Breakout Session 5:
Frontiers in Social Science

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DSO Proposers Day

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Why DARPA?

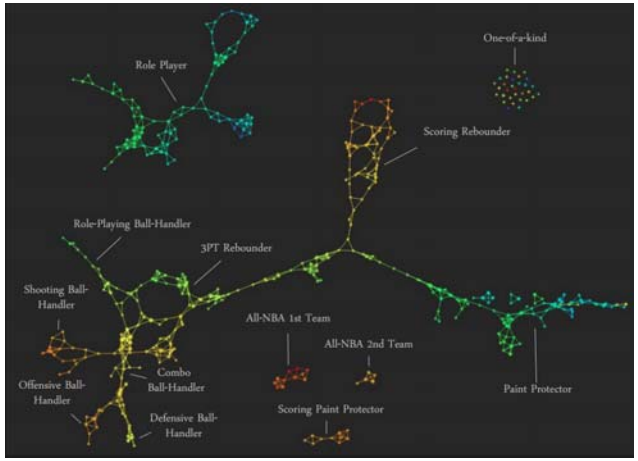
- "Imagine how much harder physics would be if electrons could think."
  - Murray Gell-Mann

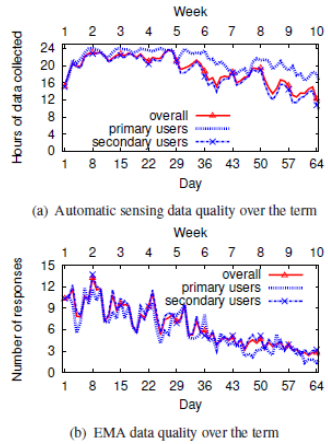
- "Imagine how much harder physics would be if electrons had feelings."
  - Richard Feynman

- "I can calculate the motion of heavenly bodies, but not the madness of people."
  - Isaac Newton

https://www.pinterest.com/explore/gary-larson/

Why now?





(a) Automatic sensing data quality over the term

(b) EMA data quality over the term

Figure 1. Compliance and quality of StudentLife data collected across the term.

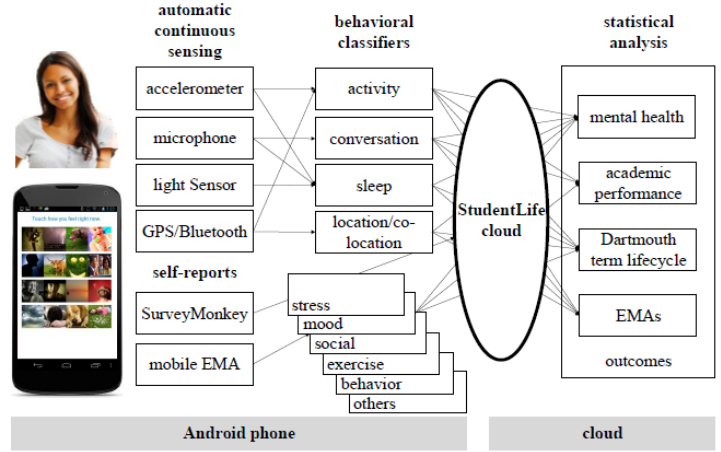
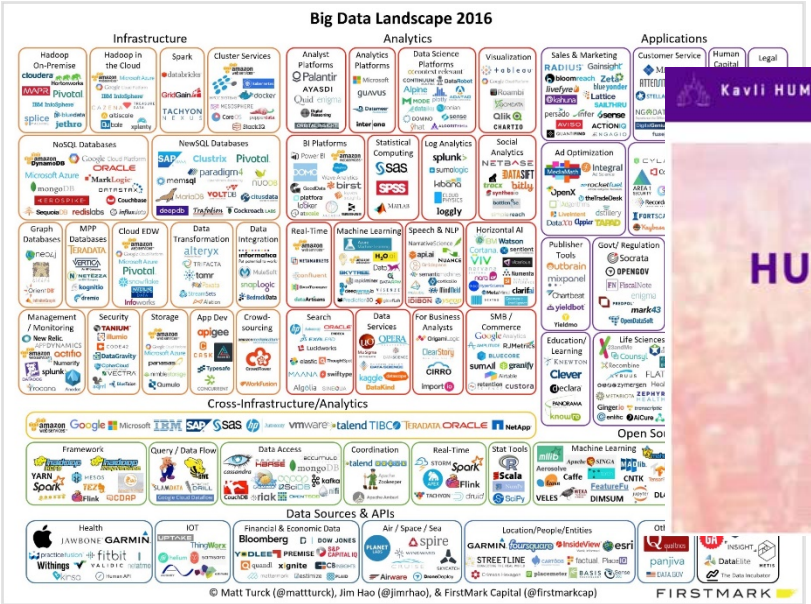
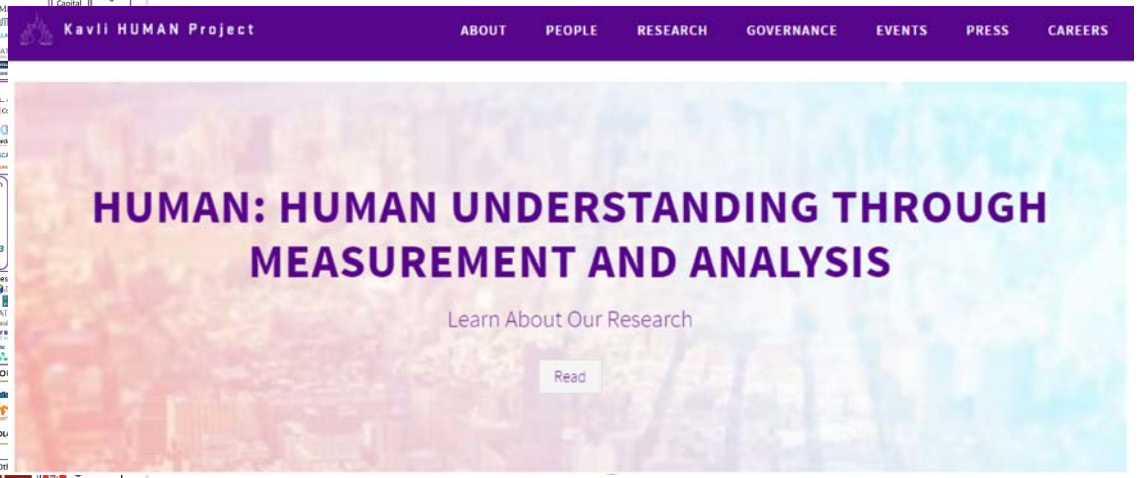


Figure 2. StudentLife app, sensing and analytics system architecture.





Campbell, A. et al. (2014) StudentLife: Assessing Mental Health, Academic Performance and Behavioral Trends of College Students using Smartphones http://dx.doi.org/10.1145/2632048.2632054

http://kavlihumanproject.org/

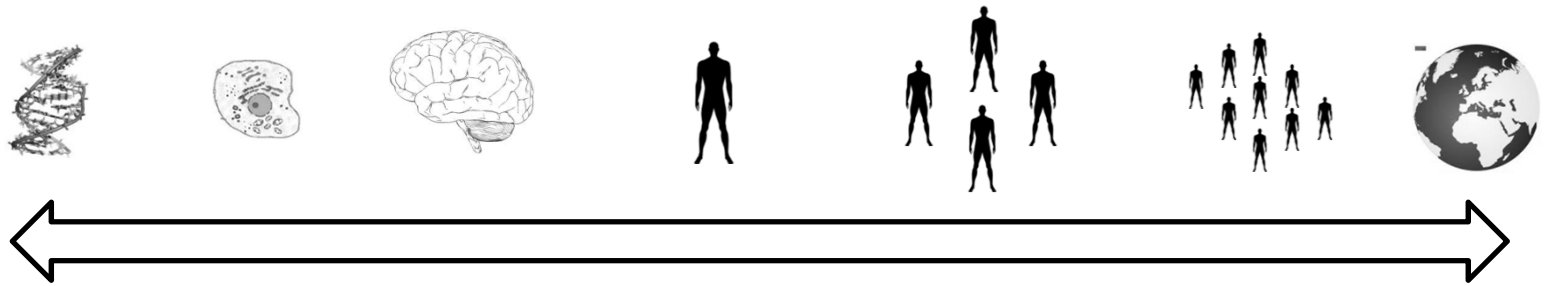
http://www.sloansportsconference.com/wp-content/uploads/2012/03/Alagappan-Muthu-EOSMarch2012PPT.pdf

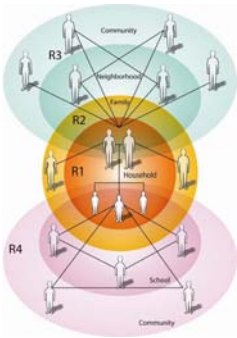
http://www.slideshare.net/mjft01/big-data-landscape-2016

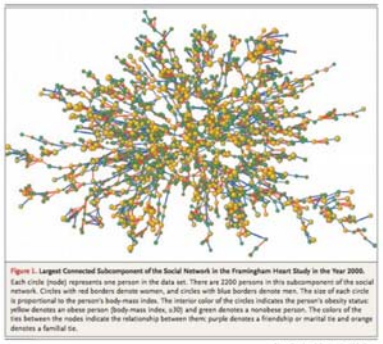
"This isn't rocket science."

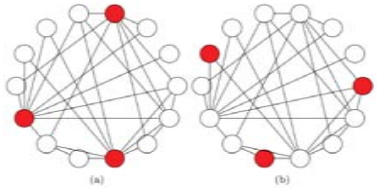
"Comprehensive accounts of human behavior cannot be achieved if the biological, cognitive, or social levels of organization are considered unnecessary or irrelevant."

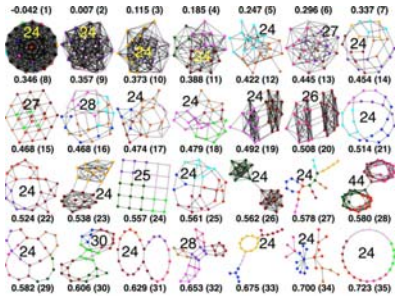
- Necka, Cacioppo, and Cacioppo (2015)

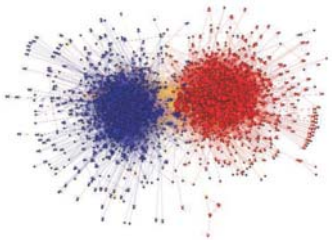












http://www.technologyreview.com/view/538866/the-social-network-illusion-that-tricks-your-mind/

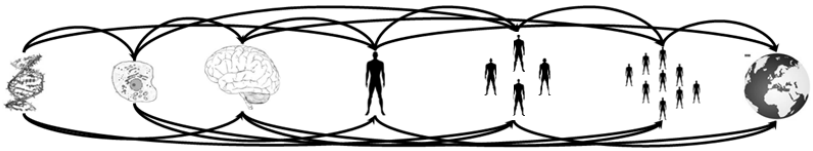
Gieannetto, D. and Heydari, B. (2015) Nature: Scientific Reports | 6:21870 | DOI: 10.1038/srep21870

http://www.cdc.gov/pcd/issues/2009/jul/08_0265.htm

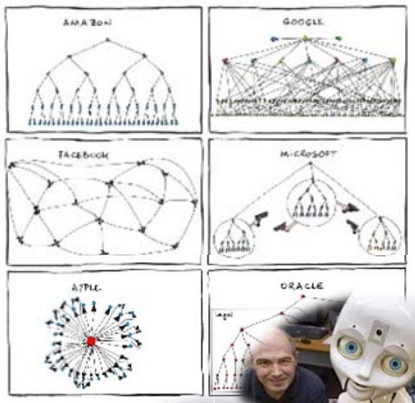
http://jhfowler.ucsd.edu/computational_social_science.pdf

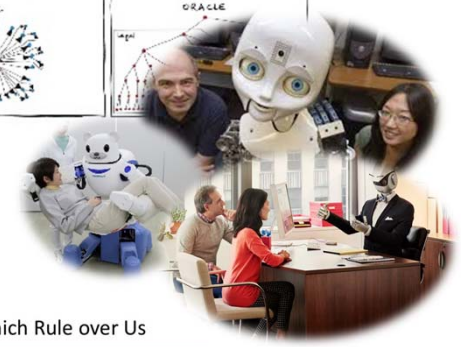
Some potential frontiers?

- New approaches for dealing with:
  - Multiple determinism
  - Non-additive determinism
  - Reciprocal determinism
  - Non-determinism

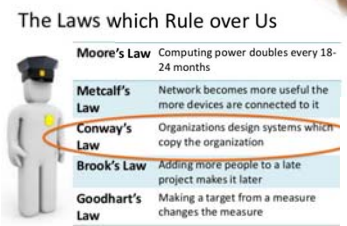


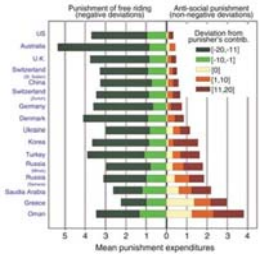
- New research questions:
  - How to put "*the*" brain back into its larger context as "*one among many*" brains?
  - What does a machine need to know about us to be a teammate and not just a tool?





- New transdisciplinary communities for "escape velocity":
  - Getting past Conway's Law and Henrich's Caveat:
    - "Organizations [disciplines] which design systems [studies]... are constrained to produce designs [studies] which are copies of the communication structures of these organizations [disciplines] —*Melvin Conway [Adam Russell]*
    - Going beyond WEIRD participants





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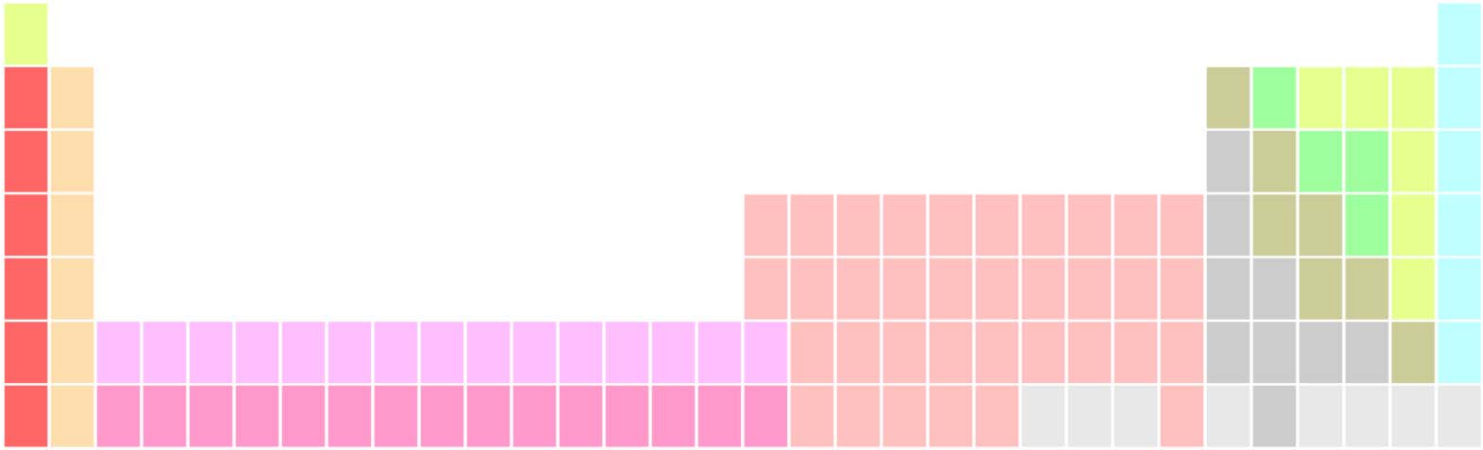
http://www.slideshare.net/allankellynet/conways-law-continuous-delivery
doi:10.1017/S0140525X0999152X

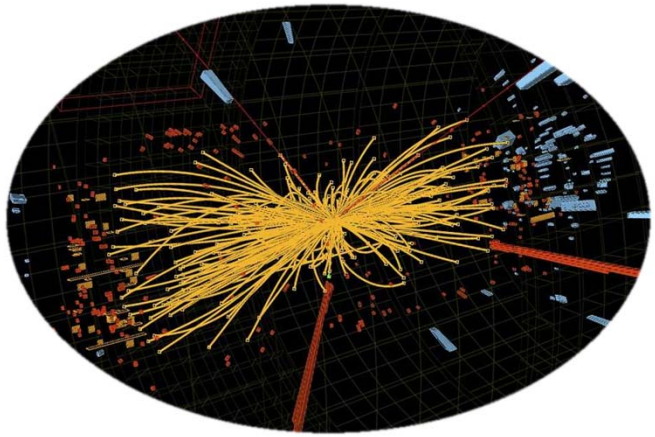
Challenge Question 1: A Social Science Periodic Table?

- A Social Science Periodic Table
  - What would this look like?
  - How would it be constructed?
  - Who would work on this?
  - How would we know if we're right?
  - What problems might be solved?



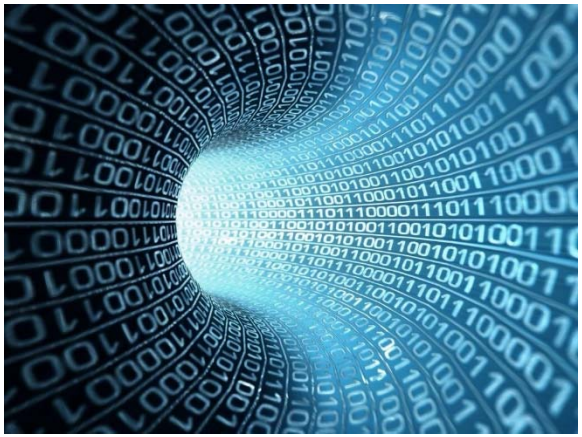
Challenge Question 2: Social Science Supercollider?

- Social Science Supercollider
  - How might it work?
  - What platforms, data, models could be used?
  - Which disciplines would be needed?
  - How would results be communicated and validated?
  - What problems might it address?

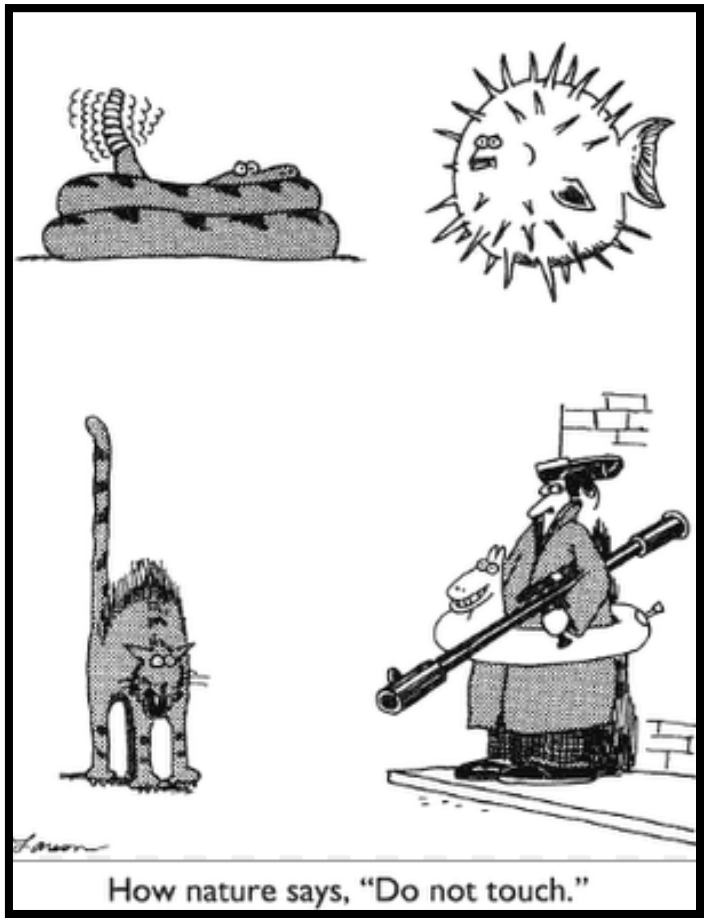


Challenge Question 3: DARPA's unique role(s)?

- DARPA's unique role(s) at the frontiers of social science
  - Data? (collection, curation, dissemination)
  - Technology? (models, visualizations, simulations)
  - Applications? (analysis, design, forecasting)
  - Community? (multi-, inter-, trans-disciplinary)
  - Other?



The “hardest science”



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Some possible "Grand Challenges"?

From "Accelerating Scientific Discovery by Formulating Grand Scientific Challenges," Dirk Helbing, ETH Zurich

- Under what conditions do quantitative changes make a qualitative difference ('more is different') or vice versa? How do qualitative and quantitative features affect each other?
- Under what conditions is the dynamics of a system sensitive to probabilistic events ('noise')? How do extreme events come about? To what extent do network interdependencies create new forms of (potentially catastrophic) risks? How to quantify, measure, and communicate systemic risks?
- When and how do heterogeneity (diversity) and randomness (fluctuations, noise) change the system dynamics fundamentally?
- When do correlations matter and generate a co-evolutionary dynamics that cannot be captured by a mean-field approximation or 'representative agent approach'? Which network structures promote aggregate effects through correlations, which ones average over neighboring interactions?
- What phenomena may occur in strongly coupled and interdependent systems and under what conditions? How to characterize these phenomena? What universality classes exist?
- Under what conditions do concepts such as Adam Smith's 'invisible hand', equilibrium, efficient markets, or rational agents work well? What are their limitations?
- Are there explanatory principles underpinning human societies and, if yes, which ones? What principles allow socially interactive systems to work well? What are the driving forces underlying the dynamics and evolution of these systems?
- How to operationalize and verify or falsify qualitative interpretations in the social sciences?
- What are the contributing factors and dynamics of conflict? How to avoid, overcome or moderate conflict, or turn it into a creative force? How to facilitate a peaceful interaction of people with incompatible values and diverse cultural backgrounds?
- How to bridge between qualitative and quantitative social science approaches, e.g. overcome the gap between abstract concepts and concrete contents? To what extent can cultural developments be understood as a result of interactions, history and context? What roles do networks of people and institutions, co-location effects, and randomness play?
- How to perform large-scale behavioral experiments in an efficient and ethically acceptable way? How to integrate experimental data and theories of the social, economic, behavioral, cognitive, and neuro-sciences into computational social science?
- How to promote "risk-wise" behavior?
- How network structures may affect the emergence of shocks –
  - Different types of interdependence between and among networks, including full and partial node overlap, correlated edge dynamics, and purely functional dependencies such as complementary or competitive interactions;
  - How shocks propagate within a given social network and how they propagate to other functionally-related networks;
  - How these networks re-organize following shocks.

From http://arxiv.org/pdf/1208.3883v1.pdf