.cse.rl.ac.uk/svn/eurace/tests/unit-test. Get the the entire folder unit-test-generator that contain the following files: main_code.c,

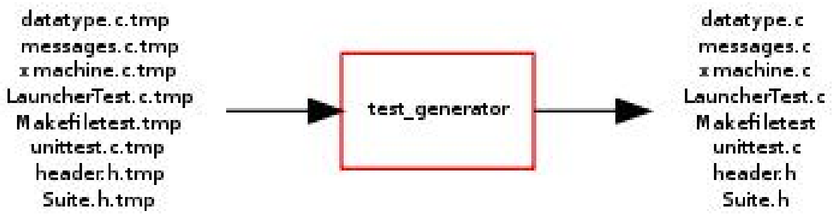


Figure 3: The inputs and outputs of the test_generator

Makekile , datatype.c.tmp , header.h.tmp , Suite.h.tmp, Suite.c.tmp, messages.c.tmp, LauncherTest.c.tmp Now you are ready to build.

3.2 Making

Before you can use **test_generator**, you must make it.
Make test_generator
% make
This may take a while, depending on the load on your system and on your file server, it may take anywhere from a few seconds to an minut or more.

3.3 Generating test case and suite organization

The test_generator are used to generate the code of unit-test using the model's information and the suites's definition. The test_generator produces a platform to launch the agents's transition functions defined for the agents. This aim is reached creating an enviroment and its objects with the same interface builded in the flame project. This enviroment include a pseudo-messageboard and a pseudo-list of agents, and a template for generating type of data and dynamic arrays . The code generated is formed by a set of C code files and a Makefile, the figure 3.3.1 show the test_generator's inputs and outputs. The output files that the test_generator produces are placed in the same folder of the agent model and they need to be compiled.

3.3.1 Compiling the system of unit-test

3.4 Running

Run the system of unit-tests:
% cd ../unit-test/unit-test_generator/
% ./test_generator path_of_model/suites.xml
The directory path identified by the path path_of_model contains the agent model (typically model.xml) and the configuration file suites.xml. At this point you have create the system of test for your agent model that needs to be compiled. This procedure will produce a set of C files and a make files.

3.5 The suite of eurace model test

The Unit test generator distribution contains as an example of its validation the suite related to the eurace model, with more precision the integrated_model1.0, which are located in the same repository. The rules.xml **??** is a simple example which is explained how configure an integrity test.

4 Appendix

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