Modelling & Simulation

Q. What are the features of R?

Ans → R is a well developed, simple and effective prog language which include conditional loops, user defined recursive functions and ~~for~~ I/O functions.

2) It has an effective data handling and storage facility

3) It provides a suite of operators for calculations on arrays, lists, vectors and matrices.

4) It provides a large, coherent and integrated collection of tools for data analysis.

5) It provides graphical facilities for data analysis and display either directly on computer or printing on paper.

R-object

vectors, lists, matrices, arrays, factors and data frames

simplest form of data object is vectors.

Creating a vector

```
model ← c("Red", "Green")
print(model)
print(class(model))
```

o/p

"Red" "Green"

character

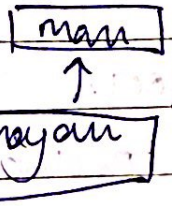
Q. What is R-script? What does the 6 classes of vectors mean?

- character 'a', 'awc'
- numeric 2.5, 3
- integer 1L, 2L, 5L → int
- logical True, false
- complex 1+4i, 5i
- raw

Continue after Matrix

Instance — IS_A / HAS_A

* shayam is a main

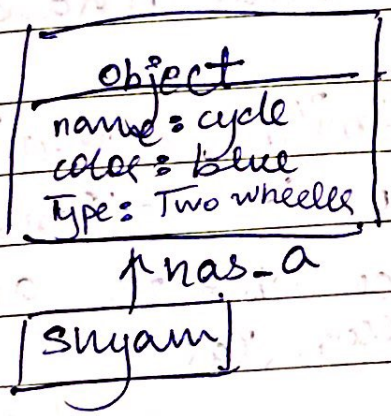


* shyam has_a cycle

Has_a (shyam, cycle)

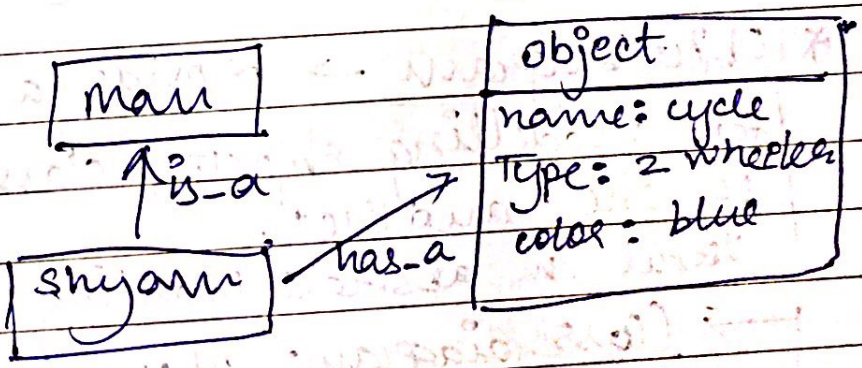
main (shaym)

is_a (shayam, main)



Links

shyam ~~has~~ is_a main who has_a cycle.



Aggregation

A man has 2 eyes

Simulation refers to a broad collection of methods and applications to mimic the behaviour of real systems, usually, on a computer with appropriate software.

Computer Simulation → It refers to methods for studying a wide variety of models of real world systems by numerical evaluation using soft. design to initiate the systems operation or characteristics over time.

Practically, simulation is the process of designing and creating a computerised model of a real or proposed system for the purpose of conducting numerical experiments to give us a better understanding of the behaviour of that system for a given set of conditions.

Diff kinds of simulations

Static v/s Dynamic

Time doesn't play an important role in static model but plays an important role in dynamic model

Continuous v/s Discrete

In a continuous model, the state of the system can change continuously over time
In discrete model, change can occur only at separated points in time
If a model shows both continuous

Q what do you understand by comp simulation and what are its diff types? (5)

and discrete change in the same model, it is called as mixed continuous discrete model

Deterministic Vs stochastic

System models with no random input are deterministic.

Stochastic models operate with atleast some inputs being random.

software: Arena easily handles deterministic & stochastic models and provides many probability distributions and processes that can be used to represent random inputs.

Probability Distribution → { Bayes, Poissons, Binomial

Binomial Random variable

It counts the number of successors in a seq of n trials.

A binomial random variable takes only integer values b/w 0 and n and for $k = 0, 1, 2, 3 \ldots n$

S_n → Success

$$P\{S_n = k\} = \binom{n}{k} p^k (1-p)^{n-k}$$

The expectation of a random variable with n trials and probability of success, p, on each trial is.

$$E[S_n] = np$$

The variance of a binomial random variable with n trials and probability of success p on each trial is

$$\text{Var}|S_n| = npq = np(1-p)$$

→ A sample space is denoted by Ω_n, is a set of all possible sequences of n 0's and 1's, representing all possible outcomes of the composite experiment.

Composite exp → repeating a elementary exp n times

Elementary exp → it is a physical exp with 2 outcomes & it is also called as Bernoulli's trial.

Q. A coin is flipped two times. Find the probability of getting a success when
i) Both heads
ii) One head & one tail

Ans → i) P(H) P(H)
$\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{4} = {}^2C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^{2-2}$

ii) $\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) * 2 = \frac{1}{2}$

P(H) P(T)
P(T) P(H)

Levin → Ch 1, 3, 4, 8.2, 8.4,
Kelton → Ch 1, 2

Q. Coin is flipped 4 times i) Two heads atleast
ii) one tail atmost

Ans i) = $1 - {}^4C_1 \left(\frac{1}{2}\right)^1 \left(\frac{1}{2}\right)^3 = 1 - \frac{4}{2^4} = \frac{3}{4}$

ii) 0T + 1T

${}^4C_0 \left(\frac{1}{2}\right)^0 \left(\frac{1}{2}\right)^4 + {}^4C_1 \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)^3 = \frac{1}{2^4} + \frac{4}{2^4} = \frac{5}{2^4}$

Q. Design a problem of getting a success ~~with~~ of 9 H.

Ans → Let us take n tosses

so $P = {}^nC_9 \left(\frac{1}{2}\right)^9 \left(\frac{1}{2}\right)^{n-9}$

so we can take any value of n.

Eg n = 9, 10 ...

Q. write a simulation to experimentally simulate coin flipping game & the eg. Experimentally determine the prob of →

a) winning in the cases of ~~working~~ winning with 1, 2, 3 ... 10 heads

is a - set of all possible outcome of composite expt.

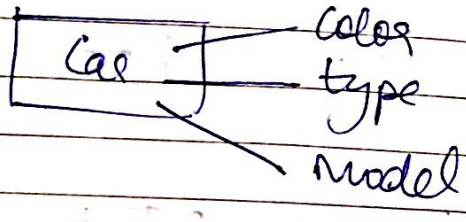
objects of Simulation Model

Entities

Attributes

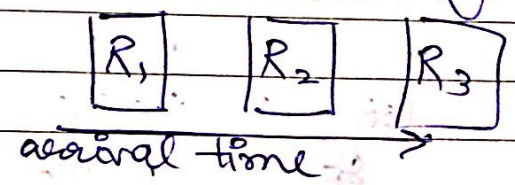
Global variables

Local variables



Q. What are different pieces of simulation model.

Queues



M M1 Queen model Eg → TOC automata

Simulation Clock → Discrete 0,1

→ Continous

Starting & Stopping states

↳ from where you begin

→ where you end

System → that constitutes of all of these things.