COMPLEX-IT and the SACS TOOLKIT:

A Case-Based Computational Modeling Platform for Policy Evaluation

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Case-Based Complexity
A basic introduction

What is a case-based computational view?

- The goal:
  - cluster groups or cluster trends,
  - based on some profile of factors,
    - physical, biological, psychological, social, ecological…
  - and, understand how the clusters differ as a function of their respective profiles.

What is a case-based computational view?

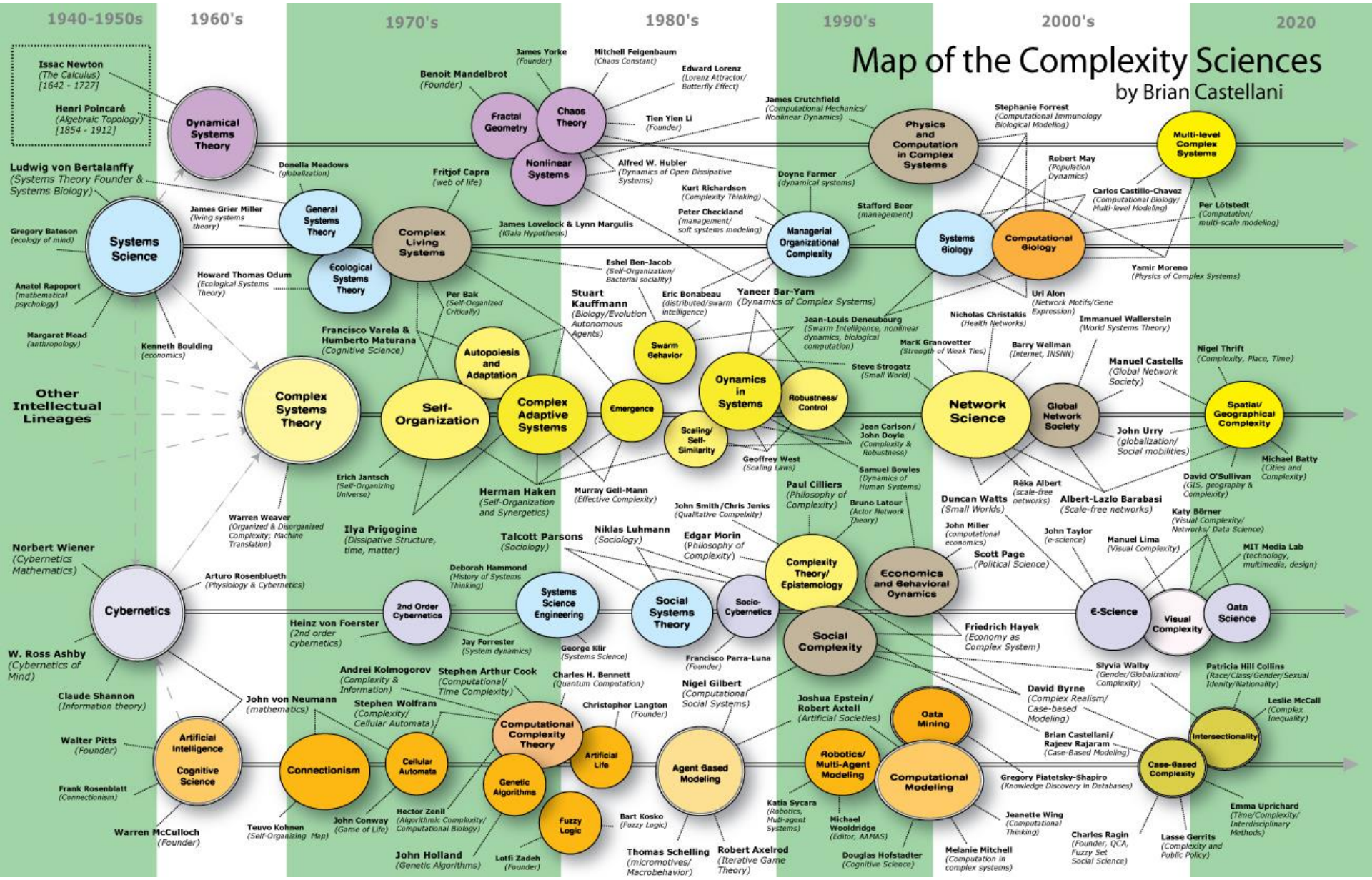
- Two types of databases
  - Relational and therefore a network of interconnected groups or trends (*a set of communities in a region*)
  - Or non-relational, and therefore assumed relatively independent (*random sample of health trajectories*)

What is a case-based computational view?

- Policy evaluation
  - Explore how policy impacts groups or trends based on changes to their respective profiles.
    - Past, present or future
  - This impact can be for an individual group or trend or the entire set of groups/trends.
  - This impact can be examined in terms of knock-off effects
    - how changes in one dimension of a profile impact other dimensions, or how changes to one or more groups or trends impact the other groups or trends.

What is a case-based computational view?

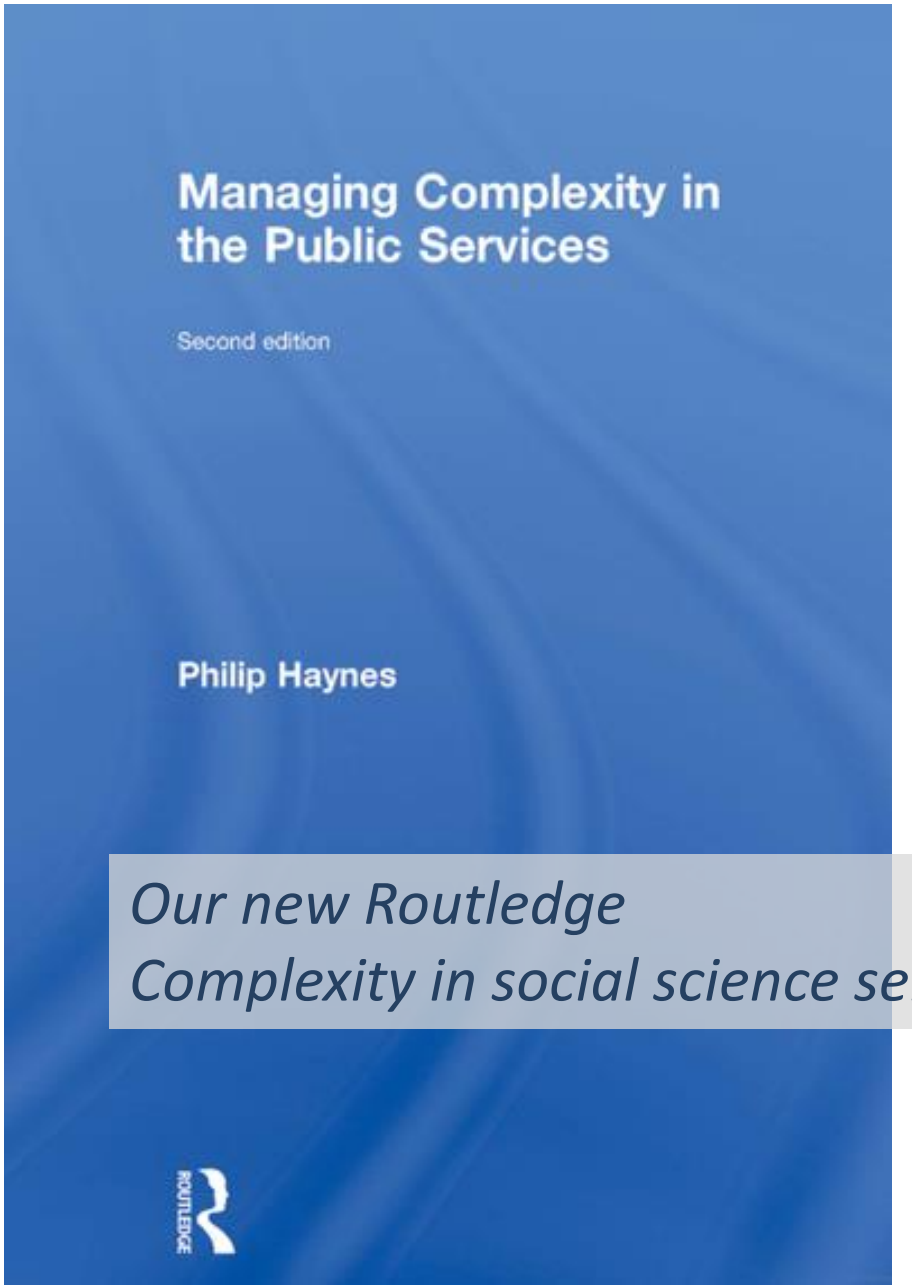
- Methods
  - There is no one method or set of methods for conducting such analyses.
  - We use a computational approach
    - K-means cluster analysis
    - Artificial neural nets, specifically topographical
    - Geospatial modeling
    - Data visualization
    - Complex networks
    - Agent-based modeling
    - Differential equations


1940-1950s
1960's
1970's
1980's
1990's
2000's
2020
Map of the Complexity Sciences
by Brian Castellani
Issac Newton
(The Calculus)
[1642 - 1727]
Henri Poincaré
(Algebraic Topology)
[1854 - 1912]
Dynamical Systems Theory
Ludwig von Bertalanffy
(Systems Theory Founder & Systems Biology)
Systems Science
Gregory Bateson
(ecology of mind)
Anatol Rapoport
(mathematical psychology)
Margaret Mead
(anthropology)
Kenneth Boulding
(economics)
Donella Meadows
(globalization)
James Grier Miller
(living systems theory)
General Systems Theory
Howard Thomas Odum
(Ecological Systems Theory)
Ecological Systems Theory
Other Intellectual Lineages
Complex Systems Theory
Warren Weaver
(Organized & Disorganized Complexity; Machine Translation)
Norbert Wiener
(Cybernetics Mathematics)
Cybernetics
Arturo Rosenblueth
(Physiology & Cybernetics)
W. Ross Ashby
(Cybernetics of Mind)
Claude Shannon
(Information theory)
Walter Pitts
(Founder)
Frank Rosenblatt
(Connectionism)
Warren McCulloch
(Founder)
Artificial Intelligence
Cognitive Science
Benoit Mandelbrot
(Founder)
James Yorke
(Founder)
Mitchell Feigenbaum
(Chaos Constant)
Edward Lorenz
(Lorenz Attractor/ Butterfly Effect)
Fractal Geometry
Chaos Theory
Nonlinear Systems
Tien Yien Li
(Founder)
Alfred W. Hubler
(Dynamics of Open Dissipative Systems)
Fritjof Capra
(web of life)
James Lovelock & Lynn Margulis
(Gaia Hypothesis)
Complex Living Systems
Per Bak
(Self-Organized Criticality)
Eshel Ben-Jacob
(Self-Organization/ Bacterial sociality)
Stuart Kauffmann
(Biology/Evolution Autonomous Agents)
Eric Bonabeau
(distributed/swarm intelligence)
Swarm Behavior
Francisco Varela & Humberto Maturana
(Cognitive Science)
Autopoiesis and Adaptation
Self-Organization
Complex Adaptive Systems
Emergence
Erich Jantsch
(Self-Organizing Universe)
Herman Haken
(Self-Organization and Synergetics)
Murray Gell-Mann
(Effective Complexity)
Ilya Prigogine
(Dissipative Structure, time, matter)
Talcott Parsons
(Sociology)
Niklas Luhmann
(Sociology)
Deborah Hammond
(History of Systems Thinking)
2nd Order Cybernetics
Systems Science Engineering
Heinz von Foerster
(2nd order cybernetics)
Jay Forrester
(System dynamics)
George Klir
(Systems Science)
Andrei Kolmogorov
(Complexity & Information)
Stephen Arthur Cook
(Computational/ Time Complexity)
Stephen Wolfram
(Complexity/ Cellular Automata)
John von Neumann
(mathematics)
Computational Complexity Theory
Charles H. Bennett
(Quantum Computation)
Christopher Langton
(Founder)
Artificial Life
Connectionism
Cellular Automata
Genetic Algorithms
Fuzzy Logic
Teuvo Kohnen
(Self-Organizing Map)
John Conway
(Game of Life)
Hector Zenil
(Algorithmic Complexity/ Computational Biology)
John Holland
(Genetic Algorithms)
Lotfi Zadeh
(Founder)
Bart Kosko
(Fuzzy Logic)
Yaneer Bar-Yam
(Dynamics of Complex Systems)
Jean-Louis Deneubourg
(Swarm Intelligence, nonlinear dynamics, biological computation)
Steve Strogatz
(Small World)
Dynamics in Systems
Robustness/ Control
Scaling/ Self-Similarity
Geoffrey West
(Scaling Laws)
Jean Carlson / John Doyle
(Complexity & Robustness)
Samuel Bowles
(Dynamics of Human Systems)
Paul Cilliers
(Philosophy of Complexity)
Bruno Latour
(Actor Network Theory)
John Smith/Chris Jenks
(Qualitative Complexity)
Edgar Morin
(Philosophy of Complexity)
Complexity Theory/ Epistemology
Socio-Cybernetics
Social Systems Theory
Francisco Parra-Luna
(Founder)
Nigel Gilbert
(Computational Social Systems)
Agent Based Modeling
Thomas Schelling
(micromotives/ Macrobehavior)
Robert Axelrod
(Iterative Game Theory)
Katia Sycara
(Robotics, Multi-agent Systems)
Robotics/ Multi-Agent Modeling
Michael Wooldridge
(Editor, AAMAS)
Douglas Hofstadter
(Cognitive Science)
Joshua Epstein/ Robert Axtell
(Artificial Societies)
Data Mining
Computational Modeling
Melanie Mitchell
(Computation in complex systems)
Jeanette Wing
(Computational Thinking)
Gregory Piatetsky-Shapiro
(Knowledge Discovery in Databases)
Brian Castellani/ Rajeev Rajaram
(Case-Based Modeling)
Case-Based Complexity
Charles Ragin
(Founder, QCA, Fuzzy Set Social Science)
Lasse Gerrits
(Complexity and Public Policy)
Emma Uprichard
(Time/Complexity/ Interdisciplinary Methods)
Physics and Computation in Complex Systems
James Crutchfield
(Computational Mechanics/ Nonlinear Dynamics)
Doyne Farmer
(dynamical systems)
Kurt Richardson
(Complexity Thinking)
Peter Checkland
(management/ soft systems modeling)
Managerial Organizational Complexity
Stafford Beer
(management)
Eric Bonabeau
(distributed/swarm intelligence)
Mark Granovetter
(Strength of Weak Ties)
Nicholas Christakis
(Health Networks)
Barry Wellman
(Internet, INSNW)
Immanuel Wallerstein
(World Systems Theory)
Uri Alon
(Network Motifs/Gene Expression)
Yamir Moreno
(Physics of Complex Systems)
Network Science
Duncan Watts
(Small Worlds)
Réka Albert
(scale-free networks)
Albert-Lazlo Barabasi
(Scale-free networks)
John Miller
(computational economics)
John Taylor
(e-science)
Scott Page
(Political Science)
Economics and Behavioral Dynamics
Friedrich Hayek
(Economy as Complex System)
Social Complexity
Stephanie Forrest
(Computational Immunology Biological Modeling)
Robert May
(Population Dynamics)
Carlos Castillo-Chavez
(Computational Biology/ Multi-level Modeling)
Per Lötstedt
(Computation/ multi-scale modeling)
Multi-level Complex Systems
Systems Biology
Computational Biology
Global Network Society
Manuel Castells
(Global Network Society)
John Urry
(globalization/ Social mobilities)
Spatial/ Geographical Complexity
Nigel Thrift
(Complexity, Place, Time)
Michael Batty
(Cities and Complexity)
David O'Sullivan
(GIS, geography & Complexity)
Katy Börner
(Visual Complexity/ Networks/ Data Science)
Manuel Lima
(Visual Complexity)
MIT Media Lab
(technology, multimedia, design)
E-Science
Visual Complexity
Data Science
Slyvia Walby
(Gender/Globalization/ Complexity)
Patricia Hill Collins
(Race/Class/Gender/Sexual Identity/Nationality)
Leslie McCall
(Complex Inequality)
Intersectionality
David Byrne
(Complex Realism/ Case-based Modeling)

SACS TOOLKIT: A new, case-based computationally-grounded mixed-methods platform for modeling complex systems.

COMPLEX-IT: A new APP for modeling complex systems based on case-based complexity and the SACS Toolkit.

See all of our papers and COMPLEX-IT at: www.personal.kent.edu/~bcastel3/



Our new Routledge
Complexity in social science series

COMPLEX-IT

A free R-Studio package for modeling complex systems from a case-based perspective

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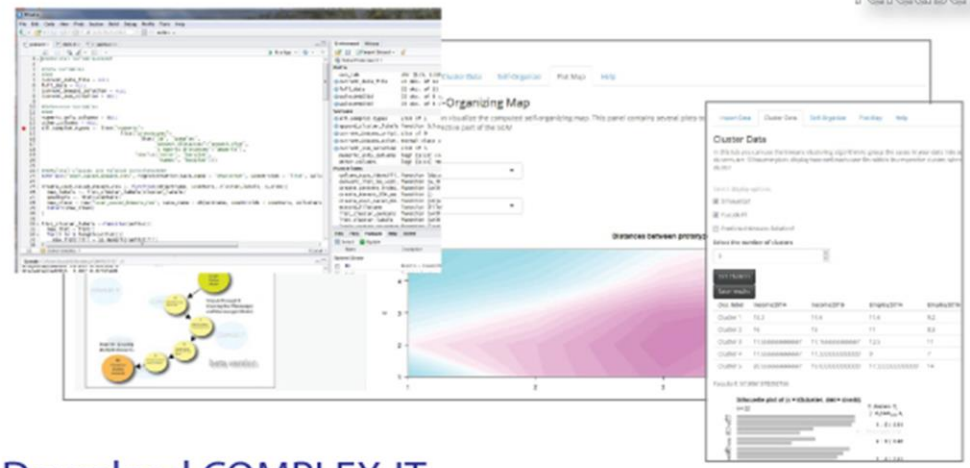
Identify Data | Import Data | Cluster Data | Self_Organize | Plot Map | Predict | Agent-Based | Help

PAPERS

beta version release 2017



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Articles on COMPLEX-IT

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