Simio Basics 2
(Batching, Functions, Variables, and Statistics)

Chuljin Park & Seong-Hee Kim

Hanyang University/Georgia Tech

Assembly Operation Model
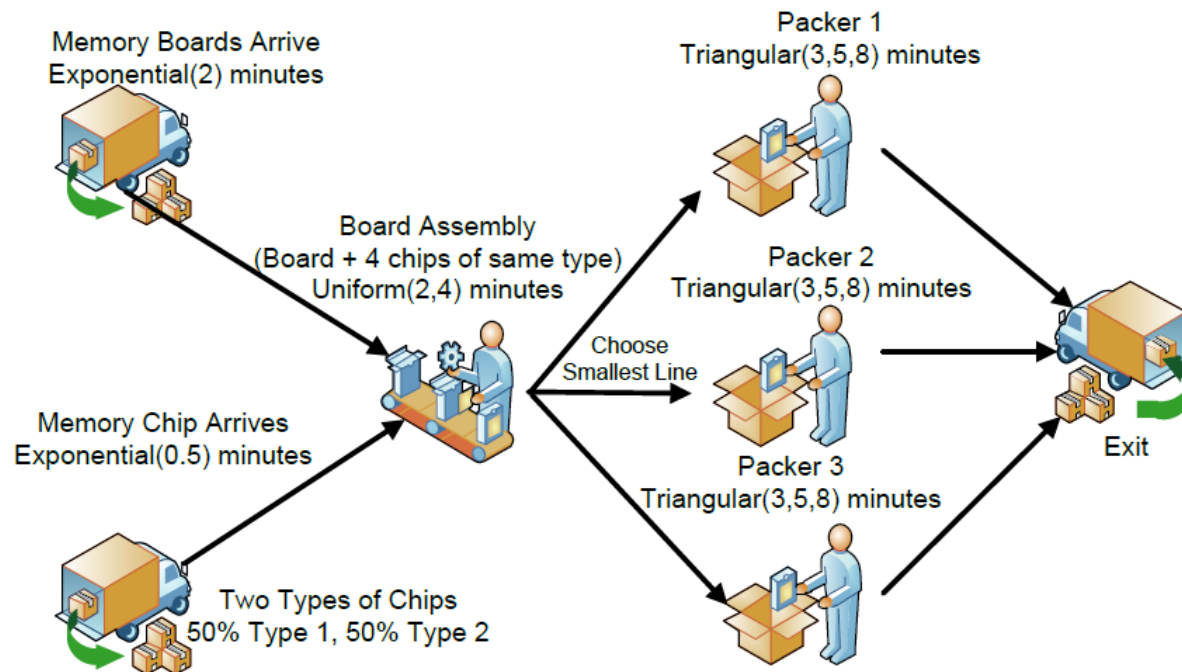
- Each memory board requires four chips.

Figure 5.1: Memory Board Assembly and Packing

© Joines and Robert

Numerical Distributions

	From	To	Travel time (minutes)
Travel Times	Memory board arrivals	Board Assembly	Uniform(3,5) minutes
	Memory chip arrivals	Board Assembly	Uniform(4,6) minutes
	Board Assembly	Packer Station 1	Pert(10,12,15) minutes
	Board Assembly	Packer Station 2	Pert(5,7,10) minutes
	Board Assembly	Packer Station 3	Pert(4,5,7) minutes
	Any Packer Station	Exit	3.5 minutes

Arrival Information	Interarrival time for Memory Boards	Exponential(2) minutes
	Interarrival time for Memory chips	Exponential(.5) minutes
	50% of memory chips are of type 1 and 50% are of type 2	Discrete
Processing Times	Board Assembly processing time	Uniform(2,4) minutes
	Packing time for all Packers	Triangular(3,5,8) minutes

© Joines and Robert

Creating Two Types of Chips

- Table with $RandomRow$ can be used.

- Here we will use a variable.

- Each entity carries state variable $StaChipType$.

  Q: Where should we define it, under Model or ModelEntity?

- Under State Assignments
  - Chip Type will be Random.Discrete(1, 0.5, 2, 1)
  - Change ModelEntity.Picture depending on type.

Before Exiting - Repeating Property Editor

Items:

ModelEntity.StaChipType, Random.Discrete(1,0.5,2,1)
ModelEntity.Picture, ModelEntity.StaChipType - 1

Properties:

☐ Show Commonly Used Properties Only

⊟ **Basic Logic**	
State Variable Name	**ModelEntity.StaChipType**
New Value	**Random.Discrete(1,0.5,2,1)**

Basic Logic
State Assignments (Basic Logic)

Add   Delete

Close

Creating a New Symbol

- Project Home **tab** > Create **section** > New Symbol > Create New Symbol

- Set height to a non-zero value (e.g., width 0.1 meter and height 0.2 meter) so that you can manually change it later.

- To display batched chips on a memory board, use EntMemoryBoard > Attached Animation **tab** > Draw Queue > BatchMembers.

Combiner/Separator

Combiner
Separator

Memory board should be
connected to ParentInput
for Combiner and ParentOutput
for Separator.

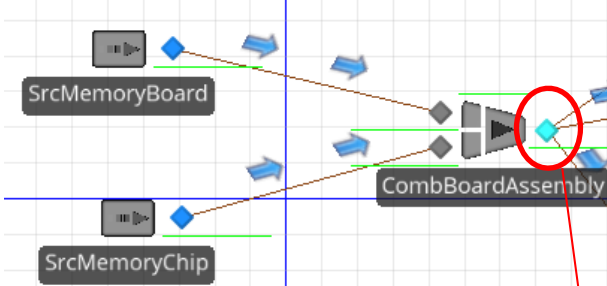Properties: CombBoardAssembly (Combiner)

☐ Show Commonly Used Properties Only

Matching Logic	
Batch Quantity	**4**
☐ Matching Rule	**Match Members**
Member Match Expression	**ModelEntity.StaChipType**
Parent Ranking Rule	First In First Out
Member Ranking Rule	First In First Out
Process Logic	
Capacity Type	Fixed
Initial Capacity	**4**
⊞ Parent Transfer-In Time	0.0
⊞ Member Transfer-In Time	0.0
⊞ Processing Time	**Random.Uniform(2,4)**
⊞ **Buffer Capacities**	
⊞ **Reliability Logic**	
⊞ **State Assignments**	
⊞ **Secondary Resources**	
⊞ **Financials**	
⊞ **Add-On Process Triggers**	
⊞ **Advanced Options**	
⊞ **General**	
⊞ **Animation**	

Selection Based on Shortest Queue

First define ListNodes from
Definitions **tab** > List

	Node
▶	Input@SrvPacker1
	Input@SrvPacker2
	Input@SrvPacker3
✱	

SrcMemoryBoard

CombBoardAssembly

SrcMemoryChip

Properties: Output@CombBoardAssembly (TransferNode)

☐ Show Commonly Used Properties Only

⊟ **Crossing Logic**	
Initial Traveler Capacity	Infinity
Entry Ranking Rule	First In First Out
⊟ **Routing Logic**	
Outbound Link Preference	Any
Outbound Link Rule	Shortest Path
⊟ Entity Destination Type	**Select From List**
Node List Name	**ListNodes**
⊟ Selection Goal	**Smallest Value**
Selection Expression	**Candidate.Node.AssociatedStationLoad**
Selection Condition	
Blocked Destination Rule	Select Available Only
⊟ **Transport Logic**	
Ride On Transporter	False
⊞ **Tally Statistics**	
⊞ **Add-On Process Triggers**	

Or use the following selection expression

$Selection\ Expression:$ Candidate.Node.NumberTravelers.RoutingIn +
Candidate.Server.InputBuffer.Contents.NumberWaiting +
Candidate.Server.Processing.Contents.NumberWaiting[55]
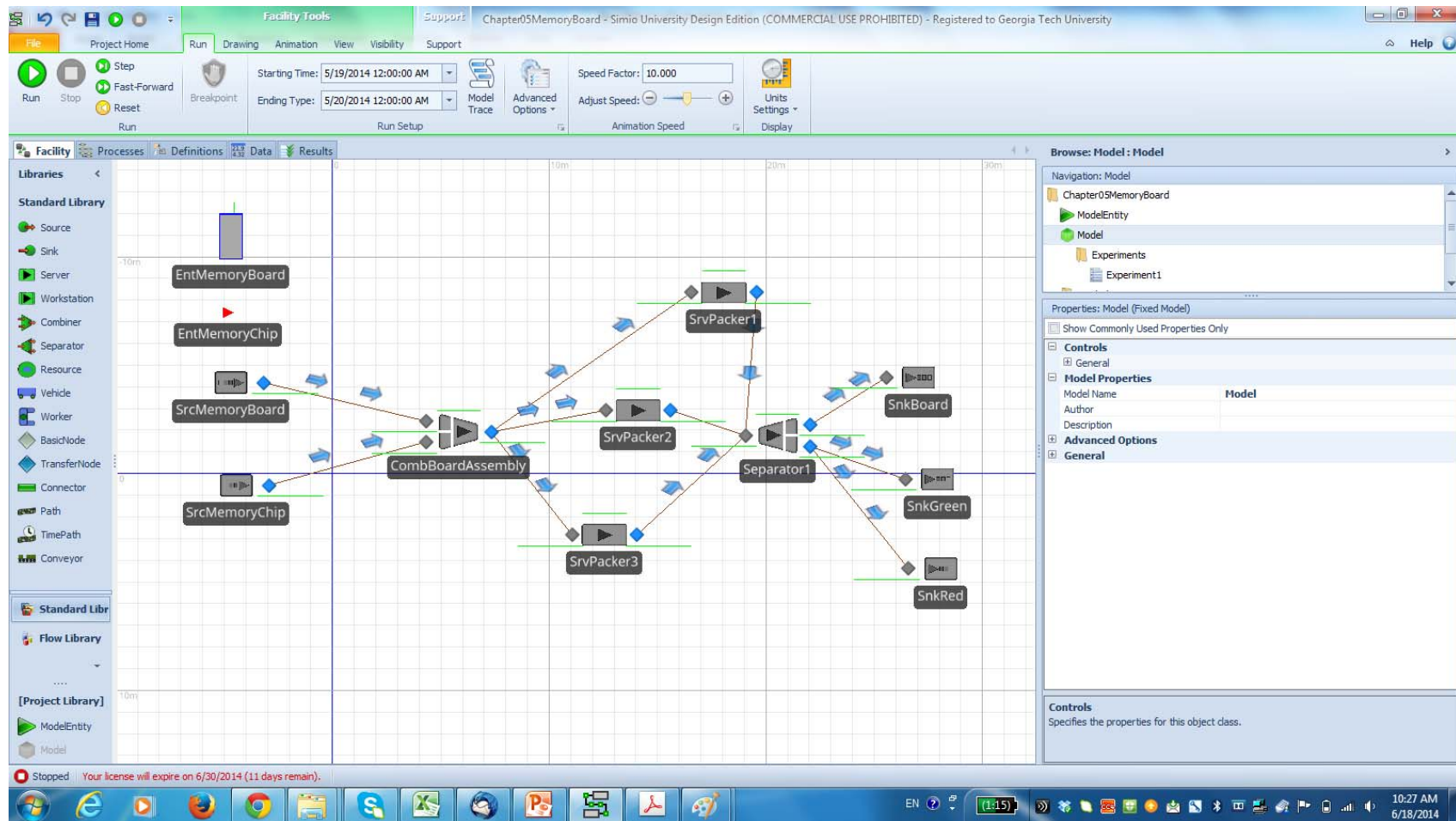
Enhance Animation

- Change an entity picture after packers.
- We will increase height of memory board to 1 meter so that the combined entity picture looks like a box.

Each Packer Server >
State Assignments >
Before Exiting
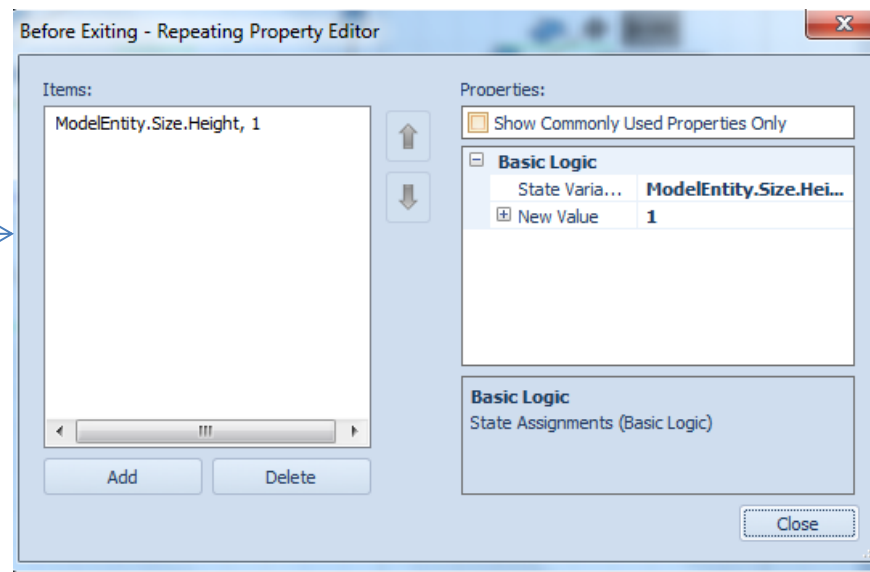
Time To Travel

- Currently the connector type between packers and separator is "time path" with the same distribution.

- Can we make it easy to change the travel distribution? Yes! Use a property variable (control of a model).

  - You can manually define TimeToExit (with type "expression") under Definitions>Properties and set Travel Time of each path to TimeToExit.

  - Or right click on Travel Time > Set Referenced Property > Create New Referenced Property >TimeToExit.

Look Up Table

- Packer 1 is only 80% as efficient when there is zero in the input buffer queue, 90% when there is one, and 100% for all others.
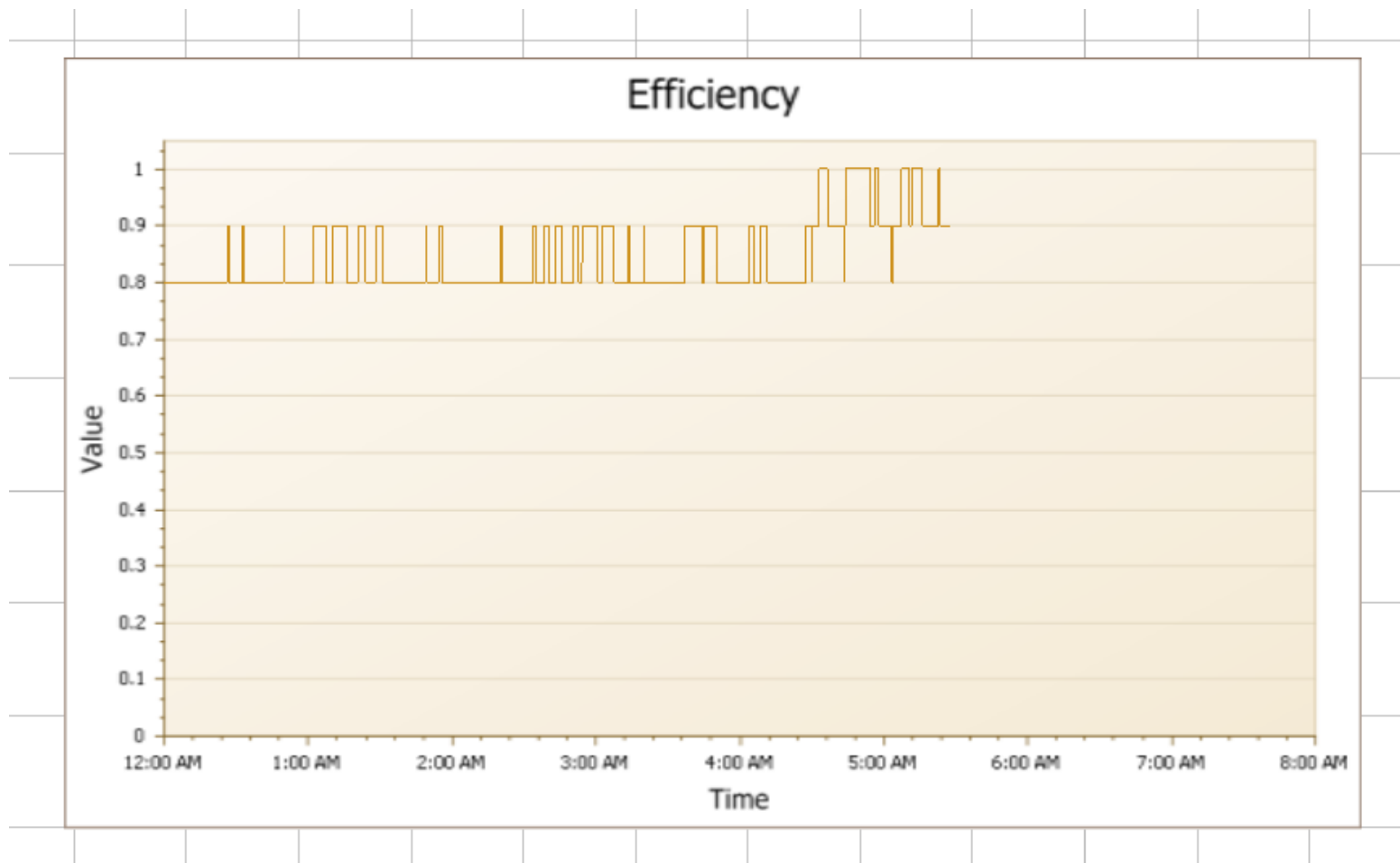

Data tab > Lookup Tables

Processing Times = Random.Pert(3,5,8) / LookupTableEfficiency[SrvPacker1.InputBuffer. Contents.NumberWaiting]

- For a long expression, use Definitions tab>Functions.

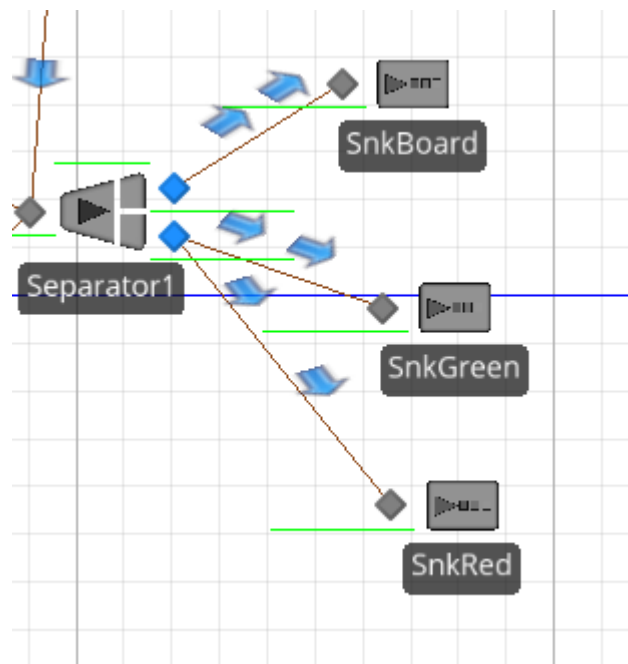Processing Times = Random.Pert(3,5,8) / FncEfficiency

Efficiency

User-Defined Statistics

- Task 1: We want to separate flow time statistics for memory board, chip type 1, and chip type 2.
- Task 2: Get Packer 1 average efficiency.

Task 1: separate flow times

Use a different Sink for each type.

In Model window, go to Results tab>Sink

Sink	SnkBoard	[DestroyedObjects]	FlowTime	TimeInSystem	Average (Ho...	0.7141
					Maximum (Ho...	1.4063
					Minimum (Ho...	0.3421
					Observations	677.0000
		InputBuffer	Throughput	NumberEntered	Total	677.0000
				NumberExited	Total	677.0000
	SnkGreen	[DestroyedObjects]	FlowTime	TimeInSystem	Average (Ho...	0.6457
					Maximum (Ho...	1.2971
					Minimum (Ho...	0.3730
					Observations	1,348.0000
		InputBuffer	Throughput	NumberEntered	Total	1,348.0000
				NumberExited	Total	1,348.0000
	SnkRed	[DestroyedObjects]	FlowTime	TimeInSystem	Average (Ho...	0.6623
					Maximum (Ho...	1.3018
					Minimum (Ho...	0.3494
					Observations	1,360.0000
		InputBuffer	Throughput	NumberEntered	Total	1,360.0000
				NumberExited	Total	1,360.0000

In Experiment, use Expression
"SinkName.TimeInSystem.Average"
 for flow time statistics.

In Model window, go to Results tab>Sink

Sink	SnkBoard	[DestroyedObjects]	FlowTime	TimeInSystem	Average (Ho...	0.7141
					Maximum (Ho...	1.4063
					Minimum (Ho...	0.3421
					Observations	677.0000
		InputBuffer	Throughput	NumberEntered	Total	677.0000
				NumberExited	Total	677.0000
	SnkGreen	[DestroyedObjects]	FlowTime	TimeInSystem	Average (Ho...	0.6457
					Maximum (Ho...	1.2971
					Minimum (Ho...	0.3730
					Observations	1,348.0000
		InputBuffer	Throughput	NumberEntered	Total	1,348.0000
				NumberExited	Total	1,348.0000
	SnkRed	[DestroyedObjects]	FlowTime	TimeInSystem	Average (Ho...	0.6623
					Maximum (Ho...	1.3018
					Minimum (Ho...	0.3494
					Observations	1,360.0000
		InputBuffer	Throughput	NumberEntered	Total	1,360.0000
				NumberExited	Total	1,360.0000

In Experiment, use Expression "SinkName.TimeInSystem.Average" for flow time statistics.

Task 2: Packer 1 average efficiency

- For Paker1 efficiency, note that it should be "state statistics".
- Tally Statistics uses a plain average while State Statistics uses time-average.
  - Tally statistics: average flow time, average waiting time, average delay time etc.
  - State statistics: utilization, average # in queue, average number in system etc.
  - Output statistics: return the last value of a variable when a replication is done.
- Definitions tab > Elements > State Statistics > define name as StaStatEfficiency. Then set state variable name to StaEfficiency.