What-if analysis

Strategy

- Decision makers need to evaluate beforehand the impact of a strategic or tactical move
- But some process are just "too complex"
  - Mathematical models is too abstract
  - Building real systems with multiple configurations is too expensive

⇒ Simulation is a good compromise

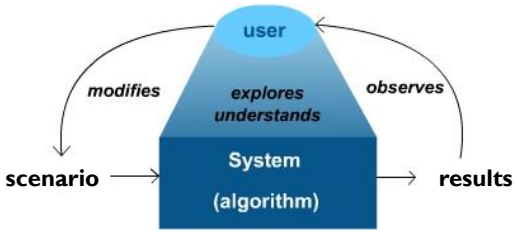
Simulation

Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of a system

– Shannon

What-if analysis

- A data-intensive simulation whose goal is to inspect the behavior of a complex system under some given hypotheses (called "*scenarios*")
- What-if analysis ≠ Forecasting



Disadvantages

- Simulation can be expensive and time consuming
- Each model is unique
- Managers must choose solutions they want to try in scenarios
- Overfitting vs. non-repeatability

Simulation tools

- Spreadsheets
  - Excel
  - Calc
  - Numbers
- Ad-hoc
  - Applix TM1
  - Powersim
  - QlikView
  - SAP BPS
  - SAS Forecast S.
  - …

Simulation tools

- Write your own simulator!
  - from scratch
  - in Java

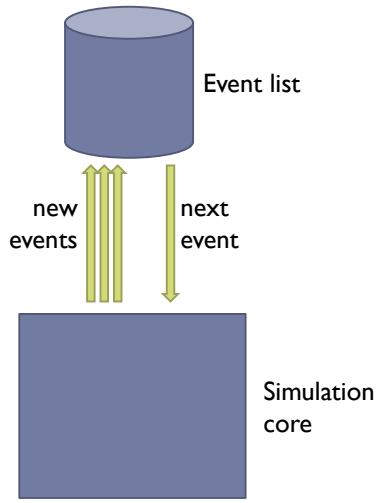
Taxonomy

- Deterministic or Stochastic
  - Does the model contain stochastic components?
- Static or Dynamic
  - Is time a significant variable?
- Continuous or Discrete
  - Does the system state evolve continuously or only at discrete points in time?

Discrete Event Simulation (DES)

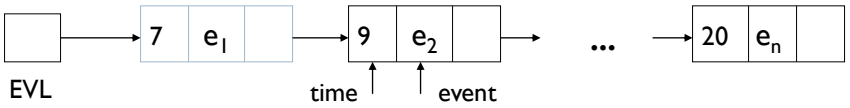
- Discrete event simulation is dynamic and discrete, it can be both deterministic or stochastic
- Changes in state of the model occur at discrete points in time
- The model maintains a list of events ("*event list*")
  - At each step, the scheduled event with the lowest time gets processed (i.e., the event list is a *priority queue*)
  - The event is processed, new events are scheduled

Discrete Event Simulation (DES)



The event list

- An event contains at least two fields of information
  - time of occurrence (timestamp): time when the event should happen
  - what the event represents



- Simulation terminates when the event list is empty
- Conceptually endless simulations, like weather, terminates at some arbitrary time

The simulation core

- Manager
  - Process events
  - Defines the strategy
- Additional data structures
  - Auxiliary tasks

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