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(Q1) Define four entities, attributes, event and activities to be considered for the simulation of Railway reservation system.

Ans Entities are the individual elements of the system that are being simulated and whose behaviour is being explicitly tracked. Each entity can be individually identified. Attributes are the properties of objects (that is entities and resources). The collection of variables necessary to describe system at any time point is state. Event is the instant of time where the state changes.

entities and their attributes:

- Train Entity: attributes are id, trainname, train number, train seat number, train type.
- Ticket entity: attributes of ticket are ticket id, ticket customer, ticket type, ticket date, ticket description
- Booking entity: attributes of booking are booking id, booking title, booking type, booking date.
- customer entity: attributes are customer id, customer name, customer email, username, address, etc.

Activities: • user login and authorisation
• logout, login
• select ticket, cancel ticket
• postpone travel date, refund ticket

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(Q3) demonstrate all the steps of simulation with help of real example.

→ Steps of simulation are:

1) Problem formulation: Every study should begin with a statement of the problem. If a problem statement is being developed by the analyst, it is important that policy makers understand and agree with the formulation.

2) Setting of objectives and overall project plan: The objective indicates the questions to be answered. At this point, a determination should be made concerning whether simulation is the appropriate methodology for problem as formulated and objectives as stated.

3) Model conceptualization: The construction of a model of a system is probably as much art as science. The art of modelling is enhanced by an ability to abstract the essential features of a problem, to select and modify basic assumption results.

4) Data collection: There is constant interplay between the construction of model and collection of the needed input data. As the complexity of the model changes, the required data elements can also change.

5) Model translation: Most real world systems result in the models that require a great deal of information storage and computation, so the model must be entered into a computer

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recognizable format.

6) Verified: Verification pertains to the computer program ~~perhaps~~ prepared for the simulation model. Is the computer program performing properly? With complex models, it is difficult, if not impossible, to translate the model successfully in its entirety without a good deal of debugging.

7) Validated: validation usually is achieved through the calibration of model, an iterative process of comparing the model against the actual system behaviour and using the discrepancies between the two, and the insight ahead, to improve the model.

8) experimental design: The alternatives that must be simulated must be determined. often the decisions concerning which alternatives to simulate will be a function of runs that have been completed and analysed.

9) Production runs and analysis:
Production runs and their subsequent analysis are used to estimate measures of performance for system designs that are being simulated.

10) more runs: Given the analysis of runs that have been completed, the analyst determines whether additional runs are needed and what design those additional experiments should follow.

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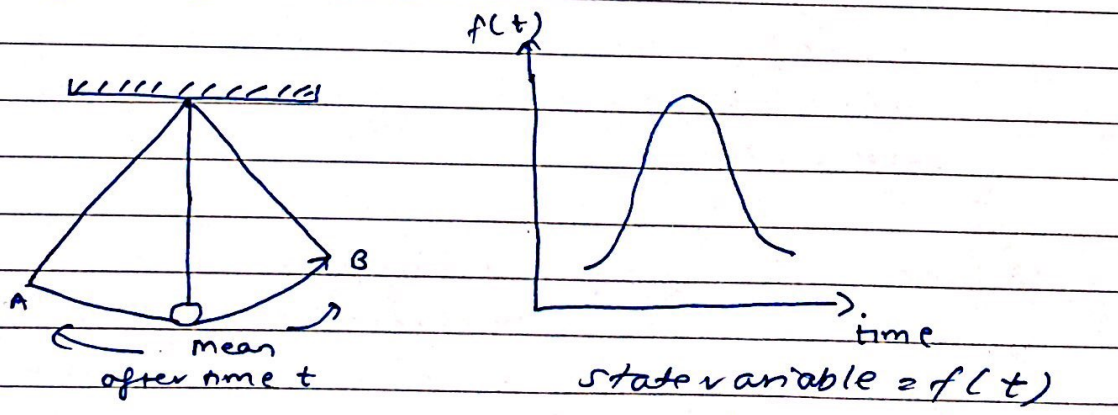
11) documentation and reporting: There are two types of documentation: program and progress. Program document is necessary to understand how program operate.

12) implementation: The success of implementation phase completely depends on how well the previous 11 steps are performed. It is also contingent upon how thoroughly the analyst has involved the ultimate model user during the entire simulation process.

2) Illustrate the type of simulation associated with "movement of pendulum". Justify your answer.

→ Movement of pendulum can be classified as deterministic, continuous and dynamic simulation.




clearly, the state variables such as force, tension, potential energy are changing with time and the motion changes w.r.t to previous state of the pendulum bob. Thus it is dynamic.

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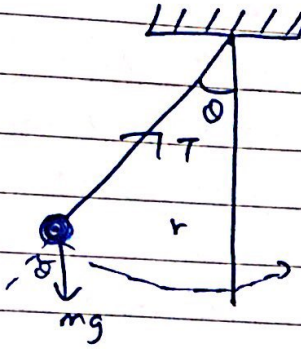
The graph between the time and the pendulum function dependent on time have continuous relation. ie. every instant, there is slight variation of state variables such as position, velocity and torque, etc. Thus, it is continuous simulation as well as deterministic simulation.




Q5) Classify the following systems as static or dynamic, deterministic or stochastic, discrete or continuous with justification

(a) Traffic lights system

- dynamic system: as the lights in the signal changes with time in a fixed manner
- Deterministic system: as we are able to predict the future states of the traffic light provided we know the three interval of each light.
- Discrete system: as only when the light changes after a certain time does the state variable of the system change, the state variables aren't changing continuously.

(b) Car rental company

Static system as the functioning of the company is independent of time, time isn't a relevant parameter.

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Stochastic system as we can't determine the future states of the ~~rentals~~ rental company with accuracy, we can only provide a probability of its state.

Discrete system as the state of the system only changes when a car is rented out or ~~rental~~ returned but not continuously throughout time

c) Wifi network system in a house

Static system as the functionality of the network is independent of time, its functions regardless of what time of the day it is.

Deterministic system usually, one can determine the future state of the network as running unless random powercuts occur. Considering randompower cuts or maintenance, this system is stochastic system but in ideal scenario, it is deterministic.

Discrete system as the state of the network will only change in specific conditions such as, power outages or maintenance of system but not at every instant of time.

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d) Online food delivery system

Dynamic system as the online food delivery system has particular operating hours depending on time. This causes change in system.

Deterministic system considering an ideal case where the system isn't under maintenance or the restaurant doesn't cancel the order or the delivery person doesn't get delayed, if we ignore these one off scenarios, we can predict the order arrival but considering a practical scenario, this is stochastic system as time to order arrival is a rough estimate that doesn't account for random scenarios.

Discrete system as the state of system isn't ever changing it only changes once a task is completed or an activity occurs such as once food is delivered it will change its state.

(Q4) Relate a situation where Simulation is used as (a) analysis tool (b) design tool

Simulation analysis tool:

Simulation analysis tool is the tool for developing a mathematical representation of an actual or proposed product in a computer model. Simulation can be used as an analyzing tool in many industries. It can be used to analyze mining operations, analyse manufacturing

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plants and supply chains. A real life example of simulation as an analysis tool is is stock market and finance and trading as well as crypto where the real time analysis of different currencies and stocks are analyzed and updated.

Simulation as design tool:

Simulation can be used as a design tool in many industries. It can be used in CAD, CAM and virtual reality softwares, and also in military to plan war bases, to design weapons and equipments suitable for wars. A real life simulation as design tool would be designing the layout and plan of a building to explore it virtually in 3D.