CS 6702: Topics in Computational Sustainability

Coursework #1

Due: February 17th, 2011

Computational Sustainability is an emerging and multi-disciplinary field that must identify and address new computational problems. This assignment is intended to give the student experience in finding computational problems sustainability researchers and policy-makers encounter in their work and any existing research on these problems. To accomplish this goal, the student will have to identify the links between research papers from conferences and journals in Computer Science and the relevant sustainability fields. A non-exhaustive list of relevant journals and conferences is included at the end of this document. Students are also encouraged to start their research with lecture readings from the course, or the background readings listed on the course website.

Students may complete a *reaction paper*, a *research problem presentation*, or an *annotated bibliography* to fulfill this assignment. Guidelines for each follow. Students are encouraged to choose a topic for the reaction assignment that matches their final project interests. The topics of student reaction assignments will be posted later in the semester, to help students form teams for the final project. *Students are encouraged to consult the faculty team and course assistants to discuss ideas.*

Reaction Paper

Deliverables: Paper (approximately 5 pages)

A reaction paper should identify one or two computational issues concerning a sustainability topic, and then react to current research papers that encounter or address these issues. A reaction paper can be written in four steps:

1. **Find a seed paper that addresses or encounters computational issue(s) in a sustainability topic**. The seed paper should be a strong starting point from which to build a "network" of papers you can react to. Here are some ways to find a seed paper:
    a. Use a paper whose presentation you have seen in class or in a related talk.
    b. Use one of the background readings from the course website.
    c. Search through key journals in the area you are considering (see the list at the end of this document).
    d. Use Google Scholar. Try combining your favorite sustainability topics with computational keywords. For example, combining terms like poverty, ecosystem, agriculture, renewable energy, or conservation with keywords like algorithm, network, machine learning, modeling, game theory, or optimization.

    e. *Ask the faculty/research team and course assistants for advice. Come to office hours!*
2. **Populate a list of research papers to serve as the references for your reaction paper.** Here are some ways to populate your list of papers:
    a. Check the papers cited by your seed paper.
    b. Use the "Cited By" link on Google Scholar to find papers that cite the seed paper. Other bibliographic databases like CiteSeer may also help.
    c. Check the author's website for related work.
    d. Search for the paper on Google. Is the paper discussed on forums or blogs that point to other sources?
3. **React**. Using the references compiled above, you should present your sustainability topic and the computational issue(s) encountered in this sustainability topic. You should then form a reaction to the current research. Good reactions will do the following:
    a. Address some of the following questions about each reference:
        i. What is the main problem the author is addressing?
        ii. Why is the problem important for sustainability?
        iii. What is the central claim, argument, or point of the paper?
        iv. What assumptions does the paper make?
        v. Are the models or techniques presented in the paper supported by theory, experiment, and/or evidence?
        vi. What are the main strengths and weaknesses of the paper?
        vii. What future work can come from this paper?
    b. Consider the references collectively.
        i. How do the papers relate to one another?
        ii. What is the overall picture they portray?
        iii. Is there a next logic step?
4. **Re-edit your work.** No one gets it exactly right the first time around.

Research Problem Presentation

Deliverables: Presentation to the class. **Approval from Professor Gomes or Selman is needed to give a research problem presentation.**

A research problem presentation should identify a specific computational problem encountered in one or more sustainability fields, and then a survey of the current research that addresses the problem. A research problem presentation is a good option for students currently engaged in sustainability-related research. A good research problem presentation will do the following:

1. **Identify and define the computational problem and its sustainability applications**.
2. **Identify the current best algorithms, models and techniques for solving the problem**.
3. **Present the problem and current best solutions**. Your presentation should explain and motivate your chosen problem to the class. You should

then present the research you identified in Step 2, addressing some of the following issues:

a. What weaknesses or assumptions exist in the current research?
b. What computational requirements (time, space) must problem solutions address? How does current research address them?
c. Are there other computational methods that could be used to solve the problem that current research has not explored?
d. Do existing problem formulations / models adequately address the underlying sustainability issues?
e. Are there optimizations/improvements that could be made to current techniques that are themselves research questions?

Annotated Bibliography

Deliverables: 20 references in bibtex format and one-paragraph annotations for each reference.

The annotated bibliography should be composed of references that address a topic in Computational Sustainability of the student's choice. Students should choose topics with a computational focus that apply to sustainability. Some example topics are:

1. Optimization methods for species conservation.
2. The modeling of complex adaptive systems like ecosystems, the ocean-atmosphere system, systems from epidemiology, social networks, etc.
3. Models and methods from economics and game theory for the management of natural resources.
4. Computational methods for crisis management in underdeveloped or at-risk regions.

A one-paragraph annotation should be provided for each reference. Annotations should be a short review of the paper with a focus on the computational problems and solutions found therein.

Some Relevant Journals/Conferences

- Journal of Environmental Economics and Management (JEEM)
- Conservation Biology
- Biological Conservation
- Ecology
- Ecology Applications
- Ecology Economics
- PNAS Sustainability Science (special issues)
- IEEE Spectrum
- Resource and Energy Economics
- Environmental and Resource Economics
- Science
- American Journal of Agricultural Economics
- Energy Policy

- AAAI
- AAMAS (International Conference on Autonomous Agents and Multiagent Systems)
- ECAI (European Conference on Artificial Intelligence)
- IJCAI (International Joint Conference on Artificial Intelligence
- UAI (Uncertainty in Artificial Intelligence)
- ICML (International Conference on Machine Learning)
- KDD (Conference on Knowledge Discovery and Data Mining)
- CP (International Conference on Principles and Practices of Constraint Programming)
- CPAIOR (International Conference on Integration of Artificial Intelligence and Operations Research Techniques in Constraint Programming for Combinatorial Optimization Problems)