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CS-805: SIMULATION and MODELING
Tutorial 1

UNIT-1

Q1. Define Simulation and explain the need for simulation?

A simulator is a collection of hardware and software systems used to mimic the behaviour of multiple entities or phenomena. Simulated entities or phenomena typically range from real-world realms to the operation of integrated circuits to the behaviour of light aircraft in the wind. You can also use the simulator to analyse and validate theoretical models that are difficult to understand from a purely conceptual level. These phenomena range from black hole testing to very abstract computational model research. In this way, simulators play an important role in industry and academia. While simulators are becoming more recognized as a viable and necessary research tool, people still need to be vigilant about issues that may affect them. Many issues are related to the computational limitations of existing hardware platforms but will be resolved as soon as a more powerful platform is installed. Unfortunately, another issue is within the simulator and is related to the complexity associated with the simulated system. This section focuses on some of the main strengths and weaknesses of modern simulators.

Q2. Describe the different types of Simulation?

Live: Simulation involving real people operating real systems

- Involve individuals or groups.
- May use actual equipment.
- Should provide a similar area of operations.
- Should be close to replicating the actual activity.

Virtual: Simulation involving real people operating simulated systems. Virtual simulations inject Human-In-The-Loop in a central role by exercising:

- Motor control skills (e.g., flying an airplane)
- Decision skills (e.g., committing fire control resources to action)
- Communication skills (e.g., members of a C4I team)

Constructive: Simulation involving simulated people operating simulated systems. Real people can stimulate (make inputs) but are not involved in determining outcomes. Constructive simulations offer the ability to:

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- Analyse concepts.
- Predict possible outcomes.
- Stress large organizations
- Make measurements.
- Generate statistics.
- Perform analysis.

Q3. Compare and Contrast simulation and Modelling?

Modelling: Modelling is the act of building a model. A model is a product (physical or digital) that represents the system of interest. The model is similar, but much simpler than the system represented, but approaches almost every real feature of the closest real system. A good model is a good trade-off between realism and simplicity. The main feature of the model is operability. The model can be a physical model, such as a house-scale model of physical architecture, an aircraft model, a mannequin, or a model organism in biological research. Or a conceptual model (computer model, statistical or mathematical model, business model, etc.).

Simulation: Simulating is the act of using a model for a simulation. Simulation is the process of using a model to study the behaviour and performance of a theoretical or real system. Simulations allow you to use models to investigate the characteristics of existing or proposed systems. The purpose of the simulation is to investigate the characteristics of a real or fictitious system by manipulating variables that cannot be controlled by the real system. Simulation allows you to evaluate your model to optimize system performance or make predictions about your system. Simulations are useful for investigating the properties of real system models that are complex, large / small, fast / slow, inaccessible, extremely dangerous, or infeasible. The target model must be correct on the system represented, but simulations can use the model to explore countries that the original system cannot do.

Q4. What Are Simulation Models?

Simulation models aim to improve system behaviour and logic behaviour by using statistical descriptions of related activities. For example, a line can run at an average speed of 1000 units per hour. Assuming this happens, we do not know when and what happened, such as whether there was an interruption or outage due to regular maintenance. The effects of such delays can increase (or be absorbed) given the impact on downstream units.

Model simulation has "entities" (machines, materials, people, etc.) and "activity" (processing, transportation, etc.). There is also information about the logic that manages each activity. For example, processing can only be started if the range of available materials, the person running the machine, and the conveyor to retrieve these products are empty. When an activity is started, the time to completion is often calculated using the example statistical distribution.

Q5. Discuss the Advantages and disadvantages of Simulation?

Advantages

- Can be safer and cheaper than the real world.
- Able to test a product or system works before building it.
- Can use it to find unexpected problems.
- Able to explore 'what if…' questions.
- Can speed things up or slow them down to see changes over long or short periods of time.

Disadvantages

- Mistakes may be made in the programming or rules of the simulation or model.
- The cost of a simulation model can be high.
- The cost of running several different simulations may be high.
- Time may be needed to make sense of the results.
- People's reactions to the model or simulation might not be realistic or reliable.

Q6. List down the criteria for selection of Simulation Software?

The steps for selecting simulation software:

1. Establish the commitment to invest in simulation software to solve your problem.
2. Clearly state the problem (or class of problems) that you would like to solve.
3. Determine the general type of simulation tool required to solve the problem.
4. Carry out an initial survey of potential solutions.
5. Develop a list of functional requirements.
6. Select the subset of tools that appear to best meet the functional requirements.
7. Carry out a detailed evaluation of the screened tools and select a solution.

Q7. Identify the application areas of simulation and explain them by listing some of open-source simulator software in respective areas?

- Simulation of Technology for performance optimization

- Safety Engineering

- Testing

- Training

- Education

- Video games

- Entertainment

- Healthcare

- Scientific modelling of nature systems or human systems