**Quiz 2 Notes Page**

**Approaches to building PowerPoint:**

A virtual world needs to accurate, policy-relevant, and computationally feasible

Accuracy – deviating by at most x% from an expected result

We rarely have infinite time and computers to test all our ideas

**Continuous mathematical models** – capture the essence of a phenomenon using math

Some problems are hard to write as equations and even harder to solve, that happens when there is a lot of heterogeneity (spatial heterogeneity, individual heterogeneity)

CMM requirements – homogeneous population, not for policymakers or community, individual decision making does not significantly change the outcome, then use math CMM

**Cellular Automaton** – has two components: a set of cells and rules that change the cells’ content

Cells change based on the previous state of neighboring cells and themselves, a cell is only in one state as any point in time

No movement, only interact with nearby cells, and have a single state

**Agent Based Models** – interact with the environment and each other, have complex states

Types of agents, characteristics, states for the environment, rules for agents

Recipe to abstract a problem as agents – Isolate the agents, find all the numbers that matter, summarize the change

**Textbook Chapter 0 – Why Agents-Based Modeling:**

ABM is a form of computational modeling whereby a phenomenon is modeled in terms of agents and their interactions

**Visualizing Cellular Automata:**

**Introduction**

These two tasks are currently arduous, as the commonly employed offer little support to identify temporal trends or excessive model variability. We addressed these two tasks by developing, implementing, and evaluating a new visual analytics environment that uses several linked visualizations. Our empirical evaluation of the proposed environment assessed (i) whether modelers could identify temporal patterns and variability, (ii) how features of simulations impacted performances, and (iii) whether modelers can use the familiar slider-based visualization together with our new environment. Results shows that participants were confident on results obtained using our new environment.

Visualization is a typical component of Modeling and Simulation (M&S) studies.

The design and development of our visual analytics solution serves to answer the following three questions: Q1 Can modelers and analysts correctly, confidently, and quickly identify temporal patterns and variability? Q2 How do performances depend on features of the simulation, such as have more time steps or dealing with more variability? Q3 Can the slider-based visualization, with which modelers and analysts are most familiar, be used together with our proposed solution?

**Background**

Visualizations have been categorized as ‘computationally enhanced visualizations’ and/or ‘visually enhanced mining’, depending on whether the visualization is the primary means of data analysis or presents only an interface to results computed by data mining

Multi-run simulation data refers specifically to the various datasets obtained when one stochastic

model is run with one set of parameter values

**DESIGN OF THE VISUALIZATION ENVIRONMENT**

Our visualization environment is motivated by the need to identify temporal patterns and variability

in data produced by cellular automata. in 2016 we proposed a visualization for CA based on clock glyphs.

The main visualization builds on the principles from section 2.1 and our previous experience with modelers to represent the whole CA at once, where each cell is divided into 8 equal segments whose color

represents the main state during the corresponding part of the simulation. This visualization gives an intermediate between the aggregate of the main visualization and raw simulation runs.

**APPLICABILITY ACROSS APPLICATION DOMAINS**

HIV spread, crowd movement, burning forest, sand pile

**DESIGN OF THE EMPIRICAL EVALUATION**

The identification of temporal patterns and variability is mapped onto two specific tasks. The first task focuses on temporal patterns: participants have to find the cells that mostly end the simulation in the same state as they started. In other words, the temporal pattern of interest is a cycle. The second task focuses on replications: users have to find where there is significant variation in the simulation, both spatially (i.e. which cells) and temporally (i.e. which divisions of cells). In other words, users need to find areas where replicates disagree a lot on the simulation outcome. The first task is routinely carried out as we need to find if, and where, the simulation stabilizes. The second task typically serves to assess whether more simulation runs are needed to get a clear consensus on the outcome.

**Results**

Studies comparing two visualizations generally use these metrics as they are highly objective. The time on task and errors are thus typical performance measures for the efficiency and effectiveness, respectively. Details on these two metrics can be found in introductory readings on user experience. User confidence has also been employed in many studies, for instance to assess whether users were unsure when accomplishing a task, or if they were over-confident to the point of overlooking essential steps. We note that many other variables can be employed to measure the participants’ experience.

**Conclusion**

Our proposed visualization efficiently supported users in performing key modeling tasks, by aggregating information (across time steps and simulation runs) as well as through interactive tools for filtering and details on demand. Additional work is needed to also aggregate many elements (via multi-resolution techniques), find specific patterns (by adapting motif mining to cellular automaton), or tailor the environment to features found in the simulation run (such as the number of states and transitions).

**Selecting the Right Tool for the Job:**

Based on expert opinion and a survey of modelers engaged in participatory processes, we offer practical guidelines to improve decisions about method selection at different stages of the participatory modeling process.

**Introduction**

Numerous tools and methods facilitate stakeholder engagement in participatory modeling (PM), which Stave (2010) defined broadly as “… an approach for including a broad group of stakeholders in the process of formal decision analysis.”

The selection of methods is both a critical and a difficult task that ideally requires (1) knowledge of available methods and tools, and (2) careful examination of selection criteria and trade-offs.

**Overview of PM Methods**

These methods can be, used separately or be combined within some of the more general methodologies such as SSM or ComMod described above. Here we view them as reusable components that can be reassembled in a variety of ways for future PM projects. The methods and tools discussed below are commonly used in PM but do not constitute an exhaustive list.

**Selecting Appropriate Methods**

The goals of a PM study should offer the starting point for any discussion about the PM methods needed. These goals may be positioned on two extreme ends of a continuum. At one end, some studies are designed to highlight knowledge diversity, to make different voices in the community heard, and to understand sources of conflict. In these studies, the models themselves are mainly boundary objects for communication of different worldviews. They do not have to be scientifically accepted representations of the real-world systems, and they may not be consolidated into a single model.

**Conclusions**

There is much improvement yet to be made in how modeling methods are selected for PM projects. There are many methods already available, and choices are not simple. In too many cases, the selection process seems to be largely driven by the past experience of participants, rather than by the particular needs of the project. While logic tells us that this is probably not the best strategy, we do not have much, if any, evidence that this is a bad thing. To a large extent, this is because there are almost no method comparisons documented for PM projects, i.e. where one method was substituted by another and where results were meaningfully compared. Comparing across projects is difficult because each project is unique. While the problems may be similar, the stakeholders involved are always special, and group dynamics are hard to reproduce.