Course Overview for PoCS

Last updated: 2023/08/22, 11:48:23 EDT

Principles of Complex Systems, Vols. 1, 2, & 3D
CSYS/MATH 6701, 6713, & a pretend number,
2023–2024| @pocsvox

Prof. Peter Sheridan Dodds | @peterdodds

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

The PoCSverse
What's the John Dory?
1 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

These slides are brought to you by:

The PoCSverse
What's the John Dory?
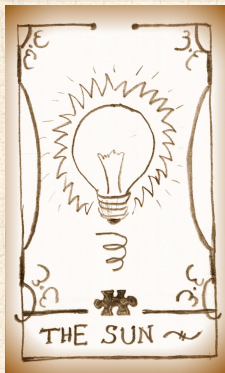2 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

Sealie & Lambie Productions

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?
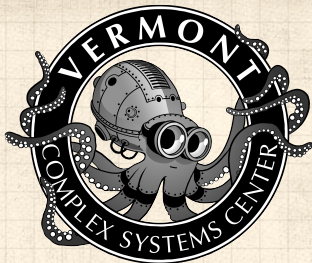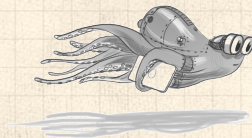
These slides are also brought to you by:

The PoCSverse
What's the John Dory?
3 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

Special Guest Executive Producer

 On Instagram at pratchett_the_cat

Outline

Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

THE SUN

Describe | Explain | Create | Share | Ethos: Play

vermontcomplexsystems.org⟶

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

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☑

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

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/ ↗
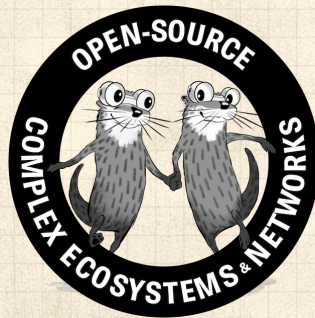
We're interested in many things:

- 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

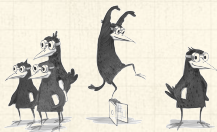## Leveling up—Scaffolded educational mission:

- 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:

Poster 1 (blue):
BE STRANGE AND ADORABLE
Approved by the Robocuous in an Eightfold Way
2023
Persephone McFoggleton
has snaffled
The Graduate Certificate in
Complex Systems and Data Science
Vermont Complex Systems Center · University of Vermont

Poster 2 (green):
KNOW MANY THINGS
Approved by the Robocuous in an Eightfold Way
2023
Basil Gastropodhunter
unlocked the next level of
Masters in
Complex Systems and Data Science
Vermont Complex Systems Center · University of Vermont

Poster 3 (yellow):
SOMETHING TO CROW ABOUT
Approved by the Robocuous in an Eightfold Way
2023
Emanuel Fuguestate
has ascended to the plane of
PhD in
Complex Systems and Data Science
Vermont Complex Systems Center · University of Vermont

Poster 4 (red):
A GOOD POSTDOGTORAL FELLOW
Approved by the Robocuous in an Eightfold Way
2021
2023
Porcupina Thwackett
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 ⧉.

- Prof. Laurent Hebert-Dufresne's "Modelling Complex Systems" (CSYS/CS 302).

- Prof. Jim Bagrow's "Data Science I" (STAT 287)

- The Sequel to PoCS:
  "Complex Networks" (CSYS/MATH 303).

- But really it's the PoCSverse:
  Principles of Complex Systems Vols. 1 and 2

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

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

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

The PoCSverse
What's the John Dory?
14 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

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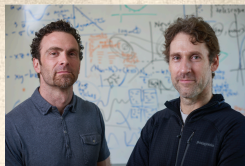Sandhya Gopchandani
Anne Marie Stupinski
Summer Jiang

Tyler Gray
Aaron Schwartz
Eric Clark
Ben Emery
David Dewhurst
Colin Van Oort
Laura Jennings

Chris Danforth
Peter Dodds

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

Computational Story Lab ++;
compstorylab.org

Nick Allgaier
Psychiatry Res Asst Prof
Dilan Kiley
Chobanian Group
Tom McAndrew
Cardiovascular Research Foundation
Emily Cody
Data Scientist Adobe
Morgan Frank
MIT Media Lab PhD Student
Cathy Bliss
UVM Lecturer
Mark Ibrahim
Data Scientist Insight
Ross Lieb-Lappen
Dartmouth PhD
Cold Regions Research & Engineering Laboratory
Eitan Pechenick
Maine School of Science & Math
Andy Reagan
Data Scientist MassMutual
Sven McCall
Maps, Apple

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

Computational Story Lab ++;

The PoCSverse
What's the John
Dory?
15 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

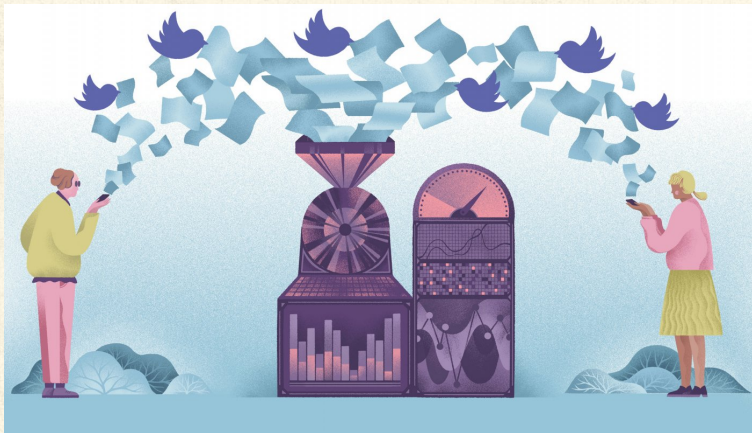# Outside

Inside the Lab that's Quantifying Happiness ⬀
by Rowan Jacobsen, August 2017.
(Reprinted in UVM Quarterly, 2018.)

Courses:

The PoCSverse
What's the John
Dory?
15 of 58

Orientation
Course information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

- 🪢 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 ☒)
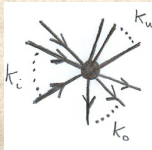- 🪢 MATH 266: Chaos, fractals & dynamical systems (@NonperiodicFlow ☒)
- 🪢 MATH 330: Ordinary Differential Equations (@dallthethingsdt ☒)

🪢 Courses act as research incubators and have helped generate many papers ☒

Orientation

Course Information
Centers, Books, Resources
Topics
Narrative Arc
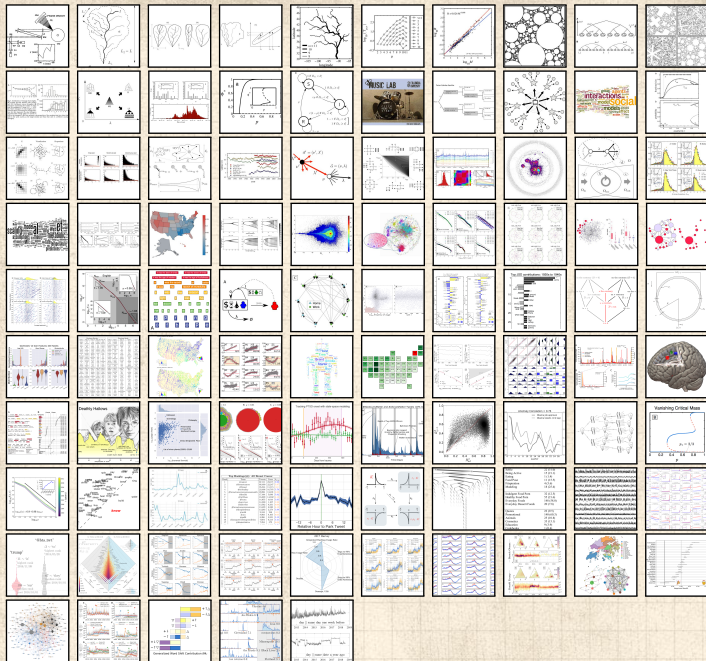Tarot Cards
Projects

References

Basics:

The PoCSverse
What's the John
Dory?
18 of 58
Orientation
Course Information
Centers, Books, Resources
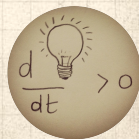Topics
Narrative Arc
Tarot Cards
Projects

References

- ♻ Instructor: Prof. Peter Sheridan Dodds
- ♻ Lecture room and meeting times:
  Mann Hall, 102C, 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/2023-2024pocsverse
- ♻ Course Twitter handle: @pocsvox

The PoCSverse
What's the John
Dory?
19 of 58

Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

Potential paper product:

⬢ The Syllabus ⬀.

Office hours:

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

THE SUN

Exciting details regarding these slides:

- Three servings (all in pdf):
  1. Fresh: For in-class Deliveration.
  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 XƎLᴬTEX, 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 and make math look good:

```
\setmainfont[Ligatures=TeX]{Open Sans}
\setsansfont[Ligatures=TeX]{Open Sans}
\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 18 of Principles of Complex Systems, Vols. 1, 2, & 3D.
- 🎲 In-person lectures will be called Stories (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 ⬀

Team PoCS

The PoCSverse
What's the John
Dory?
24 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

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.

 Microsoft Teams   slack

Grading breakdown:

The PoCSverse
What's the John
Dory?
25 of 58

Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

🎲 Assignments (75%)—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 (1%)—Everyone is expected to behave well.

THE SUN

How grading works:

The PoCSverse
What's the John
Dory?
26 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

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.

THE SUN

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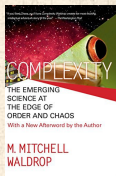
Do check the course Twitter account, @pocsvox, for updates regarding the course (part of the course site).

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.

THE SUN

Popular Science Books:

The PoCSverse
What's the John
Dory?
29 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
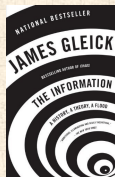Tarot Cards
Projects

References

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) ⬀

Popular Science Books:

The PoCSverse
What's the John
Dory?
30 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

"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** ☑
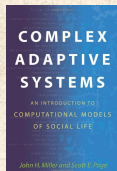by James Gleick (2011). [6]

Books on Complexification:

The PoCSverse
What's the John
Dory?
31 of 58
Orientation
Course Information
Centers, Books, Resources
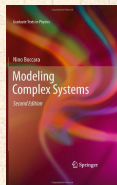Topics
Narrative Arc
Tarot Cards
Projects
References
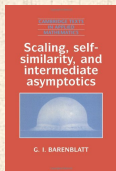
"Scaling, self-similarity, and intermediate asymptotics" 𝕒 ⬀
by G. I. Barenblatt (1996). [3]

"Creation of the Universe" 𝕒 ⬀
by Zhi and Xian (1989). [17]

See Freeman Dyson's ⬀ The Key to Everything ⬀.

On complex sociotechnical systems:

The PoCSverse
What's the John
Dory?
32 of 58
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]
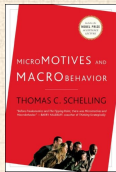
"Micromotives and Macrobehavior" a ↗
by Thomas C. Schelling (1978). [14]
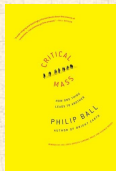
"Critical Mass: How One Thing Leads to
Another" a ↗
by Philip Ball (2004). [2]

It's all about algorithms (stories):

"The Engine of Complexity: Evolution as Computation" 🅰 ↗
by John E. Mayfield (2013). [10]

"On the Origin of Stories: Evolution, Cognition, and Fiction" 🅰 ↗
by Brian Boyd (2010). [5]

"The Storytelling Animal: How Stories Make Us Human" 🅰 ↗
by Jonathan Gottschall (2013). [7]

THE SUN

A few textbooky books (dated):

The PoCSverse
What's the John
Dory?
34 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

"Complex Adaptive Systems: An introduction to computational models of social life" a 🗗
by Miller and Page (2007). [11]
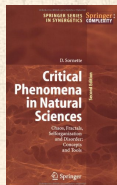
"Critical Phenomena in Natural Sciences" a 🗗
by Didier Sornette (2003). [15]

"Modeling Complex Systems" a 🗗
by Nino Boccara (2004). [4]

Eventually: "Principles of Complex Systems"

Centers:

The PoCSverse
What's the John
Dory?
35 of 58
Orientation
Course Information
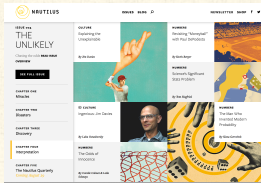Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

- 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 PoCSverse
What's the John
Dory?
36 of 58
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 SUN

The nature of PoCS:

⊞ Transitional from standard coursework to research-focused work. #alittlescary

Major themes:

⊞ The Complexity Manifesto⧉;

⊞ Complex Systems ≡ 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.

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

Complex Systems are the Big Story:

Complex Systems
with
Network Structure

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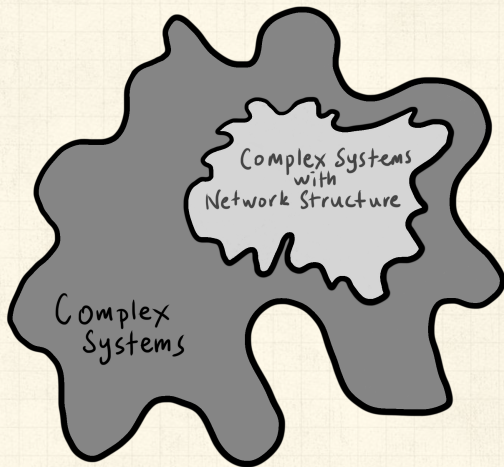
Only a bit networky: Fluids-at-large (the atmosphere, oceans, ...), organism cells, ...

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

Cryptolect:

Course mascot:

The PoCSverse
What's the John
Dory?
40 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

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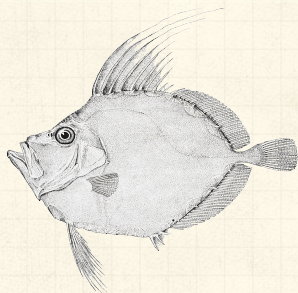
- What's the Story?
- What's the John Dory?
- What's the John Dory for Rhyming Slang ☐?
- Hemiteleia: beers ⇒ Edward Lears ⇒ Edwards.
- Also: Taxis ⇒ Boris Spasskies ☐ ⇒ Borises

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

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.

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

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]).

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

Topics:

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.

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

Topics:

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

PoCS
Principles of
Complex Systems
@pocsvox
What's the Story?

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

THE SUN

THE SUN

THE END

Projects

The PoCSverse
What's the John
Dory?
51 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects
References

- 🎲 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 SUN

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,
- ...

References I

The PoCSverse
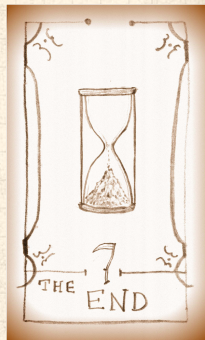What's the John
Dory?
54 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

[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. Boccara.
     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

The PoCSverse
What's the John
Dory?
56 of 58
Orientation
Course Information
Centers, Books, Resources
Topics
Narrative Arc
Tarot Cards
Projects

References

[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.

References IV

[12] M. Mitchell.
Complexity: A Guided Tour.
Oxford University Press, New York, NY, 2009.
pdf ✇

[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.

THE SUN

References V

[16] M. M. Waldrop.
Complexity: The Emerging Science at the Edge of
Order and Chaos.
Simon & Schuster, New York, NY, 1993.

[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.

THE SUN