Computer Simulation

Module 5: Arena

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Introduction

Module Overview

Last Module: We looked at general principles behind simulation languages. How do they work?

This Module: We'll learn about Arena, a popular simulation language.

Idea: Go through a series of tutorials that will allow you to fearlessly simulate real-world systems.

More Overview

This module is built on numerous mini-tutorials.

Many will be self-contained and will focus on a specific topic…

…Yet the tutorials are organized in groups that build to a common goal (e.g., a non-trivial demo).

Each lesson contains written notes, but you must WATCH the videos to see the “live” stuff.

I Gotta Have More Overview!

Rough Groupings of Topics:

A. Introductory material ← now
B. Modeling multi-channel systems
C. Building to a call center model
D. Some demos on interesting miscellaneous models

Pre-Show Notes…

- Arena is easy, but if it's not your cup of tea (whatever reason),…
- …There are many other simulation languages around.
- Arena is a good choice to enable you to learn those languages.
- In any case, we'll do lots of examples from which you may find useful applications.

The Next Few Lessons

Our first job is to cover some basics:

- Process-Interaction ← next
- Let's Meet Arena!
- The Arena Basic Template
- Create-Process-Dispose Modules
- The Process Module
- Resources, Schedules, Queues
- The Decide Module

Summary

This Time: Discussed what's coming up in this module on the Arena computer simulation language.

Next Time: A brief review of the Process-Interaction modeling approach. We'll use this to get our subsequent terminology straight and to re-introduce P-I.

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Process-Interaction Review

Lesson Overview

Last Lesson: We simply discussed what's coming up in this Arena module.

This Lesson: A quick review of the Process-Interaction approach that Arena uses.

Idea: It's just a flowchart!

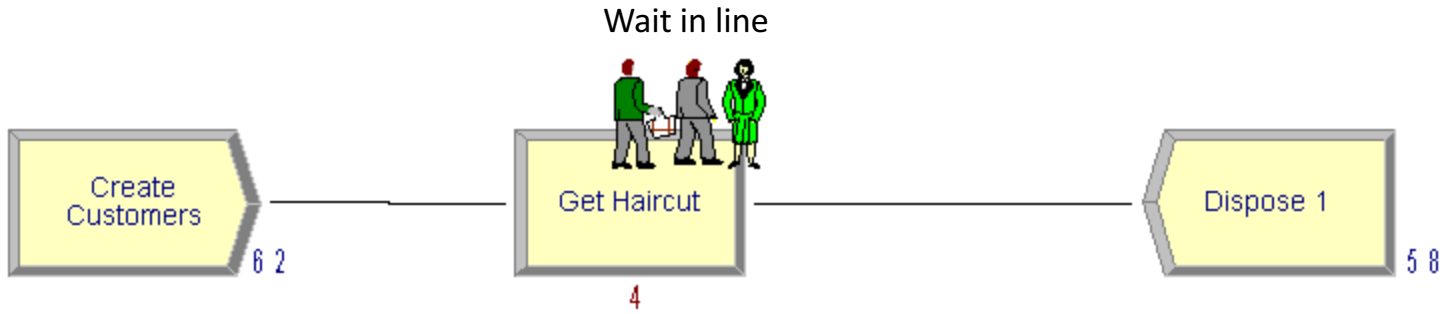
Process-Interaction

- Consider a generic customer (entity) and the sequence of events and activities (processes) it undergoes as it moves through the system.
- At any time, the system may have many entities interacting with each other as they compete for resources.
- Arena takes this *process-interaction* "world view."

P-I (cont'd)

- The entities flow through a network of modules (blocks) that describe their behavior.
- The network can be represented as a process flowchart.
- Example: People show up at the barber, get served (maybe after waiting in line), and then leave.
- In Arena:
  - Create (generate cust arrivals)
  - Process (use the barber)
  - Dispose (outta here)

If It Quacks Like a Flowchart…



Generate arrivals

Get Haircut

Outta here!

Summary

This Time: Talked about the Process-Interaction modeling approach and how it relates to Arena.

Next Time: A first look at Arena. How to get it, and a sneak peak.

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Let’s Meet Arena!

Lesson Overview

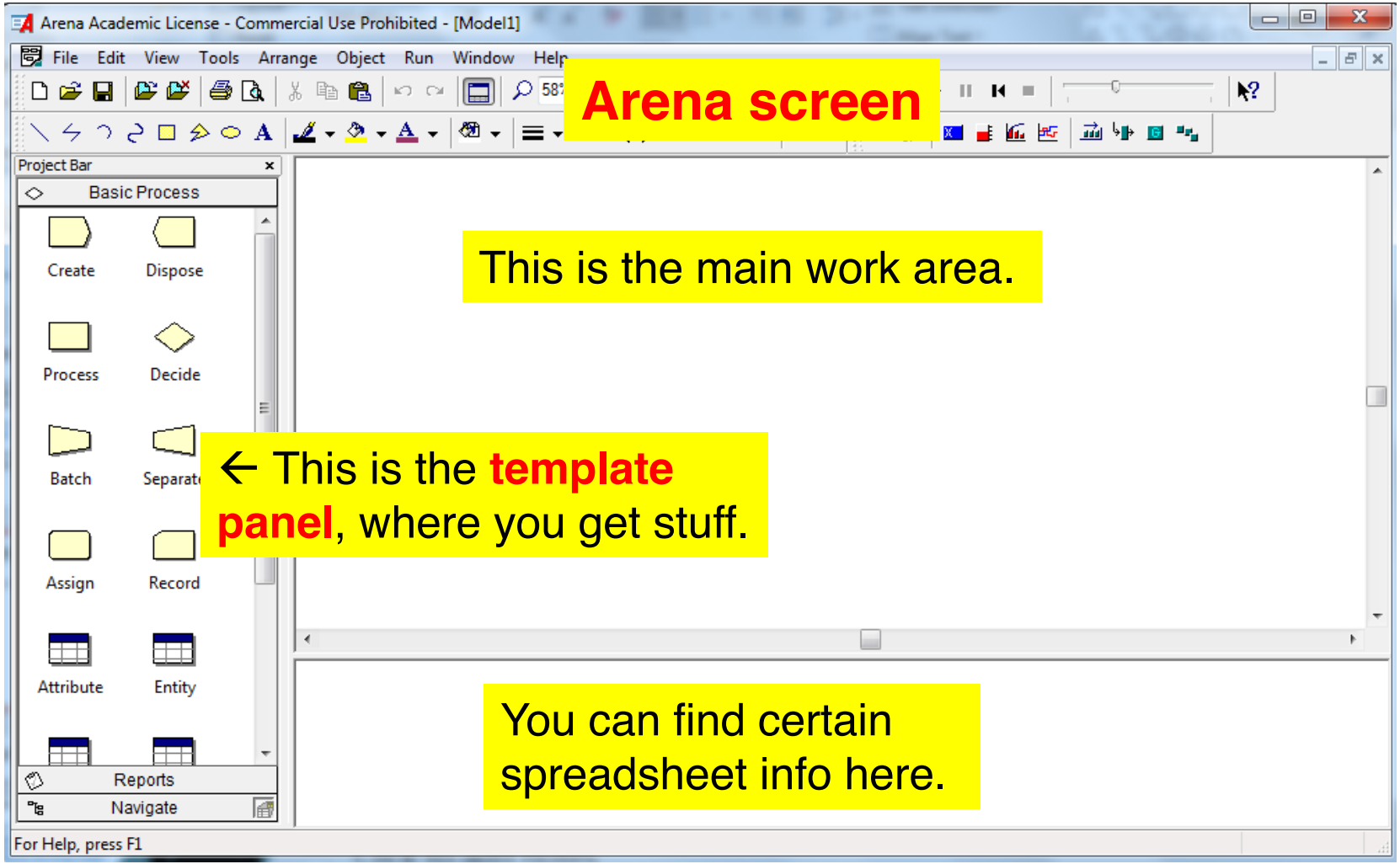
Last Lesson: Reviewed the Process-Interaction approach. This is what Arena uses.

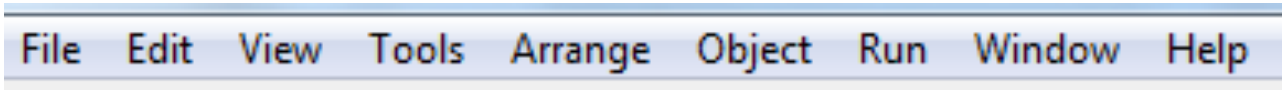
This Lesson: Let's finally meet Arena!

We'll show how to get the software, and then take a first look.

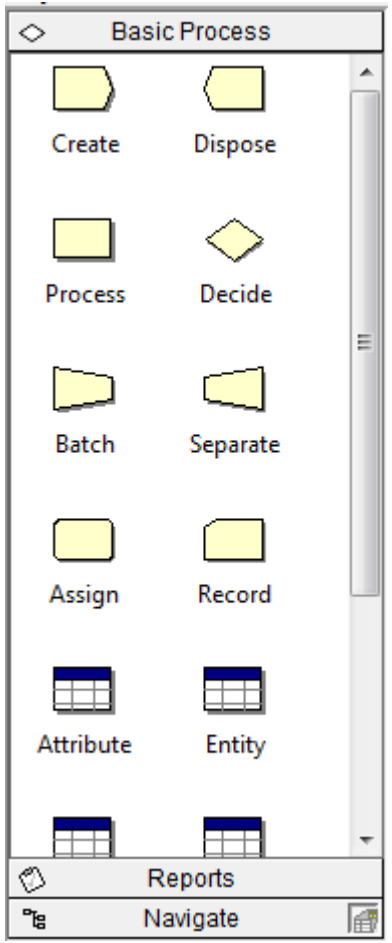
Getting Arena

- Easy to download and install free student version of Arena.
- https://www.arenasimulation.com/academic/students
- This is a Windows product.
- If you're indeed using Windows, then there is certain Arena stuff you'll occasionally use that's stored deep down in a "Rockwell Software" directory (don't worry about this for now).
- If you don't have Windows, it ain't a problem…
- You can also use Arena via the Georgia Tech virtual labs.
- Or you can really be nerdy and partition your disk to use a Windows OS.


Arena Academic License - Commercial Use Prohibited - [Model1]
File Edit View Tools Arrange Object Run Window Help
Arena screen
Project Bar
Basic Process
Create
Dispose
Process
Decide
Batch
Assign
Record
Attribute
Entity
Reports
Navigate
This is the main work area.
← This is the template panel, where you get stuff.
You can find certain spreadsheet info here.
For Help, press F1



- File: Lets you do the usual New, Open, Close, Save,…, but also allows you to import different template panels and background pix.
- Edit: Allows you to edit entity pix, insert objects, other nice stuff.
- View: See various toolbars, customize your “named views”, etc.
- Tools: Lots of cool toys, including Input Analyzer, OptQuest, AVI capture, macros,…
- Arrange, Object, Window: Various visualization aids.
- Run: Set a run up and make it go as fast as you want or step-by-step.



- This is the Basic Process template panel.
- It does very basic stuff that a Univ. of Georgia student might be able to handle on a good day.
- The panel consists of modules (I call ‘em blocks sometimes) such as Create, Dispose, Process, etc., that will be connected together as a flowchart for our simulation model.
- The other items such as Attribute, Entity, etc., are related to spreadsheets.

- Demo Time! Look at the screen, go buttons, speed, zooming, etc.

Summary

This Time: Finally got to meet Arena! We downloaded Arena and then reviewed what the main screen looks like.

Next Time: We'll look at the Basic Process template in more detail. The components of this template will allow us to put together our first simulations.

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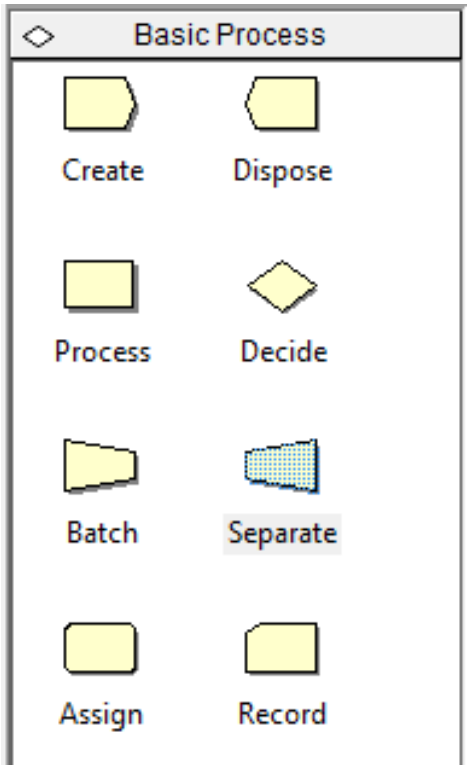
Basic Process Template

Lesson Overview

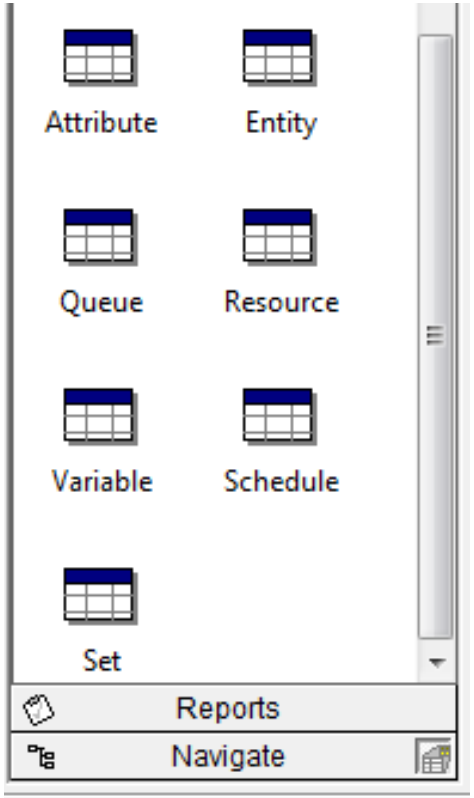
Last Lesson: We were introduced to Arena and went on our first date with it.

This Lesson: We'll look at the Basic Process template in some detail. The items from this template will allow us to put together our initial simulations.

Idea: Click and drag items to build the simulation.



- This is the top half of the Basic Process panel.
- It does very basic stuff that a Univ. of Georgia student might be able to handle on a good day.
- More-advanced templates available for non-UGA students: File > Template Panel > Attach
- The panel consists of modules such as Create, Dispose, Process, etc., that will be connected together as a flowchart representation for our simulation model.
- Example: Create generates customer arrivals.
- You'll drag these modules over to the work area to build the flowchart, fill in some numbers, and then hit the go button to run the simulation.



- This is bottom half of the Basic Process panel.
- These items such as Attribute, Entity, etc., are spreadsheets that are both informational and which will allow us to change certain system parameters.
- Example: The Variable spreadsheet defines global quantities such as WIP that are updated as the simulation progresses. Resource keeps track of the names and capacities of the different resources (servers).
- Demo Time! Look at a couple of modules and spreadsheets. Load a new template. Build a model.

Summary

This Time: Reviewed the modules and spreadsheets available on the Basic Process template.

Next Time: We'll learn about the Create, Process, and Dispose modules, and then build our first official simulation.

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Create-Process-Dispose Modules

Lesson Overview

Last Lesson: Learned about the Basic Process template.

This Lesson: We'll discuss the Create, Process, and Dispose modules, and then build our first official simulation.

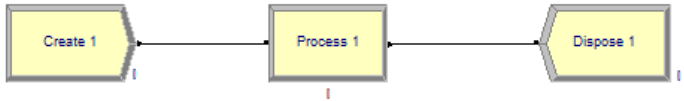
Idea: The modules are easy, but it turns out that there's a lot going on inside of them.

Create-Process-Dispose

- Create: Periodically generate customer arrivals.
- Process: Have work performed on the customers; maybe have to wait in line.
- Dispose: Customers leave the system after service.
- Fun Facts:
  - “Dispose” is called “Terminate” in the language GPSS
  - “Send to Die” in Automod.

How to Use

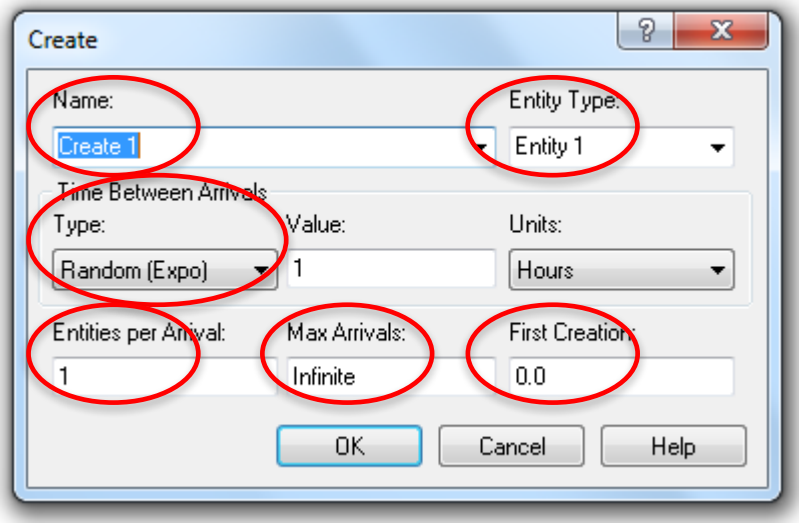
- Drag and drop from template.
- Modules (usually) connect automatically.



- Connects are “instantaneous” for customers.
- Hit “go” and see guys move…
- …But customers don’t look good and no lines form. Be patient and see demos.

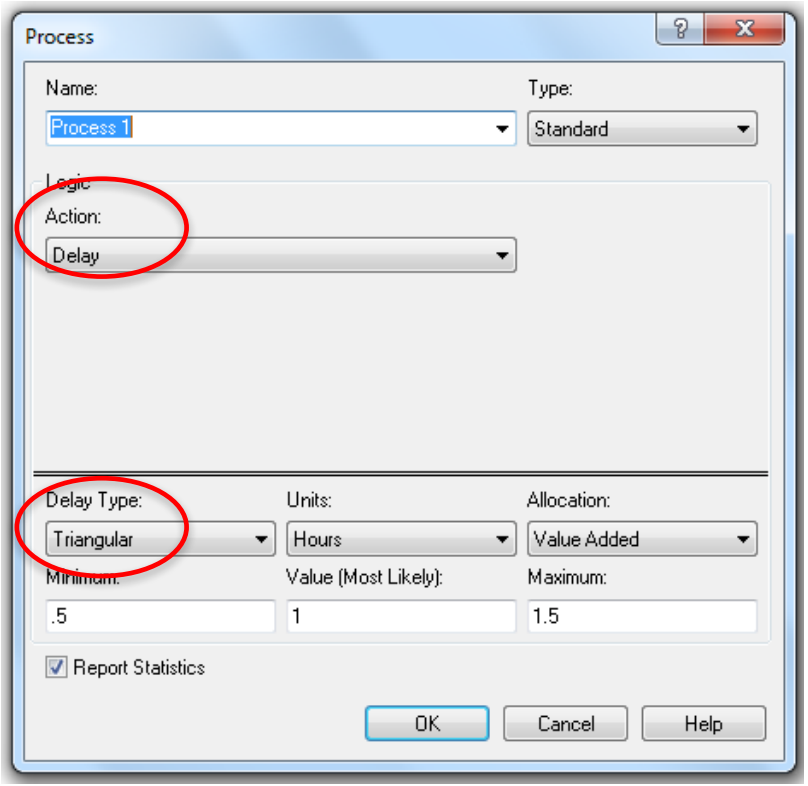
Deeper Dive into Create

- Click into modules and see required inputs.
- Example: Create
- Fields for
  - The name of the module
  - The type of entity (customer)
  - Interarrival distribution
  - # of customers per arrival
  - Maximum # of arrivals allowed
  - Time that the first guy shows up



Process and Dispose Modules

- Process module has fields for
  - The name of the module
  - Type of action. This is where you can try to reserve a server or free a server who's currently in use. More on this in next lesson.
  - How long will you be delayed? I.e., what is the service time?
- Dispose module
  - Nothing deep here – you just get rid of entities.
  - You can name the module.



Demo Time!

- Create-Process-Dispose
- Connecting the modules
- Go over input fields
- Expressions and Build Expression
- CONT and DISC functions
- Some other Arena-defined functions

Summary

This Time: Discussed aspects of the Basic Process template's Create-Process-Dispose modules.

Next Time: Deep dive on the Process module. It does a lot more than you may think!

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Details on the Process Module

Lesson Overview

Last Lesson: Learned about the Create-Process-Dispose modules.

This Lesson: We'll learn more goodies about the Process module.

Idea: It allows you to grab servers, use them, and then let them go for the next guy to use. And along the way, it automatically sets up a queue!

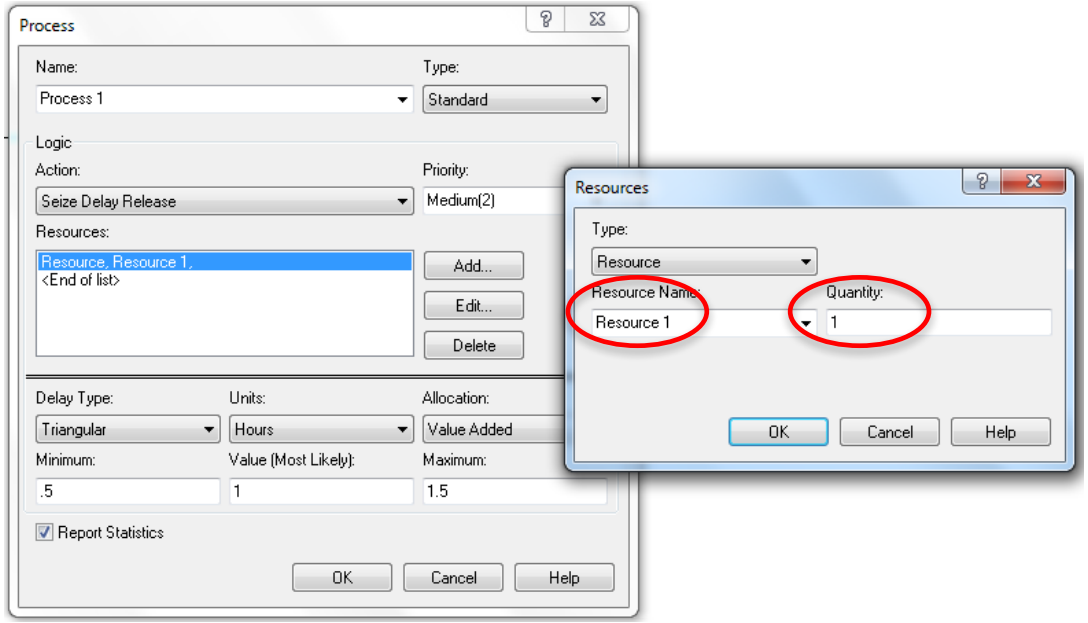
Seize-Delay-Release

You'll take one of the following "actions" in the Process module:

- Delay: Spend time in the Process (self-service).
- Seize-Delay-Release: Grab at least one resource (server), spend time getting served, and then free the server for the next customer. If you Seize and the server isn't available, you may have to wait in a queue. www.youtube.com/watch?v=eAyVgPtC5Zc
- Seize-Delay: Grab at least one resource and spend time getting served. Remember to Release the server sometime later, else he gets deadlocked and a giant line will form!
- Delay-Release: Use a previously Seize'd server for a while, and then free him for the next guy to use.

Resource Dialog Box

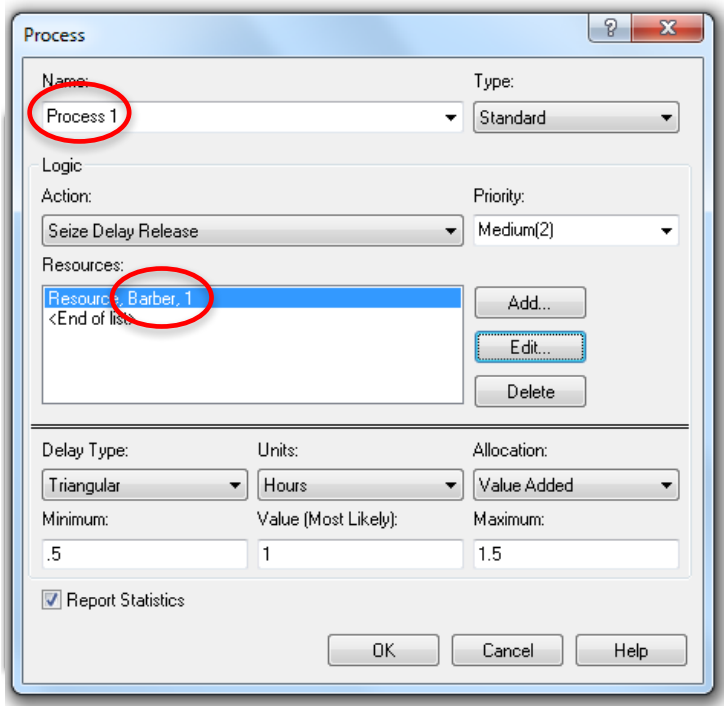
If you do a Seize or Release, a dialog box pops up asking which and how many resource(s) you want to Add (Seize) or Delete (Release).



Resource Dialog Box (cont'd)

Example:

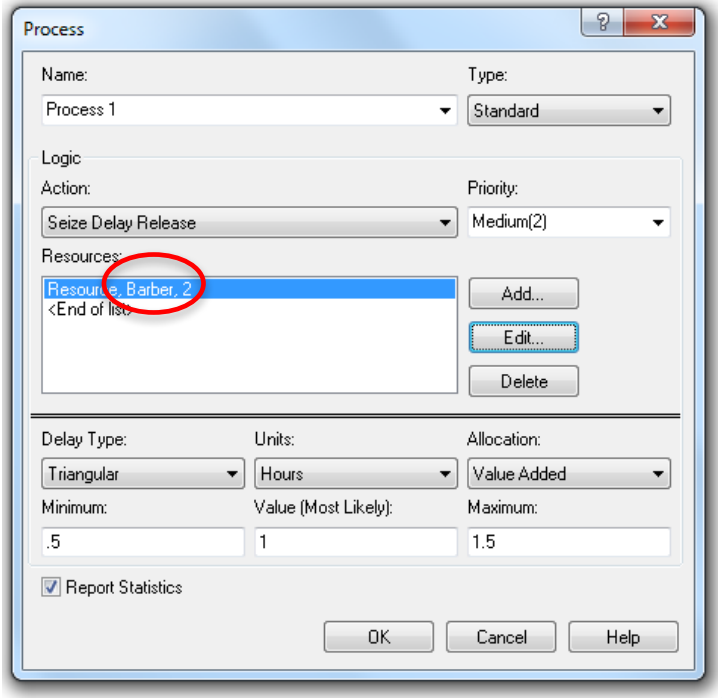
- A customer walks into the Process module, and does a Seize-Delay-Release to grab and use one unit of the resource Barber.
- Hit the Add button, name the resource Barber, and set Quantity = 1.
- The Process is given a default name of "Process 1" and includes the resource as well as the default queue "Process 1.Queue" (talk about later).
- Process = Resource + Queue



Resource Dialog Box (cont'd)

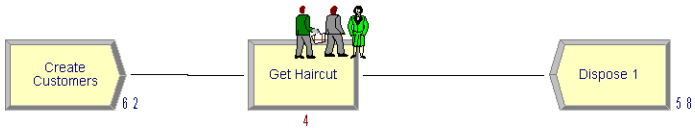
Slightly Different Example: Now every customer uses TWO barbers. (They all have lots of flowing locks like your gentle teacher). How to do?

- Set Quantity = 2 in Add or Edit box.
- Distinction: There may be 5 barbers in the store, but each customer needs exactly 2 of them. We'll show in the next lesson how to use the Resource Spreadsheet to set the Barber's "capacity" to 5.



Demo Time!

- Different permutations of Seize-Delay-Release
- Notice that a queue magically pops up!



- Multiple resources
- Warning about deadlocks

Summary

This Time: Learned lots more about the Process module, including the Seize-Delay-Release sequence and the associated queue that magically gets set up.

Next Time: We'll finally take a look at some Arena spreadsheets: Resource, Schedule, and Queue.