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Research paper

A Survey Paper on Modern Online Cloud-Based Programming Platforms

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Abstract

Coding has more significance in any domain and there is availability of a variety of online cloud-based programming platforms. Programming involves several phases such as requirements identification, design solution, coding and testing. The main aim of any program is, it must meet the user requirements. Once programming is completed, the program must test against the user requirements. Hence there is need to understand and develop various test cases against user requirements specification to test the program. This paper gives an overview on how to identify, understand and resolve enforced test cases in programming over modern cloud-based compilers such as hackerrank, hacker earth, codechef etc.

Keywords:*user requirements, cloud base compilers, online programming platforms, design of test cases, enforcing test cases in to program..*

1. Introduction

Currently internet services have become an important and recent developments in technology make available the Cloud computing everywhere through internet. In early days the task of programming did on offline computers where there is need to install required infrastructure and computing resources such as editors, compilers etc. Because of cloud computing all computing resources are available as software as service, platform as service and infrastructure as service [1] So, it is convenient to programming on any platform with out using a specific configured system. Modern cloud based compilers enable to do programming on any machine irrespective of its configuration. Programming is a method that primes from an original design of mathematical model to executable computer programs. Software development involves activities such as analysis, developing understanding, generating algorithms, verification of requirements of algorithms including their correctness, and resource usage and execution of algorithms in a programming language. While coding most coders follow an edit-compile-test cycle [2]. This cycle occurs in IDEs. To keep with the large and quickly evolving code base and high levels of reprocess coders practice a cloud-based build system. Writing code for any problem involves understand of problem statement, understanding constraints and framing a solution. In this regard this survey paper discusses about the programming task on various cloud based compilers by considering some of already existing programming platforms. The main challenge while programming on modern online programming platforms is to meet the given constraints by resolving various test cases. Usually test cases are used to automated evaluation of code. The general criteria involved in programming over online platforms is first problem statement need to read, after reading the problem statement the programmer has given sample input and the resulting expected output.

The test cases are mainly classified as formal test cases [5] and informal test cases [5]. Formal test cases are employed to test that all the requirements of software are met and are branded by an input and by an expected output. Regularly there are two test cases for each requirement one is positive and another one is negative. Informal test cases are used to test complexity involved in program and used to evaluate the complexity during the execution of the program. These test cases are not written but activities and results are stated after test have been run and these test cases are design without using formal requirements. Besides user input, output and formal requirements two more important constraints in programming are amount of memory and amount of time required to complete the execution of programs such as space complexity and time complexity. A problem may have more than one solution hence there is need to choose the best one to solve the problem by comparing the performance of solution in terms of time and space complexity. Even modern cloud-based programming platforms are also not exception to this. The execution time of any solution depends on the size of the input is known as order of growth [6]. Order of growth is very useful to compute the running time of a solution. There are different notations to represent the order of growth. These notations are known as asymptotic notations.

O-Notation: It denotes upper limit. For a given function g(n), we denote by O(g(n))) the set of functions: O(g(n))= { f(n): there exist positive constants c and n_0 such that $0 \leq f(n) \leq c * g(n)$ for all $n \geq n0$ }.

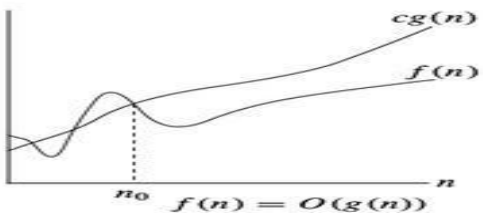


Fig.1: Big O notation

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Ω-Notation: It denotes lower limit. For a given function g(n), we denote by Ω(g(n)) the set of functions: Ω(g(n)) = { f(n): there exist positive constants c and n_0 such that $0 \le c * g(n) \le f(n)$ for all $n \ge n_0$ }

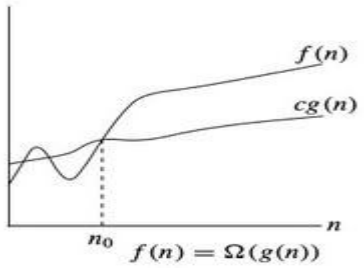


Fig.2: Big omega notation

Θ-Notation: It denotes tight bound. For a given function g(n), we denote by Θ(g(n)) the set of functions: Θ(g(n))= { f(n) : there exist positive constants c_1,c_2 and n_0 such that $0 \le c_1 * g(n) \le f(n) \le c_2 * g(n)$ for all $n>n_0$ }

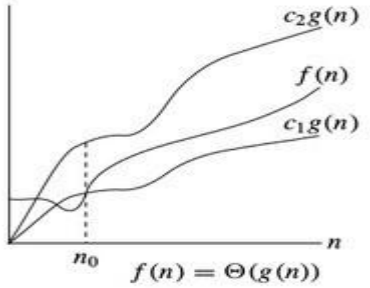


Fig.3: Theta notation

This paper lets an overview on programming and understanding the test cases over the modern cloud-based programming platforms. In further sections each section gives outline of programming task on variety of platforms such as hackers rank, hackers earth, code chef etc.

2. Hacker Rank

Hacker Rank [7] is one of the most popular cloud based an online platform, where programmers throughout the world come together to solve problems in a wide range of computer science domain such as algorithms, machine learning, artificial intelligence, as well as to practice various programming paradigms like structural programming, object-oriented programming and functional programming [4]. Through this platform one can learn programming, earn by programming, create challenges, and create contests. The challenges cover a wide range of domains such as Algorithms, data structures, programming languages such as C, C++, Java etc., databases and cryptography and security. All the challenges in this platform are debugged and tested against variety of test cases. A test case is a set of conditions on variables under which a tester will judge whether a program is success or not. These test cases are either simple test cases or hidden test cases. So that the programming in this platform can also called as test case driven programming [8]. For every challenge problem statement need to understand and then start writing code. The problem statement followed by sample input and output. it doesn't mean that given inputs and output will solve all the test cases. Ones the code has been written, it need to test against all the test cases. All test cases may or may not reveal in the problem statement itself. There may be some hidden test cases which require some out of box thinking about the problem. When run the code against hidden test cases, depending on the output generated by code it will result the following judgements.

Accepted: When the code passed all the test cases. Executed successfully.



Fig.4: Accepted status.

Wrong Answer: When the output produced by code did not match the expected output. Then there is need to rethink about the solution because the solution approach may not fit to challenge.



Fig.5 : Wrong Answer status

Terminated due to time out: When code doesn't solve problem efficiently in stipulated period. For example, when the written solution is $O(2^n)$ when n=100, it will surely timeout so that there is need to optimize the algorithm.

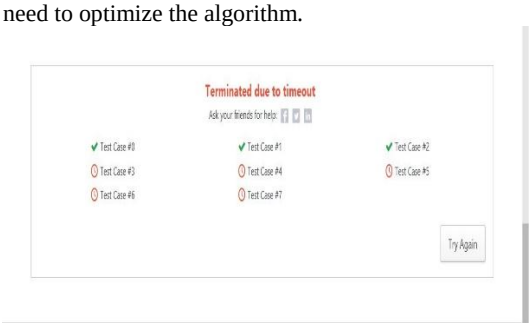


Fig.6: Terminated due to time out

Compile Time Error: When there is syntactical error in code, it will result compile time error.

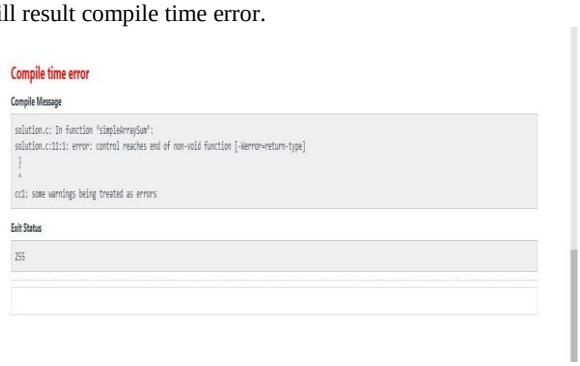


Fig.7: compile time error

Runtime error: If the code terminated unexpectedly, attempt to divide by zero. Then code must re-examine and avoid conditional statements that causes run time errors.

Segmentation Fault: When code is running overrun the memory or not enough memory is allocated. Then there is need to examine the variable declarations and their sizes that are equal to given input and outputs.

Abort called: When code is using maximum resources, may be large amount of memory used exceeds the memory limit. Then code must modify to reduce the usage of resources.

3. Hacker Earth

Hacker Earth [9], which conduct coding challenges for coders that help to identify good talent, will compete with 19 other start-ups throughout the world. It is a competitive programming platform which support over 32 programming languages include c, c++, java, etc.. and it was developed by Like hackerrank, hacker earth is also a cloud based online programming platform on which people throughout the world together can solve the problems from different domains such programming, data structures, machine learning and etc. Hacker earth compiler works in Linux environment so whenever code didn't pass test case it will generate the following signals as runtime errors.

SIGSEGV: This is the most common runtime error may be caused by an out of scope array index, buffer overflow and incorrectly initialized pointer.

SIGXFSZ: When output limit exceeds hacker earth compiler returns this status signal

SIGFPE: This status signal will generate by hacker earth compiler due to floating point error or attempt to divide by zero.

SIGABRT: This status signal will produce when ever program abnormally terminate due to insufficient resources such as not availability of enough memory.

NZEC: This signal means program return a value different from 0 i.e it will happen due forgot to write return 0.

MLE: This signal generate when the program trying to allocate memory beyond the indicated size.

Wrong Answer: When the code did not give expected output, this compile produces this message. Then there is need to understand input and output of program and modify the code according to that.

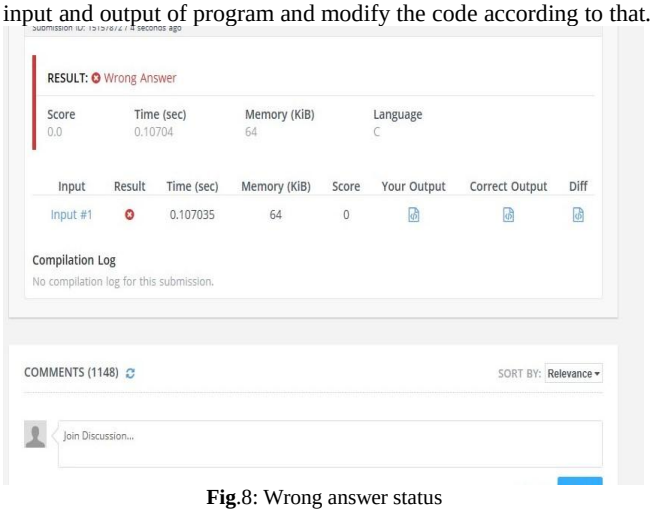


Fig.8: Wrong answer status

To resolve above mentioned errors, one can use the following set of rules that can guide to minimise the runtime errors.

1. Make sure that we are not using variables that have not been initialized.
2. Check every single occurrence of accessing an array element see if it could possible out of bounds.
3. Make sure we are not declaring too much of memory.
4. Make sure we are not declaring too much of stack memory.

4. Code Chef

Codechef is ne of the most popular platform to help programmers to solve and practice variety of problems from different domains such as algorithms and computer programming and participate in contests. Program should read from and write to standard output. After submitting a solution codechef IDE will give below possible results [10]:

1. **Accepted**: If code ran successfully and gave expected output. If there is a score for the problem, this will be displayed in parenthesis next to the checkmark.
2. **Time Limit Exceeded**: If code was compiled successfully, but it didn't stop before time limit. Try optimizing solution approach.
3. **Wrong answer**: If code compiled and ran successfully but the output did not match with expected output. Then there is need to change solution approach.
4. **Runtime Error**: If code compiled and ran but encountered an error. The most common reasons are using too much memory or dividing by zero. Then there is need to change conditional statements in the code.
5. **Compilation Error**: If there are syntactical mistakes in code, it will return compilation error. Then there is need to check and modify the syntax of the statements.

5. Conclusion

The main moto of this article is to give an outline about the programming over online cloud-based compilers by resolving test cases. This article was prepared by working on above discussed platforms. In addition to above mentioned cloud-based programming platforms few more also available due to limitations we could not cover all of them. Due to availability of this kind of cloud-based programming platforms, one need not to buy and install different programming language compilers explicitly but can use them as software as service.

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