

# I501: Introduction to Informatics

Fall 2020

Online via Zoom / Wednesdays 11:15 a.m. - 01:45 p.m.

**Instructor:** Dr. Staša Milojević  
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**Office hours:** Mondays/Wednesdays 2:30 p.m. – 3:30 p.m. (via Zoom)

**Associate Instructor (AI):** Zackary Dunivin

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## COURSE SYLLABUS

### Course description:

The course deals with the foundations of Informatics as an interdisciplinary field. We will study concepts such as Information, Technology, Knowledge, Modeling, and their impact on science and society. The course will also attempt to define and understand what computational and systems thinking can bring to science and society. The goal of this course is to introduce doctoral students beginning their program of study in informatics to the range of theories, methods, and applications of informatics research and to help them situate themselves within the broad interdisciplinary epistemological framework of informatics.

## Course Objectives:

Upon successful completion of this course, students should be able to:

- Understand the roles of theory building and modeling in science;
- Critically evaluate the theories, methods, and applications of informatics research;
- Understand the role of modeling and systems thinking in structuring inquiry and applying them in research;
- Present research in manner intelligible to an interdisciplinary audience.

## Readings:

There is no required textbook for this course. The assigned reading materials will be made available through the “Files” section of Canvas.

## Assignments and Grading:

The grade for the course will be based on the following components:

1) Warm-up questions	20%
2) Research article presentation	5%
3) Reading memos	15%
4) Reading discussion questions	5%
5) Informatics colloquium attendance	5%
6) Class participation	10%
7) Modeling assignment	
a. Presentation	5%
b. Final report	35%

### 1) Warm-up questions.

The warm-up questions will give you an opportunity to reflect on the week’s readings prior to the class, and prepare for an in-class discussion. They will also provide an opportunity for application of the material covered in class and to encourage the integration of conceptual material and practical experience. I will pose a question and/or give you a task to do related to the weekly course topics. Your answers to the question should consist of **2-3 paragraphs, and be about 300-500 words** long (unless requested otherwise in the assignment).

Responses to warm-up questions will constitute 20% of the student's final course grade. Each response will be assigned a numerical grade on a scale of 0 to 2:

0 = no response

1 = Response indicates some understanding of readings but demonstrates no original thought

2 = Response indicates good understanding of readings and demonstrates original thought

Warm-up questions will be posted on Canvas. Responses are to be submitted only via Canvas no later than **5:00 p.m. on Monday before class**. Late submissions will be penalized 50%. Assignments that are submitted after the start of the class will not be accepted. No email submissions.

## 2) Research article presentation

At some point during the semester (Sessions 3 through 11), each student will do one **5-minute research article presentation accompanied by 2-5 slides**. In the first week of the semester, students will choose one article and a date for presentation from the list of eligible research articles available on Canvas. During your presentation, you will describe the context of the article as it is situated in its field, and you will summarize its concepts, methodology, and results, including pertinent figures from the article on your slides. While you are encouraged to discuss the choices that the authors made while constructing and writing the research article, please refrain from evaluating or critiquing the merits of the research article. This presentation is an exercise in identifying and succinctly presenting the major points of a research article without editorializing. A discussion will follow your presentation to further explore and critique the article, but you will not be expected to lead this discussion. Your presentation slides are to be submitted only via Canvas no later than **11:00 a.m. on Wednesday before class**. Late submissions will be penalized 50%. Assignments that are submitted after the start of the class will not be accepted. No email submissions.

## 3) Reading memos.

Each week in the semester (Sessions 3 through 11) students will submit a **400-word reading memo** for one of the research articles that your classmates are presenting that session (please see the research article presentation schedule on Canvas after Week 1). However, **on the week that you are completing your own research article presentation during class, you will be exempt from this assignment**. Your memo should briefly summarize the concept, methods and results of the paper in your own words and present a thoughtful reflection. During the reflection you may critique the concepts or methods of the paper, offer comments on the interpretation of results, connect the article to your own work, touch on practical implications, or spin off ideas for future research. However, you should not attempt to do all these things during your reflection! (Pick only one or two.)

Reading memos will constitute 15% of the student's final course grade. Each response will be assigned a numerical grade on a scale of 0 to 2:

0 = no response

1 = Response indicates some understanding of readings but demonstrates no original thought

2 = Response indicates good understanding of readings and demonstrates original thought

All memos are to be submitted only via Canvas no later than **5:00 p.m. on Tuesday before class**. Late submissions will be penalized 50%. Assignments that are submitted after the start of the class will not be accepted. No email submissions.

## 4) Reading discussion questions

Each week in the semester (Sessions 3 through 11), all students (including the presenter) will submit **2 discussion questions totaling fewer than 70 words** about the article they selected for their reading memo. The questions you submit may be presented during class to encourage discussion following the student-led research article presentation.

Reading discussion questions will constitute 5% of the student's final course grade. Each response will be assigned a numerical grade on a scale of 0 to 2:

0 = no response

1 = Response indicates some understanding of readings but demonstrates no original thought

2 = Response indicates good understanding of readings and demonstrates original thought

All discussion questions are to be submitted only via Canvas no later than **5:00 p.m. on Tuesday before class**. Late submissions will be penalized 50%. Assignments that are submitted after the start of the class will not be accepted. No email submissions.

#### **5) Informatics colloquium attendance.**

You should attend at least three informatics-related colloquia and/or job talks during the semester. To verify your attendance, you will need to write up a **2-3 paragraph reflection on 3 of the talks you attend**, which includes a one-paragraph summary of the talk and 1-2 paragraph critique and commentary. If you find a colloquium or other academic presentation that are relevant to your work or other Informatics scholarship not part of the Informatics talk series (e.g., Rob Kling Center, Cognitive Science, Computer Science), let me know what they are so we can decide whether they can be used to fulfill this requirement. The colloquium reflections are each to be submitted only via Canvas no later than **a week after the talk occurred**. Late submissions will be penalized 50%. Assignments that are submitted more than three days after the deadline will not be accepted. No email submissions. Grading will be binary (completed, not completed).

#### **6) Class participation.**

Discussion is a critical component of this course. You will be asked to read and to engage in critical discussions on what you have read. Therefore, a significant portion (10%) of your grade will come from your engagement in class discussions. Critique is an important part of academic life, so I want you to be critical, yet learn to do this in a way that is productive and thoughtful. You are expected to display knowledge of having read and synthesized all of the readings, to engage in class activities and discussions, and to provide thoughtful discussion of the readings while being respectful to classmates' comments and opinions.

#### **7) Modeling assignment.**

Over the course of the semester, students will conceptualize and develop a model for a forest, and a **3000-7000 word report and 10 minute in-class presentation** of your completed model will serve as the final for this class. For years, the U.S. Forestry service has developed models for forests, both nationally and at the local level, but their models have typically been from the perspective of and for the use of the timber industry. In this assignment, students will identify themselves with a particular stakeholder for a forest, and develop a model in alignment with their interests. While you will not be required to gather data and technically build the model, you will need to develop a comprehensive description of a model that could hypothetically be built, develop educated hypotheses as to its behavior, and explain how your model's completeness and usefulness would be evaluated. Consider this assignment an extended thought experiment. A more complete description of the assignment and its component parts will be available on Canvas. In class presentations will take place during sessions 12 and 13, on **November 11<sup>th</sup> and 18<sup>th</sup>** respectively, and your final written report will need to be submitted only via Canvas no later than **midnight on Friday, November 20<sup>th</sup>**. Late submissions will be penalized 50%. Assignments that are submitted after November 21<sup>th</sup> at midnight will not be accepted. No email submissions.

**For written work submitted for grading:** Deadlines will be stated clearly. Any late assignment, if accepted at all, will be downgraded. If a student cannot complete an assignment (or presentation) on the assigned date, it is the student's responsibility to discuss their situation with the instructor.

**Graded work** in this course will be evaluated according to four criteria:

- Written and/or oral clarity, spelling and grammatical correctness
- Insight into the concepts and issues addressed in the course
- Originality in interpretation and analysis
- Appropriate use of relevant literature

All material submitted for this course should be typewritten and legible, with appropriate references in a consistent format of your choice (e.g. MLA, APA, Chicago). If you want some help with writing, IUB has an excellent Writing Center on campus with staff who can assist with all phases of the writing process (<https://wts.indiana.edu/>)

## **Course Policies:**

### ***Course correspondence***

#### ***Announcements***

Class announcements will be made via Canvas Announcements. Not receiving or reading course announcements does not excuse one from the contents. No exceptions. Ensure your Canvas Notification settings are setup appropriately. To access past course announcements, go to Canvas > Announcements.

#### ***Contacting Instructors via E-mail***

Questions regarding course content, assignments and their grading are best answered during office hours. For non-assignment questions, feel free to use e-mail. Please include the course number in the subject line. Please give the instructors up to **24 hours** to reply to your emails. We do not guarantee that we will be able to respond to your queries and concerns over the weekend, so make sure to contact us Monday to Friday for a prompt reply.

### ***Students with Special Needs***

Every attempt will be made to accommodate qualified students with disabilities (e.g. mental health, learning, chronic health, physical, hearing, vision neurological, etc.) You must have established your eligibility for support services through the appropriate office that services students with disabilities. Note that services are confidential, may take time to put into place and are not retroactive; Captions and alternate media for print materials may take three or more weeks to get produced. Please contact Disability Services for Students at <http://disabilityservices.indiana.edu> or 812-855-7578 as soon as possible if accommodations are needed. The office is located on the third floor, west tower, of the Wells Library, Room W302. Walk-ins are welcome 8 AM to 5 PM, Monday through Friday. You can also locate a variety of campus resources for students and visitors that need assistance at: <http://www.iu.edu/~ada/index.shtml>

### ***Mental Distress***

Sometimes life can present challenges and we all react to them in different manners. Some are more prone to anxiety and depression than others, and these can be exacerbated by deadlines, relationship issues, financial difficulties, etc. The University offers resources to help students in distress. Please consider using them if you're having difficulties. For more information, see <http://healthcenter.indiana.edu/counseling/>

### ***Academic Misconduct***

We take academic misconduct very seriously when it does occur in the course. As instructors, we are bound by University rules when dealing with these sorts of situations. It is expected that you will abide by The Indiana University Code of Student Rights, Responsibilities, and Conduct (<http://www.iu.edu/~code/code/index.shtml>). Some examples of academic misconduct include (but are not limited to): copying a friend's homework, forgetting to use quotation marks correctly, using an assignment from another class, using an assignment from a previous I123 student, turning in old work (if you are retaking the course), etc. If you have any questions, please contact us ASAP. We will respond to acts of academic misconduct according to University policy concerning plagiarism. Sanctions for plagiarism can include (at minimum) a grade of F for the assignment in question and/or for the course and must include a report to the Dean of Students Office. In addition to plagiarism, falsely signing in for attendance, assignments, harassment of students/instructors, etc. are also treated as cases of

academic/personal misconduct. All cases will be reported to the University in accordance with the [Student Code of Conduct](#) and University guidelines.

### ***Sexual Misconduct and Title IX***

As your instructor, one of my responsibilities is to create a positive learning environment for all students. Title IX and IU's Sexual Misconduct Policy prohibit sexual misconduct in any form, including sexual harassment, sexual assault, stalking, and dating and domestic violence. If you have experienced sexual misconduct, or know someone who has, the University can help. If you are seeking help and would like to speak to someone confidentially, you can make an appointment with: Sexual Assault Crisis Services (SACS) at (812) 855-8900 (counseling services); Confidential Victim Advocates (CVA) at (812) 856-2469 (advocacy and advice services); IU Health Center at (812) 855-4011 (health and medical services). It is also important that you know that Title IX and University policy require me to share any information brought to my attention about potential sexual misconduct, with the campus Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, those individuals will work to ensure that appropriate measures are taken and resources are made available. Protecting student privacy is of utmost concern, and information will only be shared with those that need to know to ensure the University can respond and assist. I encourage you to visit [stopsexualviolence.iu.edu](http://stopsexualviolence.iu.edu) to learn more about the resources available to victims of sexual assault or harassment.

### **COVID-19:**

**We are all in this together, and need to work together to keep each other healthy.**

### **Masks and Physical Distancing Requirements**

All students signed the Community Responsibility Acknowledgement (CRA). Your agreement to the public health measures in the CRA is a condition of physical presence on the campus this fall. Included in that commitment were requirements for wearing masks in all IU buildings and maintaining social distancing in all IU buildings. Both are classroom requirements.

Both requirements are necessary for us to protect each other.

- Therefore, if a student is present in a class without a mask, the student will be asked to put on a mask and I will report the student to the Division of Student Affairs: Office of Student Conduct.
- If a student refuses to put a mask on after being instructed to do so, the instructor may end the class immediately, and contact the Office of Student Conduct. Violation of the mask rule is a threat to public safety within the meaning of the [Summary Suspension Policy](#).
- If a student comes to class without a mask twice, the student's final grade will be reduced by one letter (e.g., from an A to a B, for instance).
- If the student comes to class without a mask three times, the student will be withdrawn from the class without refund of tuition and reported to the Office of Student Conduct.

- If Student Conduct receives three cumulative reports from any combination of instructors or staff members that a student is not complying with the requirements of masking and physical distancing, the student [will be summarily suspended](#) from the university for the semester.

### **Student Rights**

Any student who believes another person in a class is threatening the safety of the class by not wearing a mask or observing physical distancing requirements may leave the class without consequence.

### **Attendance**

The CRA requires that you take your temperature every morning and that you refrain from attending class if you have a temperature of 100.4 or other symptoms of illness. In order to ensure that you can do this, attendance will not be a factor in the final grade. Attendance may still be taken to comply with accreditation requirements.

### **Summary Suspension Policy**

“A student may be summarily suspended from the university and summarily excluded from university property and programs by the Provost or designee of a university campus. The Provost or designee may act summarily without following the hearing procedures established by this section if the officer is satisfied that the student’s continued presence on the campus constitutes a serious threat of harm to the student or to any other person on the campus or to the property of the university or property of other persons on the university campus.”

## SCHEDULE OF LECTURES AND REQUIRED READINGS

NOTE: For each class session, the following schedule includes a topic statement and a list of required readings. **Readings are listed in the order in which they should be read.**

### Session 1 -- August 26

**Topic: Introduction to I501 + Information, data, knowledge.**

**Required readings for Session 1:**

Gleick, J. (2011). *The Information: a History, a Theory, a Flood* (pp. 204-268). New York: Pantheon Books.

### Session 2 -- September 2

**Guest speaker: NATHAN ENSMINGER**

**Topic: Computers and computing.**

**Required readings for Session 2:**

Campbell-Kelly, M., Aspray, W., Ensmenger, N. and Yost, J.R. (2014). *Computer: a history of the information machine* (pp. 3-19). Boulder, CO: Westview Press, Perseus Books

Galison, P. (1994). The ontology of the enemy: Norbert Wiener and the cybernetic vision. *Critical inquiry*, 21(1), 228-266.

### Session 3 -- September 9

**Topic: Science, scientific knowledge and scientific method.**

**Required readings for Session 3:**

Ben-Ari, M. (2005). *Just a Theory: Exploring the Nature of Science* (pp. 1-21). Amherst: Prometheus Books.

Siever, R. (1968). Perspectives: Science: Observational, Experimental, Historical. *American Scientist*, 56(1), 70-77.

Bryman, A. (1984). The debate about quantitative and qualitative research: a question of method or epistemology?. *British journal of Sociology*, 75-92.

McIntyre, L. (2019). *The Scientific Attitude: Defending Science from Denial, Fraud, and Pseudoscience* (pp. 1-8; 9-28; 81-113). Cambridge: The MIT Press.

Bishop, D. (2020). How scientists can stop fooling themselves over statistics. *Nature*, 584(7819), 9.

### Session 4 -- September 16

**Topic: Historically influential systems of thought + Theory building.**

**Required readings for Session 4:**

Abbott, A. (2004). *Methods of Discovery: Heuristics for the Social Sciences* (pp. 41-79). New York: The Guilford Press.

Stinchcombe, A. L. (1987). *Constructing social theories* (pp. 15-56). Chicago: University of Chicago Press.

Jaccard, J. & Jacoby, J. (2010). *Theory Construction and Model-Building Skills* (pp. 28-33). New York: The Guilford Press.

**Session 5 -- September 23**

**Topic: Concepts and their definitions.**

**Guest speaker:** ALEXIS PEIRCE CAUDELL

**Required readings for Session 5:**

Thagard, P. (1992). *Conceptual Revolutions* (pp. 13-33). Princeton: Princeton University Press.

Jaccard, J. & Jacoby, J. (2010). *Theory Construction and Model-Building Skills* (pp. 10-16; 75-89). New York: The Guilford Press.

**Session 6 -- September 30**

**Topic: Systems and complexity.**

**Required readings for Session 6:**

Weaver, W. (1948). Science and Complexity. *American Scientist*, 36(4), 536-44.

Von Bertalanffy, L. (1968). *General System Theory: Foundations, Development, Applications* (pp. 3-29; 30-53). New York: George Braziller.

Simon, H.A. (1962). The Architecture of Complexity. *Proceedings of the American Philosophical Society*, 106, 467-482.

Flake, G.W. (1998). *The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems and Adaptation* (pp. 1-8; 129-136). New York: The Guilford Press.

**Session 7 -- October 7**

**Topic: Networks and structural thinking.**

**Required readings for Session 7:**

Mitchell, M, C. (2009). *Complexity: A Guided Tour* (pp. 227-246; 247-257). Oxford: Oxford University Press.

Hidalgo, C. (2015). *Why Information Grows: The Evolution of Order, from Atoms to Economies* (pp. 109-125). New York: Basic Books.

Butts, C. T. (2009). Revisiting the foundations of network analysis. *Science*, 325(5939), 414-416.

**Session 8 -- October 14**

**Topic: Models and modeling.**

**Required readings for Session 8:**

Morgan, M. S., & Morrison, M. (1999). *Models as mediators* (pp. 10-37). Cambridge: Cambridge University Press.

Page, S.E. (2018). *The Model Thinker: What You Need to Know to Make Data Work for You* (pp. 13-25). New York: Basic Books.

Miller, J.H. & Page, S.E. (2007). *Complex Adaptive Systems: An Introduction to Computational Models of Social Life* (pp. 35-43). New York: Basic Books.

**Session 9 -- October 21**

**Topic: Mathematical modeling + Information theory.**

**Required readings for Session 9:**

Otto, S.P. & Day, T. (2007). *A Biologist's Guide to Mathematical Modeling in Ecology and Evolution* (pp. 17-51). Princeton: Princeton University Press.

DeDeo, S. (2018). Information theory for intelligent people.

**Session 10 -- October 28**

**Topic: Simulations and computational modeling.**

**Required readings for Session 10:**

- Miller, J.H. & Page, S.E. (2007). *Complex Adaptive Systems: An Introduction to Computational Models of Social Life* (pp. 57-77). New York: Basic Books.
- Gilbert, N. & Troitzsch, K.G. (2005). *Simulation for the Social Scientist* (pp. 1-14; 15-27). Maidenhead: Open University Press.
- Winsberg, Eric, "Computer Simulations in Science", *The Stanford Encyclopedia of Philosophy* (Winter 2019 Edition), Edward N. Zalta (ed.).

**Session 11 -- November 4**

**Topic: Causality + Predicting.**

**Required readings for Session 11:**

- Pearl, J. & Mackenzie, D. (2018). *The Book of Why: The New Science of Cause and Effect* (pp. 23-51; 135-165). New York: Basic Books.
- Hofman, J. M., Sharma, A., & Watts, D. J. (2017). Prediction and explanation in social systems. *Science*, 355(6324), 486-488.
- Simon, H. A. (1954). Spurious correlation: A causal interpretation. *Journal of the American statistical Association*, 49(267), 467-479.
- Domingos, P. (2012). A few useful things to know about machine learning. *Communications of the ACM*, 55(10), 78-87.
- Kleinberg, J., Ludwig, J., Mullainathan, S., & Obermeyer, Z. (2015). Prediction policy problems. *American Economic Review*, 105(5), 491-95.
- DeDeo, S. (2017). Wrong side of the tracks. In C.R. Sugimoto, H. Ekbja, & M. Mattioli (Eds.) *Big Data is Not a Monolith*. Cambridge, MA: MIT Press.

**Session 12 -- November 11**

**Presentations.**

**Session 13 -- November 18**

**Presentations.**

# 1. Pick a date/session

Fill your last name+first initial in this table

Session	Date	Student 1	Student 2	Student 3
3	9/9			
4	9/16			
5	9/23			
6	9/30			
7	10/7			
8	10/14			
9	10/21			
10	10/28			
11	11/4			

# 2. Pick an article

Fill your last name+first initial in this table (only one name per article; first come, first served)

ARTICLE	LAST NAME, FIRST
<p>Ackermann, K., Angus, S. D., &amp; Raschky, P. A. (2017). The Internet as Quantitative Social Science Platform: Insights from a Trillion Observations. arXiv preprint arXiv:1701.05632.  <a href="https://arxiv.org/pdf/1701.05632.pdf">https://arxiv.org/pdf/1701.05632.pdf</a></p>	
<p>Askarisichani, O., Lane, J. N., Bullo, F., Friedkin, N. E., Singh, A. K., &amp; Uzzi, B. (2019). Structural balance emerges and explains performance in risky decision-making. Nature communications, 10.  <a href="https://www.nature.com/articles/s41467-019-10548-8.pdf?origin=ppub">https://www.nature.com/articles/s41467-019-10548-8.pdf?origin=ppub</a></p>	
<p>Asur, S., &amp; Huberman, B. A. (2010, August). Predicting the future with social media. In Proceedings of the 2010 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology-Volume 01 (pp. 492-499). IEEE Computer Society.  <a href="https://dl.acm.org/citation.cfm?id=1914092">https://dl.acm.org/citation.cfm?id=1914092</a></p>	
<p>Bakshy, E., Messing, S., &amp; Adamic, L. A. (2015). Exposure to ideologically diverse news and opinion on Facebook. Science, 348(6239), 1130-1132.  <a href="https://science.sciencemag.org/content/348/6239/1130">https://science.sciencemag.org/content/348/6239/1130</a></p>	
<p>Barron, A. T., Huang, J., Spang, R. L., &amp; DeDeo, S. (2018). Individuals, institutions, and innovation in the debates of the French Revolution. Proceedings of the National Academy of Sciences, 115(18), 4607-4612. <a href="https://www.pnas.org/content/115/18/4607.short">https://www.pnas.org/content/115/18/4607.short</a></p>	
<p>Becker, J., Brackbill, D., &amp; Centola, D. (2017). Network dynamics of social influence in the wisdom of crowds. Proceedings of the national academy of sciences, 114(26), E5070-E5076.  <a href="https://www.pnas.org/content/114/26/E5070.short">https://www.pnas.org/content/114/26/E5070.short</a></p>	

<p>Bernstein, E., Shore, J., &amp; Lazer, D. (2018). How intermittent breaks in interaction improve collective intelligence. <i>Proceedings of the National Academy of Sciences</i>, 115(35), 8734-8739. (<a href="https://www.pnas.org/content/115/35/8734.short">https://www.pnas.org/content/115/35/8734.short</a>)</p>	
<p>Bettencourt, L. M., Lobo, J., Helbing, D., Kühnert, C., &amp; West, G. B. (2007). Growth, innovation, scaling, and the pace of life in cities. <i>Proceedings of the national academy of sciences</i>, 104(17), 7301-7306. (<a href="https://www.pnas.org/content/104/17/7301/">https://www.pnas.org/content/104/17/7301/</a>)</p>	
<p>Brodeur, A., Cook, N., &amp; Heyes, A. (2020). Methods Matter: P-Hacking and Publication Bias in Causal Analysis in Economics. <i>American Economic Review</i>. (<a href="https://www.aeaweb.org/content/file?id=12747">https://www.aeaweb.org/content/file?id=12747</a>)</p>	
<p>Bollen, J., Mao, H., &amp; Zeng, X. (2011). Twitter mood predicts the stock market. <i>Journal of computational science</i>, 2(1), 1-8. (<a href="https://www.sciencedirect.com/science/article/pii/S187775031100007X">https://www.sciencedirect.com/science/article/pii/S187775031100007X</a>)</p>	
<p>Botvinik-Nezer, R., Holzmeister, F., Camerer, C. F., Dreber, A., Huber, J., Johannesson, M., ... &amp; Avesani, P. (2020). Variability in the analysis of a single neuroimaging dataset by many teams. <i>Nature</i>, 1-7. (<a href="https://www.nature.com/articles/s41586-020-2314-9">https://www.nature.com/articles/s41586-020-2314-9</a>)</p>	
<p>Brockmann, D., &amp; Helbing, D. (2013). The hidden geometry of complex, network-driven contagion phenomena. <i>science</i>, 342(6164), 1337-1342. (<a href="https://science.sciencemag.org/content/342/6164/1337">https://science.sciencemag.org/content/342/6164/1337</a>)</p>	
<p>Candia, C., Jara-Figueroa, C., Rodriguez-Sickert, C., Barabási, A. L., &amp; Hidalgo, C. A. (2019). The universal decay of collective memory and attention. <i>Nature human behaviour</i>, 3(1), 82. (<a href="https://www.nature.com/articles/s41562-018-0474-5?dom=prime&amp;src=syn">https://www.nature.com/articles/s41562-018-0474-5?dom=prime&amp;src=syn</a>)</p>	

<p>Cheng, F., Kovács, I. A., &amp; Barabási, A. L. (2019). Network-based prediction of drug combinations. <i>Nature communications</i>, 10(1), 1197. (<a href="https://www.nature.com/articles/s41467-019-09186-x">https://www.nature.com/articles/s41467-019-09186-x</a>)</p>	
<p>Christakis, N. A., &amp; Fowler, J. H. (2010). Social network sensors for early detection of contagious outbreaks. <i>PloS one</i>, 5(9), e12948. (<a href="https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0012948">https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0012948</a>)</p>	
<p>Ciampaglia, G. L., Nematzadeh, A., Menczer, F., &amp; Flammini, A. (2018). How algorithmic popularity bias hinders or promotes quality. <i>Scientific reports</i>, 8(1), 15951. (<a href="https://www.nature.com/articles/s41598-018-34203-2">https://www.nature.com/articles/s41598-018-34203-2</a>)</p>	
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