Integrating Category-Partition Method with Combinatorial Interaction Testing To Produce T-Way Adequate Test Frames

Andrew Graff

August 17, 2020

1 Introduction

Testing is an important step in the process of creating useful software. Who is going to use or buy your product if it doesnt function according to the specifications? For this reason, there are countless hours dedicated to testing, debugging and maintaining software so that it performs the work expected of it. It can be a challenge to create a sustainable, thorough, and comprehensive test suite that is efficient and effective at testing software.

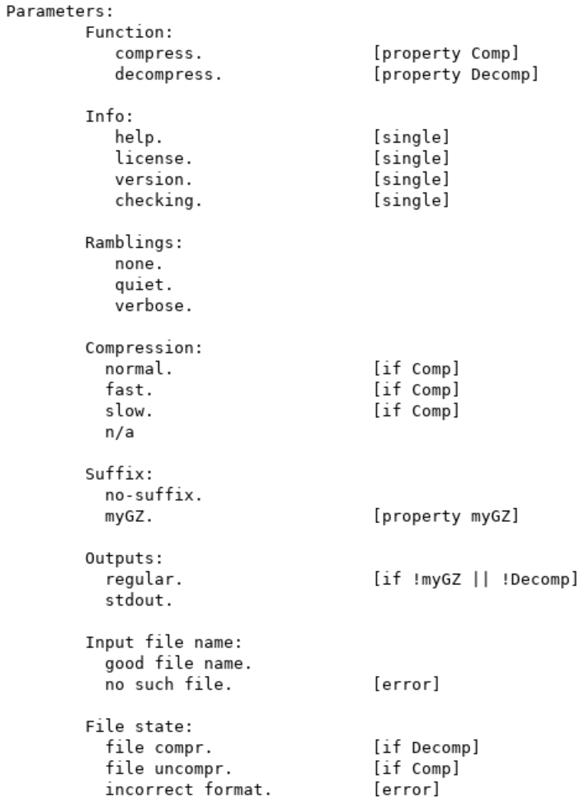
2 Project Statement

Category partitioning is a useful method for breaking up a software system to be tested, and when combined with TSL, can be useful for generating all possible test cases for the given system partition. Similarly, combinatorial interaction testing is useful for defining a subset of tests that satisfy a T-way pairwise interaction using a model and constraints file. These two methodologies and tools are separate pieces of software that require the user to generate the input to both tools. This project takes on the task of combining these two powerful methods and tools so that the user only needs to generate the category partition test specification, and an adequate coverage set of test frames is generated eliminating the need for the engineer to create the model or constraints for the combinatorial interaction testing.

3 Background

This project builds on the work of two teams that have come up with solutions to two different problems. Here we will explain each of those solutions and the tools created to support them.

The *category-partition method* uses formal test specifications to generate test case descriptions. These test case descriptions would then be used to create an executable software test. So how do you generate the formal test specifications? Depending on the size of the software system to test, the engineer may need to break the program up into smaller testable blocks. For the purposes of this project, we will use a simple example of a zip command. The test specification file can be seen in Fig. 1.



```
Parameters:
        Function:
           compress.                  [property Comp]
           decompress.                [property Decomp]

        Info:
           help.                      [single]
           license.                   [single]
           version.                   [single]
           checking.                  [single]

        Ramblings:
           none.
           quiet.
           verbose.

        Compression:
          normal.                     [if Comp]
          fast.                       [if Comp]
          slow.                       [if Comp]
          n/a

        Suffix:
          no-suffix.
          myGZ.                       [property myGZ]

        Outputs:
          regular.                    [if !myGZ || !Decomp]
          stdout.

        Input file name:
          good file name.
          no such file.               [error]

        File state:
          file compr.                 [if Decomp]
          file uncompr.               [if Comp]
          incorrect format.           [error]
```

Figure 1: Category partition input format

Combinatorial Interaction Testing -

4 Preliminary Work

Some preliminary work has been done on this project in order to determine if the work is sufficient for submission. One of the goals of the project is to combine the *tsl* tool with the *casa* tool. Source code was acquired for both tools and some initial study of the code was done. As it turns out, the *tsl* tool is written in basic C. *casa* on the other hand is written in C++. Converting *tsl* to C++ would be beneficial if code is to be combined, so that tool has been updated to compile with the g++ compiler.

Another goal of this project is to require the user to only generate the category partition test specifications, and the adequate coverage set of test frames should be generated. Excluding the contraints file that would be used by *casa* to determine which options can be called with other options, a preliminary working version of *tsl* was coded to output the combinatorial interaction testing model required to generate a set the set of test frames that would be generated with no contraints. In order to achieve this, a new struct was added to *tsl/structs.h* called *container* that keeps track of the list of non-single Choices as a vector of Choice struct pointers. This vector is used to lookup the choices and categories later for printing the test frames. In addition, a *parent* pointer was added to the Choice struct so that the Category information can be referenced when performing the lookup into the Choice* vector.

Rather than output directly all possible test frames, a new function called *make_citmodel()* was written in *tsl/output.c* to write a *.citmodel* file used as an input to *casa*. The function *generator(Flag flags)* was also modified to call *make_citmodel()*, and then make a system call to casa passing in the *.citmodel* file for the input. Then, another function created function called *process_output_file(string filename)* processes the file output by *casa* to generate the test frame final output. Ideally there should be no file io required, but this is a rough draft of the final solution.

Arguably the bulk of the work will be to translate the *properties* and *contraints* defined in the category parition test specifications into the contraints file required by *casa* to properly generate the adequate set of test frames rather than all possible combinations.