MODERN TOOLS IN COMPUTER SIMULATION FOR SOLVING BUSINESS PROBLEMS

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Queueing theory has applications in diverse fields, including telecommunications, traffic engineering, computing and the design of factories, shops, offices and hospitals.

This research has theoretical and practical aspects. Theoretical aspect considers common class of programs. Practical aspect is comparison of two programs. The task of this research is to compare GPSS with another, more modern program for simulation - Arena.

Queueing theory is the mathematical study of waiting lines, or queues. The theory enables mathematical analysis of several related processes, including arriving at the (back of the) queue, waiting in the queue (essentially a storage process), and being served at the front of the queue. The theory permits the derivation and calculation of several performance measures including the average waiting time in the queue or the system, the expected number waiting or receiving service, and the probability of encountering the system in certain states, such as empty, full, having an available server or having to wait a certain time to be served.

In queueing theory, a queueing model is used to approximate a real queueing situation or system, so the queueing behaviour can be analysed mathematically. Queueing models allow a number of useful steady state performance measures to be determined, including:

- the average number in the queue, or the system,
- the average time spent in the queue, or the system,
- the statistical distribution of those numbers or times,
- the probability the queue is full, or empty,
- the probability of finding the system in a particular state.

These performance measures are important as issues or problems caused by queueing situations are often related to customer dissatisfaction with service or may be the root cause of economic losses in a business. Analysis of the relevant queueing models allows the cause of queueing issues to be identified and the impact of proposed changes to be assessed. Base definitions of queuing model:

The requirement (application) – a service request. The incoming flow of customers – a set of requirements coming into the queueing model. The service time - the time period during which the demand is served. A mathematical model of the queueing model is a set of mathematical expressions which describe the flow of incoming requirements, the process of servicing and relationship of these expressions.

Queue is a rule according to which each service chooses an entity for processing (FIFO, LIFO, priority queue).

Service is a processing unit associated with the queue. It has a definite time of entity processing

Generator creates arriving entities in the model and the time of arrival.

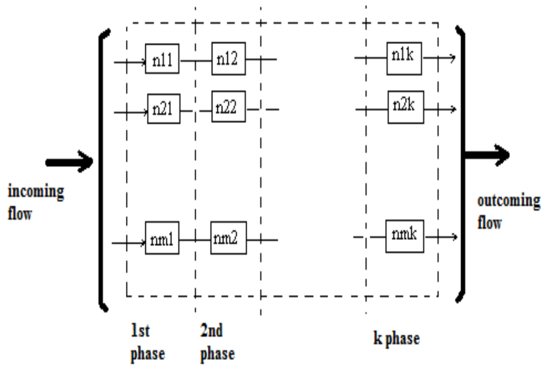

Fig. 1. Queuing model

Simulation is used for showing queuing model in process where one object (the original) is substituted by another one (the model) and fixes the original object characteristics by means of studying model characteristics with depicting time parameters.

Traditionally, building large models of systems has been via a statistical model, which attempts to find analytical solutions to problems and thereby enable the prediction of the behavior of the system from a set of parameters and initial conditions.

The term computer simulation is broader than computer modeling; the latter implies that all aspects are being modeled in the computer representation. However, computer simulation also includes generating inputs from simulated users in order to run actual computer software or equipment, with only part of the system being modeled. Computer simulation are used in many fields,

including science, technology, entertainment, health care, and business planning and scheduling.

In picture 2 you can see incoming data flow and outcoming data flow in simulation.

An example would be a flight simulator that can run machines as well as actual flight software.

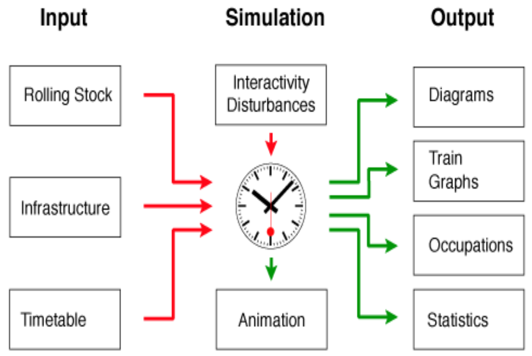

Fig. 2. Process of simulation

For simulation different tools are used. The earliest program and language was GPSS (General Purpose Simulation System).

GPSS system was developed by IBM, Jeffrey Gordon in 1961. Micro-GPSS is a language and the machine program. It contains a dictionary and grammar and allows to develop accurate models of systems. Machine software interprets the model, which is written in GPSS, and allows user to do experiment with this model on a computer. This machine program is called interpreter. This is a comprehensive modeling tool possessing the highest level of interactivity and covering areas as discrete and continuous simulation. It interactivity allows you to simultaneously explore and manage the processes of modeling. GPSS system is focused on a class of objects, the process operation which can be represented as a set of states and the rules of transition from one state to another, as defined in the discrete space-time domain. Examples of such objects are computer systems, computer networks, messaging systems, transportation facilities, warehouses, shops, business, etc. But using GPSS it is necessary to know special language of programming, special commands. At first it is necessary to think about logic of program, than code it, and GPSS program shows some statistic and result of work.

Arena was developed by Systems Modeling (Rockwell Software). First difference between them is that in Arena it is possible to depict some parameters. Arena has more convenient interface and allows you to see simulation process graphically. You need to enter time of process, time of delay in queue, time of service.

This program allows formalizing and visualizing dynamics of complex processes and systems, analyzing work flow, optimizing and analyzing business processes, finding an optimal recourses distribution (humans, equipments, finances), forecasting system behavior.

Simulation model calls for running a simulation program to produce sample histories: a set of statistics computed from these histories is then used to form performance measures of interest. The following example should be considered: a production line is conceptually modeled as a queuing system. The analytical approach willcreate an analytical queuing system and proceed to solve them. The process simulation approach instead will create a computer representation of the queuing system and run it to produce a sufficient number of sample histories. Performance measures, such as average work in the system, distribution of waiting times and so on, will be constructed from the corresponding solutions as mathematical or simulation statistics, respectively.

In the discrete event simulation paradigm the simulation model possesses a state at any point in time. The state trajectory over time is abstracted as a piecewise constant function, whose jumps (discontinuities) are triggered by discrete events. In other words, the simulation state remains unchanged unless a simulation event occurs, at which point the model undergoes a state transition. The model evolution is governed by a clock and a chronologically ordered event list: each event is implemented as a procedure whose execution can change state variables and possibly schedule other events.

This research have shown that modeling in Arena is more universal for all groups of users, because in this program you should only tools and some theory without programming language, that reach some successful results. GPSS is earlier product in simulation and have big advantages, but it’s less adopted for nowadays.

References:

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