Green DRCT:
Measuring Energy Consumption of an Enhanced Branch Coverage and Modified Condition/Decision Coverage Technique

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ABSTRACT

Being a good software testing engineer, one should have the responsibility towards environment sustainability. By using green principles and regulations, we can perform Green Software Testing. In this paper, we present a new approach to enhance Branch Coverage and Modified Condition/Decision Coverage uses concolic testing. We have proposed a novel transformation technique to improve these code coverage metrics. We have named this new transformation method Double Refined Code Transformer (DRCT). Then, using JouleMeter, we compute the power consumption and energy consumption in this testing process. We have developed a tool named Green-DRCT to measure energy consumption while performing the testing process.

KEYWORDS
Branch Coverage, Concolic Testing, Energy Consumption, MC/DC, Power Consumption

INTRODUCTION

As we know that a computer system is so essential for this current time. We may observe, that we nowadays, most of our regular jobs are dependent on computer software and hardware. However, the real disadvantage of using computer software and hardware is nothing but attracting dangerous diseases like cancer.

We know that computer system is made up of very hazardous chemical hazardous material. While using this machine system many harmful rays/gasses are emitting that pollute the environment and affect the users as well as the other peoples present in the surrounding. These harmful emissions of gasses from the monitor, CPU, and UPS cause cancer disease. If we consider a single user with the single computer system, then it may not be a big issue, but if we, find the large scale of information technology systems used by large organizations in the major cities of a country then it is a big issue which needs attention.

India is a developing country with high growth rate. India is moving towards urbanization from rural life. For these computer systems, the Internet play a major role in development. However, while
developing the country, we are facing some difficulties. The big issue is the pollution in the country. Recently, India crossed the threshold value of the contamination level, which harms the society. India is having some major cities, such as New Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Pune, and Nagpur, etc. Recently, according to the report of the Government of India, these have cities faced many problems with the pollution. We agree that this pollution caused in major by traffic, industries, and factories, etc. However, in addition to these reasons, we may observe a new and different angle of pollution level i.e. Use of computer systems. Let us, consider these cities of India only, and think for a while that approximately one out of four persons is using mobile devices and computer systems personally. Now, imagine the total population of a single city. According to our consideration of eight cities, we can increase the above calculating by eight times. Apart from this, just consider all schools, institutes, universities, government organizations, non-IT firm, etc.: The use of computer system in these groups also support to pollute the environment. Now come to IT-firms where the system of equipment is essential, and these eight cities of India are having a significant number of small to large IT firms which develop software, which again causes the pollution of the environment. If we think to reduce the number of computer systems to use, that may not be a suitable and recommendable decision. Therefore, we should go for Green computing (Kimbarhune, 2010; Suryavasnhi, & Narkhede, 2015; Panda, & Jana, 2014; Panda, & Jana, 2016; Panda, & Jana, 2017). We can conserve the energy and can reduce the carbon footprints by following the Green principles.

Since, we are software testing engineers, so, we contribute by applying Green principles of software testing techniques. We know that software testing is one of the critical phase of the software development life cycle (SDLC). Software testing can be done in two ways: 1) Manual software testing 2) Automated software testing. Since manual software testing is time consuming and not feasible for large software system, so we have moved towards automated testing techniques. Concolic testing is an automated way of software testing. There are two types of software testing methodologies: 1) White - box testing 2) Black – box testing. All the structural coverage criteria are coming under white box testing. Structural coverage testing consists of line coverage (LC), branch coverage (BC), path coverage (PC), modified condition / decision coverage (MC/DC) and multiple condition coverage (MCC). In this all criteria multiple condition coverage (MCC) is the strongest one. In our proposed approach we have chosen to modified condition decision coverage (MC/DC) testing, which are mostly redundant while in modified condition decision coverage (MC/DC) testing it requires only (n+1) number of test cases (linear number of test cases). In the practical issues and large systems, exponential number of test case generation is not suggestible.

Naumann et al. (2011) proposed a conceptual reference model known as “GREENSOFT MODEL” for better understanding and usage of Green Software development. This reference model contains the complete software development life cycle, sustainable software engineering extension, sustainability metrics, criteria for sound software growth, design and development. The main objective of this reference “GREENSOFT MODEL” is to provide support to the software users, software administrators and software developers in an efficient way while using, maintaining and creating the software.

The reference “GREENSOFT” model shown in Figure 1 contains the complete life cycle of software products. This reference model is in contrast to the traditional methodology of software development, gears up to software development life cycle thinking (abbr. SDLCT). It has the motto of “from cradle to grave”. Life Cycle Thinking (LCT) has the objective to assess the human, social, ecological and economic compatibility of a product during its whole development life cycle time duration. The process starts with the very beginning of the software product development and end with the disposal and recycling of the product. The findings that are gained from these assessments
A Web Database IR-PDB for Sequence Repeats of Proteins in the Protein Data Bank
www.igi-global.com/article/a-web-database-ir-pdb-for-sequence-repeats-of-proteins-in-the-protein-data-bank/190790?camid=4v1a

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