Part 2 for CS569 project

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Algorithm Description:

In github [3], Prof. Alex have written an algorithm which utilized random and BFS algorithm. The concept of this algorithm is very concise and but has low efficiency. It created random state and shuffle the execution order of actions, and the do the BFS search.

If size of layers is very large, and so if we want to go deeper in depth, it is rather time consuming. So I make modification of this algorithm: in every layer, we mainly go to visit the sequence of children which has the same parents. By this way, in all visited layers, we have the largest sequence of states which come from the same ancestors. I think the bugs seems to be found more often in this large sequence than others. This idea origin from the Beam search algorithm [2], where k actions are executed rather than all enabled actions are required to be implemented.

Future Improvement:

In the previous work, when the the program is terminated when time is running out or all depth is visited. We only search the largest sequence of states among from the first layer to the last layer by depth. Next time if there is still time left after searching the largest sequence, we can go back to the root and continue to keep track the second largest sequences after we checked the largest one. By this way, the opportunities to find more bugs increase.

In another aspect, coverage based test has been studied in the class. And I have interest in this part and I am considering to add the functions and concept of coverage to this modified algorithm too.

API and SYS Input:

API used in SUT:

newBranches(), allBranches(), backtrack(), enabled(), safely(), reduce(), test(), fails(), failure(), state(), backtrack(), internalReport(), prettyPrintTest()

SYS Input: as the requirement for part 1, we need to put several parameters such as timeout, seed, depth, width, etc as input. This part of work has added to test1.py too

Bugs report:

TSTL(the template scripting testing language) is used to help find bugs in a avlTree library, called avlbug1.py. This library exists bugs. The tstl file called avlefficient.tstl is used here. And this time, tester.py written by authors are implemented.

The first bug is founded in the depth 14 very quickly as follows:

```
DEPTH 14 QUEUE SIZE 33 VISITED SET 5537
Note:: There is a FailureDEPTH
Start Reducing
val0 = 11                                                    # STEP 0
val3 = 8                                                     # STEP 1
avl0 = avl.AVLTree()                                         # STEP 2
avl0.insert(val0)                                            # STEP 3
avl0.insert(val3)                                            # STEP 4
val3 = 10                                                    # STEP 5
avl0.insert(val3)                                            # STEP 6
(<type 'exceptions.AttributeError'>, AttributeError("'NoneType' object has no attribute
'right'",), <traceback object at 0x103b7d680>)
```

There are also other bugs reported, but there bugs are very similar to the above one, so the detail of them are ignored.

Of course, if you used bfsrandom.py instead of tester.1py, you will find the bfsrandom.py works very slowly to go from depth to depth. The improved algorithm can find bugs in TSTL and has higher efficiency than bfsrandom method in reference [3].

Reference:

1) Alex Groce, Jervis Pinto, Pooria Azimi, Pranjal Mittal. TSTL. A Language and Tool for Testing (Demo). ISSTA'15, 2015

2) Alex Groce, Jervis Pinto. A Little Language for Testing. NFM'15, 2015

3) https://github.com/agroce/tstl