

THE MIT MEDIA LABORATORY,  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

# MAS-581: NETWORKS, INFORMATION, AND THE EVOLUTION OF COMPLEX SYSTEMS

SPRING 2016

**First Day:** February 10    **Meet Day:** Fridays 1pm-4pm    **Room:** E14-633\* (6th Floor of the MIT Media Lab)  
**Office Hours:** None

## DESCRIPTION

This course covers the basics of networks science. The course will combine lectures, readings in group discussions, and projects, to familiarize students with ideas of network science in a research context.

### Instructor:

César A. Hidalgo PhD

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## EVALUATION

This is a pass/fail class. Attendance and participation are mandatory. Required readings are mandatory and students will be quizzed on them in front of the class. Working in groups is encouraged. The class requires students to present one network project at the end of the semester. They can work on that project individually or in pairs.

### 100% Class Participation

## READINGS

UNLESS OTHERWISE NOTED, STUDENTS NEED TO FIND THE READINGS BY THEMSELVES USING EITHER THE WEB OR THE LIBRARY RESOURCES FROM THEIR UNIVERSITIES.

### Part I Networks and their implications

Class 1: Feb 10: Class Introduction. Intro to Networks

Class 2: Feb 17: Network Structure and its consequences

**COMPLEXITY**

--Warren Weaver. "Science and Complexity" *American Scientist*, 36: 536 (1948).

**NETWORK STRUCTURE**

--Watts, DJ, & SH. Strogatz. "Collective dynamics of 'small-world' networks." *nature* 393.6684 (1998): 440-442.

--Barabási, A-L, and Réka Albert. "Emergence of scaling in random networks." *science* 286.5439 (1999): 509-512.

--Hidalgo, César A. "The value in the links: Networks and the evolution of organizations." *Sage Handbook on Management and Complexity*. London: Sage (2011): 257-569.

**Class 3: Feb 24: Network Measures & Inference**

--Granovetter, Mark S. "The strength of weak ties." *American journal of sociology* (1973): 1360-1380

--Coleman, James S. "Social capital in the creation of human capital." *American journal of sociology* (1988): S95-S120.

--Robert Putnam "Bowling Alone" (summary essay, not the full book):

--Hidalgo, César A. "Disconnected, fragmented, or united? a trans-disciplinary review of network science." *Applied Network Science* 1.1 (2016): 6.

**Class 4: March 3: Consequences of Network Structure****IMPLICATIONS OF NETWORK STRUCTURE**

--Pastor-Satorras, R, & A Vespignani. "Epidemic spreading in scale-free networks." *Physical review letters* 86.14 (2001): 3200.

--Albert, Réka, Hawoong Jeong, and Albert-László Barabási. "Error and attack tolerance of complex networks." *Nature* 406.6794 (2000): 378-382.

--Christakis, Nicholas A., and James H. Fowler. "The spread of obesity in a large social network over 32 years." *New England journal of medicine* 357.4 (2007): 370-379.

--Ronen, Shahar, et al. "Links that Speak: The global language network and its association with global fame." *Proceedings of the National Academy of Sciences* 10.1073/pnas.1410931111 (2014)

--Nickerson, David W. "Is voting contagious? Evidence from two field experiments." *American Political Science Review* 102.01 (2008): 49-57.

**Class 5: March 10: Economic Networks**

--Hidalgo, César A., et al. "The product space conditions the development of nations." *Science* 317.5837 (2007): 482-487.

--Hidalgo, César A., and Ricardo Hausmann. "The building blocks of economic complexity." *proceedings of the national academy of sciences* 106.26 (2009): 10570-10575.

--Hausmann Ricardo, et al. *The atlas of economic complexity: Mapping paths to prosperity*. Mit Press, 2014.

--Hartmann, Dominik, et al. "Linking economic complexity, institutions and income inequality." *arXiv preprint arXiv:1505.07907* (2015).

**Class 6: March 17:**

--Borondo, J., et al. "To Each According to its Degree: The Meritocracy and Topocracy of Embedded Markets." *Scientific reports* 4 (2014).

--Ohtsuki, Hisashi, et al. "A simple rule for the evolution of cooperation on graphs and social networks." *Nature* 441.7092 (2006): 502-505.

--Santos, Francisco C., and Jorge M. Pacheco. "Scale-free networks provide a unifying framework for the emergence of cooperation." *Physical Review Letters* 95.9 (2005): 098104.

**Class 7: March 24:**

--Guimerà, Roger, et al. "Team assembly mechanisms determine collaboration network structure and team performance." *Science* 308.5722 (2005): 697-702.

--Guevara, Miguel R., et al. "The research space: using career paths to predict the evolution of the research output of individuals, institutions, and nations." *Scientometrics* 109.3 (2016): 1695-1709.

--Mukherjee, Satyam, et al. "How Atypical Combinations of Scientific Ideas Are Related to Impact: The General Case and the Case of the Field of Geography." *Knowledge and Networks*. Springer International Publishing, 2017. 243-267.

#### **ADDITIONAL SUGGESTED READINGS:**

--James C. Scott, *Seeing Like a State* (Chapters 1-2)

--Hidalgo, César A. "Why Information Grows" *Basic Book* (2015)

## **SPRING BREAK**

**Class 8: April 7:**

**Programming Workshop (intro to python) [START THINKING ABOUT A PROJECT IDEA AND A TEAMMATE]**

**Class 9: April 14:**

**D3plus Workshop**

--The Data Visualization Revolution. Cesar A. Hidalgo and Ali Almosawi, *Scientific American* (2014)

--What's Wrong with Open-Data Sites and How We Can Fix Them, Cesar A. Hidalgo, *Scientific American* (2016)

**Class 10: April 21**

**Project Idea and Team Presentation**

**Class 11: April 28**

**Preliminary Results**

**Class 12: May 5**

**FINAL PRESENTATIONS 1 [15 Minutes per group]**

**Class 13: May 12**

**FINAL PRESENTATIONS 2 [15 Minutes per group]**