Modeling and Simulation-Homework1

1. What are differences between a model and a simulation?

A process of modeling is a necessary preliminary step to study any system it use for: analytical calculation and simulation.

A model is an abstract representation of a system but is also a simulation , replicating with a certain degree of accuracy, the behavior will be see in representative simulation.

2. Define discrete event dynamical systems .Why are these important for the areas of study such as computer and communication engineering ,management a.o?

Discrete event dynamical systems(DEDS) are dynamic systems with secrete state space and state trajectories that are constant on intervals .The moments in time at which transitions take place are unpredictable , state transitions are called event. They are important in domains like computer and communication engineering due to the fact that they are discrete and non-deterministic - that is ,they are generative and capable of internal elections.

3. What makes discrete event dynamical systems to have a great complexity?

The event dynamical systems have a great complexity because the number of states of DEDS “explodes” combinatorially

4. What are the types of modeling you use for simulation?

We have physical models(iconic) and mathematical (logical) models .Mathematical models allows us to test and obtaining results , studying the behavior of the model also approximate the operating mode of a system and often they are representing by appropriate software program.

5. What is the relationship between modeling and the accuracy of simulations?

The model is an abstract representation of a system with a certain degree of accuracy.

When we simulate an model there is not exactly an answers only approximations , estimates. So the accuracy of simulations is based on how much work we put in the model to have a less or more ambiquous scheme

.

6. Differentiate between verification and validation of simulations.

The difference between this two is that the verification of a simulation consists of comparing the conceptual model with the programmed code while the validation of a simulation consists of analyzing the correspondence between the model and the real system

7. Prove that the set of events attached to an experiment forms a Boolean algebra with respect to the operations defined.

### Let S be a set of elementary events , and B ⊂ P(S) a system of subsets in S

### If: 1. S ∈B;

### 2. E1, E2 ⇒ E1 ∪ E2 ∈B ; E1∩ E2∈B ; Ḕ1∈B, Ḕ2∈B

### 3. E1, E2,….., En , ….. ∈B⇒ E1,∪ E2∪……∪ En ∪……∈B

### E1∩ E2 ∩… En∩…∈B, then B is a Borel field of events

On the crowd ∑  of the events associated with an experiment, 3 operations corresponding to the logical operations can be introduced and, or, non . A and B belong to ∑.

A or B the event that occurs if and only if at least one of events A or B occurs.This event is noted by A∪ B and it’s called a reunion

A and B it is the event that occurs if and only if both events A and B occurs .Thi event is noted by A∩ B and it’s called intersection.

non A it is the event that takes place if and only if it does A doesn’t occurs. This event it’s called the contrary and is noted by **Aᶜ**

8. Using set theory, differentiate between the notions of “event “ vs “elementary event”.

An elementary event is an event which contains only a single outcome in the sample space. Using se theory , an elementary event is a singleton. An event is a set of outcomes of an experiment to which a probability is assigned

Elementary events are defined as result with Bolean values of some sample experiments. An event it may be seen as a sudden result of the simultaneous fulfillment of several condition. The event is a result of an “event-process”.

9. Toss a coin and a cubic dice at the same time. How many elementary events are possible for this experiment? Enumerate them and state their probability to occur.

So a dice has 6 faces and a coin has head=H and tail=T.

There are 6\*2=12 elementary events possible for this experiment .

The elementary events are listed like this:

[H,1] , [H,2] , [H,3] , [H,4] , [H,5] , [H,6] , [T,1] , [T,2] , [T,3] , [T,4] , [T,5] , [T,6]

Each number represent the result from the top of the dice. Each elementary event has the probability P=1/12.

10. We consider the following random variable:

x|1 2 3 4

f|3 6 2 1

Compute the average and variability

Average x= (1+2+3+4)/4=2.5

Average f= (3+6+2+1)/4=3

Variability x= ((1-2.5)2 + (2-2.5)2 +(3-2.5)2 +(4-2.5)2)/4 = 5

Variability f = ((3-3)2+(6-3)2+(2-3)2+(1-3)2)/4 = 3.5

11. After a hard winter, holes may appear in the road at an average density of 5.2/km. Compute the probability to find more holes , like 8/km of road.

The formula for this probability is:

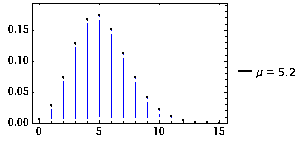
P(X = x) =

In our problem , we know the average of holes per kilometer but we don’t know the number of holes per each kilometer

λ =5.2 holes/km

X= 8 holes/km

P(X = 8) = = 0.073143362…



12. What is the utility of Finite State Automata for the control of discrete event dynamical system?

Finite state automata is one of the models based on states for discrete event dynamical system. Their use for control systems is monitoring controls inputs and setting control outputs.

13. Explain the duality between state-based models and trace-based models used for discrete event dynamical systems.

State based models represents the system as a set of states and a set of transitions between states – a transition is determined by external events.

Trace-based models

DEDS behavior is naturally described by the record or trace “left” by the appearance of discrete , qualitative changes in the system. Continuous , quantitative micro-changes can simply be ignored. Apart from state-based models , trace-based models , studied at different levels , are very useful

14. Define the structural (static) part and the dynamic part in a Petri Net model.

Dynamic Analysis:

Executes specification text to reveal properties . Requires executable specifications

Static Analysis:

Prove theorems about properties

An analysis characterizes a class of behaviors . Applied to a static model

15. Which is the most complete type of modeling used for discrete event dynamical systems and what is their formal basis?

The most complete type of modeling used for discrete event dynamical systems is the modeling at statical level , because we can use operational and simulation models in tandem. For formal basis of DEDS , the evolution over time depends on the complex interaction of the moments of occurrence of different types of events.

16. Explain in your own words why a discrete dynamical system can be considered a “language generator”. What are the language elements (alphabet,words)?

A dynamical system is a rule for time evolution on a state space. A dynamical system is a mathematical formalization for any fixed rule which describes the time dependence of a point’s position in its ambient space

A discrete dynamical system , map or cascade is a tuple(T, M, Φ) where T is the set of integers, M is a manifold locally diffeomorphic to a Banach space, and Φ is a function. Language generator create the strings of a language.

17. How is a regular language constructed , in terms of “data elements” and operations?

A regular language is a formal language that can be expressed using a regular expression . A regular language ca be defined as a language recongnized by a finite automaton. Regular languages are particularly useful in input parsing and programming language design.

Using regular expresiions in the descriptin of languages is an advantage because provides a finite compact representation.

19. When a FSA model is simplified by aggregating a set of equivalent states , is there any loss of information? Justify your answer.

Two states in a FSA model are equivalent if and only if for every string x, if M is started in either state with x as input , it accepts in both case or reject in both case. The machine does the same thing when started in either state. So in both cases, if a FSA is simplified by aggregating a set of equivalent states , there is no going to be a loss of information.

20. Explain , in a few words as possible what do you understand by supervisory control of discrete event dynamical systems.

The evolution of DEDS modelated by ASF it’s a spontaneous evolution , uncontrollable

If the complete state of the system is observable , then it can be build a controller in feedback loop , if only events are observable the implementation of a controller is made by making a copy of a system which is executed in parallel and synchronous of the system. The controller or the copy of the system plus the controller forms a supervisor.