SIMULATION LANGUAGE FOR ALTERNATIVE MODELING (SLAM)

SUJATA SAHOO
1703041001
CSE-2

WHAT IS SLAM?

- SLAM is a FORTRAN based general purpose simulation language that was introduced in 1979 by Pritsker. The language was later enhanced and called SLAM II .

- It allows systems to be viewed from a process, event, or state variable perspective.

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- SLAM II provides the network or block type of simulation capability similar to GPSS thus It allows convenient implementation of many types of simulation problems.

- By providing the capability for discrete event simulation as in SIMSCRIPT and SIMULA this allows the user to incorporate computations and logic flows into the simulation that would not be possible using network simulation alone

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- SLAM integrates the process-oriented world views, or the Discrete-event/ Continuous world-views in order to free the modeler to select the approach which best represents this system or with the approach that is more comfortable.

NETWORK MODELING

- A SLAM network is made up of nodes at which processing is performed.

- A Simulation Model normally begins with a network, or flow diagram, which graphically portrays the flow of ,modeling people, parts or information, for example through the system.

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- A SLAM network model is a network representation of a process through which entities flow. Entities are abstract representations of persons or things.

- They may be described with attributes. For example, automobiles may be an entity type with three attributes to describe them: make, year, and model.

- A SLAM network consists of nodes and branches. The nodes are the actions to be taken.

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- Examples are the CREATE node which generates entities; the QUEUE node where an entity tries to enter a queue; and the ASSIGN node where an entity's passing through will cause values to be assigned to attributes or variables.
- The branches are the representation of the times taken for the activities performed on the entities or by the entities before reaching other nodes.
- The time spent between seizing and releasing a resource, for instance is represented by a branch in the network.

Symbolisms in SLAM II network modeling

- Graphic symbols are used to represent the nodes and the branches of the network.

- It is recommended that a simulation model be graphically built first and then be coded in the input statements.

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SLAM II NETWORK SYMBOLS

Name	Symbol	Function
ACCUMULATE	FR, SR, SAVE, M	Accumulates a set of entities into a single entity
ACTIVITY	DUR, PROB, N, A	Specifies entity routing and delay (operation) times
GATE	GLBL, OPEN or CLOSE, IFL1, IFL2	Logical switch definition and initial status
OPEN	GLBL, M	Opens a gate
PREEMPT	IFL, PR, RLBL, NATR, M, SNLBL	Preempts a resource
ASSIGN	VAR=VALUE, M	Assigns values to attributes or global system variables
COLCT	TYPE, ID H, M	Collects statistics and histograms on SLAM II variables
CREATE	TBC, TF, MA, MC, M	Creates entities based on a specified arrival pattern
GOON	M	A continuation or "do nothing" node
MATCH	QLBL, NATR, NLBL	Delays entities in QUEUE nodes until a match on an attribute is made
QUEUE	IQ, QC, IFL	Delays entities until a server becomes available
SELECT	QSR, SSR	Selects among queues and servers based on prescrib
TERMINATE	TC	Terminates the routing of entities
RESOURCE	RLBL(RC), IFL1, IFL2	Resource definition and initial capacity
DETECT	XVAR, XDIR, VALUE, TOL, M	Creates (generates) an entity when a variable value reaches a prescribed threshold
ENTER	NUM, M	Entry point for entity insertion from user-written FORTRAN subprogram
EVENT	JEVNT, M	Transfer of control to user-written FORTRAN subprogram
ALTER	RLBL, CC, M	Changes the available number (capacity) of a resource
AWAIT	IFL, RLBL/UR OR GLBL, M	Delays entities until a resource is available or a gate is open
CLOSE	GLBL, M	Closes a gate
FREE	RLBL, UF, M	Makes resources available for reallocation

EXAMPLE OF A SINGLE SERVER QUEUING

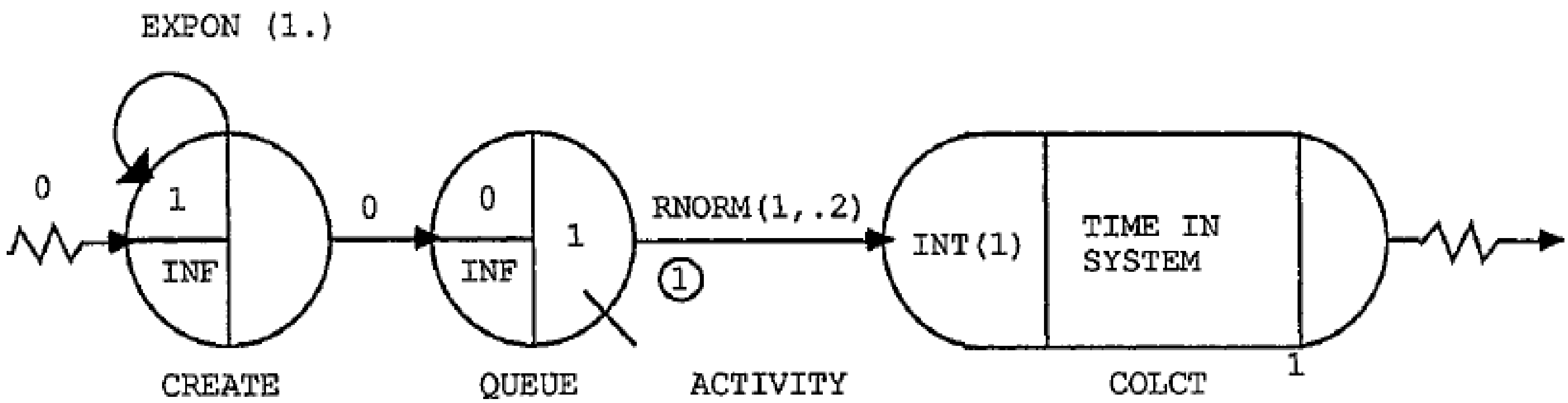

Figure 2. A Single-Server Queuing Example

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CREATE,EXPON(1.),0.,1;                  GENERATE ARRIVALS
QUEUE(1);                               WAIT FOR SERVICE
ACTIVITY(1),RNORM(1.,.2);               PROCESS
COLCT,INT(1),TIME IN SYSTEM;            COLLECT STATISTICS
ENDNETWORK;
```

Figure 3. Example Model Input

EXPLAINATION..

- The network begins with CREATE node which generates the first job arrival at simulated time 0.0 and continues to generate arrivals at a rate drawn from an exponential distribution. A Queue node is used to delay arrivals until the station is available.
- The processing time of the station is sampled from normal distribution and it is represented by the ACTIVITY or branch, following the QUEUE. When the activity is done, a COLCT node records the interval between departure time and jobs arrival time, which was stored in attribute 1.

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- Unless the network was constructed using TESS the diagram is then translated into a set of input statements where each symbol corresponds to an input statement, and each statement may be followed by a comment which describes the processing being performed.

- The output from this model would automatically report statistics on job waiting time, queue length, station utilization, time in system and throughput.

USING DISCRETE EVENT CONCEPT

- In discrete event orientation of SLAM, the modeler identifies the discrete points in time at which the state of the system can change and develops the logic associated with each such “event” .

- SLAM provides support subroutines which perform such common simulation tasks as scheduling events, moving entities into and out of files, collecting statistics and obtaining random samples. Several interfaces are possible in a SLAM network and user-written FORTRAN inserts. One is the EVENT node which is a ”do-it-yourself” node. It involkes a user-written subroutine in which highly complex logic may be performed.

CONTINUOUS MODELING

- In a continuous simulation model the state of the system is represented by variables that change continuously over time. The modeler specifies equations which determine the values of state variables and the step size or time increment, between the updating of variable values.

- For continuous simulations, SLAM provides a set of special storage arrays which the modeler uses to encode the equations of continuous variables.
- In combined models these variables may be affected by the occurrence of discrete events as well as by their defining equations.

Modeling with continuous variables..

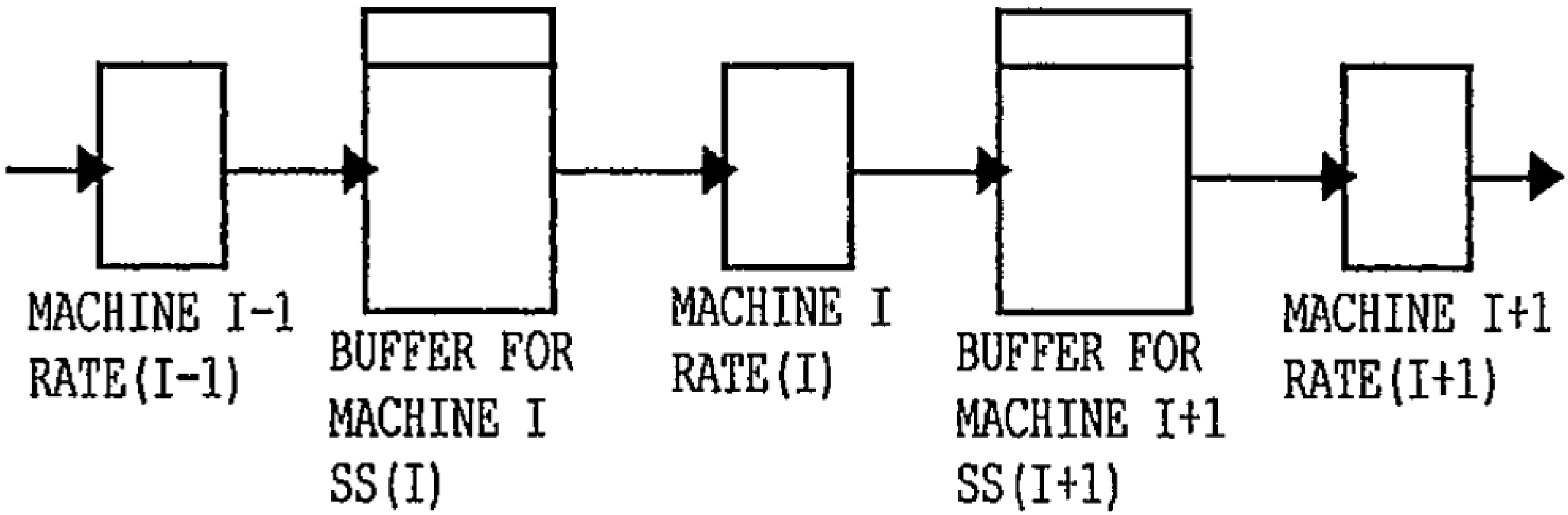

Figure 4. Modeling with Continuous Variables

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- Continuous variables have proven to be an efficient way to model high-speed, high volume systems such as packaging lines. In such a system, a buffer area between 2 machines may contain several hundred items-too many to be modeled individually. This increases at the production rate of feeding machine and decreases at the production rate of the following machine.

- The equations defining the rates of change for continuous variables are written in a FORTRAN subroutine.

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- SLAM updates the variable values at prescribed time intervals and monitors those variables against any threshold value defined. One threshold value , for example, would be the capacity of a buffer. When it is crossed, the feeding machine would need to stop production until the buffer level decreased enough to accept more production

MATERIAL HANDLING MOVEMENTS

- Among the most complicated elements to incorporate in a simulation model are automated devices (cranes, stacker cranes, AGVS) which follow fixed paths .
- A material handling extension to SLAM, first available in 1986, provides constructs for simulating these complexities (Pritsker,1986).

THANK YOU