FALL 2018, CMN189B: Proseminar in Mass Communication

Social Computation

Prof. Martin Hilbert; TR 6:10 – 7:30 PM, Kerr Hall; Sep. 27 – Dec. 6, 2018.

May be repeated for credit (since topic differs). **GE credit: SS, Wrt.**

Social Computation: theory and methods of social algorithmification

Humans compute information, biologically and artificially, and societies do too. We are not always sure what we compute, but the increasing merger of social and digital networks, of analog and digital footprints, of biological and artificial intelligence, shows us that digital algorithms can readily codify many tasks. Many of these processes were previously in the intangible domain of implicit human conduct, and now they become explicit code. If social entities processes information, and if an astonishing part of it is being taken up by digital technology, then the fundamental theories behind those technologies might also help us to understand how society communicates and computes information (with or without technology). In this course we use basic concepts from information theory (which underlies all digital communication systems) and from theoretical computer science (which formalize the idea of routines and dynamic processes), and apply them to different aspects of social behavior. For one, this allows us to conceptualize social and technological information processing with one single and coherent framework. We can measure how much information is communicated from humans to algorithms and vice versa. Moreover, taking this perspective illustrates that society has always computed, even long before the digital age. Laws, routines, cultural habits, and psychological prejudices can be conceptualized as communication channels. The resulting framework provides a natural perspective on how one can research, guide, and shape the often intimidating and overwhelming developments of the digital revolution.

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About the course: The course bridges concepts from both the social sciences and information theory and its extensions. Personally, I had to learn these concepts painstakingly while taking formal courses in Engineering-, Physics-, and Computer Science Departments, and by obtaining doctorates in both Economics and in Communication. This required to deal with lots of concepts from the natural and engineering sciences and from old-school industrial organization that were quite irrelevant to my goal of understanding how society processes information, but presented very high barriers of entry to study these materials. With the design of this course, it is my ambition to convey the relevant concepts from both social and technological fields to anyone who is interested in learning them.

Pre-requisites: Therefore, this course does not have any formal pre-requisites, but an interest in quantitative methods will be an important advantage. We will deal with advanced topics from both social science and mathematics, but the course is taught in a way that anyone who successfully made it to upper division courses and is not afraid of new concepts can successfully get up to speed throughout the course. Tailor-made tutorial material is provided. Some students might want to spend more of their homework time on learning how to run provided R or Python codes, others on getting used to conditional joint probabilities, and again others on reading up on socio-economic theory and currently open societal questions. However, nobody who has the ambition to learn these concepts will be left behind, and nobody will be lacking adequate material that meets her/him where they are at. In case of doubt, please contact me at Hilbert [at] ucdavis [dot] edu.

Course work: Additionally to the assigned readings, there will be weekly homework exercises during which we will apply the learned concepts to social situations and real world data. During the last 3 weeks you will focus on final course projects, where you will study one aspect of how society processes information more in depth.

About the instructor: Before joining UC Davis, Prof. Hilbert created and coordinated the Information Society Program of the United Nations Secretariat for Latin America and the Caribbean. In his 15 years as United Nations Economic Affairs Officer he has provided hands-on technical assistance in the field of digital development to Presidents, government experts, legislators, diplomats, NGOs, and companies in over 20 countries. Policy makers from the highest political levels have officially recognized the ensuing impact. He retired early from his tenured appointment at the UN to be able to spend more time on studying how and what society computes. He has written five books about digital development and his articles are published in the most recognized academic journals, such as *Science, Psychological Bulletin, Trends in Ecology and Evolution, World Development, Technological Forecasting & Social Change*, and has been featured in popular outlets, including *The Wall Street Journal, Washington Post, The Economist, NPR, BBC, NatGeo, Discovery, PBS, Die Welt,* among others. More: www.martinhilbert.net

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10 week schedule (with some illustrative readings: other tailor-made reading material will be provided)

0) **Course Overview**: from sociological structuration to algorithmification

1) **Algorithmic Information Theory**: from social routines, over laws, to flow charts
   How does society computer and process information?
2) **Probabilistic Information Theory**: sources and channels
   How did the "mathematical theory of communication" (aka 'information theory') solve communication?
3) **Different Kinds of Information and Communication**: transfer entropy et al.
   Are there different kinds of information? How to measure them?
4) **Information Dynamics**: static and dynamic social structure
   What does observational data in time reveal about underlying processes?
5) **Decision Trees & Minimum Description Length**: reverse engineering observed structure
   What are some methods and concepts to reveal the structure underneath observational footprints?
6) **Markov Chains** and Models
   How can we model the computational algorithm (the state machine) underneath observed processes?
7) **Predictive State Machines**: optimal algorithms from data (white box machine learning)
   Is there a way to identify the most effective and efficient algorithm to represent any observed process?
8) **Social Evolution** & the Fitness Value of Information
   How does understanding the relation between structures in space and time allow us to improve things?
9) - 11) **Project** discussions & Presentations

Diverse as it seems, we will use similar concepts and measures throughout. In this sense, we will pursue very similar ideas, but apply them to different situations. This is because in essence, we study 4 different kinds of **communication channels**:

Input ↔ Output Channels (sessions 2, 3 & 5)
Reality ↔ Model Channels (sessions 1 & 6)
Past ↔ Future Channels (sessions 4 & 7)
System ↔ Environment Channels (session 8)