

Course Overview for PoCS

Last updated: 2024/09/10, 07:35:29 EDT

Principles of Complex Systems, Vols. 1, 2, & 3D
CSYS/MATH 6701, 6713, & a pretend number, 2024–2025

Prof. Peter Sheridan Dodds

Computational Story Lab | Vermont Complex Systems Center
Santa Fe Institute | University of Vermont



Licensed under the [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/)

The PoCVerse
What's the John
Dory?
1 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References



These slides are brought to you by:

Sealie & Lambie
Productions



The PoCverse
What's the John
Dory?
2 of 59

Orientation

Course Information
Centers, Books, Resources

Topics

Narrative Arc

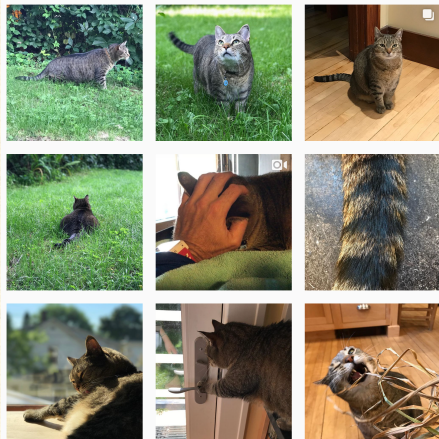
Tarot Cards



Projects

References

These slides are also brought to you by:

Special Guest Executive Producer



 On Instagram at [pratchett_the_cat](https://www.instagram.com/pratchett_the_cat) 

The PoCverse
What's the John
Dory?
3 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References



Outline

The PoCSverse
What's the John
Dory?
4 of 59

Orientation

Course Information
Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References

Orientation

Course Information
Centers, Books, Resources

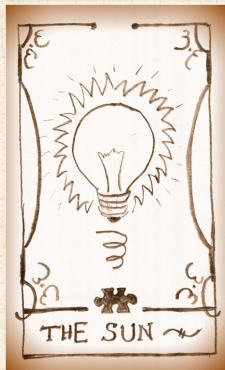
Topics

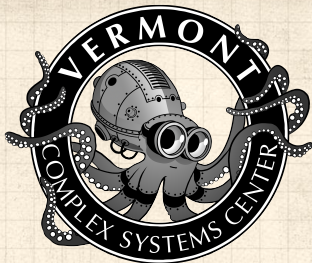
Narrative Arc

Tarot Cards

Projects

References





The PoCverse
What's the John
Dory?
6 of 59

Orientation

Course Information
Centers, Books, Resources

Topics

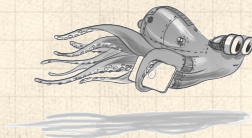
Narrative Arc

Tarot Cards

Projects

References

Describe | Explain | Create | Share | Ethos: Play




vermontcomplexsystems.org 




Vermont Complex Systems Center (2006–):

-  Diverse research and teaching portfolio.
-  Funding from many sources: NSF, NIH, DARPA, Microsoft, MITRE, Computer Associates, MassMutual, Google, foundations.
-  Regular global press coverage: NYT, BBC, WaPo, NatGeo, ...
-  Conferences: “Big Data, Big Stories”, “Big Scale, Big Fail”, “Prediction: the Next Big Thing”, [NetSci 2019](#) , [ALife 2020](#) .
-  Fully developed educational platform in Complex Systems and Data Science.
-  Complex Networks Winter Workshops in Quebec City
-  Faculty hires of true Complex Systems scholars.
-  Numerous NSF CAREER awards (including PECASE).
-  Connecting Graduate and Undergraduate Students across campus (SCRaPS).
-  Paper Shredder, Research Jam, and ComplexiTea.
-  [Talkboctopus](#) 

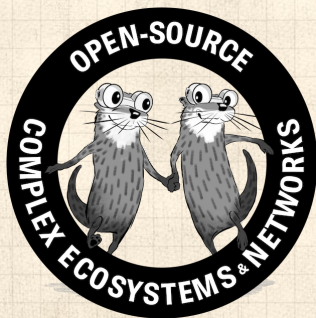
Some Major support:

 MassMutual Center for Excellence in Complex Systems and Data Science


vermontcomplexsystems.org/partner/MMCOE/ 


 University of Vermont-Google Open-Source Complex Ecosystems And Networks (OCEAN)


vermontcomplexsystems.org/partner/OCEAN/ 





We're interested in many things:


 Sociotechnical systems


 Social Contagion and Influence


 Happiness and Well-being


 Language and Stories


 Social unrest

 Conflict

 Robotics


 Artificial Intelligence

 Complex Networks


 Climate


 Biology


 Ecology

 Geomorphology


 Space


 Complex Fluids


 (Smart) Power Grids


 Critical infrastructure


 Defense


 Public Policy


 Health and Medicine


 ~~Brainz~~ Brains


 Neuroscience


 Food systems


 Epidemiology

 Pandemics

 Organizations

 Economics

 Wealth inequality

 Financial Systems

Leveling up—Scaffolded educational mission:



Data Science Undergrad.



Graduate Certificate in Complex Systems and Data Science



Fall, 2015–: MS in Complex Systems and Data Science



Fall, 2018–: PhD in ~~The Study of Interesting Things~~ Complex Systems and Data Science




All the words: <http://vermontcomplexsystems.org>

Dipoloma-posters:

2023
Approved by the Babbeclaps in an Eightfold Way

BE STRANGE AND ADORABLE



Persephone McFoggleton
has snaffled
The Graduate Certificate in
Complex Systems and Data Science
Vermont Complex Systems Center - University of Vermont

COMPLEX SYSTEMS CENTER
UNIVERSITY OF VERMONT

2023
Approved by the Babbeclaps in an Eightfold Way

KNOW MANY THINGS




Basil Gastropodhunter
unlocked the next level of
Masters in
Complex Systems and Data Science
Vermont Complex Systems Center - University of Vermont

COMPLEX SYSTEMS CENTER
UNIVERSITY OF VERMONT

2023
Approved by the Babbeclaps in an Eightfold Way

SOMETHING TO CROW ABOUT



Emanuel Fuguestate
has ascended to the plane of
PhD in
Complex Systems and Data Science
Vermont Complex Systems Center - University of Vermont

COMPLEX SYSTEMS CENTER
UNIVERSITY OF VERMONT

2023
Approved by the Babbeclaps in an Eightfold Way



A GOOD POSTDOGTORAL FELLOW





Porcupina Thwackett
Vermont Complex Systems Center - University of Vermont


COMPLEX SYSTEMS CENTER
UNIVERSITY OF VERMONT

Graduate Certificate in Complex Systems and Data Science:

 Principles of Complex Systems is one of three core requirements for UVM's five course Certificate of Graduate Study in Complex Systems .









 Modelling Complex Systems I and II

 Data Science I and II

 Principles of Complex Systems Vols. 1 and 2

Framing (funfully):

Science = Area of study + Instruments of study

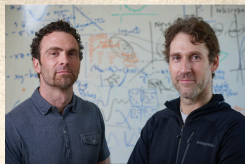
-  Stars and Telescopes = Astronomy
-  Rocks and Hammers = Geology
-  Water and Partial Differential Equations = Fluid Dynamics
-  Brains and Giant Imaging Machines = Neuroscience
-  People and Deception = Social Psychology
-  Mathematics and Mathematics = Pure mathematics
-  Mind and Mind = Psychotherapy, Insight meditation, ...
-  Complex Systems + Data Science = Postdisciplinary Systems Science



Michael Arnold Jane Adams Todd DeLuca Sophie Hodson Sandhya Gopchandani Anne Marie Stupinski Summer Jang



Tyler Gray Aton Schwartz Eric Clark Ben Emery David Dewhurst Colin Van Dort Laura Jennings



Chris Danforth Peter Dodds



Abby Ross Northfield Mount Hermon School Chris Fusting Data Science Consultant Ryan Gallagher Northwestern PhD student John Ring Lindsay Ross Brendan Whitney Henry Mitchell Sarah Howerter Kayla Horak U of Wisconsin



compstorylab.org



Nick Altaper Psychiatry Res Asst Prof Dylan Kiley Chobanian Group Tom Mylonides Cardiovascular Research Foundation Emily Coody Data Scientist Adobe Morgan Frank MIT Media Lab PhD Student Cathy Bliss UVM Lecturer Mark Ibrahim Data Scientist Insight Ross Luo Dartmouth PhD Cold Region's Research & Engineering Laboratory Eran Pechemek Maine School of Science & Math Andy Seaman Data Scientist MassMutual Sven McCall Maps, Apple



Lewis Mitchell Adelaide Faculty Jake Williams Drexel Faculty Isabel Khouramian Cornell PhD Facebook Data Scientist Fletcher Hazlehurst Sharon Alajajian Research Scientist Univ of Pennsylvania Kamron Harris U Washington Postdoc Paul Lissardi Colorado PhD Student Suma Dixit Apple Data Scientist Mike Foley Northeastern PhD student Darcy Green Climate Science UC London, MS student Lindsay Van Lier VCHIP

The PoCVerse
What's the John
Dory?

14 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References



Funding: NSF, NIH, NIDA, NASA, MITRE, James S. McDonnell Foundation, ONR, DARPA, MassMutual, Google, Computer Associates; [YOUR WONDERFUL FUNDING AGENCY HERE]

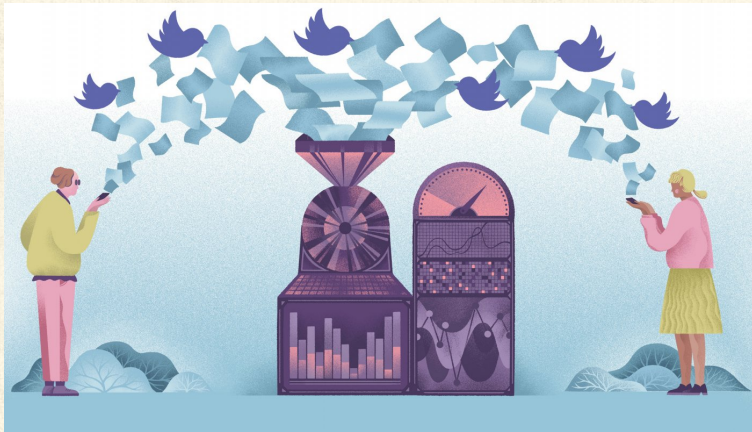


Outside

Inside the Lab that's Quantifying Happiness ↗

by Rowan Jacobsen, August 2017.

(Reprinted in UVM Quarterly, 2018.)



The PoCVerse
What's the John
Dory?
15 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards



Projects



References





Courses:







 CSYS/MATH 300: Principles of Complex Systems ([@pocsvox](#) 



 CSYS/MATH 303: Complex Networks ([@networksvox](#) 

 MATH 124/122: Matrixology (Linear Algebra) ([@matrixologyvox](#) and [@svdthematrices](#) 

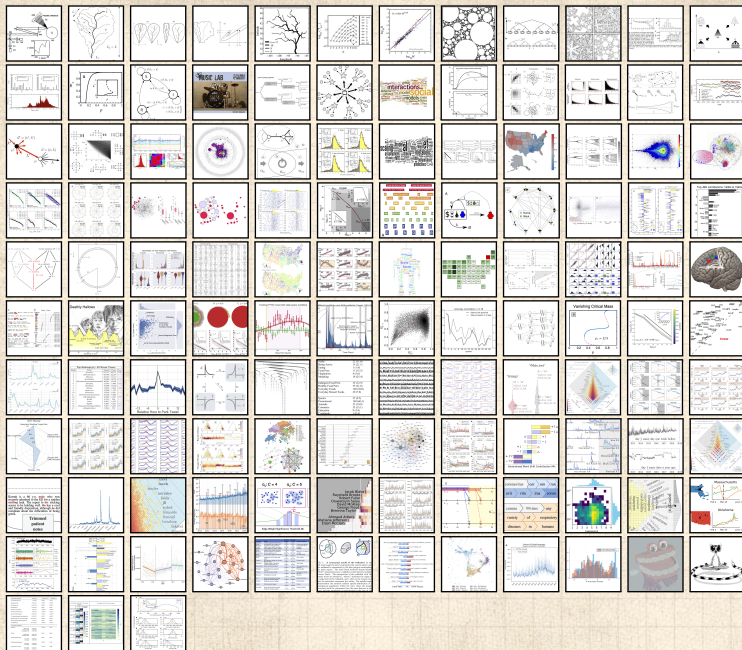
 MATH 237: Numerical Analysis ([@MachEps237](#) 

 MATH 266: Chaos, fractals & dynamical systems ([@NonperiodicFlow](#) 

 MATH 330: Ordinary Differential Equations ([@dallthethingsdt](#) 

 Courses act as research incubators and have helped generate [many papers](#) 





The PoCVerse What's the John Dory?

16 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References






verse
e John


on
nation
s, Resources


S




Basics:


 Instructor: Prof. Peter Sheridan Dodds

 Lecture room and meeting times:
Morrill Hall, 010, 10:05 am to 11:20 am

 Office: (in theory) The Ether and/or Innovation, fourth floor

 email: peter.dodds@uvm.edu

 Course Website:
<https://pdodds.w3.uvm.edu/teaching/courses/2024-2025pocverse> 


 Course Twitter handle: [@pocsvox](https://twitter.com/pocsvox)





Potential paper product:

 The Syllabus . and a Poster .



Office hours:

 See Teams calendar,
The Ether and/or Innovation, fourth floor

No laptops in class:

-  Please take notes with pencil/pen and paper.
-  Also okay: Writing on a flat tablet.

Approved etiquette mechanisms:

-  Raise hands for questions (always feel free to ask questions).
-  The class is a G rated environment (of course, sometimes we have to discuss bad things, science-style).



Exciting details regarding these slides:



Three servings (all in pdf):


1. Fresh: For in-class Delivery.
2. On toast: Flattened for page-turning joy.
3. Freeze-dried: Pack-and-go, 3x3 slides per page.



Presentation versions are **hyperly navigable**:

~~⌂ ⏪ ⏩ ≡~~ back + search + forward.



Web links look like this .



References in slides link to full citation at end. ^[1]











Citations contain links to pdfs for papers (if available).



Some books will be linked to on Amazon.



Brought to you by a frightening melange of X_YLaTeX , LuaLaTeX , Beamer , perl , PerlTeX , fevered command-line madness , and an almost fanatical devotion  to the indomitable emacs .

#totallynormal



More super exciting details:



We use Open Sans EB Garamond and make math look good:

```
%% \setmainfont[Ligatures=TeX]{Open Sans}
%% \setsansfont[Ligatures=TeX]{Open Sans}
%% \usefonttheme[onlymath]{serif}
\setmainfont[Ligatures=TeX]{EB Garamond}
\setsansfont[Ligatures=TeX]{EB Garamond}
\usefonttheme[onlymath]{serif}
```














Still working towards putting the course on Github/Gitlab



And finishing writing the books ...





Yet more super exciting details:



-  This is Season 20 of Principles of Complex Systems, Vols. 1, 2, & 3D.
-  In-person lectures will be called ~~Stories~~ Episodes (a more elevated framing than “Streams of consciousness”)
-  Slide-specific curated episodes are online, and are broken into clips.
-  ~~Goal for all in-person lectures: Record with ScreenFlow, curate, send to Youtube.~~
-  Office hours will run over Teams and be recorded.
-  Some new clips may be recorded in a pretend studio.
-  All lectures are bottle  episodes .
-  Other tropes  will be involved.



Wonderful foundational support for PoCS Vol. 1, ~~CoNKS~~
~~CoCoNuTs~~ PoCS Vol. 2, and PoCS Vol. 3D, has come from
the NSF:

 “CAREER: Explorations of Complex Social and Psychological Phenomena through Multiscale Online Sociological Experiments, Empirical Studies, and Theoretical Models.” 2009–2015.







 SES Division of Social and Economic Sciences
SBE Directorate for Social, Behavioral & Economic Sciences

 Abstract is [here](#) .

 People have also [said nice things about PoCS](#) 





Microsoft Teams + Slack

-  Teams = main place for discussions about all things PoCS including assignments and projects.
-  Slack = main place for students and faculty in Complex Systems and Data Science to talk about everything.
-  Teams—Automatic if enrolled in the course.
-  Slack—Once invited, please sign up here:
<https://csdsgrads.slack.com/>
-  Very good: Install Microsoft and Slack apps on laptops, tablets, phone, cats, dogs. Nothing will go wrong.
-  Everyone will behave wonderfully.




Grading breakdown:

 **Assignments (66%)**—All assignments will be of equal weight and there will be 10 ± 1 of them.

 **Projects/talks (24%)**—Students will work on semester-long projects. Students will develop a proposal in the first few weeks of the course which will be discussed with the instructor for approval.





Details: 8% for the first talk, 8% for the final talk, and 8% for the written project.

 **General attendance/Class participation (10%)**—Everyone is expected to behave well.



How grading works:

Questions are worth 3 points according to the following scale:

-  3 = correct or very nearly so.
-  2 = acceptable but needs some revisions.
-  1 = needs major revisions.
-  0 = way off.



Important things:

1. Classes run from Monday, August 28 to Friday, December 8.
2. Add/Drop, Audit, Pass/No Pass deadline—Monday, September 11.
3. Last day to withdraw—Monday, October 30 (Sadness!).
4. Reading and Exam period—Saturday, December 9 to Friday, December 15.

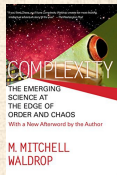
Do check the course Twitter account, @pocsvox, for updates regarding the course (part of the course site).

Academic assistance: Anyone who requires assistance in any way (as per the ACCESS program or due to athletic endeavors), please see or contact me as soon as possible.



Popular Science Books:

Historical artifact:



“Complexity: The Emerging Science at the Edge of Order and Chaos” [a](#) [↗](#)
by M. Mitchell Waldrop (1993). ^[16]

Shout-out: Dr. Andrew P. Morokoff [↗](#),
MBBS PhD FRACS D.Thau (Bug) [↗](#)



The PoCverse
What's the John
Dory?
30 of 59

Orientation

[Course Information](#)

[Centers, Books, Resources](#)

[Topics](#)

[Narrative Arc](#)

[Tarot Cards](#)

[Projects](#)

[References](#)



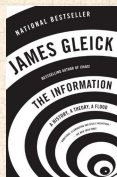
Popular Science Books:



“Simply Complexity: A Clear Guide to Complexity Theory” [a](#) [↗](#)
by Neil F. Johnson (2009). ^[9]



“Complexity: A Guided Tour” [a](#) [↗](#)
by Melanie Mitchell (2009). ^[12]



“The Information: A History, A Theory, A Flood” [a](#) [↗](#)
by James Gleick (2011). ^[6]

The PoCVerse
What's the John
Dory?
31 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References



Books on Complexification:

The PoCverse
What's the John
Dory?
32 of 59

Orientation

Course Information

Centers, Books, Resources

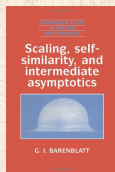
Topics

Narrative Arc

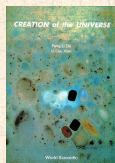
Tarot Cards

Projects

References



“Scaling, self-similarity, and intermediate asymptotics” [a](#) [↗](#)
by G. I. Barenblatt (1996). [3]



“Creation of the Universe” [a](#) [↗](#)
by Zhi and Xian (1989). [17]

See Freeman Dyson’s [↗](#) The Key to Everything [↗](#).



On complex sociotechnical systems:

The PoCverse
What's the John
Dory?
33 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

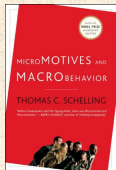
Tarot Cards

Projects

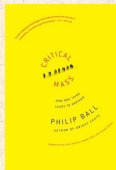
References



“Human Behaviour and the Principle of
Least-Effort” [a](#) [↗](#)
by G. K. Zipf (1949). [18]



“Micromotives and Macrobehavior” [a](#) [↗](#)
by Thomas C. Schelling (1978). [14]



“Critical Mass: How One Thing Leads to
Another” [a](#) [↗](#)
by Philip Ball (2004). [2]



It's all about algorithms (stories):

The PoCverse
What's the John
Dory?
34 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References



“The Engine of Complexity: Evolution as Computation” [a](#) [↗](#)
by John E. Mayfield (2013). [10]



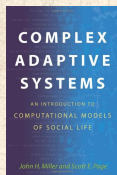
“On the Origin of Stories: Evolution, Cognition, and Fiction” [a](#) [↗](#)
by Brian Boyd (2010). [5]



“The Storytelling Animal: How Stories Make Us Human” [a](#) [↗](#)
by Jonathan Gottschall (2013). [7]



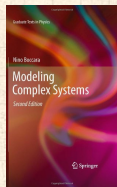
A few textbooky books (dated):



“Complex Adaptive Systems: An introduction to computational models of social life” [a](#) [↗](#)
by Miller and Page (2007). [11]



“Critical Phenomena in Natural Sciences” [a](#) [↗](#)
by Didier Sornette (2003). [15]



“Modeling Complex Systems” [a](#) [↗](#)
by Nino Boccara (2004). [4]

Eventually: “Principles of Complex Systems”

The PoCVerse
What's the John
Dory?
35 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc


Tarot Cards

Projects

References



Centers:

-  Santa Fe Institute (SFI)
-  Networks Institute at Northeastern
-  Northwestern Institute on Complex Systems (NICO )
-  MIT Institute for Data, Systems, AND Society
-  New England Complex Systems Institute (NECSI)
-  Michigan's Center for the Study of Complex Systems (CSCS )
-  Some Data Science groups (highly variable)
-  Also: Indiana, Davis, Brandeis, University of Illinois, Duke, Warsaw, Melbourne, ...,
-  Us!!!: Vermont Complex Systems Center 



Other inputs:

The PoCverse
What's the John
Dory?
37 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

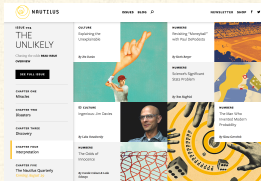
References



Complexity Digest:

<http://www.comdig.org>

<https://twitter.com/@cxdig>



Nautilus Magazine:

<http://nautil.us/>



Aeon: <http://aeon.co/>




Quanta Magazine: <https://www.quantamagazine.org/>



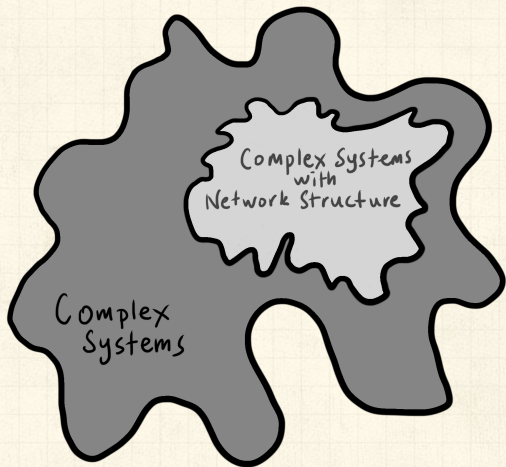
The nature of PoCS:

- Transition from standard coursework to research-focused work. **#alittle scary**

Major themes:

- The Complexity Manifesto 
- Complex Systems \equiv Modern, Normal Science;
- Roles and limits of Data, Theory, and Experiment;
- Emergence;
- Universality and Accidents of History;
- Structure and Stories: Micro-to-macro Mechanisms;
- Elements: Scaling, Surprise, Networks, Robustness, Failure, and Spreading.
- The Theory of Anything: Why Complexify?
- It's all about stories.**

Complex Systems are the Big Story:



Only a bit networky: Fluids-at-large (the atmosphere, oceans, ...), organism cells, ...

The PoCSverse
What's the John
Dory?

40 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

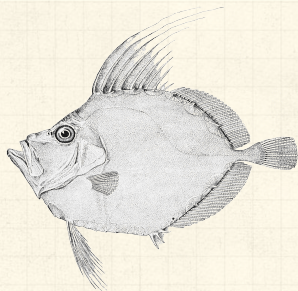
Projects








References



Cryptolect:

Course mascot:



-  What's the Story?
-  What's the John Dory?
-  What's the John Dory for Rhyming Slang .
-  Hemiteleia: beers \Rightarrow Edward Lears \Rightarrow Edwards.
-  Also: Taxis \Rightarrow Boris Spasskies  \Rightarrow Borises

The PoCSverse
What's the John
Dory?

41 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards











Projects

References








Topics:

Scaling phenomena:





-  Allometry.
-  Scaling of social phenomena: crime, creativity, and consumption.
-  Scaling in biology (elephants and platypuses).
-  Dimensional Analysis and Renormalization.
-  Power law size distributions and non-Gaussian statistics.
-  The 80/20 rule, the 1%.
-  Zipf's law.
-  Order from randomness.
-  Fundamental mechanisms for generating power law size distributions.
-  The rich-get-richer mechanism.

Topics:

Robustness—Integrity of complex systems:

-  Generic failure mechanisms.
-  Highly Optimized Tolerance (HOT): Robustness and fragility.
-  How to build optimal forests.
-  Minimization of risk as a driver of heterogeneous structures in complex systems.
-  How to optimally locate facilities: hospitals, schools, and coffee shops.

Fundamentals of Complexity:

-  Emergence: More is Different.
-  Measurement and mismeasurement.
-  Universality versus path dependence.
-  Complexification (it all starts with gravity^[17]).

Topics:

The PoCSverse
What's the John
Dory?

44 of 59

Orientation

Course Information

Centers, Books, Resources

Topics









Narrative Arc

Tarot Cards

Projects

References

Complex networks:

-  Statistical Mechanics
-  Structure and Dynamics
-  Phase transitions
-  Random Networks
-  Scale-free Networks
-  Small-world Networks
-  Why your friends are better than you.
-  More in PoCS, Vol. 2 in the spring.

Topics:

The PoCSverse
What's the John
Dory?
45 of 59

Orientation

Course Information

Centers, Books, Resources

Topics









Narrative Arc

Tarot Cards

Projects








References

Sociotechnical Systems:





-  Biological and social spreading models
-  Schelling's model of segregation [13]
-  Granovetter's model of imitation [8]
-  Collective behavior and synchrony
-  Global cooperation from bad actors
-  Global conflicts from good actors
-  Stories (Homo Narrativus)
-  The Sociotechnocene

Topics:

Collective decision making:













-  Wisdom and madness of crowds.
-  Systems of voting.
-  The role of randomness and chance.
-  Success inequality.
-  The paradox of unpredictable global fame.
-  Bonus knowledge: How to make things spread.
-  Bonus knowledge: Fate does not exist in a world of fame.

Large-scale social patterns (maybe):

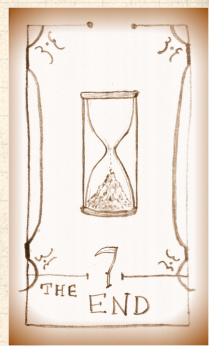
-  Movement
-  Cities
-  Happiness
-  Social media














Season's Narrative Arc (or Places We Will Go):

-  Overview of Complex Systems with bonus Manifesto .
-  Thread of Understanding Sociotechnical Systems.
-  Allometric scaling in complex systems.
-  Size distributions of system elements:
 -  Power-law size distributions.
 -  Description and Mechanisms of Becoming.
-  Robustness of Complex Systems.
-  Complex networks—how system elements are connected:
 -  Structure, Growth Mechanisms, Processes on Networks.
-  Social Contagion, Voting, Fame and Fate, Stories.
-  Complexification: The Theory of Anything and the Rise of Algorithms






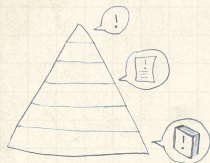
Projects


-  Semester-long projects, teams.
-  Develop proposal in first few weeks.
-  May range from novel research to investigation of an established area of complex systems.
-  Two talks + written piece.
-  Usage of the VACC  is encouraged (ability to code well = super powers).
-  Massive data sets available, including Twitter.
-  Possible: Work with Twitter data and Story Lab on socially meaningful problems.
-  Academic output (journal papers) resulting from Principles of Complex Systems and Complex Networks can be found here . Add more!
-  We'll go through a list of possible projects soon.





The narrative hierarchy—Stories and Storytelling on all


Scales: 





 1 to 3 word encapsulation = a soundbite
= a buzzframe,


 1 sentence, title,


 few sentences, a haiku,

 a paragraph, abstract,

 short paper, essay,

 long paper,

 chapter,

 book,

 ...



Orientation

Course Information

Centers, Books, Resources



Topics

Narrative Arc

Tarot Cards


Projects

References

The Boggoracle Speaks:  



References I

- [1] P. W. Anderson.
More is different.
Science, 177(4047):393–396, 1972. [pdf](#) 
- [2] P. Ball.
Critical Mass: How One Thing Leads to Another.
Farra, Straus, and Giroux, New York, 2004.
- [3] G. I. Barenblatt.
Scaling, self-similarity, and intermediate asymptotics,
volume 14 of Cambridge Texts in Applied Mathematics.
Cambridge University Press, 1996.
- [4] N. Boccaro.
Modeling Complex Systems.
Springer-Verlag, New York, 2nd edition, 2004.





References II

- [5] B. Boyd.
On the Origin of Stories: Evolution, Cognition, and Fiction.
Belknap Press, 2010.
- [6] J. Gleick.
The Information: A History, A Theory, A Flood.
Pantheon, 2011.
- [7] J. Gottschall.
The Storytelling Animal: How Stories Make Us Human.
Mariner Books, 2013.
- [8] M. Granovetter.
Threshold models of collective behavior.
Am. J. Sociol., 83(6):1420–1443, 1978. pdf 



References III

- [9] N. F. Johnson.
Simply Complexity: A Clear Guide to Complexity Theory.
Oneworld Publications, London, UK, 2009. [pdf](#) 
- [10] J. E. Mayfield.
The Engine of Complexity: Evolution as Computation.
Columbia University Press, New York, 2013.
- [11] J. H. Miller and S. E. Page.
Complex Adaptive Systems: An introduction to computational models of social life.
Princeton University Press, Princeton, NJ, 2007.
- [12] M. Mitchell.
Complexity: A Guided Tour.
Oxford University Press, New York, NY, 2009. [pdf](#) 



References IV

- [13] T. C. Schelling.
Dynamic models of segregation.
J. Math. Sociol., 1:143–186, 1971. [pdf](#) 
- [14] T. C. Schelling.
Micromotives and Macrobehavior.
Norton, New York, 1978.
- [15] D. Sornette.
Critical Phenomena in Natural Sciences.
Springer-Verlag, Berlin, 2nd edition, 2003.
- [16] M. M. Waldrop.
Complexity: The Emerging Science at the Edge of Order and Chaos.
Simon & Schuster, New York, NY, 1993.



References V

The PoCSverse
What's the John
Dory?
59 of 59

Orientation

Course Information

Centers, Books, Resources

Topics

Narrative Arc

Tarot Cards

Projects

References

[17] F. L. Zhi and L. S. Xian.

Creation of the Universe.

World Scientific Publishing Company, 1989.

[18] G. K. Zipf.

Human Behaviour and the Principle of Least-Effort.

Addison-Wesley, Cambridge, MA, 1949.

