



<http://orthogonal-research.weebly.com>



<http://bit.do/OREL-youtube>



<http://github.com/Orthogonal-Research-Lab>

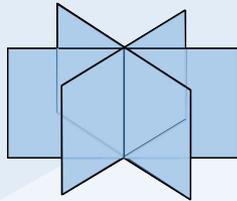
Epistemological Directories (EDs) for Research Development and Education

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Orthogonal Research and Education Laboratory

Champaign-Urbana, IL and Worldwide



<http://orthogonal-research.slack.com>



http://www.twitter.com/Orthogonal_Lab

WEB 1.0

Broadcasted Information,
Annotated Bibliographies

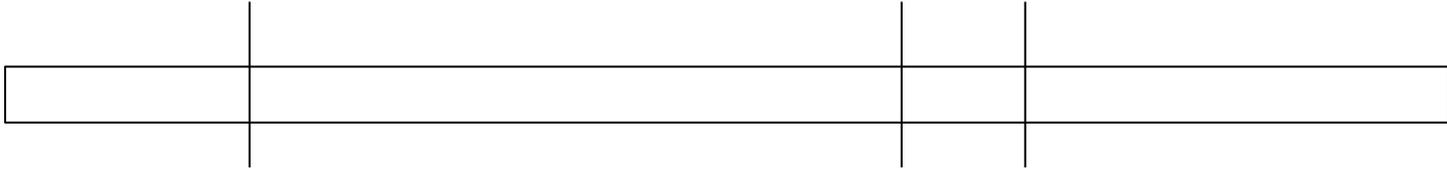
WEB 2.0

Social Media,
Version-control

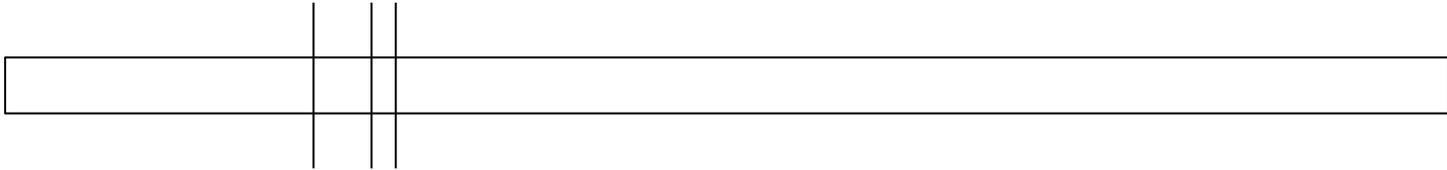
WEB 3.0

Virtual Worlds,
Semantic Web

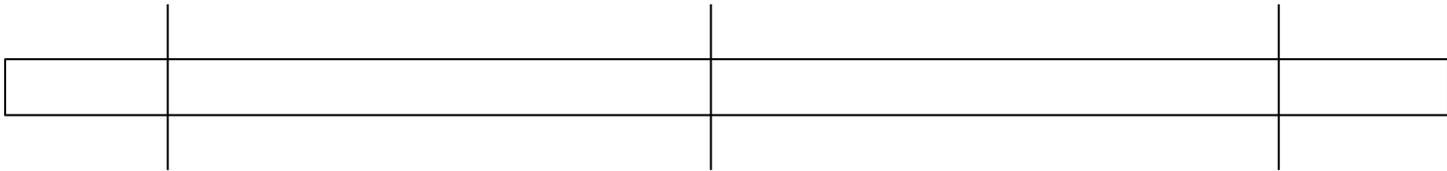
What is a historical milestone (relevance)?



Events have qualitative significance and explain a certain amount of the unknown



Can we do this without subjective judgement? Does this lead to group consensus or gatekeeping?



What are common themes across scholar/learners?

What do people commonly understand as the truth?

What are the most important things to know in order to be competent?

What kinds of things do people tend to discover over and over again (recurrence or reinventing the wheel)?

What things do people tend to know, or tend to seek out?

What are things that have the strongest relevance, regardless of whether they are “true” or “important”?

What are common themes across scholar/learners?

What do people commonly understand as the truth?

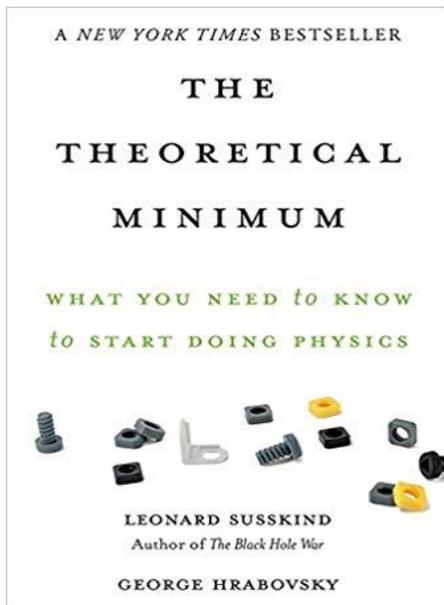
What are the most important things to know in order to be competent?

What kinds of things do people tend to discover over and over again (recurrence or reinventing the wheel)?

What things do people tend to know, or tend to seek out?

What are things that have the strongest relevance, regardless of whether they are “true” or “important”?

What is the minimal relevant information?



With an informed novice or intermediate skill level, what is the most efficient way to understand the contents of a field?

What information is most relevant to transfer learning (skill in one domain equals skill in another)?

We have observed this issue at the OpenWorm Foundation. What needs to be learned in biology, computation, or both in order to contribute in the community (code, academic research)?

Everything one needs to participate in physics -- Leo Susskind

Origins in Web 1.0

- general resources
- Areas:
 - artificial intelligence & computing
 - artificial life
 - cognitive science
 - cultural evolution
 - developmental biology
 - economics
 - epistemology & philosophy of science
 - ethology and sociobiology
 - evolutionary biology
 - evolutionary epistemology
 - evolution of language
 - genetic epistemology
 - history and social studies of biology
 - history and social studies of science
 - normative issues regarding evolution
 - philosophy of biology
 - philosophy of mind
 - theoretical biology

Author index:
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Keyword index:
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Full text search:
 AND

KLI Theory Lab

A powerful scientific database

A public service of the
Konrad Lorenz Institute for Evolution and Cognition Research

About:

A powerful search facility
People
Acknowledgements

Interact with us!

Submit your own bibliography
Submit corrections and
additions
Send us other comments

KLI Theory Lab: directory of knowledge in topical areas aligned with research done at Konrad Lorenz Institute.

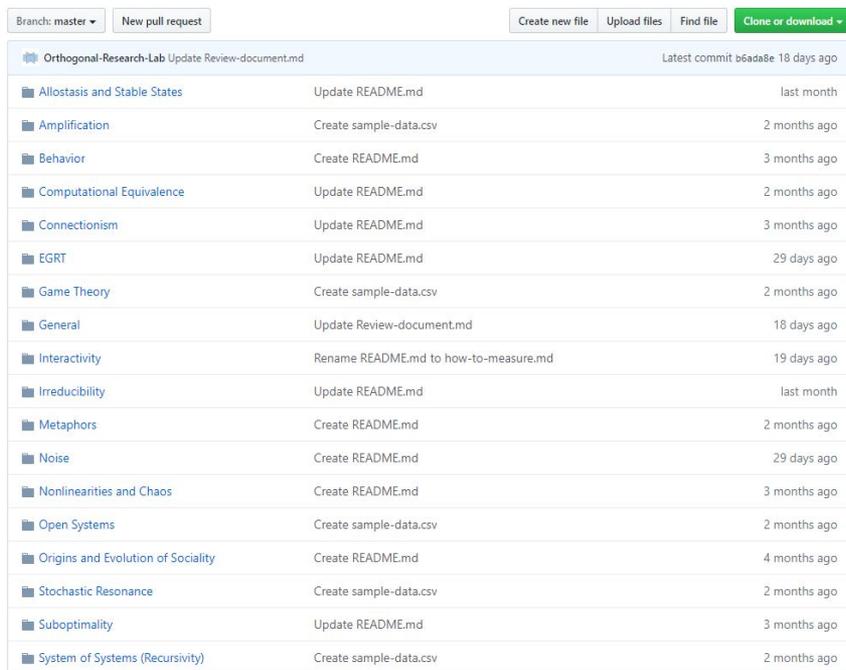
- evolution, development, cognition, genetics, behavior, computational modeling, philosophy.

Annotated bibliographies (similar to modern Wikipedia or Scholarpedia), but peer-reviewers are moderators.

Introduction to Knowledge Spaces

Knowledge Spaces (Instance #1): example using Cybernetics and Systems

<https://github.com/Orthogonal-Research-Lab/Cybernetics-and-Systems>



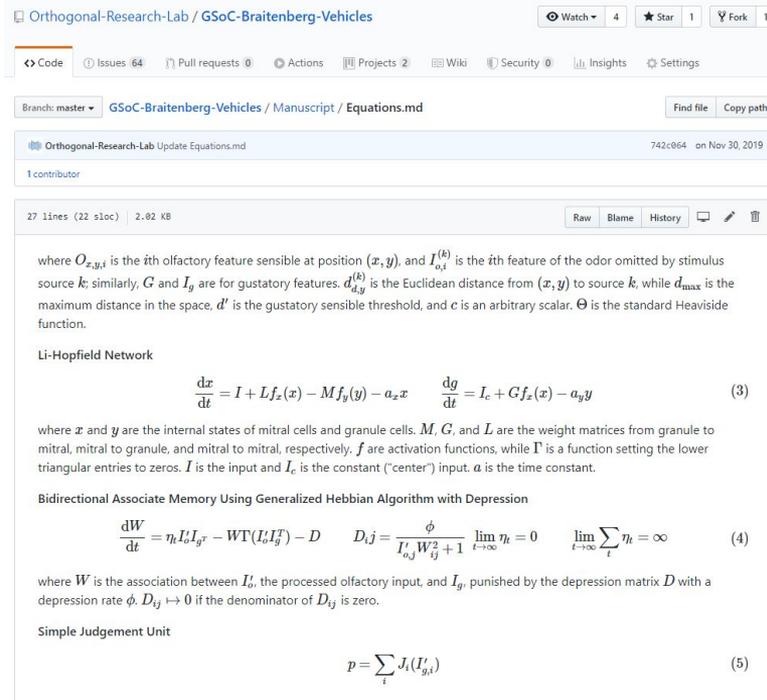
Directory/File	Commit Action	Commit Hash	Time Ago
Orthogonal-Research-Lab	Update Review-document.md	b6ada8e	18 days ago
Allostasis and Stable States	Update README.md		last month
Amplification	Create sample-data.csv		2 months ago
Behavior	Create README.md		3 months ago
Computational Equivalence	Update README.md		2 months ago
Connectionism	Update README.md		3 months ago
EGRT	Update README.md		29 days ago
Game Theory	Create sample-data.csv		2 months ago
General	Update Review-document.md		18 days ago
Interactivity	Rename README.md to how-to-measure.md		19 days ago
Irreducibility	Update README.md		last month
Metaphors	Create README.md		2 months ago
Noise	Create README.md		29 days ago
Nonlinearities and Chaos	Create README.md		3 months ago
Open Systems	Create sample-data.csv		2 months ago
Origins and Evolution of Sociality	Create README.md		4 months ago
Stochastic Resonance	Create sample-data.csv		2 months ago
Suboptimality	Update README.md		3 months ago
System of Systems (Recursivity)	Create sample-data.csv		2 months ago

Key features:

- directories as topical stubs (based on key scholarship from community, or community interest).
- version-control encourages edits from community and general public.
- directories, edits, and content can be proposed through pull requests.

Idealized Structure

Collaborative equations written in MathML,
rendered using browser plug-in



Orthogonal-Research-Lab / GSoC-Braitenberg-Vehicles

Watch 4 Star 1 Fork 1

Code Issues 64 Pull requests 0 Actions Projects 2 Wiki Security 0 Insights Settings

Branch: master GSoC-Braitenberg-Vehicles / Manuscript / Equations.md Find file Copy path

Orthogonal-Research-Lab Update Equations.md 742c964 on Nov 30, 2019

1 contributor

27 lines (22 sloc) | 2.02 KB Raw Blame History

where $O_{x,y,i}$ is the i th olfactory feature sensible at position (x, y) , and $I_{\alpha,i}^{(k)}$ is the i th feature of the odor omitted by stimulus source k ; similarly, G and I_g are for gustatory features. $d_{d,y}^{(k)}$ is the Euclidean distance from (x, y) to source k , while d_{\max} is the maximum distance in the space, d' is the gustatory sensible threshold, and c is an arbitrary scalar. Θ is the standard Heaviside function.

Li-Hopfield Network

$$\frac{dx}{dt} = I + Lf_x(x) - Mf_y(y) - a_x x \quad \frac{dy}{dt} = I_c + Gf_x(x) - a_y y \quad (3)$$

where x and y are the internal states of mitral cells and granule cells. M , G , and L are the weight matrices from granule to mitral, mitral to granule, and mitral to mitral, respectively. f are activation functions, while Γ is a function setting the lower triangular entries to zeros. I is the input and I_c is the constant ("center") input. a is the time constant.

Bidirectional Associate Memory Using Generalized Hebbian Algorithm with Depression

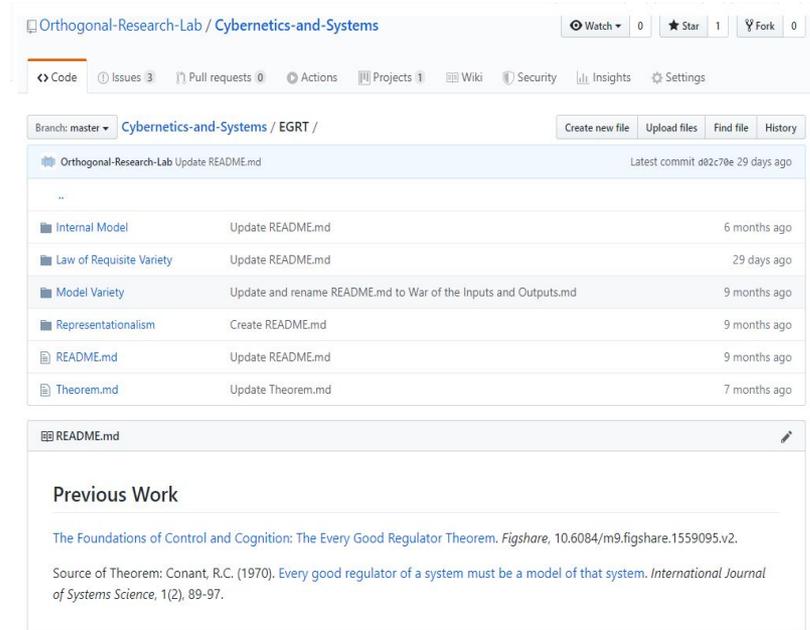
$$\frac{dW}{dt} = \eta I_i I_{gT} - WT(I_i I_{gT}) - D \quad D_{ij} = \frac{\phi}{I_{\alpha,j} W_{ij}^2 + 1} \lim_{t \rightarrow \infty} \eta_t = 0 \quad \lim_{t \rightarrow \infty} \sum_t \eta_t = \infty \quad (4)$$

where W is the association between I_i , the processed olfactory input, and I_{gT} , punished by the depression matrix D with a depression rate ϕ . $D_{ij} \mapsto 0$ if the denominator of D_{ij} is zero.

Simple Judgement Unit

$$p = \sum_i J_i(I_{g,i}) \quad (5)$$

Idealized Structure



The screenshot shows a GitHub repository for 'Orthogonal-Research-Lab / Cybernetics-and-Systems'. The repository has 0 issues, 0 pull requests, 1 project, 1 wiki, and 0 security alerts. The current branch is 'master'. The file list includes:

File	Update	Time
Orthogonal-Research-Lab Update README.md	Update README.md	Latest commit d82c79e 29 days ago
Internal Model	Update README.md	6 months ago
Law of Requisite Variety	Update README.md	29 days ago
Model Variety	Update and rename README.md to War of the Inputs and Outputs.md	9 months ago
Representationalism	Create README.md	9 months ago
README.md	Update README.md	9 months ago
Theorem.md	Update Theorem.md	7 months ago

The 'README.md' file is selected, showing a section titled 'Previous Work' with the following text:

The Foundations of Control and Cognition: The Every Good Regulator Theorem. *Figshare*, 10.6084/m9.figshare.1559095.v2.

Source of Theorem: Conant, R.C. (1970). Every good regulator of a system must be a model of that system. *International Journal of Systems Science*, 1(2), 89-97.

Topical Stubs with Directories and Files



Interactive notebooks for simulations

Introduction to Knowledge Maps

Knowledge Maps (Instance #2) are graphical representations

- timelines and historical summaries of key events in the formation and evolution of a field.

Knowledge Maps can be used to summarize directories in a knowledge space.

- visualizations including key people, events, and papers in a given domain (academic field).

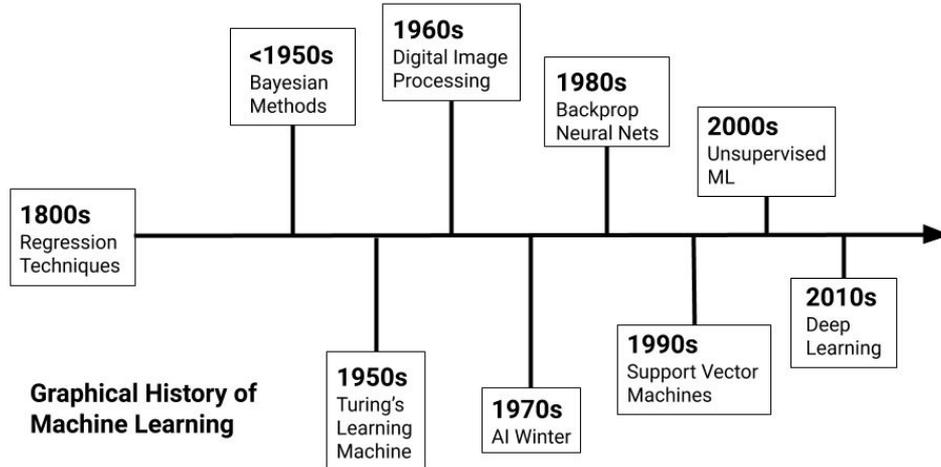
Epistemological Maps can also be used to define knowability for a particular domain

- good for formulating questions, defining open problems, and niche literature reviews.

Knowledge Maps

Machine Learning Knowledge Map:

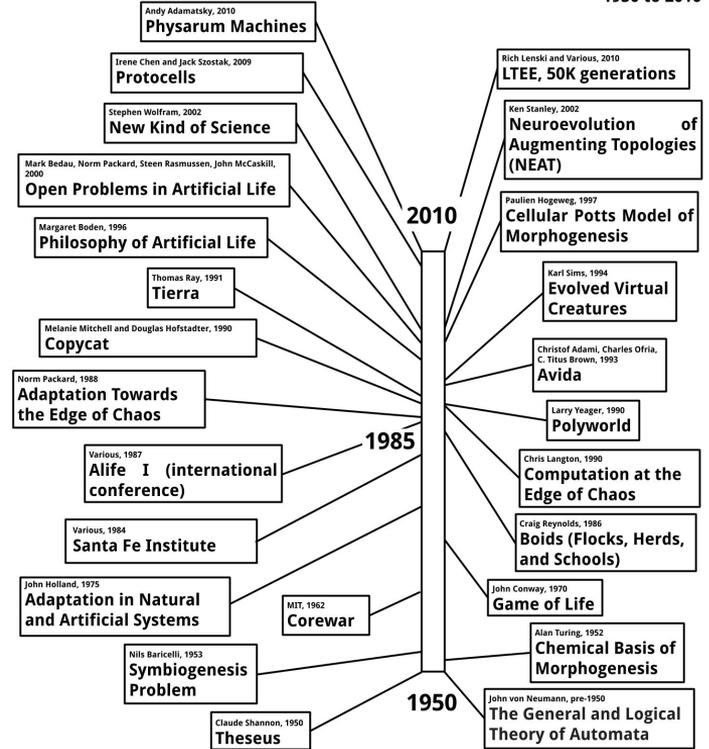
<http://tiny.cc/nxg2lz>



Knowledge Maps

Knowledge Map of Artificial Life

1950 to 2010



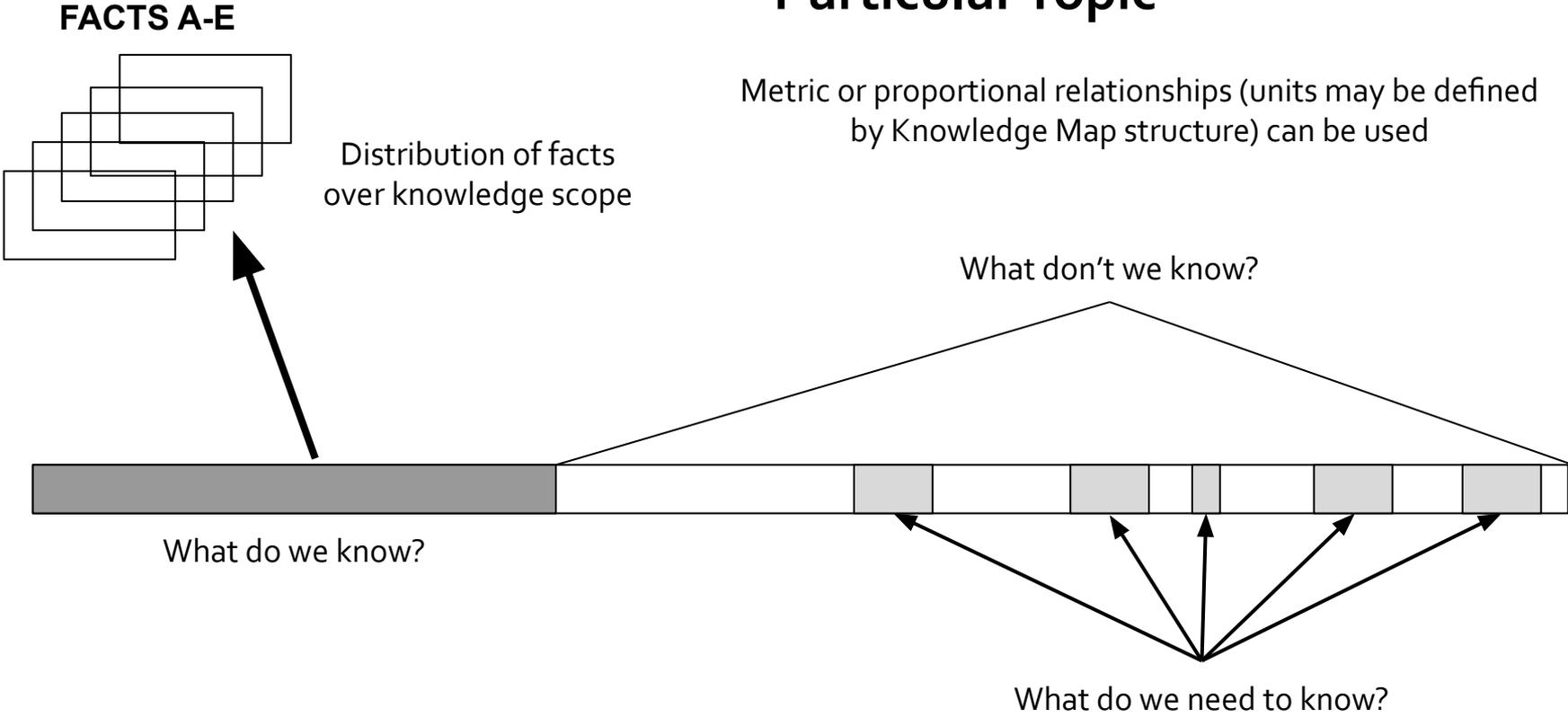
Artificial Life Knowledge Map:

<http://tiny.cc/r2g2lz>

Comparisons between Machine Learning and Artificial Life Knowledge Maps

- number of milestones per duration of timeline (entire history) depends on pedagogical aims.
- small number of milestones (Machine Learning) may take a “minimal amount of information” approach.
- milestones can stress common theme across learners (origin of major themes in field), or stress obscure events that build foundation for later advances (Corewar, Theseus from Artificial Life map).

Epistemological Map (Instance #3) for a Particular Topic



Controlled Vocabularies and Historiographies

Top-down control vs. emergence within community:

- enforce community standards, but take a historical view (epistemology emerges over time).

Wikipedia problem: what topics or people are “important”?

- who is making the conventions? Admin (tricky), majority rules (also tricky).

Clarify what is “significant”.

- key papers and events according to most in field. What lead to something else?
- what terms are most relevant in common practice and application?

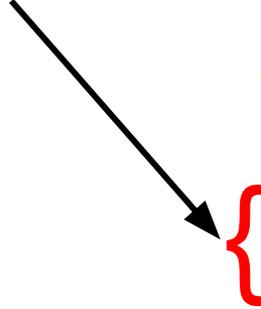
Frontier Maps (Instance #4)

Educational Resource Umbrella Project: <https://github.com/jesparent/FrontierMap>

CURRENT STATUS: Theme of Natural and Artificial Intelligence Computation & Cognition + Underlying Philosophy

Broad taxonomy outside of traditional disciplines.

Macro Tags: Techniques, Discoveries, and Ideas



jesparent / FrontierMap

Watch 1 Star 1 Fork 1

Code Issues 6 Pull requests 0 Actions Projects 5 Wiki Security 0 Insights

Educational Resource Umbrella Project

98 commits 1 branch 0 packages 0 releases 1 contributor MIT

Branch: master New pull request Create new file Upload files Find file Clone or download

Commit	Message	Time
jesparent	Update README.md	10 days ago
jesparent	Update README.md	3 months ago
jesparent	Create Hayflick Limit.md	12 days ago
jesparent	Update README.md	10 days ago
jesparent	Update readme.md	3 months ago
jesparent	Create README.md	10 days ago
jesparent	Initial commit	5 months ago
jesparent	Update README.md	last month

Frontier Maps (Instance #4)

Educational Resource Umbrella Project: <https://github.com/jesparent/FrontierMap>

CURRENT STATUS: Theme of Natural and Artificial Intelligence Computation & Cognition + Underlying Philosophy

The screenshot shows the GitHub repository page for 'jesparent / FrontierMap'. At the top, there are buttons for 'Watch' (1), 'Star' (1), and 'Fork' (1). Below this is a navigation bar with tabs for 'Code', 'Issues' (6), 'Pull requests' (0), 'Actions', 'Projects' (5), 'Wiki', 'Security' (0), and 'Insights'. The repository name 'Educational Resource Umbrella Project' is displayed. Below the name, there are statistics: '98 commits', '1 branch', '0 packages', '0 releases', '1 contributor', and 'MIT' license. A bar at the top of the commit list shows 'Branch: master' and 'New pull request'. Below this are buttons for 'Create new file', 'Upload files', 'Find file', and 'Clone or download'. The commit list shows the following entries:

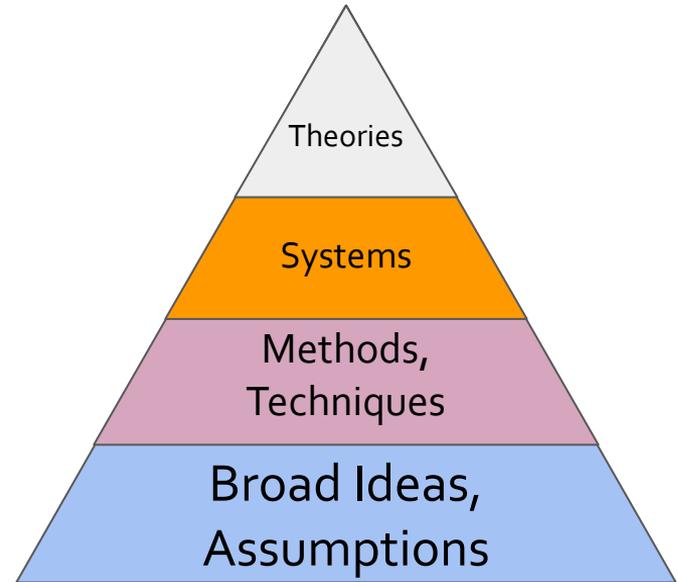
Commit	Message	Time
jesparent	Update README.md	10 days ago
jesparent	Update README.md	3 months ago
jesparent	Create Hayflick Limit.md	12 days ago
jesparent	Update README.md	10 days ago
jesparent	Update readme.md	3 months ago
jesparent	Create README.md	10 days ago
jesparent	Initial commit	5 months ago
jesparent	Update README.md	last month

Transdisciplinary topics frame the map as learner grows their educational resources: AI, Systems, Ethics



Frontier Maps should provide minimal information to become competent in a field.

- research nodes that help users interpret jargon and inscrutability of newly-encountered fields.
- staged complexities of discovery: start at the foundational aspects of a field (assumptions, broad ideas), then build up to specific techniques, systems, and theories.
- nodes can lead to other nodes (subreferents).
Semantic framework >> Wiki.



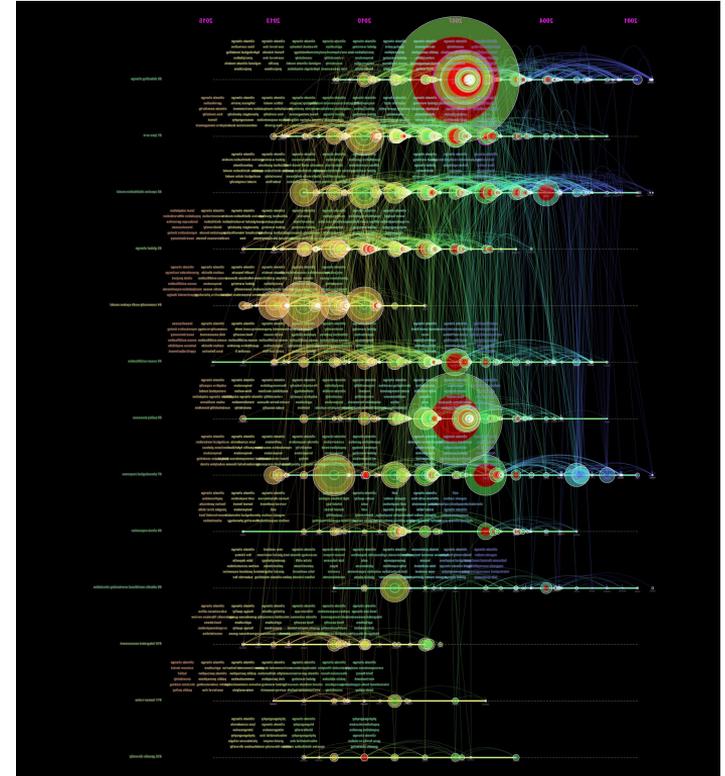
Frontier Maps: Future Developments

Interwoven Visualizations, Background, and Applications

Visualizations showing relationship between themes and individual notes.

Applications and Coding: Jupyter Notebooks, Tutorials, Presentations. Learner theme of “Demo or Die.”

Individual Scholar Paths *or* Collaborative & Open Source topical / project-based / “frontier” engagement.



Application: theory-building

Concepts can lead to constructs, which lead to relationships between variables.

Establish community standards for terminology, work on open-source papers via pull request.

Inspiration from Notetaking systems:
Evergreen system by Andy Matuschak.

- notes are a fundamental unit of knowledge.
- notes are an accumulation of knowledge.

Andy's working notes About these notes

Evergreen notes

Evergreen notes are written and organized to accumulate over time, across projects. This is about writing notes: **Most people take only t** because these practices aren't about writing effectively developing insight: **"Better note-t** **what matters is "better thinking"**. When done quite valuable: **Evergreen note-writing as fun knowledge work**.

It's hard to write notes that are worth develop principles help:

- Evergreen notes should be atomic
- Evergreen notes should be concept-ori
- Evergreen notes should be densely link
- Prefer associative ontologies to hierarc

This concept evolves in large part from Nikla which he regards as the independent intellec 70 books.

Implementing an evergreen nc

See:

- Write about what you read
- A reading habit to capture possibilities

Evergreen note-writing as fundamental unit of knowledge work

If you had to set one metric to use as a leading indicator for yourself as a knowledge worker, the best I know might be the number of **Evergreen notes** written per day. **Note-writing can be a virtuosic skill**, but **Most people use notes as a bucket for storage or scratch thoughts and Note-writing practices are generally ineffective**.

- Evergreen note-writing helps insight accumulate
- Evergreen note-writing helps reading efforts accumulate
- Note-writing helps writing accumulate: these notes are the fuel for the Executable strategy for writing, particularly if you Create speculative outlines while you write.

A caveat: **"Better note-taking" misses the point: what matters is "better thinking"**

References

Ahrens, S. (2017). *How to Take Smart Notes: One Simple Technique to Boost Writing, Learning and Thinking – for Students, Academics and Nonfiction Book Writers*.

If writing is the medium of research and studying nothing else than research, then there is no reason not to work as if nothing else counts than writing.

"Better note-taking" misses the point; what matters is "better thinking"

Lots of people write about solutions to the problem that **Note-writing practices are generally ineffective**. The vast majority of that writing fixates on a myopic, "lifehacking"-type frame, focused on answering questions like: "how should I organize my notes?", "what kind of journal should I use?", "how can I make it easy to capture snippets of things I read?", etc.

Answers to these questions are unsatisfying because the questions are focused on the wrong thing. The goal is not to take notes—the goal is to think effectively. Better questions are "what practices can help me reliably develop insights over time?", "how can I shepherd my attention effectively?" etc. This is the frame in which **Evergreen note-writing as fundamental unit of knowledge work** makes sense: **Evergreen note-writing helps insight accumulate**.

In terms of technology, what matters is not "computer-support note-taking" but "computer supported thinking."

It's easy to focus on "note-taking" because it's a visible component of an invisible practice: if you see someone insightful writing in their notebook, you might imagine that if you get the right notebook and organize it well, you'll be insightful too. And of course, taking notes is tangible. It's relatively easy, and it feels like doing something, even if it's useless (**Note-writing practices provide weak feedback**). So it's an attractive nuisance.

People who write extensively about note-taking rarely base a serious

Application: integrate with organizational course materials

☰ OW/DW Curriculum

Branch: master | New pull request

Create new file | Upload files | Find file | Clone or download

File	Commit	Time
Orthogonal-Research-Lab Update Review-document.md	Latest commit	6 days ago
Allostasis and Stable States	Update README.md	last month
Amplification	Create sample-data.csv	2 months ago
Behavior	Create README.md	3 months ago
Computational Equivalence	Update README.md	2 months ago
Connectionism	Update README.md	3 months ago
EGRT	Update README.md	29 days ago
Game Theory	Create sample-data.csv	2 months ago
General	Update Review-document.md	10 days ago
Interactivity	Rename README.md to how-to-measure.md	19 days ago
Irriducibility	Update README.md	last month
Metaphors	Create README.md	2 months ago
Noise	Create README.md	29 days ago
Nonlinearities and Chaos	Create README.md	3 months ago
Open Systems	Create sample-data.csv	2 months ago
Origins and Evolution of Sociality	Create README.md	4 months ago
Stochastic Resonance	Create sample-data.csv	2 months ago
Suboptimality	Update README.md	3 months ago
System of Systems (Recursivity)	Create sample-data.csv	2 months ago

Stream | Classwork | People | Grades

OW/DW Curriculum

Class code: m6cmgdv

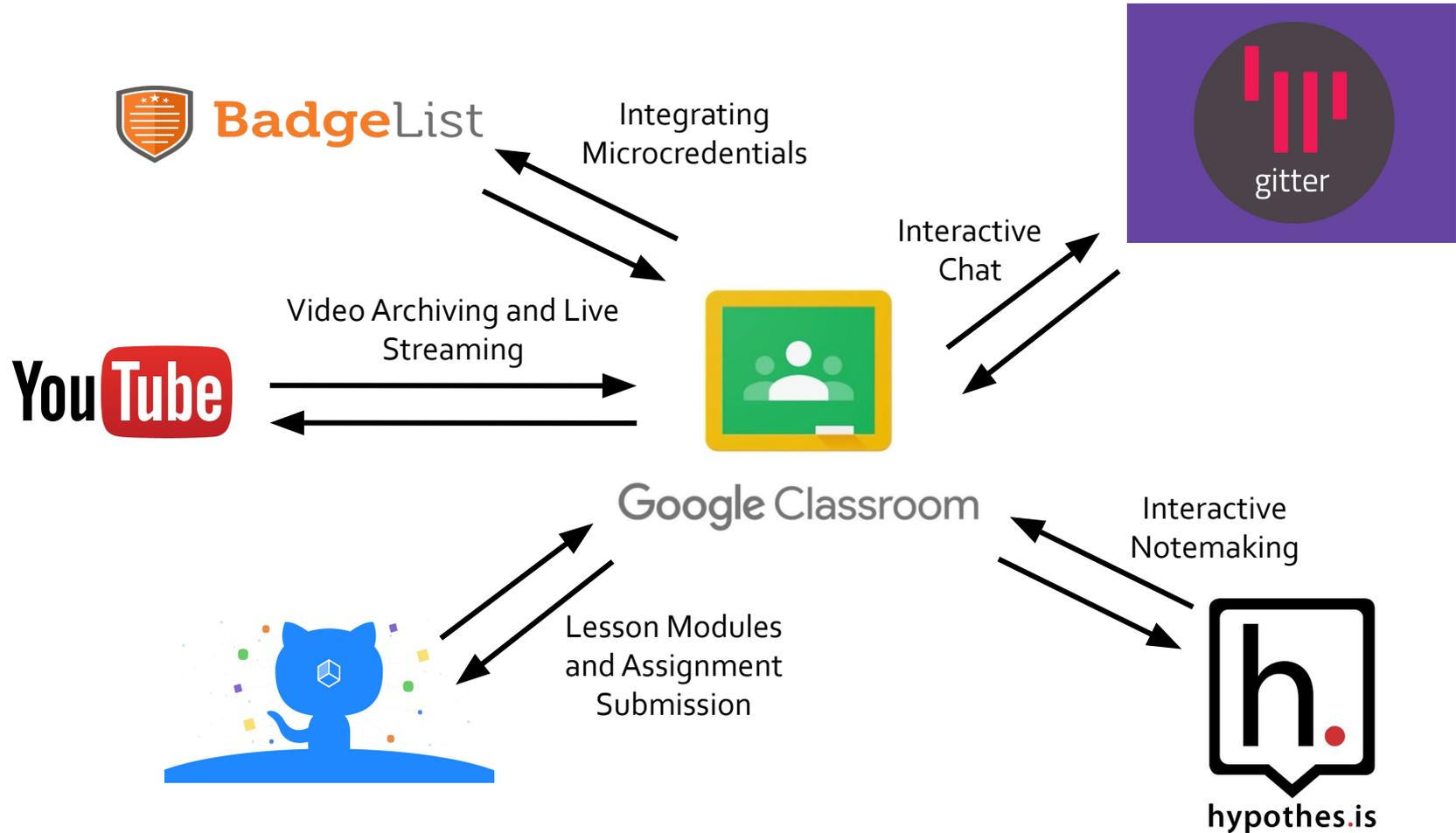
Select theme | Upload photo

Stream | Classwork | People | Grades

+ Create

📅 Google Calendar | 📁 Class Drive folder

- 📄 Microcredentials to Complete (Development) | Posted Apr 1
- 📄 Pattern Formation | Edited Apr 1
- 📄 Models and Representations | Edited Apr 1
- 📄 Dynamical Systems in Development | Edited Apr 1
- 📄 Developmental Data Science | Edited Mar 21



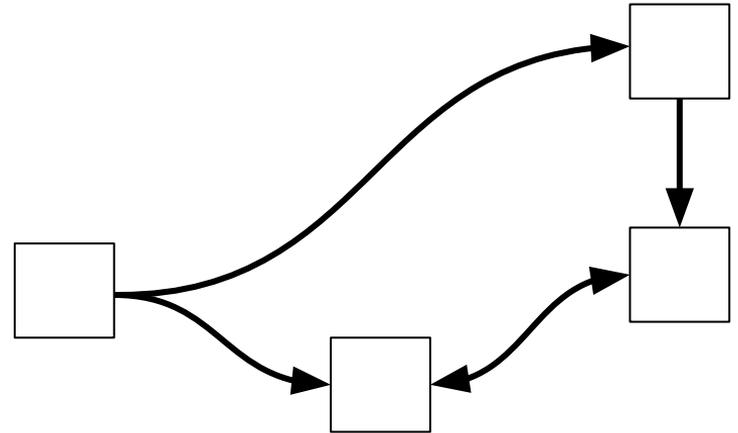
Future Direction: Cybernetic Model of Interdisciplinarity

Facilitate new contributors from allied fields on a regular basis

- regulation of cross-disciplinary contributions using common themes, identifying key papers and historical milestones with limited expertise, and relevant terms.

Model of interdisciplinary based on the practice of transdisciplinarity

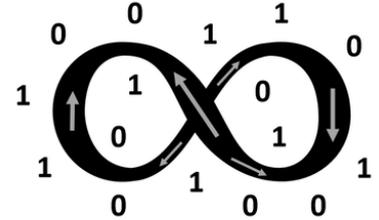
- community builds a model of knowledge (transdisciplinary) rather than simply consulting or borrowing from another field.



Data Reuse Initiative (DRI): <https://data-reuse.weebly.com/>

Are you interested in collaborating on this infrastructure? Join us as a contributor or collaborator!

- constructing maps, models, and metadata
- working towards improving academic practice
- understanding how scientists use data
- methodological education



Initiative of the eLife Ambassadors program

Thx* For Your Attention!

* internet slang or gratuitous THX 1138 reference?

I've gotta get out more.
Thx for the escort, guys!



Nice bit of individualism
you've got going on
there.....

Thx!

