

Project Part 2

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Goals

- Model a phone's response to dynamic voltage and frequency scaling (DVFS)
- Understand the impact of frequency and voltage changes on power, performance
- Understand and use Ptolemy

Methodology

- Input:
 - For each interval:
 - CPU utilization (0-100%)
 - Memory utilization (0-100%)
- Process:
 - Change the CPU utilization (300 MHz – 3 GHz)
- Output:
 - For each interval:
 - The new frequency (default – 3 GHz)
 - The new interval length (default – 1 ms)
 - Output graphs (built into Ptolemy)

DVFS Impact on Power

- Changing frequencies affects the *active* power consumption
- In addition, changing frequencies affects the *idle* power consumption

$$power = Idle\ Power_i + Active\ Power_i * CPU\ utilization_{new}$$

- Both of these combine to affect the total energy expenditure of an interval

$$Energy = interval_{new} * power$$

DVFS Impact on Time

- Changing frequencies changes the speed at which instructions are executed
 - Faster frequencies reduce execution time (to an extent!)
 - Slower frequencies increase execution time (again, to an extent!)
- The extent of impact on power, time, and ultimately, energy, is for you to discover in this project.

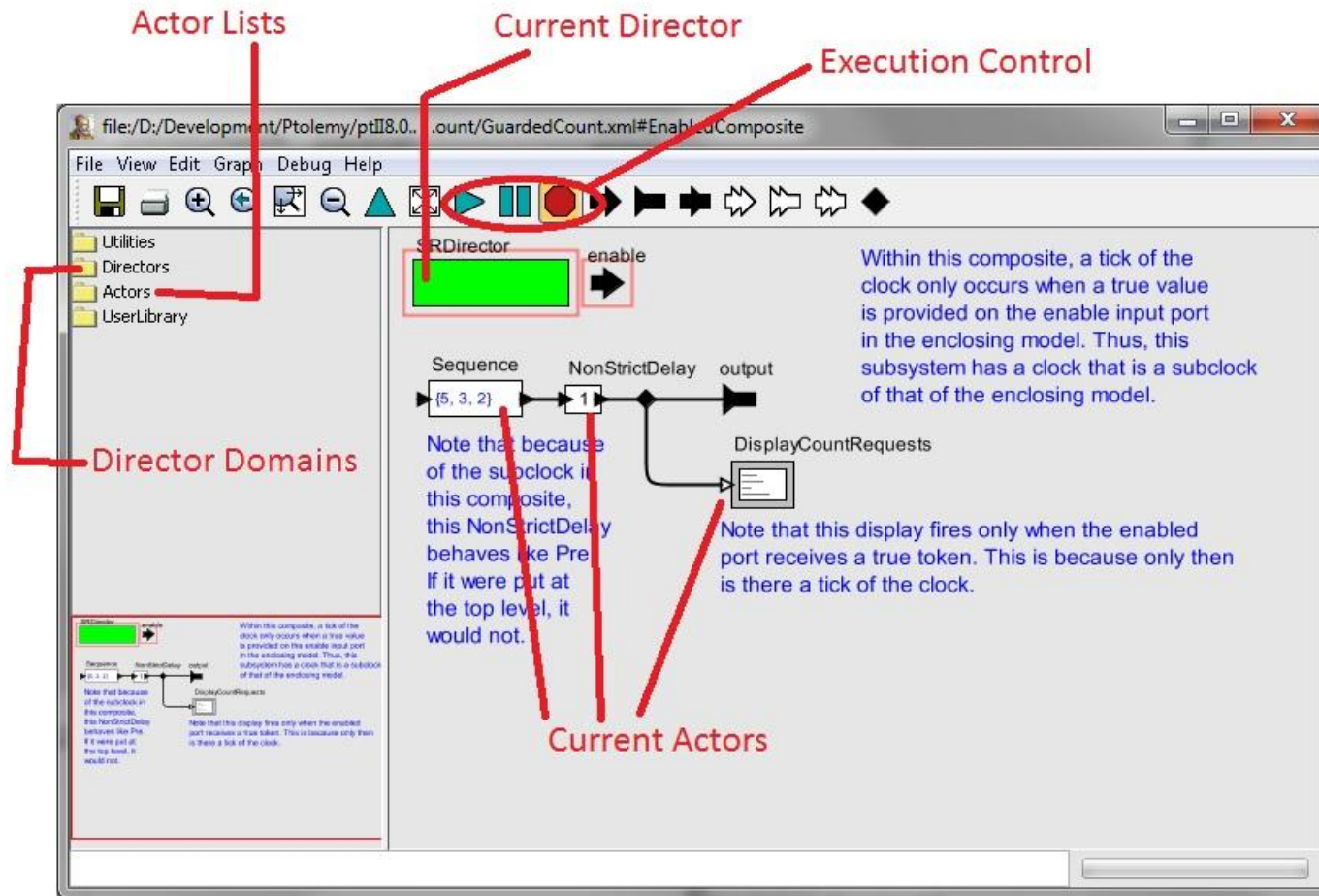
Ptolemy Introduction

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Overview

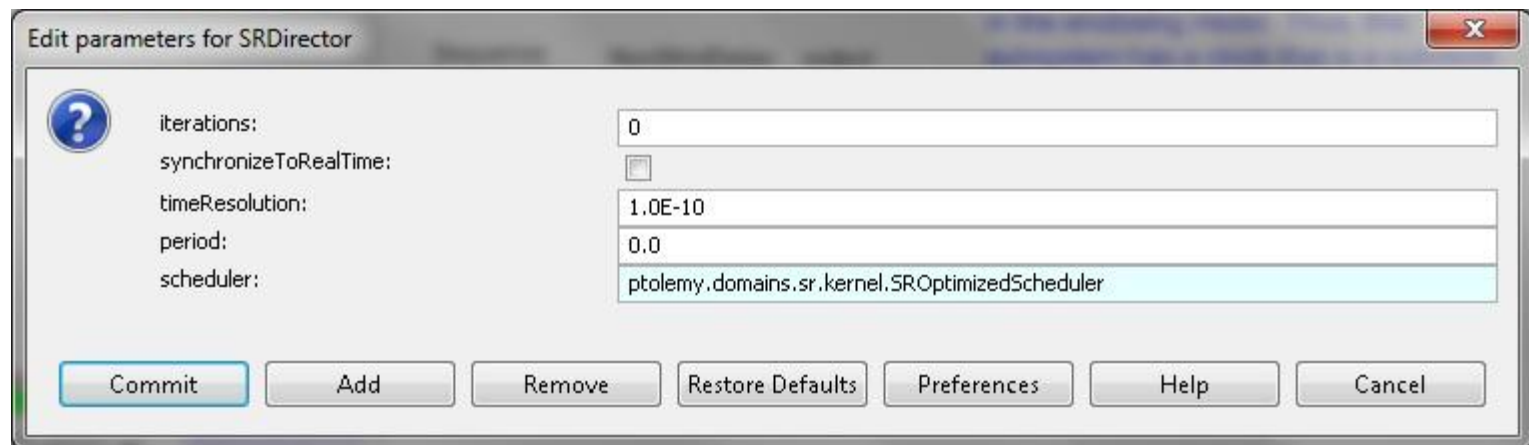
- Open-Source Modeling platform
- **Actor**-oriented *design*
 - Base unit of development
 - Individual “state” or unit of model that can communicate via messages
- **Director**-oriented *execution*
 - Director determines how actors interact with each other
 - Useful director domains for this class:
 - Process Networks (for Kahn Process Networks)
 - Dataflow (for message-passing, SDF)
 - Rendezvous
 - Synchronous Reactive (some FSM/StateChart functionality)
- Hierarchical
 - Any actor can be a composite actor or super-state (even from a different domain!)
 - Provides versatility, though at the cost of complexity

A First Look



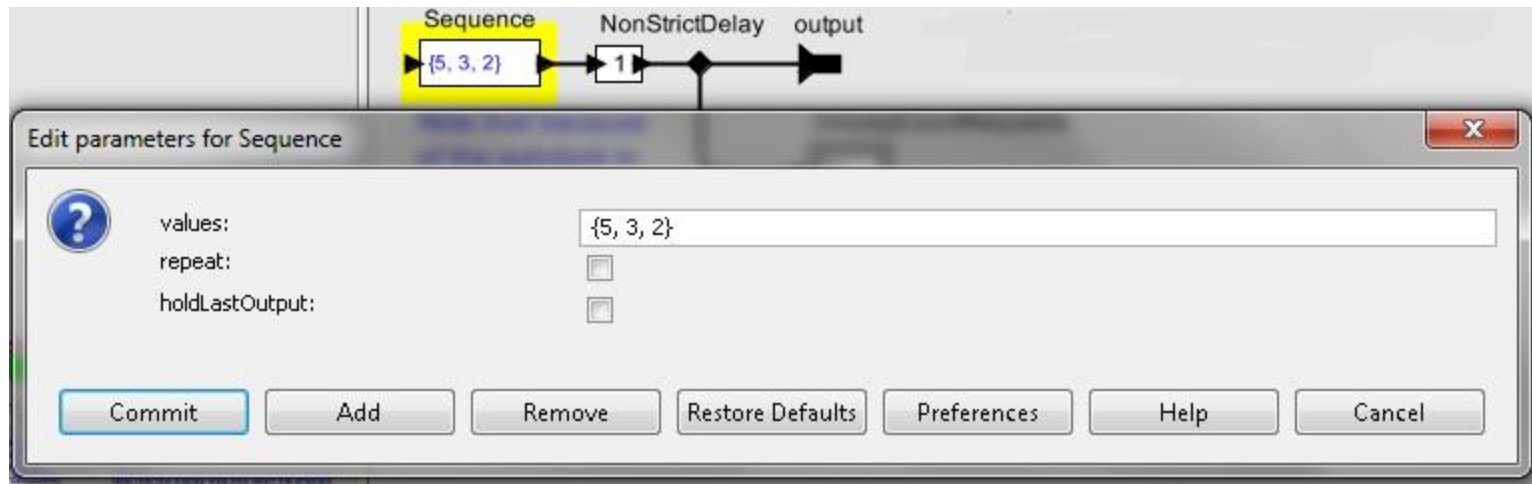
Director Settings

- Timing
 - # iterations (for discrete domains)
 - Time step, period, etc.
- Schedule sequence
 - Almost always use default (based on data flow)



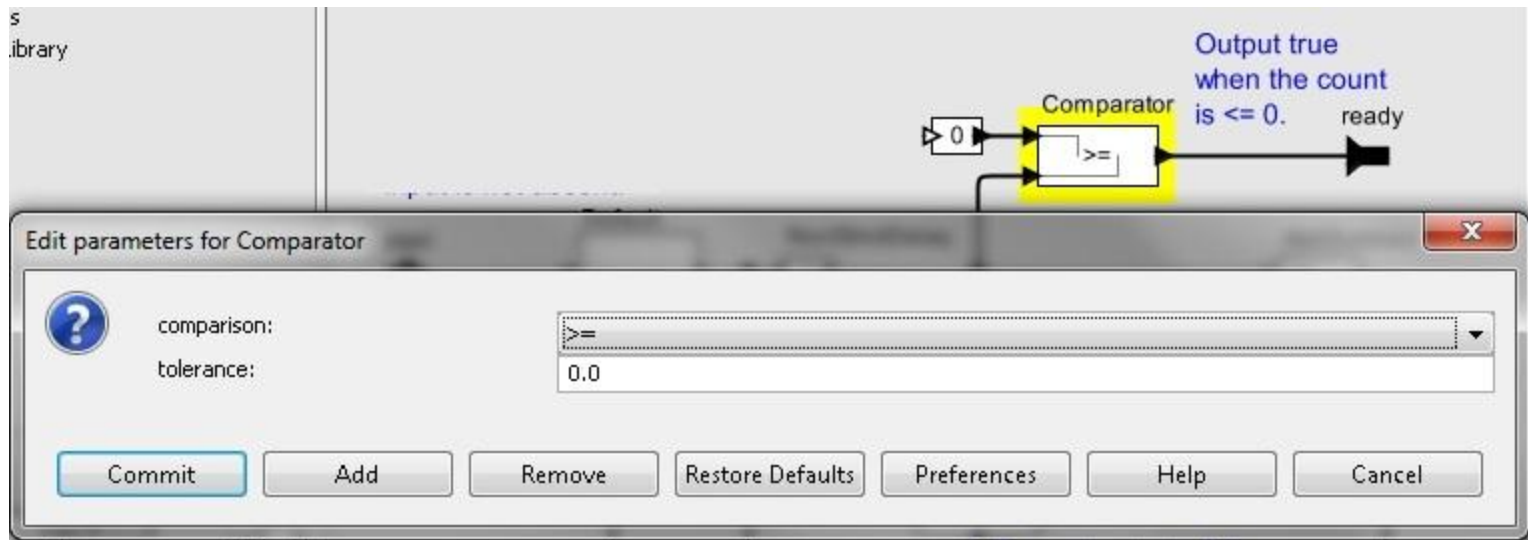
Input Actors

- Can be simple (sequence of numbers) or complex (sinusoidal waves)
- Iterate based on director settings



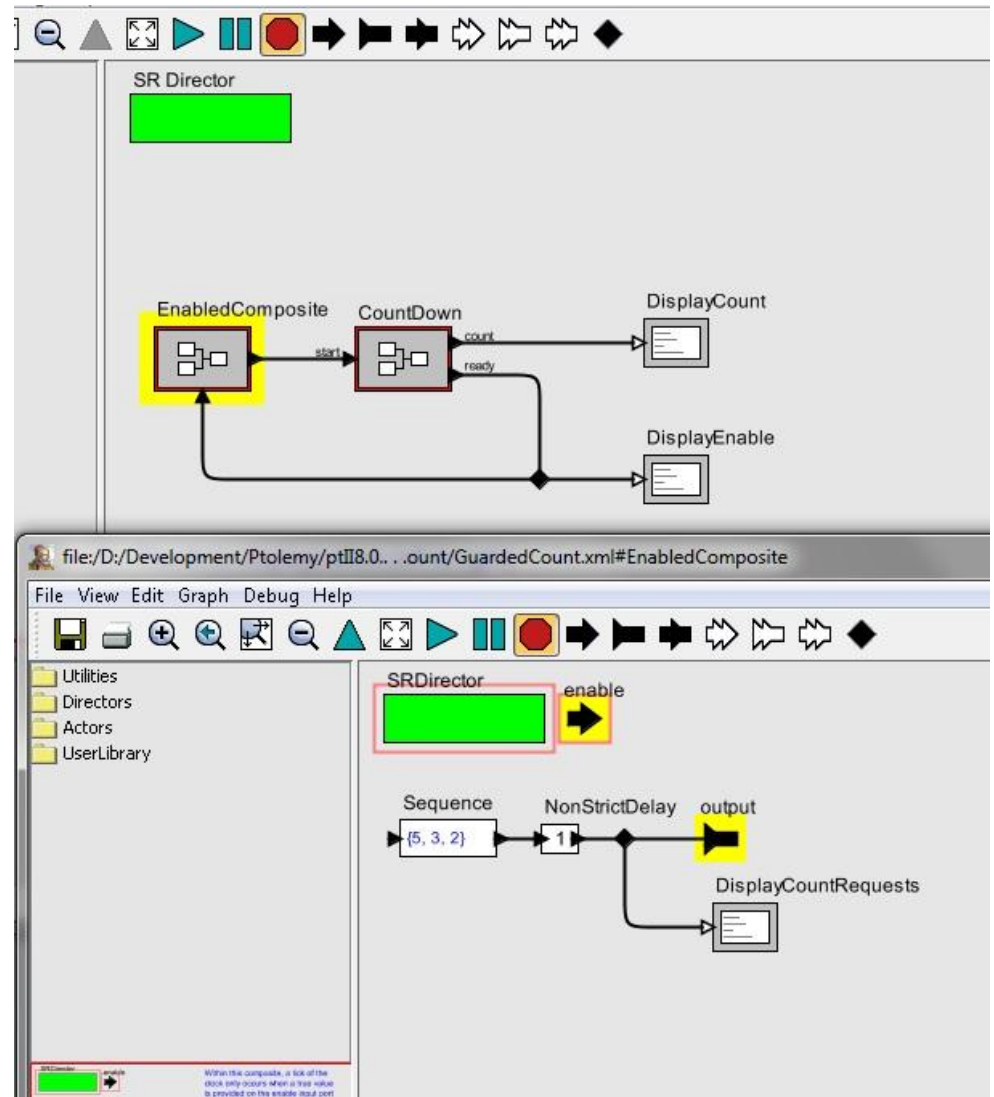
Execution Actors

- Perform operations on inputs based on built-in functionality
- Optionally, provide processed output



Output Actors

- Enable hierarchical functionality



That's really about it!

- Very simple interface, and operations, but the large number of actors, directors, and I/O makes it very powerful
- Who uses Ptolemy?
 - Agile Design
 - Agilent Technologies
 - LBNL
 - Lockheed Martin
 - RIM
 - and more...

Examples