

Sugar Labs Automated Testing Framework

CSCI 362 Final Project

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A framework presented for the automated testing
of the Sugar Labs software project

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1 Introduction

1.1 Project Description

Sugar Labs¹ is a free, open-source software that aims to increase accessibility and ease of use for classroom-setting technology-based learning. Through the project, the developers hope to provide students with an easy to understand and fun learning environment for both the technological sciences and the basics of elementary education. The code consists of two main parts - a highly interactive and graphics-based front-end supported by a logical, decision-driven back-end that manages user data, journal logs, learning assignments, and all other relevant materials.

While the project's organization follows the software engineering design principle of "separation of powers", dividing up individual tasks among many disjoint pieces of code, the tests associated with each section are neither easily accessible nor comprehensive. This is the problem we aimed to tackle.

1.2 Testing Framework

Through our work, we aim to create an automated testing framework that both highly increases the coverage of unit testing, allowing for the verification and near guarantee of fewer program faults, and allows a user of the Sugar Labs software to be able to easily integrate their tests as well as provide additional testing input for existing test classes.

This document is organized as follows. In Section 2, we thoroughly detail how to properly install the Sugar Labs project, accounting for all necessary software requirements and pre-installation command procedures. Section 3 introduces the testing plan, detailing the specifics of the five principal test cases that serve as an outline for the twenty-five introduced herein. In addition, in this section, we cover various requirements and restraints associated with such an undertaking so as to be prepared for whatever challenges may arise. In Section 4, we provide an architectural description of the automated testing framework, outlining the primary files and folders, as well as discuss in detail the implementation of the five initial test cases as introduced in the previous section. This serves as both a backbone of the testing framework and a guide for any

¹<https://github.com/sugarlabs>

future test cases. In Section 5, we include brief descriptions of the the remaining twenty implemented test cases, omitting the specifics which can be found in the actual implementation and understood alongside those previously characterized. In Section 6, we inject faults into the project code so as to demonstrate the veracity of our framework before concluding with a final review.

2 Deliverable 1: Installation

2.1 Clone and Build

In order to obtain a local instance of the project, we accessed the **sugar** repository made by the **SugarLabs** project team on GitHub². Using the command

```
git clone sugarlabs/sugar,
```

we were, then, able to clone the project to our local machines.

From there, we utilized a document written by the SugarLabs development team included in the root directory, **README.md**, to guide the process of building the project on the operating system we chose to employ, Ubuntu 16.04. This consisted of running the following commands:

```
sudo apt-get install sugar-* -y
aclocal
sudo apt-get install intltool libglib2.0-dev gtk+-3.0 -y
./autogen.sh
make
make install
```

2.2 Existing Tests

SugarLabs provided multiple testing files for ease of use. After finding the files from the root directory, we searched Python’s documentation for **unittest**, the imported package used for running the test cases. Through the use of this documentation, we were able to get most of the files tested with working output, an example of which is shown in Figure 1. The commands we used are as follows:

```
python
>> import unittest
>> import FILENAME
>> x = unittest.TestLoader().loadTestsFromTestCase(FILENAME)
>> unittest.TextTestRunner(verbosity=2).run(x)
```

Most of the tests passed, with only a few errors thrown. However, despite there being such files nicely laid out, there was neither explanation on how the tests are used nor documentation on what is and is not tested.

²<https://github.com/sugarlabs/sugar>

```

test_download (test_downloader.TestDownloader) ... 127.0.0.1 - - [30/Sep/2018
18:43:56] "GET /data/test.txt HTTP/1.1" 200 -
ok
test_download_to_temp (test_downloader.TestDownloader) ... 127.0.0.1 - -
[30/Sep/2018 18:43:57] "GET /data/test.txt HTTP/1.1" 200 -
ok
test_get_size (test_downloader.TestDownloader) ... 127.0.0.1 - - [30/Sep/2018
18:43:57] "HEAD /data/test.txt HTTP/1.1" 200 -
ok

-----
Ran 3 tests in 1.534s

OK
<unittest.runner.TextTestResult run=3 errors=0 failures=0>

```

Figure 1: A run of an included test file, test_downloader.py.

2.3 Team Evaluation

Overall the project is very organized with some help on building the project provided and only a little lacking information on testing what they have made. The developers were prepared for testing everything they needed to have tested, but only for themselves. It would have been more helpful for others looking in if there was a file that would automate the testing or at least more information on how to set up each individual test. We look forward to creating our own tests and exploring in more detail this project.

3 Deliverable 2: Introductory Test Plan

3.1 Testing Process

We have divided the process of our test plan for our five introductory test cases into the evaluation of three main subsystems. They are described as follows:

1. **Profile:** The **profile** subsystem of SugarLabs includes all files relevant to the creation of a user's profile, including the age, gender, etc. This will be evaluated based on input/output matching as well as on exception handling for invalid input.
2. **Journal:** The **journal** subsystem of SugarLabs includes all files relevant for the upkeep of a user's journal. Much like with the first subsystem, this will be evaluated based on input/output matching as well as on exception handling for invalid input.
3. **Activity:** The **activity** subsystem of SugarLabs includes all files relevant to tracking a user profile's assigned activities, essentially providing running assessment list for the user. This will be evaluated based on correctness of logged information with regards to simulated performed actions.

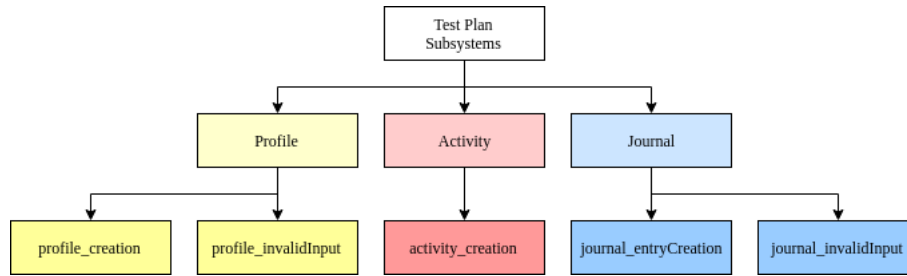


Figure 2: Overview of test plan subsystems and their associated test cases. (made using draw.io)

3.2 Requirements Traceability

For the aforementioned subsystems, the following files will be evaluated. This information is included for the ease of tracking the testing process and the evaluated files as well as the understanding of what processes in specific are being investigated.

1. **Profile:** colorpicker.py, agepicker.py, genderpicker.py for color, age, and gender selection, respectively, in the user profile creation process.
2. **Journal:** journalactivity.py, journalentrybundle.py, journalwindow.py for activity logging, entry bundling, and graphical output, respectively, in the user journal editing and viewing.
3. **Activity:** buddy.py for the activity assignment in the user activity view.

3.3 Tested Items

In this section, we described the specific items mentioned in Section 3.2 and give an in-depth description of how they are to be tested through our framework. Figure 2 shows a visualization of three three general susbsystems and their associated test cases.

3.3.1 Profile

The testing of this subsystem and the respective colorpicker.py, agepicker.py, and genderpicker.py files will begin with the creation of a test_profile.py program with specific test_profile.creation and test_profile.invalidInput functions as test cases. These test cases go as follows:

1. **test_profile.creation:** This function will consist of the selection of a valid color and a gender and the input of a valid age. The test will be passed if profile creation is carried through with according input and without the throwing of an exception.
2. **test_profile.invalidInput:** This function will consist of the input of an invalid color, gender, or age. The test will be passed if profile creation with this input throws an exception.

3.3.2 Journal

The testing of this subsystem and the respective `journalactivity.py`, `journalentry-bundle.py`, and `journalwindow.py` files will begin with the creation of a `test_journal.py` program with specific `test_journal_entryCreation` and `test_journal_invalidInput` functions as test cases. These test cases go as follows:

1. **test_journal_entryCreation:** This function will consist of the opening of the journal entry window followed by the inputting of a valid journal entry name. The test will be passed if profile creation is carried through with according input and without the throwing of an exception.
2. **test_journal_invalidInput:** This function will consist of the opening of the journal entry window followed by the inputting of an invalid journal entry name (special characters, escaped characters, etc.). The test will be passed if profile creation with this input throws an exception.

3.3.3 Activity

The testing of this subsystem and the respective `buddy.py` file will begin with the creation of a `test_activity.py` program with specific `test_activity_creation` function as a test case. These test case goes as follows:

1. **test_activity_creation:** This function will consist of the opening of the creation of a new activity and its assignment to a specific user profile. The test will be passed if activity creation is carried through with according input, assigned to the relevant profile, and without the throwing of an exception.

3.4 Testing Schedule

The tentative schedule for our testing plan has been defined as follows:

- 11/9/2018:** Completion of automated testing framework
- 11/19/2018:** Completion of design and implementation of testing framework; Evaluation of twenty-five test cases
- 11/28/2018:** Completion of code injection of 5 faults; Testing of chosen twenty-five test cases with faulty code.

3.5 Test Recording Procedures

Each of the implemented test cases will be coded in python and run through the terminal as described in the first deliverable. For easy auditing and understanding of previous tests, this code will include the date, time, and current software version with all output automatically being written to a log file for that specific date. These will be aggregated in a **testing** folder in the root directory of this testing framework's project.

3.6 Hardware and Software Requirements

As of the time of this document being written, Sugar Labs requires the local operating system to be either Debian 0.110 or higher, Fedora, or Ubuntu 16.04 or higher. In addition, Python 2.7, the main codebase of the software, must be installed alongside the sugar-artwork, sugar-datastore, and sugar-toolkit-gtk3 packages which can all be obtained directly from the terminal. For building the project, the packages intltool, libglib2.0-dev, and gtk+-3.0 should also be installed on the system.

3.7 Constraints

Though there are not many constraints limiting the testing process of this project, we must plan to be punctual in every step of our testing framework's implementation as required by the general outline of this course. Due to the nature of this project (in it being carried out in an educational setting), we need not worry about budgeting, staff, or weekly meeting presentations, all of which are often necessitated in government or industry settings.

3.8 System Tests

The system tests will primarily consist of checking relevant software installations. The following software, shown with their according verification commands, will be used to check that the system is up-to-date and able to run SugarLabs:

- **Python:** `python -v`
- **intltool:** `intltool --help`
- **autoconf:** `autoconf -h`
- **libglib2.0-dev:** `dpkg --get-selections | grep libglib2.0-dev`
- **gtk+-3.0:** `dpkg --get-selections | grep gtk-3.0`

3.9 Team Evaluation

4 Deliverable 3: Automated Testing Framework

4.1 Architectural Description

The automated testing framework has been subdivided in to following sections for ease of use:

- ↳ **TestAutomation:** Root directory for the automated testing framework
- ↳ **sugar:** Contains the cloned project files for the SugarLabs repository
- ↳ **scripts:** Contains scripts used for running a specific test case and for running all test cases
- ↳ **testCases:** Contains test case input


```

1  # Age Calculator Test Case
2  # This test case is to make sure that the calculate_age method works as intended
3  # Valid input is to be given
4  #
5  # test number: 1.01
6  # component: jarabe.intro.agepicker.py
7  # method: calculate_age
8  # input: birth_timestamp
9  # output: current age based on the birth_timestamp
10 #
11 # input parameters:
12 # first line: date of birth
13 # second line: current age
14 22/06/1997
15 21
16 25/12/1997
17 20
18 10/03/1990
19 28
20 29/05/1978
21 40
22 30/09/2016
23 2

```

Figure 3: Example documentation for testCase input files, allowing users to be able to understand how to modify them as necessary.

↳ **/testCaseExecutables**: Contains the test cases written in python
 ↳ **/temp**: Contains the output.log file where all testing output is piped
 ↳ **/docs**: Contains the README.txt file for the automated testing framework
 ↳ **/reports**: Contains all of the reports associated with the automated testing framework

4.2 Documentation

Each of the test cases have been written and saved to the /TestAutomation/testCaseExecutables folder, with their input files being located in /TestAutomation/testCases as described above. In each of these testCase input files is outlined a brief description of the test case and how one may go about modifying it for their own purposes. An example of such is provided in Figure 3

4.3 Test Case Specifications

For the first step in the implementation of our automate testing framework we wrote and executed five primary test cases. These are specified below.

- age_calculator
 - **Test ID**: 1.01
 - **Test Requirement**: Correlated age input is properly recognized by the system as correct input and subsequently processed.
 - **Test Component**: jarabe.intro.agepicker
 - **Test Method**: calculate_age

- **Test Input:** Input is provided in the form of two-line input, the first being the birthdate of the user and the second the correct age of said user. Input: (22/06/1997, 21), (25/12/1997, 20), (10/03/1990, 28), (29/05/1978, 40), (30/09/2016, 2)
 - **Expected Output:** Output is expected to return True for each of the input test cases, as the calculated age and input age will match. Expected Output: True, True, True, True, True
- age_calculator_invalid
 - **Test ID:** 1.02
 - **Test Requirement:** Noncorrelated age input is properly recognized by the system as incorrect input.
 - **Test Component:** jarabe.intro.agepicker
 - **Test Method:** calculate_age
 - **Test Input:** Input is provided in the form of two-line input, the first being the birthdate of the user and the second the correct age of said user. Input: (22/06/1997, 22), (25/12/1997, 21), (10/03/1990, 29), (29/05/1978, 41), (30/09/2016, 3)
 - **Expected Output:** Output is expected to return False for each of the input test cases, as the calculated age and input age will match. Expected Output: False, False, False, False, False
- buddy_nickname
 - **Test ID:** 2.01
 - **Test Requirement:** A user must be able to set and be returned the nickname of their account's "buddy"
 - **Test Component:** jarabe.model.buddy
 - **Test Method:** set_nick, get_nick
 - **Test Input:** Input is provided in the form of a string, representing the buddy nickname. Input: bigboidan
 - **Expected Output:** Output is expected to return the input string for each of the input test cases, as the set method should properly set the nickname, and the get method should properly return the nickname. Expected Output: bigboidan
- buddy_key
 - **Test ID:** 2.02
 - **Test Requirement:** A user must be able to set and be returned the key of their account's "buddy"
 - **Test Component:** jarabe.model.buddy
 - **Test Method:** set_key, get_key
 - **Test Input:** Input is provided in the form of a two eight-letter codes joined by an underscore, representing the buddy key. Input: DEADBEEF_DEADCODE
 - **Expected Output:** Output is expected to return the input key for each of the input test cases, as the set method should properly set the key, and the get method should properly return the key. Expected Output: DEADBEEF_DEADCODE
- buddy_color

- **Test ID:** 2.03
- **Test Requirement:** A user must be able to set and be returned the color of their account's "buddy"
- **Test Component:** jarabe.model.buddy
- **Test Method:** set_color, get_color
- **Test Input:** Input is provided in the form of a six-digit hex number, representing the buddy color. Input: FF00FF
- **Expected Output:** Output is expected to return the input number for each of the input test cases, as the set method should properly set the color, and the get method should properly return the color. Expected Output: FF00FF

4.4 Team Evaluation

This deliverable was definitely the most challenging task so far for this project. We decided to use python as our scripting language since that is what the project was written in to begin with, making it much easier to interact with the project files the sugarlabs team created. After creating a few test cases, we had some other issues to resolve like redirecting the output from unittests to a file instead of the terminal. Overall we are happy with the framework layout and our ability to create the rest of the test cases moving forward.

5 Deliverable 4: Complete Testing Specifications

5.1 Test Case Specifications

5.2 Team Evaluation

6 Deliverable 5: Testing Fault-Injected Code

6.1 Team Evaluation