

Primary Materials from the 2016 CogNovo CoLLaboratoire Workshop on Network Consciousness

Date of Workshop

15–20 August 2016

Location

Plymouth University, CogNovo Doctoral Programme / Cognition Institute, Plymouth, UK

Organizers / Workshop Leaders (CogNovo doctoral candidates)

- Diego Maranan
- Jack McKay Fletcher
- Mihaela Taranu
- Michael Straeubig

Participants

Invited participants:

- Doris Rogobete
- Pieter Steyaert
- Roberto B. Figueroa Jr.
- Ali Northcott

Central Question

The workshop asked whether highly-connected networks—such as the Internet—could be said to be conscious, or could become conscious. It approached this question through the lenses of embodied, situated, enactive, extended, and distributed

cognition. The intent of the workshop was to explore the suggestion that highly connected networks such as the Internet could be considered conscious and whether such a network might be more likely to be conscious if it had a body. It frames these questions through theories of extended, situated, enactive, and embodied cognition. The background sets out two contrasting positions. Some theories suggest that consciousness might emerge from sufficiently complex or highly networked systems. The proposal, however, notes that connectedness alone may be insufficient: a conscious agent may need to be situated within an environment, while embodied approaches to cognition emphasize the importance of a physical body. In particular, the proposal highlights the sensorimotor dimensions of embodiment and suggests that the nervous system may have evolved in relation to the need to navigate and interact safely with the physical world.

The proposal organizes its questions into three broad areas: the body, the group mind, and the environment. Under the question of the body, it considers whether the Internet of Things, together with sensors, actuators, and human users, could constitute something analogous to the Internet's hands, arms, legs, feet, ears, eyes, skin, noses, and tongues. It also raises the possibility of modeling such distributed organization on systems such as slime mold. Under the question of the group mind, it asks whether increasingly sophisticated social networks might themselves constitute conscious group minds, or alternatively function as extensions of human minds. Under the question of the environment, it asks what environment such an intelligence would inhabit and how it might interact with physical space.

The proposal identifies the intended output as a research proposal built around focused research questions, a cross-disciplinary literature review, and innovative methodologies. Suggested methods include digital ethnography, big-data analytics, network analysis, visual analytics, data mining, social-media sentiment analysis, sculpture, computational modeling, and performance. Possible proofs of concept include visualizations, maps, diagrams, performances, and interactive installations. The document includes references to a broad set of readings comprising popular articles, books, scholarly articles, and online resources.

Key Themes

- The Internet as an entity, an environment, and a collection of agents
- Embodied and sensory dimensions of machine consciousness
- The Internet of Things (IoT) as a nascent sensorimotor system
- Distributed human-machine cognition

- Network properties of the brain (neural networks, cell assemblies, semantic networks, functional/structural networks)
- Centrality measures (PageRank, Katz centrality) and small-world networks
- Consciousness markers and candidate empirical tests
- The “hard problem” and the “harder problem” of consciousness
- Artificial life, worms, and tremes as models for emerging digital organisms
- Systems-theoretic perspectives on consciousness

Outputs

- A preliminary distributed, situated, enactive, embodied model of human-machine cognition
- A set of focused research questions
- A cross-disciplinary bibliography
- Candidate experimental approaches, consciousness markers, and proofs of concept
- Individual summaries and reflections from workshop participants
- Press documentation of the summer school
- Photographic documentation of working sketches and notes

Provenance

These materials were produced during the week-long ColLaboratoire workshop in August 2016. Some materials were originally published on a public workshop website, now offline; others survive as original workshop files, presentations, photographic records, and later institutional press documentation. The present bundle is an archival reconstruction compiled from the original files, notes, and presentations. The original intellectual work dates to 2016; this compilation and its metadata are dated 2026.

Summary of Bundle Contents

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1	Are Networks (Becoming) Conscious? – Summer School Proposal	Proposal	8	Original workshop plan
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6	Group and Individual Reflections	Report	15	Individual summaries and group model
7	An Embodied Perspective: Linking Embodied Cognition with Distributed Cognition	Report / Web page archive	3	Embodied cognition argument
8	Distributed Human-Machine Cognition Model	Report / Web page archive	6	Core model and figures
9	SemantiCreeper	Image / Web page archive	1	Speculative prototype
10	References/Bibliography	Bibliography	4	2016 citation list
11	Press Info on CoLLaboratoire Summer School 2016	Press/info	9	2017 institutional document about the 2016 programme

Archive DOI

10.5281/zenodo.23099982

Are Networks (Becoming) Conscious? – Summer School Proposal

Original Filename

2016.07.15 - CLSummerSchoolWorkshopProposal.pdf

Date

Initial proposal: 6 April 2016

Additional material: 15 July 2016

Authors

Diego Maranan, Jack Fletcher, Michael Straeubig, Mihaela Taranu

Description

This document is the original 2016 proposal for the CoLaboratoire summer-school workshop "Are Networks (Becoming) Conscious?", subtitled "Situated, enactive, embodied, group and extended cognition perspectives on networks." The initial draft of the proposal is dated 6 April 2016; additional material is dated 15 July 2016. This was the proposal submitted to the CoLaboratoire 2016 steering/organizing committee.

Are Networks (Becoming) Conscious?

Situated, enactive, embodied, group and extended cognition
perspectives on networks

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[Are you willing to tutor the students during the summer school:](#)

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[Is there any teaching involved in this project?](#)

Project summary

Abstract

Could highly-connected networks (such as the Internet) said to be conscious? Is such a network more likely to be consciousness if it has a body? Does the Internet have a 'body'? This project will take into account extended, situated, enactive, and embodied theories of cognition, investigating the possibility of modelling networked-based consciousness. The goal of this project would be to compose a compelling and potentially fundable research proposal that includes research questions, a literature review, a discussion on possible methodologies, and proofs of concepts or initial results.

Background

Some theories of cognition suggest that consciousness emerges out of any highly networked system—such as the Internet—might constitute some kind of (emerging) consciousness (Koch, 2014; Stibel, 2014). Critics counter that connectedness is not sufficient for consciousness. For instance, a conscious agent must be situated within and in relationship to some kind of environment. Furthermore, according to *situated*, *enactive*, and *embodied* accounts of cognition (Clark & Chalmers, 1998a; Wilson, 2002), intelligence is not possible without a physical body. The mind, after all, is not (just) situated in the brain, and the sensorimotor dimensions of the body are essential components of consciousness. It has been suggested, for instance, that the reason why we have a nervous system in the first

place was to make navigation and interaction with the physical world safer for the organism (move away from danger, move towards things that reinforce survival).

Questions

The networked consciousness hypothesis might be more plausible if we expand what we mean by “environment” (cf. the *extended mind* hypothesis by Clark & Chalmers, 1998b) and if we try to imagine what might constitute the “body” of the network:

- **The body:** Consider a network that is connected to agents that do sense and act on the world, such as the Internet. If we consider the Internet to be not just a highly connected network of digital hardware, but also of humans, sensors, and actuators that interface with them (cf. the ‘Internet of Things’), could the Internet be understood to have a kind of sensorimotor system capable of sensing and acting on the physical world? In other words, what happens if we consider human users and other sensors and actuators as the Internet’s hands, arms, legs, and feet, as well as its ears, eyes, skin, noses, tongues? Can the Internet be modelled, for instance, like slime mold (Jabr 2012): simple in structure but exhibiting intelligent behavior?
- **The group mind:** Consider the growing number of channels of communication between individuals are creating increasingly sophisticated social networks. Could such social networks be seen as conscious ‘group minds’? Are these channels of communication as an extension of our minds, rather than a mind itself? Or is there an emergent and separate consciousness that arises?
- **The environment:** If we think of some network as a kind of intelligence, what is its environment? Are the other inhabitants of the environment, and if so, who are they? Is the environment located in a physical space, or is it another kind of space altogether? If it's another kind of space, the question remains: how does this intelligence interact with physical space?

Output

The goal of this project would be to compose a compelling and fundable research proposal made up of the following:

- A set (or several sets) of focused **research questions** and goals.
- The start of an inspired cross-disciplinary **review of literature** (e.g., from computer science, the arts, neuroscience, psychology, and the humanities)
- Ideas for innovative **methodology** for representing, collecting, analysing, and communicating data and results. For instance, how can we prove, argue for, or provide evidence that can support one set of views over another? Are there any experiments that would need to be done? What disciplines and tools are needed? Possible methods and approaches include digital ethnography, big data analytics, network analysis, visual analytics and visualisation, data mining, social media sentiment analysis, sculpture, computational modelling, performance
- **Proofs-of-concept:** visualizations, maps, diagrams, performances, interactive installations, initial findings, etc.

References

Clark, A., & Chalmers, D. (1998a). Embodied, situated, and distributed cognition. *A Companion to Cognitive Science*, 506–517.

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Koch, C. (2014). *In which I argue that consciousness is a fundamental property of complex things...: A BIT of Consciousness*. MIT Press.

Stibel, J. M. (2014). *Breakpoint: why the web will implode, search will be obsolete, and everything else you need to know about technology is in your brain*.

Wilson, M. (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review*, 9(4), 625–636.

Who had the idea (preferably more than one person):

Diego Maranan, Jack Fletcher, Michael Straeubig, Mihaela Taranu

Are you willing to tutor the students during the summer school:

Diego Maranan: yes

Jack Fletcher: ?

Michael Straeubig: Maybe a short heads up for people who read too much Daniel Dennett and think the problem is (going to be) solved (soon).

Mihaela Taranu: Yes, a short lecture/overview on paradigms of consciousness from a philosophical/neuroscientific point of view. But if we invite a nice speaker I guess this will be out.

Is there any speaker relevant to this particular project you would like to invite

- Christoph Koch
- Andy Clark
- David Chalmers?
- Thea Ionescu?

Is there any teaching involved in this project?

Possibly but hasn't been identified

Could highly-connected networks (such as the Internet) be said to be conscious? Some theories of cognition suggest that they might. Critics counter that connectedness is not sufficient for consciousness. For instance, a conscious agent must be situated within and in relationship to some kind of environment. Furthermore, according to situated, enactive, and embodied accounts of cognition, intelligence is not possible without a physical body. The mind, after all, is not (just) situated in the brain, and the sensorimotor dimensions of the body are essential components of consciousness. It has been suggested, for instance, that the reason why we have a nervous system in the first place was to make navigation and interaction with the physical world safer for the organism (move away from danger, move towards things that reinforce survival).

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- **The group mind:** Consider the growing number of channels of communication between individuals are creating increasingly sophisticated social networks. Could such social networks be seen as conscious ‘group minds’? Are these channels of communication as an extension of our minds, rather than a mind itself? Or is there an emergent and separate consciousness that arises?
- **The environment:** If we think of some network as a kind of intelligence, what is its environment? Are the other inhabitants of the environment, and if so, who are they? Is the environment located in a physical space, or is it another kind of space altogether? If it's another kind of space, the question remains: how does this intelligence interact with physical space?

Other questions arise:

- Does intelligent behaviour imply intelligence?
- Does intelligence imply consciousness?

Output

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- **Proofs-of-concept**: visualizations, maps, diagrams, performances, interactive installations, initial findings, etc.

Readings

Popular articles

- BBC. (2014, November 18). Will the internet become conscious? *BBC Future*.
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Are Networks (Becoming) Conscious? – Kickoff Presentation

Original Filename

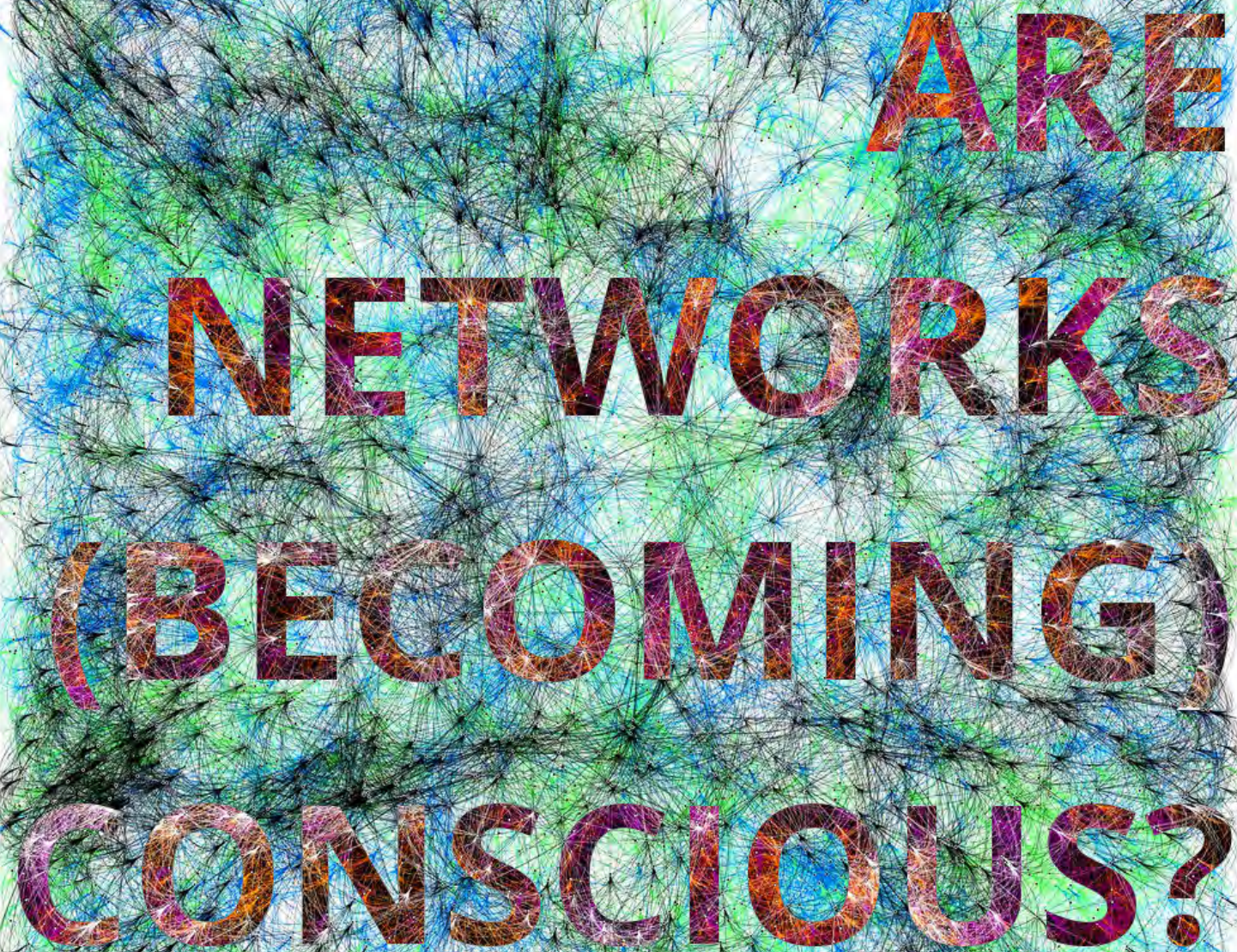
2016.08.16 - Talk1-Introduction - Diego.pdf

Date

16 August 2016

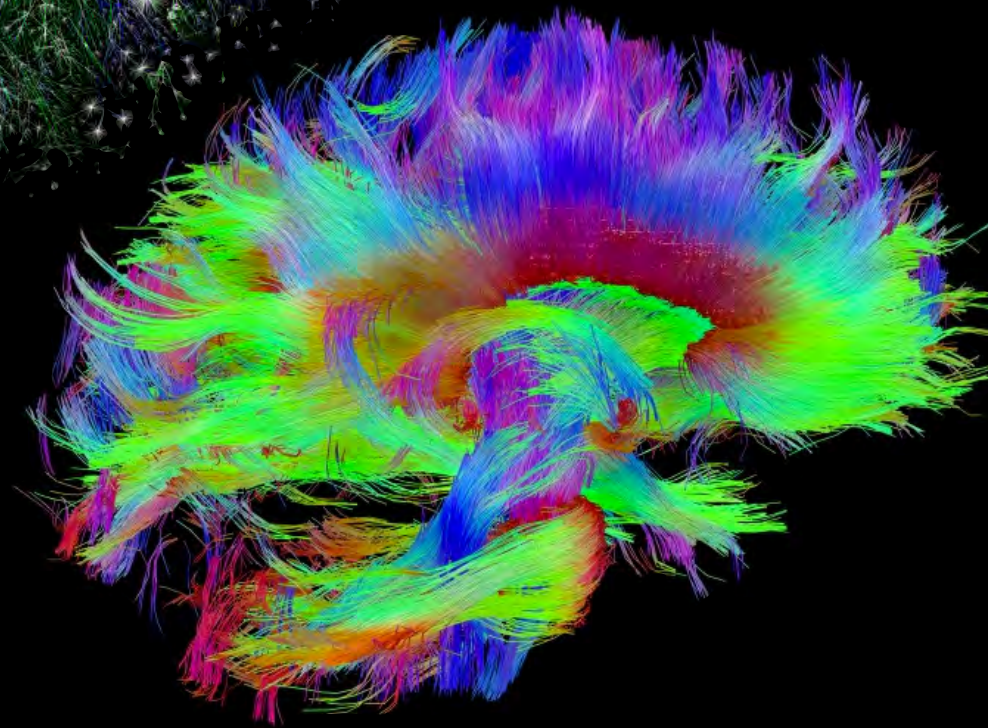
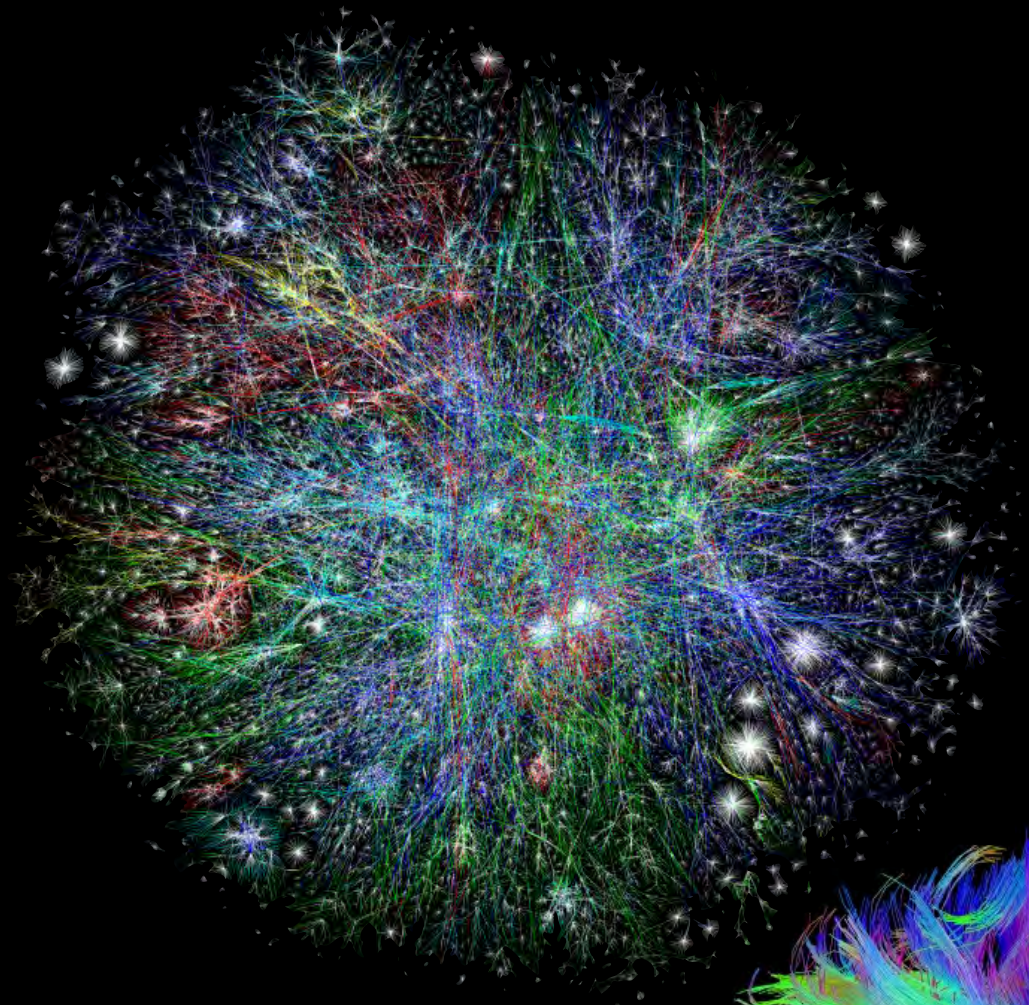
Author

Diego Maranan



ARE NETWORKS (BECOMING) CONSCIOUS?

(a Temporary
Autonomous
Zone)



What it is consciousness?

Why does it matter?

What would an answer look like?

Common sense

What we experience from waking up till we sleep

Behavioural

What you can observe in “the body”

Neurological

What you can infer from the brain

Philosophical

“what it is like to feel something”

Which version? Self-consciousness, metacognition, conscious access

(Koch 2012)

What is consciousness?

‘success criteria’

Why does it matter?

What would an answer look like?

How do we set the scene?

Rhetorical
Behavioural
“Neurological”
Phenomenological

What it is consciousness?

Why does it matter?

What would an answer look like?

How do we set the scene?

What are our success criteria?

- Redefining the problem: from “is it?” to “how/when to what extent etc. is it?”
- Delimitation of the problem; definitions
- Deciding where we lie in the Boorstin’s epistemological inversion away from “compact descriptions”
- How do we deal with issue of multiple scales (Malina): time, space (“physical”), complexity
-

ON TECHNICAL MEDIATION —
PHILOSOPHY, SOCIOLOGY, GENEALOGY

Bruno Latour

After Daedalus' escape from the labyrinth, according to Apollodorus, Minos used one of Daedalus' own subterfuges to find his hiding place and take revenge. Minos, in disguise, heralded near and far his offer of a reward to anyone who could thread the convoluted shell of a snail. Daedalus, hidden at the court of King Cocalus and unaware that the offer was a trap, managed the trick by replicating Ariadne's cunning: he attached a thread to an ant and, after allowing it to penetrate the shell through a hole at its apex, he induced the ant to weave its way through this tiny labyrinth. Triumphant, Daedalus claimed his reward, but King Minos, equally triumphant, asked for Daedalus' extradition to Crete. Cocalus abandoned Daedalus; still, the artful dodger managed, with the help of Minos' daughters, to divert the hot water from pipes he had installed in the palace, so that it fell, as if by accident, on Minos in his bath. (The king died, boiled like an egg.) Only for a brief while did Minos outwit his master engineer—Daedalus was always one ruse, one machination, beyond his rivals.

In the myth of Daedalus, all things deviate from the straight line. The direct path of reason and scientific knowledge—episteme—is not the path of every Greek. The clever technical know-how of Daedalus is an instance of *metis*, of strategy, of the sort of intelligence for which Odysseus (of whom the *Iliad* says that he is *polymetis*, a bag of tricks) is most famed.¹ No unmediated action is possible once we enter the realm of engineers and craftsmen. A *daedalion*, in Greek, is something curved, veering from the straight line, artful but fake, beautiful and contrived. Daedalus is an inventor of

- Internet is part of us
- Internet is an extension of us (organology)



CoLaboratoire

After hours doorbell!

How can the methods from behavioural psychology and neuroscience be applied to the study of non-human things/networks/etc?

What kind of evidence will satisfy us?

Networks in the Brain – Framing Talk

Original Filename

2016.08.16 - Talk2-NetworksInTheBrain - Jack.pdf

Date

16 August 2016

Author

Jack Fletcher

Networks in the brain

Jack Fletcher

Why?

- The goal of this workshop is to explore the question:

Are networks becoming conscious?

Why?

- The goal of this workshop is to explore the question:

Are networks becoming **conscious**?

We know of one network which seems to contribute to consciousness.

Why?

- The goal of this workshop is to explore the question:



Are networks becoming conscious?

We know of one network which seems to contribute to consciousness.

Why?

- The goal of this workshop is to explore the question:



Are networks becoming conscious?

We know of one network which seems to contribute to consciousness.

In what ways is the brain a network?

Why?

- The goal of this workshop is to explore the question:



Are networks becoming conscious?

We know of one network which seems to contribute to consciousness.

In what ways is the brain a network?

What are the properties of these networks?

Why?

- The goal of this workshop is to explore the question:



Are networks becoming conscious?

We know of one network which seems to contribute to consciousness.

In what ways is the brain a network?

What are the properties of these networks?

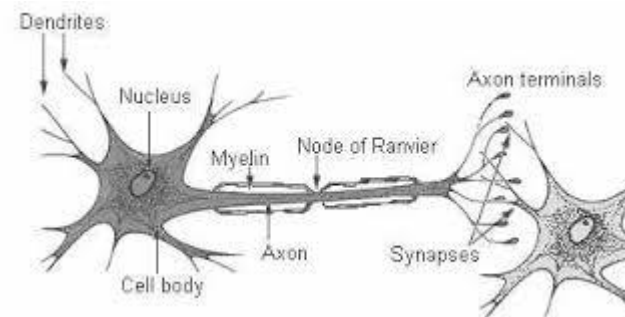
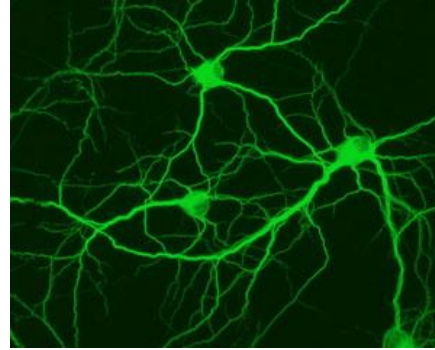
Are these properties necessary for consciousness?

Goal of this presentation

- Introduce the levels in which the brain can be seen as a network.
 - Neural networks
 - Cell assemblies
 - Functional + structural brain networks
 - Semantic networks
- Explain how the properties of the network structure can be exploited to understand cognition.
 - Centrality and the brain
 - Small worldness
- Speculate: **Should we see the same network properties in other possibly conscious networks?**

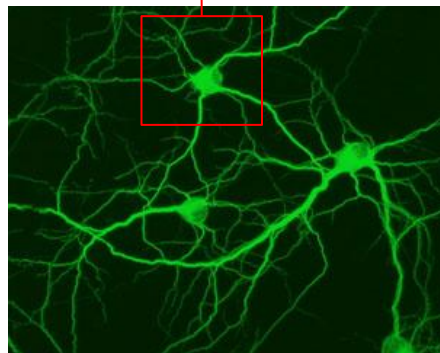
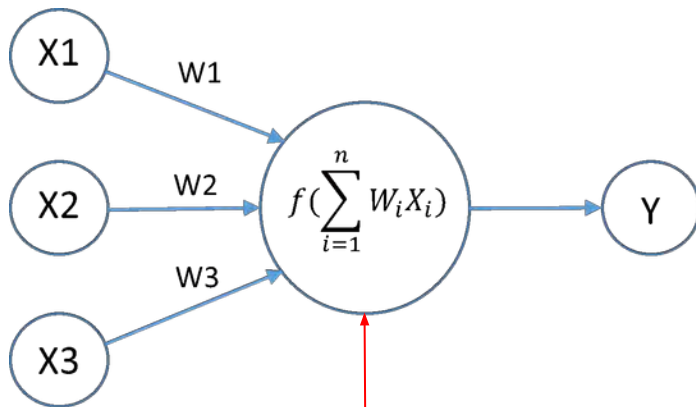
Level zero: Neural networks

- **Neurons are** thought to be the fundamental Information processing units of the brain.
- A neuron `stores' information in its electrical activity.
- It `talks' to other neurons with **synaptic connections** using electrical and chemical signals.
- There are 100,000,000,000 of them!!



Level zero: Neural networks

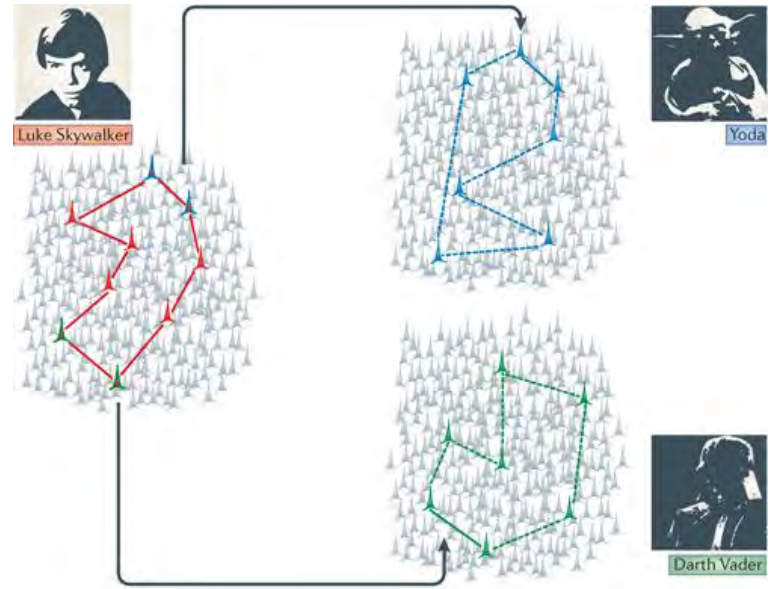
- We can abstract the function of a neuron.
- The value of a neuron is the weighted sum of the input neurons.
- Using networks of these neurons, one can do computations! (Turing Complete in certain cases)
- **Grandmother neuron:** a neuron represents a distinct concept, i.e your grandmother?!





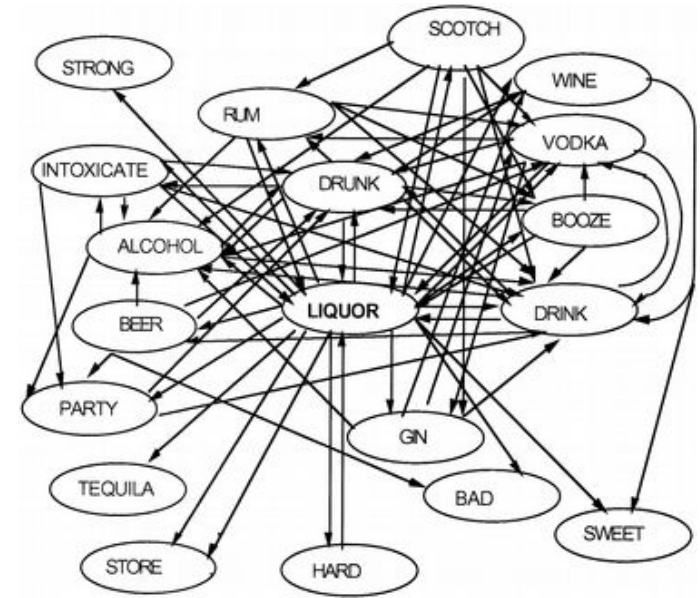
A level up: Cell assemblies (Hebb)

- A **cell assembly** is a collection of neurons with strong synaptic connections which represent a concept, percept or action.
- **Robust:** if one neuron is lost, the whole concept is not lost. **Efficient:** one neuron can be used in different assemblies
- Episodic memory, motor movements, and language through **Synfire chains**?
- Networks of assemblies can now be made!



← Sideways: Semantic networks

- A **semantic network** represents associations between concepts.
- Nodes represent concepts and edges represent semantic associations.
- They are arguably implemented in neural networks using cell assemblies!





A level up again: Functional and structural networks

- Generally on a much larger scale, each network node is made of millions of neurons!

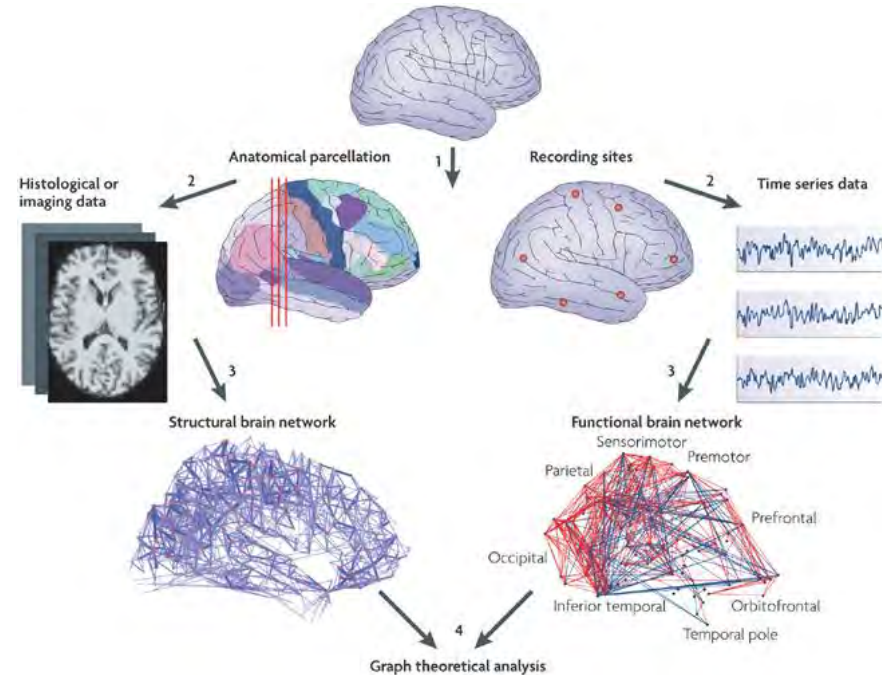
- **Structural brain network:**

A network is created by looking at the physical connections between areas of the brain.

- **Functional brain network**

A network is created using fMRI/EEG:

If two areas of the brain 'activate' together then an edge is drawn between the two



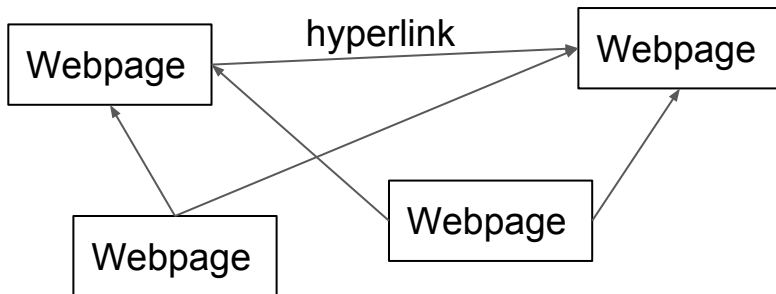
Recap

- We can see the brain as a network on multiple levels:
 1. Neural networks (traditional neuroscience/ AI)
 2. Cell assemblies (theoretical neuroscience)
 3. Semantic networks (psychology)
 4. Functional and structural networks (clinical neuroscience)
- Each network is useful for understanding different aspects of cognition!
- Each level is connected with a lower level, but how?!

Google, semantic networks and neurons!

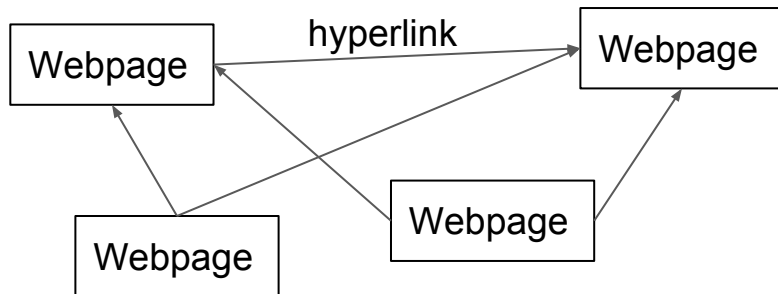
Google, semantic networks and neurons!

- Google have a problem:
 - A user searches a term, for example “The weather in Plymouth”
 - Lots of web pages contain this query (22,000,000)
 - How does Google decide what what webpage to display first (and second, third, fourth....)?
- The answer: exploit the network structure of html pages:



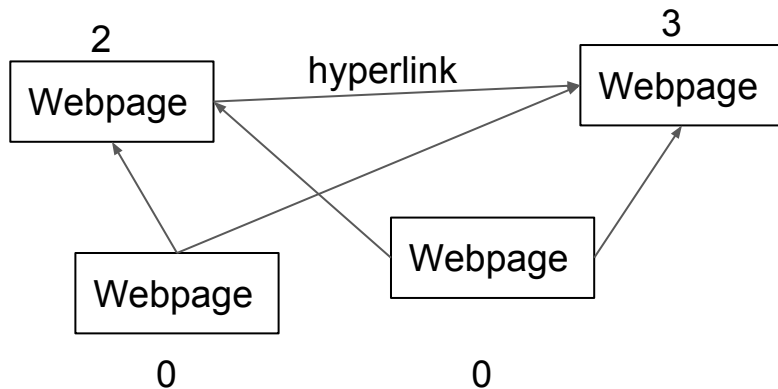
Google, semantic networks and neurons!

- We can see hyperlink a “vote of trust” i.e if bbc news links to your blog page it implies your web page is good in someway.
- In general, a method for “finding the most important node in a network” is called a **centrality measure**.



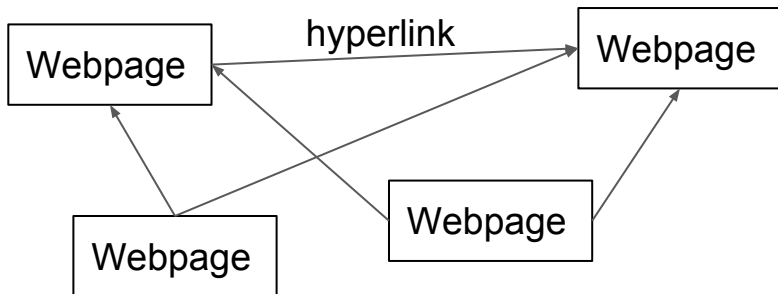
Google, semantic networks and neurons!

- A simple centrality measure is to count how many edges point to node. This is called **In-Degree centrality**.
- However, Google use a centrality measure called **PageRank**.



Google, semantic networks and neurons!

- **PageRank model:** You start on a webpage and randomly click on links. Every so often you jump to a random webpage and continue clicking links. You do this process forever. The amount of times you visit a web page is proportional to its PageRank!
- Google show webpages with high pagerank first!

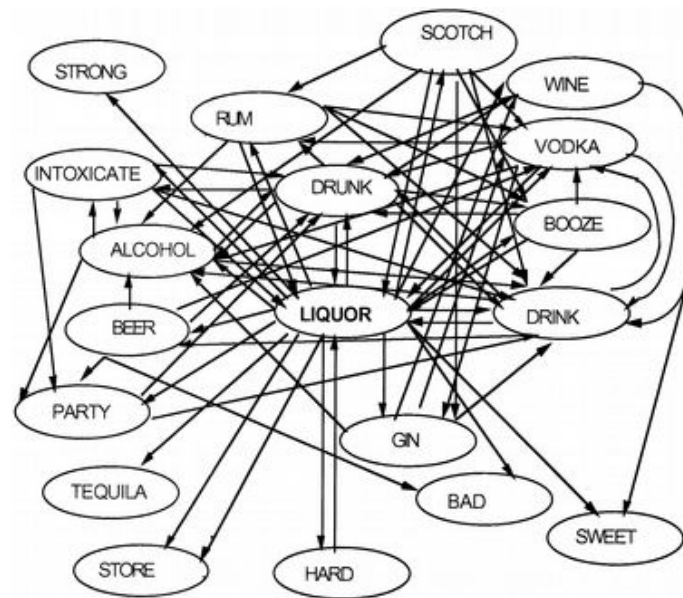


$$PR(p_i; t + 1) = \frac{1 - d}{N} + d \sum_{p_j \in M(p_i)} \frac{PR(p_j; t)}{L(p_j)}$$

Google, semantic networks and neurons!

- What about PageRank on semantic networks?

Any guesses?

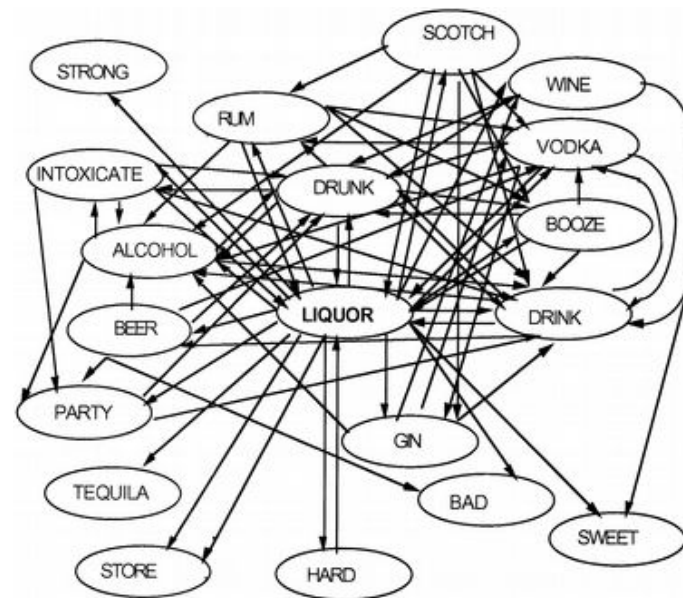


Google, semantic networks and neurons!

- What about PageRank on semantic networks?

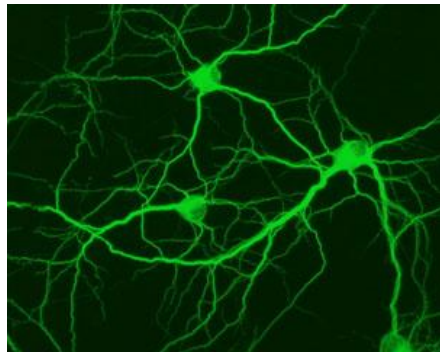
Any guesses?

- It is found that concepts with high PageRank are recalled more regularly by participants!
- That is, if I give you a query, i.e “think of word beginning with a”. You will recall the word with highest PageRank which begins with that letter!



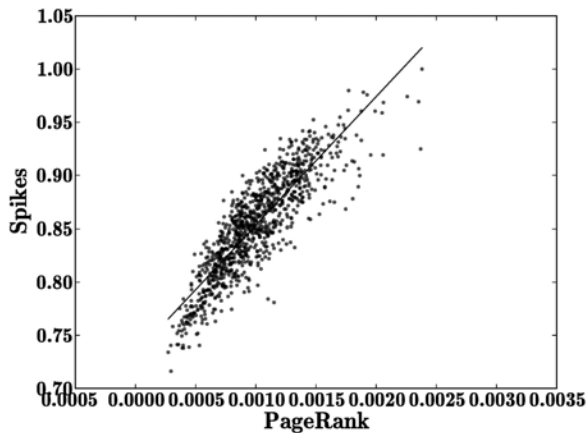
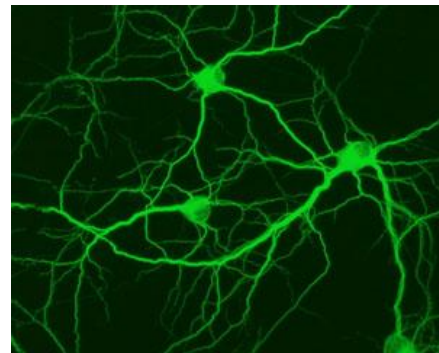
Google, semantic networks and neurons!

- What about PageRank on neural networks?
Any guesses?



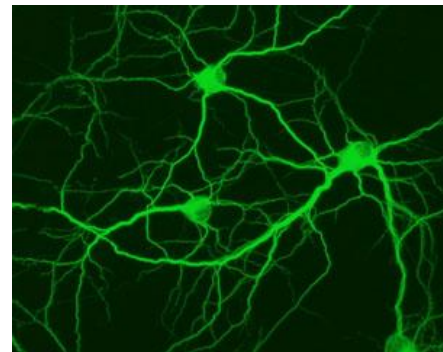
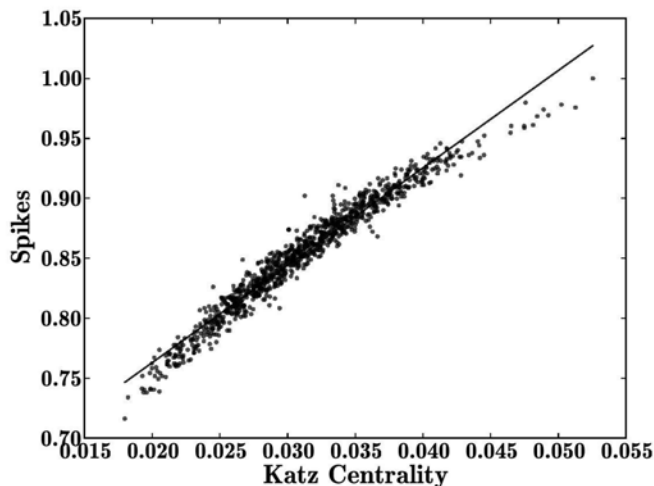
Google, semantic networks and neurons!

- What about PageRank on neural networks?
Any guesses?
- I find that neurons with high PageRank are more Active! (0.87 correlation)



Google, semantic networks and neurons!

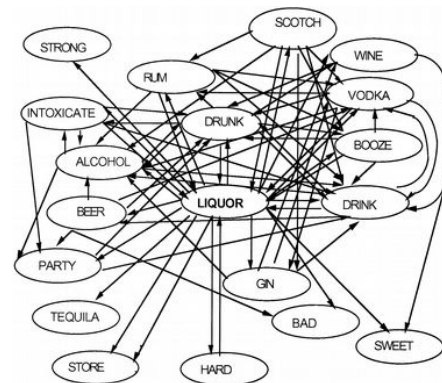
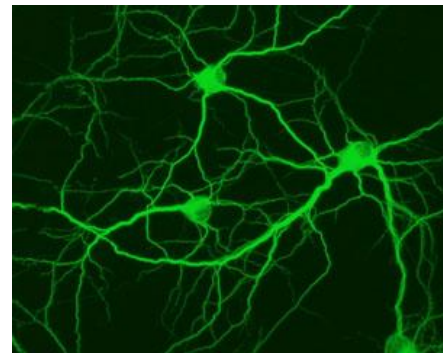
- However, I find that another centrality measure called **Katz Centrality** outperforms PageRank. (0.98 correlation)



Google, semantic networks and neurons!

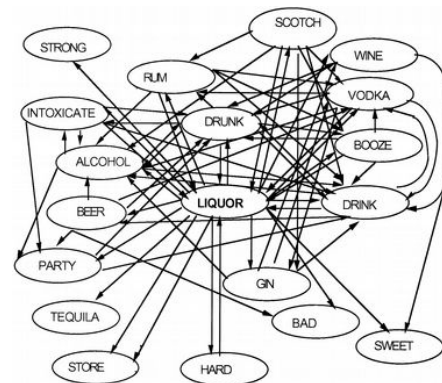
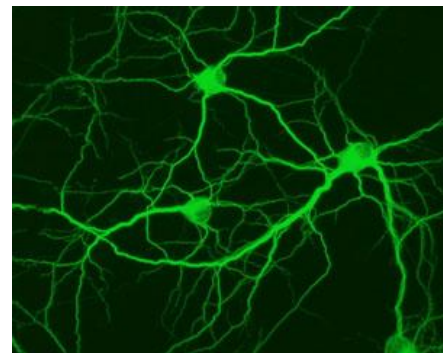
- Why are words with high PageRank recalled more regularly in semantic networks?

Any guesses?



Google, semantic networks and neurons!

- **Hypothesis:** if we were to use **Katz centrality** instead of PageRank on the semantic network, it would better predict the recalled words!
- This is because Katz centrality better predicts neural activity!



Thought experiment

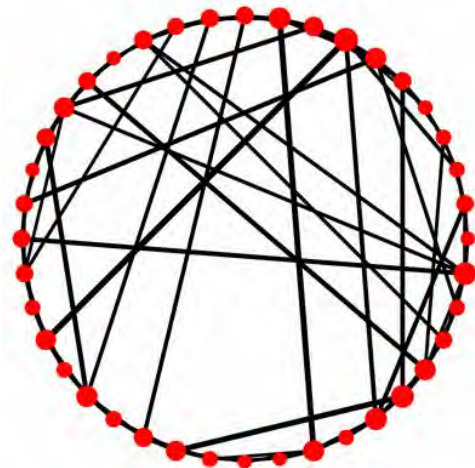
- You are allowed to remove 1 million neurons from your enemy's brain.
Your goal is to reduce brain function (consciousness?) as much as possible.
how do you decide on what neurons to remove?
- Perhaps a good tactic is to remove neurons with high Katz Centrality as these neurons may be involved in representing important concepts and actions.
- Would this tactic work in other possibly conscious networks?

Small World Networks

- The ‘**small worldness**’ of a network concerns the average path length between any two nodes in a network.
- If the typical distance (L) between two nodes is:

$$L \propto \log N$$

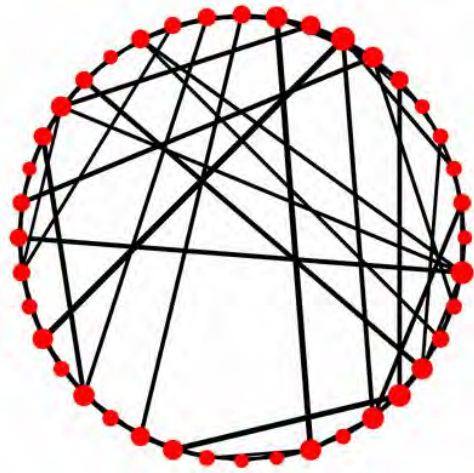
- Where N is the number of nodes in the network then we say the network is a “small world network”



Small World Networks

- This type of wiring supports efficient information exchange between nodes in the network.
- Small worldness in functional brain networks correlates with intelligence and creativity!
- Social networks satisfy this property, as do neural networks!
- **Should we see small worldness in other possibly conscious networks?**

$$L \propto \log N$$

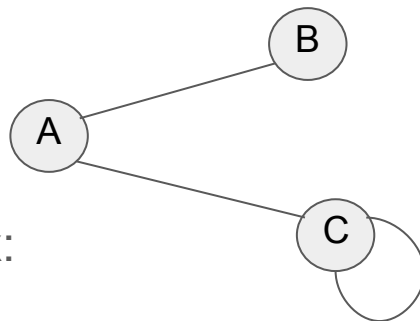


What is a network?

- A network (or graph) is a set of nodes (or vertices), $\mathbf{V}$ and a set of tuples, $\mathbf{E}$ representing edges between them. We say $\mathbf{G} = (\mathbf{V}, \mathbf{E})$.
- Example: $\mathbf{V} = \{A, B, C\}$
 $\mathbf{E} = \{(A, B), (A, C), (C, C)\}$
- We can also represent this graph as an adjacency matrix:

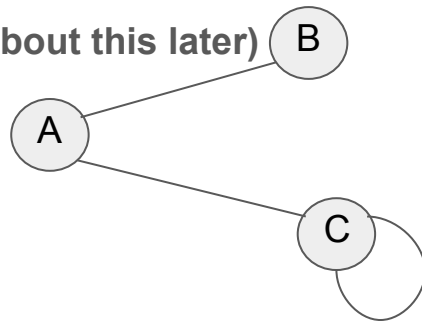
$\mathbf{G} =$

	A	B	C
A	0	1	1
B	1	0	0
C	1	0	1



Network theory

- Natural questions about networks arise:
 - What is the shortest path between two nodes. (Dijkstra's Algorithm)
 - **Applications:** routing packets on the internet as to reduce transmission delay, laying cables, delivering items, google maps, sat nav....
 - In walk, can we visit each node exactly once in a graph and arrive home, what is this path? (Hamiltonian paths, Travelling salesman problem)
 - **Applications:** UPS, FEDEX, Tesco delivery, optimally cutting metal with a robot arm. (In fact any NP-Complete problem!)
 - **What is the most important node in a network (centrality, will talk about this later)**
 - **What is the typical distance between two nodes? (small-world)**



Observations from a Systems-Theoretic Perspective - Framing Talk

Original Filename

2016.08.16 - Talk3 - Systems-TheoreticPerspectivesOn Consciousness - Michael.pdf

Date

16 August 2016

Author

Michael Straeubig

ARE NETWORKS (BECOMING) CONSCIOUS? - OBSERVATIONS FROM A SYSTEMS-THEORETIC PERSPECTIVE

MICHAEL STRAEUBIG, COGNOVO, PLYMOUTH UNIVERSITY

COGNOVO SUMMERSCHOOL | AUGUST 2016 | PLYMOUTH, UK

PRELUDE: AN ICONOGRAPHY OF CONSCIOUSNESS









PRELIMINARIES

THIS DOESN'T WORK

CONSCIOUSNESS EXPLAINED

AWAY



DANIEL C. DENNETT

Author of *Brainstorms* and coauthor of *The Mind's Eye*

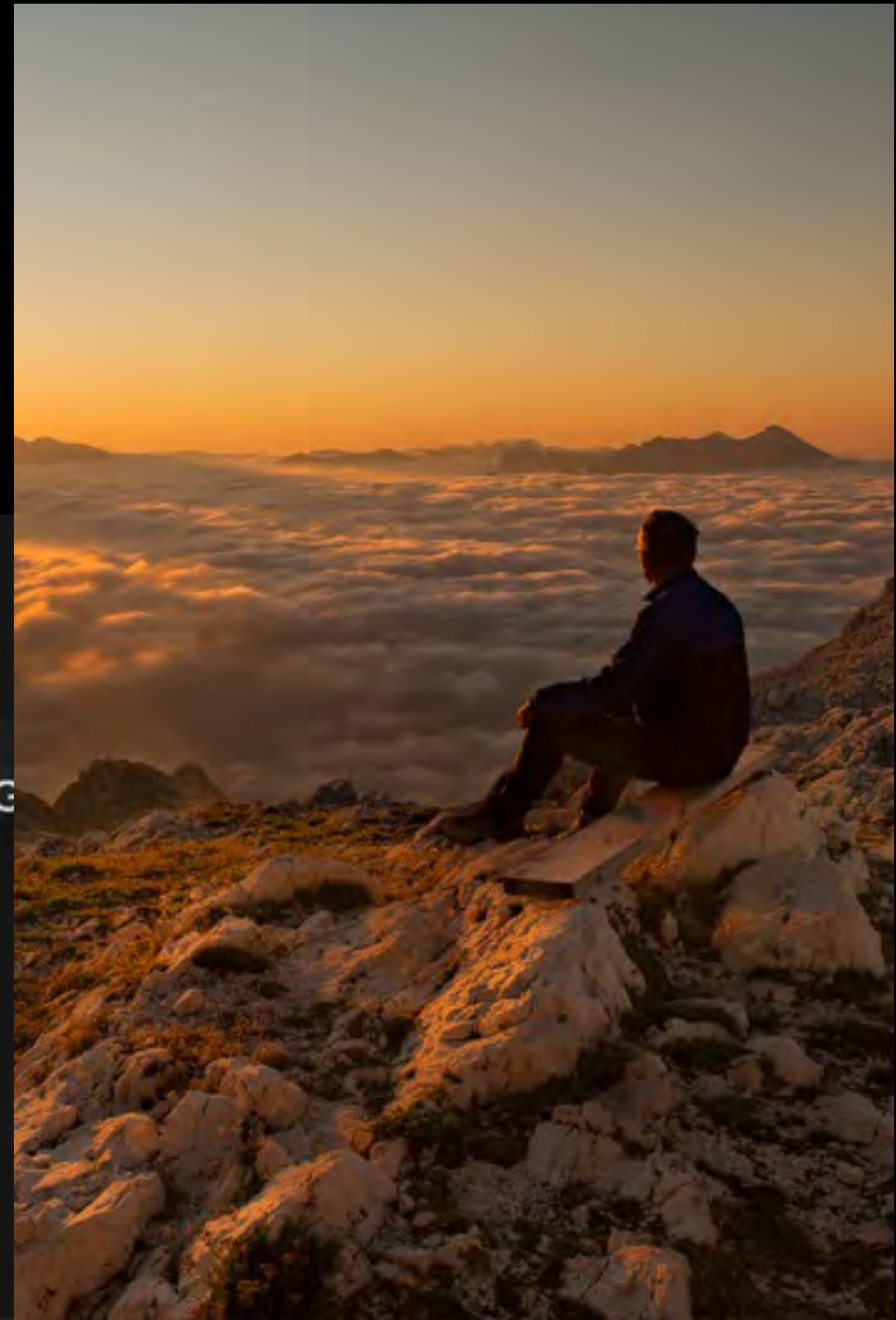
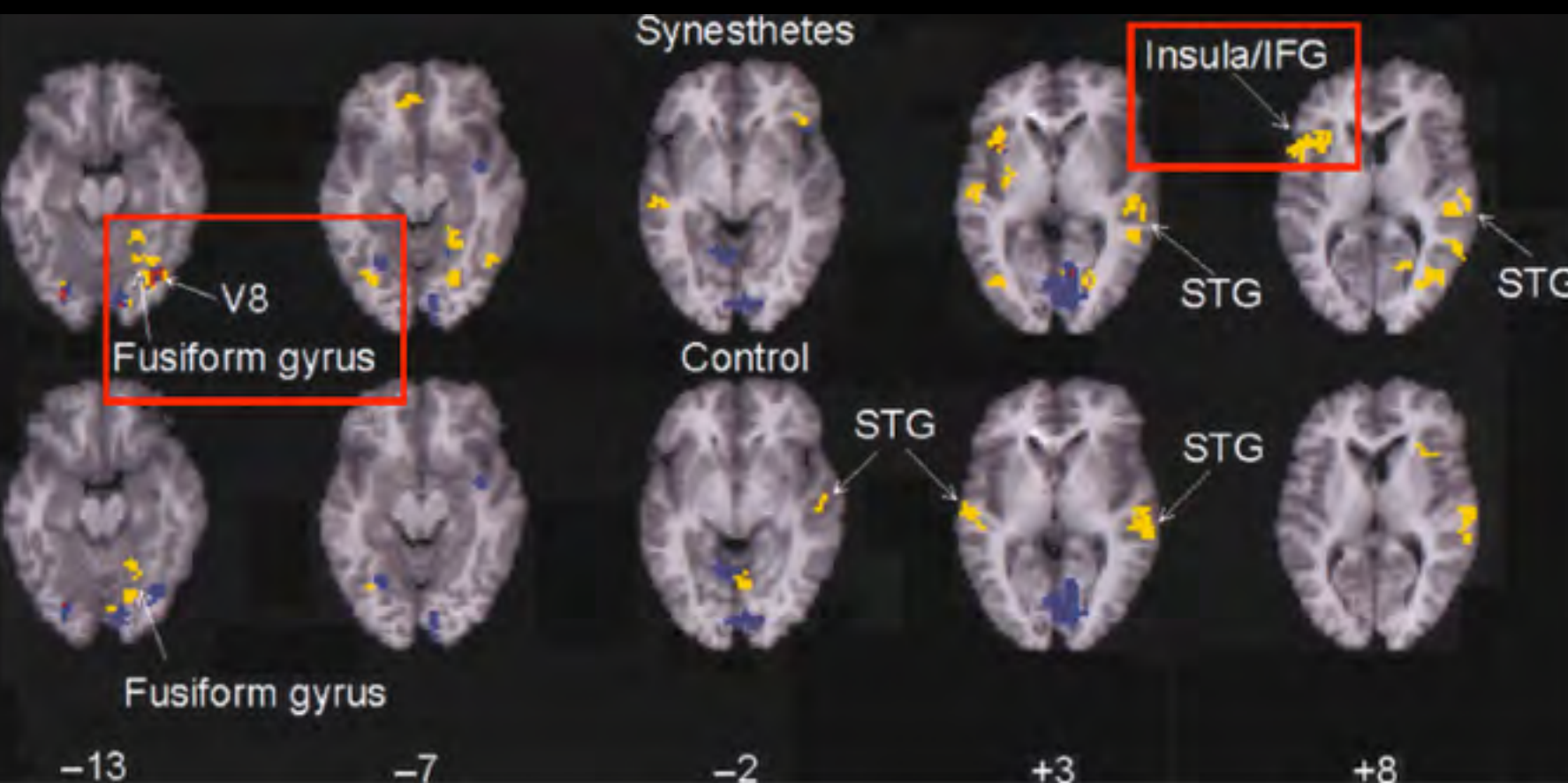
THIS MIGHT WORK



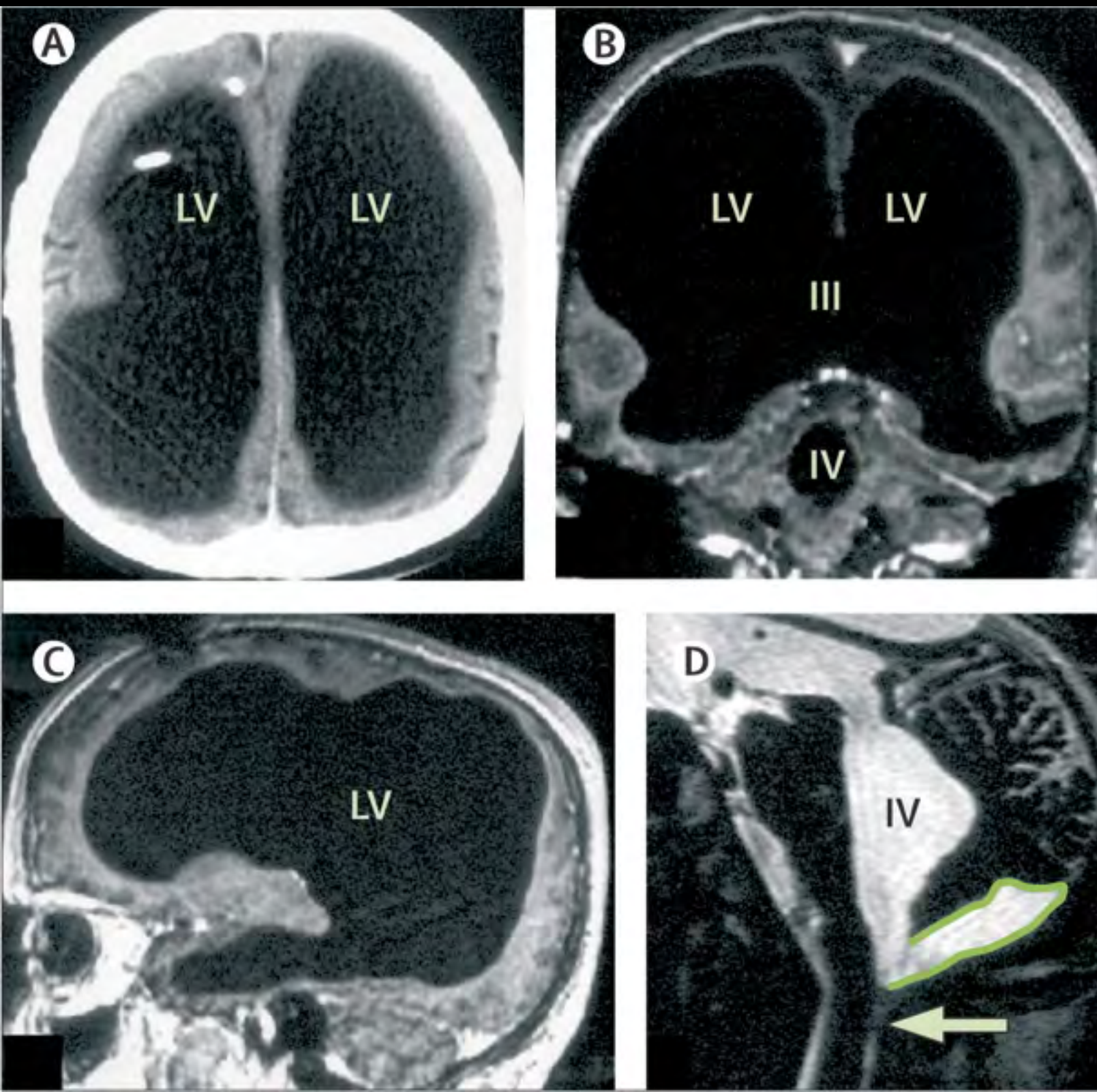
1ST PERSON PERSPECTIVE PHENOMENOLOGY VS. 3RD PERSON PERSPECTIVE OBSERVATION



LANGUAGE

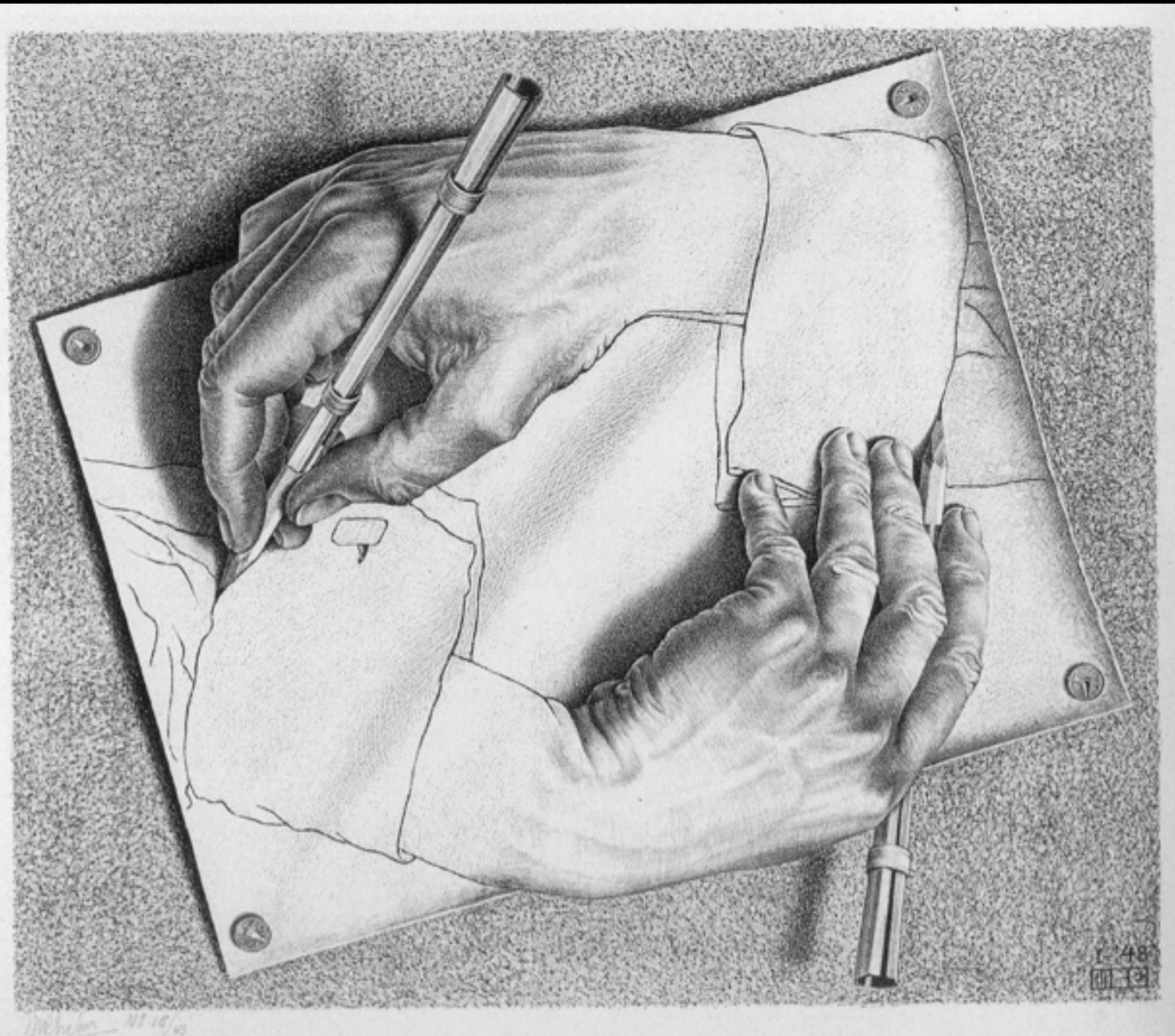


TOPOLOGY?



CONSCIOUSNESS

OBSERVING CONSCIOUSNESS



SYSTEMS THEORY/(IES)

SYSTEMS

Systems

Machines

Organisms

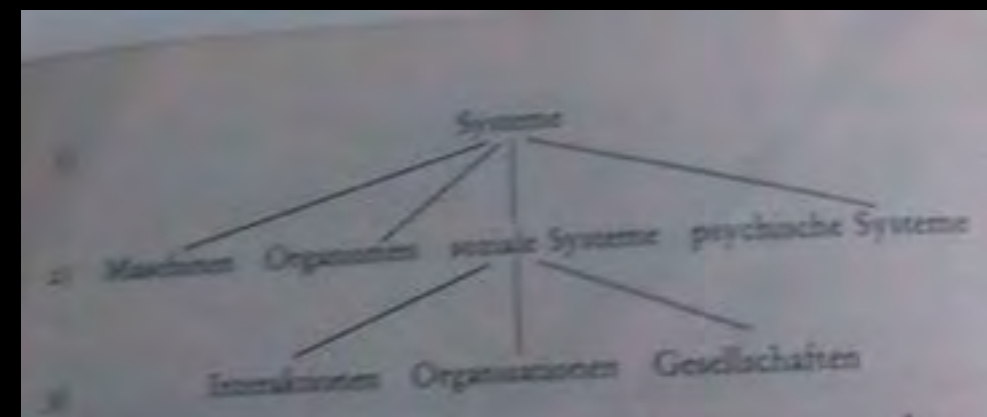
Social Systems

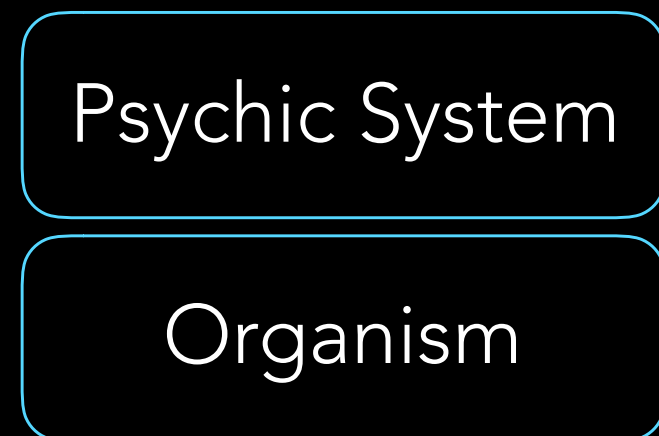
Psychic Systems

Interactions

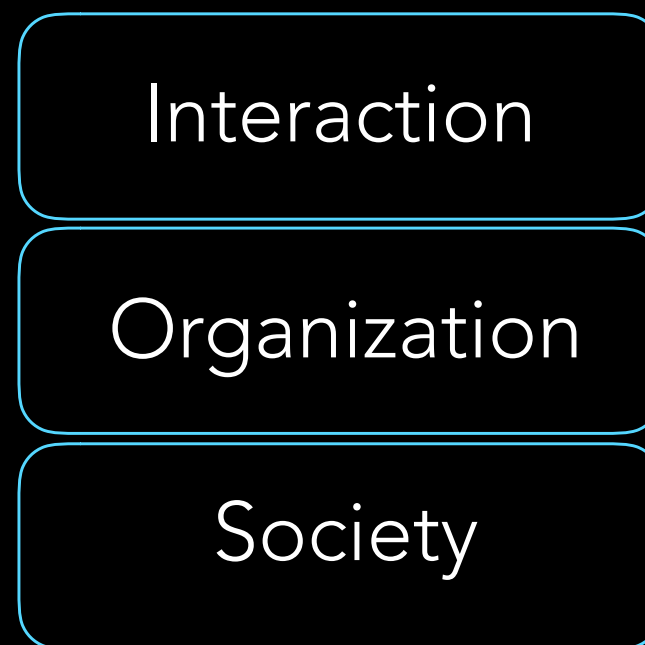
Organizations

Societies

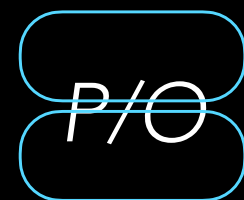
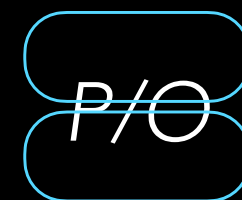
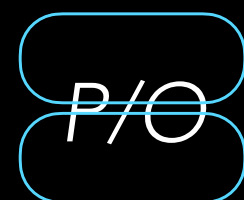
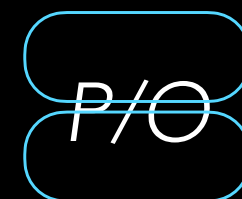




P/O (Person)



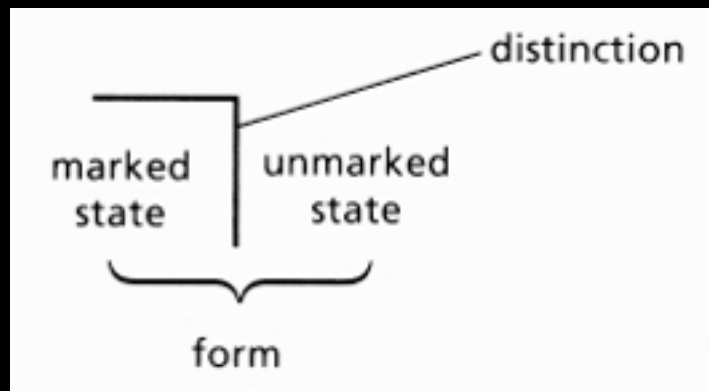
Social System



OBSERVERS

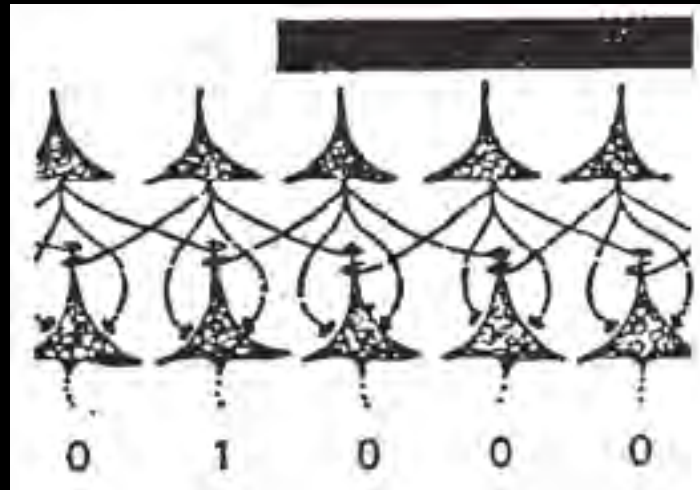


DISTINCTIONS



DISTINCTIONS AS LOGICAL OPERATIONS

SPENCER-BROWN



DISTINCTIONS AS EPISTEMOLOGY

SECOND ORDER
CYBERNETICS,
(RADICAL)
CONSTRUCTIVISM

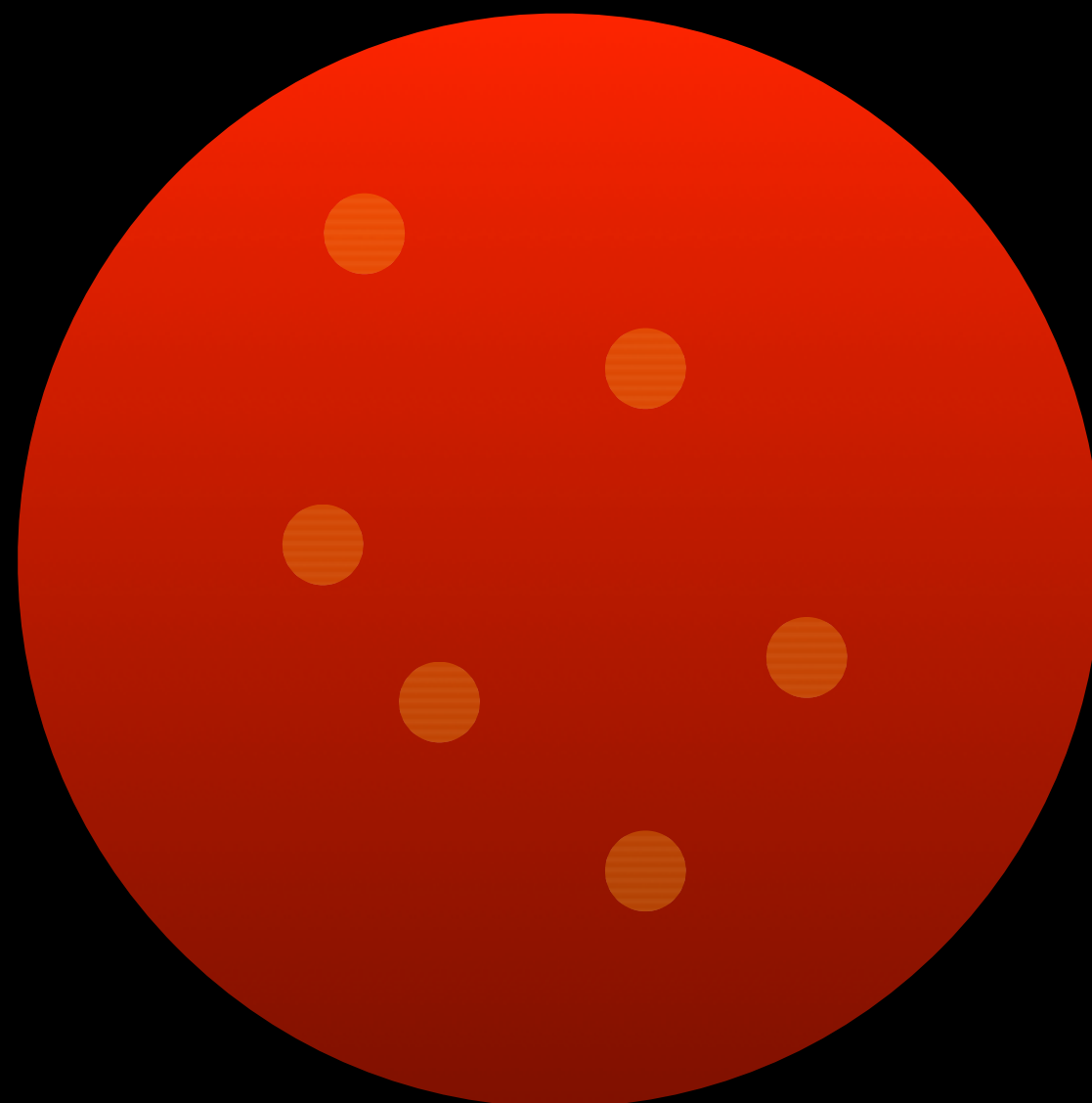
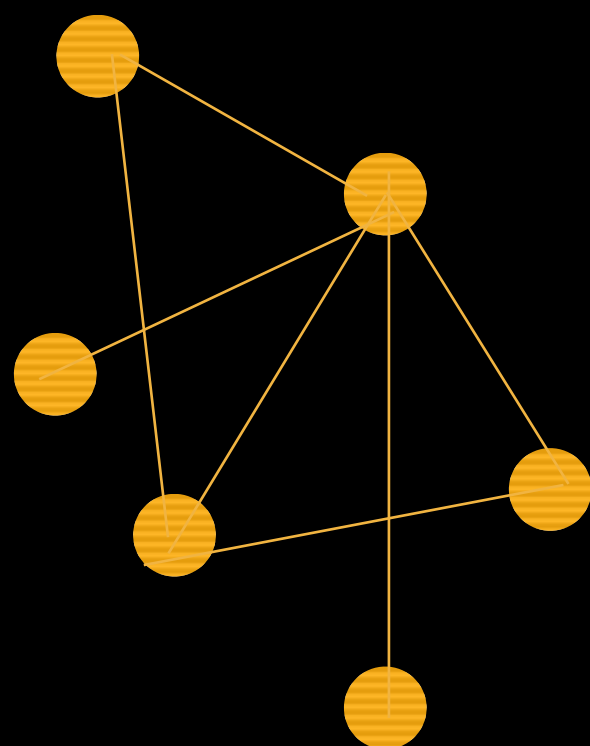


DISTINCTIONS AS OPERATIONS THAT CONSTRUCT MEANING

LUHMANN

(Bateson 2000a), (Derrida 1973), (Foerster 1973), (Glanville 2008), (Glaserfeld 2004), (Luhmann 1996), (Luhmann 2000), (Maturana and Varela 1980), (Spencer-Brown 2008), (Watzlawick 2011)

SYSTEM | ENVIRONMENT



SELF



MEANING

ACTUAL \ POTENTIAL

MEDIUM | FORM

ARE NETWORKS
(BECOMING) CONSCIOUS?

SYSTEMS

Systems

Machines

Organisms

Social Systems

Psychic Systems

Interactions

Organizations

Societies

DISTINCTIONS

STATES OF MIND



SELF

000000000:	00	00	00	00-04	00	00	00-00	00	00	00-04	00	00	00				
000000010:	01	AE	00	00-01	00	03	00-00	00	00	00-00	00	00	00	Go	Go	♥	
000000020:	1A	00	00	00-73	00	65	00-72	00	76	00-69	00	63	00	→	s	e	r
000000030:	65	00	73	00-2E	00	65	00-78	00	65	00-00	00	34	00	e	.	e	x
000000040:	00	00	5C	00-53	00	79	00-73	00	74	00-65	00	6D	00	\	S	e	v
000000050:	52	00	6F	00-6F	00	74	00-5C	00	69	00-6E	00	66	00	R	o	t	i
000000060:	5C	00	6F	00-65	00	6D	00-37	00	41	00-2E	00	50	00	\	e	m	?
000000070:	4E	00	46	00-00	00	02	AE-00	00	02	00-03	00	00	00	N	F	Go	♥
000000080:	00	00	00	00-00	00	1A	00-00	00	53	00-37	00	74	00			→	S
000000090:	67	00	74	00-6F	00	70	00-78	00	2E	00-65	00	78	00	g	t	o	7
0000000A0:	65	00	00	00-34	00	00	00-5C	00	53	00-79	00	73	00	e	4	p	x
0000000B0:	74	00	65	00-6D	00	52	00-6F	00	6F	00-74	00	5C	00	t	e	\	S
0000000C0:	69	00	6E	00-66	00	5C	00-6F	00	65	00-6D	00	37	00	i	n	R	e
0000000D0:	41	00	2E	00-50	00	4E	00-46	00	00	00-02	AE	00	00	A	f	\	t
0000000E0:	02	00	03	00-00	00	00	00-00	00	00	00-22	00	00	00	.	P	o	m
0000000F0:	43	00	43	00-50	00	72	00-6F	00	6A	00-65	00	63	00	Go	♥		"
000000100:	74	00	4D	00-67	00	72	00-2E	00	65	00-78	00	65	00	C	C	P	j
000000110:	00	00	34	00-00	00	5C	00-53	00	79	00-73	00	74	00	t	M	r	e
000000120:	65	00	6D	00-52	00	6F	00-6F	00	74	00-5C	00	69	00	e	4	\	S
000000130:	6E	00	66	00-5C	00	6F	00-65	00	6D	00-37	00	41	00	n	R	o	e
000000140:	2E	00	50	00-4E	00	46	00-00	00	04	AE-00	00	02	00	.	f	N	?
000000150:	03	00	00	00-00	00	00	00-00	00	1A	00-00	00	65	00	♥	P	F	Go
000000160:	78	00	70	00-6C	00	6F	00-72	00	65	00-72	00	2E	00			→	♥
000000170:	65	00	78	00-65	00	00	00-34	00	00	00-5C	00	53	00	x	l	e	.
000000180:	79	00	73	00-74	00	65	00-6D	00	52	00-6F	00	6F	00	e	x	4	\
000000190:	74	00	5C	00-69	00	6E	00-66	00	5C	00-6F	00	65	00	y	t	e	R
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Figure 4.12 – The configuration data of the driver

SYSTEM | ENVIRONMENT



471



327

**Internet of Shit**

@internetofshit

**Following**

Really fun: some apps may be exploiting this –
Uber found you'd accept up to 9.9x surge price
if your battery's low



This Is Your Brain On Uber

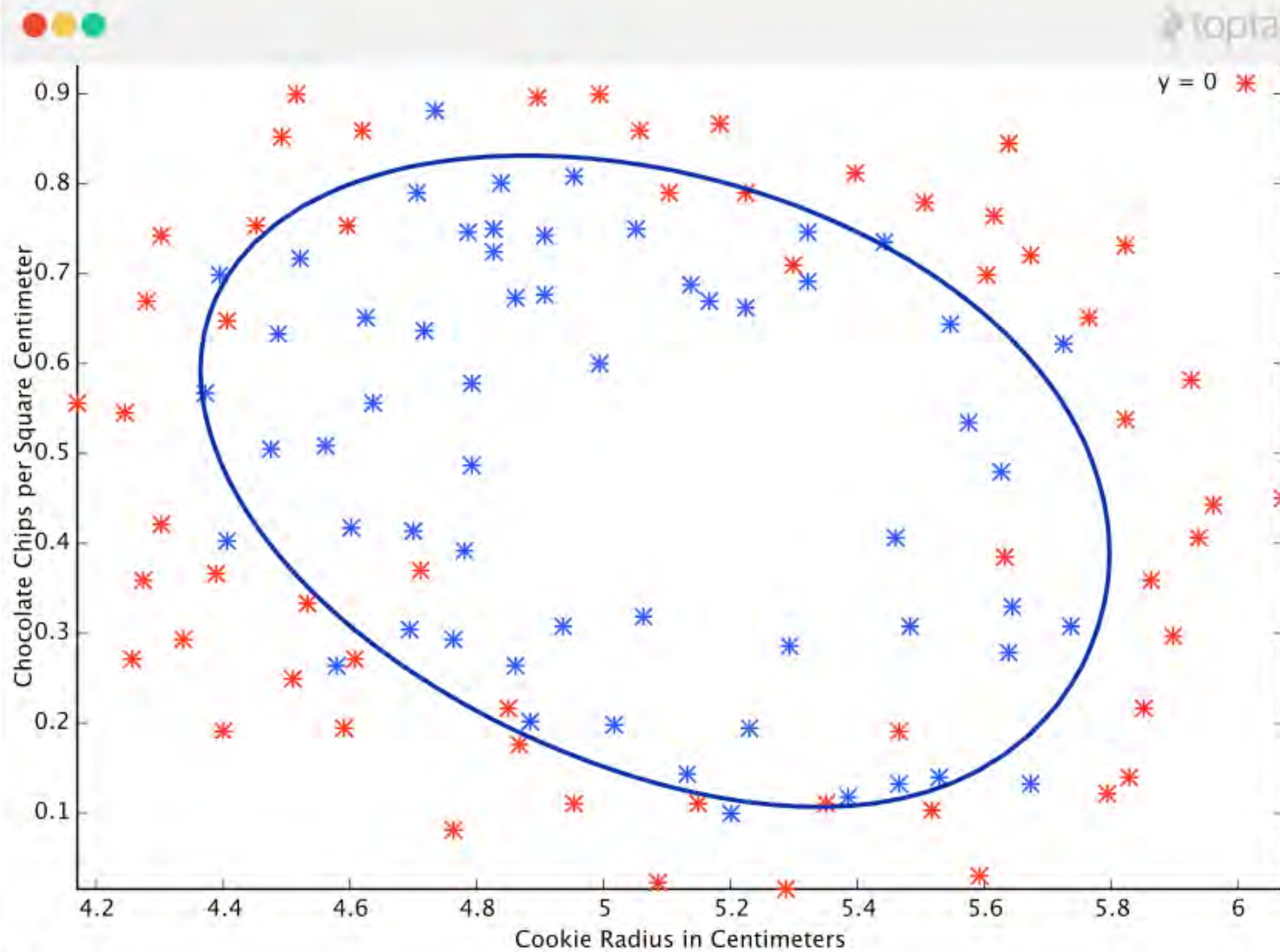
This week we feature Keith Chen, a behavioral economist at UCLA and the head of economic research at Uber. Keith explains why surge pricing makes us nuts and d...

[npr.org](https://www.npr.org)

MEDIUM | FORM

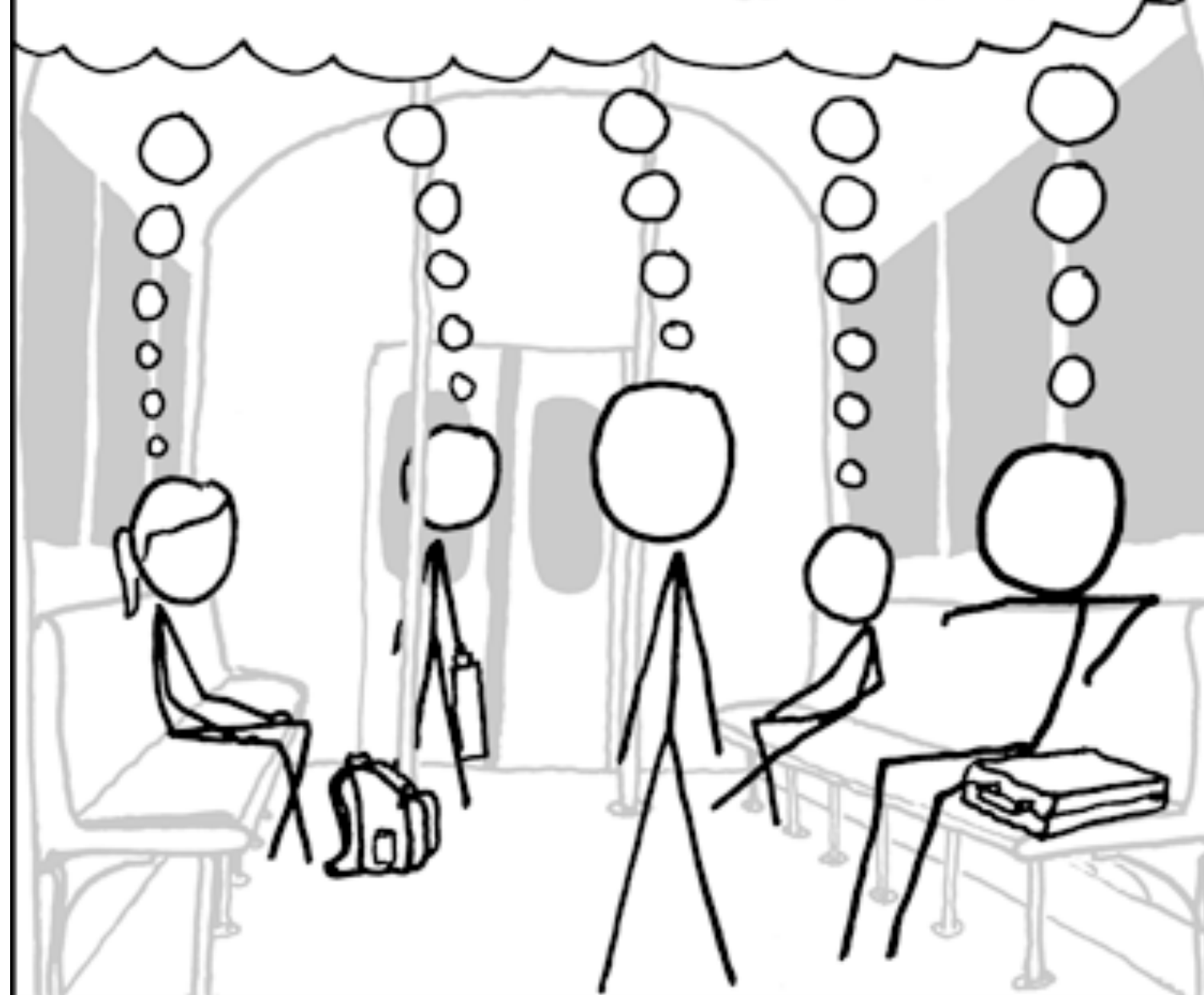


MEANING



OBSERVERS

LOOK AT THESE PEOPLE. GLASSY-EYED AUTOMATONS
GOING ABOUT THEIR DAILY LIVES, NEVER STOPPING
TO LOOK AROUND AND *THINK!* I'M THE ONLY
CONSCIOUS HUMAN IN A WORLD OF SHEEP.



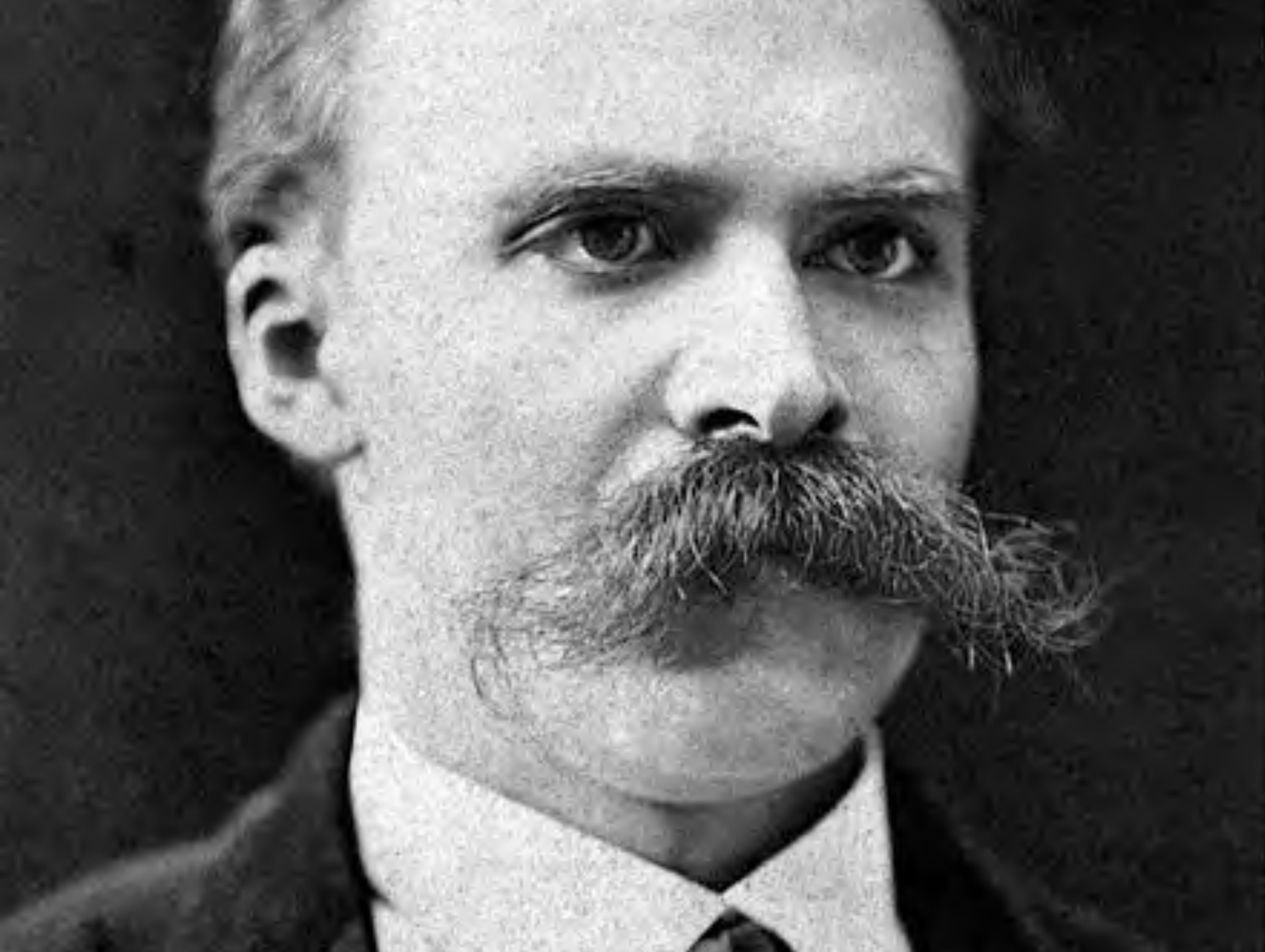


IMAGE CREDITS

- Brain of a white Collar Worker: The Lancet 2007 370, DOI: (10.1016/S0140-6736(07)61127-1), Copyright © 2007 Elsevier Ltd.
- Cat picture, <https://www.youtube.com/watch?v=tntOCGkgt98>
- Consciousness P2: <https://www.quora.com/If-you-copied-your-consciousness-to-an-avatar-would-you-die-and-that-copy-live>
- Consciousness P3: <http://garethjyoung.com/how-we-misunderstand-consciousness-and-where-we-might-look/>
- Consciousness P4: <http://quotesgram.com/consciousness-quotes-zen/>
- Consciousness P5: <http://humansarefree.com/2014/04/10-scientific-studies-proving-that.html>
- Consciousness Explained: [https://en.wikipedia.org/wiki/File:Consciousness_Explained_\(first_edition\).jpg](https://en.wikipedia.org/wiki/File:Consciousness_Explained_(first_edition).jpg)
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adapted from (Nunn et al. 2002)
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- Self, <https://carljungdepthpsychology.files.wordpress.com/2014/10/ac551-veil.jpg>
- Self / XKCD: <https://xkcd.com/610/>
- Spy vs. Spy, http://5cense.com/10/storni_loop.htm
- Stuxnet, <http://www.slideshare.net/hiepnhatrang/stuxnet-under-themicroscope-16184017>
- Third person / First person perspective, <http://www.kindercloud.com.au/counselling/>, <http://www.udel.edu/ILP/images/home-main.jpg>.
- Uber surge pricing, <https://twitter.com/internetofshit/status/760132042860404736?lang=en>

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THANK YOU

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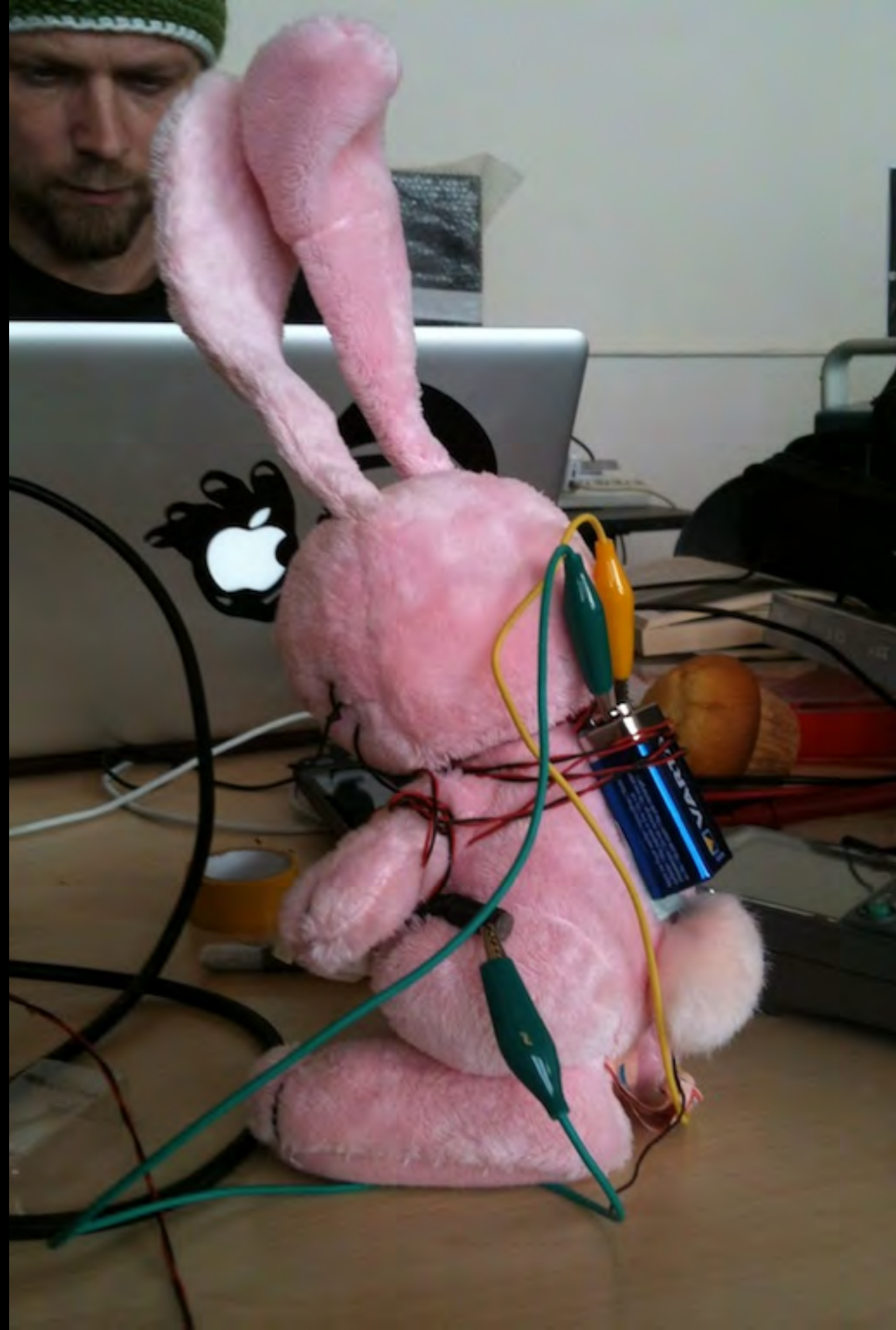
i3games.de

[@crcdng](https://twitter.com/crcdng)

cognovo.eu/project-9

Special Thanks: John Matthias, Jane Grant,
Mike Phillips, James Brocklehurst, Emma
Whittaker, Sue Denham

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Sketches, Scribbles, and Rough Notes from the Workshop

Original Filename

2016.08.20 - Sketches, scribbles, rough notes from the workshop.pdf

Date

20 August 2016

Authors

Workshop facilitators and participants

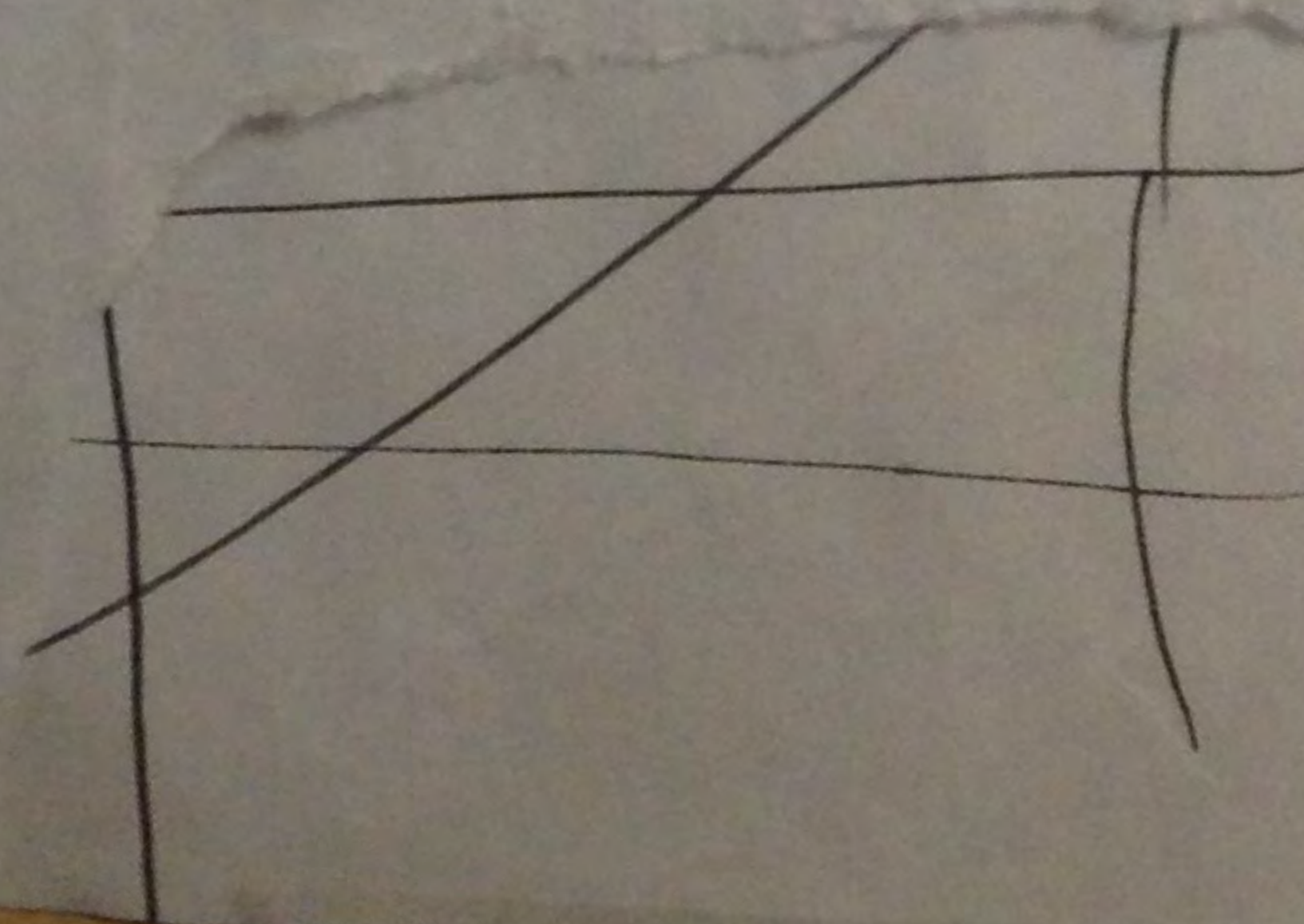
Tasks:

① Visualization of the model
↳ (unfolds time) (Doms)

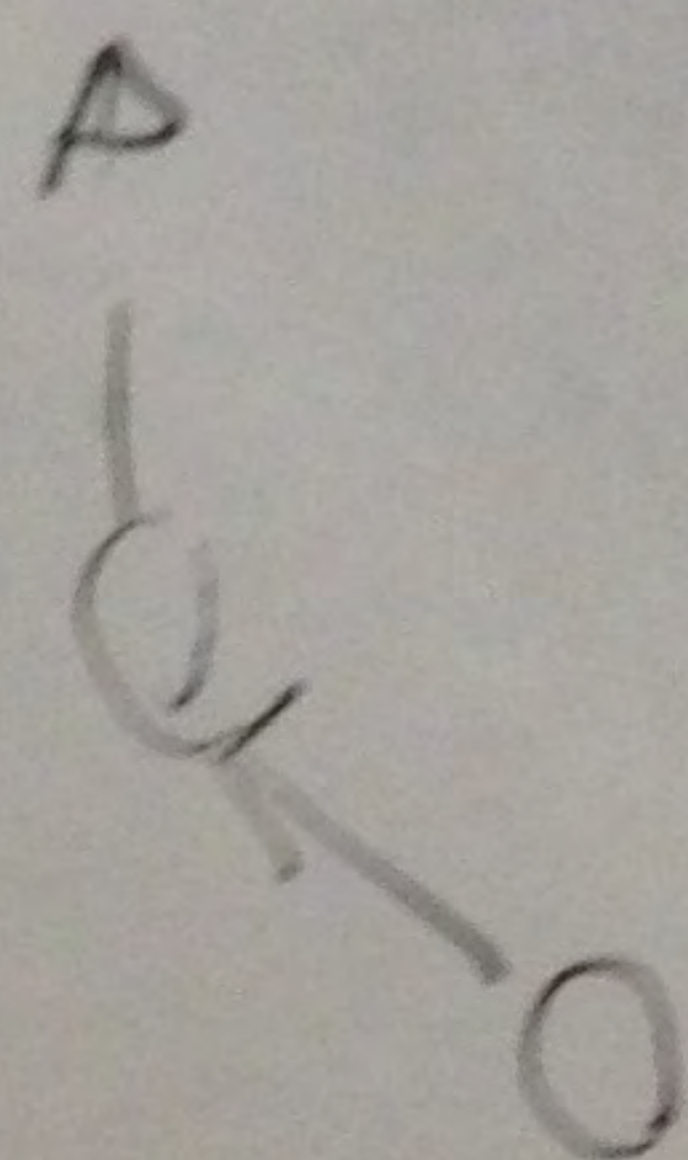
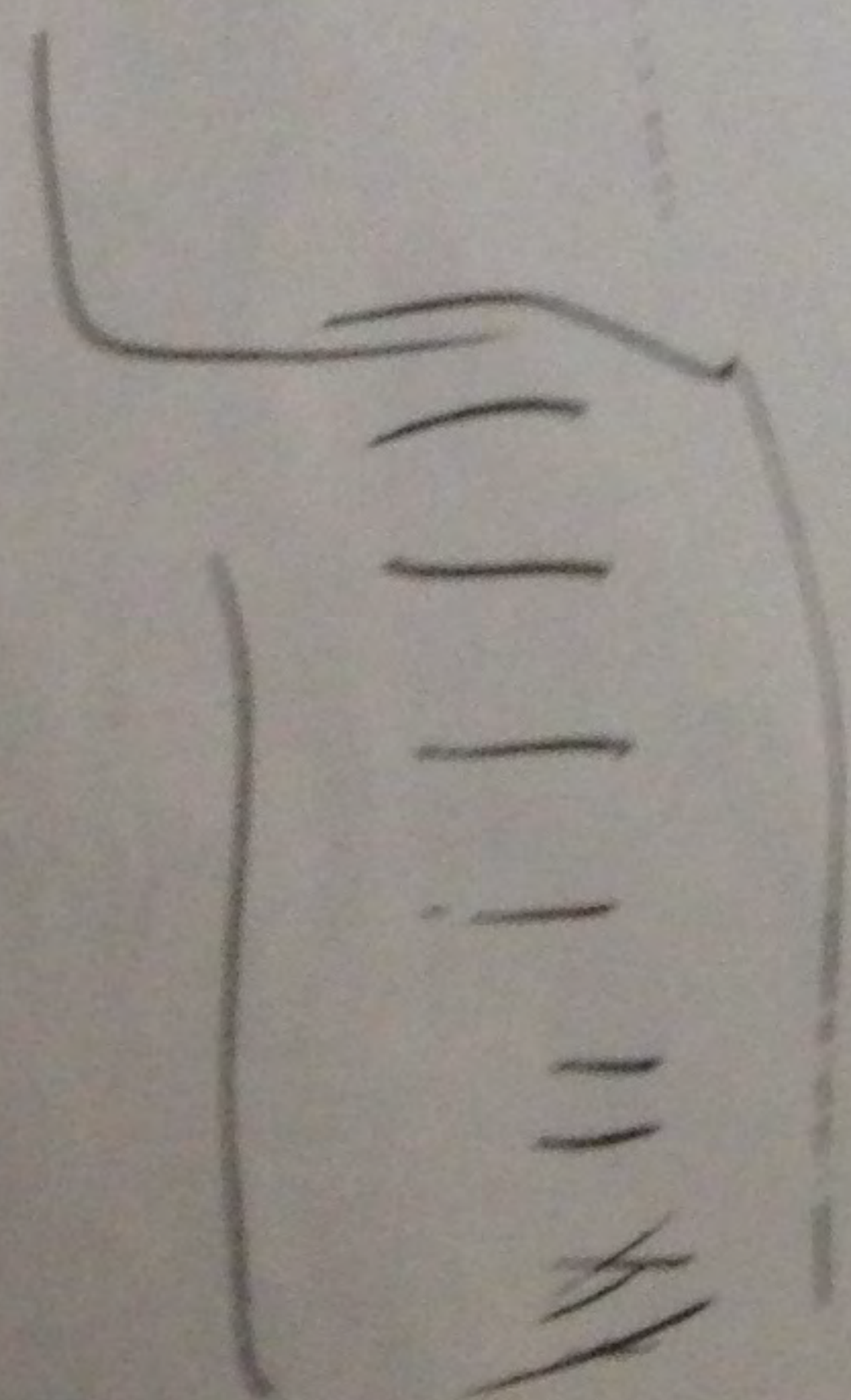
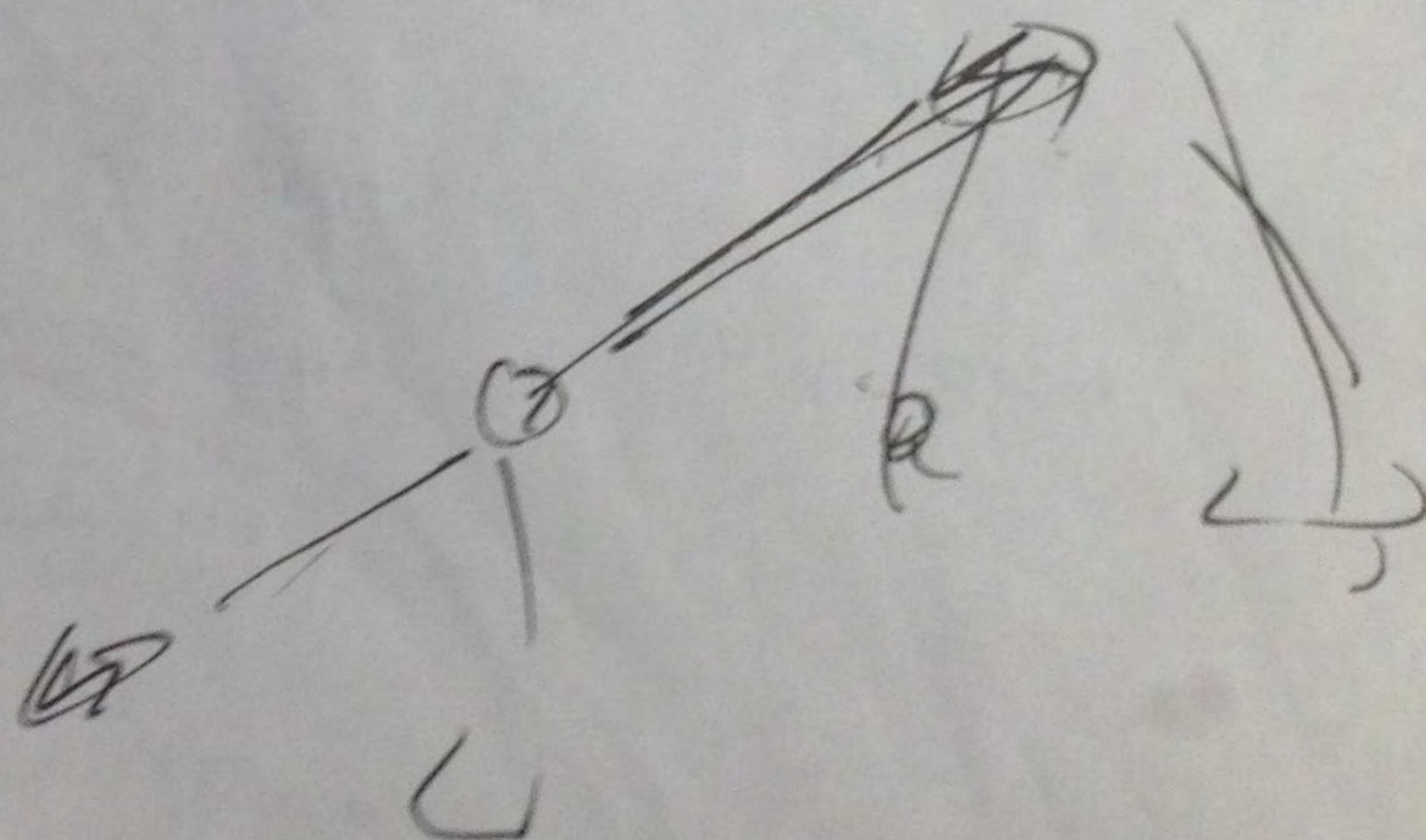
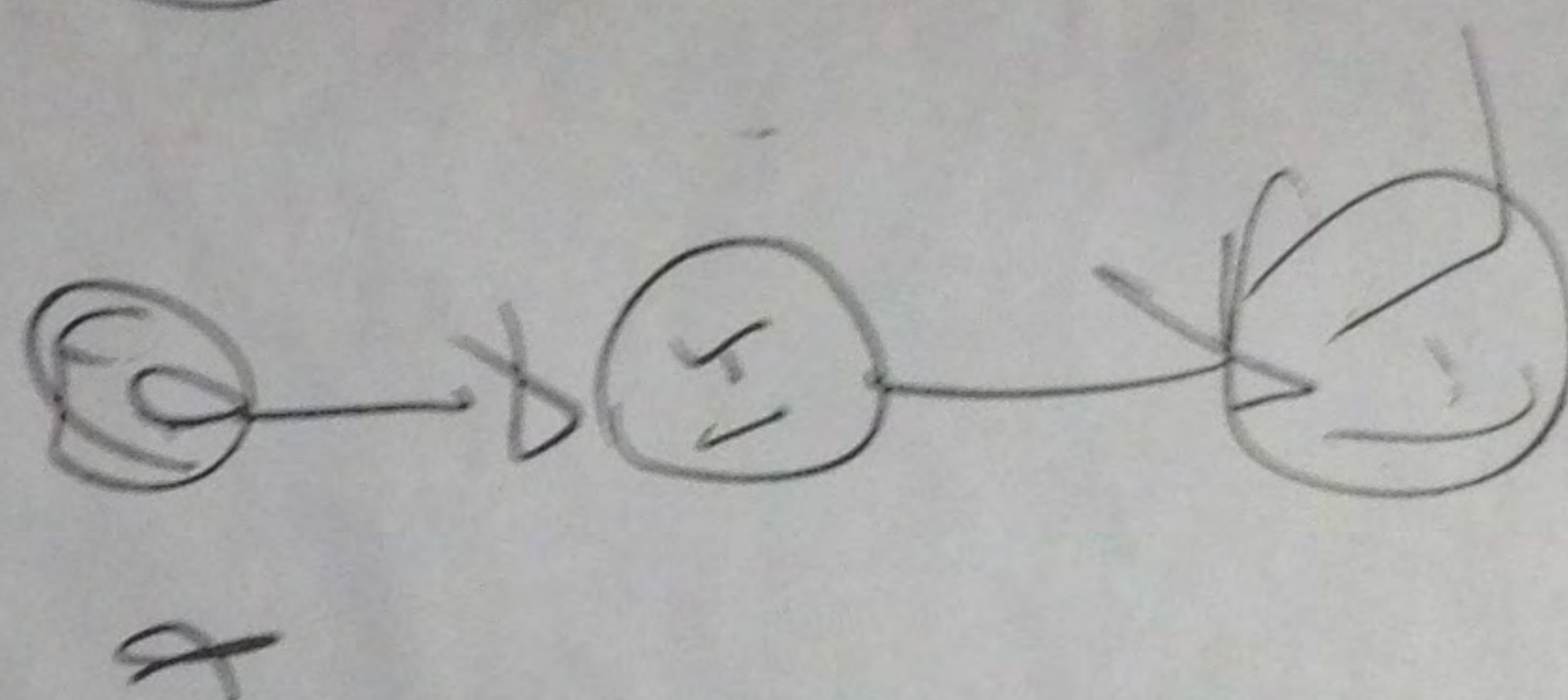
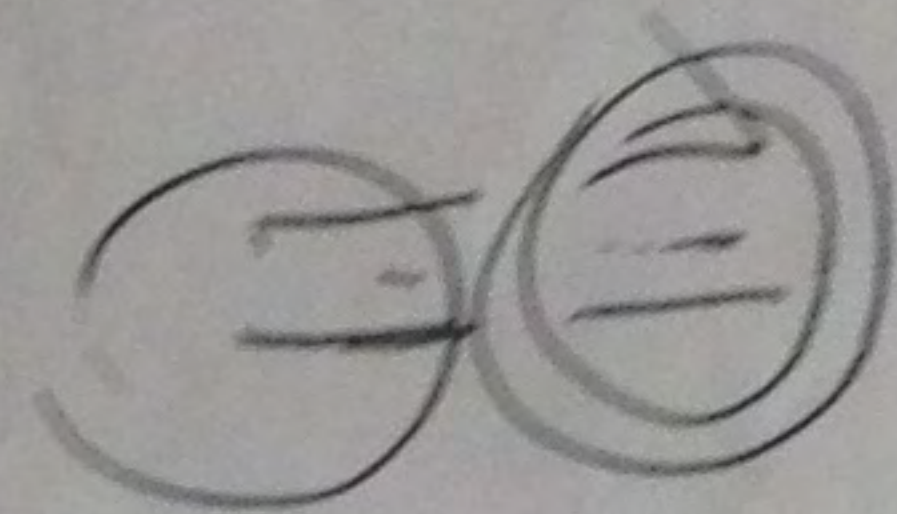
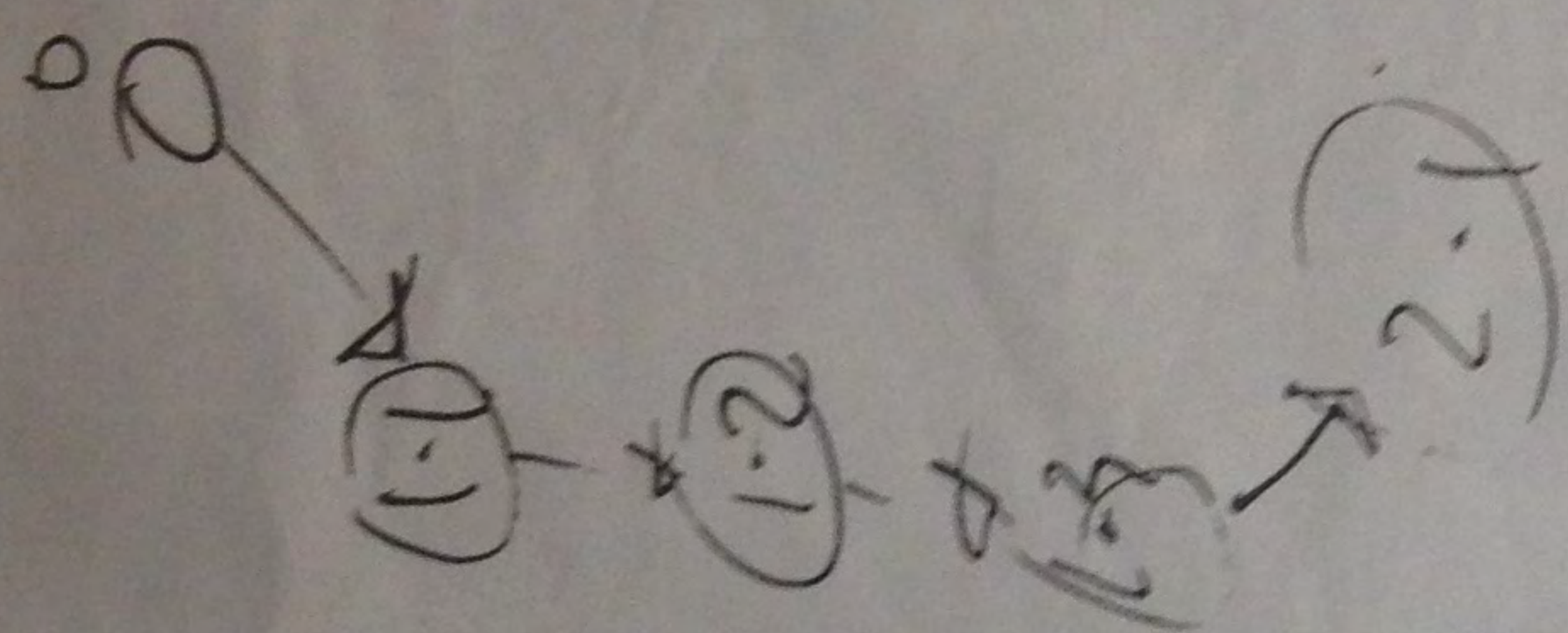
② Actions (Guys - Mahoele)

③ Distributed cognitive work

↳ give reason why to think q50.1
why it is reasonable -



$$\begin{array}{r} 1 \\ 11 \\ 22 \\ 33 \\ \hline 21 \end{array}$$



Consciousness = a function of ~~type of~~ ~~process~~ in living beings

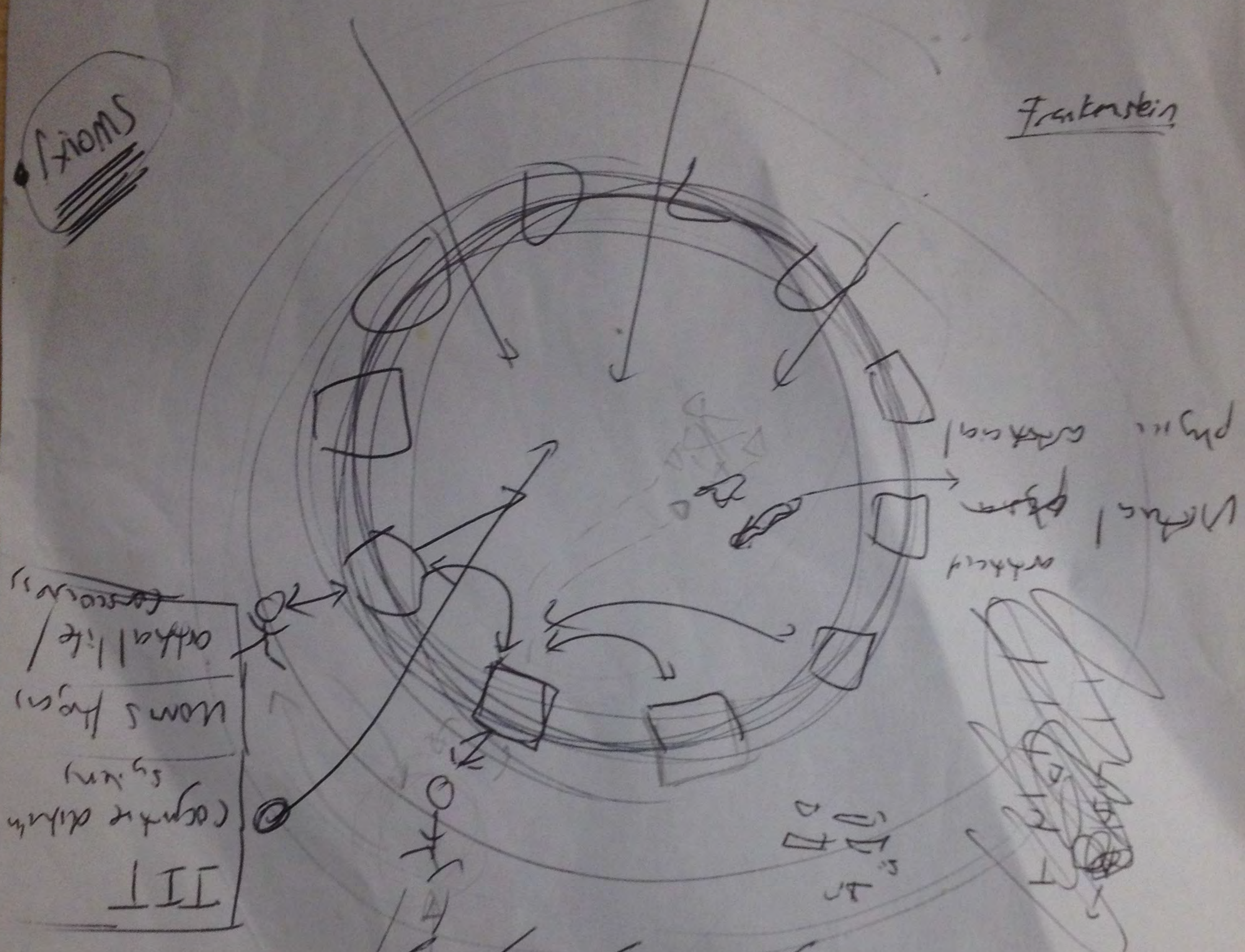


CoLaboratoire

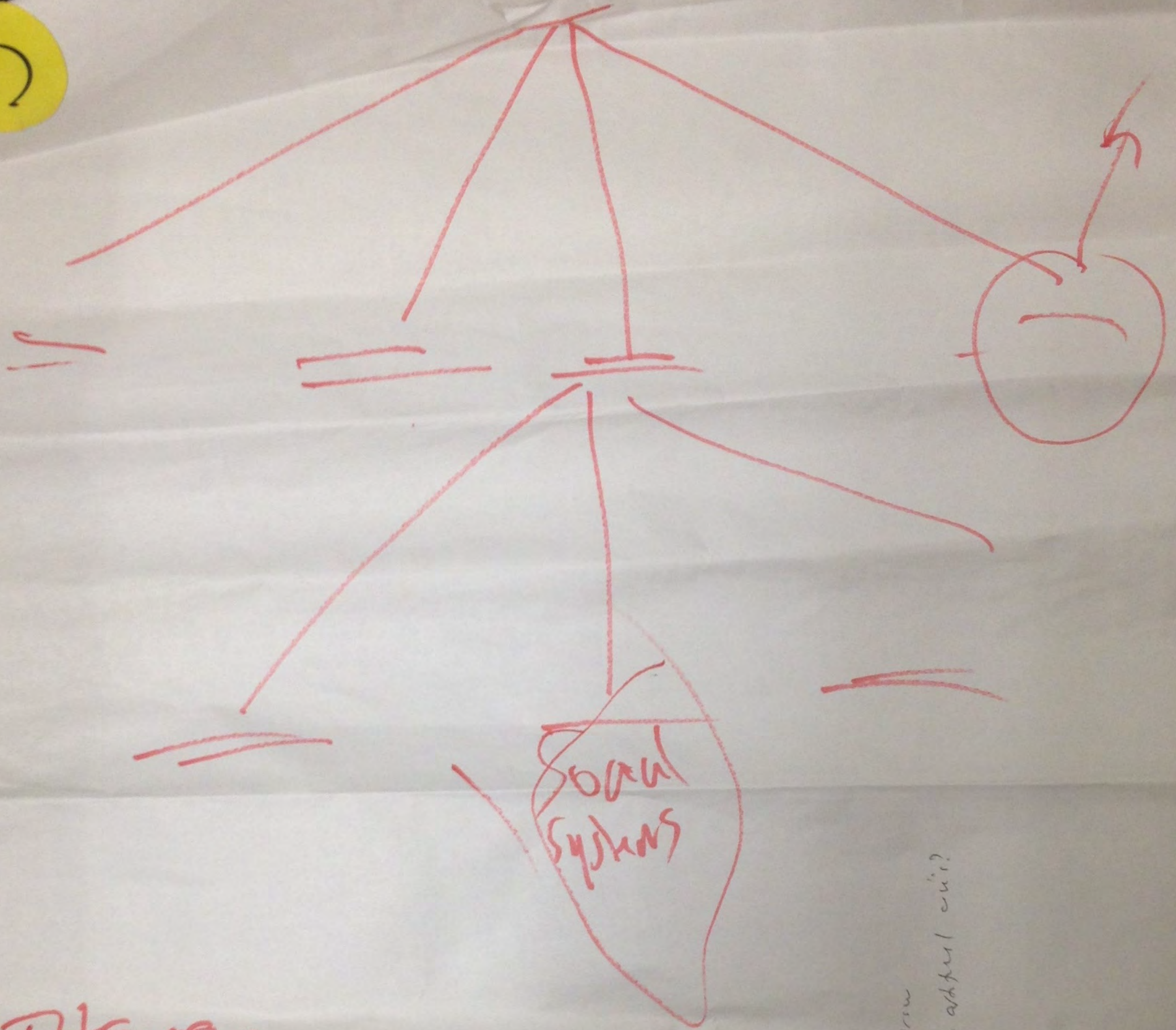
"Why" → function

Axioms

Frankenstein



	Consciousness Level	Consciousness-type
Humans	3	B
Humans + Networked Machines	3	A, C
Networked machines only	2	
dog	1	

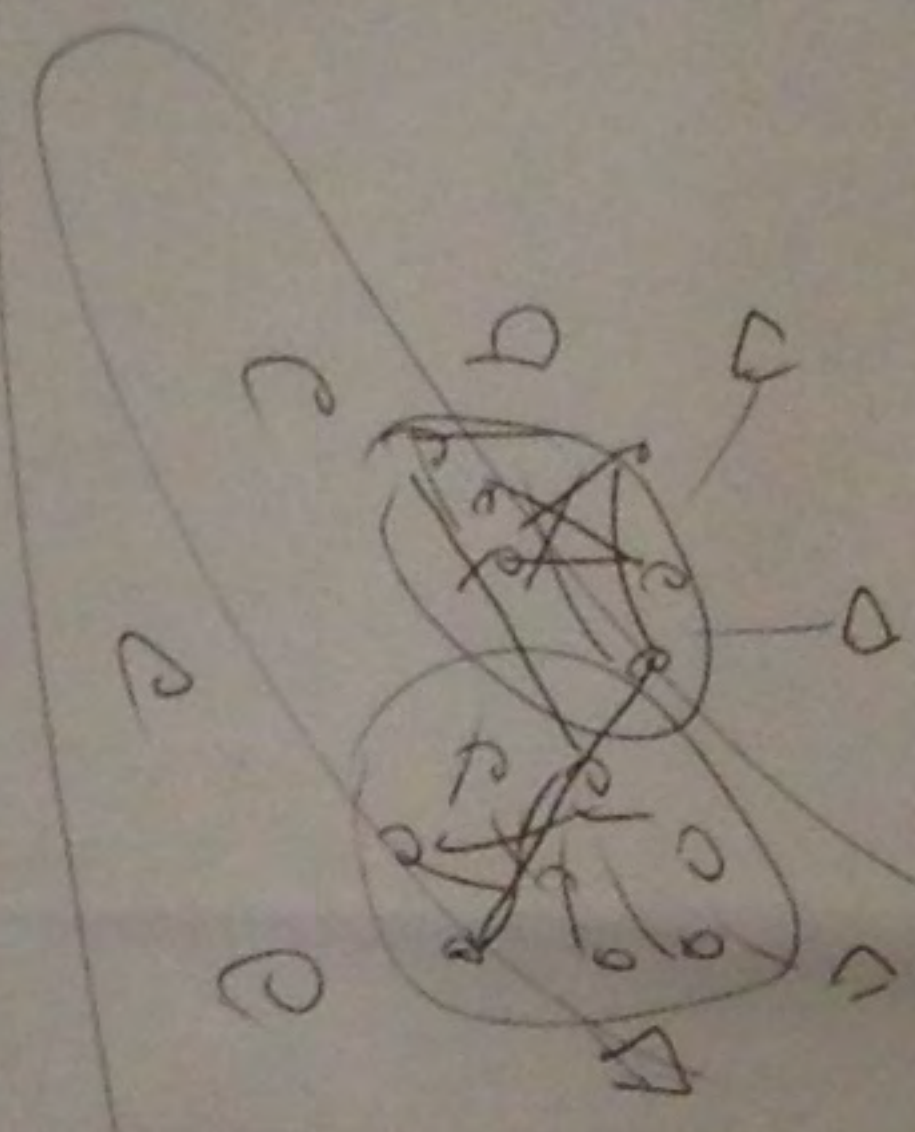


THEMES
METHODS
UNITS OF ANALYSIS

Unification

Life → death
artificial life → artificial unit?

Why IT cannot prove or disprove what consciousness is and what it would be



autonomous movement

Networked ~~vert~~ Cognition

Integrative

Networked
Integrative

Interactive

Distributed

Embodied

Situated

Self-similar

Dynamic

Evolutionary

MAKING

phys-

activity

EXPERIMENTATION

analysis

data

ASKING

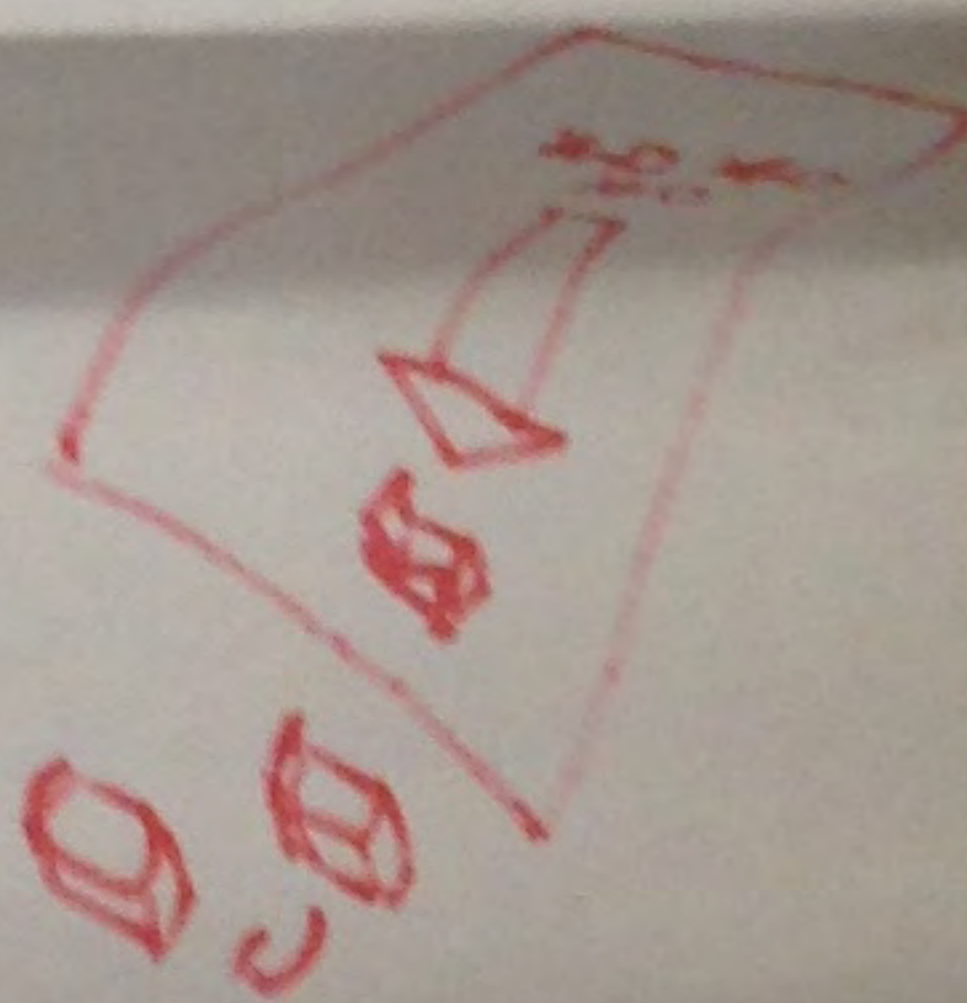
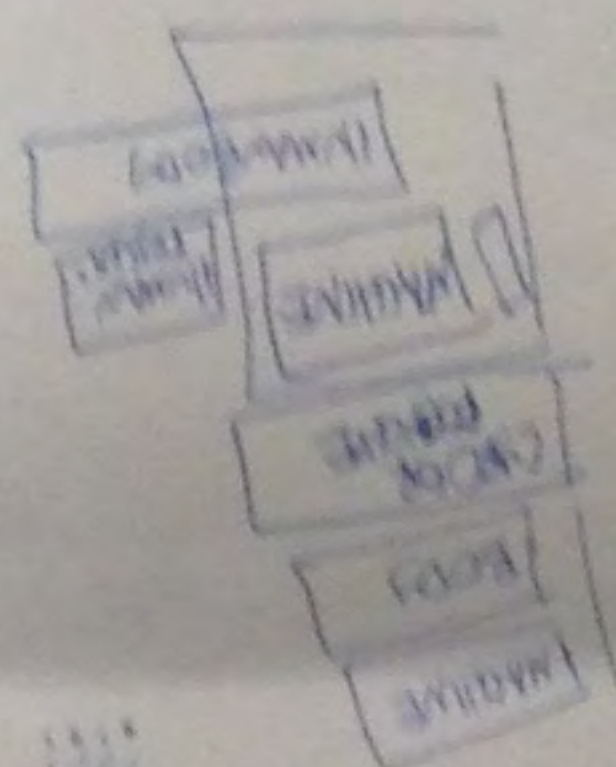
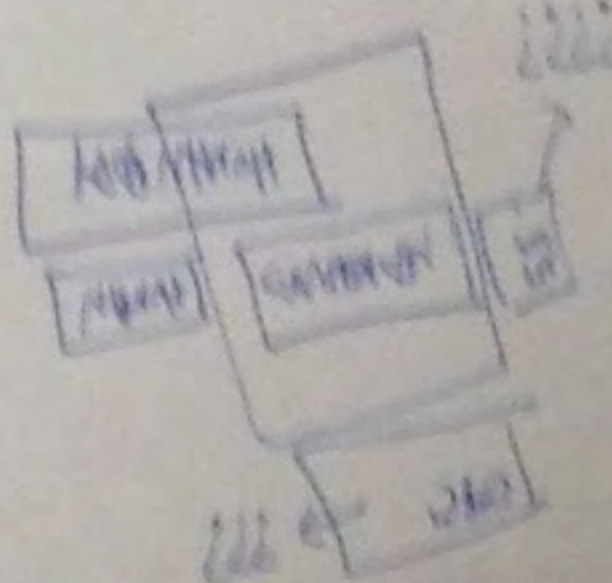
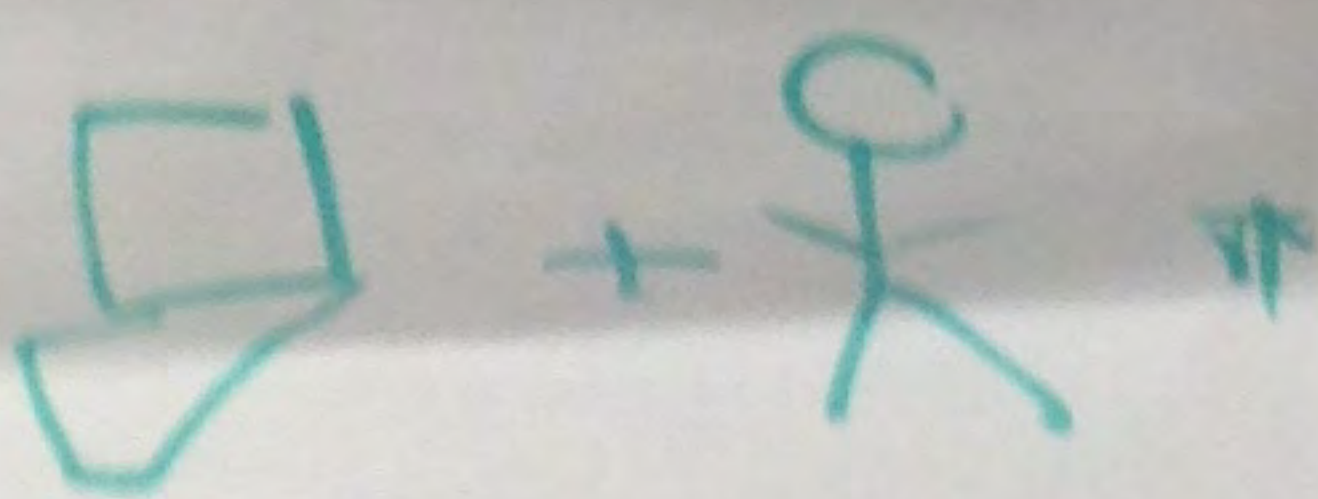
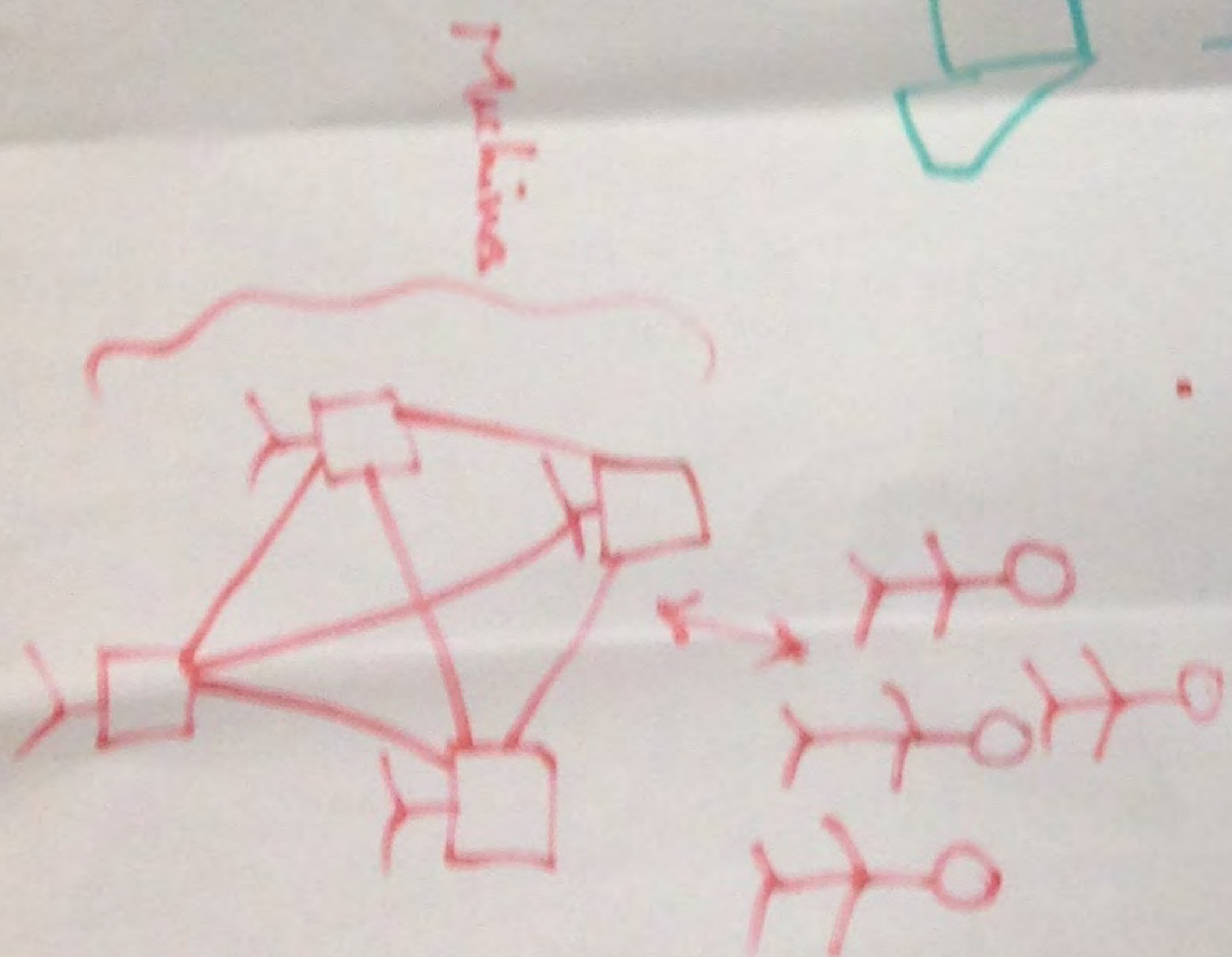
complex

process

de spanning

archiving
inspiring

WRITING



CONS.

Behavior

Self-organized

① Emergence

② Self-initiated

③ acting on environment

Network

① globally

② mainly parallel

③ small worldness

④ hierarchies

⑤ gradual degradation

Cogn

① network

② self-organization

Physical

① spin motor loop

② enantiom

|| ||

WE RAISE OUR CONSCIOUSNESS

STATES OF SENTIENCE + AWARENESS

(Nathaniel)

Neuroscience (Seale) the brain can't consciousness

But raised of emergent properties

Seat of consciousness

COMPUTATION

Cognitive Study # - models of human mental process

proposals that solve problems

tools as stimuli + extensions (improvements on our ability)

MIND / CONSCIOUSNESS

- Self
- others
- tools
- environment

interacting with the social

look beyond biology

consciousness at nonorganic

tools

tools

tools

tools

tools

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tools

tools

Each is a unit process for meaning

Some tools

process + compute

whole distributed system

AI

Internet

Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

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Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

Cognitive

But

tools

function

mediate

process

compute

whole distributed system

AI

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Agree on:

1) Humans $\approx$ prefrontal cortex
~~Take~~ Network computer $\rightarrow$ Visual cortex
Sensory motor

2) Sharing of consciousness?

3) Internet is ~~not~~ conscious BY ITSELF

4) Interaction

PSYCHE
BIO

 $\approx$

PSYCHE
PHYSIOLOGY

5) Internet is not just computers,
it also has people

6) We agreed that certain questions
were useful and interesting.

7) Some questions are more difficult

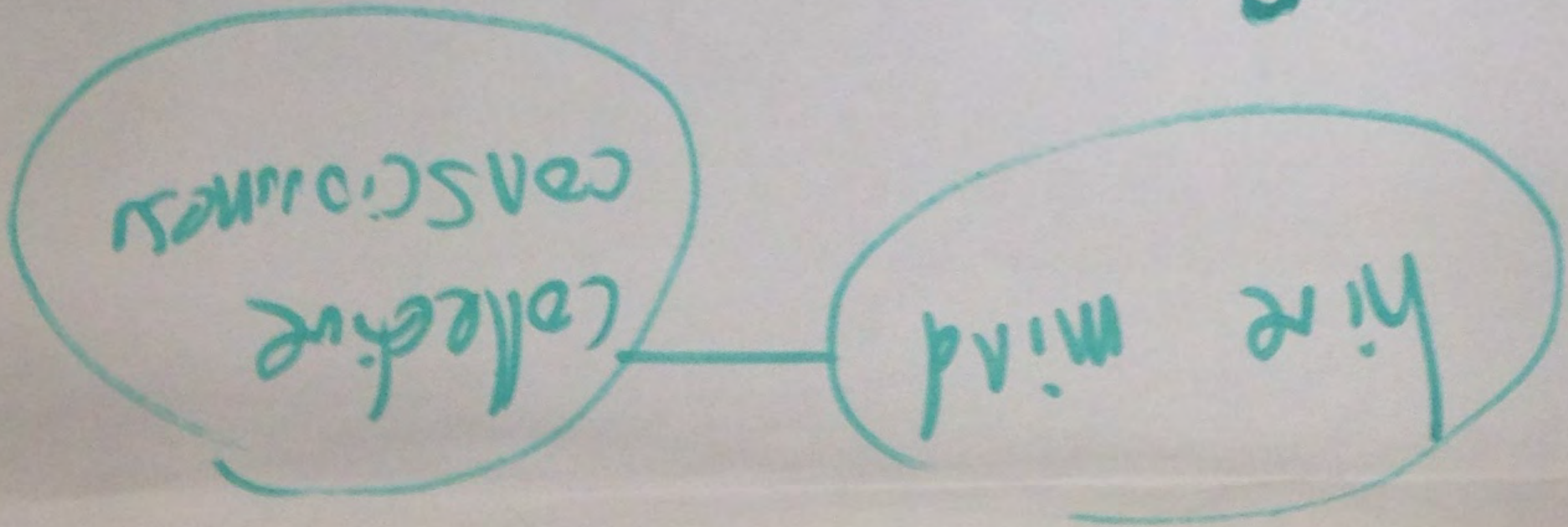
8) ~~sub~~ subsystems might be a more
fruitful thing to look at

9) The environment plays a role
rather "as a whole"
(it is a whole) we are deeply connected

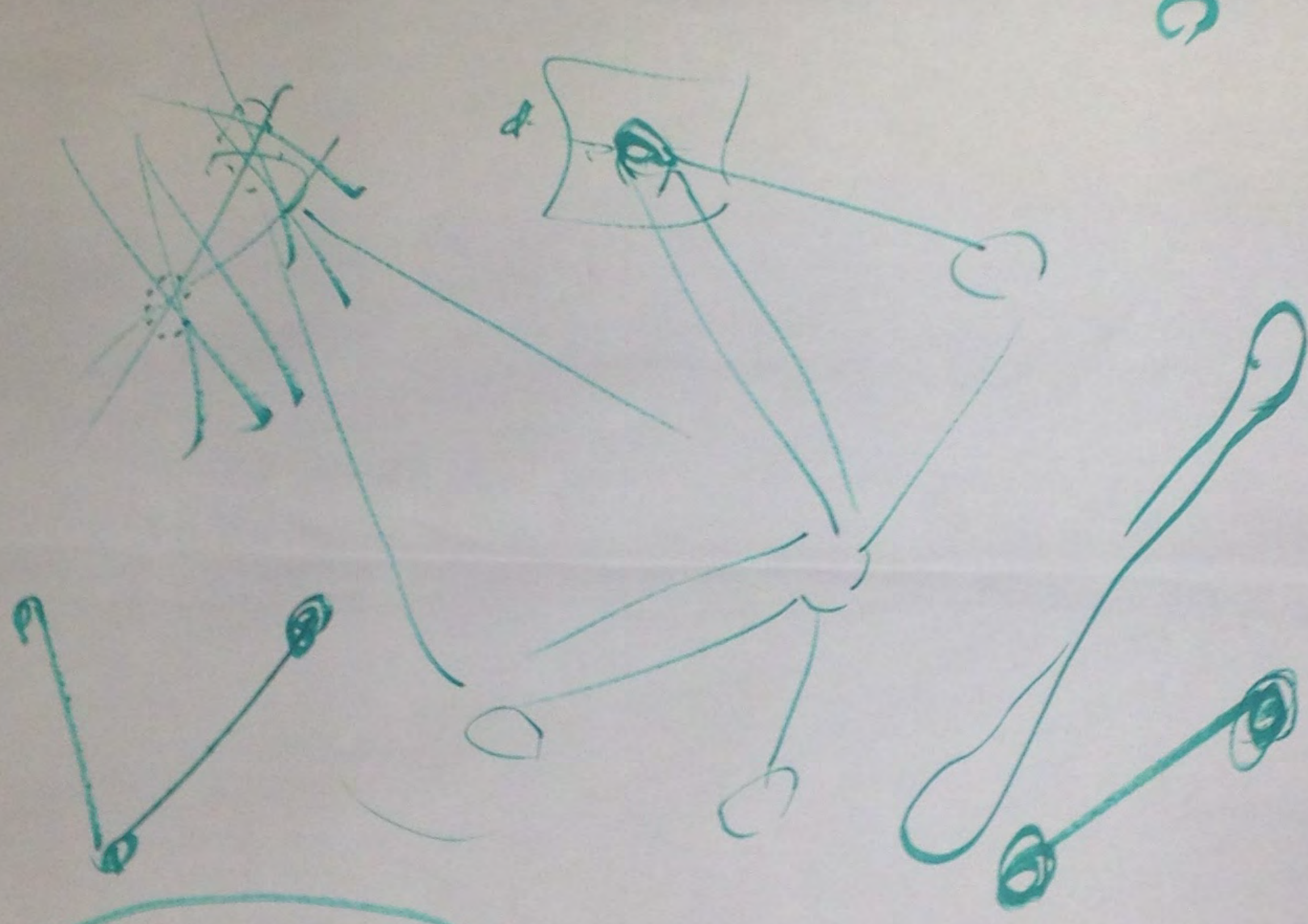
10) Where do we draw boundaries, where do we
draw lines?

Content Cor
State

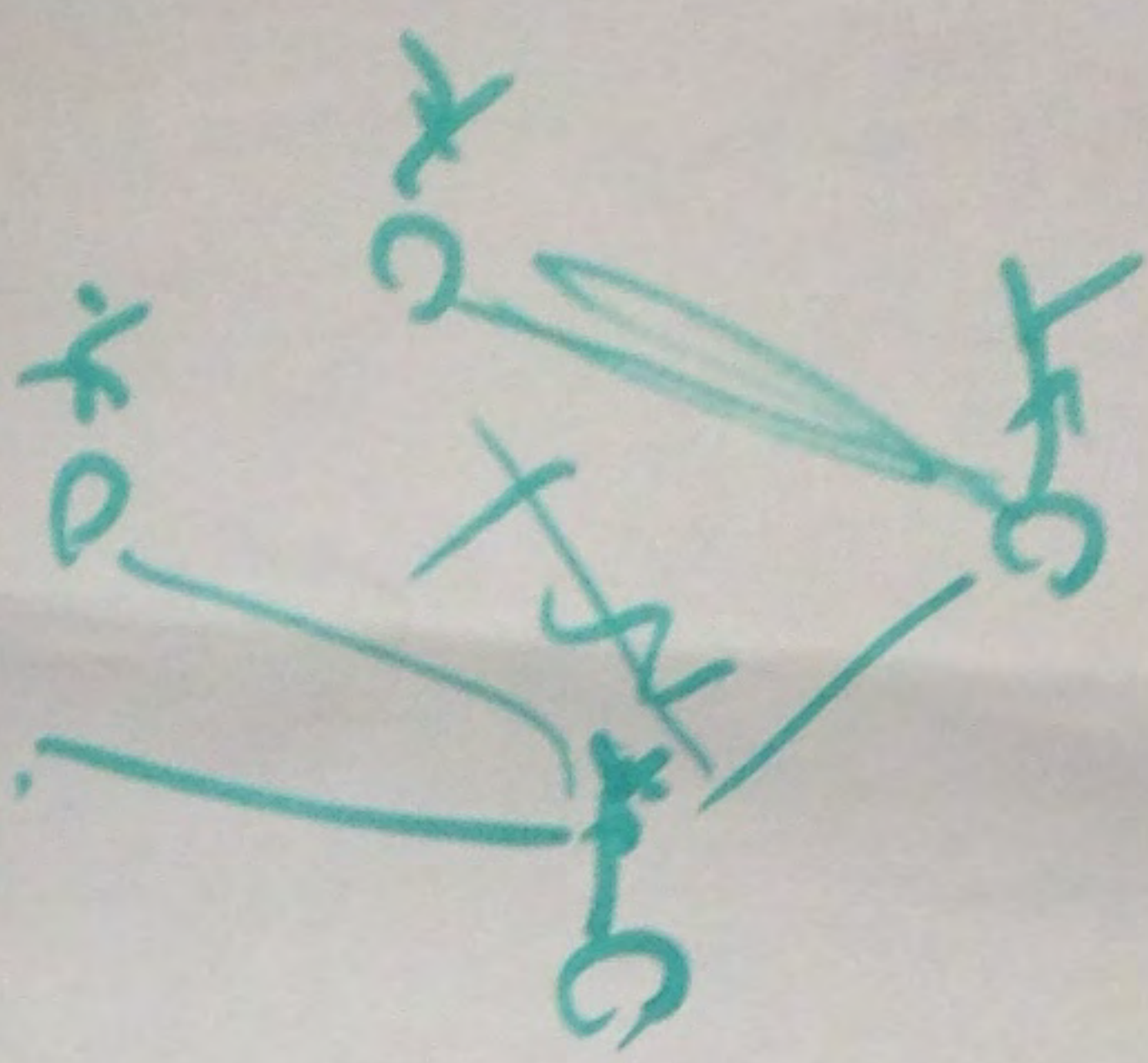
plasticity



Speed
Scope
Persistence



Memor
mental operations



humans
for
humans

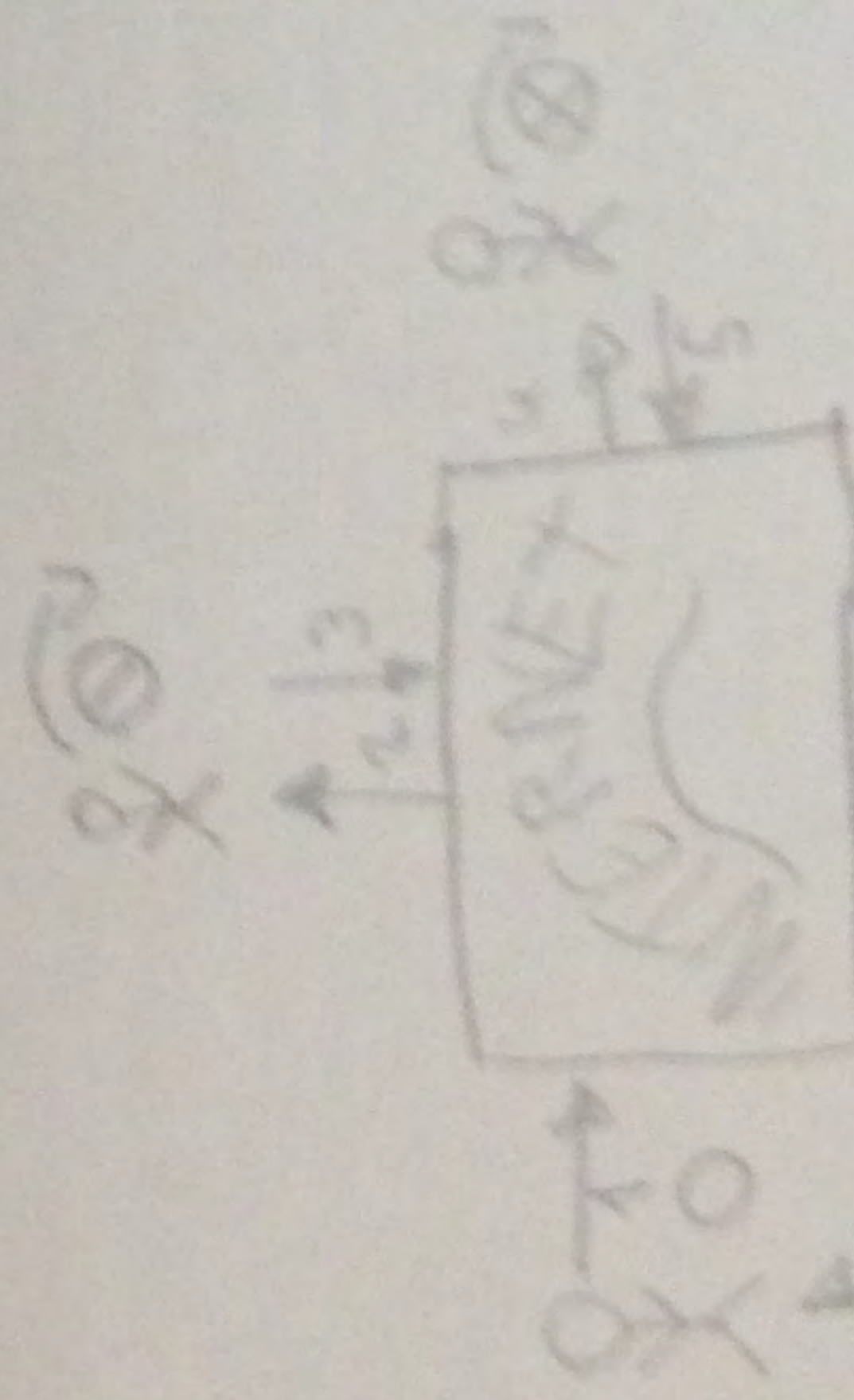


- ① altruism / self-sacrifice
- ② massive parallel
- ③ special roles?
- ④ plausibility
- ⑤ ~~play~~ sensorimotor loop
- ⑥ environment
- ⑦ meta cognition
- ⑧ self awareness

① observe patterns
qualitative
analysis

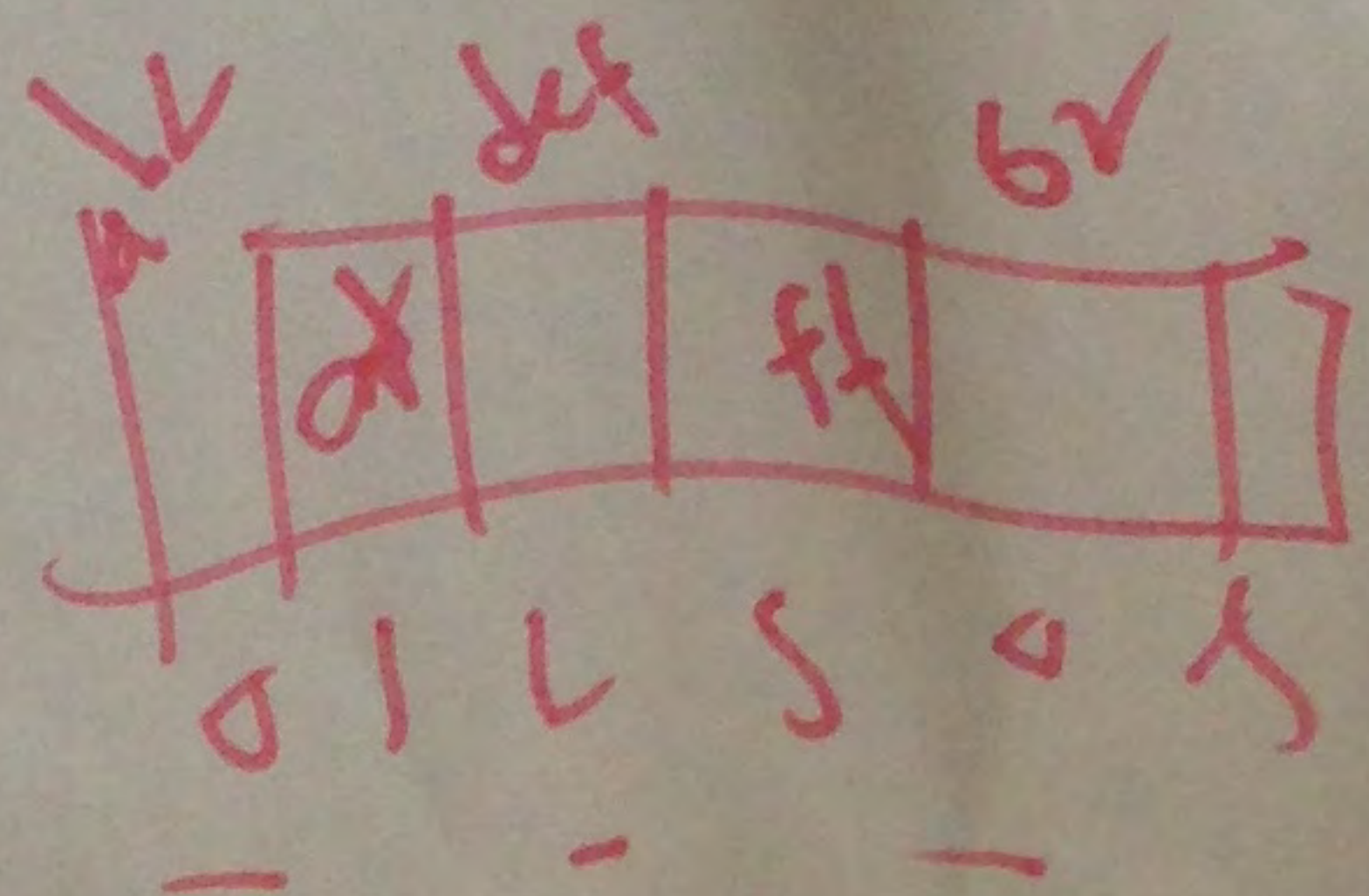
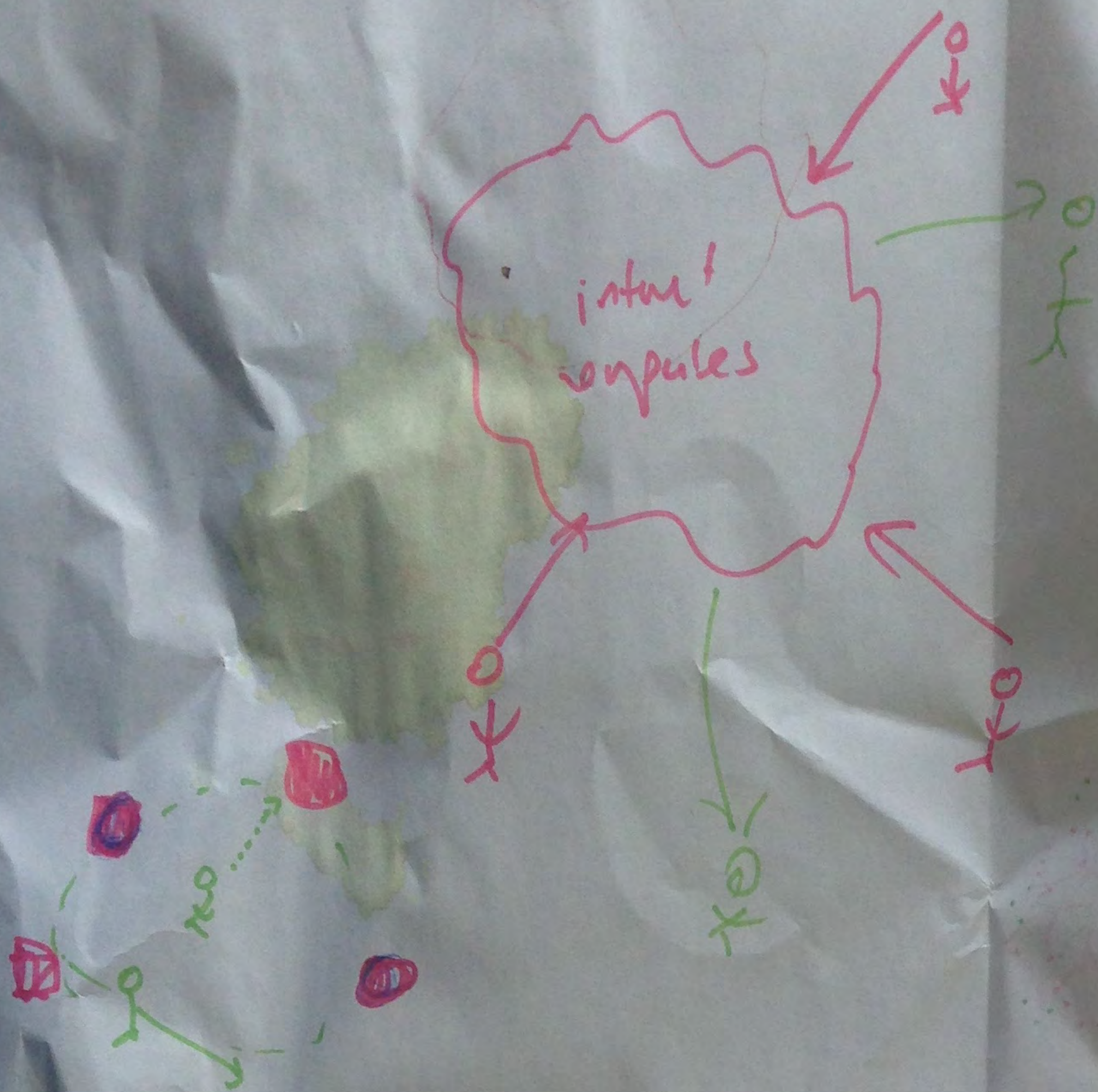


LOW-CATEGORY MIND BEHAVIOUR
THROUGH NETWORK EFFECTS



Individual = low network

Modification of behaviour
Perception



abc
== cat ==
def
== ff ==
or



Group and Individual Reflections

Original Filename

2016.08.17 - GroupAndIndividualReflections.pdf

Date

17 August 2016

Authors

Workshop facilitators and participants

Project report

Individual summaries

Ali

Starting with are networks becoming conscious

Tackling the 'hard question' initially we felt required trying to find an agreed perspective or view on which brought up a lot of questions:

Consciousness

What is consciousness

- What do we look for in a conscious being
- What is required in order for consciousness to exist
- How do we know if something is conscious
- Is consciousness inherent
- Is it a property / product of a material (brain) living thing

Although other levels of consciousness were considered we initially focused on what we look for in humans as this was considered a conscious being and so human standards and models were considered primarily :

We identified a series of human consciousness markers or identifying features of consciousness:

Consciousness - Perceiving oneself being self aware of oneself as a complex system and within time / space

Distinguish between self and other

Consciousness:

- Self awareness (visual) – we are talking about giving a prime - images and words presented creates response for conscious and unconscious vision
- Free Will
- Strategic Control
- Proactive / initiating action or actions (Agency)
- Plasticity
- Small worldness
- Massively Parallel (multiple neurons in humans – not anywhere near)
- Making Tools
- Specialisation
- Sensory motor loop (slime mold)
- Empathetic power

We talked about the stages in evolution of human development in which consciousness and cognition developed and the importance of environment – embodiment in relation to the above alongside survival

Some of which were also considered signifiers of intelligence and issues around cognition theories, information theories, integration / distribution, consciousness theories, social theories, AI theories, Philosophy – dualismAll came into play.

We considered the following :

1. Its not conscious
2. Conscious by itself
3. symbiotic
4. An extension of our consciousness (reflection of)
5. Helps form the connection of group mind (collective / hive)
6. Potentially conscious

We tried to consider experiments that are used in human / animal tests that could potentially be transposed into a test for consciousness in the internet (network) that could illicit these findings within the internet of these human consciousness indicators:

We considered models and tests used to:

- Agitate, excite, tickle and provoke the network
- Get a communication

Tests considered:

- Red dot mirror test

Etc

However we were trying to talk / consider to the machine / internet as though it were human

And we needed to clarify what we meant by the internet or the network that we were exploring:

What is the internet (network)

- Mechanical Device
- Software / programs / online devices
- Worms / viruses etc
- Internet of things
- Humans
- Environment internet
- Environment human
- Artificial intelligence artificial
- Information
- Networks / systems
- Psychic overlaps

Relationships of consciousness – social models and ideas

Simbiotic

Interdependent / connected

Shared /distributed....

Collective

Multi processing

Layered

Anologie

Flows of content between elements of the network (human – artifact.....)– information sharing – transforming (enriched or disrupted)

We talked about the internet as both an environment / host and potential entity

And again went back to levels of consciousness

We all eventually said that we did not feel that the internet could be considered conscious in human terms currently – but perhaps could have a different level of consciousness or be a potential environment for emerging consciousness / life form (virtual) and may have some of the features necessary to be perceived as conscious in human terms

However current terms – information rich – meaning poor - Could it (the network) be overloaded.....

We felt that a worm or virus (non hostile) was the closest to an organism existing in the internet that could represent some model of: LIFE / Consciousness and could be explored further

the worm fits well, and there are some lovely parallels between the Worm as a virus - and other areas that we are looking at:

Potentially the internet only being able to support or having - a lower level of consciousness at this stage of its evolution.

And in looking at the current developments in the ability to create artificial life, being in its early stages of development, they can reprogram at DNA level (visually a worm like structure!) but at this stage can only implement this at the level of bacteria and Algae at this stage - so heading towards a worm)perhaps would be an ambition!

Also on a different note: The words that Roger said in his talk about how we were information poor and meaning rich and are now information rich and meaning poor keeps coming to mind.

Perhaps we should let it sleep and evolve

A model emerged that showed the interactive and symbiotic interconnected relationship and ways of viewing our multiple thoughts and ideas – that seemed to be more of a model of cognition and potential consciousness model

- Looking at the following areas:
- Distributive cognitive systems (people – tools – artefacts - environment)
- Integrated information theory
- Virtual Worms / trojans / virus (algae rather than parasite) the most sophisticated version Artificial life Craig Ventere

Question

Does it need to be alive to be conscious in order to have artificial consciousness does it need artificial life.

The states of the machine / network / human hybrid

Stages of evolution and the meme and the treme as as the 3rd stage (consciousness in human terms is an illusion)

- Pre Biology – chemistry – membrane - cell (current state of internet 'consciousness)
- Gene (fundamental Evolutionary algorithm) – humans are not the designers design emerges
- Meme / memes – emergence of self and illusion of consciousness – 'constructed' concepts – god self – separate.....all memes still are generated from the bottom up
- Treme – still constructed from the bottom up undepining – but memes construct (think they design with god like illusion) tremes – machines – programs – software that initially is in our image (aspects of our cognition process – activities) when it becomes autonomous..... It or parts of it

This created from humans at a point of illusion when they are behaving in the image of a god that they constructed in there disembodied – big brain thinking – to extend their brains further – it was constructed without awareness – not only a reflection of a disembodied mind – with a dislocated body now in pieces – but a fragmented reflection of the whole system – of the evolutionary algorithm in all its parts but both in indigenous form

So it may well become a host for or emerge an human illusion consciousness or consciousness in other levels all underpinned by Evolutionary algorithm and design up notion (Artificial – human – meme construction)

- Artificial 'consciousness' human form modeled on (but fractured) meme
- Artificial and human 'consciousness' – merging not indigenous (treme)
- Artificial or authentic indigenous emergence (evolutionary algorithm in actual material of the whole)

BUT treme needs to be able to replicate and adapt itself in order to become...

Dark view of a future in which we are enslaved to the construction and may well become defunct

Doris

- We started from different, diverging conceptualisations of the Internet consciousness:
 1. it exists by itself
 2. it includes the people in a symbiotic manner (Internet = networks + people)
 3. it is an extension of people's consciousness (people borrow a part of their own consciousness to the Internet)
 4. People and the internet are different parts of an organism that has a consciousness (the Internet = basic sensory-motor cortices; humans – prefrontal cortex)

The Distributed Cognition Theory - In distributed cognition, one expects to find a system that can dynamically configure itself to bring subsystems into coordination to accomplish various functions.

—Cognitive processes may be distributed across the members of a social group.

—Cognitive processes may involve coordination between internal and external (material or environmental) structure. —Processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events.

Permitting the boundary of the unit of analysis to move out beyond the skin situates the individual as an element in a complex cultural environment

We tried to find objective signs/signatures of consciousness at the Internet, starting from the human markers of consciousness (see shared doc below). We arrived at the conclusion that there is no experimental way (with the current methods) to test these markers for the internet.

An important difference must be discussed – **internet as an entity vs internet as an environment**. As it turns out, just like humans (who are entities, with a body that is an environment for bacteria and other organisms) the internet can be conceptualised as an entity that hosts a wide array of virtual organisms (viruses, worms etc.).

!!! Include Illustration of the Internet as an environment

Now, starting from the distributed cognition theory and the dynamic systems theory, we arrived at a cognitive model of the Internet.

This model includes the representation of 2 elements:

1. The relationship between 3 different systems – the Effective Environment, The Human System and the Machine System – from the perspective of the Dynamic Systems Theory, people are set in an environment with which they continuously interact and that changes in response to people change

The internet interacts with people, people interact with the environment, and the Internet interacts with the environment – all in a reciprocal manner that results in changes for all the sides. All 3 systems co-evolve in a reciprocal interactive manner.

2. The flow of content between people and the Internet – people put information into the hardware components of the Internet. This hardware turns content into numbers, info that is included into the cloud/into the Internet network. This information is transformed, combined and multiplied by the networks and provided to people.

Now, people not only put information into the network, but they also take out information.

The information they take out, is NOT the one they put in (it is transfigured inside the network, as it makes contact with other information coming from other people).

This flow of content is selective – people selectively process and take out info from the system and they send back in information in a selective manner, contributing to the evolutionary selection of **tremes**.

This process has 2 processes within it:

1. The process of transforming the information by the network

2. The process of selectively attending to and distributing of information from the network by people.

Diego

Honour the room. Inspired by functionalist theories of consciousness, such as Tononi's information integration theory and Baars' Global Neural Workspace theory, the starting point of this project was the question of whether highly-connected networks (such as the Internet) were (becoming) conscious. I hope you agree that it's a bit ambitious to try to treat this as the primary research question for a one-week summer school. And it's really best to take this as a provocation rather than an actual research question. Because the goal of this project was to come up with a research proposal that everyone could take away with them and serve as the basis for future work.

Results

Theoretical model

We have a distributed, situated cognitive model of information. Elements of the model include humans and computers situated in an effective environment. The model is able to clarify some of the contradictions in typical thinking about the internet:

- **Ontology:** is the Internet an agent, a collection of agents, or an environment (as Sue) for agents? The answer is yes to all three; the model describes how this might be so, depending on how you "slice and dice" the model..
- **Agency:** The model also resolves some of the questions around how machines affects our interpretation of technology-mediated human agency (Latour). Are machines an extensions of people? Are machines in a co-evolutionary relationship with humans? The model shows that both are true inasmuch as (again) they are different way to slice and dice the model.

- **Scale:** The model is self-similar across scales. The self similarity can be explained in terms of replicant theory: replicants such as genes, memes, and tremes are translated; the translation boundaries correspond to hierarchical boundaries.
- **Dynamic change:** The model retrodicts and predicts Internet behaviour across time. These retrodictions and predictions are also related to scale (see previous point). The Internet of Things affects how the changes across space and time will be.

The model is model of distributed cognition, *not* consciousness. We suggest, however, that further analysis and refinement of the model *might* reveal it to be a useful model for distributed and situated consciousness. The reason we shied away from claiming a model of consciousness is *not* because of the ‘hard problem’ of how qualia arises from matter, but because of another phenomenological obstacle: only I can assert with absolute certainty than I am conscious at this moment. I can’t even do the same with you. Because a first-person perspective is necessary for any certainty of consciousness, and anything else is only a really, really good guess. Consciousness can only be asserted by those that are conscious (cf. Tononi). And this is “the harder problem”.

Experimental paradigm

We did *not* come up with an experimental paradigm. however, our model is sufficiently complete and general enough to be subjected to, say, IIT analysis. However, we are ambiguous about IIT’s assertion that its ontological postulates are sufficient and necessary conditions for the phenomenological axioms. However, until “the Internet” (or its inhabitants) asserts their own consciousness (cf. IIT phenomenological axiom 1), and unless we can interpret their response, we reject that measure of consciousness of the Internet may simply be computable via IIT.

Playful serious exploration

We are trying to hasten the ability of citizens of the Internet to assert their consciousness. Hence, the worm!

Process

- We split the project into three components: Theory, Experimenting, Making
- Experimental model
 -
- Theory
 - Consciousness
 - Definitions of consciousness
 - We started with definitions of consciousness from cognitive neuroscience and psychology, and explored whether these definitions could make sense to networks.
 - We struggled with making the distinctions between *consciousness-as-we-know-it* (CAWKI) versus *consciousness-as-it-might-be* (CAIMB), though we had not identified explicitly as such

- We struggled with the question of whether any one being can attribute consciousness in any other being (even other humans). Even the most
 - Consciousness and life: we explored the notion that life is a necessary property of consciousness (regardless of whether it's CAWKI or CAIMB)
- Networks
 - Definitions of the internet: We had conflicting definitions of the internet. Does it include people? Is it people + computers? Implicit in all of this was the attribution of agency to technology-mediated activity (Latour), resulting in conflicting interpretations of the relations between computers and people: Are machines an extensions of people? Are machines in a co-evolutionary relationship with humans?
- Experimenting
 - Methods: because our definitions were imprecise, we struggled with trying to devise
 - Empirical: we proposed a typology of markers of consciousness
 - Neural
 - Behavioural
 - Cognitive (self reports)
 - Physical
 - Speculative
 - Speculative anthropology

Mihaela

Theory

How self-awareness develops: the organism evolves as the psyche evolves (co-evolution).

Internet as	Which part of it	Keywords	Possible experiments
Group of {humans} extended by/expressed by {machines}	Part of it	Social networks	
	All of it	Collective human consciousness (?)	
{humans + machines} communicating with each other	Part of it	Cyborg	
	All of it	"The Borg"	

{machines} communicating with each other	Part of it	A community of artificial consciousnesses	
	All of it	A single artificial consciousness	

Mememes and treemes

Markers of consciousness?

- Behavioural
 - Self-initiated
 - Strategic control
- Neural/'Networkial'
 - Plasticity
 - Massive parallel
 - Small worldness
 - Hierarchical
 - Capable of graceful degradation
- Cognitive
 - *Metacognition*
 - *Self-awareness*
 - *Awareness of the environment*
 - *'Free will'*
 - *Belief*
 - *Intentions*
 - *Desires*
- Physiological
 - *Sensorimotor loop*
 - *Existing and manipulates an environment*

The Wikipedia case

- Does Wikipedia have metacognition? How would you decide?
- Does Wikipedia have self-awareness?
- Does Wikipedia have beliefs?
- Does Wikipedia have intentions?
- Does Wikipedia have desires?
- Does Wikipedia have a sensori-motor loop?
- Does Wikipedia exist

- Is Wikipedia aware of its environment?

Questions:

- What is consciousness?
- What is the nature of the relationship between people and the networked computers?
And what sort or level of consciousness might exist in this relationship?
- What are plausible explanatory models for postulating that the Internet is conscious?
 - IIT
 - Distributed Consciousness Theory (DCT)
 - Artificial life and artificial consciousness
- Why is it plausible?
 -
- Is the Internet an environment for consciousness?
 - Is the Internet an environment for conscious entities to exist?
 - Is the Internet an environment for *emerging* consciousness?
 - Are there existing conscious entities already “living” in the Internet?
 - How can we test these questions?
 - Can we unleash something in the Internet that can become conscious?
- Can we make the Internet conscious?
- To what extent is the Plymouth University intranet conscious?

Experiments

Experiments from psychology

- Subjective reports
 - “Are you conscious?”
- Behavioural observation
 - Command following
- Self-awareness tests
 - Mirror tests (in babies)
- Awareness of the environment tests
 - Response Priming tasks
- Multistable perception

Experiments from neuroscience

- Neural signature
 - fMRI ‘maps’ as signature of awareness
 - EEG rhythms as markers of awareness
- Perturbing (TMS experiment)
- Destroying

- If Internet = Hardware + Firmware + Software, then
 -
- If Internet = Hardware + Firmware + Software + People, then
 -

Making

Factors for consciousness?

- (i) Awareness:

Overview

1. What is the Internet? How we define it? - what is its environment?
 - The Internet might actually be an environment in which (presupposedly) conscious beings/programs might reside/appear. It consists of numerous computers, highly connected to each other. Each human contributes with a part of its own consciousness/information to the Internet's consciousness/information. This information, that is put in by every person, combines in a way that becomes different from its initial state (eg. If we want to take out the 20% that we put in, we will get it in another form, combined with the information put in by others - One person contributes to a Wikipedia article with 20% of its knowledge. That information will combine with other information put in by other people. If you search for the 20% that you put in, you will get back a different, combined version of it). Now, a program created by a person can access a part of this information and bring it back in a form that corresponds with the requirements of the person running the program (the guy's program that searches for meaningful sentences coming out of Wikipedia articles analysis) - this program might be a 'creature' that resides in this environment that is the Internet.
2. What kind of sample do we use? What size?
 - We might test these programs/virtual entities that reside in the Internet, that might present conscious behavior
3. What kind of measurements do we use?

Sand Box

Each individual makes an Psychic (?consciousness?) investment we place a percentage of into the machine and this forms its psychic system (?consciousness? true or virtual / artificial) of the machine - Symbiotic / collective / hive / hybrid

The model (Overview) is for shared somantic knowledge – distributed somantic knowledge.

To what extent can we say that this could serve for a model for consciousness if we put forward the question that the environment could be an environment for consciousness (in human form or other levels) and that consciousness may also be distributed and shared in the same ways as information in this model.

Looking at the following areas:

Distributive cognitive systems/Dynamical systems

Integrated information theory

Virtual Worms / trojans / virus (algae rather than parasite) the most sophisticated version

Artificial life Craig Venter

Question

Does it need to be alive to be conscious in order to have artificial consciousness does it need artificial life.

Dynamical systems?

Making a parallel with human cognition and inspired by dynamical systems we consider that consciousness happens continuously and in real time. Breaking down the processes into discrete time steps may not fully capture the phenomenon.

An alternative approach is to define the artificial consciousness of the internet as:

- (1) a state of the system at any given time
- (2) a phenomenon, defined as the change over time in overall state
- (3) a state set or **state space**, representing the totality of overall states the system could be in (2).

The system is distinguished by the fact that all of these states belong together; that is, a change in any aspect of the system depends on other aspects of the system (3).

2) van Gelder, T. (1998). The dynamical hypothesis in cognitive science. Behavioral and Brain Sciences, 21, 615-665.

(3) van Gelder, T. & Port, R. F. (1995). It's about time: An overview of the dynamical Approach to cognition. In R.F. Port and T. van Gelder (Eds.), Mind as motion: Explorations in the Dynamics of Cognition. (pp. 1-43). Cambridge, MA: MIT Press.

Axioms:

(Self-evident truth about consciousness)

IIT Phenomenological Axioms

1. (My) consciousness exists
 2. (My) consciousness is structured
 3. (My) consciousness is informative
 4. (My) consciousness is integrated
 5. (My) consciousness is exclusive
 6. **Axiom 1 can only be postulated by those possessing consciousness**
-
- 1)
 - 2) Consciousness might be dependent on life (*Consciousness is a property of life.*)
 - 3) Consciousness exists in different states.
 - 4) States of consciousness are continuous.
-
- 5) Consciousness can only be described by beings who possess them.
 - 6) Descriptions of consciousness

Readings

- <http://www.architalbiol.org/aib/article/viewFile/15056/23165867>

Computers

Possible model of the "Consciousness Internet" - The Interactive Model of Consciousness

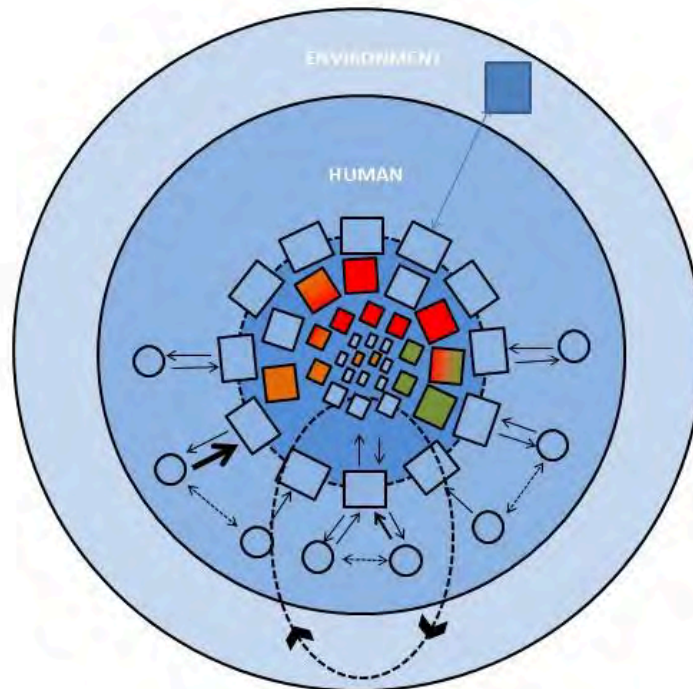
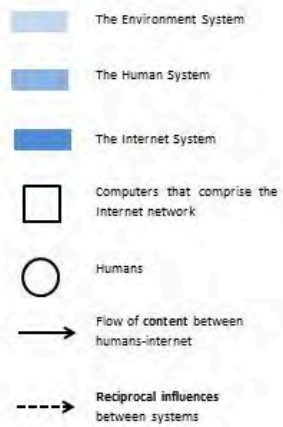
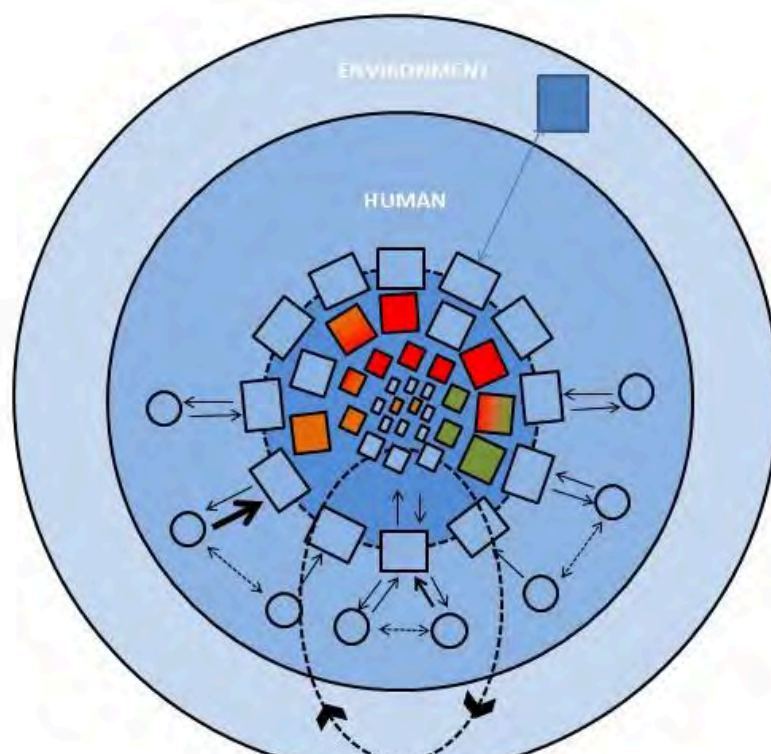
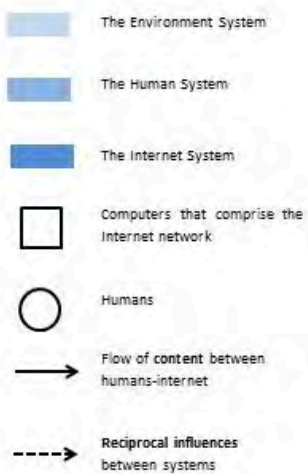


Figure 1. The interactive model of the Internet



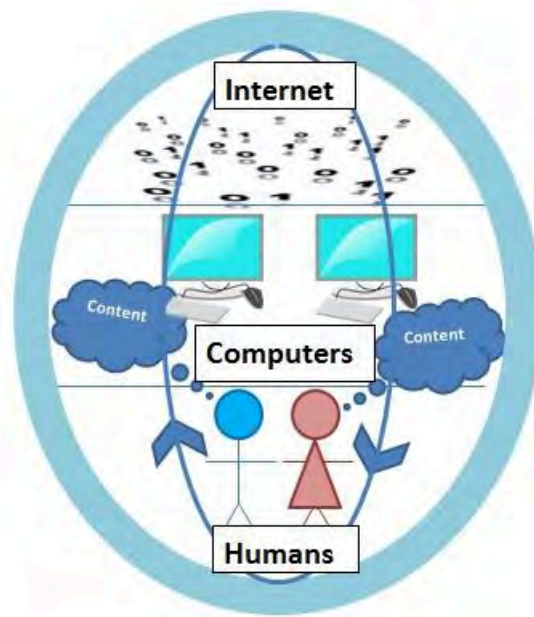


Figure 2. The flow of content between the Human System and the Internet System

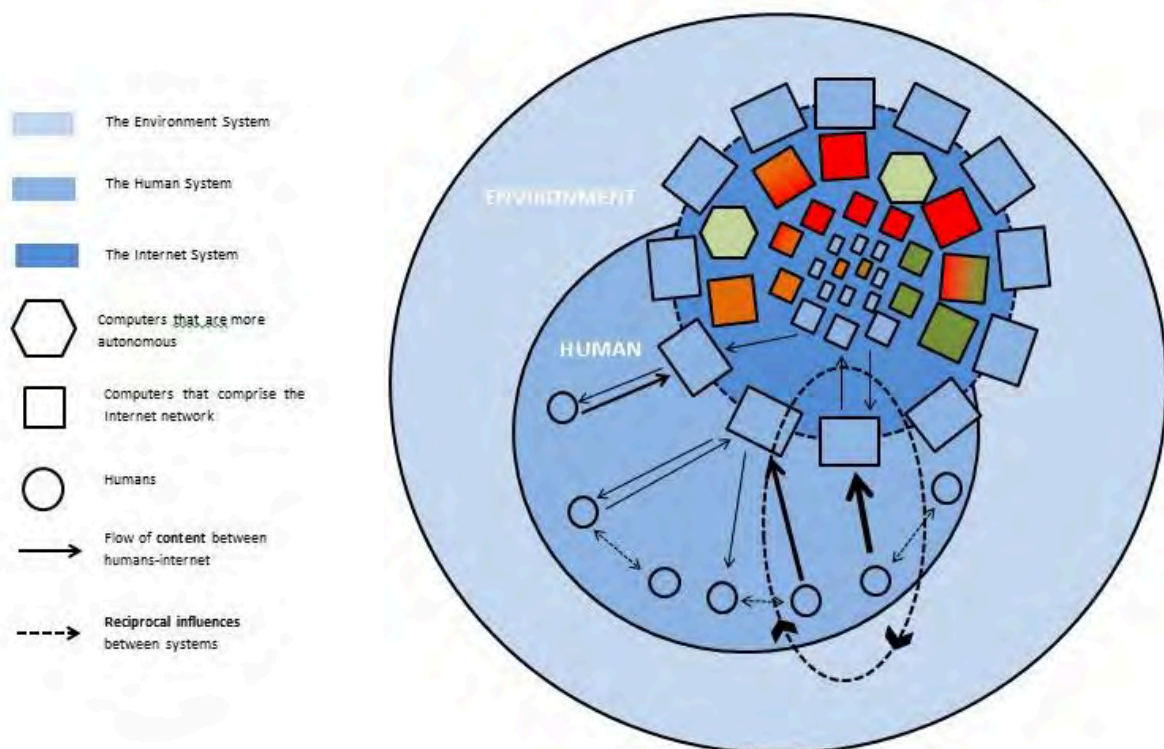


Figure 3. A model of a possible evolution of the Internet over time

An Embodied Perspective: Linking Embodied Cognition with Distributed Cognition

Original Filename

2016.08.24 - An embodied perspective_ Linking embodied cognition with distributed cognition.pdf

Date

Published on the workshop website 16 August 2016; PDF capture/print date 24 August 2016

Authors

Workshop facilitators and participants

Provenance

Originally published on the workshop website. Archived from <http://www.arenetworksconscious.com/blog/embodiedcognition/>



ARE NETWORKS (BECOMING) CONSCIOUS?

A ColLaboratoire Workshop



An embodied perspective: Linking embodied cognition with distributed cognition

The project started from the question of whether highly-connected networks (such as the Internet) could be said to be conscious, as some have suggested. Critics counter that connectedness is not sufficient for consciousness. For instance, a conscious agent must be situated within and in relationship to some kind of environment. Furthermore, according to situated, enactive, and embodied accounts of cognition, intelligence is not possible without a physical body. The mind, after all, is not (just) situated in the brain, and the sensorimotor dimensions of the body are essential components of consciousness. It has been suggested, for instance, that the reason why we have a nervous system in the first place was to make navigation and interaction with the physical world safer for the organism (move away from danger, move towards things that reinforce survival).

The networked consciousness hypothesis might be more plausible if we expand what we mean by “environment” (cf. the extended mind hypothesis) and if we try to imagine what might constitute the “body” of the network:

- **The body:** Consider a network that is connected to agents that do sense and act on the world, such as the Internet. If we consider the Internet to be not just a highly connected network of digital hardware, but also of humans, sensors, and actuators that interface with them (cf. the ‘Internet of Things’), could the Internet be understood to have a kind of sensorimotor system capable of sensing and acting on the physical world? In other words, what happens if we consider human users and other sensors and actuators as the Internet’s hands, arms, legs, and feet, as well as its ears, eyes, skin, noses, tongues? Can the Internet be modelled, for instance, like slime mold: simple in structure but exhibiting intelligent behavior? Can it sense not only its environment, but also aspects of itself?
- **The group mind:** Consider the growing number of channels of communication between individuals are creating increasingly sophisticated social networks. Could such social networks be seen as conscious ‘group minds’? Are these channels of communication as an extension of our minds, rather than a mind itself? Or is there an emergent and separate consciousness that arises?
- **The environment:** If we think of some network as a kind of intelligence, what is its environment? Are the other inhabitants of the environment, and if so, who are they? Is the environment located in a physical space, or is it another kind of space altogether? What, in other words, is the Internet organism’s *effective environment* (Clark, 1998)?

Other questions arise. For instance, can internet consciousness be measured? Indices of consciousness have been proposed (such as Tononi’s measure, ϕ). Such an index has been evaluated in different sleep/wake, anaesthesia-induced, and vegetative and brain-damaged patients. Could the method used in this case be adapted to measure potential internet consciousness? The basic idea is to measure the complexity of brain responses measured by EEG when stimulating the brain using TMS: i.e., a perturbation approach. What if you perturb the internet .. stimulate it in some way .. can you somehow track the complexity of the disturbances?

Still other questions arise. Does intelligent behaviour imply intelligence? Does intelligence imply consciousness?

These (and other questions) became the subject of the week-long workshop.

SHARE THIS:



8/24/2016

An embodied perspective: Linking embodied cognition with distributed cognition – Are Networks (Becoming) Conscious?

 August 16, 2016  Mihaela Taranu  Questions

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A Model of Distributed Human-Machine Cognition

Original Filename

2016.08.24 - DistributedHuman-MachineCognitionModel.pdf

Date

24 August 2016

Authors

Workshop participants

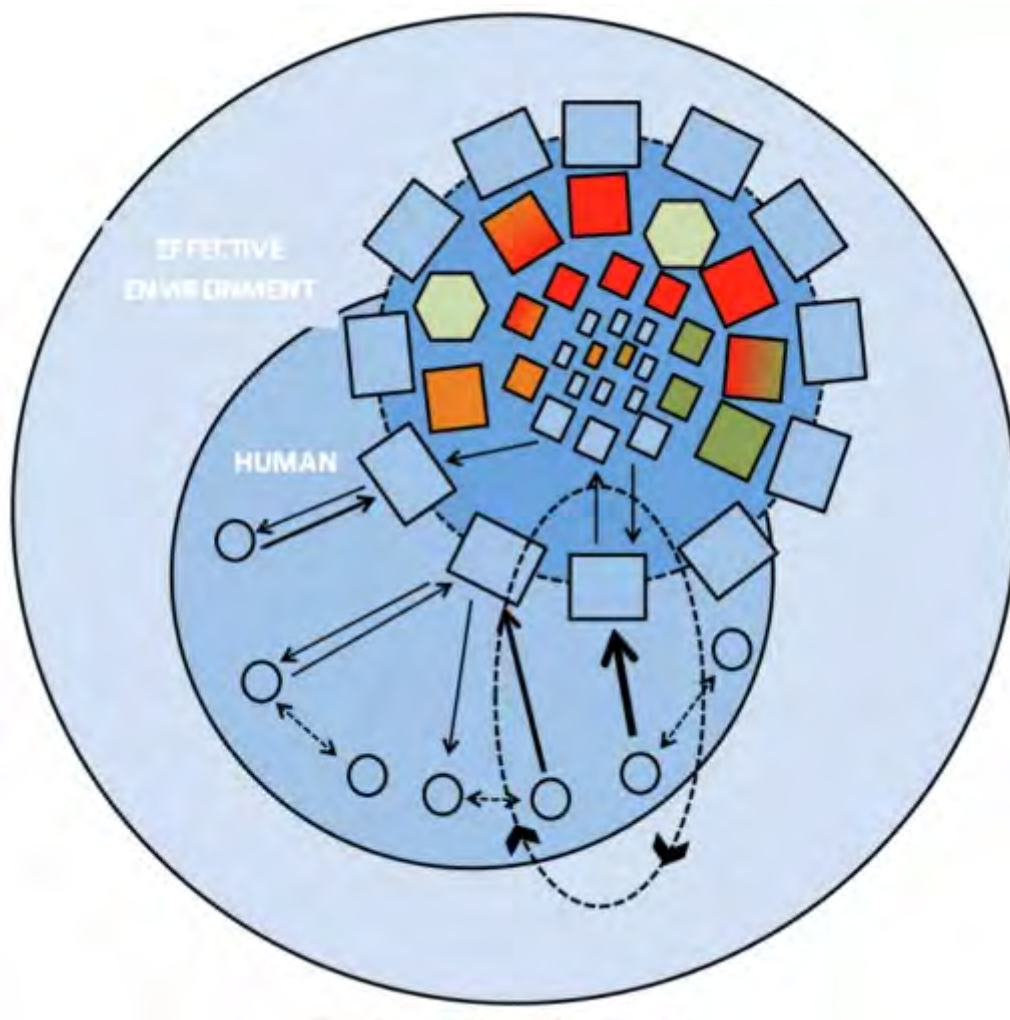
Provenance

Originally published on the workshop website. Archived from
<http://www.arenetworksconscious.com/blog/about/our-model/>



ARE NETWORKS (BECOMING) CONSCIOUS?

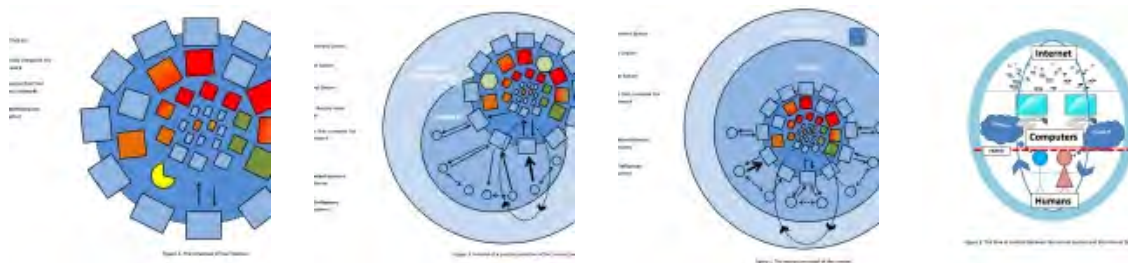
A ColLaboratoire Workshop



A Model of Distributed Human-Machine Cognition

One of the outputs of the workshop was a distributed cognitive model of information. (Well, it might actually be more than just that: it might be a distributed, situated, enactive, embodied, integrative model of cognition. We'll have to think more deeply about it, as we did only take one week to develop it!) Elements of the model include humans and computers situated in an effective environment. The model is able to clarify some of the contradictions in typical thinking about the internet:

- **Ontology:** is the Internet an agent, a collection of agents, or an environment (as Sue) for agents? The answer is yes to all three; the model describes how this might be so, depending on how you “slice and dice” the model..
- **Agency:** The model also resolves some of the questions around how machines affects our interpretation of technology-mediated human agency (Latour). Are machines an extensions of people? Are machines in a co-evolutionary relationship with humans? The model shows that both are true inasmuch as (again) they are different way to slice and dice the model.
- **Scale:** The model is self-similar across scales. The self similarity can be explained in terms of replicant theory: replicants such as genes, memes, and tremes are translated; the translation boundaries correspond to hierarchical boundaries.
- **Dynamic change:** The model retrodicts and predicts Internet behaviour across time. These retrodictions and predictions are also related to scale (see previous point). The Internet of Things affects how the changes across space and time will be.



The model is model of distributed cognition, *not* consciousness. We suggest, however, that further analysis and refinement of the model *might* reveal it to be a useful model for distributed and situated consciousness. The reason we shied away from claiming a model of consciousness is *not* because of the ‘hard problem’ of how qualia arises from matter, but because of another phenomenological obstacle: only I can assert with absolute certainty that I am conscious at this moment. I can’t even do the same with you. Because a first-person perspective is necessary for any certainty of consciousness, and anything else is only a really, really good guess. Consciousness can only be asserted by those that are conscious (cf. Tononi). And this is “the harder problem”.

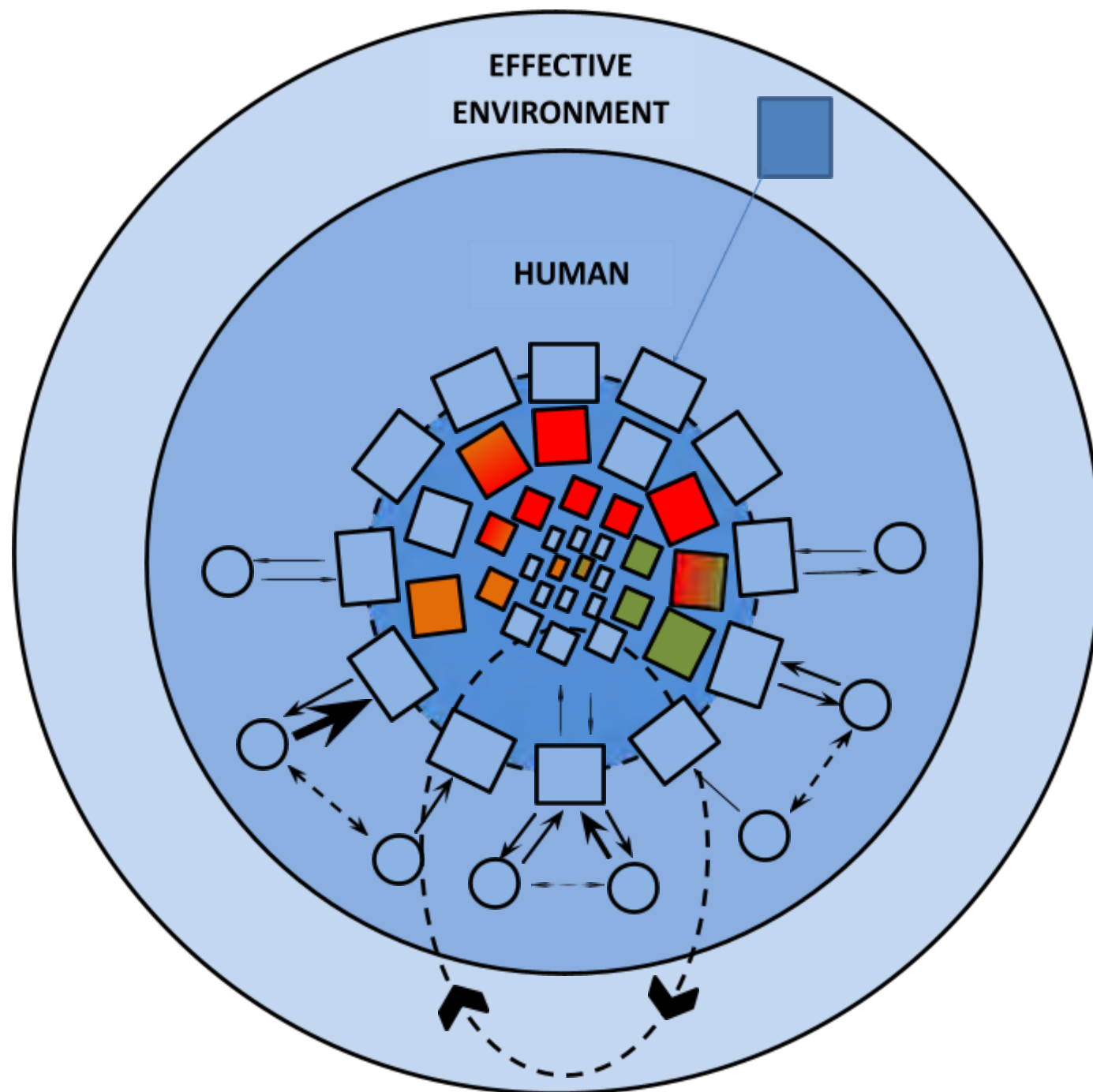
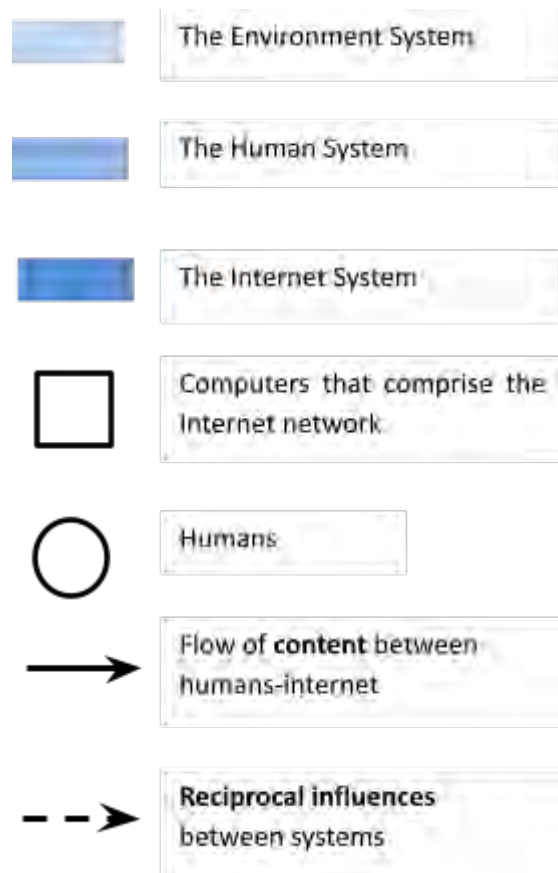


Figure 1. The interactive model of the Internet

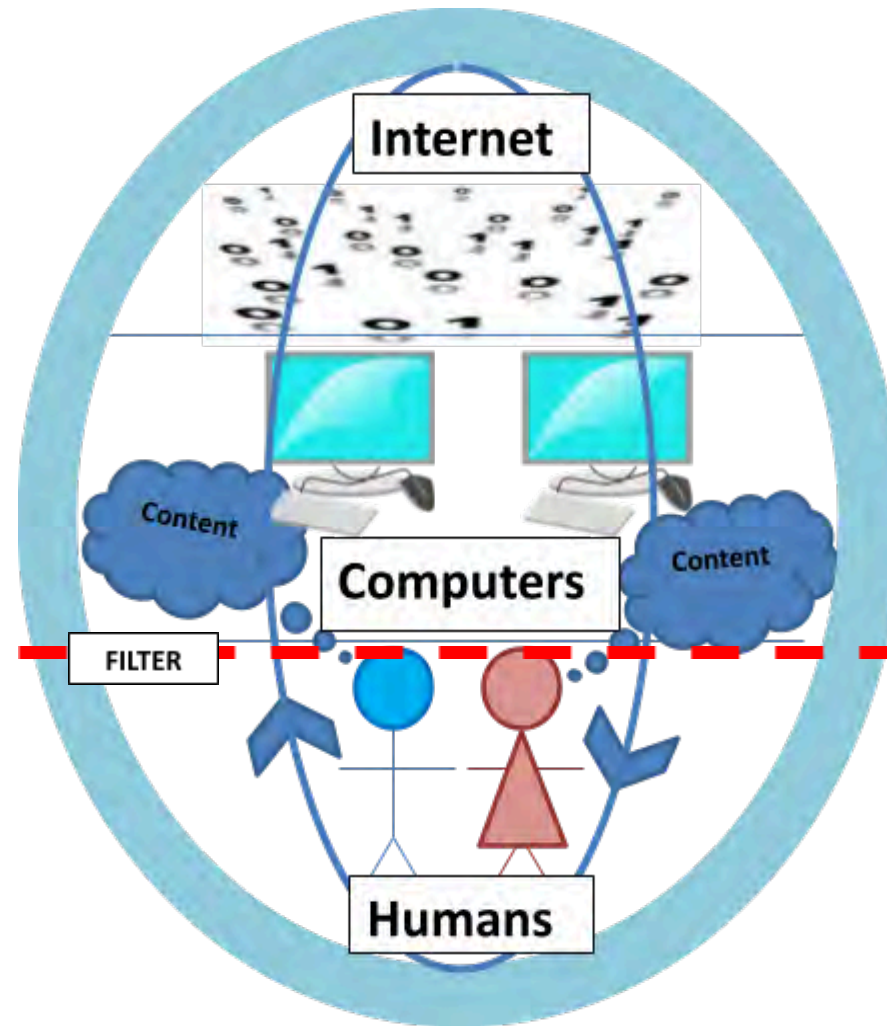


Figure 2. The flow of content between the Human System and the Internet System

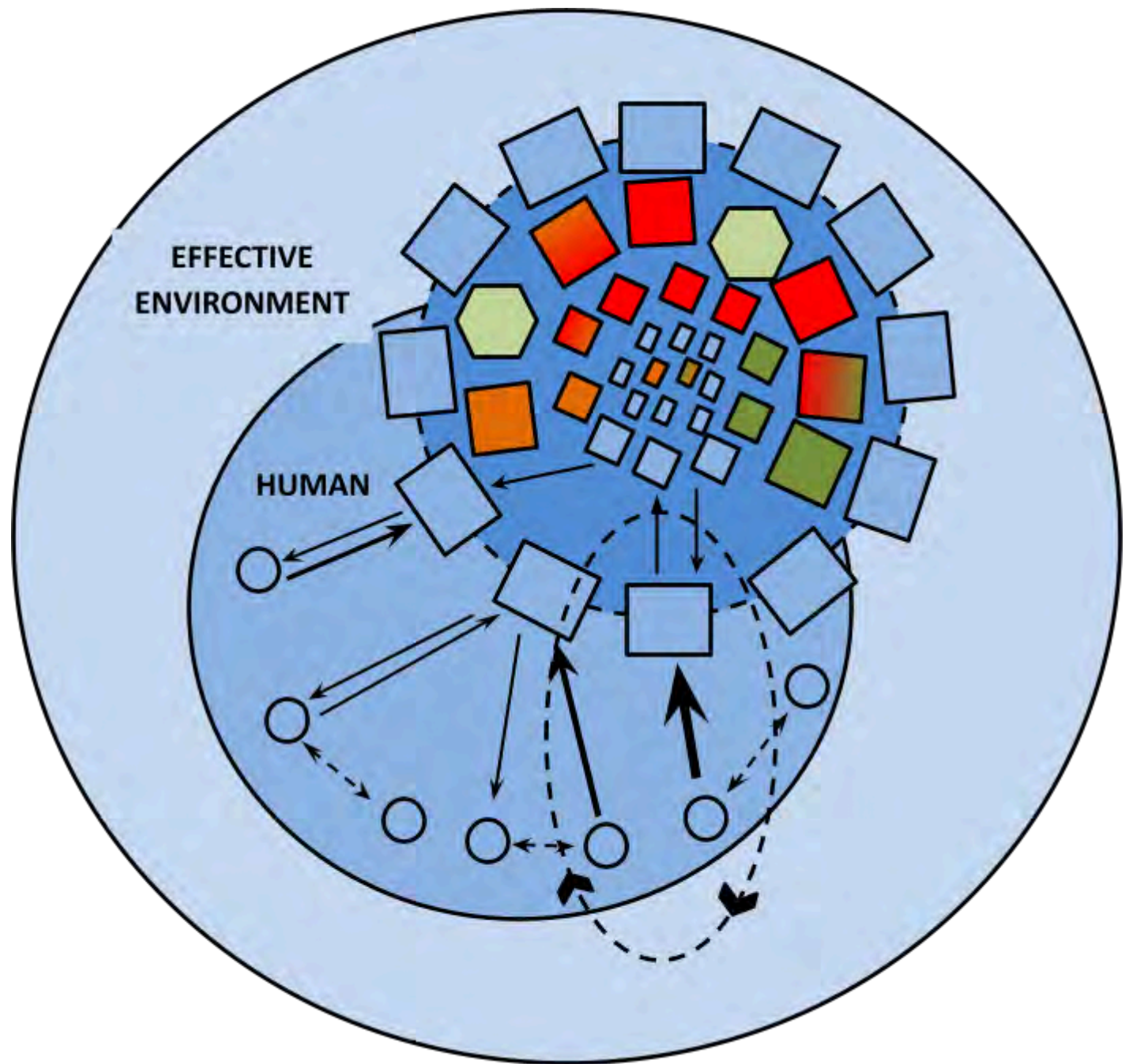
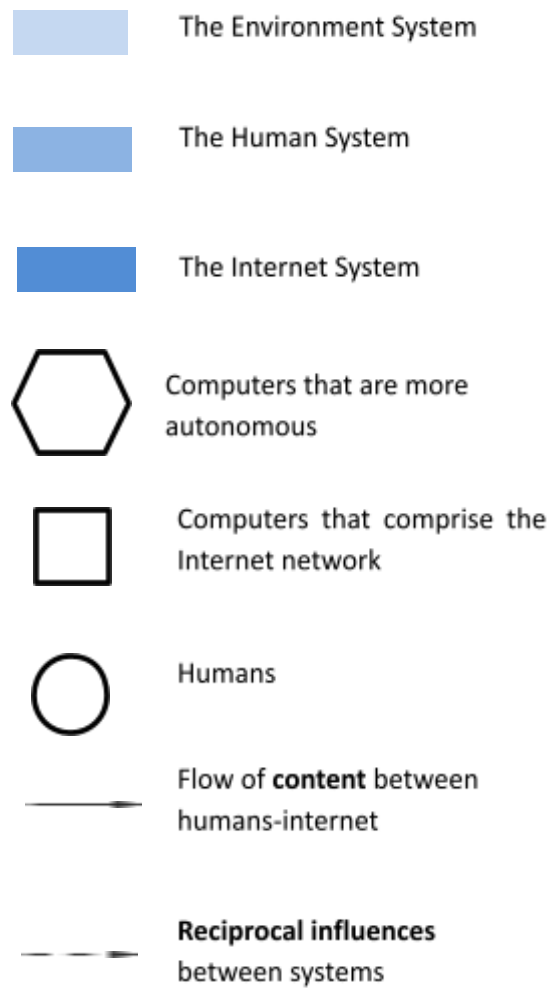


Figure 3. A model of a possible evolution of the Internet over time

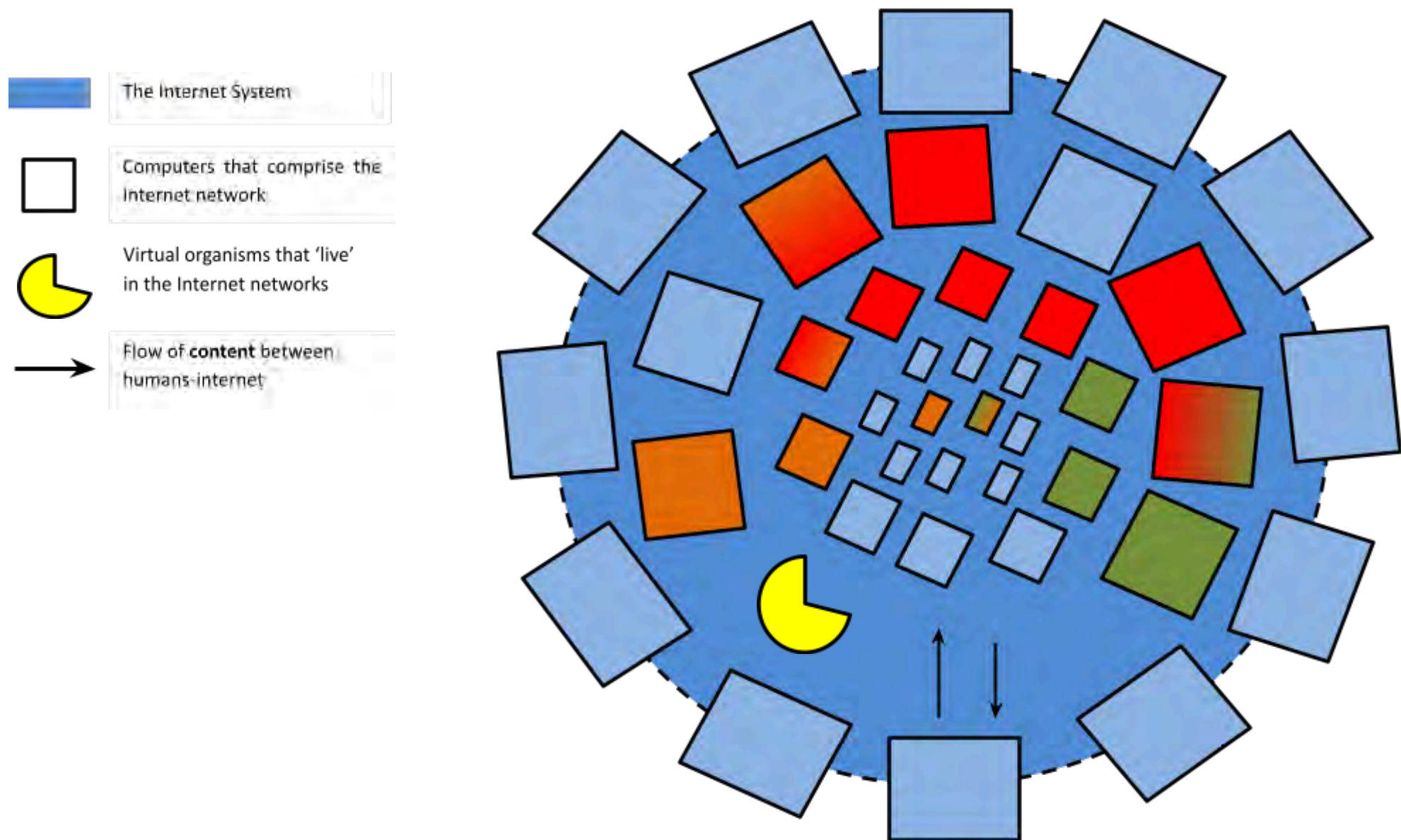


Figure 1. The Structure of the Internet

SemantiCreeper

Original Filename

2016.08.24 - SemantiCreeper.pdf

Date

24 August 2016

Authors

Workshop facilitators and participants

Description

This item documents an early and speculative software prototype known as SemantiCreeper, associated with the Are Networks (Becoming) Conscious? workshop. Surviving technical documentation is extremely limited: the archived workshop webpage preserves the title “SemantiCreeper” but no substantive project description. Retrospective recollections by workshop collaborators describe the prototype as Markov-chain-based software that used probabilistic relations among words, concepts, or states to generate or explore sequences from supplied material. They recall that it was not conceived as a definitive detector of Internet consciousness. Rather, it was imagined as a speculative probe—described in one recollection as a “spaceship to navigate cyberspace”—for seeking possible early indicators of intelligence, emergent organization, or life-like complexity within networked information environments. One retrospective analogy compared this search to identifying amino acids in an extraterrestrial environment: such a finding would not prove consciousness or life, but could motivate further investigation. In that sense, SemantiCreeper appears to have been conceived as an instrument for identifying candidate signals rather than verifying consciousness. The precise implementation, source data, outputs, authorship, and evaluative criteria have not been recovered.

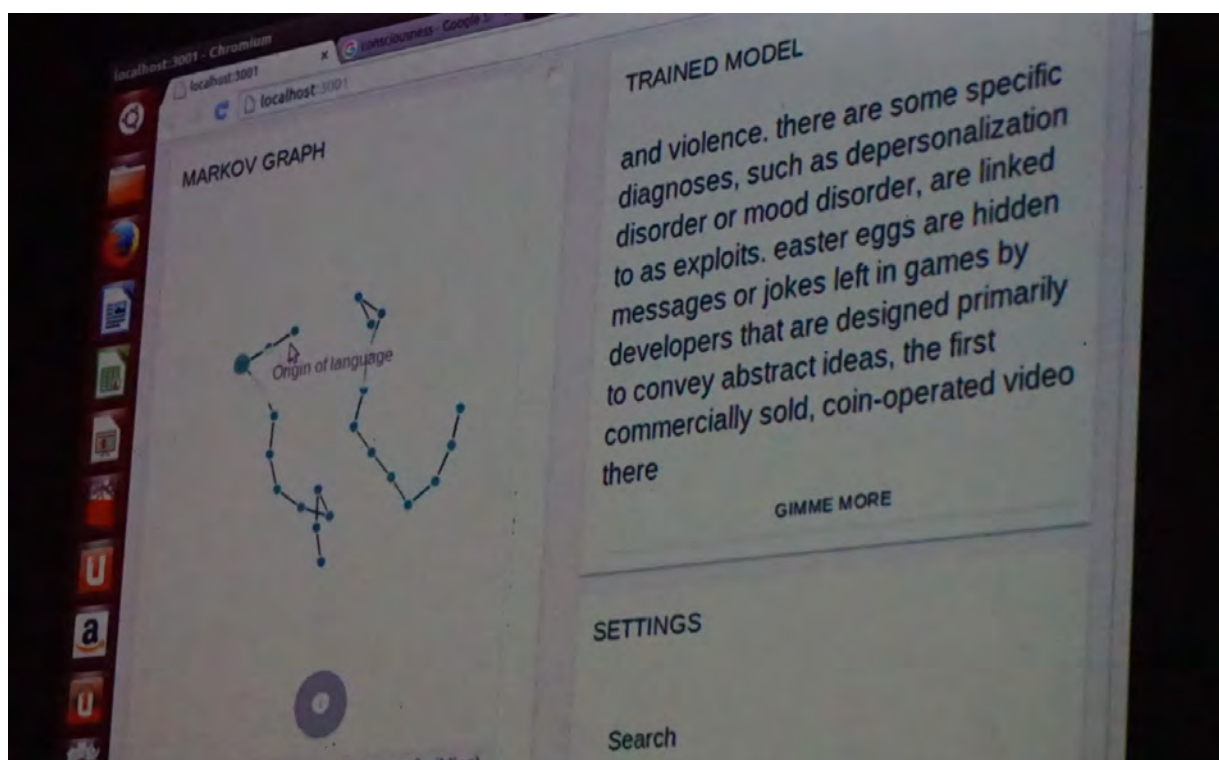
Provenance

Originally published on the workshop website. Archived from <http://www.arenetworksconscious.com/blog/about/semanticreeper/>



ARE NETWORKS (BECOMING) CONSCIOUS?

A ColLaboratoire Workshop



SemantiCreeper

Lorem ipsum...

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References / Bibliography

Original Filename

2016.08.24 - References.pdf

Date

24 August 2016

Authors

Workshop participants

Provenance

Originally published on the workshop website. Archived from
<http://www.arenetworksconscious.com/blog/bibliography/>



ARE NETWORKS (BECOMING) CONSCIOUS?

A ColLaboratoire Workshop

Bibliography

While we will strive to keep the list below updated...

.. it's probably best if you view it as an online [Zotero collection](#).

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An interesting debate that erupted recently based on Robert Epstein's article (first on the list)

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Press Info on CoLLaboratoire Summer School 2016

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2017.07.11 - Press info on CoLLaboratoire Summer School 2016.pdf

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11 July 2017 (content from 2016, posted 26 August 2016)

Authors

CogNovo blog, various contributors

Provenance

Institutional press document created in 2017 about the 2016 summer school; includes retrospective project information. Originally from the CogNovo website. Archived from <http://www.cognovo.eu/news/collaboratoire2016.php>

ColLaboratoire

[BACK TO ALL NEWS](#)



Feedback from our participants

We have gathered a bit of feedback that we would like to share:

*This week resulted in a powerful experience,
I've learned so much and found lots of
pleasure in our collaborations.*

*[Collaboratoire] was an absolute hit with me
and i have been telling people that it was one
of the best weeks of my life. I will admit that i
was tiring however we did work hard yet it
was all worth while because having such an
amazing bunch of people working as a whole
team kept me buzzing.*

*a huge congratulations and many thanks for
organising such a brilliant summer school. i
had such a stimulating week, with an amazing
cohort and a truly inspiring group of project
leaders.*

*It was quite surprising to see how the
participants embraced all of the different
information we threw at them, almost seems
like Cognovo is contagious.*

*the project work was so outside of my comfort
zone I learned an awful lot and loved every
second of it.*

.....

Posted on 26 August 2016

Collaboratoire - the CogNovo Summer School 2016

During the week from 15 to 20 August 2016, the CogNovo headquarter at Plymouth University was buzzing with unusual visitors: we sent out a

call for a summer school "ColLaboratoire" on social creativity and collaboration, and a number of absolutely fantastic participants came to work with us. During our initial call in February we offered six different projects to our applicants to choose from, of which we implemented four during the week in August: "Are Networks (Becoming) Conscious?", "NAO that's what I'm talking about", "Remapping the Sensorium: Do You Hear What I See?", and "Let's Improv it".

Besides project specific goals, the overarching aim of this summer school was to teach, observe, and learn how collaborations in diverse and trans-disciplinary research groups arise and can be fostered. For the facilitators of the four projects as well as the organisers of the whole week, the summer school provided an ideal test environment to evaluate experiences they have made during their more than two years working in the interdisciplinary environment of the CogNovo research group.

We hope that everyone involved learned something from this week and that our guests returned to their home institutions with something they didn't have before
ColLaboratoire - maybe it was even the beginning of a new multidisciplinary (conscious) network?

Organisation

Organisation: Ilaria Torre, Kathryn B. Francis,
Tara Zaksaitė, Christos Melidis

While many summer schools seem to treat the organisational part as a necessary evil and in the best case as an administrative task, ColLaboratoire took a different approach: social events, welcome packages, and other small details were orchestrated as part of a holistic experience. Starting from our own shared experience of working closely in a multidisciplinary research group, we were interested in the question if and how the environment fosters collaboration and how communication across disciplines can be established within a short amount of time. Also

the choice of invited speakers was intended to reflect the breadth of involved research fields without compromising on domain specific depth. For that reason Roger Malina, an astronomer who has a long history in interdisciplinary work, was invited to frame the work for the week. Alexandra Supper, who works at the intersection between science, technology, and sensory studies, gave an overview on the topic of sonification as a transdisciplinary research tool and finally Susan Blackmore speculated on the third replicator, the treme machine, in the context of conscious networks.

Let's Improv it

Facilitators: Klara Łuczniak, Abigail Jackson

In our research project, we focused on basic human abilities to understand ourselves and each other on the level of actions, intentions, and emotional states. We explored the role and perception of the emotional aspects of physical touch and the ability to touch each other through space. We explored how kinaesthetic empathy allows us to understand others through embodied knowledge of our own states. As a result, we invited all ColLaboratoire participants on the last day to take a part in a 20-minute somatic movement experience. We shared our insights and reflection through embodied practice in darkness and silence, trusting the idea that much of the key knowledge in our lives is gained through experience. This way of sharing, which was novel for most in the group, was very well received, and gave participants a new way to relate to touch, their own bodies and the space between each other. Our research, as well as the influence of the summer school's topics and the group's social dynamics resonated through the movement of the group, creating a unique experience of sharing the space through individual and collective choices, finally resolving in togetherness in movement and rest.

"Nao" that's what I'm talking about

Facilitators: Joana Galvão, Ilaria Torre

During the Collaboratoire Summer School, we had an interdisciplinary group of participants who worked on developing a performance with two NAO robots, Snap and Pop. The participants learned how to program the robots using the Choregraphe software, which creates behaviour, monitors and controls NAO. In the conceptual discussion for the project, we agreed on creating a piece that would interact and challenge the expected empathetic response to robots from the audience. We experimented with the idea of shifting preconceived emotional responses towards the robots. With this in mind, the final presentation consisted of exploring the robots' verbal and non-verbal communication when interacting with the audience, inciting a range of emotions and challenging their initial perceptions. At the end, we applied a questionnaire to collect responses about the audience's experiences.

Are Networks (Becoming) Conscious?

Facilitators: Diego S. Maranan, Mihaela Taranu, Jack McKay Fletcher, Michael Straeubig

Could highly-connected networks (such as the Internet) become conscious as some have speculated? In what ways might it makes sense to talk about an emerging Internet consciousness? What form would it take, and how would we know when it is manifest? Are there any ethical implications that arise from the possibility that we are collectively contributing to the creation of an artificially conscious networked entity? These were some the questions that were tackled at the *Are Networks (Becoming) Conscious?* workshop. Our workshop was attended by a group of postgraduate students from psychology, neuroscience, new media art, philosophy, computer science, and education. Throughout the course of the week, we grappled with thorny questions around terminological and epistemological differences

that underscore any inter-/multi-/trans-disciplinary engagement. (We also had a lot of fun!) But by taking the approach that the workshop was a "temporary autonomous zone" (a concept that Roger Malina brought to our attention in his keynote talk) in which ideas were allowed to thrive, our group arrived at a model of distributed cognition and a playful, exploratory piece of software that might serve as an example of how intelligence (and possibly consciousness) might evolve within the Internet.

Remapping the Sensorium: Do You Hear What I See?

Facilitators: Frank Loesche, David Bridges, Francois Lemarchand, Michael Sonne Kristensen, Thomas Wennekers, Susan L. Denham

In our project we explored a number of ideas on how sonification can be used to understand highly time-dependent data, in our example patterns of intersubjective synchronicity and variability in physiological data. During a collective spectatorship of a series of audio-visual stimuli and film excerpts - carefully chosen (and manipulated) for their potential of eliciting specific intended emotional reactions - we collected a range of (neuro-) physiological measures including: heart rate, skin conductance, breathing rate, electroencephalography (EEG), eye movement, and body movement were recorded from 12 participants simultaneously. We started exploring the data using visualisation techniques and machine learning algorithms, and developed a number of novel ways to map the data in a meaningful way into the audio spectrum to provide a sonified experience of the recorded data. We also prepared devices for recording and sonifying a subset of measures in live situations. As we went along, we learned about the promises and limits of each of the technologies as well as the interpretation of collectable data. Focused sessions on machine learning, semantic mapping, scene analysis, and sound generation led towards a holistic understanding not just of physiological measures

of individuals, but also of factors pertaining to group dynamics in the naturalistic setting of the film display. Furthermore [Cecilia Wee](#), curator specialising in sound for design contexts, [Matthew Dunn](#), a specialist on eye tracking, and [Maarten de Vos](#), who works intensively with mobile EEGs, joined our group during the week and helped us with interpreting the data and setting up systems for live data sonification.

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ABOUT

Through a series of linked projects and workshops, PhD students will explore the brain-basis for creativity, the emergence of creativity through social interaction and how creativity lays the foundations for problem solving capabilities.

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