**Curriculum for the Beginning NetLogo Epidemiology class**

**Supercomputing Challenge Kickoff Conference**

**October 12-13, 2013**

Background

The University of Chicago / Argonne MIDAS team developed and field tested a set of educational activities at the 23rd annual Supercomputing Challenge EXPO and Awards Day at Los Alamos National Laboratory on April 24, 2013. The Beginning NetLogo Epidemiology curriculum for the SC Kickoff on October 12-13th 2013 builds on this experience.

Participants:

We anticipate that participants in the “Beginning NetLogo” groups may have some past experience with agent based modeling in StarLogo TNG though they are still considered beginners. They have a background in Algebra but not Calculus. We expect \_\_ students per group.

About the curriculum.

This three-hour curriculum is broken into 3 segments of one hour each. At the Kickoff conference some tracks will experience these segments contiguously while others will not. It will be followed by a data analysis class.

Instructional teams:

Two instructors will lead each session. There will be 3 tracks of this curriculum being taught at the kickoff thus we will have three instructional teams: JP and AnnNet, Irene and Maureen, and Juanita and Phillip.

Purpose of the Unit:

The purpose of the test was to introduce students to agent based modeling of epidemics (and associated phenomena), the nature of complex systems, and some basic computer science constructs:

**1st hour: Introduction to Spread of Disease as a complex system phenomenon.**

* Welcome and instructor introductions (3 min)
* Introductory PPT on CA-MRSA to establish relevance of topic (12 min)
* Paper based table top Toss Up game and debrief of SIR idea model (15 min)
* Deconstruct code and report out on what the code is doing (10 min)
  + Pass out SIR code matching Toss Up game broken into two pieces
    - Setup and Run
    - Infect-neighbors and Update-infected
* Run experiments with the SIR model
  + Discuss model variables and systematic testing
  + Play then Systematic testing (10 min)
* Ask “how would we change this model to transition it from SIR to SIS?”
  + Review what we learned about SIS? What are some examples of SIS?
  + Ask for predictions – what does are the dynamics of SIS?
  + Run experiments with the SIS model? Were you correct? (5 min)
* Wrap up discussion. (5 min)
  + Diseases are becoming resistant and are a threat
  + Direct analogy between Participatory Sim and Computer Sim
  + Modeling and Sim can be used to study dynamics of disease spread

**2nd hour: Computational modeling of disease spread**

* Set the context using the Computational Science cycle (5 min)
  + In the SIR and SIS models, someone else wrote models. Now we are going to write our own model.
  + What question(s) are we trying to answer?
  + What will we need to include in the model to answer these question(s)?
* Discuss the “Spread the Red” model using the CAST diagram (15 min)
  + Abstraction phase - what are we going to include?
  + Decomposition phase – how do we break it into smaller tasks?
  + Implementation phase - Computer Science constructs (use handouts)
    - Looping and Iteration (conceptually and in NetLogo)
    - Variables (conceptually and in NetLogo)
    - Conditionals and Selection (conceptually and in NetLogo)
    - Randomness (conceptually and in NetLogo)
    - Procedures (conceptually and in NetLogo)
  + Test model and code (maybe in part 3)
  + Run experiments and conduct analysis (later in part 3)
* Build and test each part – iterative development (40 minutes)
  + Review agent based modeling phases: Setup and Run
    - Setup (with create and scatter)
    - Run (main loop – what needs to happen each tick?)
  + Write each procedure: Setup, Go, Wiggle, and Check-if-sick.

**3rd hour: Finish model (if necessary), test it, and run experiments.**

* Once the simple “Spread the Red” model is complete, let’s test it. (10 min)
  + Does it seem to do what we intended? How do we know?
  + Are there bugs in the code?
  + Are there test cases with known results we can run?
* Getting ready for experimentation, ask (5 min)
  + What were the questions we are trying to answer?
  + What experiments did we say we wanted to run?
  + What were the variables we wanted to control?
  + Did we have a hypothesis?
  + Add data collection widgets and code
* Running experiments – how to (35 min)
* Conclusions? (10 min)
  + Wrapping up the Computational Science Cycle.
  + Common pitfalls

Finally, we discussed how a model could be used to test a mitigation strategy – What might be an effective strategy to decrease the spread of CA-MRSA in the population? How would we test it using a computer model?

Materials needed:

1st hour: Introduction to Spread of Disease as a complex system phenomenon.

1. Laptops (for pairs)
2. CS-MRSA intro final version.pptx (intro ppt)
3. Toss up game (lesson plan, worksheets, dice, color pencils, cups)
4. TossUpGameDemo.mp4 (demo video for instructors only)
5. SIR model code in two pieces: Setup and Go, Infect-neighbors and Update-infecteds. (SIR TossUp NetLogo code.docx)
6. SIR data collection sheet and graph paper (Toss Up Grid for Graph.pdf)
7. SIR model in NetLogo (Toss-Up SIR 1.4.6 No Click for Excel.nlogo)
8. SIS model in NetLogo (Toss-Up SIS 1.4.6 No Click for Excel.nlogo)

2nd hour: Computational modeling of disease spread

1. Laptops (for pairs)
2. Computational Science Cycle diagram (ppt and worksheets)

(Computational Science Cycle.tiff – diagram of cycle)

(Computational Science Cycle.pptx - worksheet)

(Computational Science Process.doc - description of process)

1. CAST diagram (CAST scale diagram.pdf)
2. CS constructs and associated NetLogo commands (handout)
   1. Looping and Iteration (NM-CSforALL-Program\_Loops.mp4)
   2. Variables (Variables and Scope.pptx)
   3. Conditionals and Selection (Conditional-statement-If-then.mp4)
   4. Randomness (Video Key Points - Random Walk.docx)
   5. Procedures (Procedures in NetLogo.ppt)
3. Spread the Red model description (Spread the Red - Model desc.docx)
4. Simulation phases slides

(MRSA Agent-based Modeling intro.pptx)

(Agent-based Modeling phases.pptx)

1. Spread the Red model in NetLogo (SpreadTheRed-instr.nlogo)
2. Spread the Red movies from NM-CSforAll

(NM-CSforAll\_Modeling\_Epi\_part1.mp4)

(NM-CSforAll\_Epi\_Build\_week\_4.mp4)

Part 3: Finish model, test it, and run experiments.

1. Laptops (for pairs)
2. Computational Science Cycle diagram (ppt and worksheets)
3. CAST diagram
4. Experimental design

(Designing and Running Experiments in NetLogo v3.ppt)

1. Data collection and NetLogo commands (handout)