

CS1699 - Lecture 4 - Test Plans

FizzBuzz

FizzBuzz
Project Details
The fizzbuzz problem is a popular integral part of many introductory computer science courses. It's the first step in teaching the concepts of loops, conditionals, and functions. In this exercise, you will implement the classic fizzbuzz problem in Python. You will need to print the numbers from 1 to 100, separated by newlines. Instead of printing the number, if it is divisible by 3, instead print "Fizz". If it is divisible by 5, instead print "Buzz". If it is divisible by both 3 and 5, print "FizzBuzz".

Example Output
1
2
Fizz
4
Buzz
Fizz
7
8
Fizz
Buzz
...

Soft Error with a Test Plan
Project Details
This project is about testing soft errors. A soft error is a temporary fault that can occur in a system, such as a memory chip or a power supply. These errors can cause the system to crash or behave unexpectedly. Your task is to write a test plan for a system that is prone to soft errors. The test plan should include a variety of tests to detect different types of soft errors, such as memory corruption, power fluctuations, and temperature changes.

Test Cases / Runs / Plans / Suites



Developing a Test Plan

So you have requirements...
how do you test them?

Think About What You're Testing
1. Throw-away script?
2. Development tool?
3. Internal website?
4. Enterprise software?
5. Operating system?
6. Avionics software?

Your test plan should flow from the functional requirements through the non-functional requirements.

Example
System shall fail gracefully.
This will mean something very different for an MRI machine and a website.

The Seven Testing Principles
1. Testing shows presence of defects.
2. Exhaustive testing is impossible.
3. Testing is context-dependent.
4. Defects cluster.
5. Avoid the "pesticide paradox".
6. Testing is expensive dependent.
7. Planning prevents surprises.

Testing Shows Presence of Defects
You can never really "prove" software is free of defects.
Absence of evidence IS NOT evidence of absence.
"You there are "normally" present bugs in software, like a hole in a vehicle other rabbit hole to go down, and this concept is going to come up for maybe 1% of testers."

Testing Can Never Show All Defects or Possible Failure Cases
1. What if an estimator destroys the entire surface with flaws?
2. Will system work correctly under 100% Test of instructions?
3. What happens when memory fails at instruction 1, 2, 3, etc?
4. Concurrency and parallelism?
5. What if the value of pi was slightly shifted in our Universe, would program work correctly?

Exhaustive Testing is Impossible
Could you prove a spellchecker could work with every possible input?
Early Testing
It is always, always, always better to discover a problem sooner rather than later.
Report early, report often.
Don't wait to test.

Defect Clustering
Defects tend to cluster in certain areas of code or functionality.
Usually due to technical difficulty of implementing bad requirements, etc.
If you find many errors in one module, don't assume that others are "bad". (Garfield's Fallacy)

Pesticide Paradox
If you keep testing over and over with the same test plan, you'll only ever find bugs in that test plan.
You will need to test other aspects of the system and revise the test plan.

Testing is Context-Dependent
How much you test
What tools you use
What documentation you provide...
All very based on software context.

Absence of Errors Fallacy
Let's say we prove the fully tested and working software is going to be a masterpiece.
Or else we say we actually wanted a masterpiece and have (specific) nice vs. ridiculous.

Verification vs Validation
Verification - "Are we building the software right?"
Validation - "Are we building the right software?"

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Buzz
Fizz
7
8
Fizz
Buzz
11
Fizz
13
14
FizzBuzz
16
17
Fizz
19
Buzz
21
Fizz
23
24
FizzBuzz
26
27
Fizz
29
Buzz
31
Fizz
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Fizz
73
74
FizzBuzz
76
77
Fizz
79
Buzz
81
Fizz
83
84
FizzBuzz
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Absence of Errors Fallacy
Let's say we write a fully tested and working program to do a task.
Or worse, we actually wanted a functionality we have (specific) after we coded it.

Verification vs Validation
Verification - "Are we building the software right?"
Validation - "Are we building the right software?"

FizzBuzz

FizzBuzz Requirements

1. The function shall accept one argument, a positive integer.
2. If argument is not a positive integer, do not print anything.
3. The function shall print the numbers from 1 to n, where n is the argument passed in, separated by newlines.
4. The output shall be appropriate to the system, with the exceptions enumerated in requirements 3, 4, and 5.
3. If the current number being printed is evenly divisible by 3 print "Fizz".
4. If the current number being printed is evenly divisible by 5 print "Buzz".
5. If the current number being printed is evenly divisible by 3, but not evenly divisible by 5, print "Fizz".
5. If the current number being printed is evenly divisible by 5, but not evenly divisible by 3, print "Buzz".

Example Output

```
1  
2  
Fizz  
4  
Buzz  
7  
8  
Fizz  
Buzz  
11  
Fizz  
13  
14  
FizzBuzz  
16
```

Let's...

So you have requirements...
how do you test them?

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-ISQTB (International Software Quality Testing Board)
Foundational Syllabus

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1. What if an asteroid destroys the crust of our planet, bathing the entire surface with lava?
2. Will system work correctly under 100 Tesla of magnetism?
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Testing is Context-Dependent

How you test
How much you test
What tools you use
What documentation you provide...

All vary based on software context.

Absence of Errors Fallacy

Let's say we gave our fully tested and vetted FizzBuzz implementation to a customer.

Customer says he actually wanted a hamburger and fries (verification vs validation).

FINDING DEFECTS DOESN'T HELP IF IT'S NOT WHAT THE USER WANTS!

Verification vs Validation

Verification - "Are we building the software right?"

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Test Cases / Runs / Plans / Suites

Test Cases

A test case is the lowest level of a test plan.
It consists of:
1. Input values
2. Other preconditions
3. Execution steps (or Procedure)
4. Output values
5. Other postconditions

See IEEE 829, "Standard for Software Test Documentation", for more details

Example

Assuming an empty shopping cart, when I click "Buy Widget", the number of widgets in the shopping cart becomes one.

Preconditions: Empty shopping cart
Execution Steps: Click "Buy Widget"
Postconditions: Shopping cart displays one widget

Example

Assuming that the SORT_ASCENDING flag is set, calling the sort method with [9,3,4,2] will return a new array sorted from high to low, i.e., [2,3,4,9].

Precondition: SORT_ASCENDING flag is set
Input values: [9,3,4,2]
Execution steps: Call sort method
Output values: [2,3,4,9]

Test Plan

A group of test cases makes up a test plan. These are usually associated functionally or in other ways.

Examples:
Database Connectivity Test Plan
Pop-up Warning Test Plan
Calculator Subsystem Test Plan
Pressure Safety Lock Test Plan
Regression Test Plan

Pressure Safety Lock Test Plan

LOW-PRESSURE-TEST
HIGH-PRESSURE-TEST
SAFETY-LIGHT-TEST
SAFETY-LIGHT-OFF-TEST
RESET-SWITCH2-TEST
RESET-SWITCH3-TEST
PULSE-MOTOR-TEST
RAPID-CHANGE-TEST
GRADUAL-CHANGE-TEST
MEDIAN-PRESSURE-TEST
LIGHT-FAILURE-TEST
SENSOR-FAILURE-TEST
SENSOR-INVALID-TEST

A Group of Test Plans is a Test Suite

Regression Test Suite

Pressure Regulation Regression Test Plan
Power Regulation Regression Test Plan
Water Flow Regression Test Plan
Control Flow Test Plan
Security Regression Test Plan
Secondary Safety Process Test Plan

Test Run

The actual execution of a test plan or suite.

During this execution, the status of each test case is recorded. Possible statuses include:

PASSED FAILED PAUSED
RUNNING BLOCKED ERROR

PASSED - The test case met all postconditions and expected values. No other problems were observed (e.g., test met all postconditions, but screen turned fuchsia afterwards).

FAILED - The test case did not meet one or more postconditions or expected values, or an unexpected problem occurred.

PAUSED - The test started, but is not complete due to internal factors (e.g., the tester went to lunch).

RUNNING - The test is currently executing. This is useful for long-running background tests.

BLOCKED - The test cannot proceed due to external factors (e.g., waiting for a machine to be available).

ERROR - There is a problem with the test itself. For example, it says "Output should be sorted, returning [1,9,7,2,3]". The test could also not meet requirements. In this case, the tester should discuss with the relevant systems engineer, test writer, or requirements analyst.

If a test fails, a DEFECT should be filed.

Note that this need not be official; if you're doing preliminary testing, it may be sufficient to just talk to the developer.

Developing A Test Plan or Suite

Start top-down: what is a good way to subdivide the system into features (test plans)?

For a given feature (test plan), what aspects do I want to test?

For each aspect, what test cases do I want that will hit different equivalence classes / success or failure cases / edge or corner cases / etc.? How deep should I go down?

Try to have test cases be independent of each other, and reproducible!

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2. The function shall print the numbers from 1 to n, where n is the argument to the function, separated by newlines appropriate to the system, with the exceptions enumerated in requirements 3, 4, and 5.
3. If the current number being printed is evenly divisible by 3 and 5, instead of printing the number, print "FizzBuzz".
4. If the current number being printed is evenly divisible by 3, but not evenly divisible by 5, print "Fizz".
5. If the current number being printed is evenly divisible by 5, but not evenly divisible by 3, print "Buzz".

Argument: 20

1

2

Fizz

4

Buzz

Fizz

7

8

Fizz

Buzz

11

Fizz

13

14

FizzBuzz

16

Example Output

Let's Come up with a Test Plan!

Equivalence Classes?

Boundary Values?

Base case?

Success vs Failure Cases?

Edge cases, Corner/Pathological cases?

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4
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Fizz
7
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Fizz
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Fizz
13
14
FizzBuzz
16
17
Fizz
19
Buzz
21
Fizz
23
24
FizzBuzz
26
27
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