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Fuzzy Based White Box Testing Techniques

Vishal Chandra

Affiliated to SGVU, Jaipur, Rajasthan India

Abstract: ***One of the most important parts of any software development is testing the software or software testing. After coding phase testing starts. Software testing is the process or series of process, use to determine that code written in computer language are working as it was designed to do and not anything unintended. There are various types of testing, but they are broadly defined in two categories black box testing and white box testing. This paper used fuzzy theory to check the consistency or acceptability of software. In white box testing we have a full knowledge of code and working of code. Testing team has test cases such that they can observe all codes. Fuzzy theory lies between yes or no. Before this paper testing team either accept or reject the software. But after this paper testing team can determine the degree of acceptation and rejection. Thus there is flexibility in testing methodology. Programmers can rectify their codes. I have given membership function to all types of white box testing. The output will be {not acceptable, marginal acceptable, fully acceptable}.therefor we far away from rigid boundary.I use different white box testing techniques to get the unique output, so that we can justify the test. This paper described the working process of different white box testing technique with integration of fuzzy theory and most frequently used techniques in white box testing are dataflow testing, control flow testing, path testing, branch testing and loop testing with the essence of fuzzy theory.***

Keywords: White box testing, fuzzy theory, fuzzy logic, Data Flow Testing, Control Flow Testing, Loop Testing, Branch Testing.

1. Introduction

Software testing is a set of processes that conducted with the intention of errors finding. It ensures that the proposed or designed system is working according to the specification given by the user or customer. The two mainly and most important goals of software testing are to determinethe system developed according to the customer or user requirement and to dig out bugs or errors. Testing is expensive, laborious expensive and also time consuming task, so the choice of testing method must be so that it is based on the risk to the system. Glassbox testing techniques isthe most important and useful software testing techniques, it is very effective in decision, validating design, finding programming errors, implementation of errors and assumptions in software.

Glass box testing based on of internal workings and structure of software. White box testing is based on idea of how the system is implemented. The some of the advantages of white box testing such reveals error in hidden it helps in removing extra lines of code. The disadvantage of white box testing is, it is very expensive.

Some important types of white box testing are
- Control Flow Testing
- Branch Testing
- Basis Path Testing
- Data Flow Testing
- Loop Testing

Some synonyms of white box testing are
1)Glass box testing
2)Clear box testing
3)Open box testing
4)Transparent box testing
5)Structural testing
6)Logic driven testing
7)Design based testing

Different Forms of White box Testing Techniques are:-

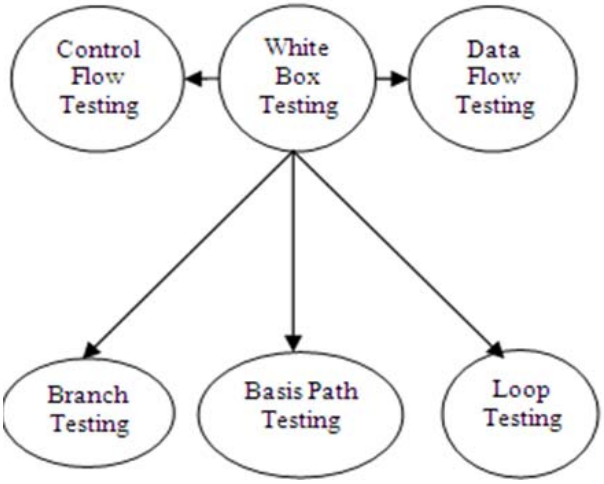

Figure 1: white box testing

Four categories of white box testing techniques are used:
1. Loop testing
2. Branch testing
3. Data flow testing
4. Control flow testing

1.1 Loop Testing

Loop testing is one of the types of white box testing which mainly focuses on the validity of loop. Loops are simple to test until and unless dependencies between loops exist between the loops or among the loop and the code it contain. There are four categories of loops
1. Simple Loop
2. Nested Loop
3. Concatenated Loop
4. Unstructured Loop

Loop testing is depend upon loop travelling. For loop testing there are three membership functions.
{Few loop, more loop, all loops}

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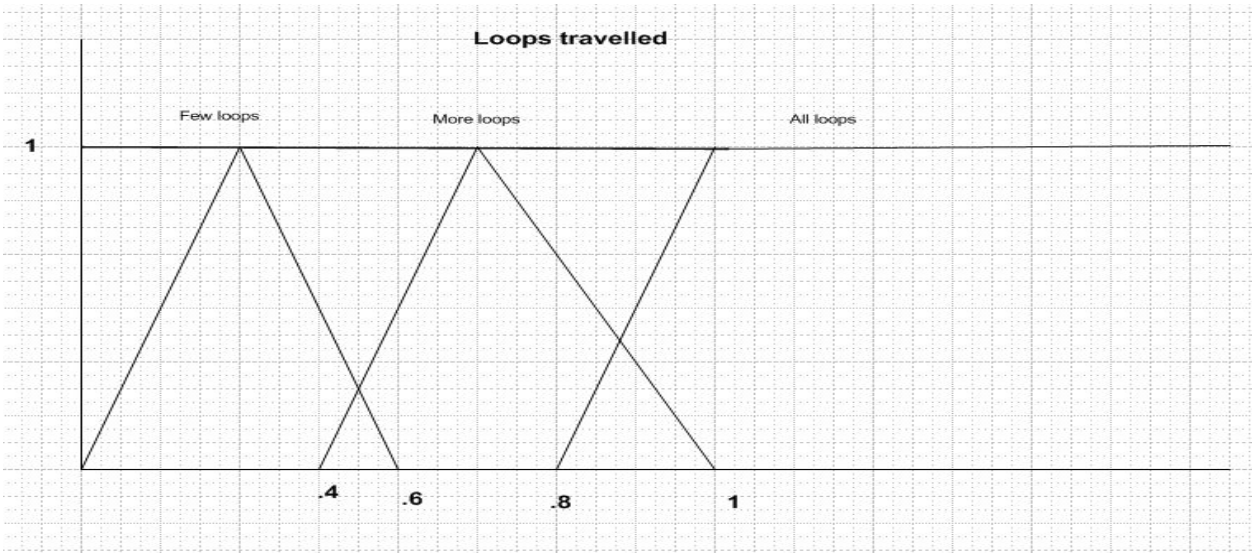

Figure 2: Loop Testing

Given graph shows if loop travelled is between 0 – 60 percent then it is few loops are travelled if it is 40-100 is more loops are travelled and if 80 and more is all loops travelled.

1.2 Branch Testing

One of the other type of testing is branch testing. It is also known as decision testing and condition testing. they comes under white box testing. it ensure us that outcome from the condition is tested at least once. Branch testing has objective to test every true and false condition over statement which also includes compound condition.

Fuzzy branch testing
it has membership functions are as follows
Few condition = few branches
More condition = more branches
All condition =all branches fig 3.
Linguistic variables {few branches, more branches, all branches}

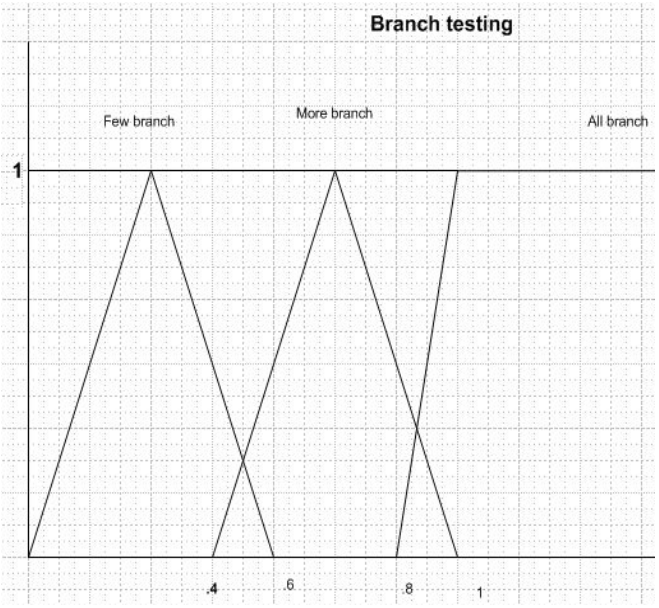

Figure 3: Branch testing

Simplified Dataflow Diagram

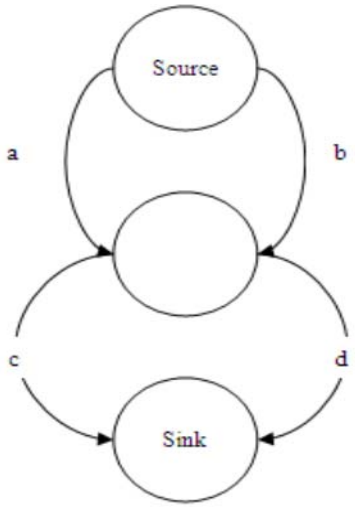

Figure 4: Data flow diagram

Here branches shows conditions if it is between 0-60% then few branchif 40 – 80 more if more branch than 100 then it is all branches

1.3 Data Flow Testing

Data flow testing is one of the important parts of white box testing which gives the idea of how data flow in the program. To show data flow testing we need data flow diagram. Data flow testing takes enough paths to assure that:

1) Each and Every data object must have been initialized before its use.
2) All objects have been used at least once.

Some of the important points of data flow testing are:

1) All the data flow anomalies must be resolved.
2) To avoid integration problems by doing all data flow operation on a variable within the same routine.
3) When possible use explicit declaration of data.

Data flow testing linguistic variables {few objects, more objects, all objects}

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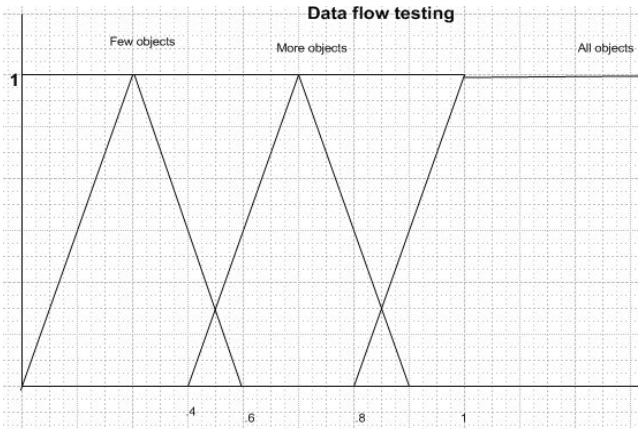

Figure 5: Data flow testing

1.4 Control flow testing

One of the white box testing technique to find bug is control flow testing. Control flow testing applies to all software and is effective for any software. Earlier Researches shows that control flow testing detect about 50% of all bugs during unit testing. Control flow testing is more effective for unstructured code. Most bugs can result in control flow errors. The adequacy of the test cases measured with a metric called coverage. Now, we will define various coverage methods:

1. Statement coverage
2. Branch coverage
3. Condition coverage

1.4.1 Statement Coverage

It is a measurement of the percentage of statements which have been executed by test cases during testing. Anything less than 100% statement coverage means that not all lines of code have been executed. We can determine statement coverage by identifying cyclomatic number an executing this minimum set of test cases. Linguistic variables of statement coverage {few statement, many statement, all statement}

1.4.2 Branch Coverage

The most strong logical coverage criterion is known as branch coverage or decision coverage. It is a measurement of the percentage of the decision point at which program have been evaluated as either true or false in test cases during testing.

Linguistic variables are { few branch, more branch, all branch}

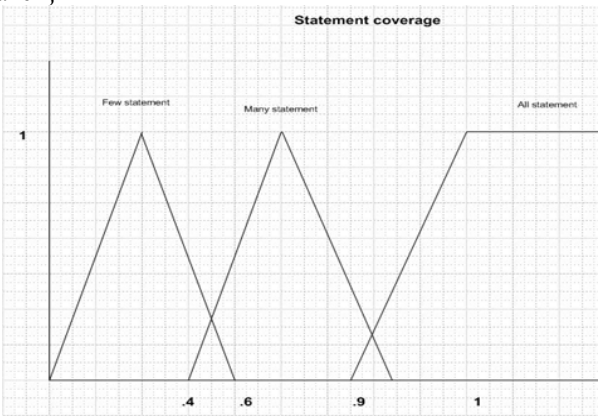

Figure 6: Statement Coverage

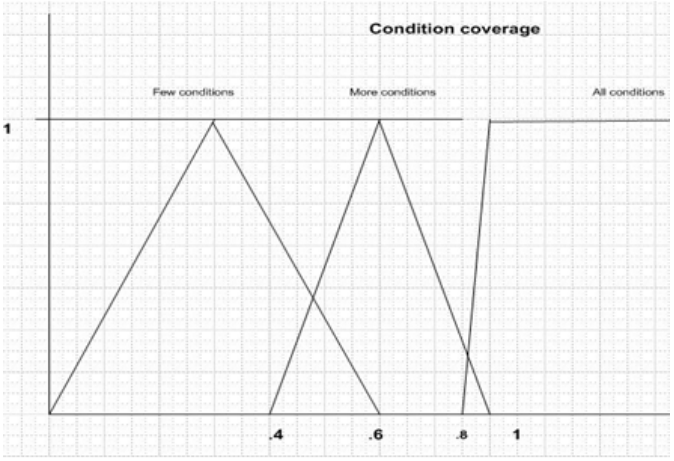

Figure 7: Condition Coverage

1.4.3 Condition coverage

A criterion which is stronger than decision coverage is condition coverage. It is a measure of percentage of crisp sub-expressions for the program that have been measured as both true and false outcome in test cases.

2. Conclusion

On the basis of this paper it is conclude that we can use fuzzy theory in software testing. It also shows the flexibility of testing methods. It shows the degree of acceptability of testing of software. All white box techniques are same as it is but by this paper I added the feature of fuzzy. This paper makes testing automated. It makes testing realistic as human thinks between two rigid boundary of yes and no or 1 and 0

3. Future Scopes

I have written this paper vary few number of white box testing techniques. It might be possible that we can add some more techniques. There are various factors which affect Glass box testing. Glass box testing is done by human not by computer. Using this paper we can make it automated. In future this type of testing is use to get more flexible result. With the help of this testing mechanism will be easy and flexible.

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Author Profile

Vishal Chandra has done B. Tech (CSE) and he is Pursuing M. Tech in artificial intelligence

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