From simplicity to universality & undecidability

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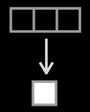
January 13, 2022. Bachelor Thesis presentation
@Gemma_DLC

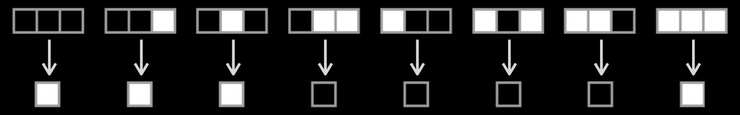
Simple rules can generate lots of complexity.

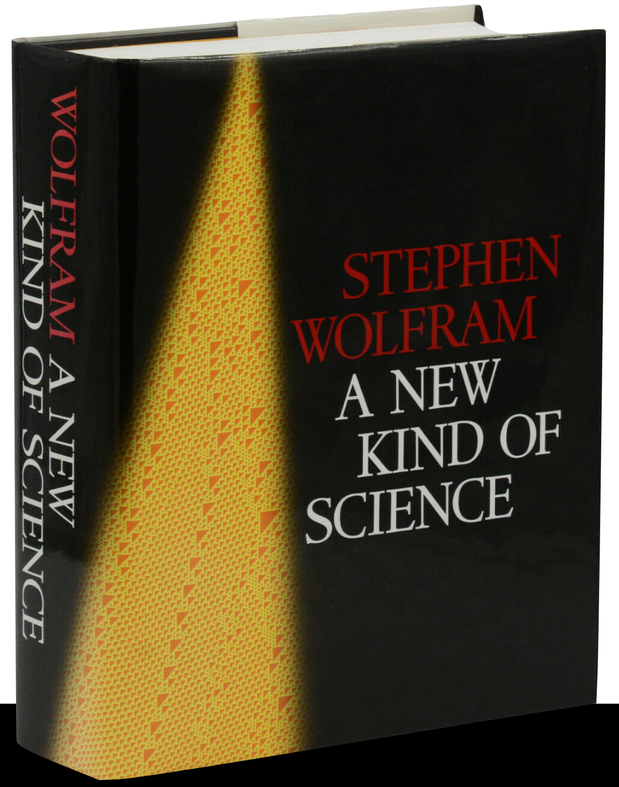
Gemma De las Cuevas

Cellular automata.



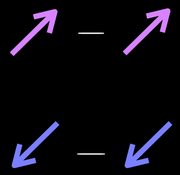
Cellular automata.



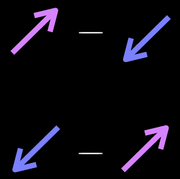


Spin models.

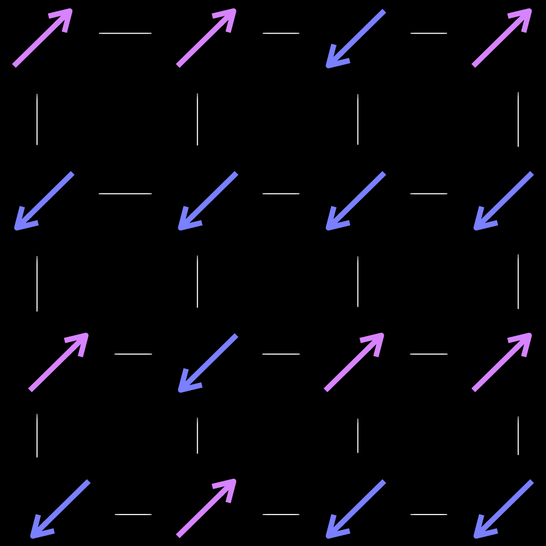
Little energy



More disorder



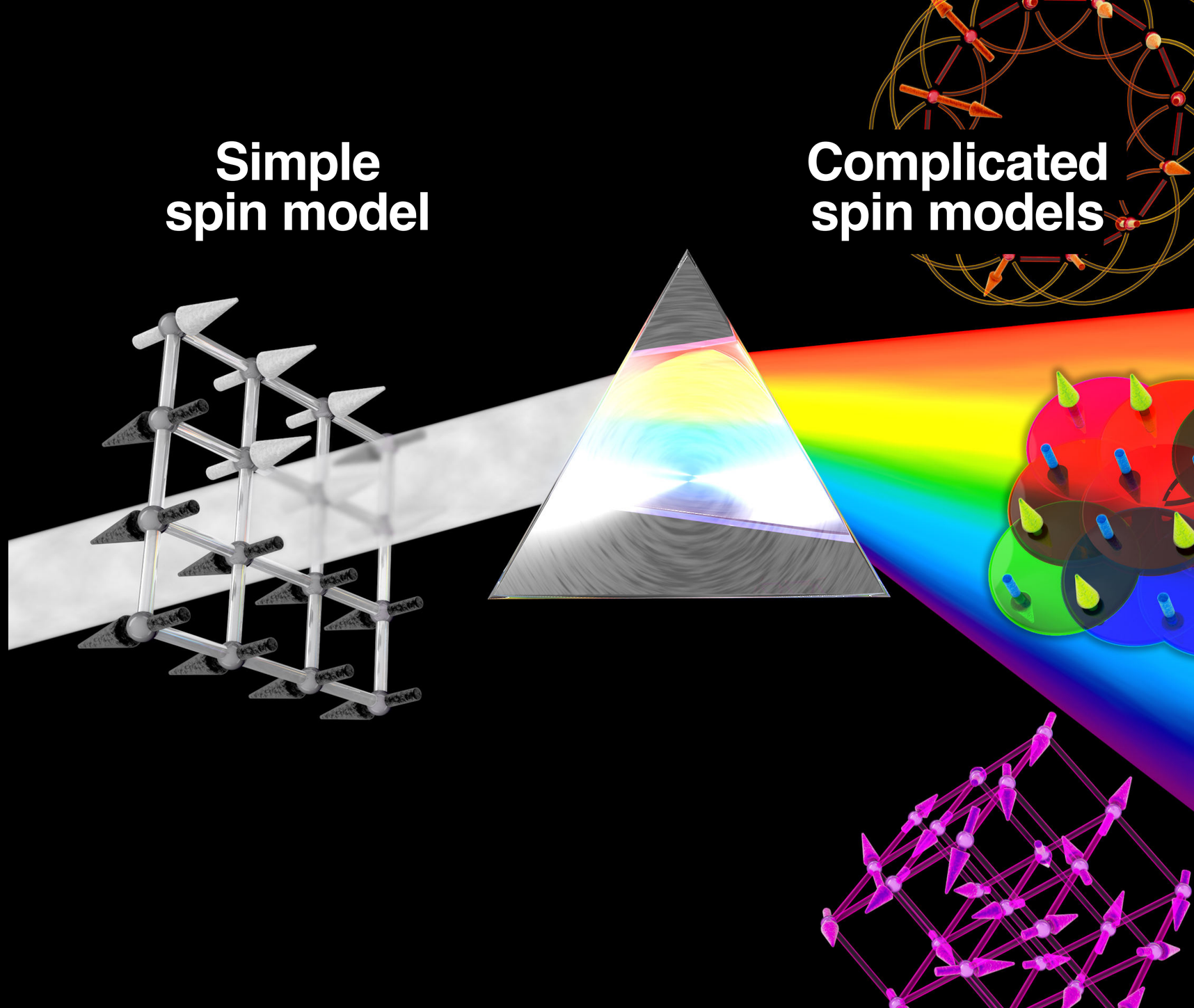
Simple spin model



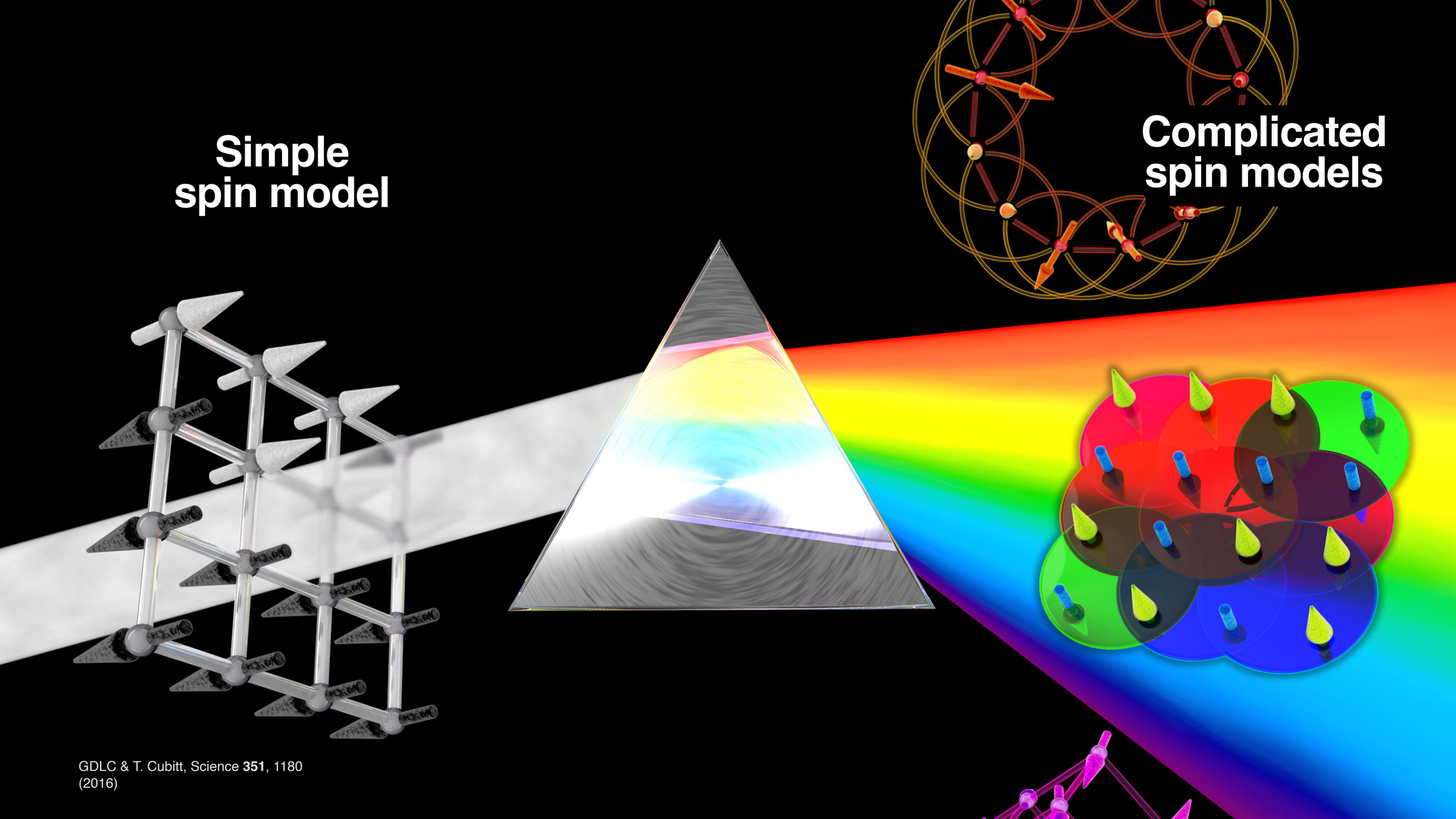
Spin models.

Simple spin model

Complicated spin models

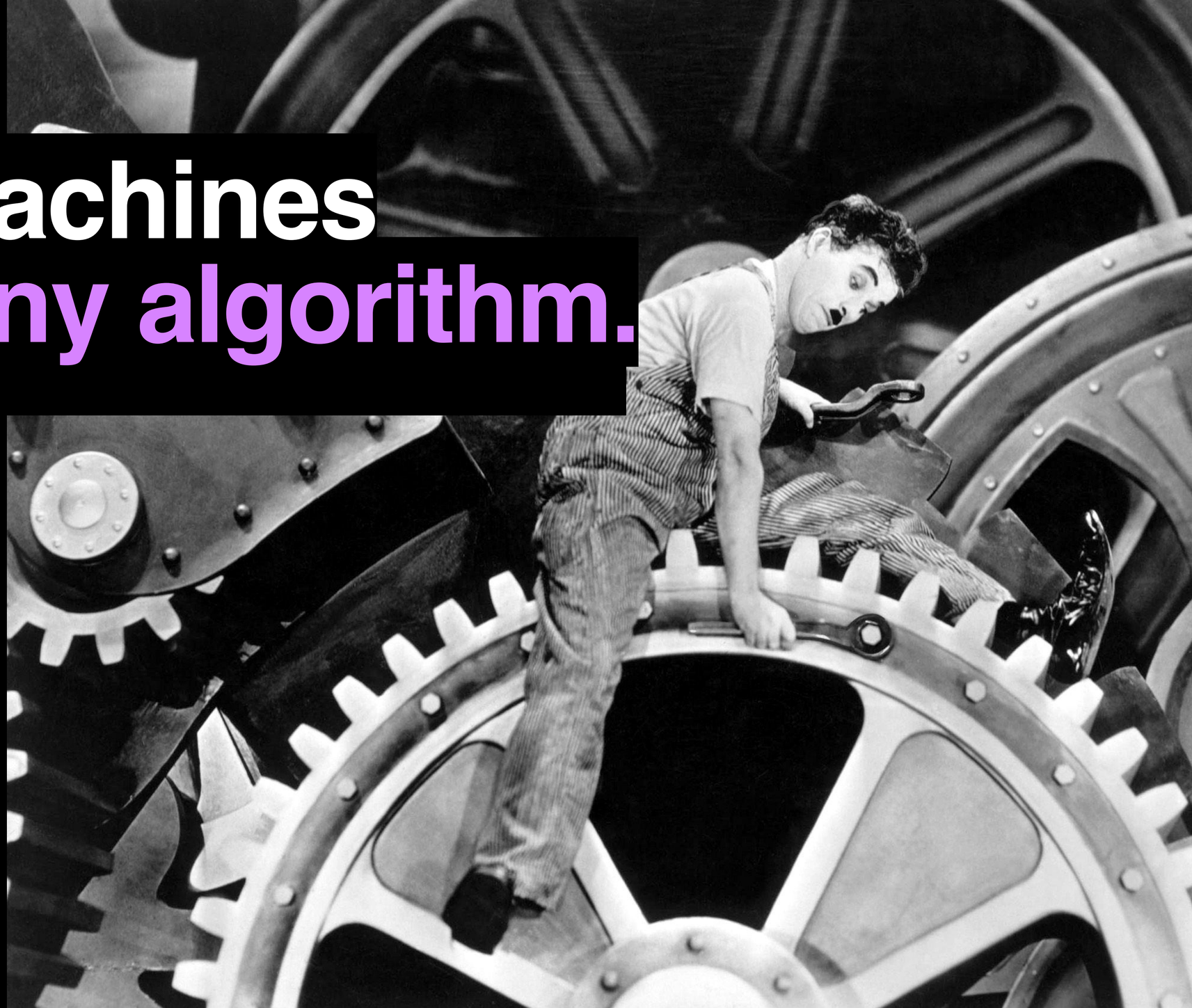


GDLC & T. Cubitt, Science **351**, 1180 (2016)

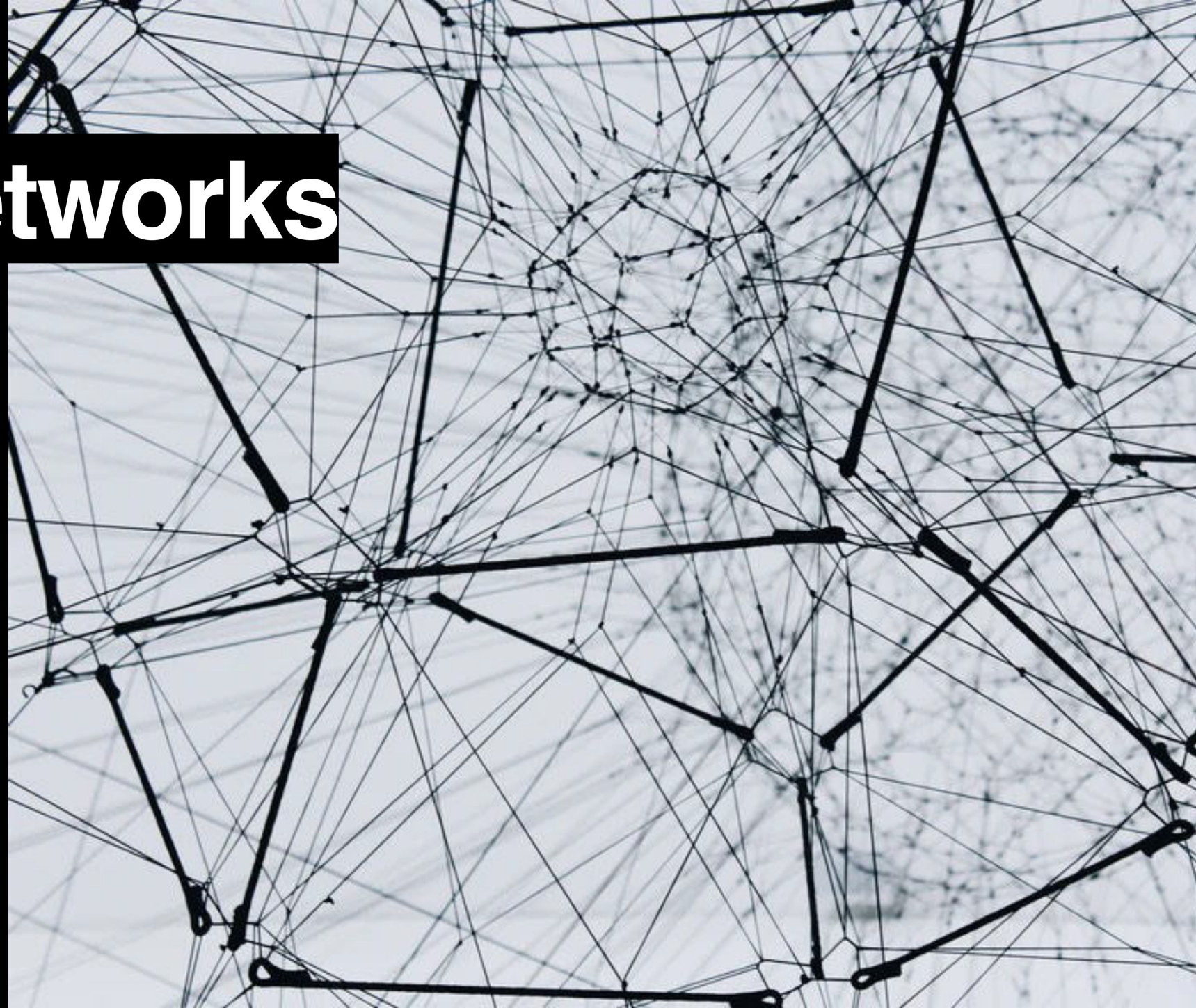


GDLC & T. Cubitt, Science **351**, 1180 (2016)

Simple machines can run any algorithm.



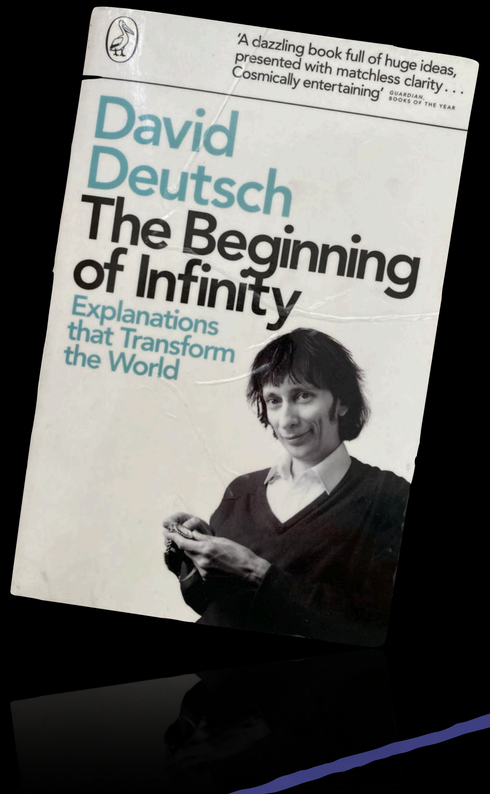
Neural networks



Why do simple rules generate so much complexity?

Because they jump to universality.

The jump to universality

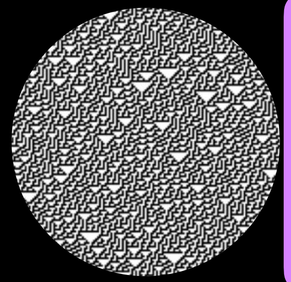


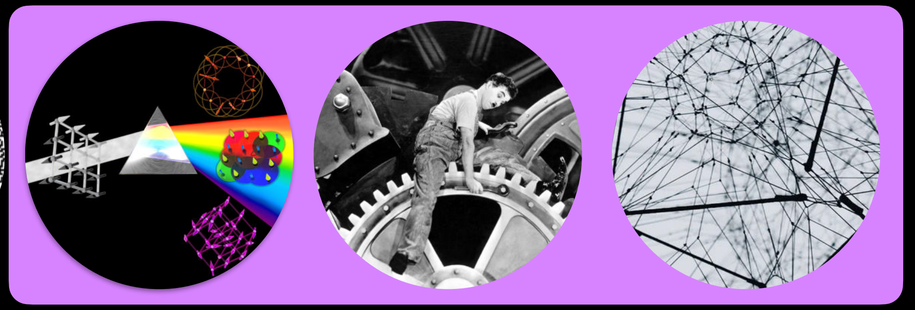
Intuition

Complexity of system

Complexity of rules

The jump to universality





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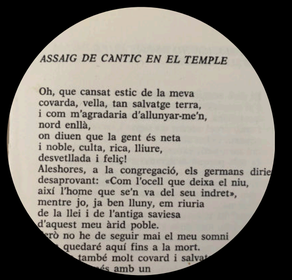

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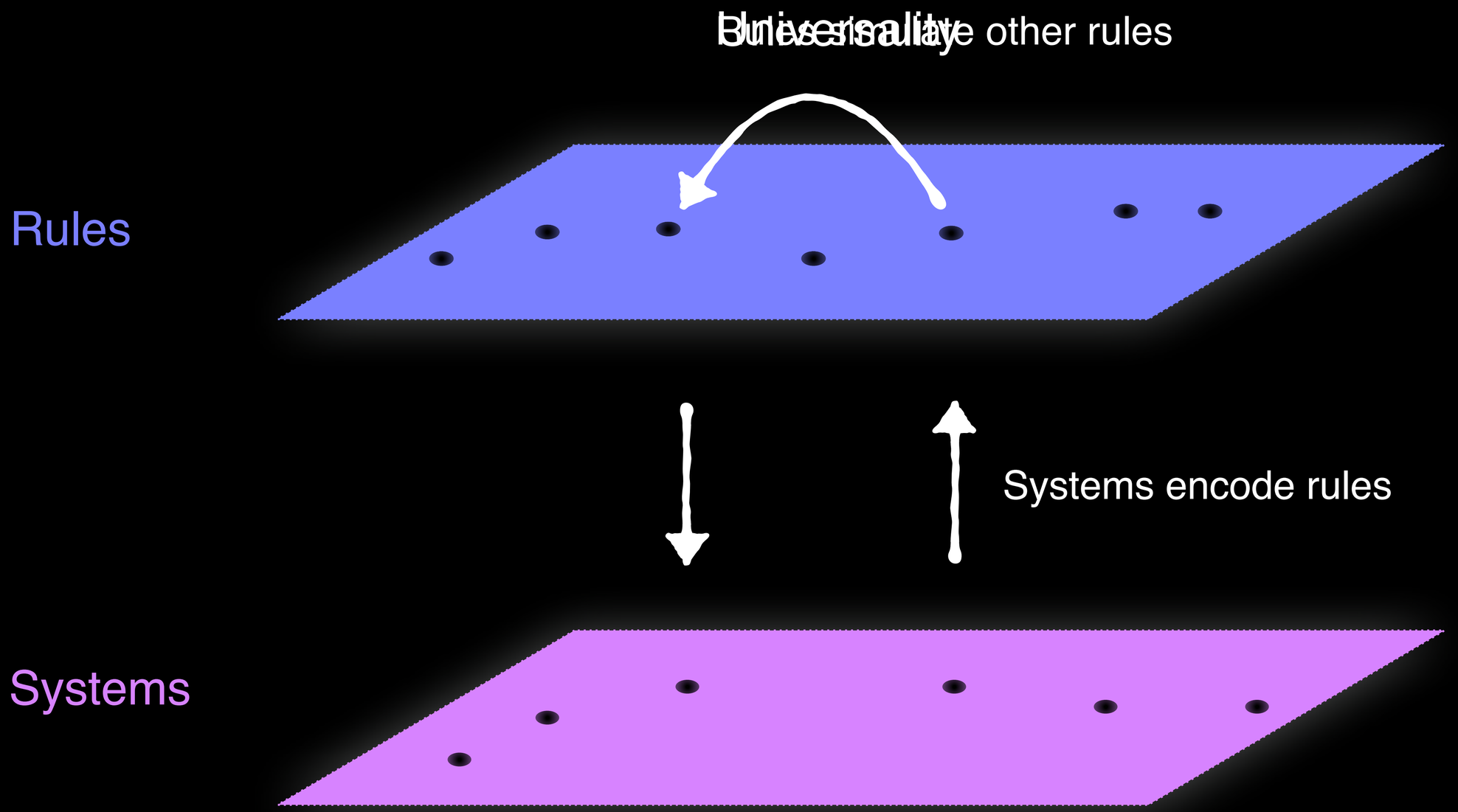
Intuition

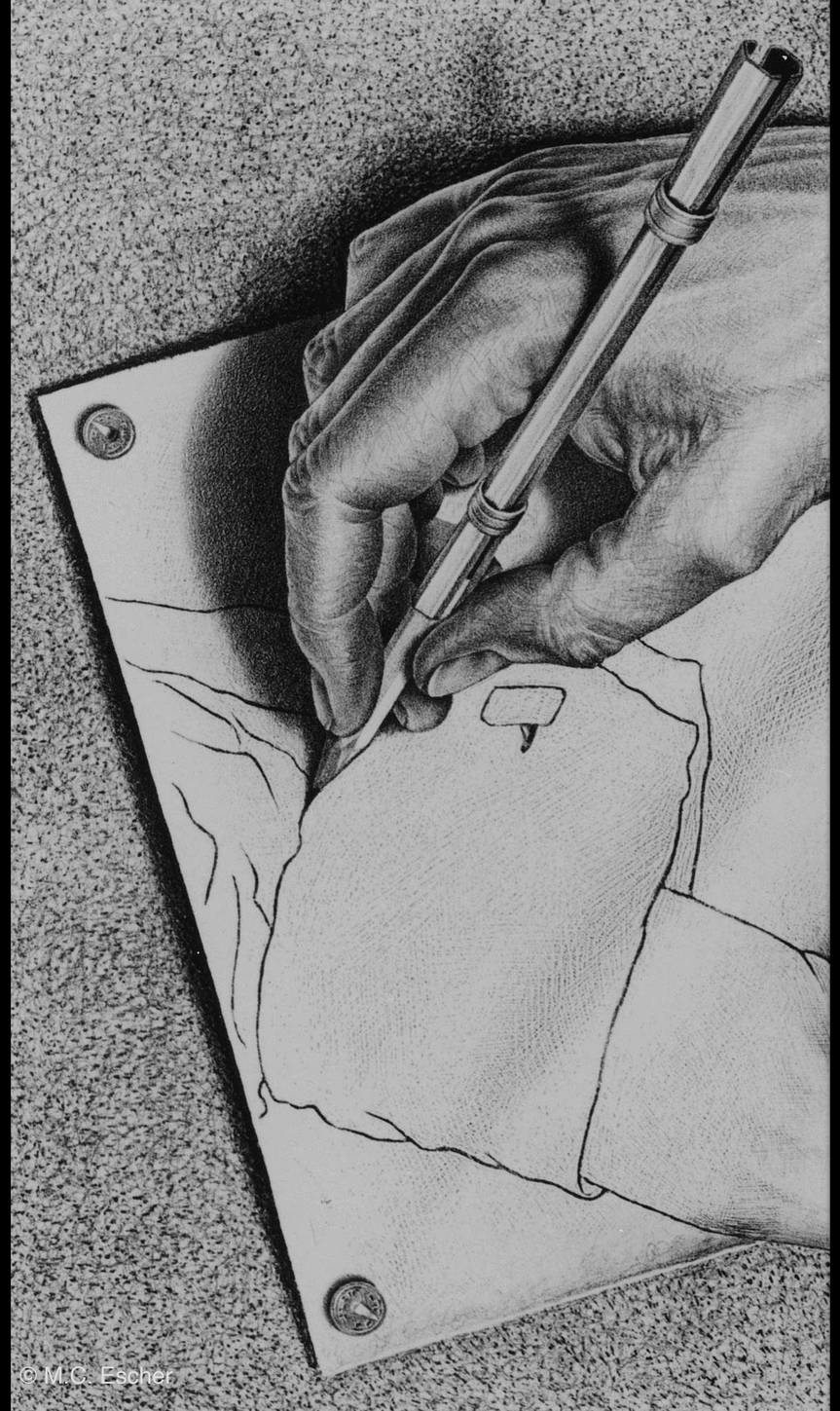
Complexity of system

Complexity of rules

Why do they jump to universality?

Because a hierarchy becomes entangled.


Universality
Universality
Universality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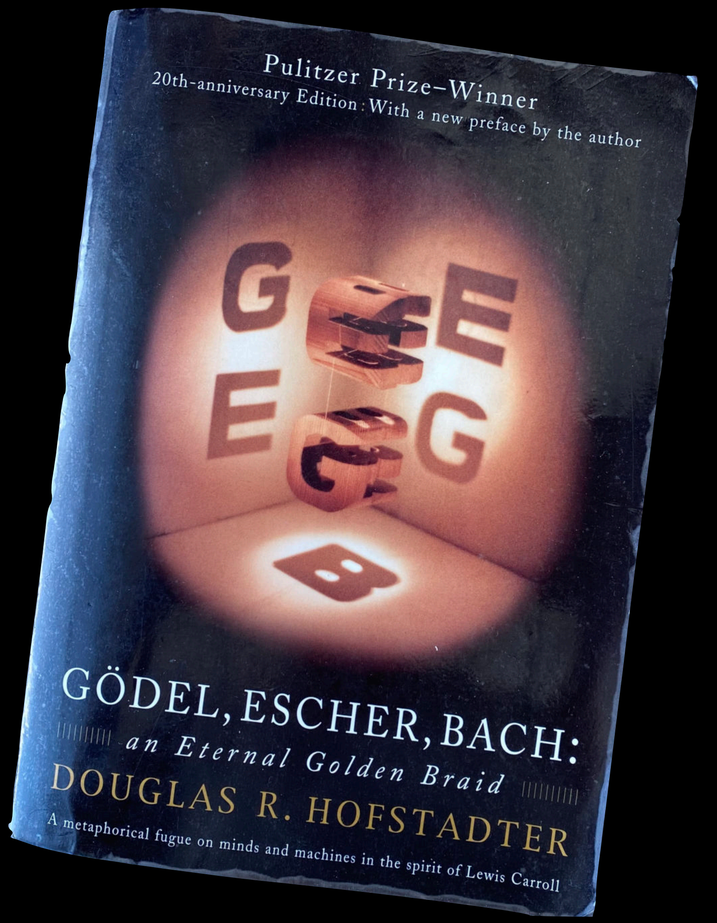
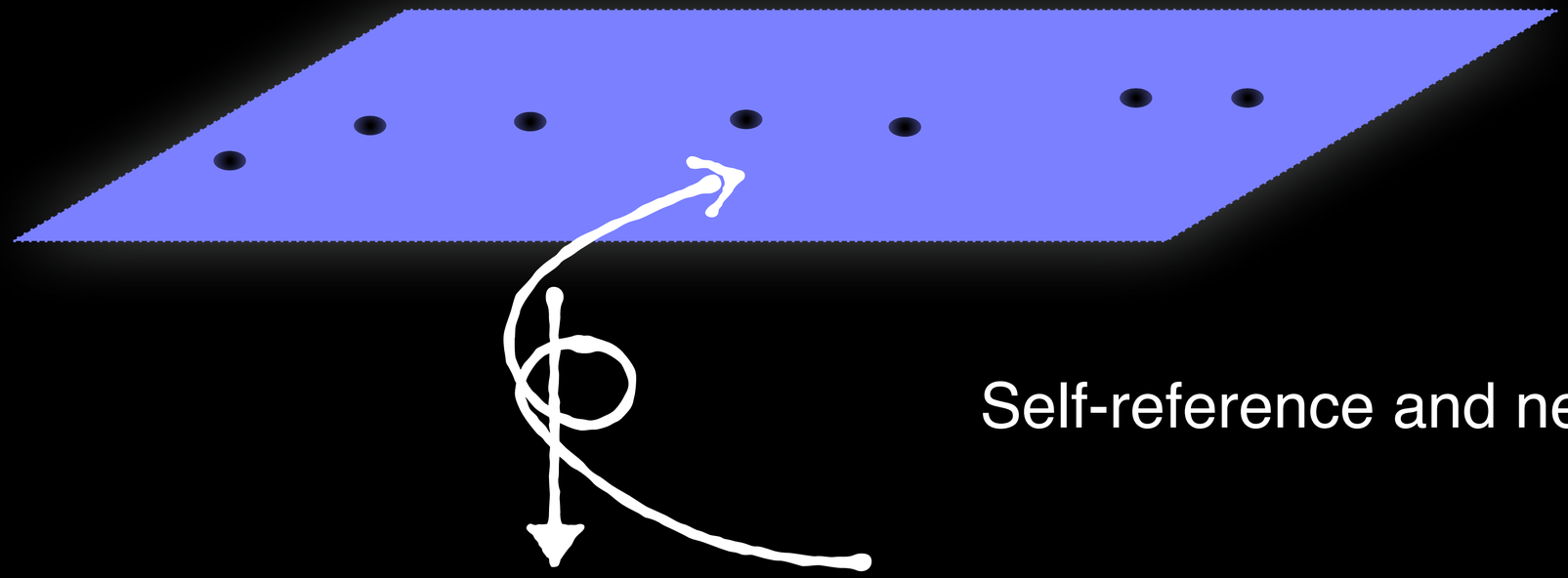

Pulitzer Prize–Winner
20th-anniversary Edition : With a new preface by the author
GÖDEL, ESCHER, BACH:
an Eternal Golden Braid
DOUGLAS R. HOFSTADTER
A metaphorical fugue on minds and machines in the spirit of Lewis Carroll

Undecidability

Rules



Self-reference and negation

Systems

Undecidability

Universality

Undecidability

FQXi FORUM August 4, 2020

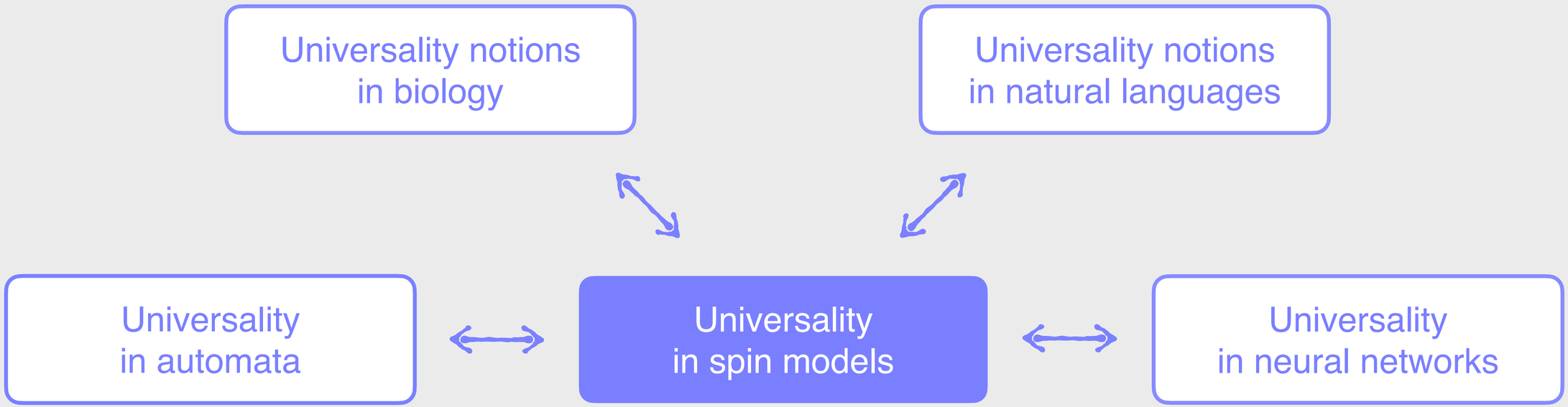
CATEGORY: Undecidability, Uncomputability, and Unpredictability Essay Contest (2019-2020) [back]

TOPIC: Universality Everywhere implies Undecidability Everywhere by Gemma De las Cuevas [refresh]

Goal

Understand the reach of universality & undecidability.

1 Establish rigorous links among:



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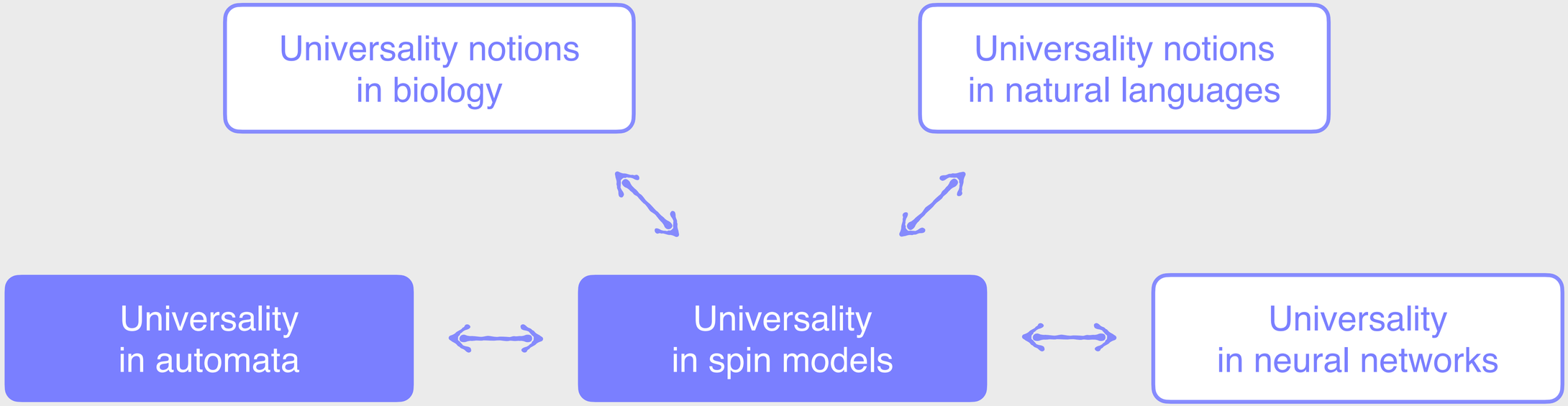

2 Establish an overarching framework for universality.

delascuevasgroup.com

We are a research group based in Innsbruck, in the middle of the Austrian Alps. We work on universality & undecidability and on mathematical physics topics. We also have a Youtube channel where we try to explain what we do. We have strong connections with the Algebra group, sharing a weekly group seminar as well as many fun group activities. If you are interested in visiting us or joining our group, get in touch.

Our logo is mixture of an impossible triangle (like the liar paradox) and a mountain. If you come visit us we can give you a sticker and a mug with the logo :)

(PS: We couldn't find a group name that reflected our research topics, so we had to settle for Gemma's family name... :-/)

Latest News

Great skiing day at Kühtai

We enjoyed a beautiful sunny day skiing at Kühtai today! Thanks for that! In the picture: Sebastian, Mirte, Gemma, Benni, Tobias Fritz and Tobi Reinhart

Tomáš Gonda is a new Postdoc in our group - Welcome!!

Dec 16, 2021

Why can the brain (and not a computer) make sense of the liar paradox?

Dec 3, 2021

TEDx talk