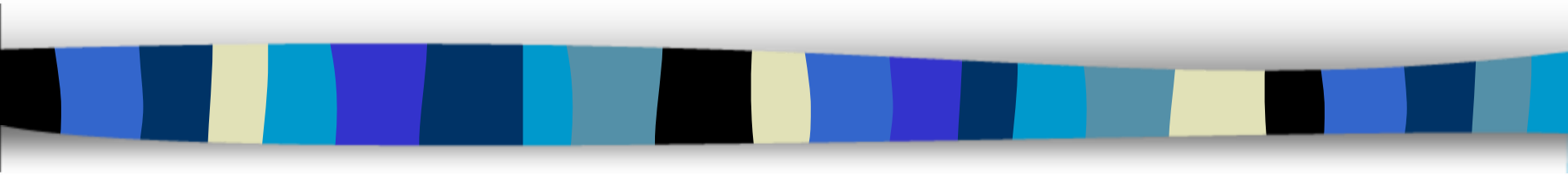
Systems Modelling and Simulation (Lab 1)



Discrete Event Simulation Software

Simulation Software

Arena, SIMUL8 and WITNESS, SIMUL some of the most popular simulation packages

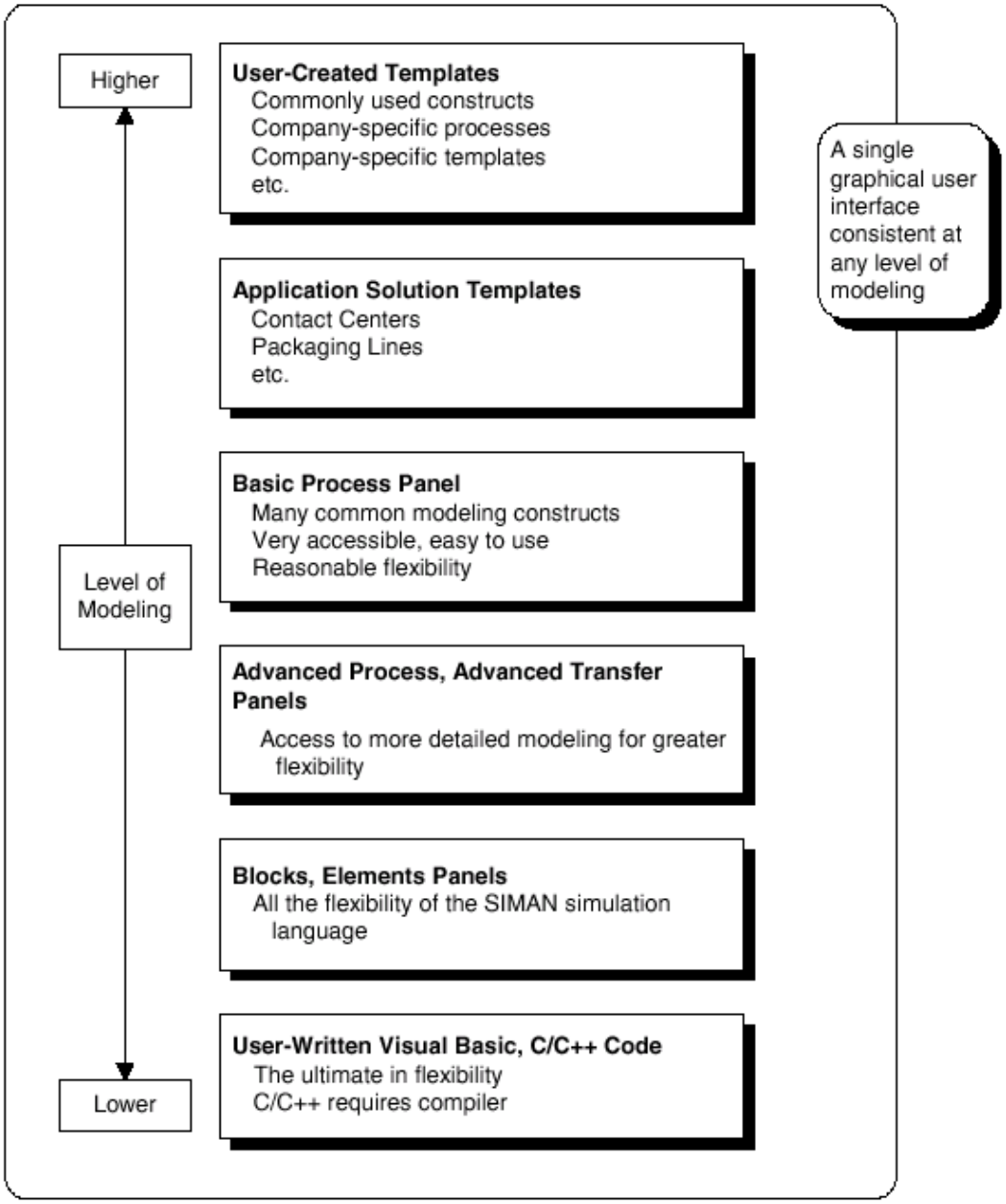
Arena

Provides an integrated framework for building simulation models in a wide variety of applications. It integrates all the functions needed for a successful simulation including:

1) animation
2) analysis of inputs and outputs data
3) model verification

into one comprehensive environment.

Arena Hierarchical Structure



Arena Template Concepts (1)

- **Entities :** In every simulation model entities are objects under a particular process, and they move along the system.

  Example:

  manufacturing → raw material and products,

  banks → customers are the entities,

  hospitals → patients.

  In a typical Simulation project there can be one or many different types of entities.

- **Attributes :** Are the characteristics of each entity and represent values associated with individual entities. In atypical system we can define as many attributes as we need for the entities.

  Example:

  length, or weight, or patients the type of the disease.

Arena Template Concepts (2)

- **Stations :** Stations are boundaries to show the segmentation of each process in a system.

  Example:

  Production line a process is performed by a station i.e. drilling, milling, filling, etc. And in offices these boundaries could be departments.

- **Resources :** Resources are stationary/non stationary elements that are allocated to entities and perform or assist in processing. They have a capacity and status e.g. busy, idle, inactive, or failed.

  Resources may be used to represent **people, machines, or even physical systems**.

  Seize and *Release* are two other terminology's used followed by *Queue*

Arena Template Concepts (3)

- **Queues :** explains waiting status of entities due to the status of the system. Entities who are waiting to be serviced by the servers create queues. entities enter the queue and are removed from it based on change in the state of the system.

  Queuing rules: FIFO, NIFO, LIFO, LVF, HVF or other criteria's which influences the way entities can be served.

- **Transporters :** Entities move in the system via transporters. Transporters can be used to represent material handling or transfer of devices. Some examples for transporters are; AGVs, trucks, forks, cranks, carts, etc.

- **Conveyors :** Conveyors are devices that move entities form one station to another in one direction. Such as escalators and horizontal conveyors.

Arena Template Concepts (4)

- **Variables :** Represent values that describe the characteristics of the system.
  - **These values are available to all entities. But not specific entity**
  - **Used for many different kinds of things**
    - *Travel time between all station pairs*
    - *Number of parts in system (Work-in Process)*
    - *Simulation clock (built-in Arena variable)*
  - **Name, value of which there's only one copy for the whole model**
  - **Not tied to entities**
  - **Entities can access, change variables**
  - **Some built-in by Arena, you can define others**

Statistical Accumulators

- *Statistical accumulators*
  - **Variables that "watch" what's happening**
  - **Depend on output performance measures desired**
  - **"Passive" in model — don't participate, just watch**
  - **Many are automatic in Arena, but some you may have to set up and maintain during the simulation**
  - **At end of simulation, used to compute final output performance measures**

Statistics for a given system

- Statistical accumulators for a possible processing system
  - **Number of parts produced so far Total of the waiting times spent in queue so far**
  - **No. of parts that have gone through the queue**
  - **Max time in queue we've seen so far**
  - **Total of times spent in system**
  - **Max time in system we've seen so far**
  - **Area so far under queue-length curve $Q(t)$**
  - **Max of $Q(t)$ so far**
  - **Area so far under server-busy curve $B(t)$**
- Time Persistent Stats
- Observed Stats

Lets begin

Open Arena Application