GPSS (Part I)

Discrete Event Simulation
2005-2006 Fall Term

Prof. Dr. Nadir Yücel, Ass. Prof. Dr. A. Şima Uyar

GPSS

- General Purpose Simulation System Language
- GPSS program consists of sequence of statements

<table>
<thead>
<tr>
<th>Location</th>
<th>Block Type Name</th>
<th>Fields</th>
<th>Comment</th>
</tr>
</thead>
</table>

A GPSS statement:

Terminology

- block diagram
- blocks = activities
- transactions (Xacts) = units of traffic moving along the block diagram
- air traffic control system: planes moving through a sequence of control zones
- communication system: messages
- hospital: patients, equipment, ...

Xacts have unique id numbers (positive integer)
- no Xacts when simulation begins
- Xacts are created and introduced into model
- Xacts leave model: destroyed
- current block
- next block attempted
- many Xacts in system
- only one Xact moves at a time

Terminology

- Xact tries to move from its current block into its next block attempted
- Xact stops moving
  - moves into block that holds Xact for a simulated time
  - next block attempted refuses Xact: blocks Xact
  - moves into block which destroys Xact
  - when Xact stops, another Xact starts moving
  - sources = birth blocks: create Xacts
  - sinks = death blocks: destroy Xacts

Terminology

- simulated clock
  - positive real values
  - time cannot go back in GPSS
  - modeler chooses base time unit
  - event scheduling

Terminology

- simulated clock
  - Xact created (NOT introduced into system)
  - Xact introduced into system
  - Xact moves along its path until it stops

- event scheduling
  - Xact created (NOT introduced into system)
  - Xact introduced into system
  - Xact moves along its path until it stops
Example

Simulation of a Repair Shop
- Faulty parts (fp) repaired
- Only 1 repairman
- 8 hour shift

<table>
<thead>
<tr>
<th>Order of events</th>
<th>Event</th>
<th>Time of occurrence</th>
<th>Simulated time of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Begin</td>
<td>8:00am</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>1st fp arrives, repair begins</td>
<td>8:22:30am</td>
<td>8:22:30am</td>
</tr>
<tr>
<td>3</td>
<td>2nd fp arrives, start repair</td>
<td>8:36:12am</td>
<td>8:36:12am</td>
</tr>
<tr>
<td>4</td>
<td>3rd fp arrives, start repair</td>
<td>8:40:18am</td>
<td>8:40:18am</td>
</tr>
<tr>
<td>5</td>
<td>Repair of 1st fp ends, repair of 2nd fp begins</td>
<td>8:42:36am</td>
<td>8:42:36am</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example

Simulated clock time | Description of events
----------------------|------------------------
0.0                   | Xact for fp1 created and scheduled to come into system at 22.5
22.5                  | fp1 introduced into system, Xact for fp2 created and scheduled to come into system at 36.2, repair of fp1 begins (Xact moves into block which will hold it until 42.6 to simulate repair action)
36.2                  | fp2 introduced into system, Xact for fp3 created and scheduled to come into system at 46.3, fp2 waits
46.3                  | fp3 introduced into system, Xact for fp4 created and scheduled to come into system at 42.6, fp3 waits
42.6                  | fp4 introduces repairman and leaves system, repair of fp2 begins

GPSS Statements

- Block statements
  - Correspond to blocks in diagram
  - Executed when Xact enters
  - Block statements
    - Has unique locations
    - Provided by system
    - May have labels
    - Given by modeler
    - Operation keyword
    - May have operands
    - Some may have defaults

- Control statements
  - Do not correspond to blocks
  - Not shown in diagram
  - Some may have labels
  - For some labels not allowed
  - Has operation keyword
  - May have operands
  - Some have defaults

- Comments statements
  - Used for comments

- Compiler directives
  - Used as directives for compiler

GPSS Statements

- Generate A,B,C,D,E
  - Create Xact for future entry into system
  - Birth block
  - A: Mean value of interarrival time
  - B: Half range of interarrival time
  - C: Start delay time
  - D: Creation limit
  - E: Priority
  - Interarrival time uniformly distributed in A±B
  - Self-propagating

Block Statements
Generate example
GENERATE 15.0, 4.5
- interarrival times uniformly distributed in (10.5, 19.5), i.e., 15.0±4.5
- at time 0.0, 1st Xact created
- interarrival time chosen randomly (e.g., 16.7)
- Xact scheduled to move into system at 16.7 (0.0+16.7)
- at time 16.7, 1st Xact leaves block, 2nd Xact is created
- interarrival time is chosen randomly (e.g., 14.3)
- Xact scheduled to move into system at 31.0 (16.7+14.3)
- at time 31.0, 2nd Xact leaves block, 3rd Xact is created

Example: Manufacturing Shop
A machine tool in a manufacturing shop is turning out parts at the rate of every 5 minutes. As they are finished, the parts are turned over to an inspector who takes 4±3 minutes to examine each one and rejects about 10% of the parts as faulty. Each part will be represented by an Xact and the base time unit for the system is chosen as 1 minute. Simulate for 100 parts to leave the system.
Example: Manufacturing Shop

What if asked to simulate system for 100 faulty parts to leave the system?

START 100

GENERATE 5
ADVANCE 4,3
TRANSFER 0,1,ACC,REJ
ACC TERMINATE 0
REJ TERMINATE 1