Beijing CSSS 2006

Summary and Closing Thoughts

4 August 2006

David Feldman

Week I

1. **Dave Feldman:** Tools and Foundations in Complex Systems: Chaos, Information Theory, Computation Theory, Measures of Complexity.
2. **Cosma Shalizi:** Power Laws, Statistics for Complex Systems, Reconstructing Causal States.
3. **Henry Wright:** Foragers and the Emergence of Agriculture, Villages and the Emergence of Tribal Alliance Systems, Raising Civilizations.
4. **Andreas Wagner:** Graph Theory and Biology, Molecular Evolution of Biological Networks
5. **Jon Wilkins:** Coalescence, Evolutionary Landscapes and Approximate Bayesian Computation.

(14 lectures)

Week II

1. **Marc Feldman and Li Shuzhou:** Introduction to Population Dynamics in China, Rural-urban Migration in China Social Networks, Niche Construction.
2. **Jing Han:** Soft Control, Computational Complexity, Genetic Algorithms for NP problems.
3. **Jim Crutchfield:** Is Anything Ever New?, Computational Mechanics, Finitary Processes and Evolutionary Dynamics.
4. **Raissa D'souza:** Understanding Networks: Theory and Application. I–III.

(11 lectures)

Week III

1. **Bill Wang and James Minnett:** Language Evolution and Acquisition I–V.
2. **Lee Altenberg:** Overview of Evolutionary Computation, Spectral Analysis of Evolutionary Dynamics, Higher Order Evolutionary Phenomena.
3. **Hao Bai-Lin:** Applied Symbolic Dynamics, Languages and Biological Sequences, Complexity of Biological Sequences.
4. **Van Savage:** Scaling in Biology, I & II.

(13 lectures)

Week IV

1. **Herbert Gintis:** Unifying the Behavioral Sciences, An Agent-based Model of General Equilibrium, Evolution of Cooperation.
2. **Michelle Girvan:** Finding Community Structure in Networks, Monkeys and Future Directions for Research in Networks.
3. **Bernhard Meister:** The Maximum Entropy Formalism in Finance.
4. **Chris Wood:** Research at the Santa Fe Institute.

(7 lectures)

Also ...

1. **Student Workshops** on R, Agents, Loops, Philosophy, GAs and Game Theory, and the Renormalization Group.
2. **Roundtable discussions** on different aspects of science and research.
3. **Many announcements** from Dave and other SFI staff.
4. **Scavenger hunt** to the Summer Palace.
5. **Many trips** to the forbidden city, the Great Wall, etc.
6. **Many meals** in Beijing restaurants.
7. **Other stuff** that I probably am glad I don't know about.
8. **And also some stuff** that I know about but wish I didn't.

Some Descriptive Statistics

1. **45 lectures**
2. This corresponds to **2.3 days**
3. Approximately **900 slides**, all of which Li Li helped to photocopy.
4. Let us assume that the entropy per word of written English is around 1 bit per symbol.
5. Then, assuming 25 words per slide, and 4.5 symbols per word, the lectures have transmitted at least **100,000 bits** or **1 kb**.
6. The largest set of slides was Henry Wright's second lecture, which was **77 MB**.
7. You are now joining a select group of around **2000 CSSS alumni**.

Goals of the CSSS

1. **Complex Systems Content:** Provide a foundation in some of the central tools and themes in the study of complex systems and introduce students to some current areas of application and advanced topics.

2. **Interdisciplinary, Collaborative Research:** Give students hands-on experience and develop skills for working in in collaborative groups that span disciplines.

3. **International Collaboration:** Give students experience and develop skills for working in international research collaborations.

Whether or not we've met these goals is ultimately up to you to decide.

Thoughts on Models

- I believe it is extremely valuable to try and answer a question different ways.
- Too often math classes teach us to solve problems that have already been posed.
- This is the case for any class whose title is a method.
- As many others have said, be careful about the assumptions hidden in models.
- **When we use models, they use us back.**

Some Final Thoughts and Advice, Big and Small

- Keep in touch with CSSS colleagues after the school ends.
- Interdisciplinary work is hard: it is usually up to *you* to make the connections.
- Most people I know who are excellent researchers:
  - Know more than they have to know
  - Are good at both math/theory and computation.
- Review literature thoroughly. Use the science citation index.
- Interdisciplinary is good, but it's a means, not an end.
- Try not to lose your passion for big questions
  - If you pursue a career in academia, you will be pressured to pursue traditional, safe problems.
  - You will also be pressured to chose a discipline.
  - It is wise to give in to this pressure, but try to do so in a way that lets you keep working on risky, interdisciplinary, BIG problems.

Enjoy the Questions

> have patience with everything unresolved in your heart and to try to love the questions themselves as if they were locked rooms or books written in a very foreign language. Don't search for the answers, which could not be given to you now, because you would not be able to live them. And the point is to live everything. Live the questions now. Perhaps then, someday far in the future, you will gradually, without even noticing it, live your way into the answer.

Rainer Maria Rilke, 1903 in Letters to a Young Poet