"Computer Simulation as a Research and Teaching Tool at Whitman"
CDLTI report
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In our proposal, we articulated a desire to "discuss what kinds of computer simulation methods are currently used [on Whitman's campus], and find inspiration from each other of new ways we could develop our own and our student's abilities to use these tools." To work towards this goal, we collectively read and discussed "Principles of Modeling and Simulation, A Multidisciplinary Approach" edited by Sokolowski and Banks, 2009, during weekly lunch meetings during January and February. Beginning in March, excepting the spring break, we met weekly to present computer simulation methods and algorithms from our own disciplines and experience, ending with a final afternoon meeting in May where we discussed how we could continue to support each other as we each pursue our individual applications of computer simulation to our classes, student mentoring relationships, and scholarly research.   In total, we met 15 times for 1 hour each.

Individual learning goals for participants varied, depending on their current familiarity with computer simulation and the current simulation-related projects in which they were engaged. As a group, we found the textbook less useful than we had potentially hoped, but did discuss the variety of applications of computer simulation. In some cases, computer simulation is used to verify a model – given a proposed understanding of how a physical or social system works, we can build a simulator according to that understanding and see if the simulation results seem to match observed reality. When models for a proposed system are already well understood, computer simulations built on those models can be used to conduct experiments or explore "what-if" questions, such as how weather and climate models are used to predict future conditions. Such simulations are not perfect replacements for real-world experiments, but are sometimes the only feasible, cost-effective, or ethically-acceptable approach to conduct such experiments. Finally, computer simulations can be used to visualize or communicate information – allowing both researchers and students to gain insight into how and why a system works.

Having read and discussed a survey of concepts related to computer simulation, we then discussed in more detail about our existing work with computer simulation. Out of the participants, our current computer simulation activities span the set of applications of computer simulation described above. Frank Dunnevant uses simulation to validate proposed mathematical models of how toxic chemicals are released into waterways as a result of dredging incidents. Dalia Rohksana uses well-established computer simulations to conduct experiments on the chemical behavior of enzymes. Albert Schueller and John Stratton use computer simulations to gain insight into how systems function in research and classroom contexts, respectively. Other participants brought other examples, giving us perspectives on simulations for systems from cosmology to quantum chemistry.

Those of us already using computer simulation in our classes became more confident in our ability to present those portions of our curriculum through increased understanding of common terminology and the broader context of computer simulations. For many participants, the most immediate interdisciplinary impact of this workshop is in the increased capability of mentoring students in research settings where computer simulation methods are required. For instance, at the time of writing of this

report, a couple members of this workshop are engaged with a rising senior pursuing an Economics-Mathematics combined major. This student is interested in pursuing an honors thesis based on agent-based modeling of in-school social networks, combining concepts from economics and sociology and methodology from mathematics and computer science to gain insight into this important social system. This project could not be supported by any individual faculty member on campus, but through this workshop, the connections were made that allowed the formation of an interdisciplinary faculty advisory group to support this student. Furthermore, this workshop will enhance the coming offering of Computer Simulation Methods by John Stratton, by informing what kinds of simulation methods are already represented on campus and connecting with potential guest lecturers.

For future iterations of this workshop, participants overall had two themes in terms of feedback. One was that although the book read at the beginning of the semester served its purpose and stimulated discussion, it left many of us unsatisfied. Finding a book with the appropriate amount of breadth, high-level perspective, and practicality was difficult, but future workshop leaders are certainly invited to attempt to improve on the current selection, or curate a collection of articles and other readings. The readings for the upcoming Computer Simulation Methods undergraduate course may be a good starting point. The second main theme of the feedback was that some people thought it would be helpful or useful to actually build a simulation of some kind during the workshop. This could be very beneficial, and the primarily challenge would be balancing between supporting participants pursuing independent implementations with diverse interests, or finding some common project(s) that multiple participants could agree on and find value in.

Otherwise, the format seemed to meet the needs of this group well. In particular, because this workshop focused more on the use of computer simulation in research, taking turns presenting our simulation-based student research activities or potential activities helped us share relevant experience. This workshop was primarily instigated to plant the seed of a Whitman faculty community of expertise with computer simulation methods. A precise repeat of this workshop is therefore unlikely to be helpful, but a more narrowly focused workshop could be. For instance, a future workshop could even involve some of the same participants and specifically explore the uses of computer simulation in our curriculum, and sharing experience of what makes a particular computer simulation a good tool for student learning. A future workshop could also specifically explore the use of computer simulation for making predictions about the future, and how that relates to public and political discourse. These are just some examples, but the cohort of this workshop should increase the general awareness and literacy around computer simulation on campus and lay the groundwork for more specialized workshops in the future.