Chapter 1
Modeling as a Research Approach in Computing

ABSTRACT

This chapter is an introduction in the field of system investigation with presenting basic directions used in the computing filed as benchmark, modelling and measuring (monitoring). A brief discussion of features and capabilities for each approach without going into depth is presented to determine the place of modeling in the sphere of methods and tools for investigation and evaluation of computer parameters and processes. Some examples of carried out experiments for discussed approaches are presented as initial information. In general modeling theory, two main groups of models can be defined (physical and mathematical), and the place and features of computer modeling as a part of the mathematical models is discussed. Another topic discussed in this first chapter is the consideration of modeling as a method of scientific knowledge. In addition, the expediency of using computer modeling, as well as the main directions of its application are discussed.

1. INTRODUCTION: METHODS AND MEANS FOR RESEARCH IN COMPUTER FIELD

The computer system (CS) is a set of hardware and software components that function together in solving a certain class of tasks, which requires the application of an appropriate approach to studying their functionality. Each study must be tailored to a set main goal and an appropriate approach must be chosen to achieve it. On the other hand, for the effective conduct of the research, it is necessary that it is based on a correctly prepared experiment plan based on predetermined primary and secondary factors. Primary factors are essential for conducting the research, because they reflect basic parameters of the object or process, important for achieving the set goal. Secondary factors are additional parameters and characteristics that somehow influence the primary factors and therefore cannot be ignored.

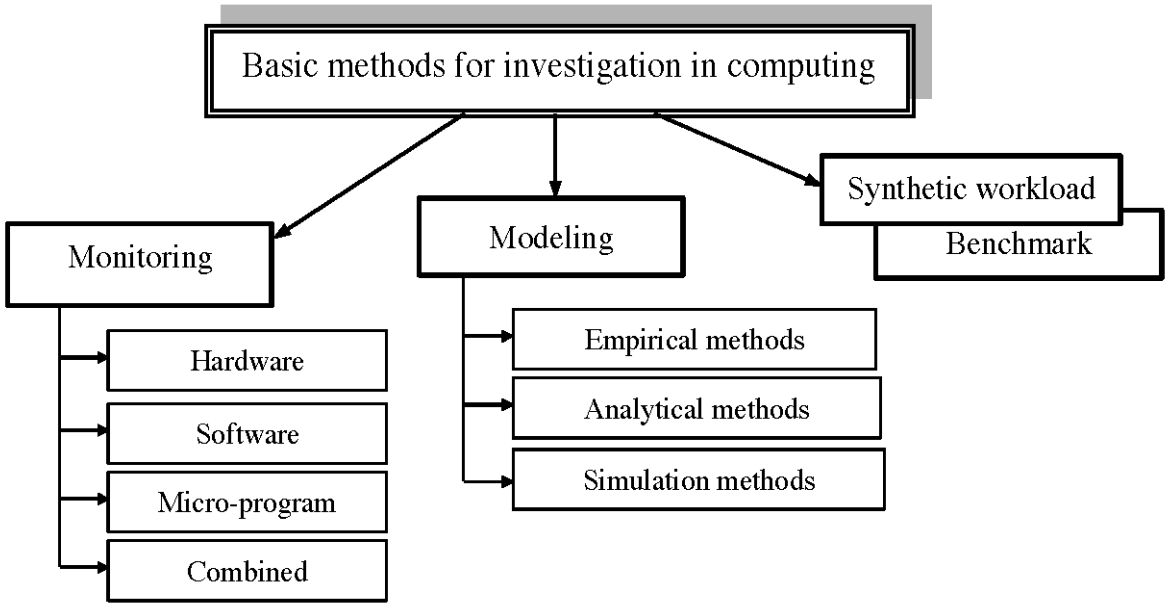
When conducting each research, the necessary information is accumulated, which is subjected to analysis (Wrigh & Ma, 2022) to obtain estimates for the selected performance indicators, allowing to make an adequate assessment of behavior (Romansky, 2022b). This is valide for conducting research in

DOI: 10.4018/978-1-6684-8947-5.ch001

all forms of computing, from traditional computing, e.g., in healthcare data volumes (Shukla, 2023a) to modern cloud computing technologies, Internet of Things, fog computing (Rathi et al., 2022), etc. An important requirement is to ensure reproducibility of research results, which is discussed in (Raghupathi et al., 2022), where research in computing was reviewed based on three factors – method, data, and experiment. The conclusion drawn is that appropriate methods must be chosen for each specific study and correct determination of factors to ensure reproducibility of experimental results.

One of the main requirements for the successful conduct of an effective experiment in the field of computer technology is the choice of the right method and means of research, and the general classification of the main directions (methods) is presented in Figure 1. Three main directions have been formed with the corresponding technological approaches and research methods, which are oriented towards experiments for the study of computer systems and processes. Each one of these directions has its own specifics and offered opportunities for conducting effective research, and it is possible to apply them together in combined experiments.

Figure 1. General classification of methods for investigation in computing



Synthetic Workload and Benchmark

Analytical dependencies (program mixtures) are one of the initial directions in the study of computer system performance parameters. They are implemented as software tools giving an approximate estimate of processor performance through usability weights for individual classes of operations when solving a given class of tasks. The program load on the processor is defined as a priori based on a statistical analysis of executed typical programs for various applications. So, for example, if the number of operation classes (in particular, all operations) is n, then the performance of the processor is calculated using the formula: