Εργαστήριο Δικτύων

Network Simulator

Network Simulation

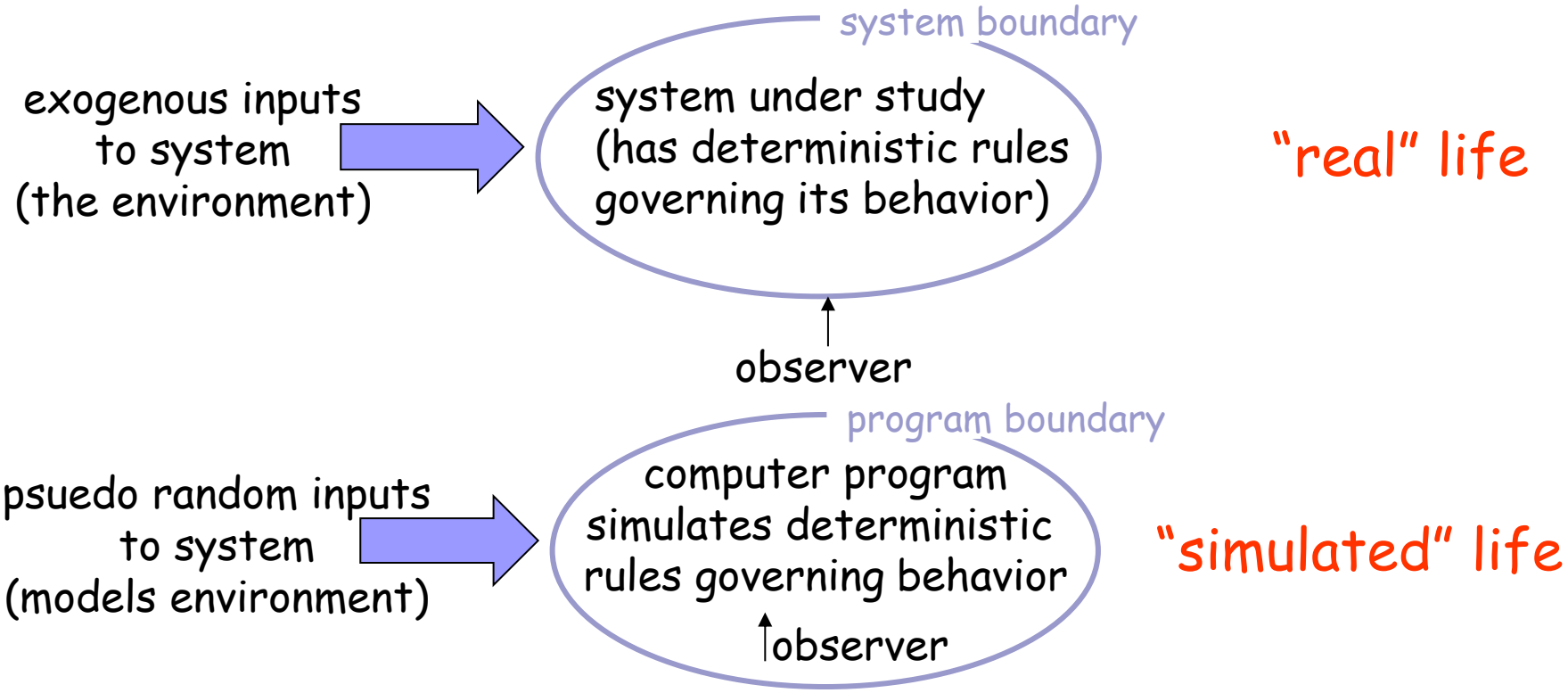
Motivation:

- Learn fundamentals of evaluating network performance via simulation

Overview:

- fundamentals of discrete event simulation
- ns-2 simulation

What is simulation?



Why Simulation?

- real-system not *available, is complex/costly or dangerous* (eg: space simulations, flight simulations)
- quickly evaluate design *alternatives* (eg: different system configurations)
- evaluate *complex functions* for which closed form formulas or numerical techniques not available

Simulation: advantages/drawbacks

- advantages:
  - sometimes cheaper
  - find bugs (in design) in advance
  - generality: over analytic/numerical techniques
  - detail: can simulate system details at arbitrary level
- drawbacks:
  - caution: does model reflect reality
  - large scale systems: lots of resources to simulate (especially accurately simulate)
  - may be slow (computationally expensive – 1 min real time could be hours of simulated time)
  - art: determining right level of model complexity
  - statistical uncertainty in results

The evaluation spectrum

- Numerical models
- Simulation
- Emulation
- Prototype
- Operational system

Programming a simulation

What ‘s in a simulation program?

- *simulated time:* internal (to simulation program) variable that keeps track of simulated time
- *system “state”:* variables maintained by simulation program define system “state”
  - e.g., may track number (possibly order) of packets in queue, current value of retransmission timer
- *events:* points in time when system changes state
  - each event has associate *event time*
    - e.g., arrival of packet to queue, departure from queue
    - precisely at these points in time that simulation must take action (change state and may cause new future events)
  - model for time between events (probabilistic) caused by external environment

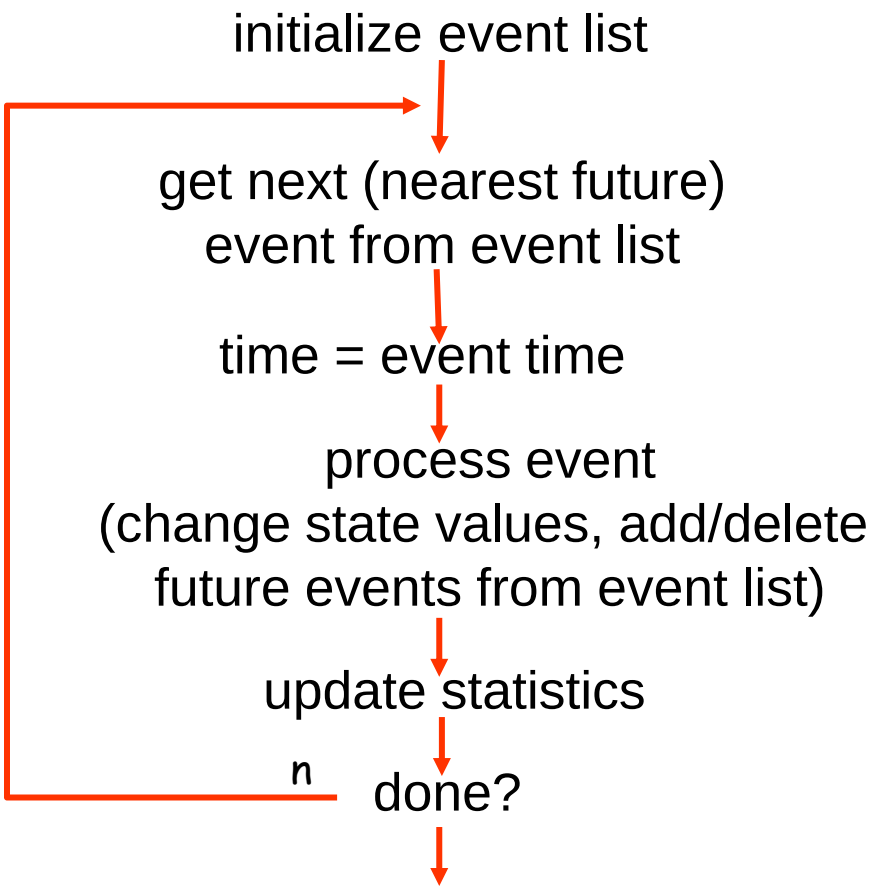
Event vs time driven simulations

- Time driven: For continuous systems, time-driven simulations advance time with a fixed increment. With this approach the simulation clock is advanced in increments of exactly Δt time units. Then after each update of the clock, the state variables are updated for the time interval $[t, t+\Delta t]$.
- Event Driven: In event-driven simulation the next-event time advance approach is used.

Event Driven Simulators

- simulation program maintains and updates list of future events: event list
- Need:
  - well defined set of events
  - for each event: simulated system action, updating of event list

Simulator Block Diagram*



Known Simulators

- Network Simulator – NS
- NetSim
- OPNET
- Omnet