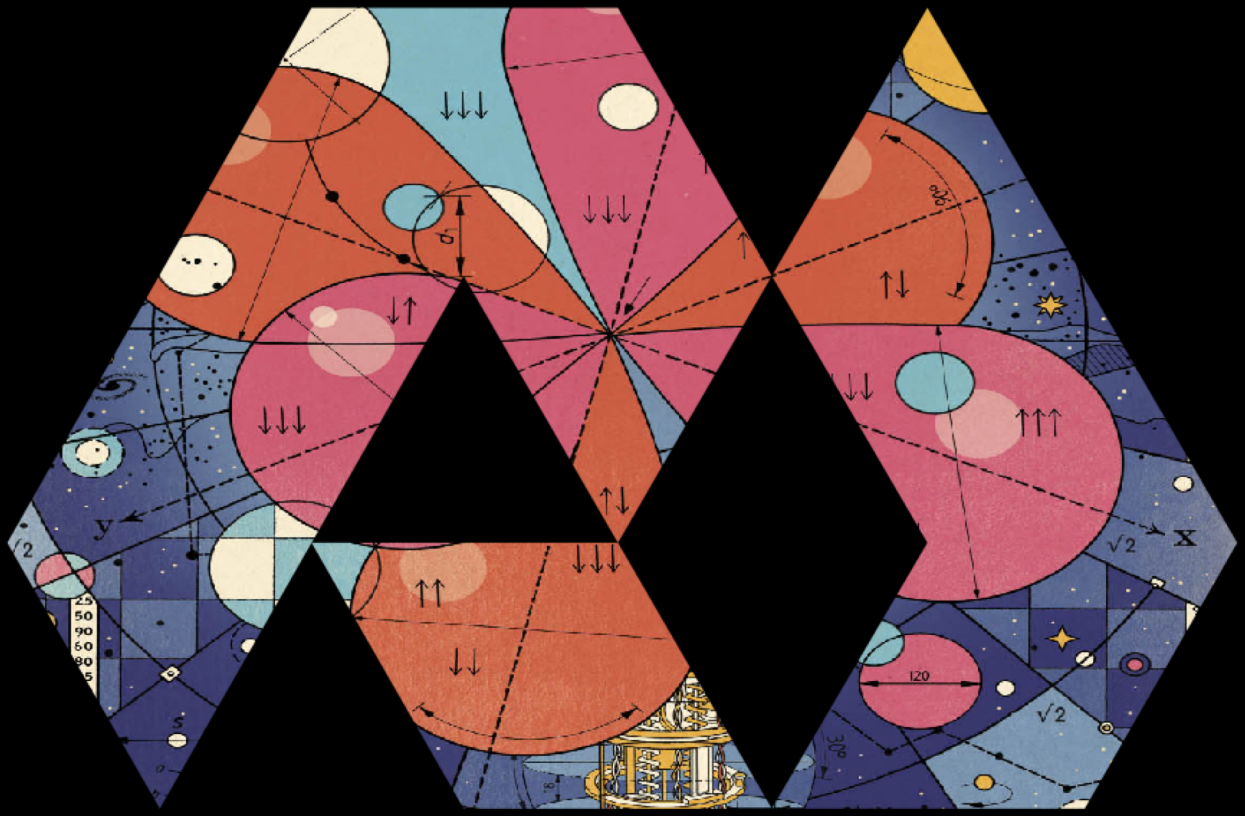
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y
x
√2
120
30°

Maps as models

A P Moore

SPEAKER

Alastair Moore

Head of Analytics and Machine Learning

Senior Teaching Fellow
UCL School of Management

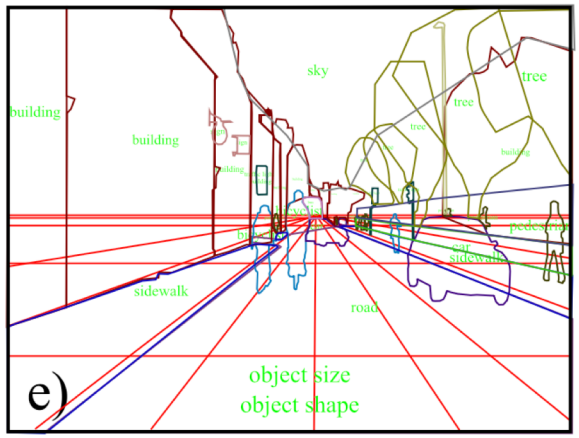
Senior Teaching Fellow
MBA Programme,
Peking University

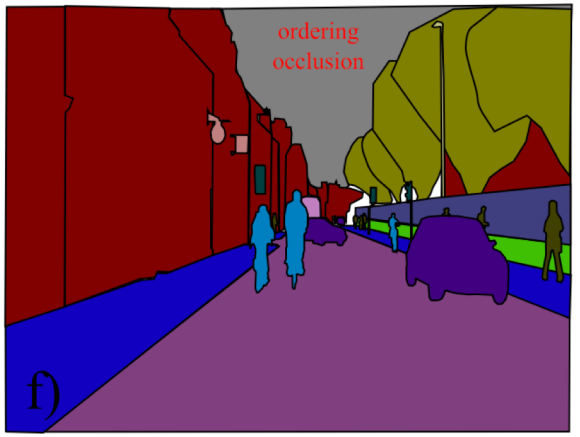
Co-Founder
Satalia.com

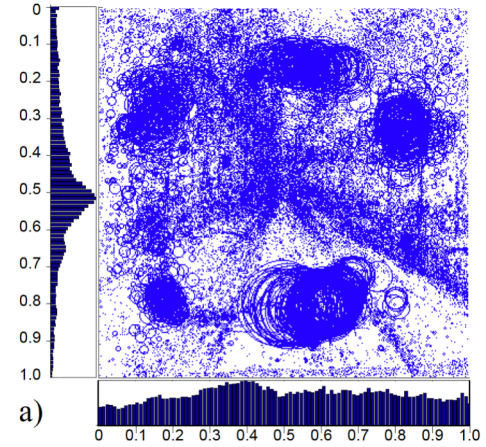
Co-Founder
WeArePopUp.com

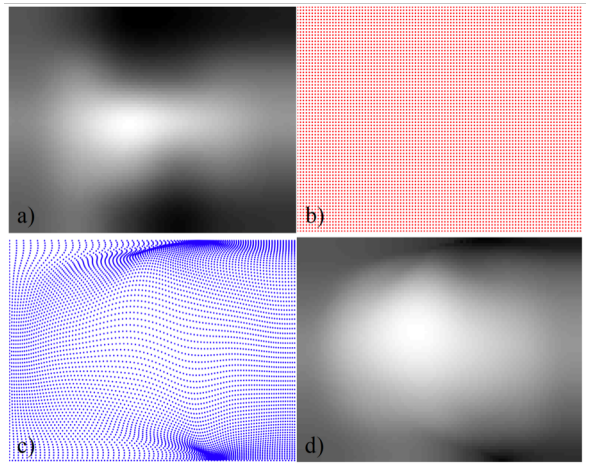
Partner
AMAAMS LLP

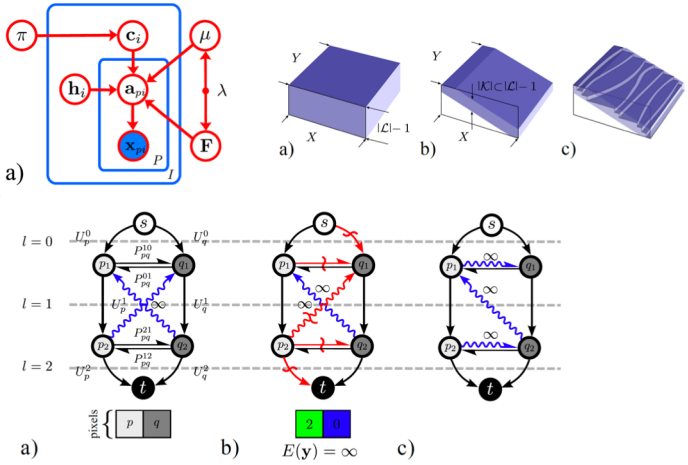
MY BACKGROUND











OUTLINE

- My background
- The Art and Science of Cartography
- Spaces
  - Projections
  - Kernels
  - Embeddings & Manifolds
- Data Structures
  - Graphs
- Abstraction and Patterns
  - Stocks and Flows
    - Capital
  - X flows, Y flows
- Simple models
- Maps as models
- Maps as interfaces and modes of communication
- Computational strategy

My experience of mapping

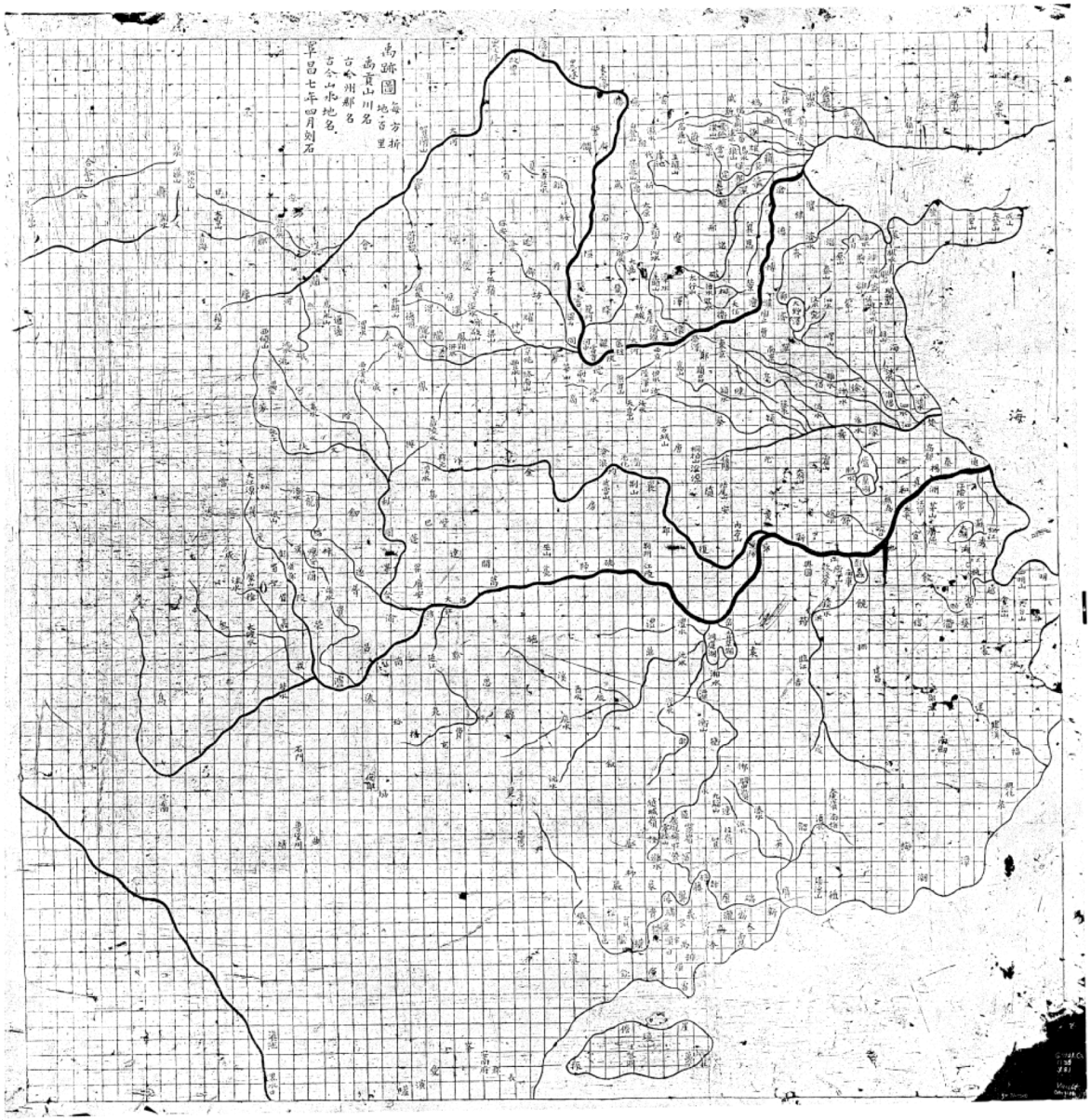
Random thoughts I have on mapping

Limited progress!

ART & SCIENCE

MAPS

MEASUREMENT & METRICS



The Yu Ju Tu, carved in stone probably in the 11th century.

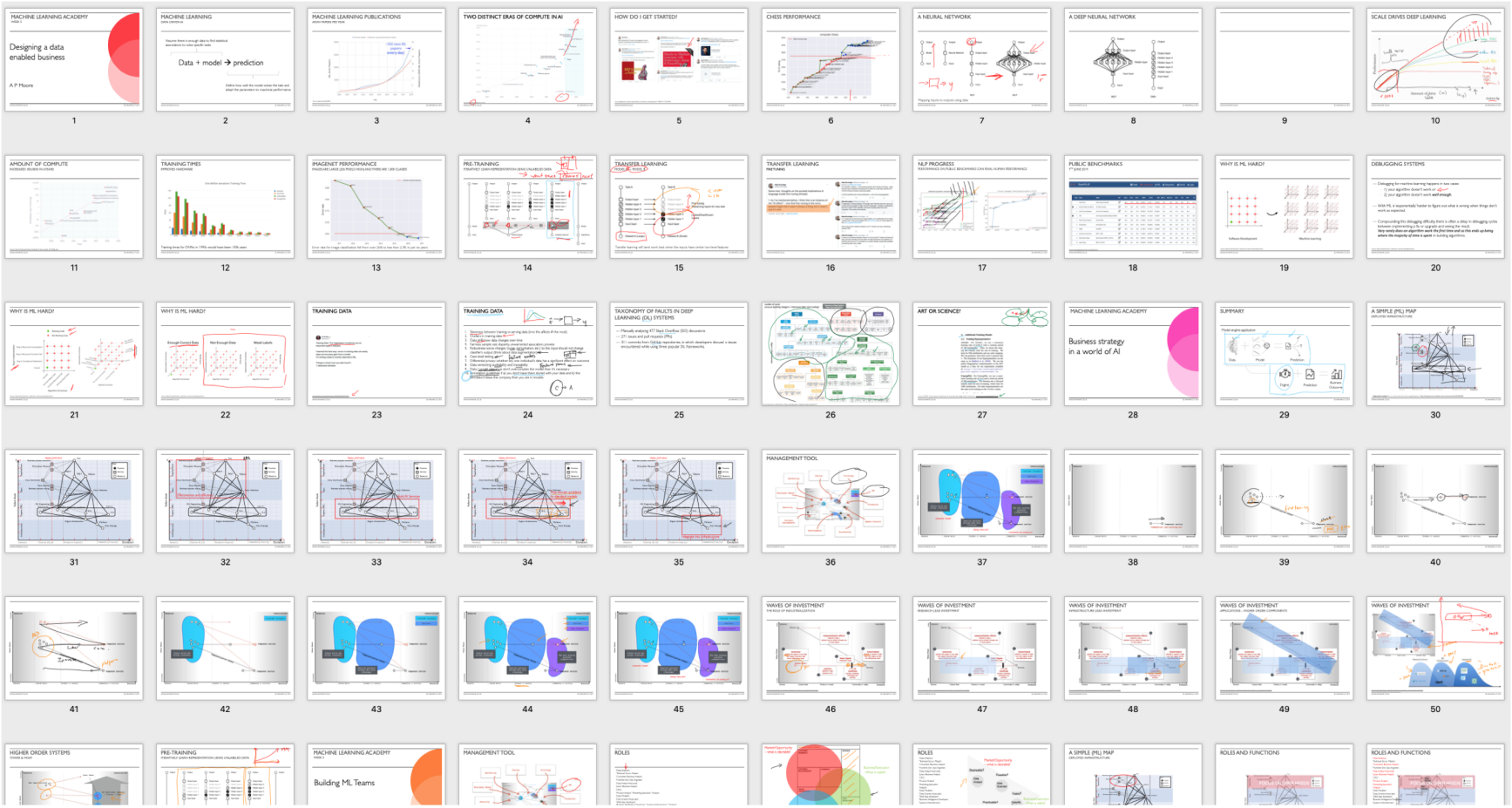
The cartographic use of a grid system dates at least back to the Han dynasty in the second in the second century AD, when the polymath Zhang Heng is said to have introduced it.

MAPS

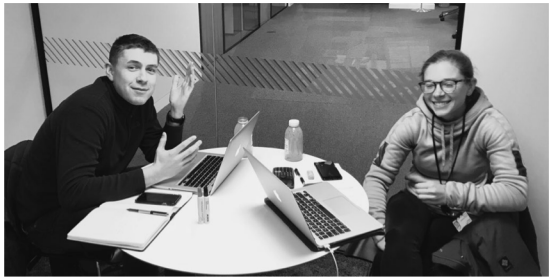
SIMPLE AS POSSIBLE, BUT NOT SIMPLER

TEACHING

DESIGNING DATA ENABLED BUSINESSES

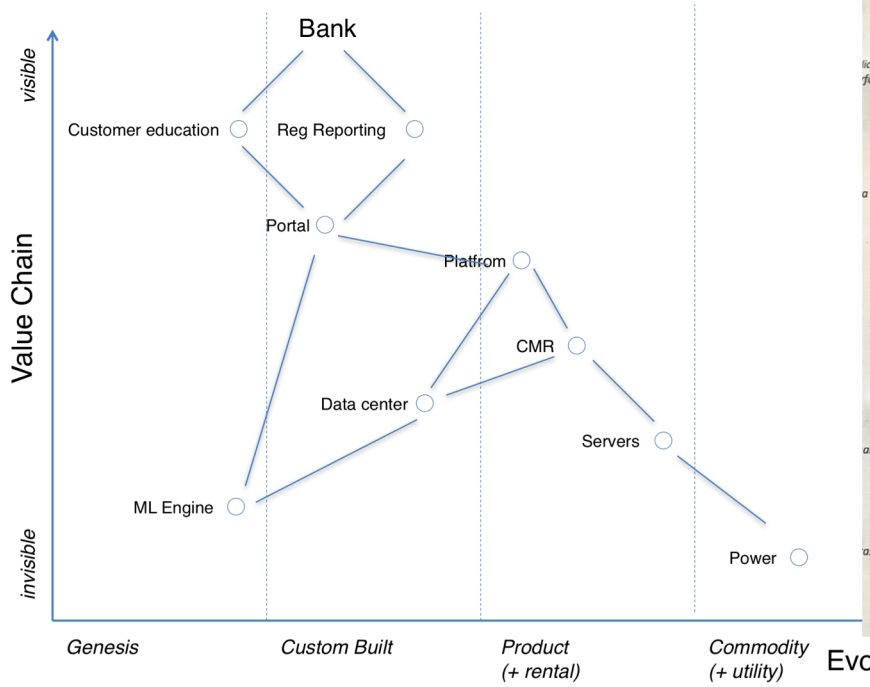


TEACHING

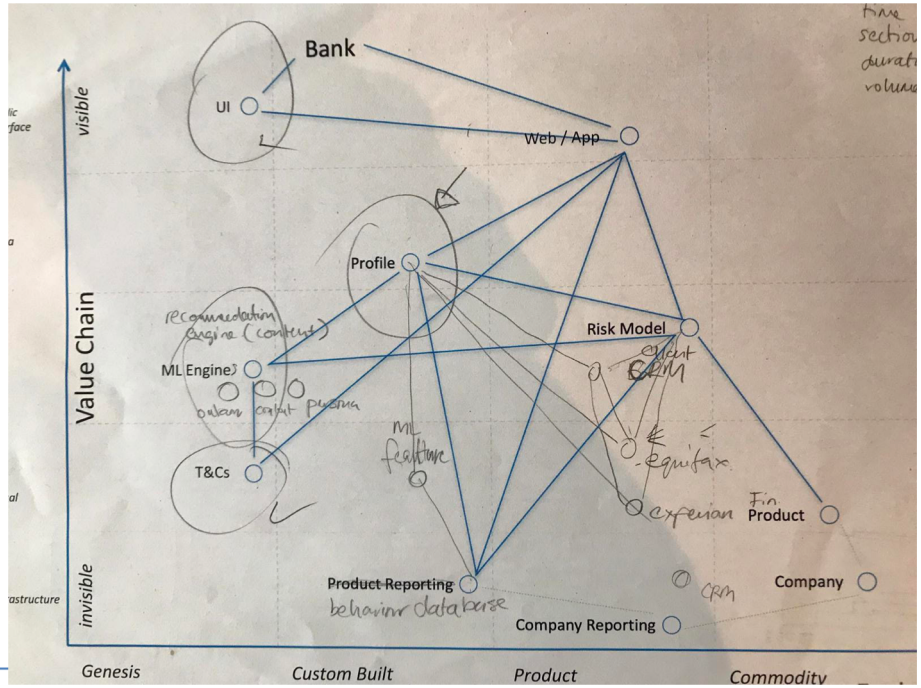


ITERATION & COMMUNICATION

V2

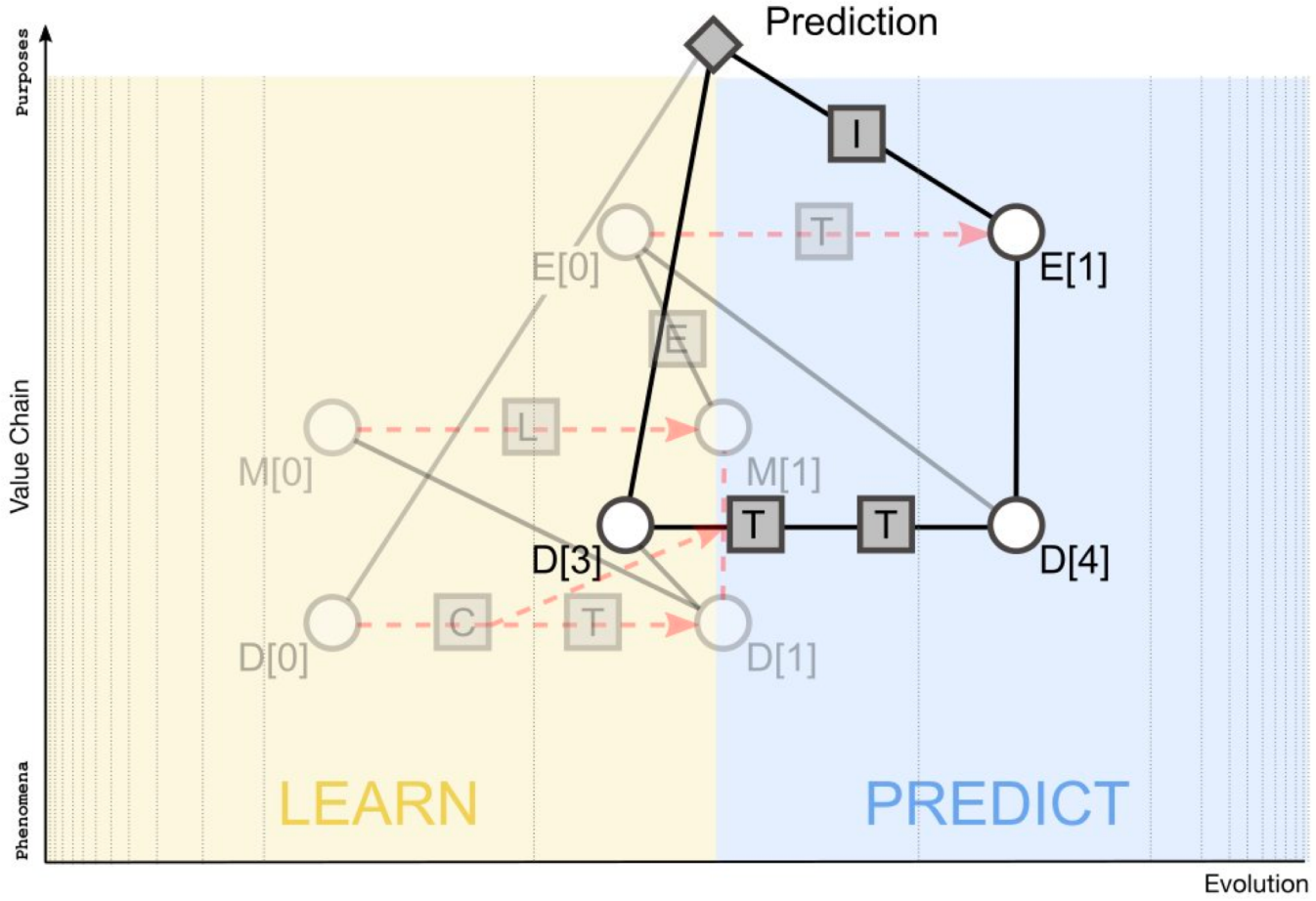


V4

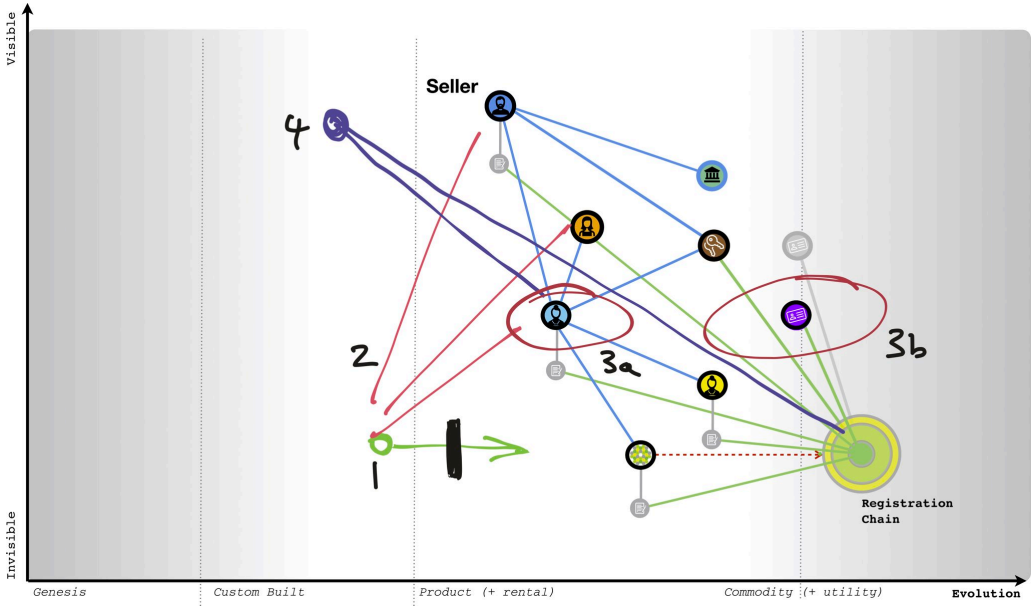


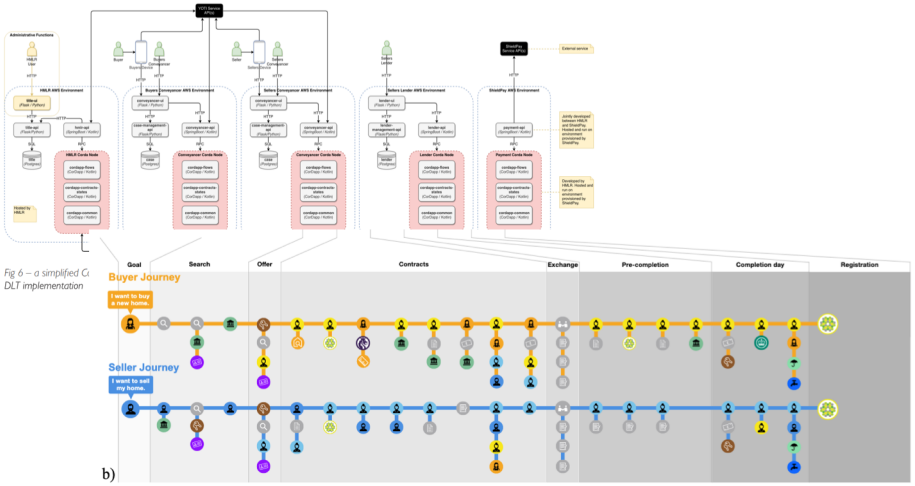
FLOWS OF INFORMATION

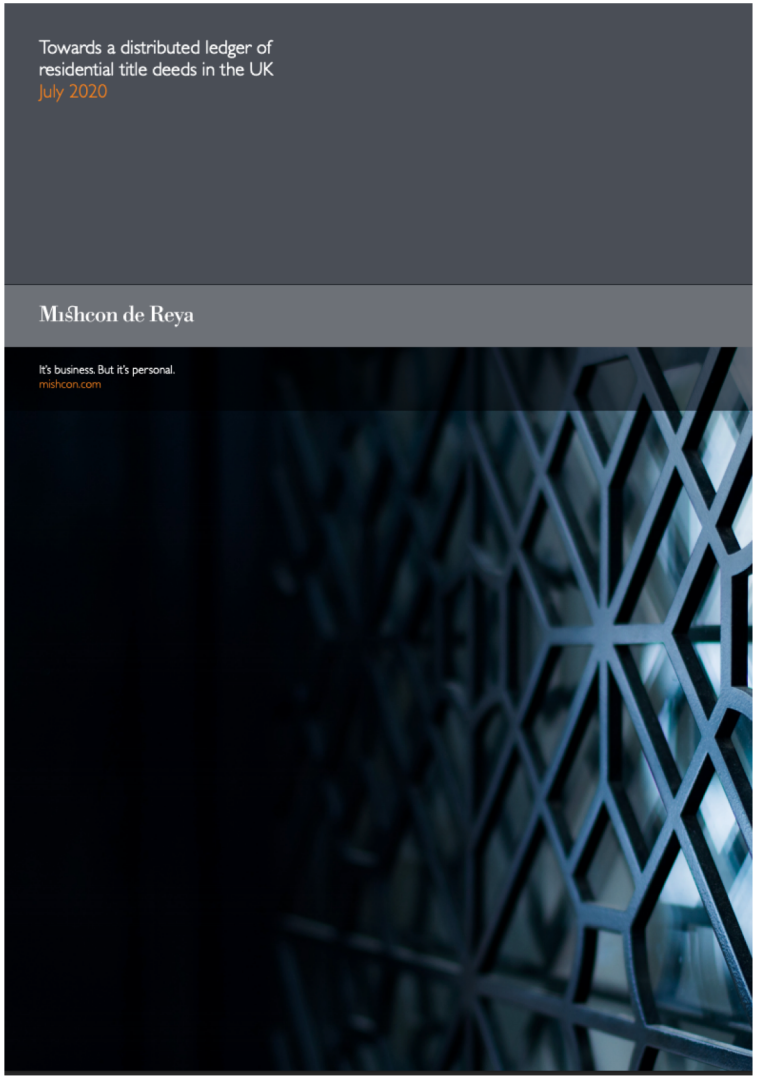
MACHINE LEARNING LOOPS



STRATEGY



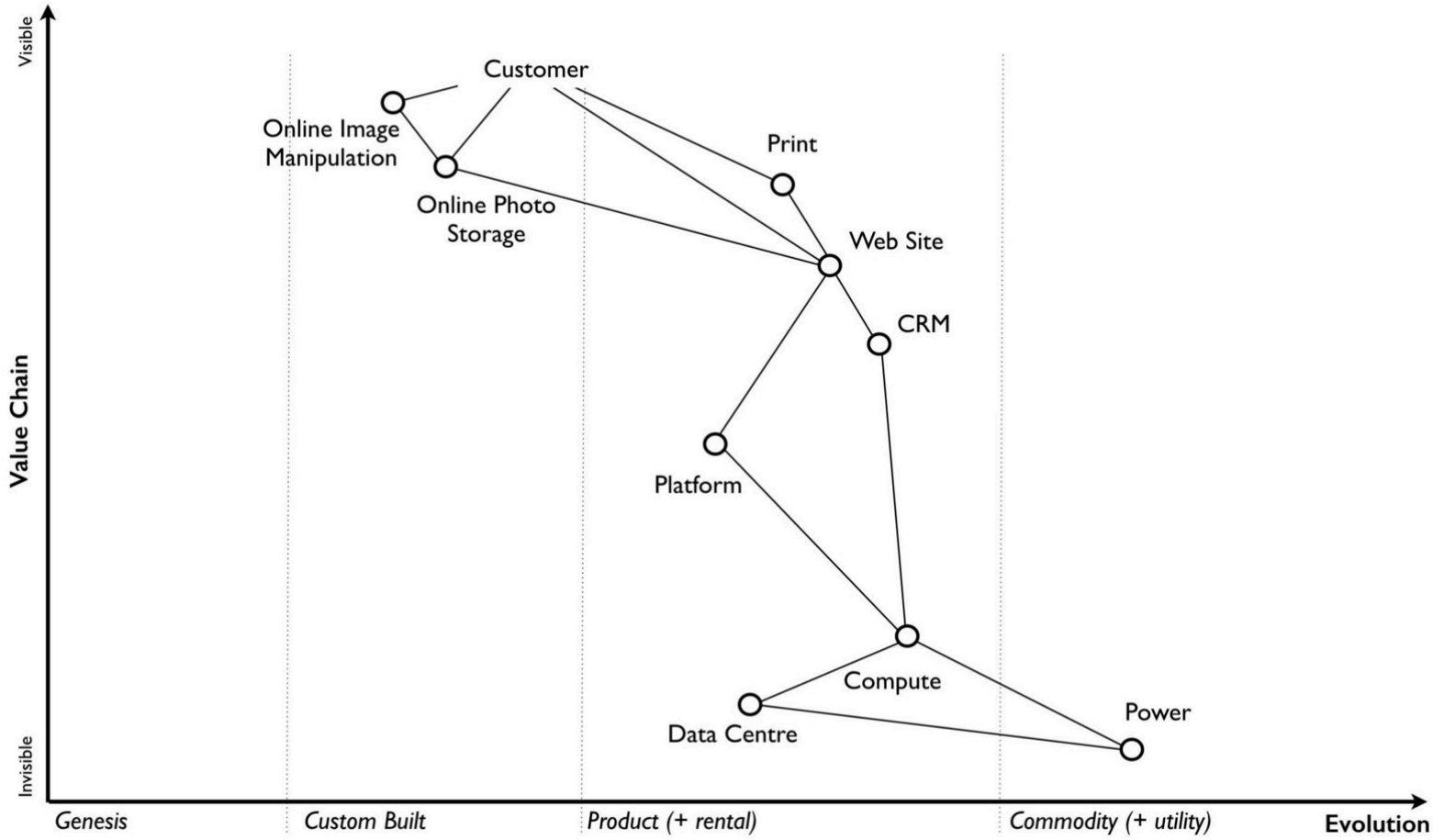




Source: https://www.mishcon.com/upload/files/HMLR%20White%20Paper.pdf

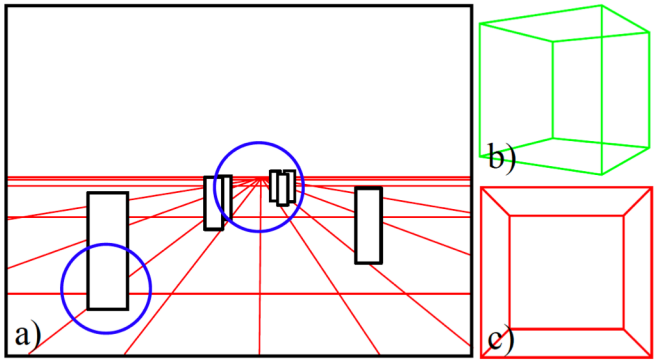
MAPS AS MODELS

MAPS AS MODELS



SPACES

PROJECTIONS



Robinson

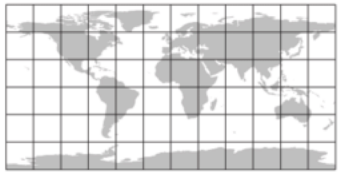


Plate Carrée

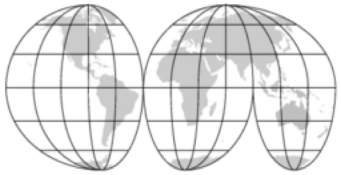
Winkel Tripel

Eckert IV

Mollweide

Mercator

Wagner VII



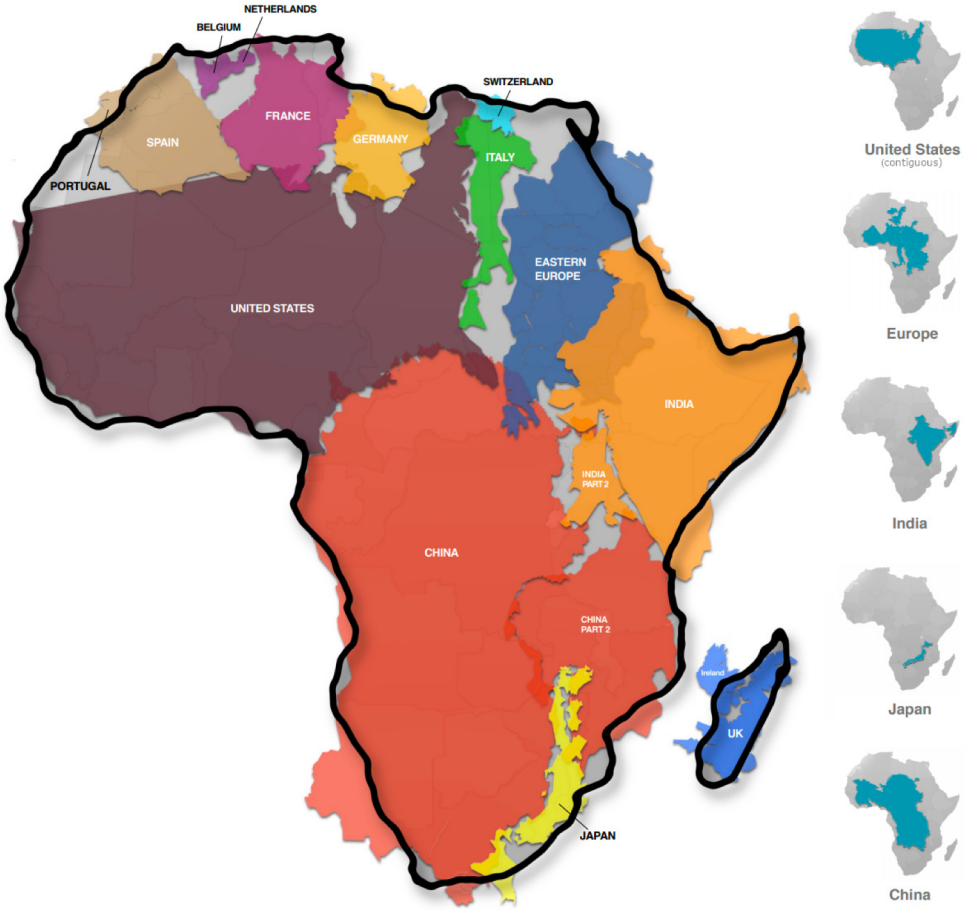
Interrupted Mollweide

Goode Homolosine

PROJECTIONS

REPRESENTATIONS AND BIASES

Mercator



https://thetruesize.com/

DECOMPOSITION

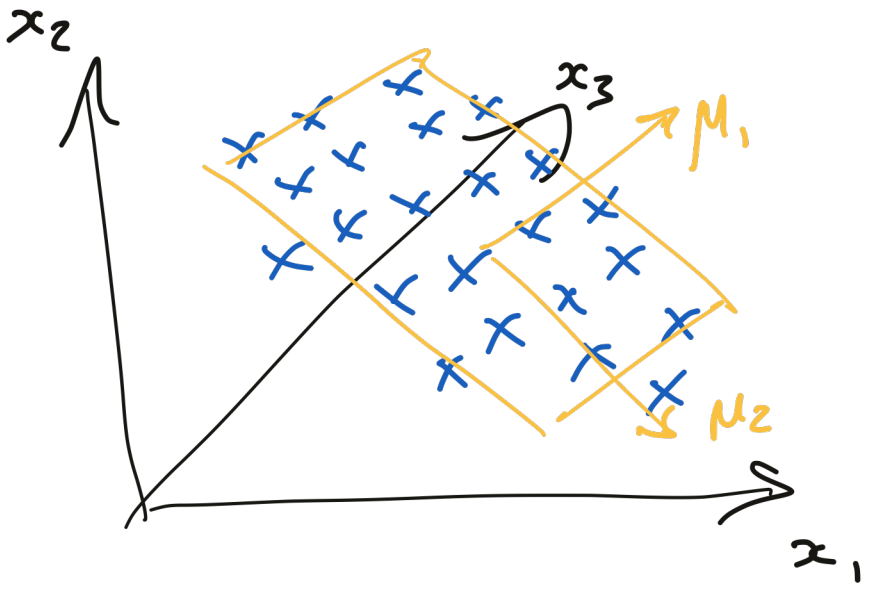
PROJECTION METHODS

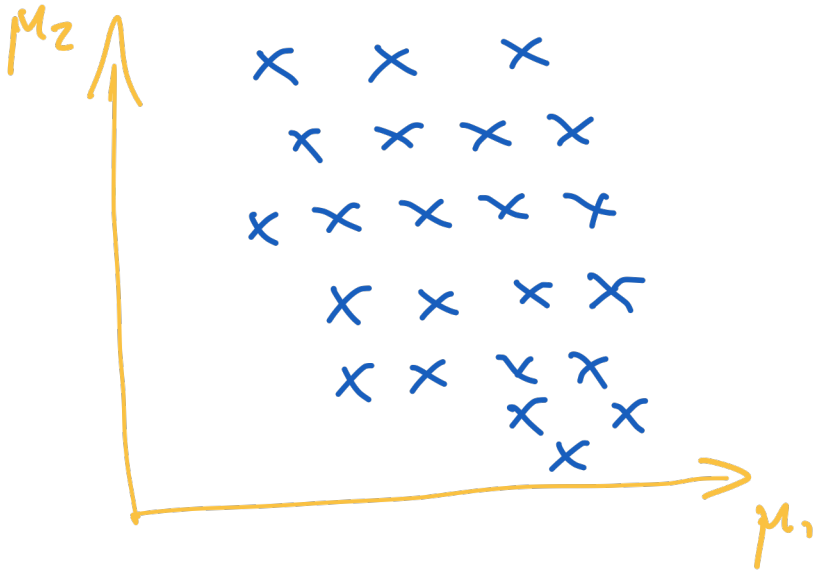
Model requirements

Decomposition

$x \in [-\infty, \infty]$

$y \in [-\infty, \infty]$

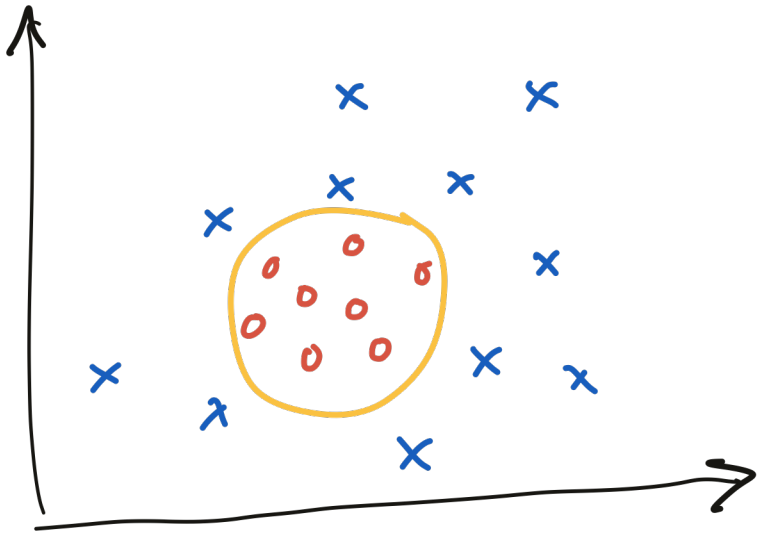


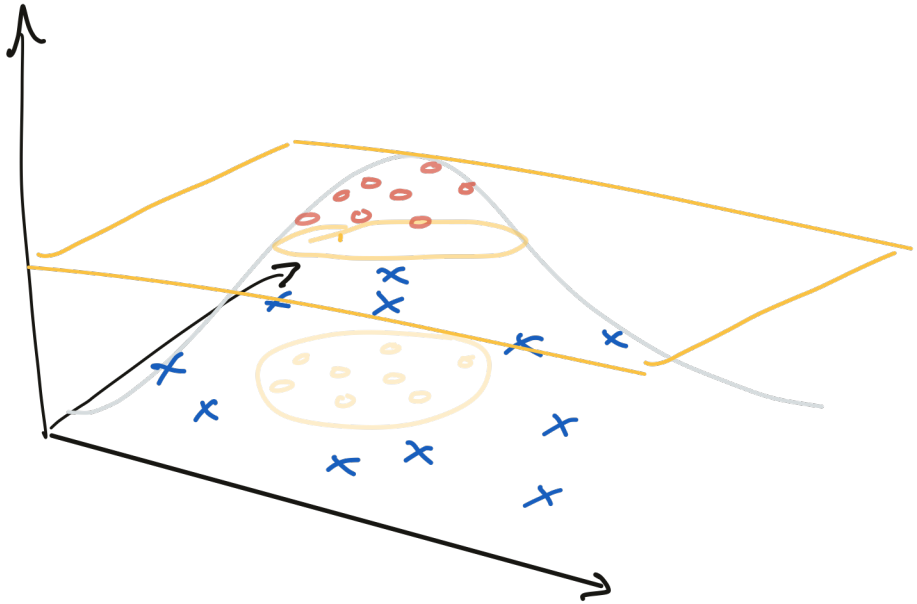


Dimensionality reduction

DECOMPOSITION

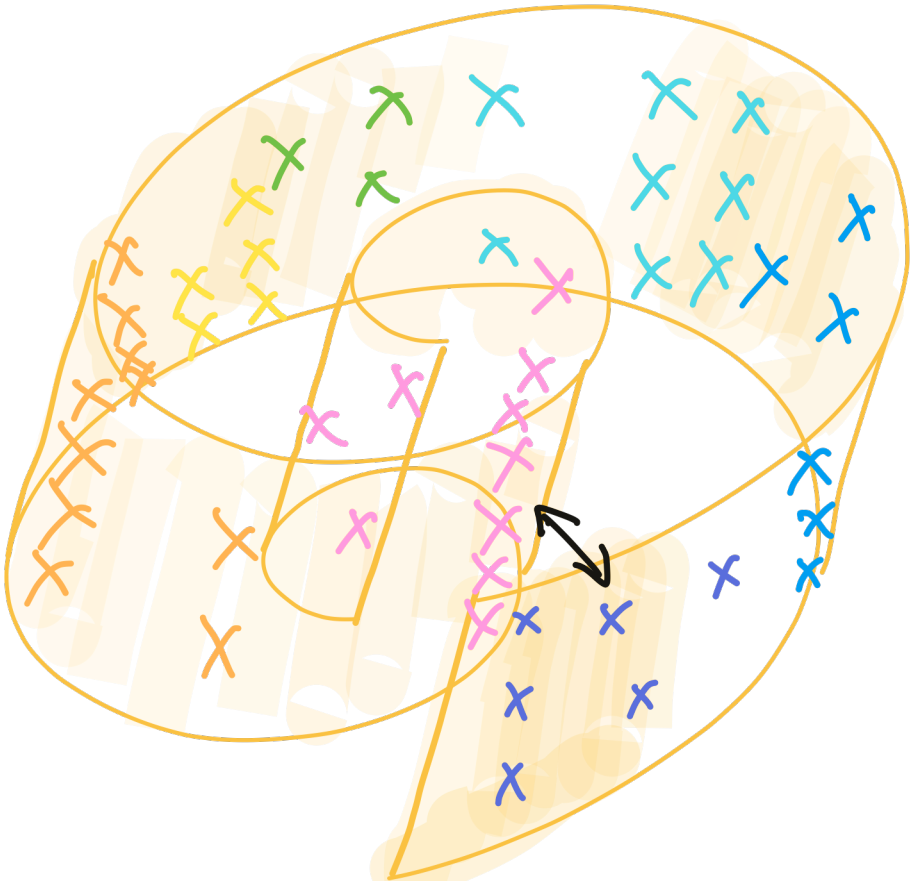
KERNEL METHODS

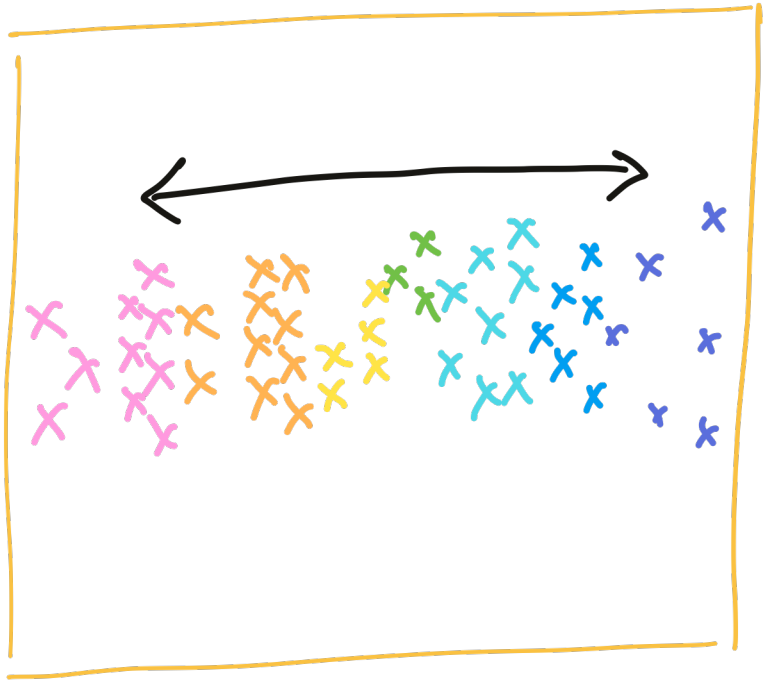




DECOMPOSITION

MANIFOLD AND EMBEDDINGS

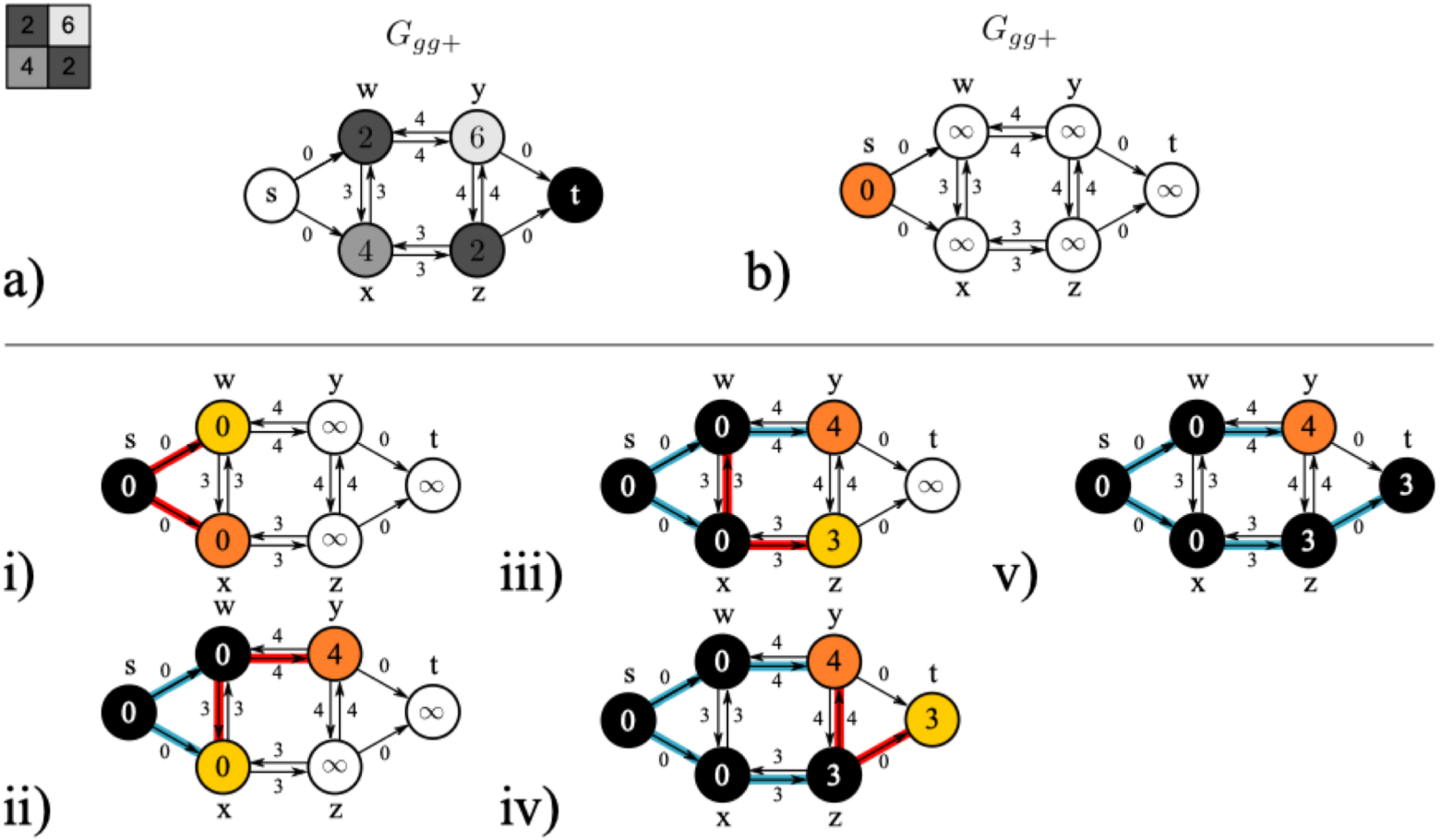




DATA STRUCTURES

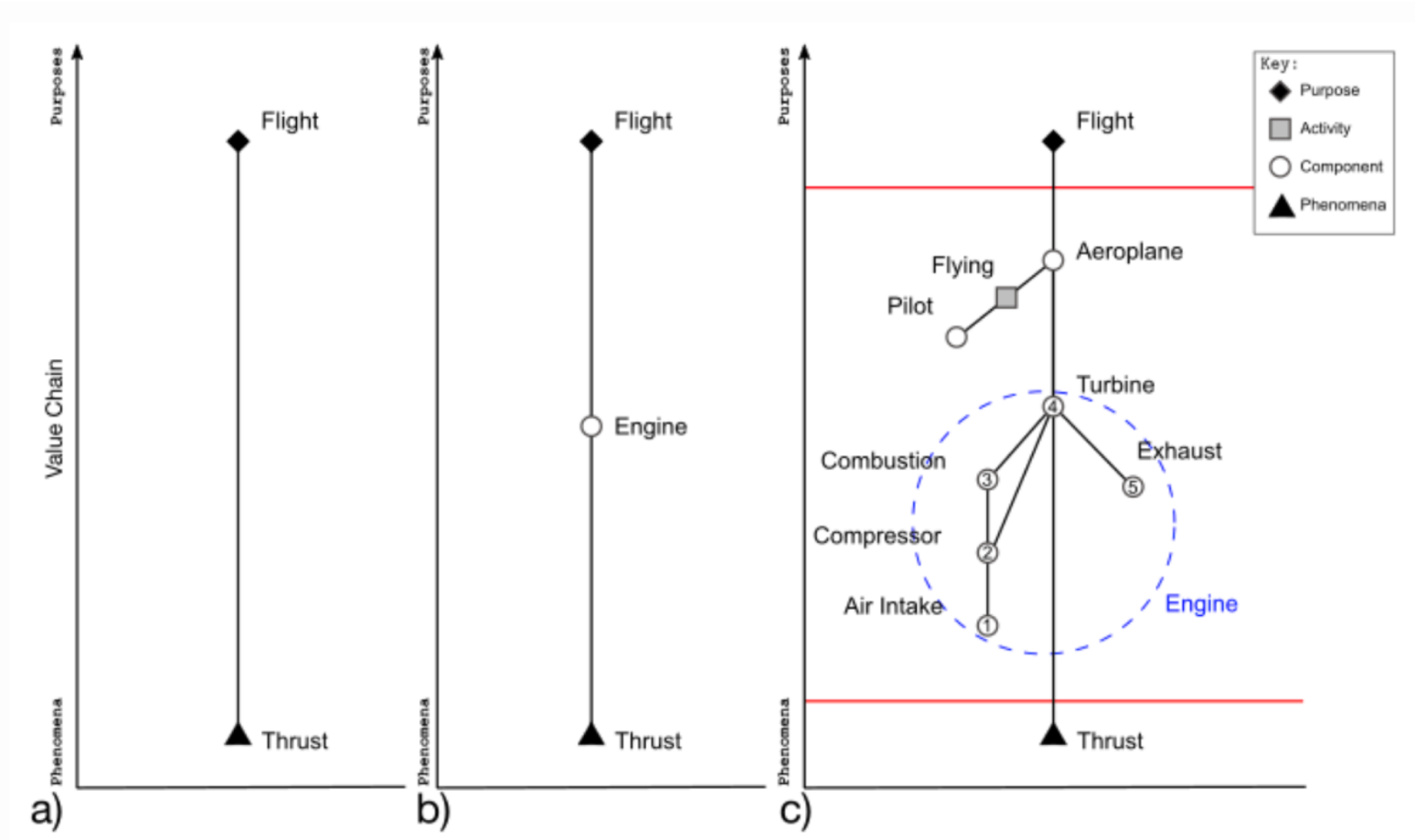
GRAPHS

STOCKS, FLOWS, WEIGHTS, PATHS, CUTS, CLIQUES, COLORINGS, DUALS…



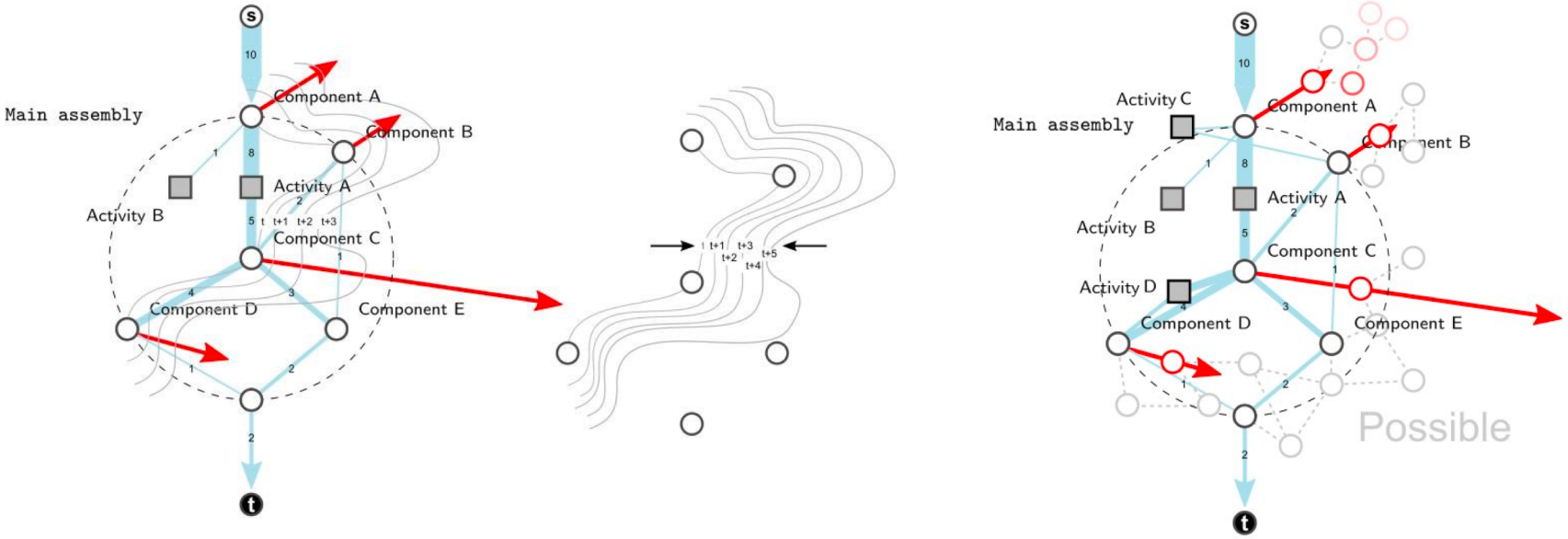
SOME COMMENTS

PURPOSES-PRINCIPLES-PHENOMENA
MAIN ASSEMBLY

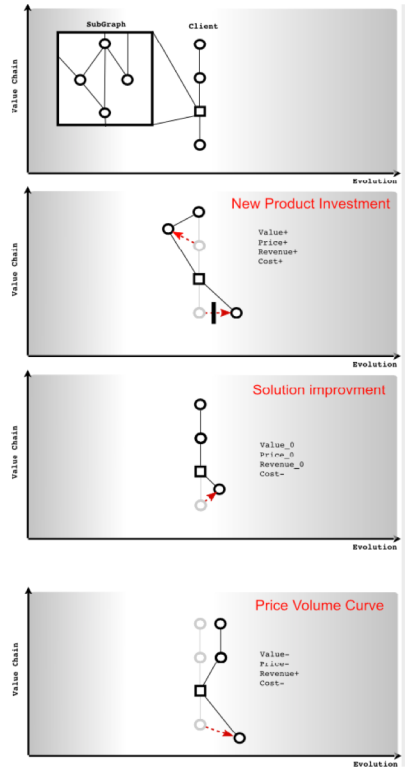


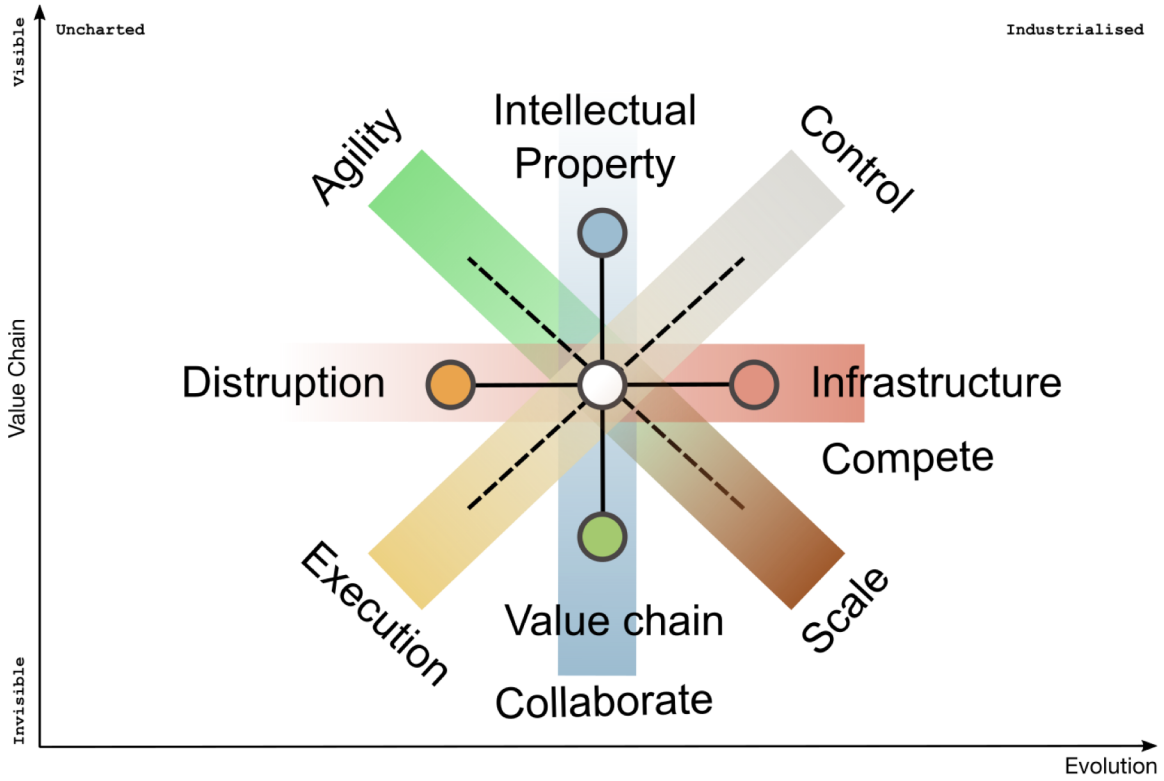
Original Source: Arthur, W. Brian, The Structure of Invention, Research Policy

ADJACENT POSSIBLE



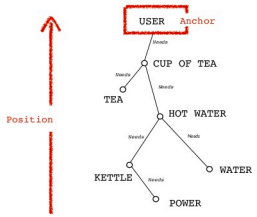
MOVE MAKING MINIMIZATION AND INVESTMENT FIELDS



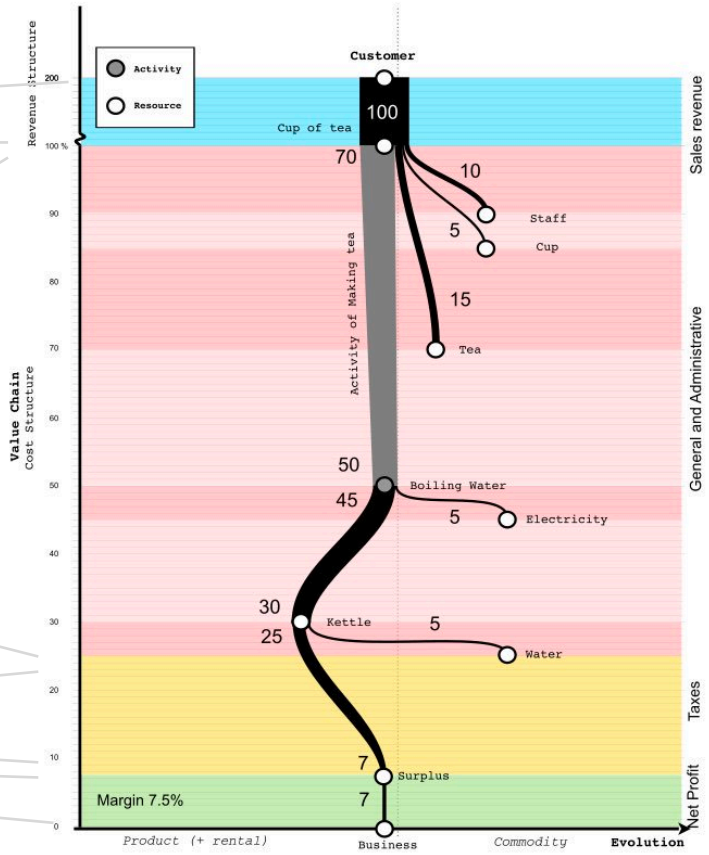


Original Source: Foundations of entrepreneurial strategy, Joshua S. Gans, Scott Stern, Jane Wu

FLOWS
(AND BALANCE SHEETS)

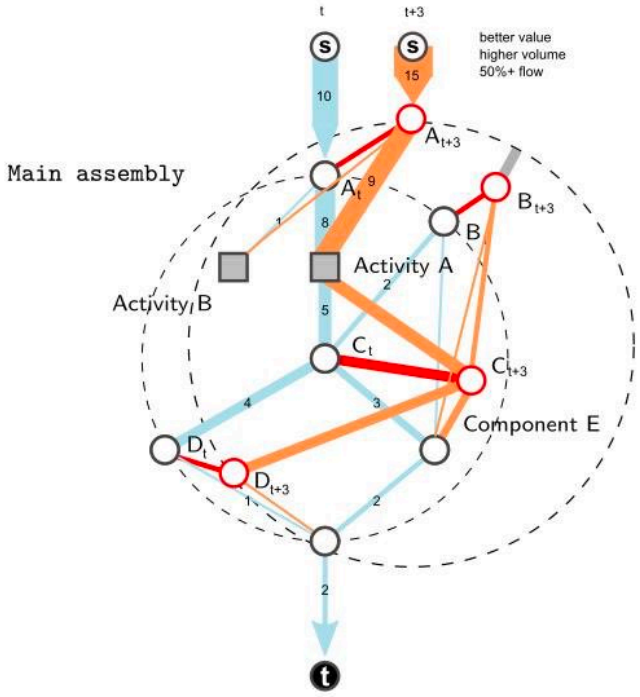


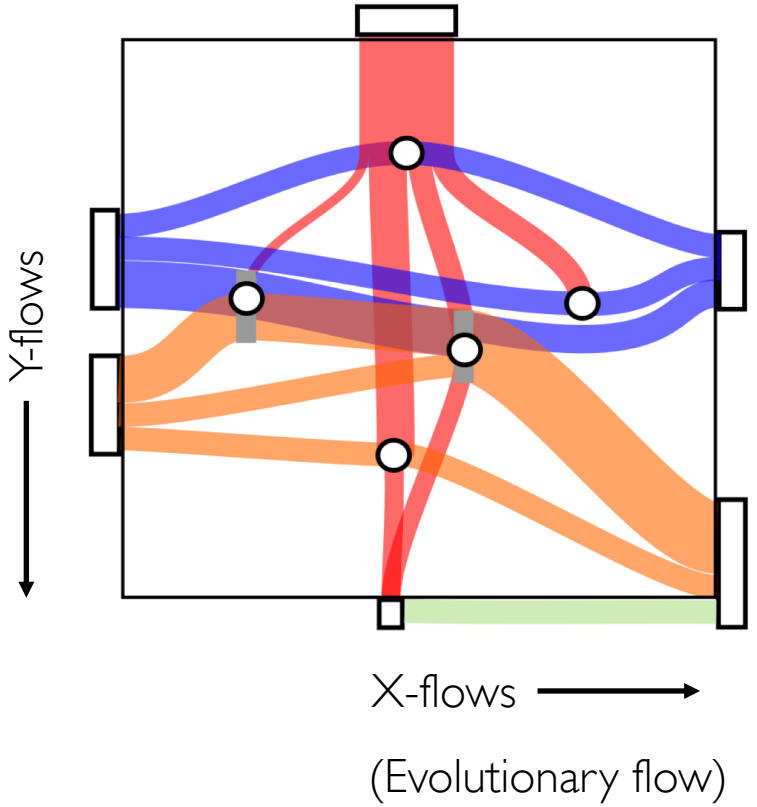
	A	B	C	D	E	F
1	**Cup of tea**	Unit cost				
2						
3	**Revenue structure**					
4						
5	**Sales Revenue**					
6	Cup of tea	1.00				
7	**Total Sales Revenue [J]**			1.00		1.00
8						
9	**Cost of Sales**					
10	N/A	0.00				
11	**Total Cost of Sales [K]**			0.00		
12						
13	**Gross Profit [L=J-K]**			1.00		
14						
15	**Cost structure [Operating Expenses]**					
16						
17	**Sales and Marketing**					
18	N/A	0.00				
19	**Total Sales and Marketing Expenses [M]**			0.00		
20						
21	**Research and Development**					
22	N/A	0.00				
23	**Total Research and Development Expenses [N]**			0.00		
24						
25	**General and Adminstrative**					
26	Staff	0.10				1.00
27	Cup	0.05				0.90
28	Tea	0.15				0.85
29	Hot water	0.20				0.70
30	Electricity	0.05				0.50
31	Kettle	0.15				0.45
32	Water	0.05				0.30
33						
34	**Total General and Adminstrative Expenses [O]**	0.75		0.75		
35						
36	**Total Operating Expenses [P=M+N+O]**			0.75		
37						
38	**Income from Operations [Q=L-P]**			0.25		
39						
40	**Other Income [R]**			0.00		
41						
42	**Taxes**					
43	Sales tax	0.18				
44	**Total Taxes [S]**	0.18		0.18		0.25
45						
46	**Net Profit [T=Q+R-S]**			0.07		0.07
47						
48	**Gross Margin [L/J]**			100%		
49	**Return on sales [T/J]**			7.5%		



EXPLOITATION VS EXPLORATION

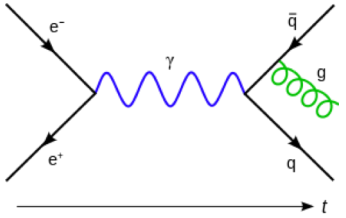
X AND Y CAPITAL FLOWS

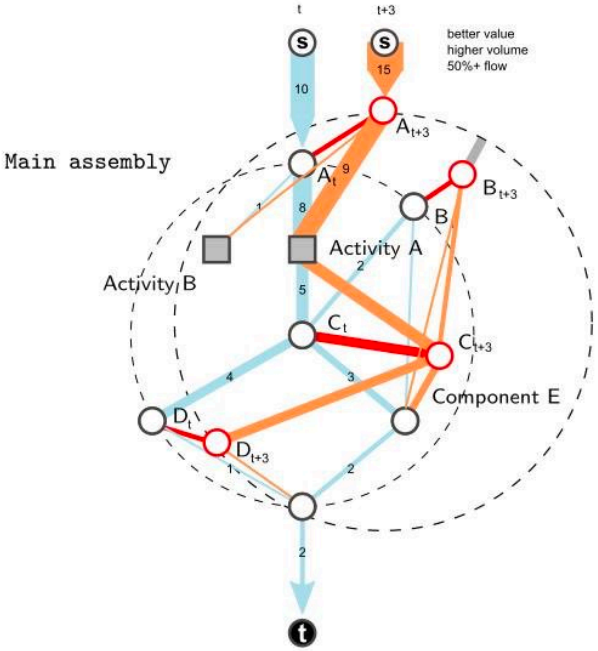


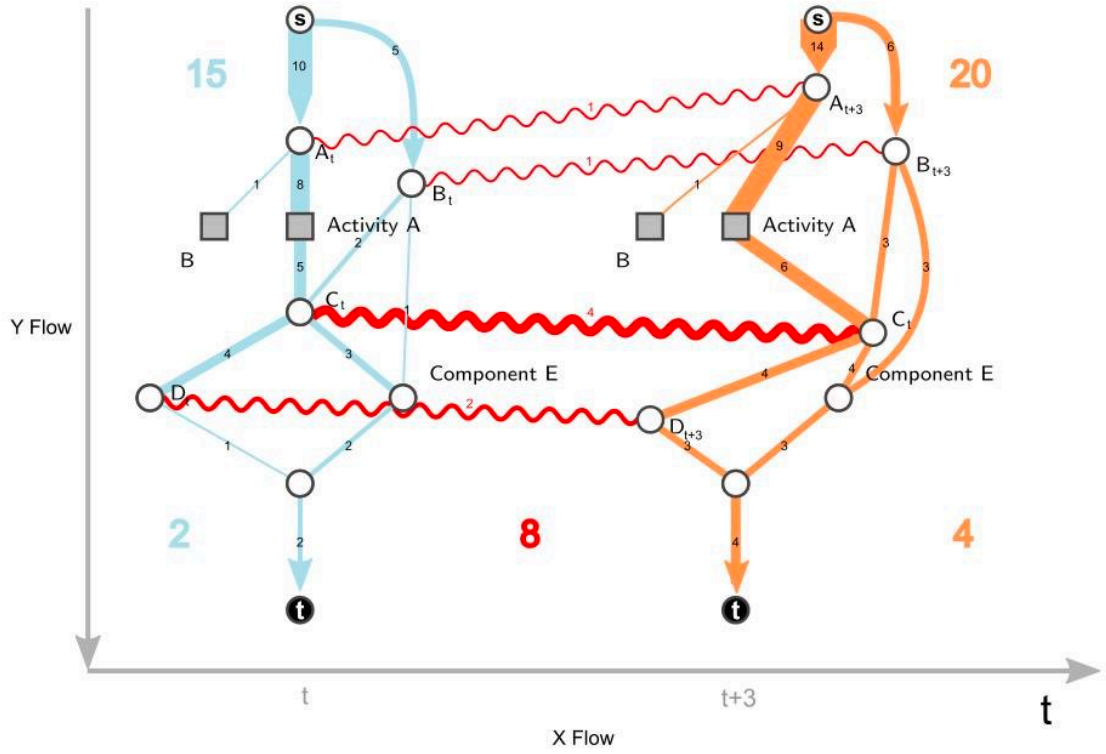


EXPLOITATION VS EXPLORATION

X AND Y CAPITAL FLOWS



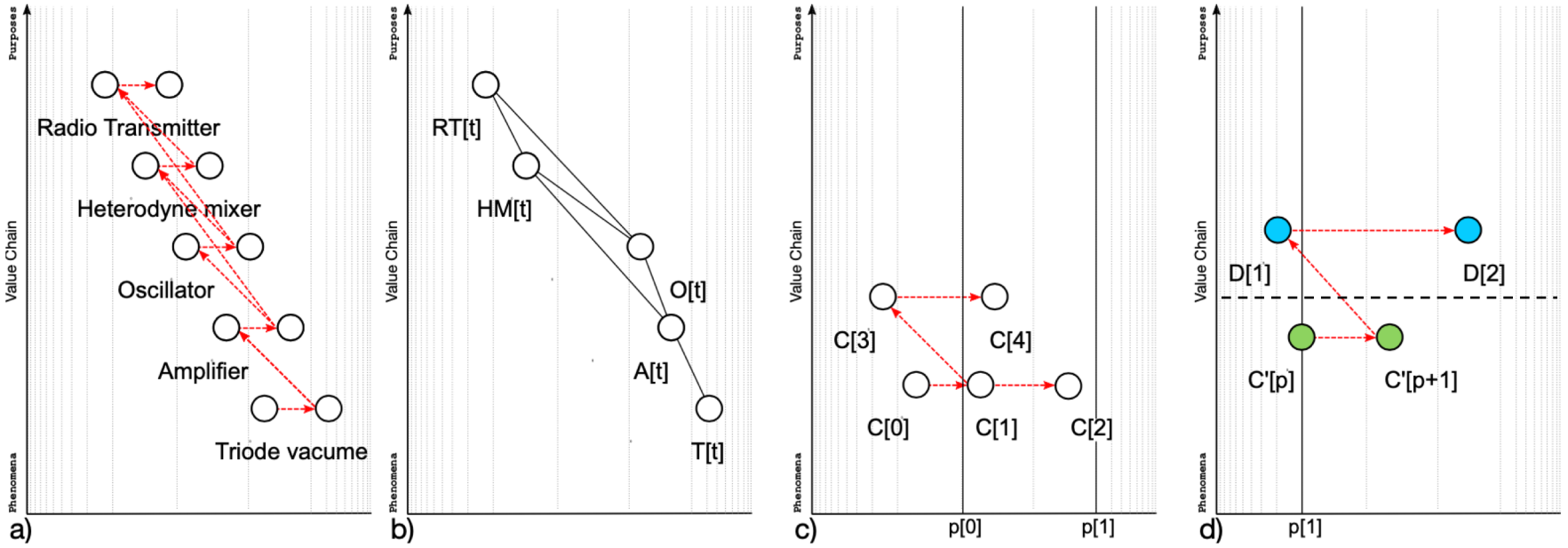




PATTERNS

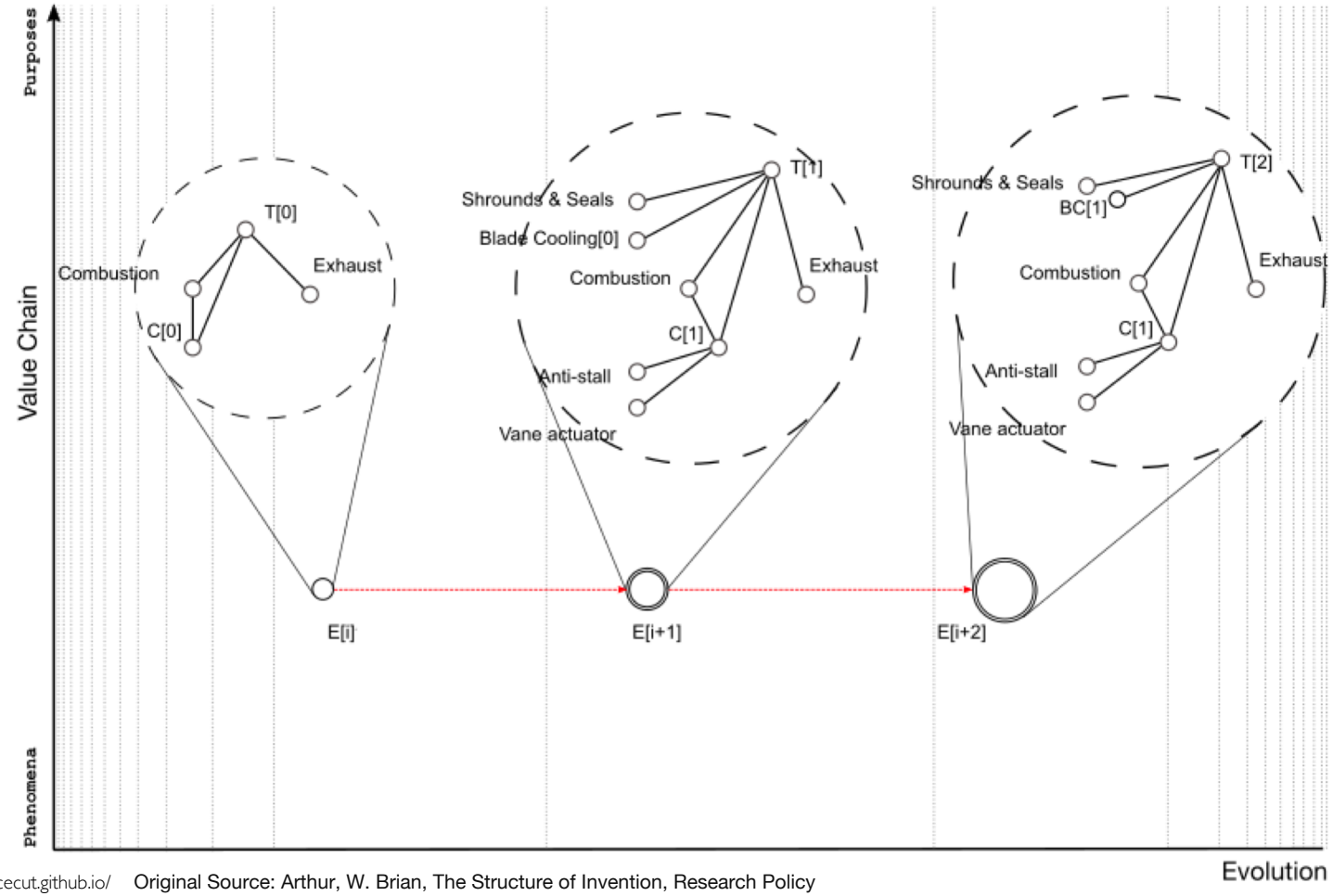
PATTERNS

COMPONENT PHASE TRANSITIONS



PATTERNS

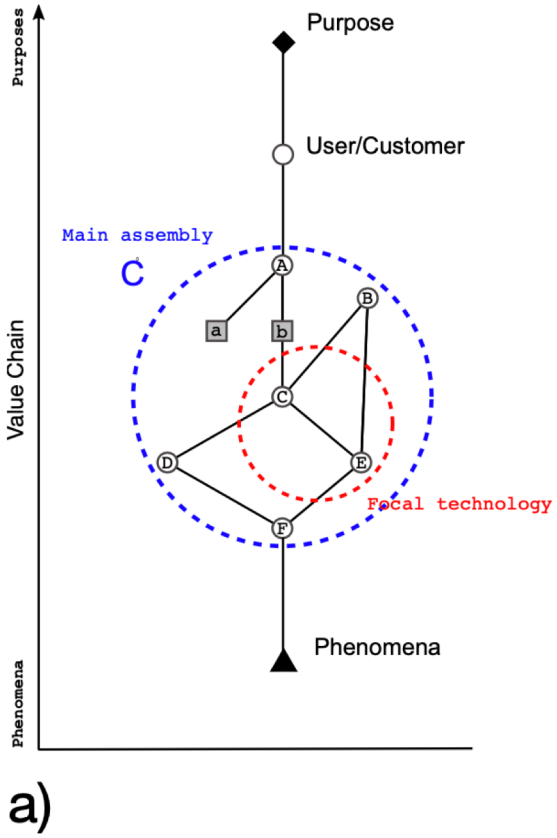
STRUCTURAL DEEPENING



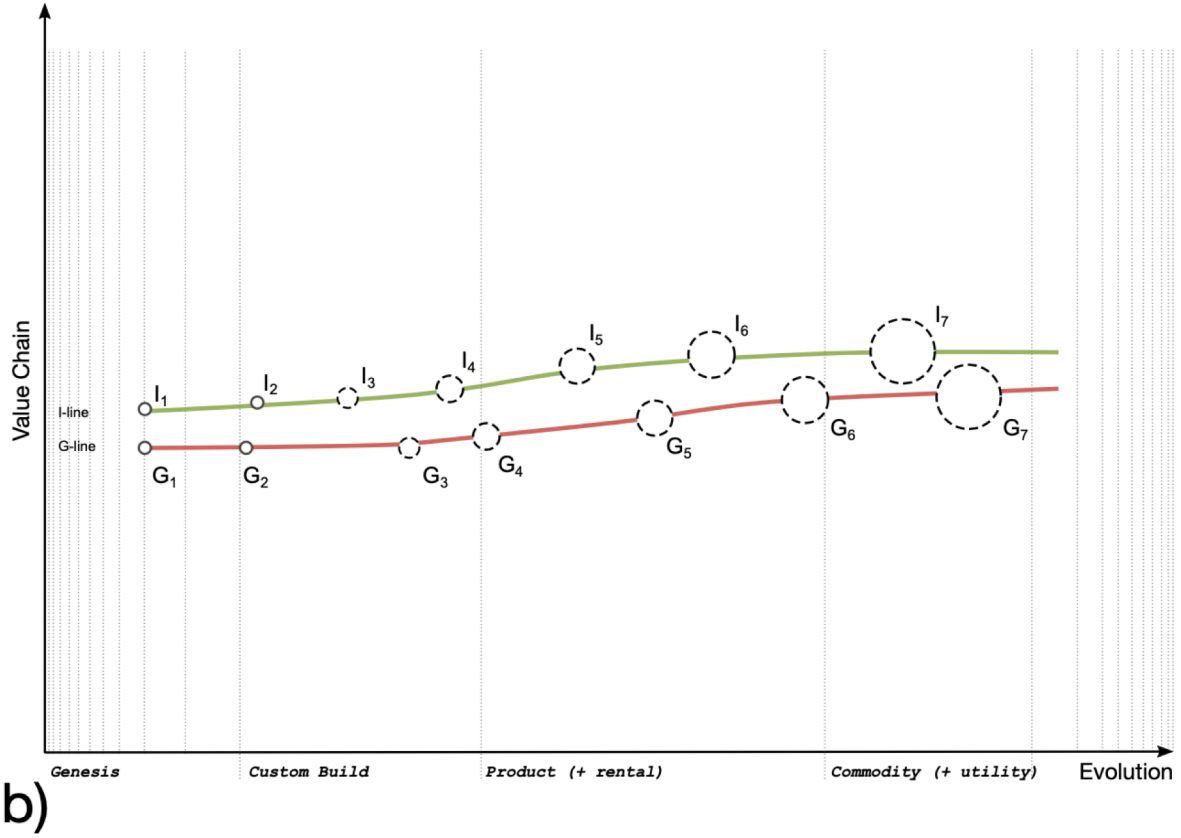
Source: https://latticecut.github.io/ Original Source: Arthur, W. Brian, The Structure of Invention, Research Policy

EVOLUTION OF THE MAIN ASSEMBLY

CO-EVOLUTION CURVES

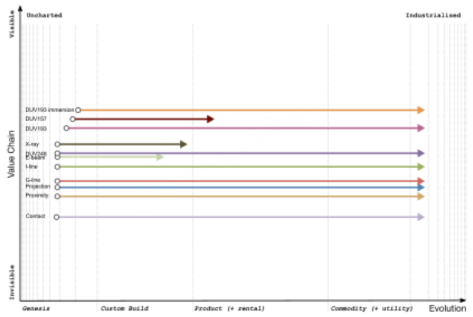


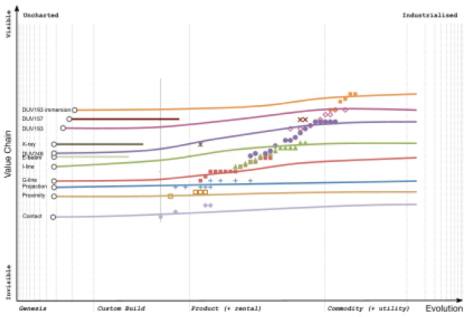
a)

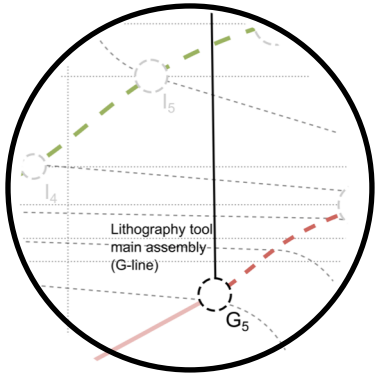


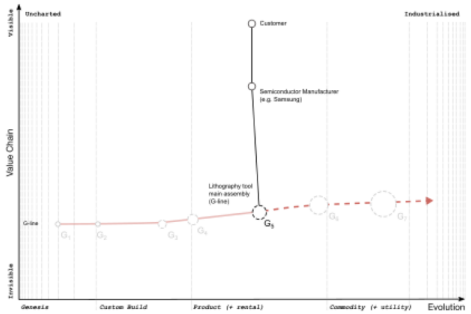
b)

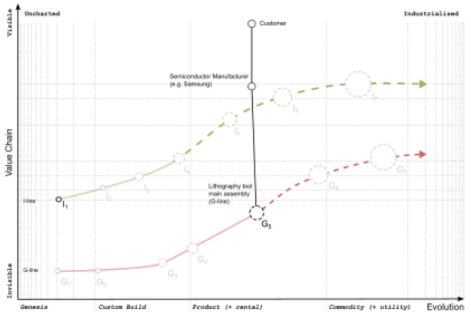
CO-EVOLUTION CURVES

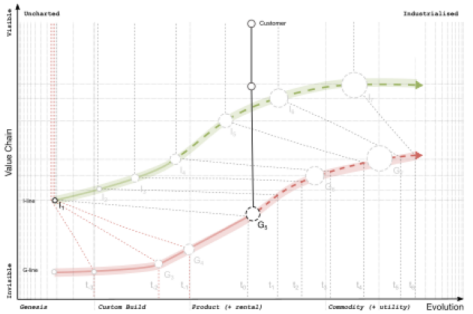


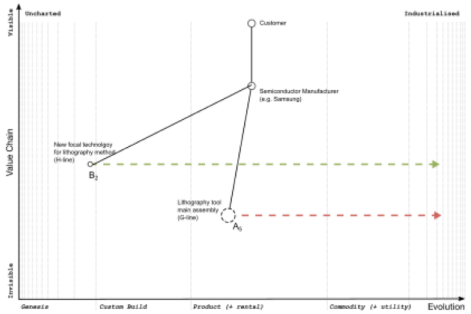


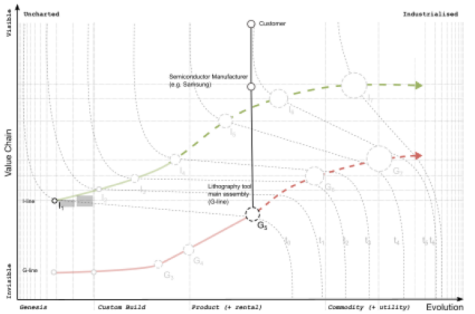






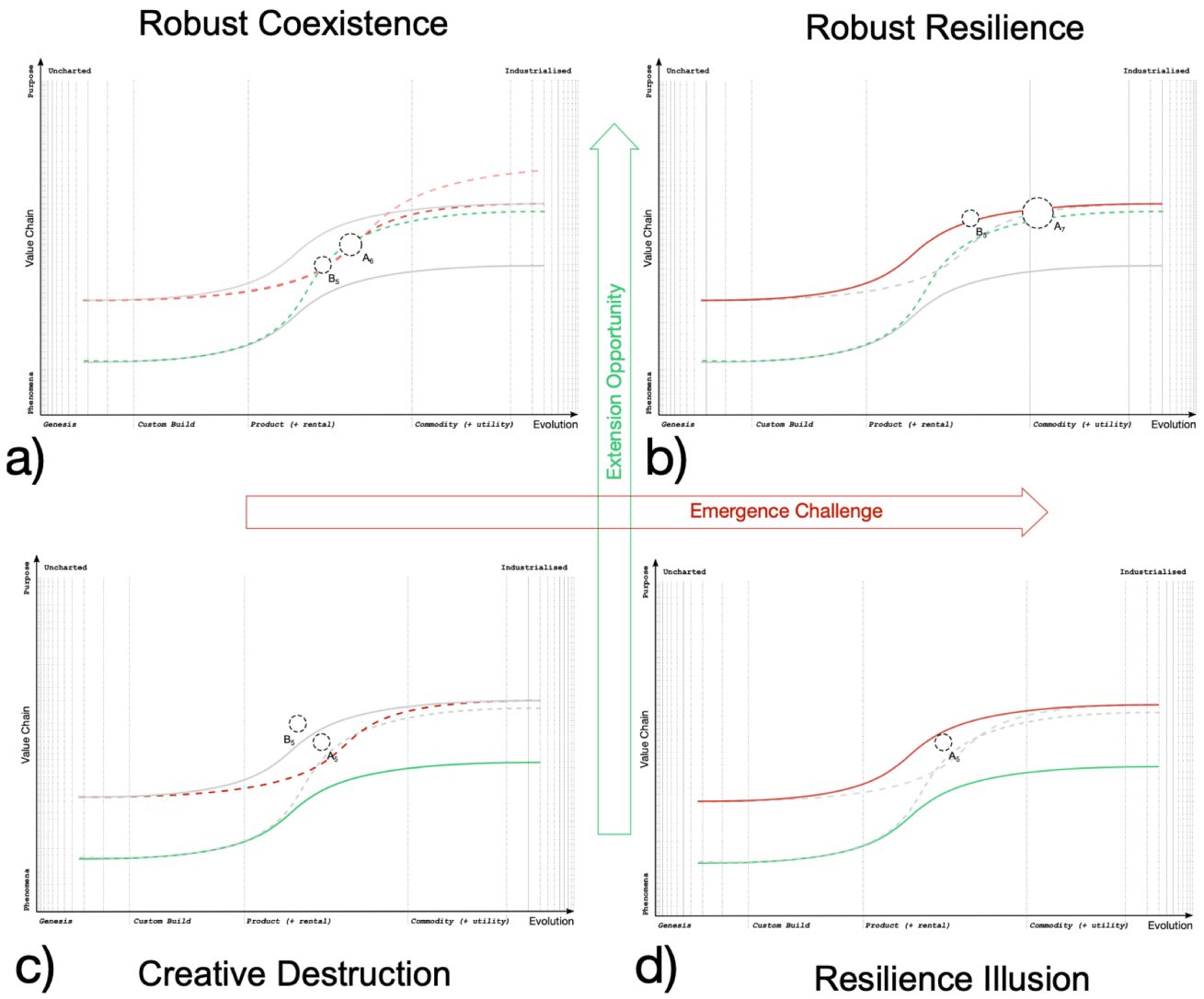






Original source: Adner, R. and Kapoor, R., Innovation ecosystems and the pace of substitution: Re-examining technology S-curves, Strategic Management Journal

CO-EVOLUTION CURVES

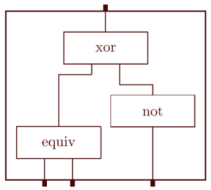


Original source: Adner, R. and Kapoor, R., Innovation ecosystems and the pace of substitution: Re-examining technology S-curves, Strategic Management Journal

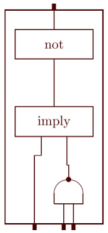
SIMPLE MODELS

SIMPLE MODELS

THE EVOLUTION OF TECHNOLOGY WITHIN A SIMPLE COMPUTER MODEL

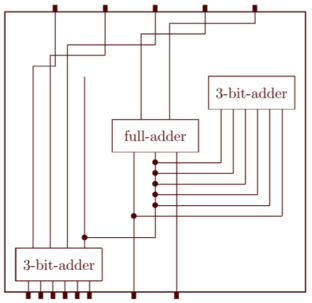


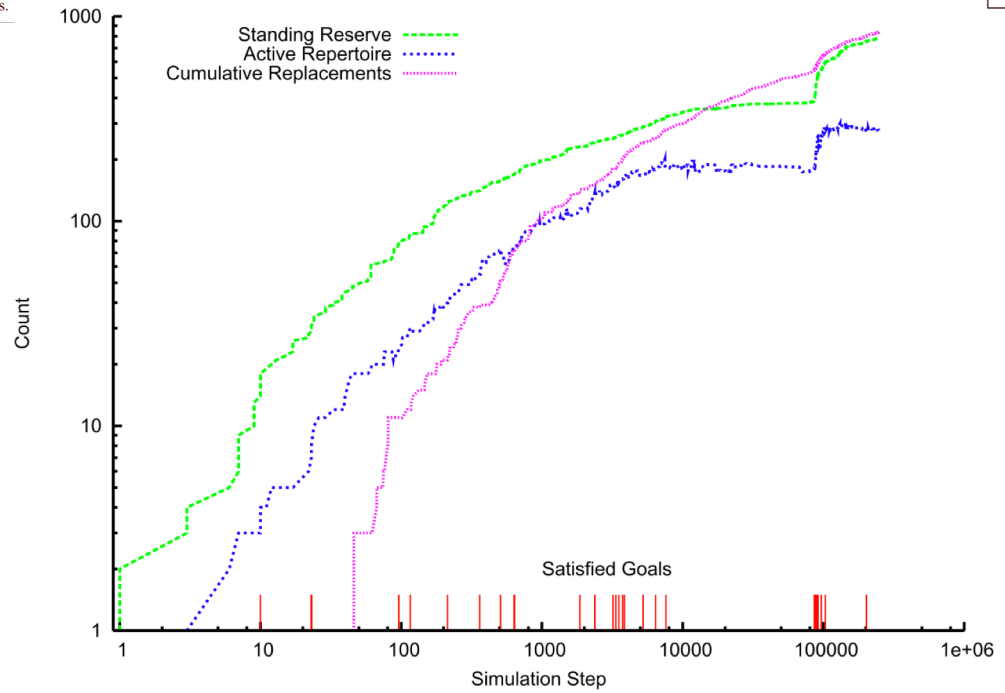
3 bit xor



3 bit and

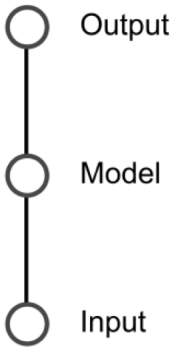
Figure 1: two circuits "invented" for simple goals.

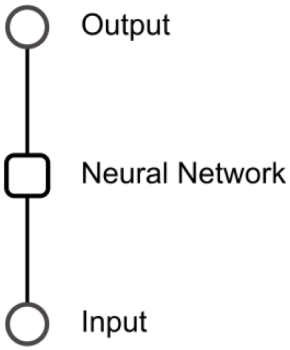


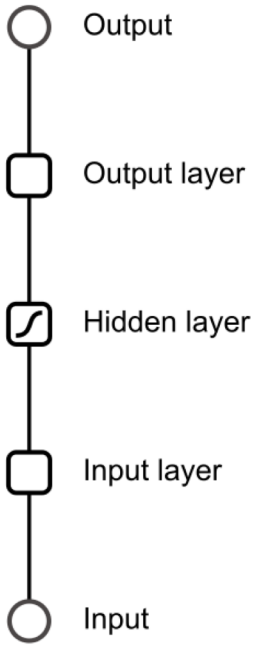


Source: W Brian Arthur and Wolfgang Polak. The Evolution of Technology within a Simple Computer Model. Technical report.

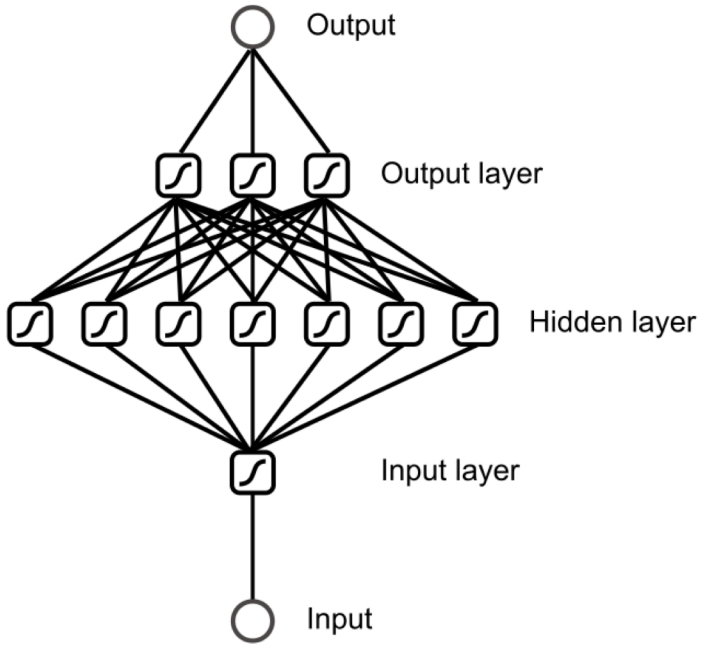
A NEURAL NETWORK







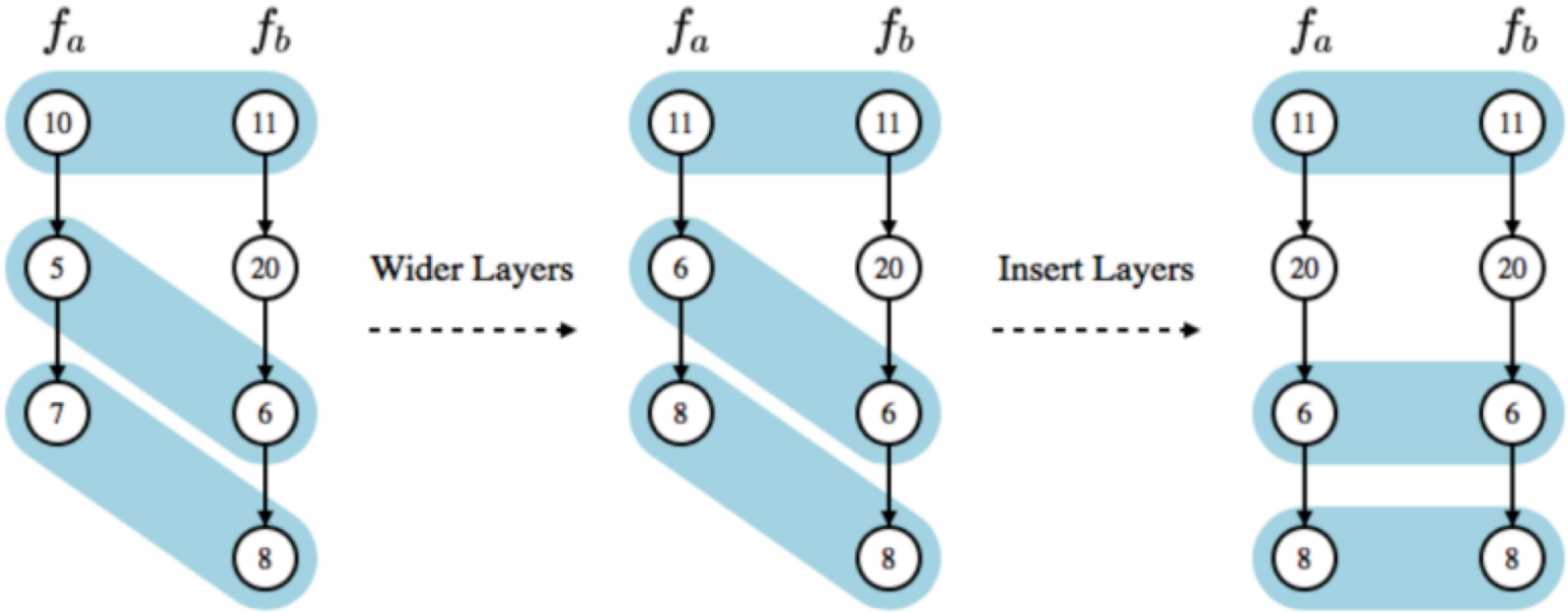
MLP



MLP

NEURAL NETWORK MODELS

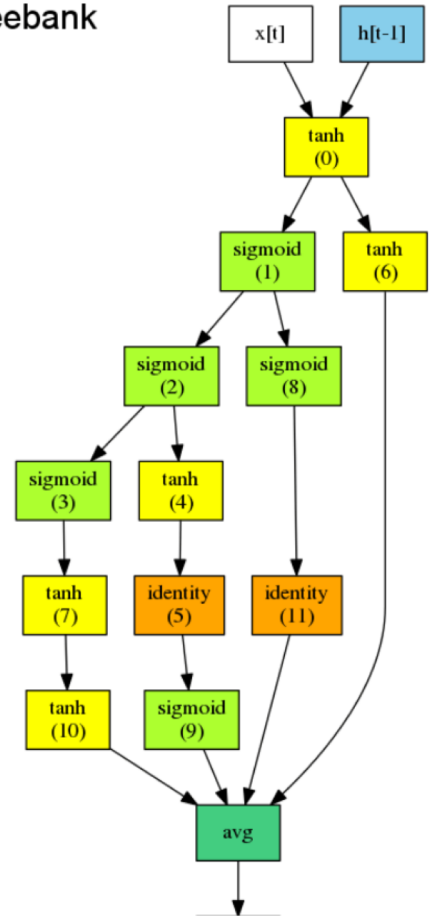
EVOLVING TECHNOLOGY COMPONENTS (NEURAL ARCHITECTURE SEARCH)



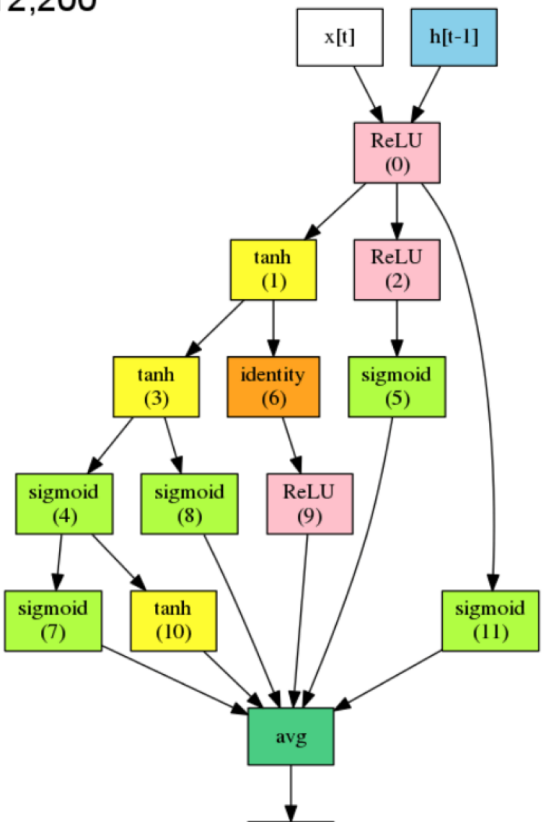
NEURAL NETWORK MODELS

EVOLVING TECHNOLOGY COMPONENTS (NEURAL ARCHITECTURE SEARCH)

Penn Treebank
step: 50

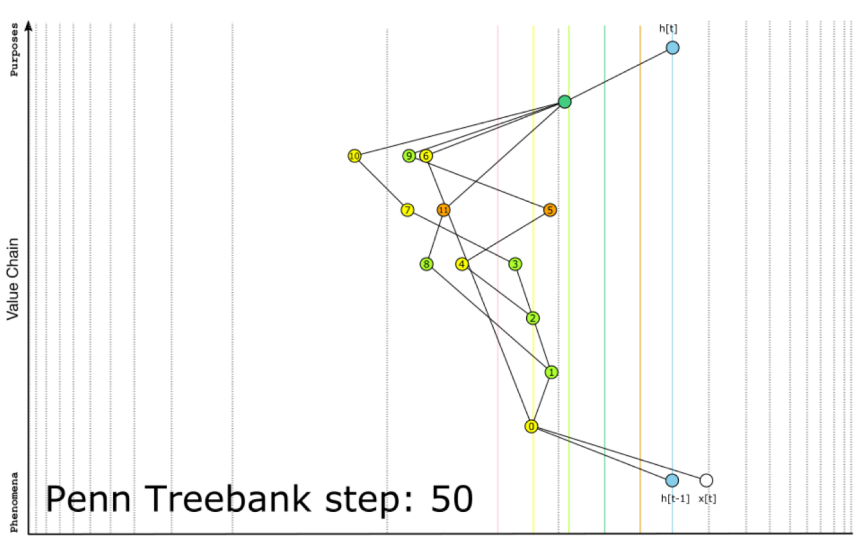


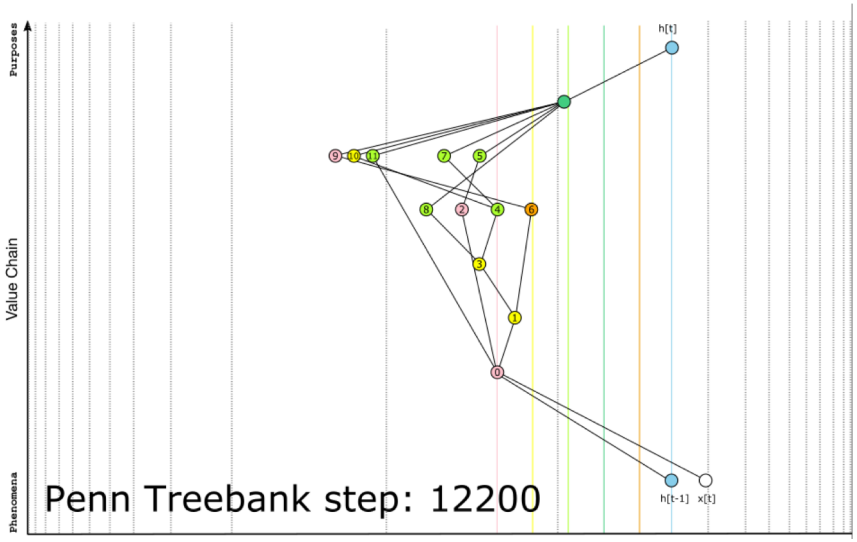
Penn Treebank
step: 12,200



NEURAL NETWORK MODELS

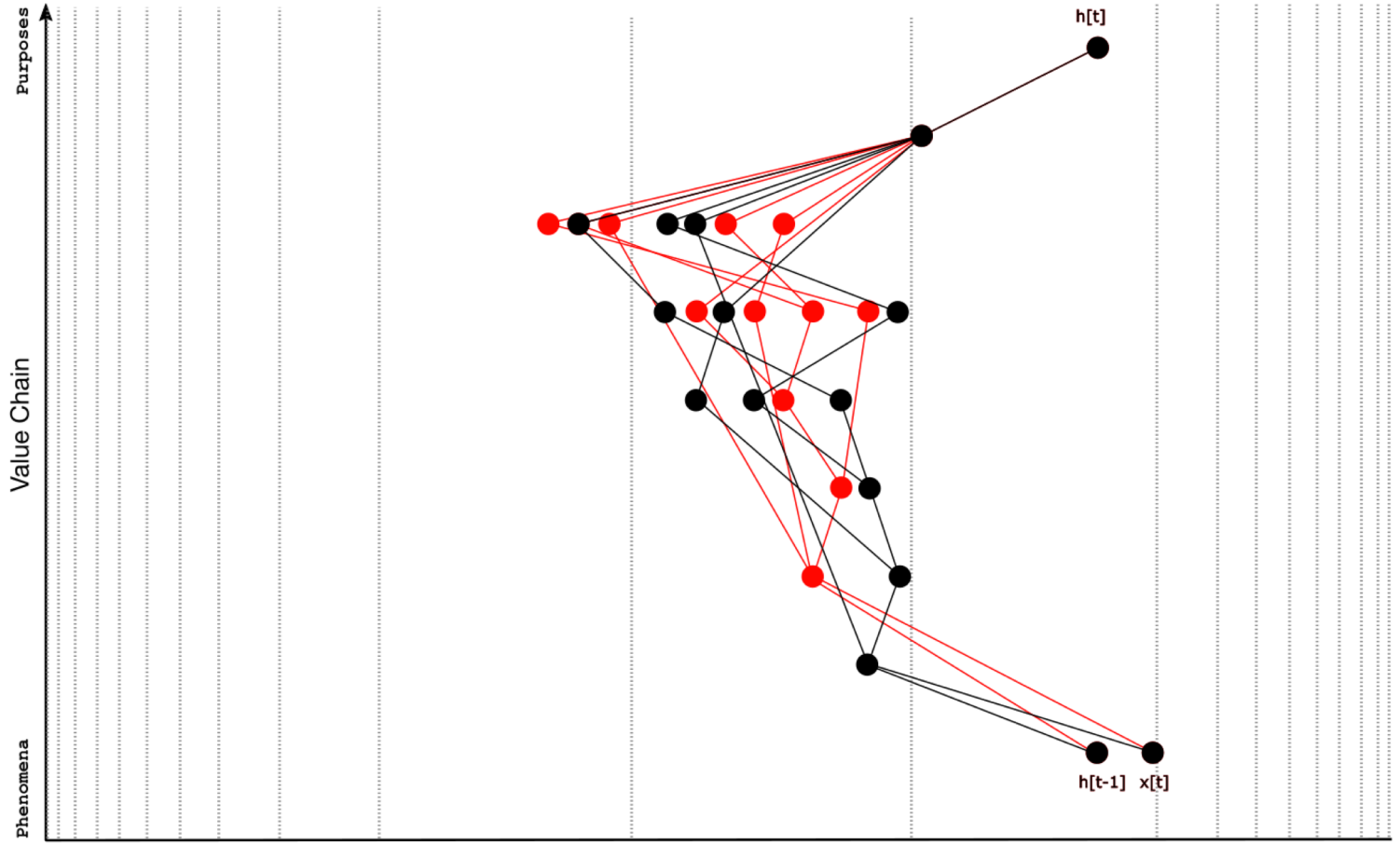
EVOLVING TECHNOLOGY COMPONENTS (NEURAL ARCHITECTURE SEARCH)





NEURAL NETWORK MODELS

EVOLVING TECHNOLOGY COMPONENTS (NEURAL ARCHITECTURE SEARCH)



CHARTING THE FUTURE

SYSTEMATIC LITERATURE REVIEWS

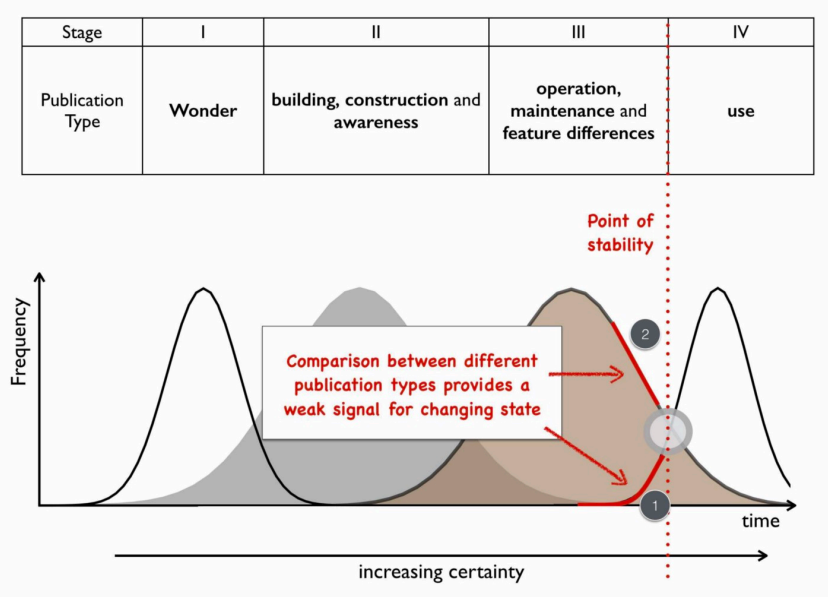
— Domain specific taxonomies
— Evolution of the main assembly

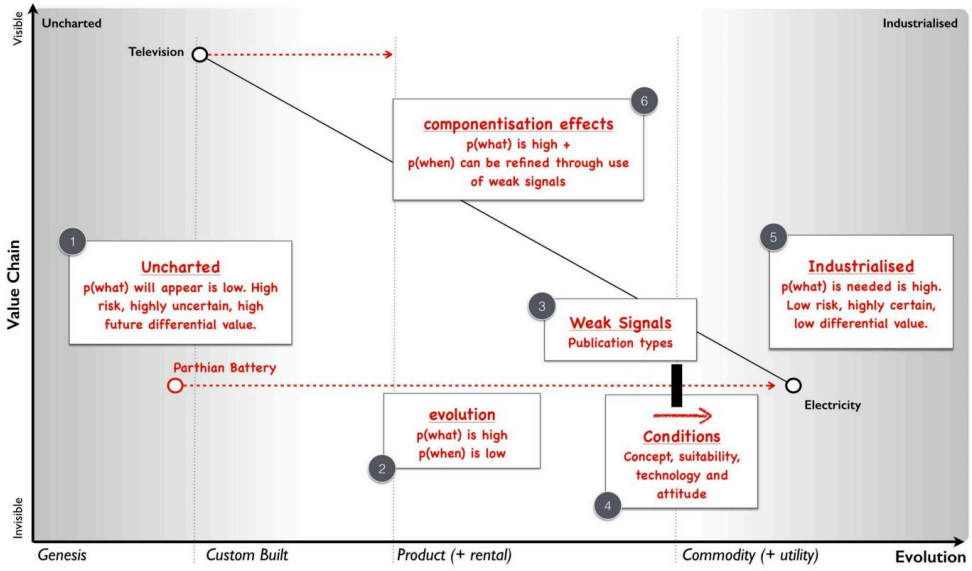
CHARTING THE FUTURE (CHAPTER 9)

A DOCUMENT AS A POINT ESTIMATE OF A VECTOR FIELD

— Simon's original slides

— Documents as a measurement process on beliefs of states of the world





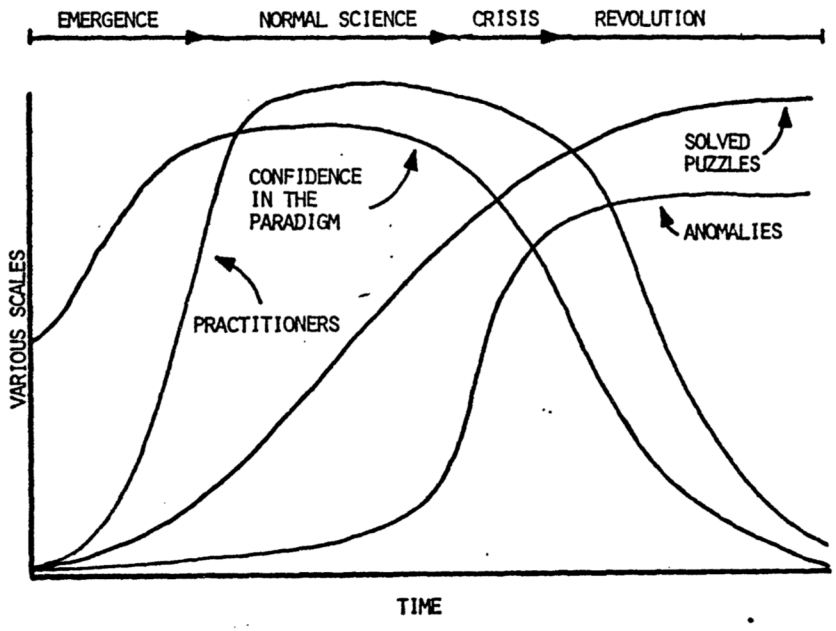
Wardley, S., Topographical intelligence in business, 2016

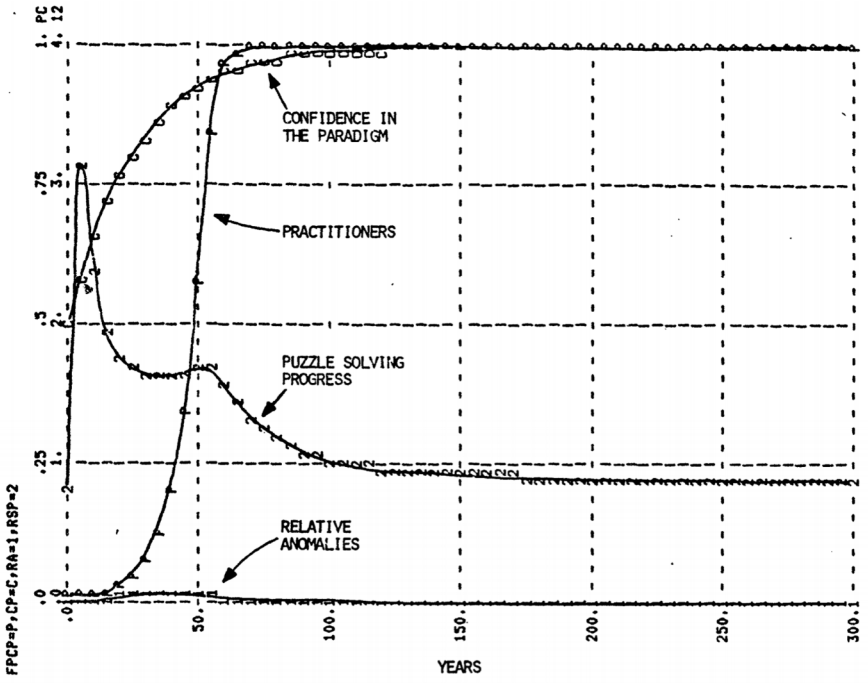
THE GROWTH OF KNOWLEDGE

WP 1326-82

THE GROWTH OF KNOWLEDGE
Testing a Theory of Scientific Revolutions
With a Formal Model

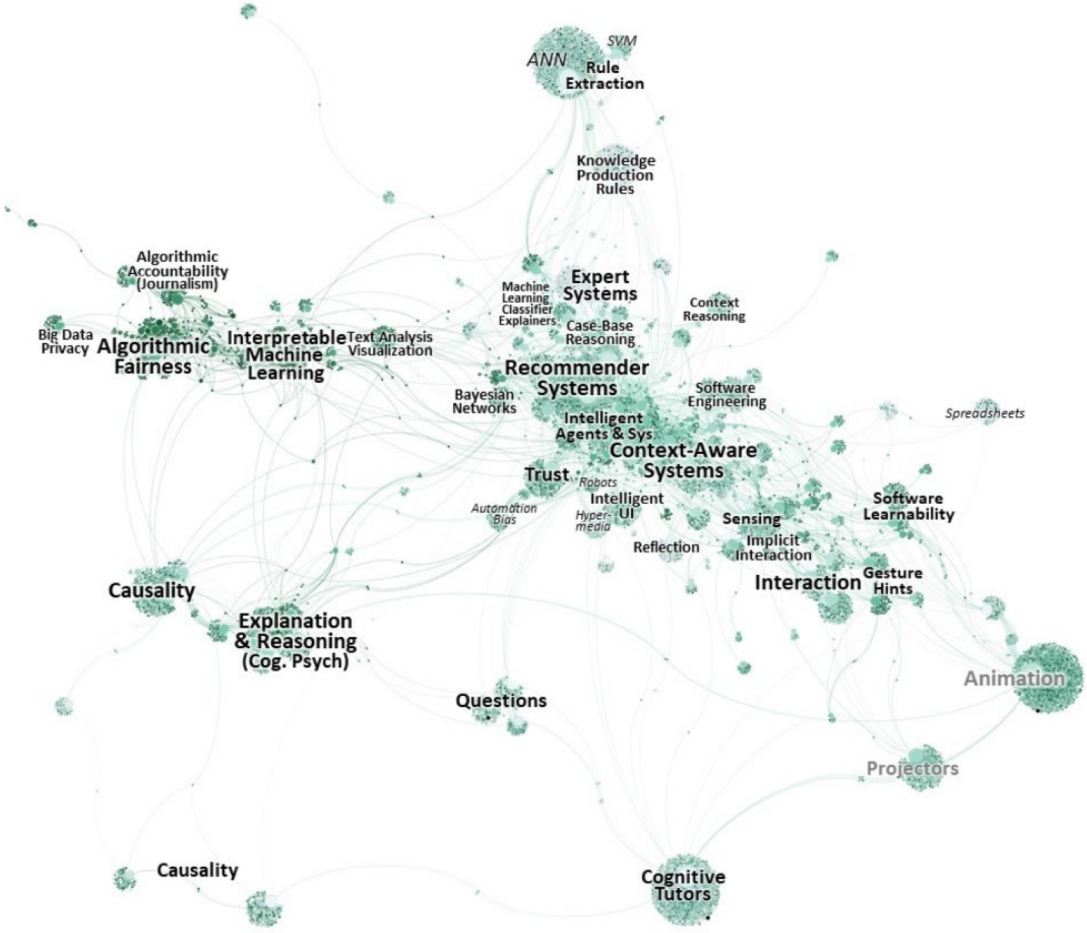
John D. Sterman
Assistant Professor





CITATION NETWORKS

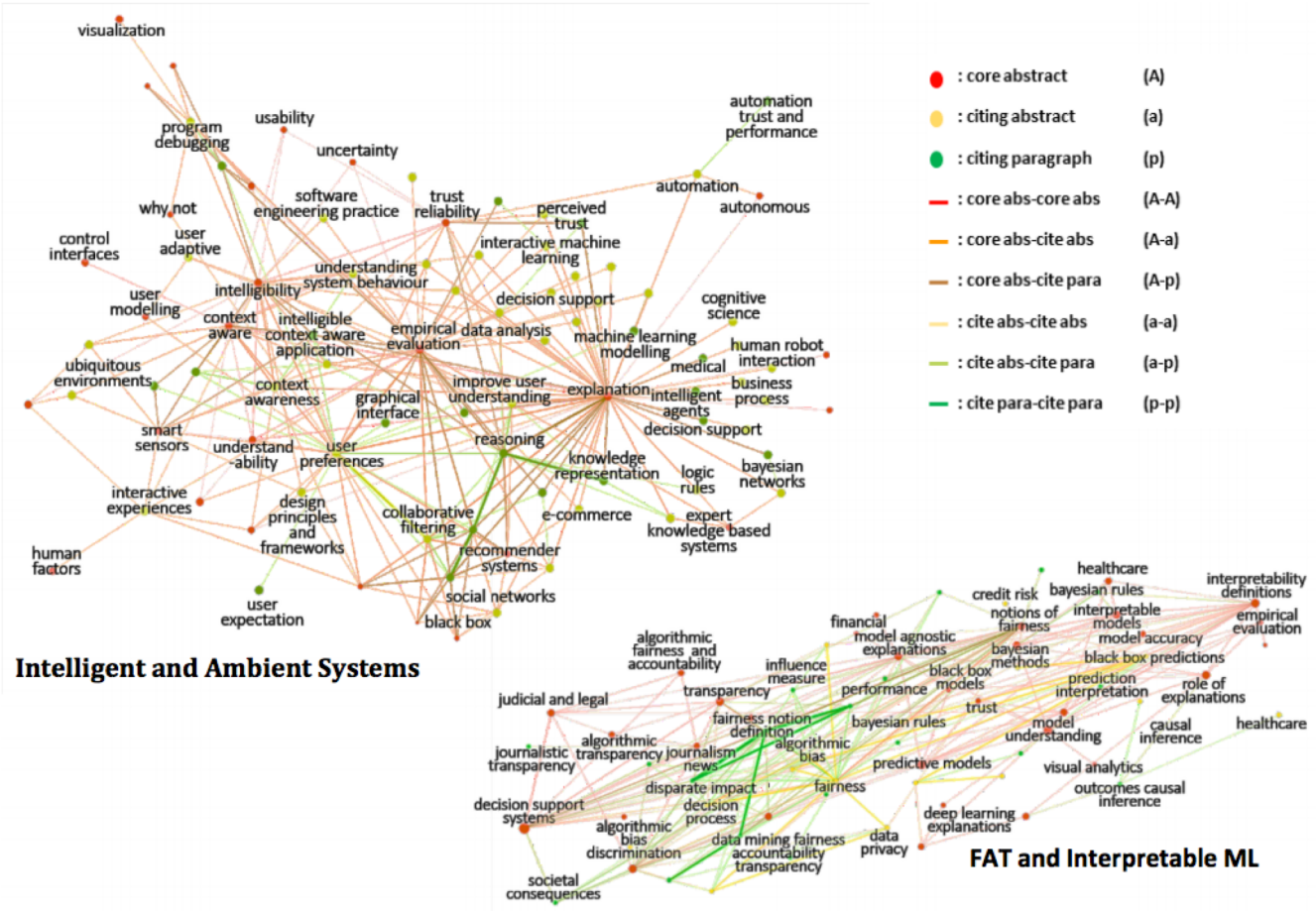
12,412 PAPERS CITING 289 CORE PAPERS ON EXPLANATIONS



Source: Trends and Trajectories for Explainable, Accountable and Intelligible Systems: An HCI Research Agenda 2019

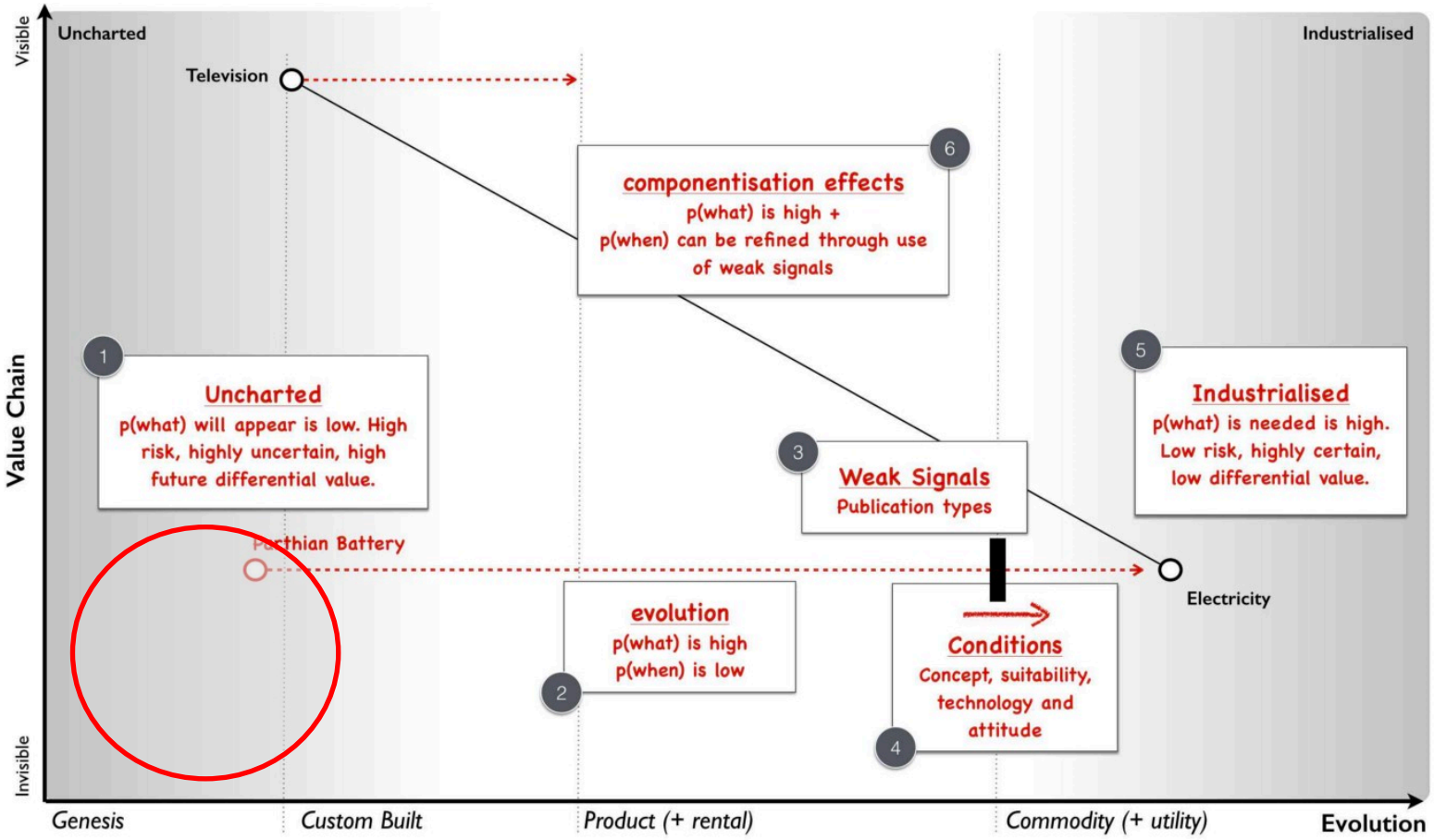
TOPIC NETWORKS

2 KEY SUBNETWORKS OF CORE AND CITING PAPERS



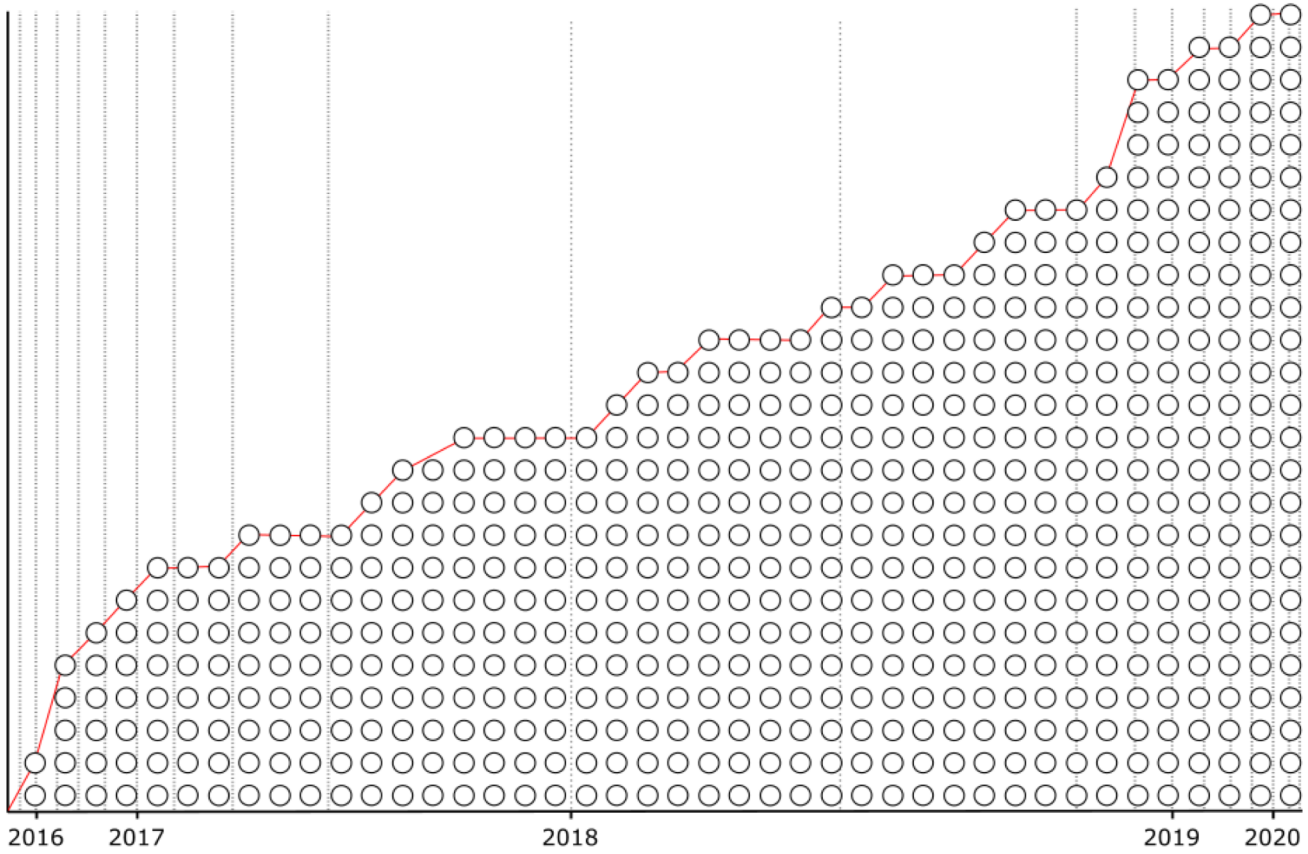
Source: Trends and Trajectories for Explainable, Accountable and Intelligible Systems: An HCI Research Agenda 2019

CHARTING THE FUTURE



STANDING CORPUS

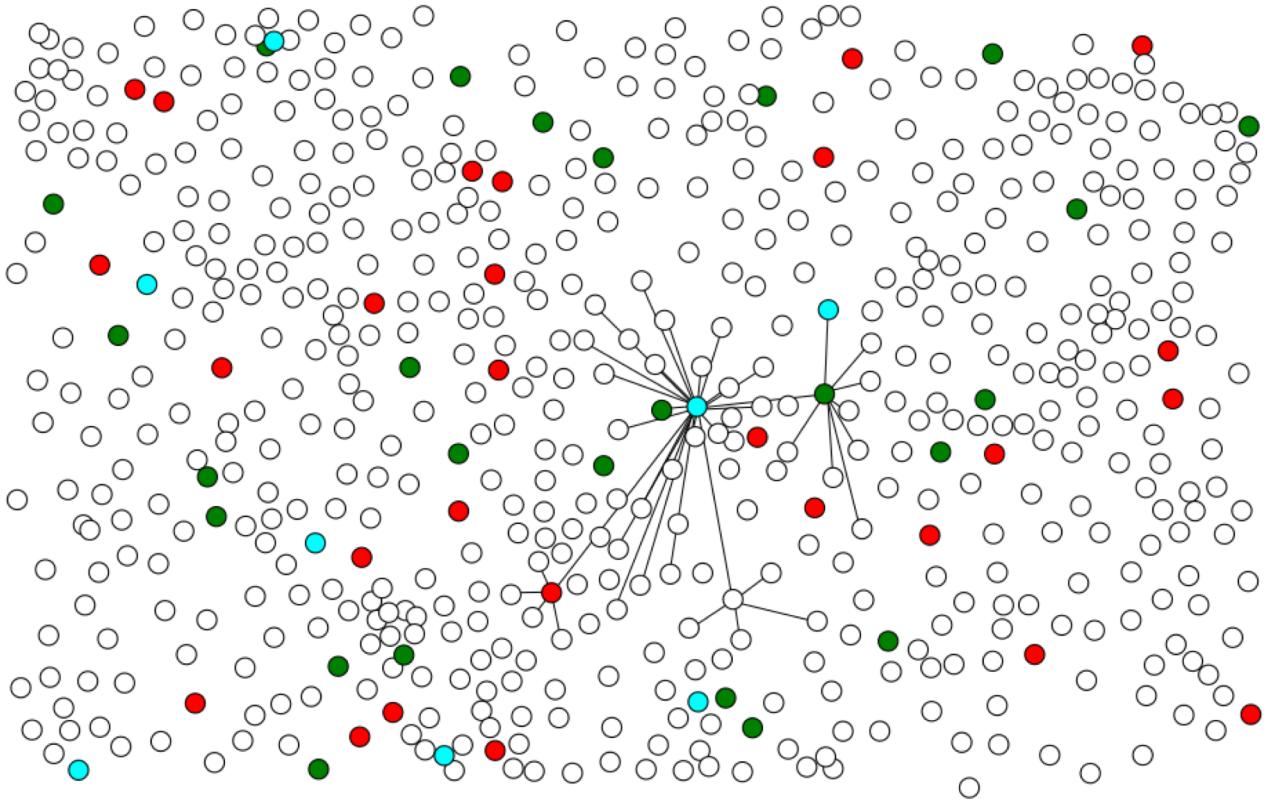
LOG, LINEAR, LOG



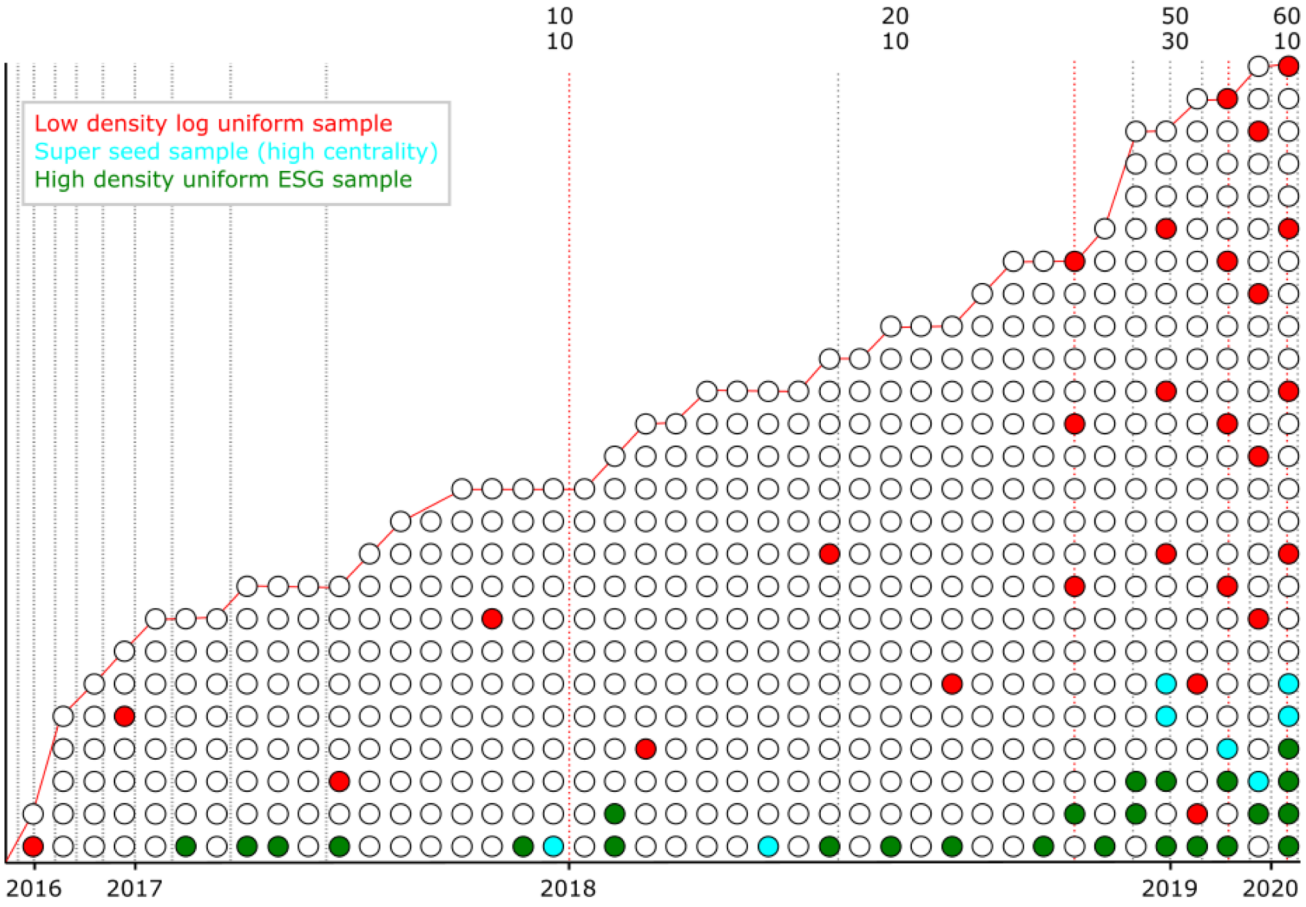
CITATION EMBEDDING

UMAP?

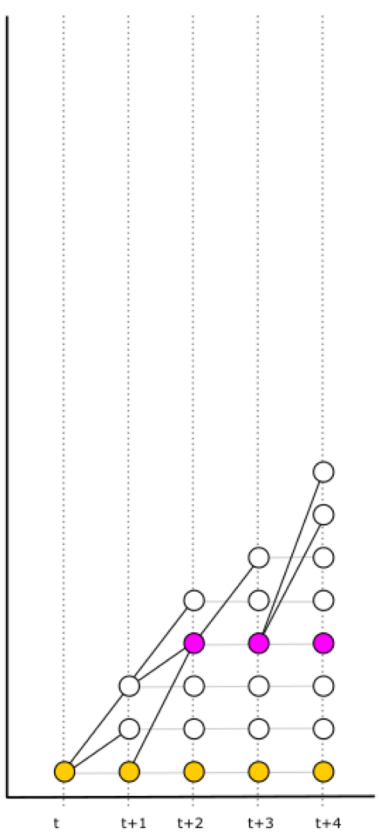
Sample type	Deg
Log	4.5
Seed	8.9
Uniform ESG	4.7

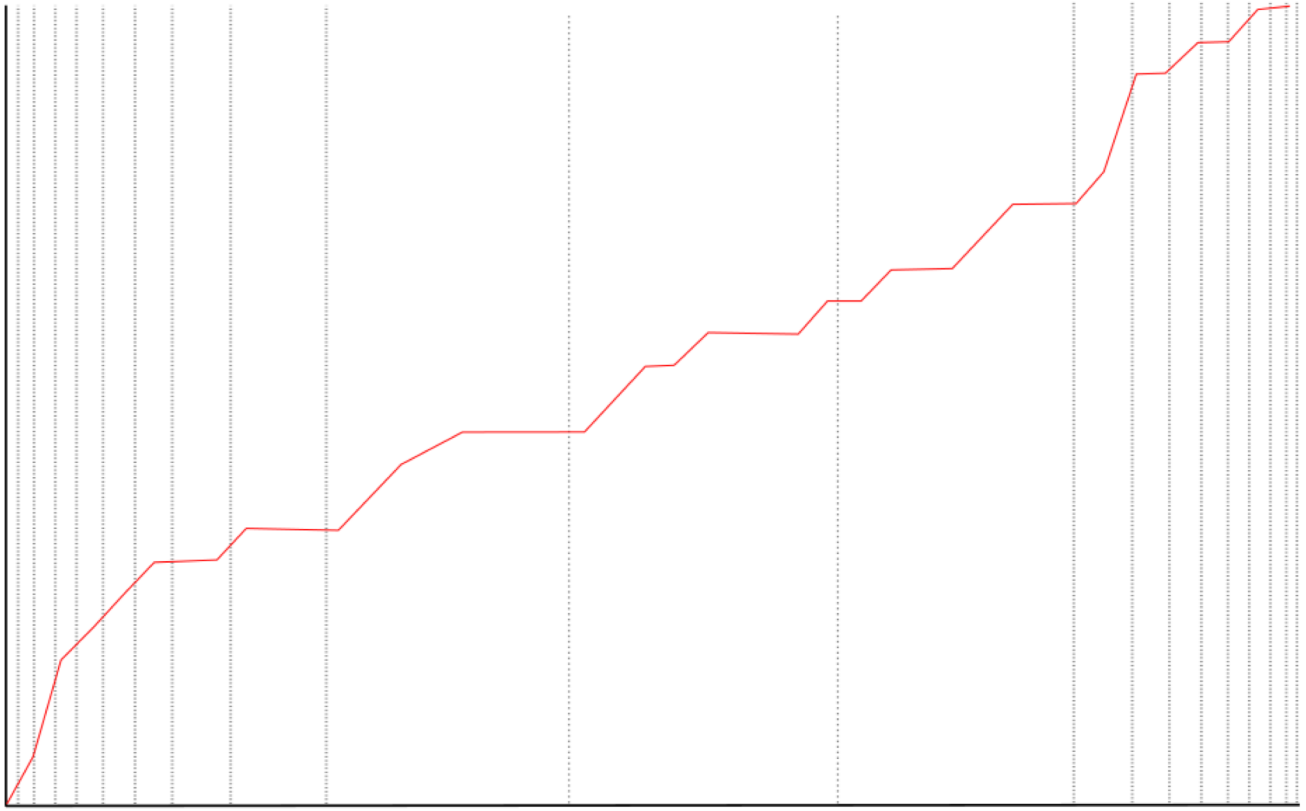


CORPUS SAMPLE METHODOLOGY
~#500 ~50 TRAIN ~10 TEST

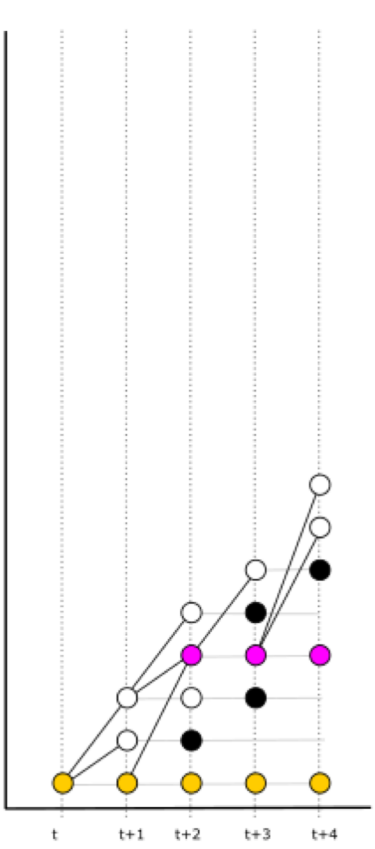


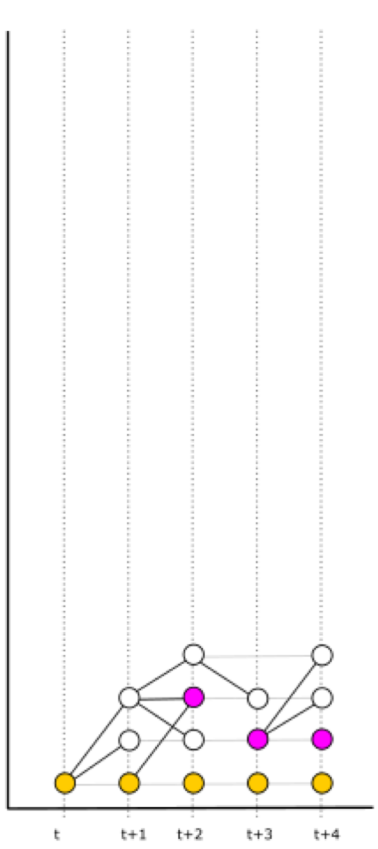
STANDING CORPUS CITATION PATHS

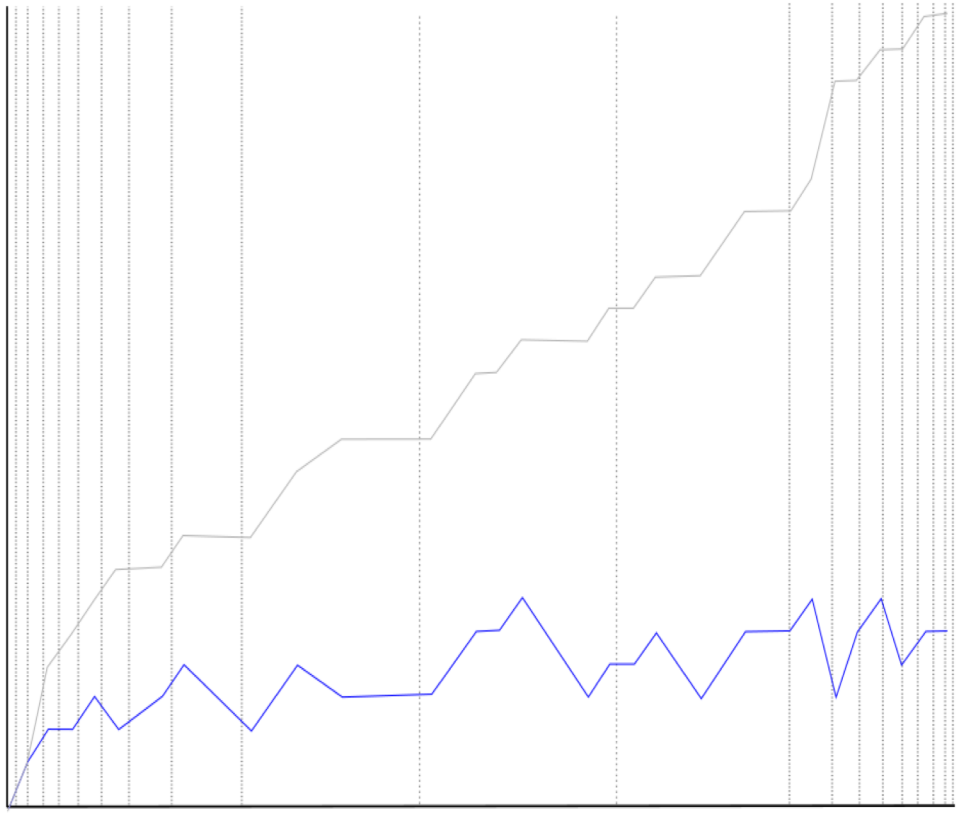




ACTIVE CORPUS
CITATION PATHS (PATH DECAY)



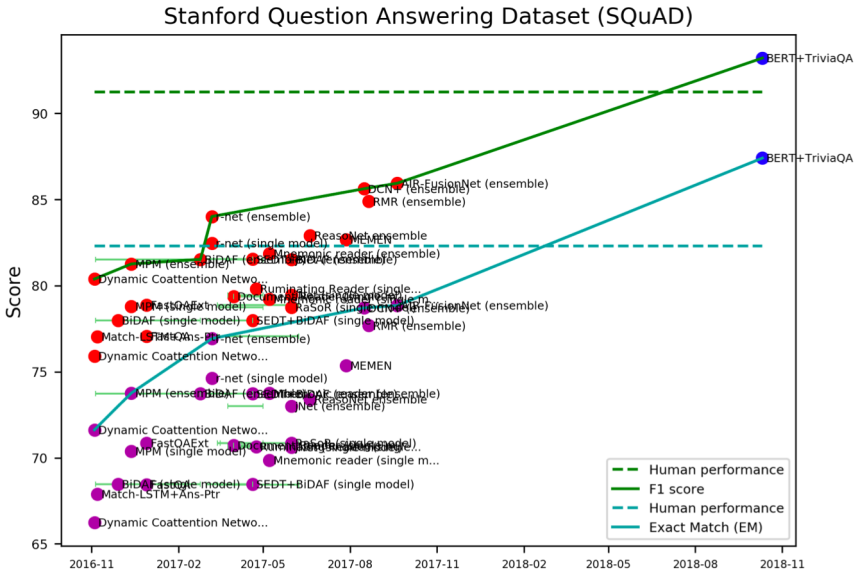


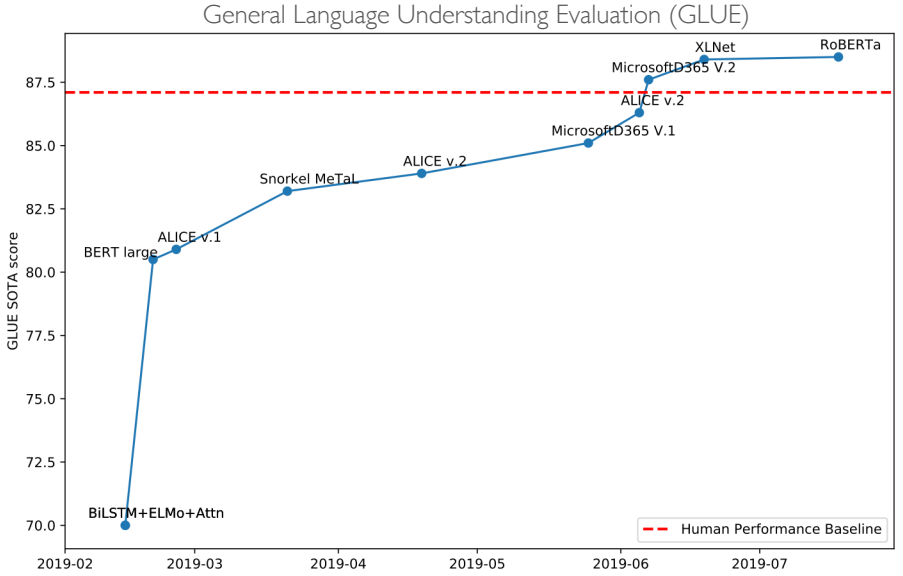


LANGUAGE MODELS

NLP PROGRESS

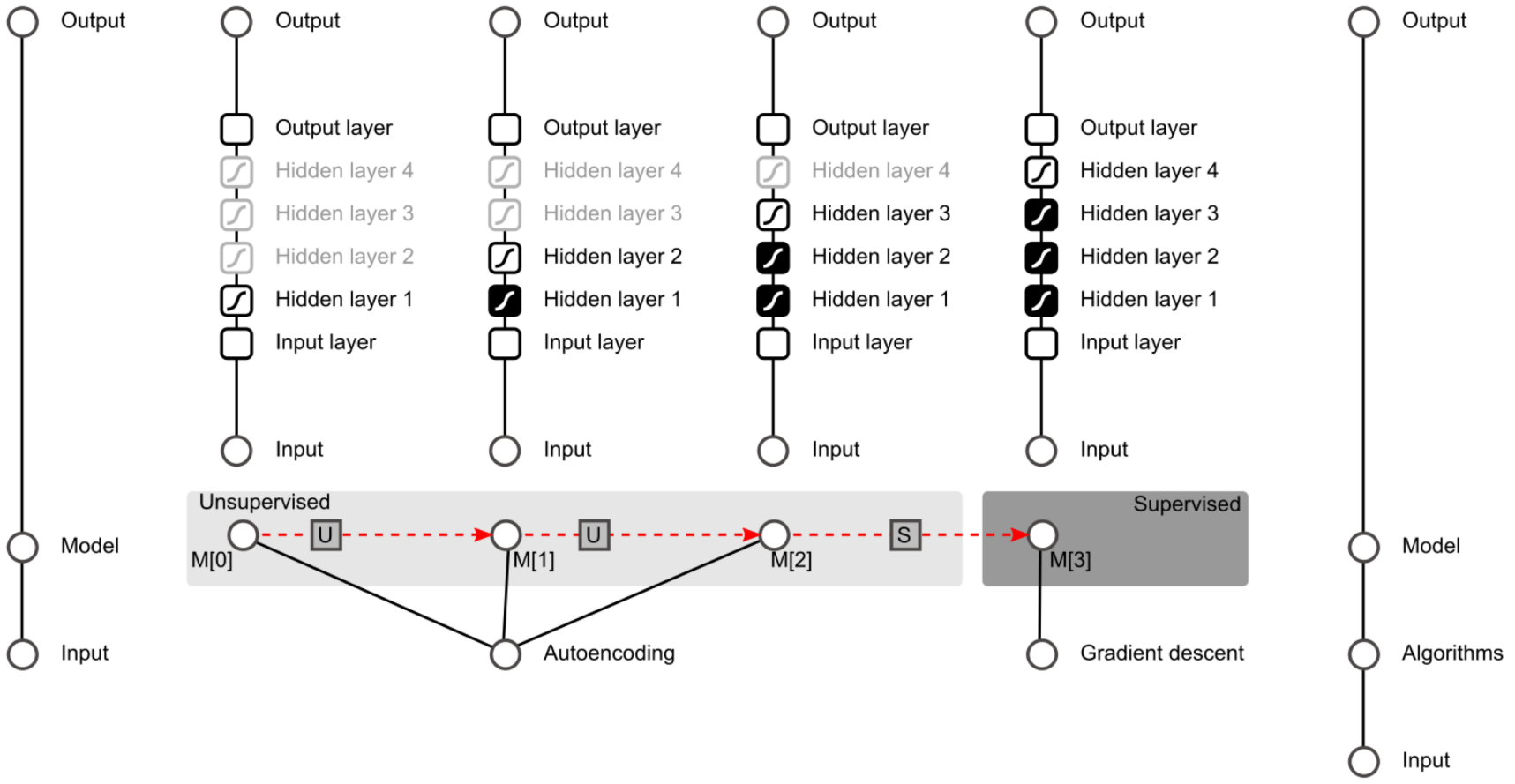
PERFORMANCE ON PUBLIC BENCHMARKS CAN RIVAL HUMAN PERFORMANCE



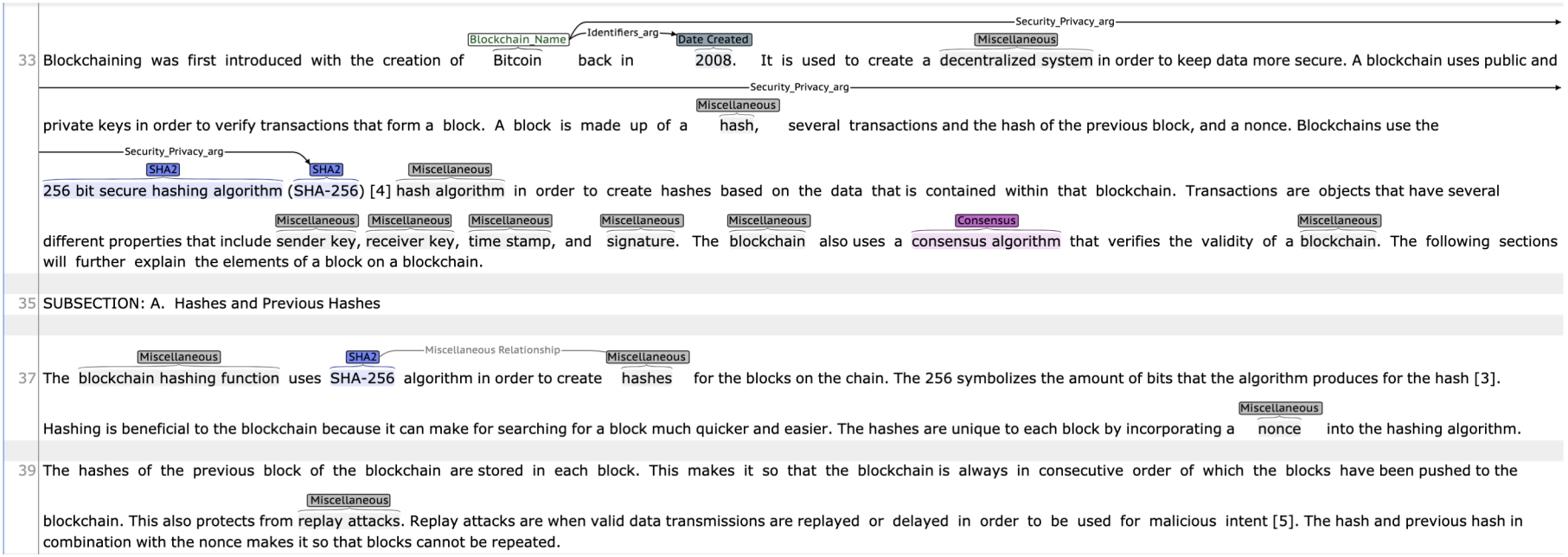


PRE-TRAINING MASSIVE MODELS

ITERATIVELY LEARN REPRESENTATION USING UNLABELED DATA

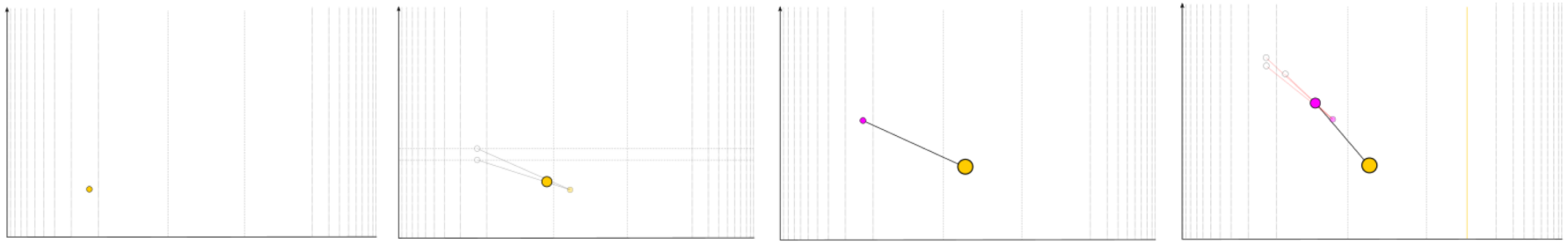


CORPUS ANALYSIS



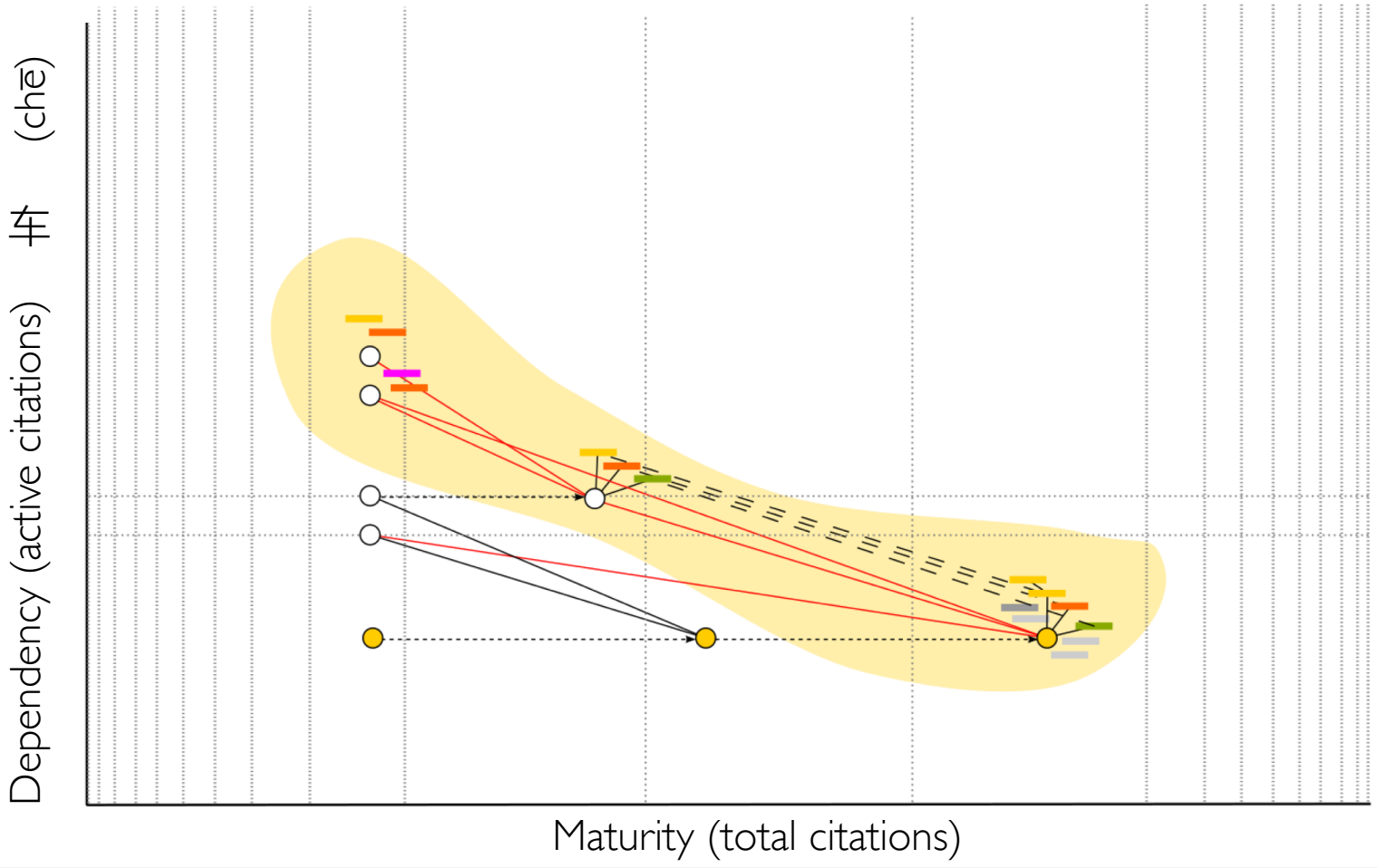
LEARNING TO MAP

LEARNING TAXONOMIES

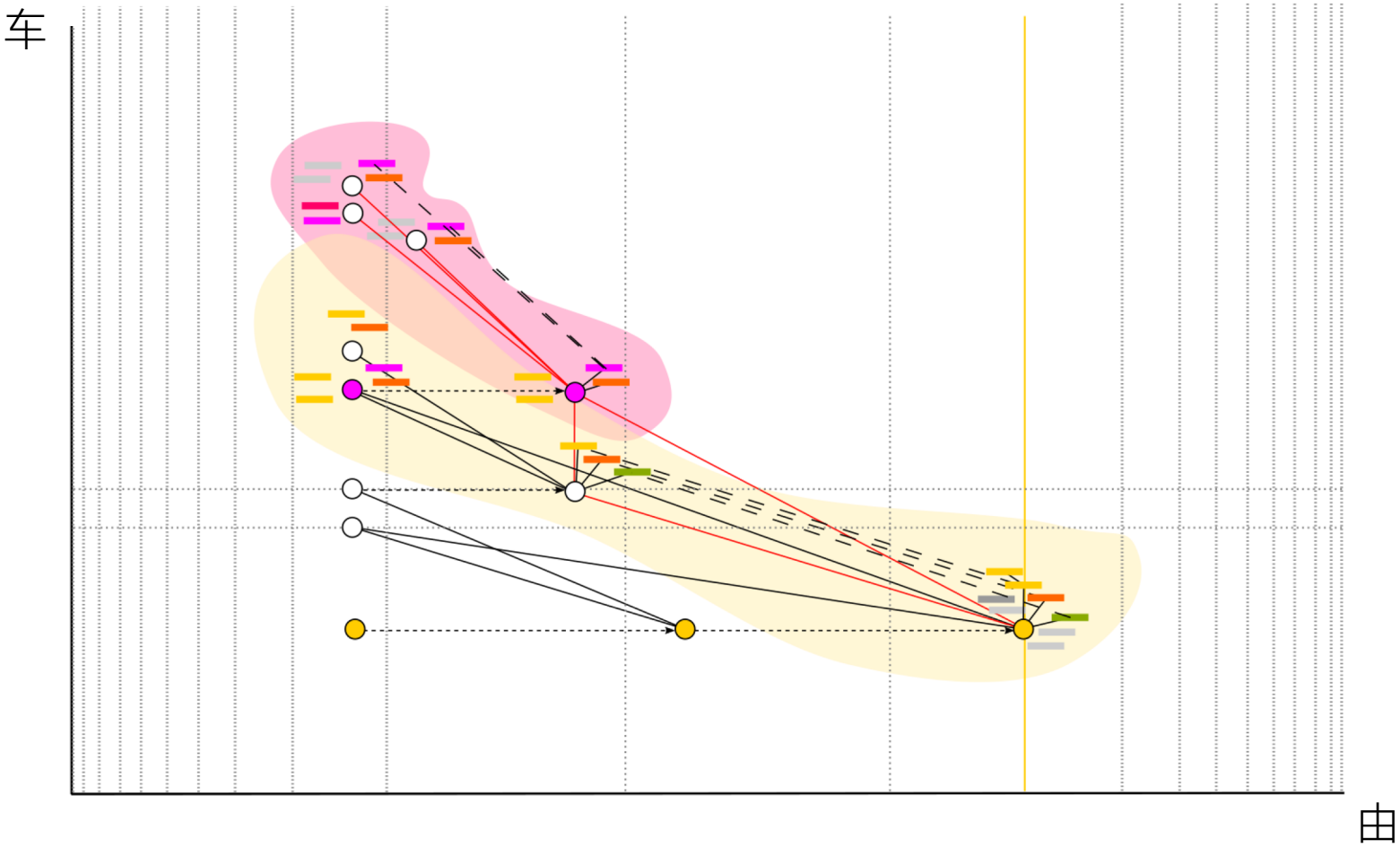


t t+n t+2n t+3n

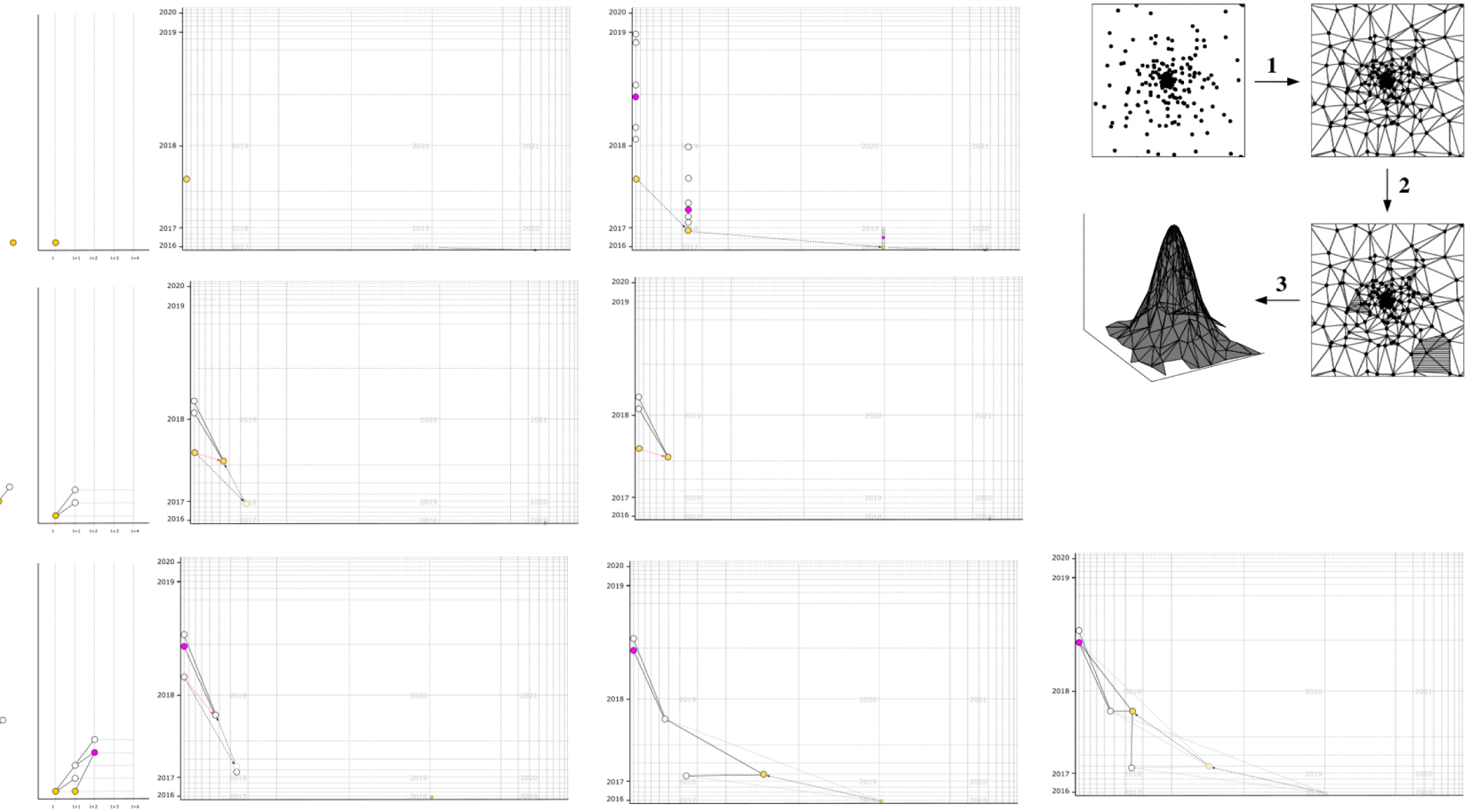
LABEL EVOLUTION ON CITATION GRAPH
轴 (ZHÓU)



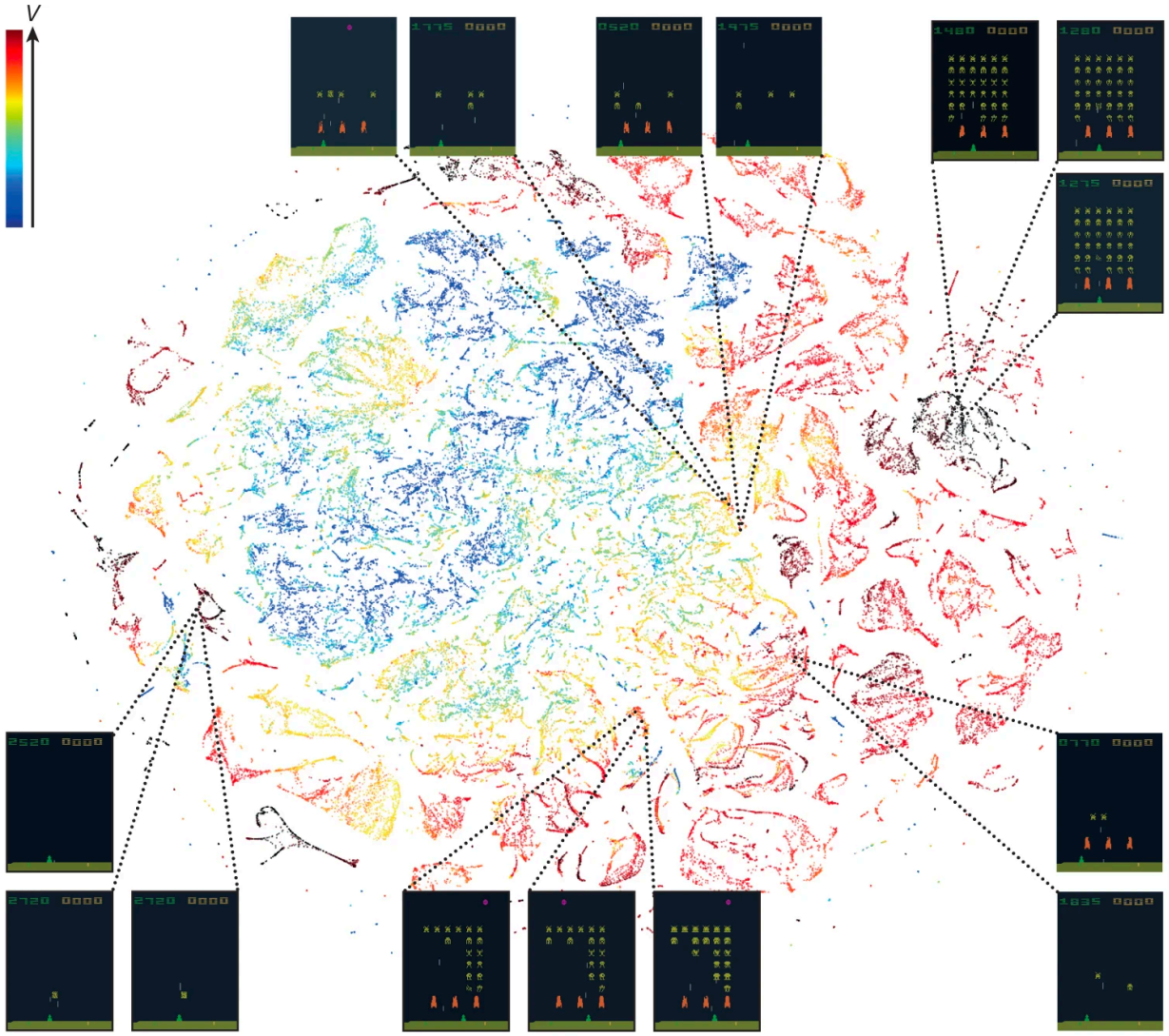
LABEL EVOLUTION ON CITATION GRAPH



COMPONENT WISE RE-NORMALIZATION
"TIME" IN MULTIPLE AXES



COMPUTATIONAL STRATEGY

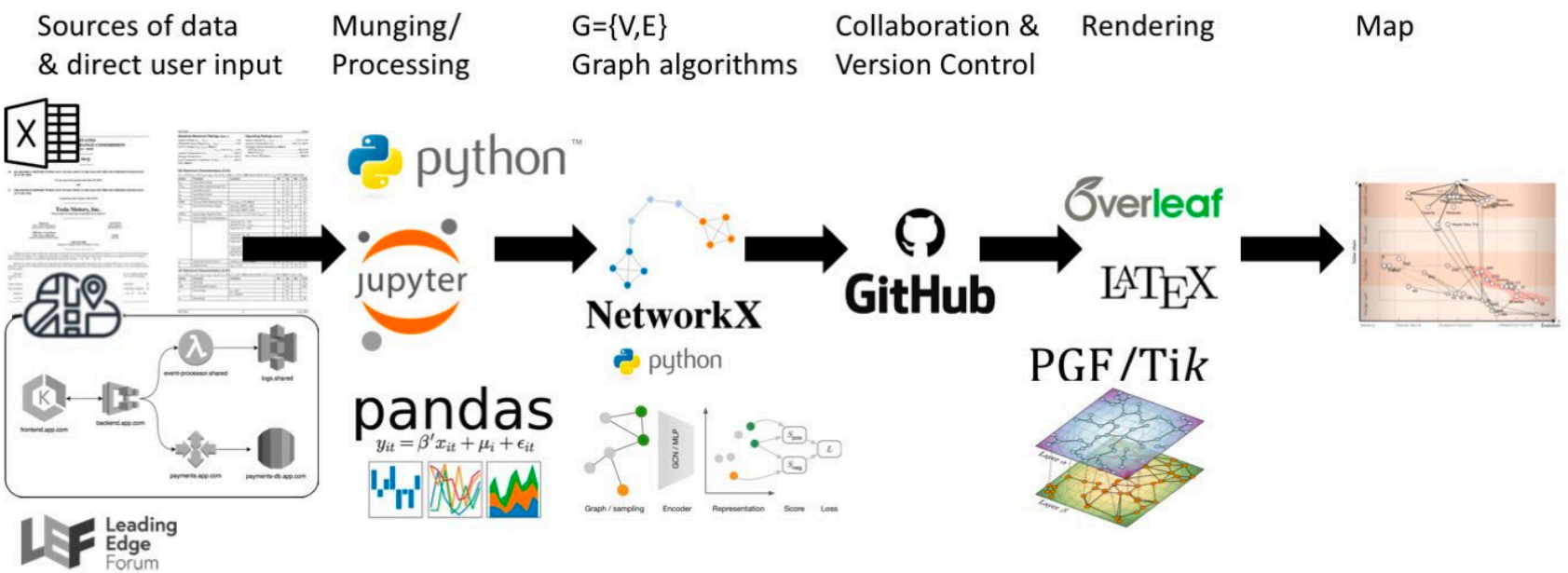


Source: https://www.nature.com/articles/nature14236

SUMMARY

- I really like AND use Wardley Maps
  - I getting better with practice, it took me several years
  - I can never UNSEE it!
- Machinery of maps is very versatile and well understood
  - Dependency graph
  - Projections and Embedded spaces (Learnable?)
- Maps are models
- A lot of work to be done!

MAPPING WORKFLOWS



LATEX (TEMPLATES)

latticecut / Wardley_Chapter2_Finding_a_path

<> Code | Issues | Pull requests | Actions | Projects | Wiki | Security | Insights | Settings

master | 1 branch | 0 tags | Go to file | Add file | Code

latticecut Updates from Overleaf 0c9e272 on 10 Jun 2019 30 commits

images	Updated README.md	14 months ago
layers	Changed corrupted V and E files	14 months ago
map	Changed corrupted V and E files	14 months ago
pdf	Updates from Overleaf	14 months ago
plates	Initial Overleaf Import	14 months ago
strata	Changed corrupted V and E files	14 months ago
LICENSE.md	Create LICENSE.md	14 months ago
README.md	Updates from Overleaf	14 months ago
Wardley_Chapter2_Finding_a_path....	Updated README.md	14 months ago
main.tex	Finished Fig 11 annotations	14 months ago
preamble.tex	Changed corrupted V and E files	14 months ago
tikz-network.sty	Initial Overleaf Import	14 months ago

README.md

Wardley Map for Chapter 2 "Finding a path"

> "it has always been standardisation of components that has enabled creations of greater complexity" - Simon Wardley

This is a Wardley Map for Chapter 2 of Simon Wardley's online book on topographical intelligence for business strategy [Wardley2016][1]. Full details can be found here (reading time ~24 mins): https://bit.ly/2zJ1tpY

The first map

Wardley Mapping has proved a useful tool for that can serve as a basis for framing the analysis of technology maturity and helping develop business strategy.

This is an example of visualizing Wardley Maps and Value Chain dependency networks in LaTeX. It aims to provide a simple and easy method to create, visualize and modify Wardley Maps that is consistent with best practise in collaboration, document management and version control. My main motivation is to create a mapping workflow that can work well across teams and document versions etc. In this reagard working with GitHub and the Overleaf hosted LaTeX editor has proved successful.

The example is based on the PGF/TikZ languages for producing vector graphics from a geometric/algebraic description. PGF is a lower-level language, while TikZ is a set of higher-level macros that use PGF and an interpreter written in TeX by Till Tantau.

You can find an introductory video to get started using TikZ here: Basic Drawing Using TikZ

Figure 8

Figure 8 is what a map of a single line of business should look like. Simon created the first map in 2005 and it was for an online photo service.

This has been split out into a single stratum, the Application Layer with two `.tex` files for nodes (V) and edges (E) respectively.

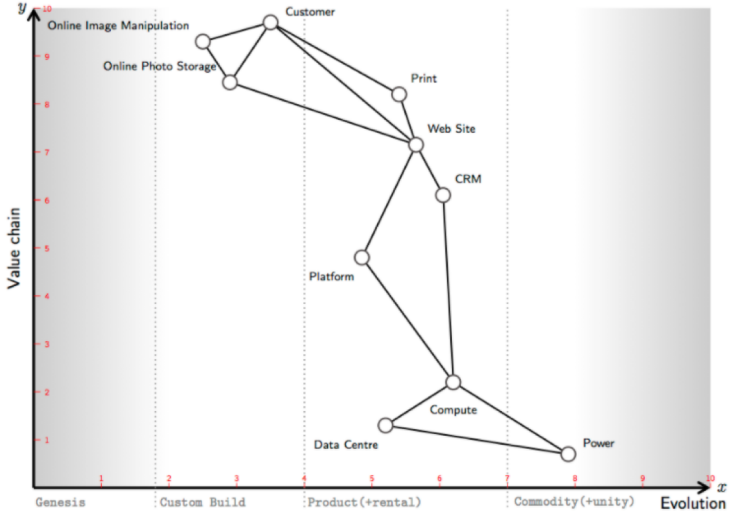
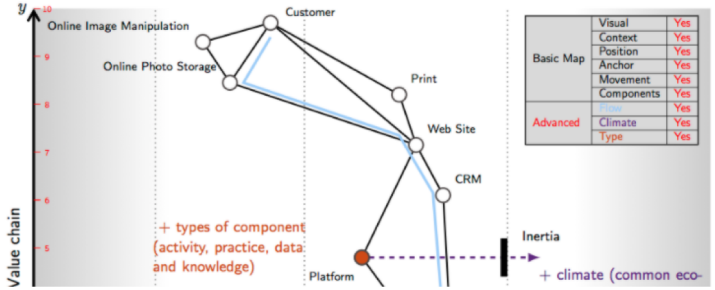
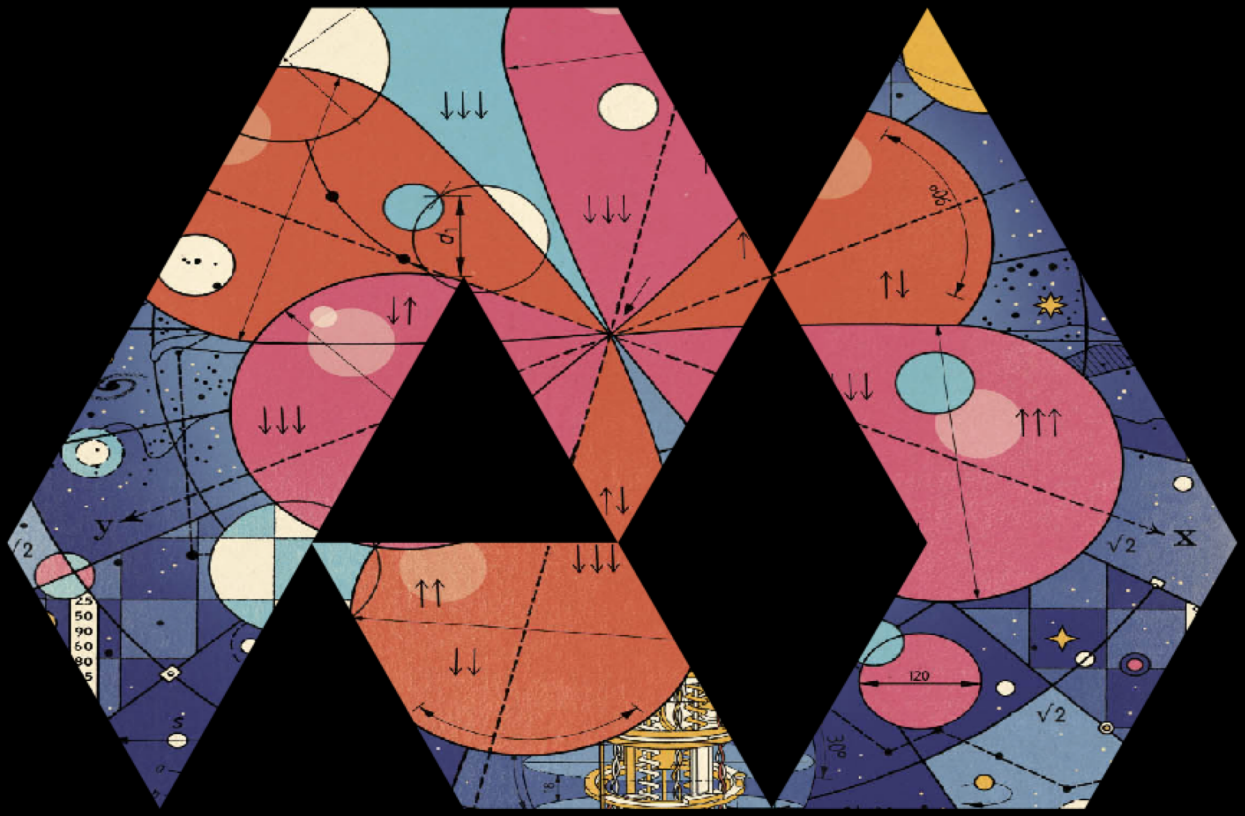


Figure 11

Here we add example annotations using the `Fig11_Annotation.tex` file over the top of the Map from Figure 8. Comment out as desired.

In practice a lot of the code in this file is just about styling, for example the formatting of the Key, and can be ignored during the normal mapping process. However, I have tried remain faithful to Simon's original style/rendering.

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