

CAP 4800/5805 Computer Simulation Concepts

Lecture 7 and 8

Model Components

- States, events, and time are three of the most fundamental concepts in system modeling
- A *state* describes the system for an interval of time
- An *event* is a point in time that designates a change in state
 - *External event* is an input to a model. Input comes from outside the system.
 - *Internal event* is an input to model. Input comes from a lower-level abstraction model and not from outside the system
- An event is an instantaneous state, so an event is just a special kind of state which has no time duration
- The definition of *input* is relative to the particular system being described. An input is the information presented to a system
- An *output* is the information produced from a system
- Some systems without an input are sometimes termed *autonomous* systems
- *Time* is a basic concept of systems, and is denoted by either an integer or a real number

Model Definition

A deterministic system $\langle T, U, Y, Q, \Omega, \delta, \lambda \rangle$ within classical systems theory is defined as follows:

- T is the *time* set. For continuous systems $T = R$ (reals), and for discrete time systems, $T = Z$ (integers)
- U is the *input* set containing the possible values of the input to the system
- Y is the *output* set
- Q is the *state* set

- Ω is the set of *admissible* (or *acceptable*) input functions. This contains a set of input functions to use during system operation. Often, due to physical limitations, Ω is a subset of the set of all possible input functions ($T \rightarrow U$)
- δ is the transition function. It is defined as $\delta : Q \times T \times T \times \Omega \rightarrow Q$
- λ is the output function, $\lambda : Q \rightarrow Y$

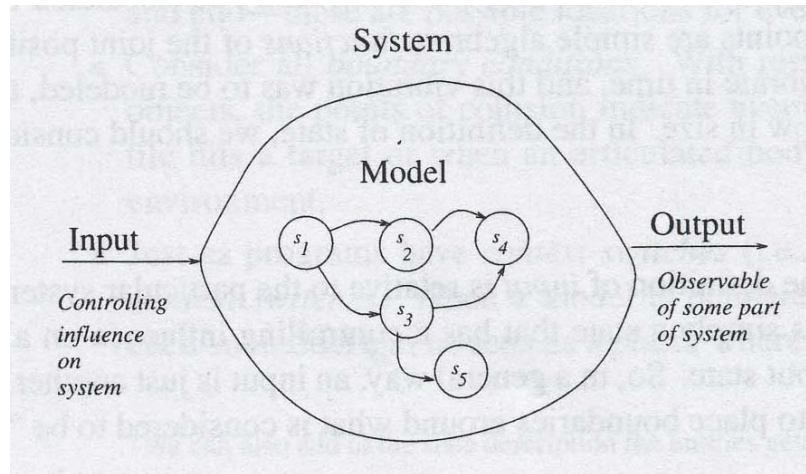


Figure 1 System with input and output

Some key pieces within the above definition

- Q is also known as the *state space* of the system. An element $s \in Q$ is termed the *state* of the system
- A pair consists of a time and a state (t, s) , where $s \in Q$ is called an *event*
- Event space is defined as $T \times Q$