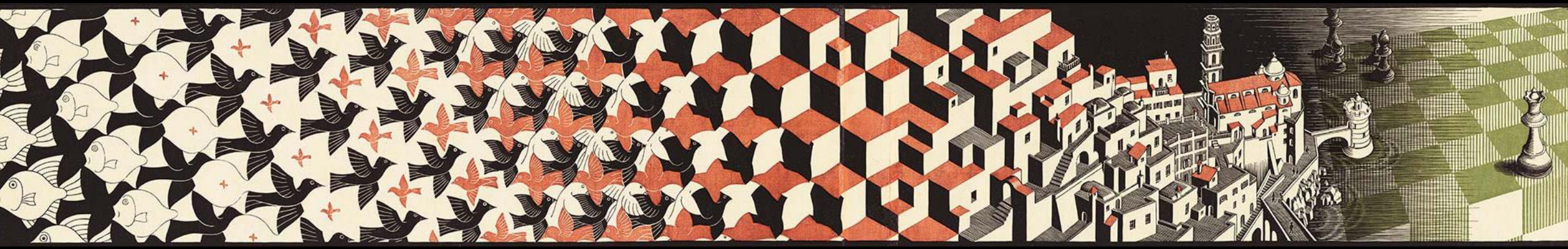
Data, Math and Methods

Week 1, Introduction



~ Vítek Růžička

What is this class about?

- Data, Math and Methods

- Data – datasciences + Art
- Math – mathematics + Art = Creative Computing
- Methods – algorithms + Art

When? What? How?

- When:
  - Wednesdays 13:30 – 17:30, usually 2 pauses per class
- Marking:
  - 50% Multiple Choice test
  - 50% Practical Exam
  - Attendance

Data, Math and Methods

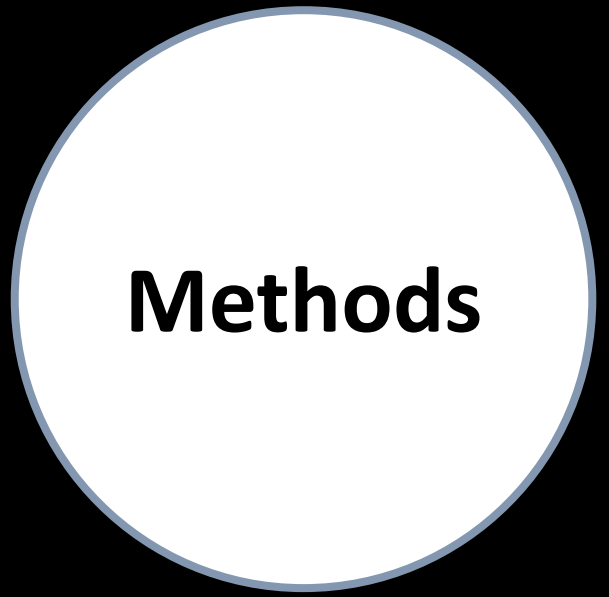
Math

- Abstraction of messy reality into a perfect word
  - of numbers
  - of rules of solving, converting, rephrasing
- Well defined
- But also chaotic / random / *stochastic* (**Statistics**)

- With precise formula solutions (Analytical solution)
- Or with *good enough* approximation of the solutions (Numerical approach)

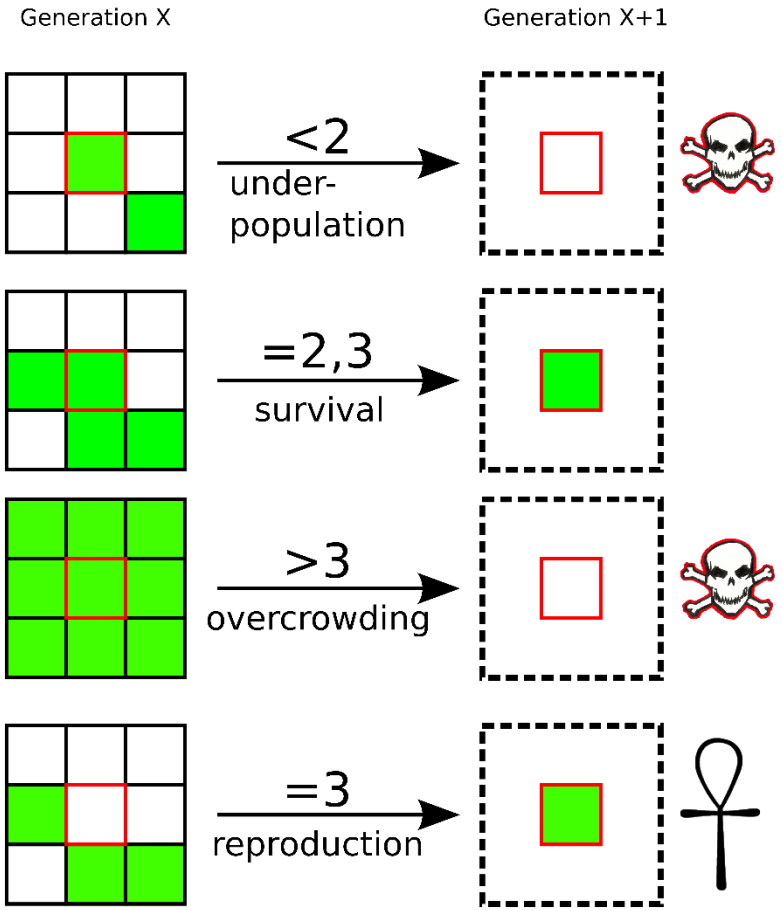
- Algorithms – recipes of steps taken to solve a problem

- Simple rules building up into more complex systems (Example: **Game of Life**)



Example: **Conway's Game of Life** (1970)

Game of Life Rules



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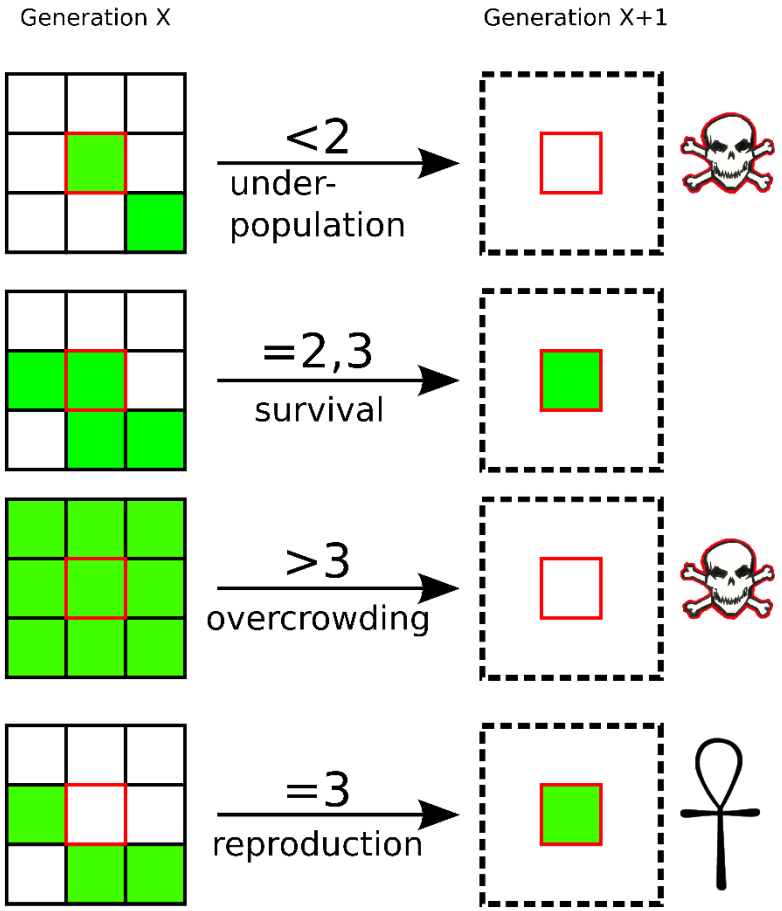
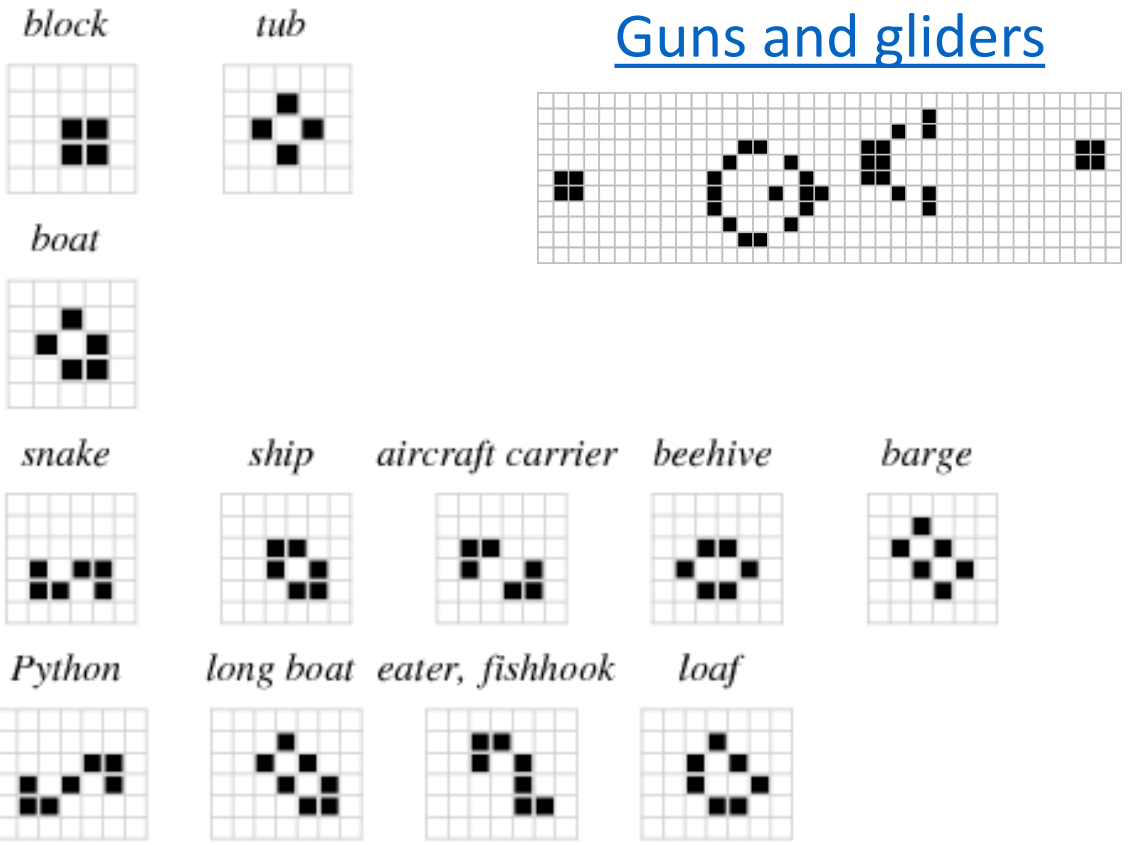
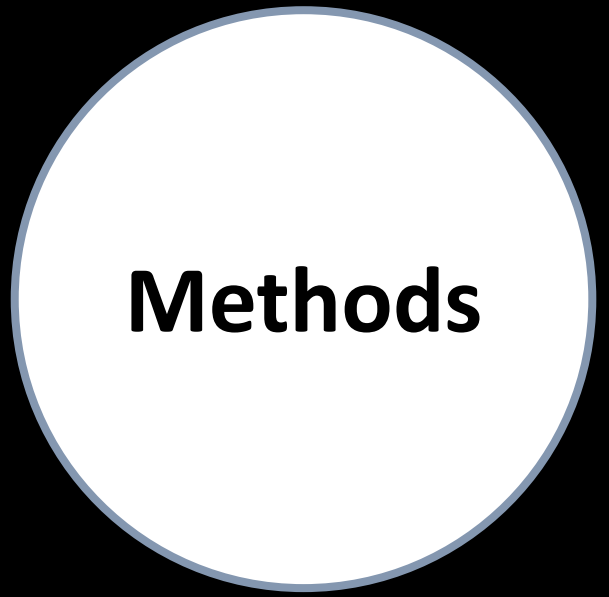




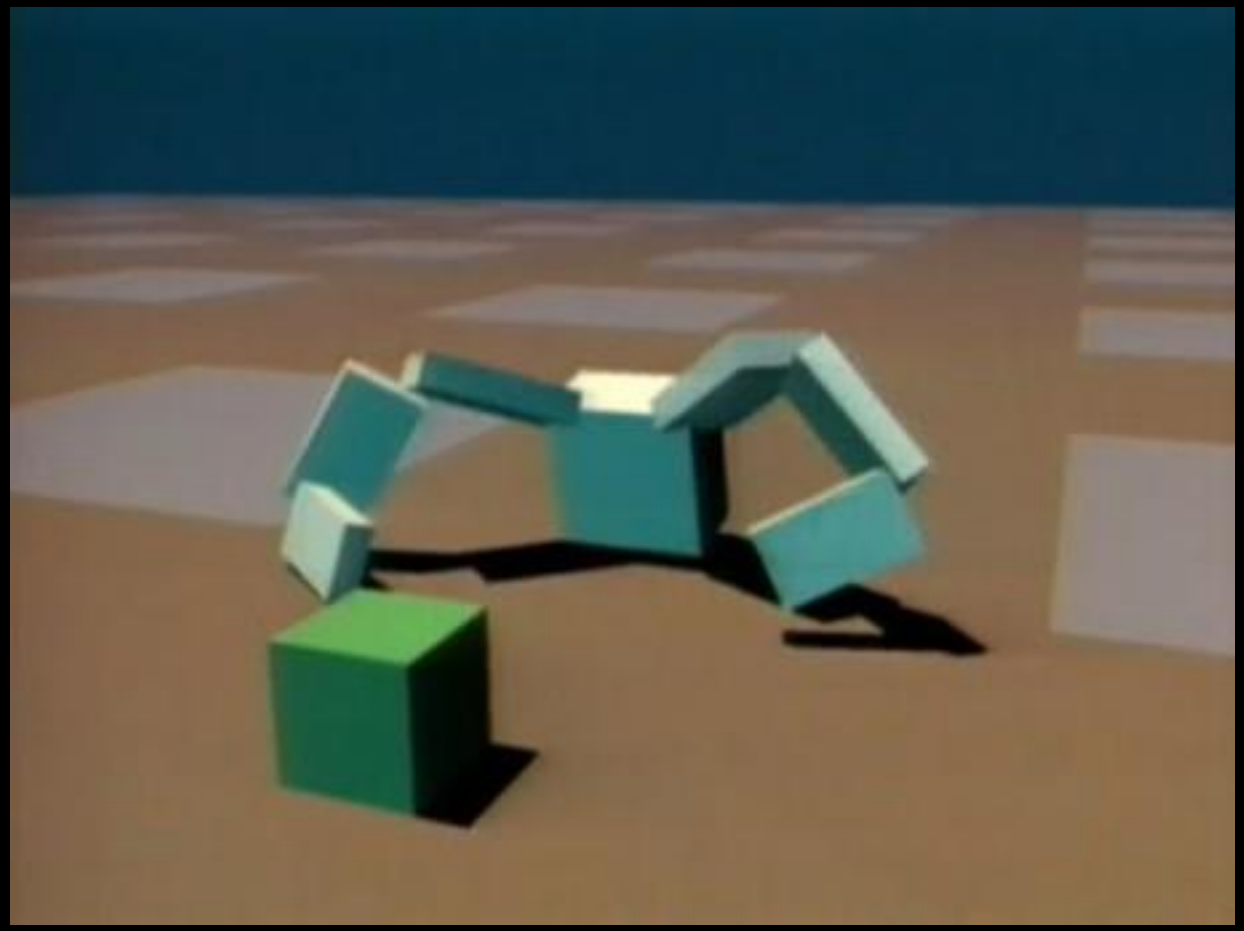
Guns and gliders

youtube.com/watch?v=xP5-iIeKXE8

- Algorithms – recipes of steps taken to solve a problem
- Simple rules building up into more complex systems (Example: **Game of Life**)
- Simulated worlds full of rules, watching what happens to the experiments we run in it (Examples: genetic algorithms by **Karl Sims**, Learning to walk, other biologically inspired algorithms)

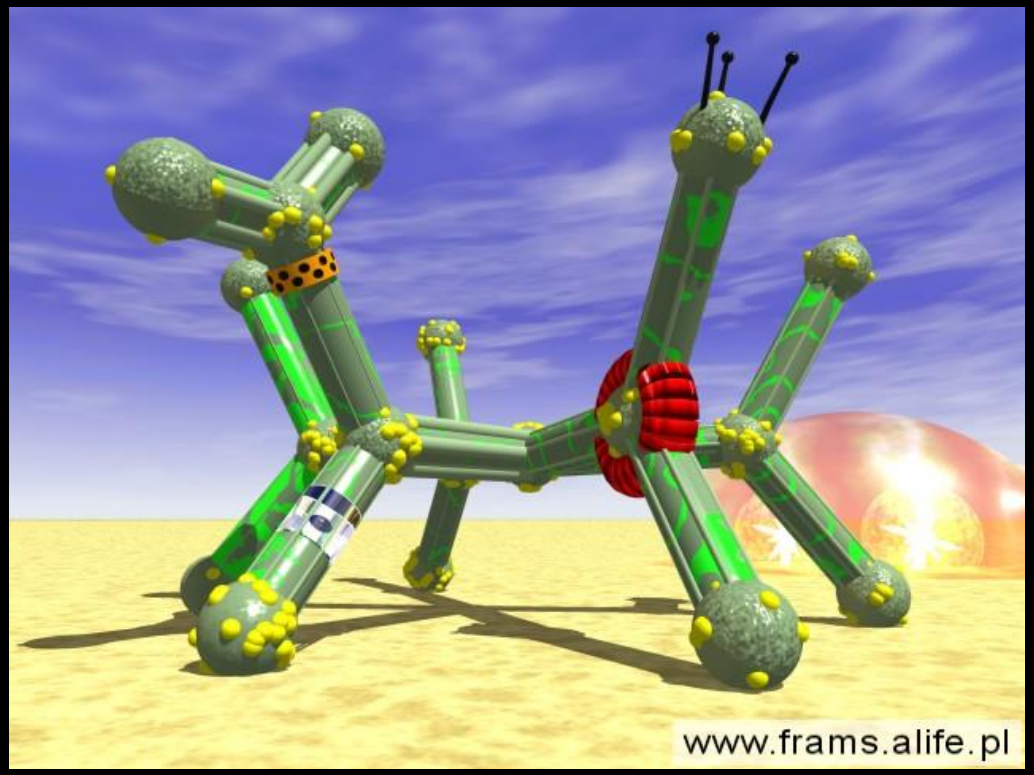


Example: **Karl Sims** - Evolved Virtual Creatures (1994)



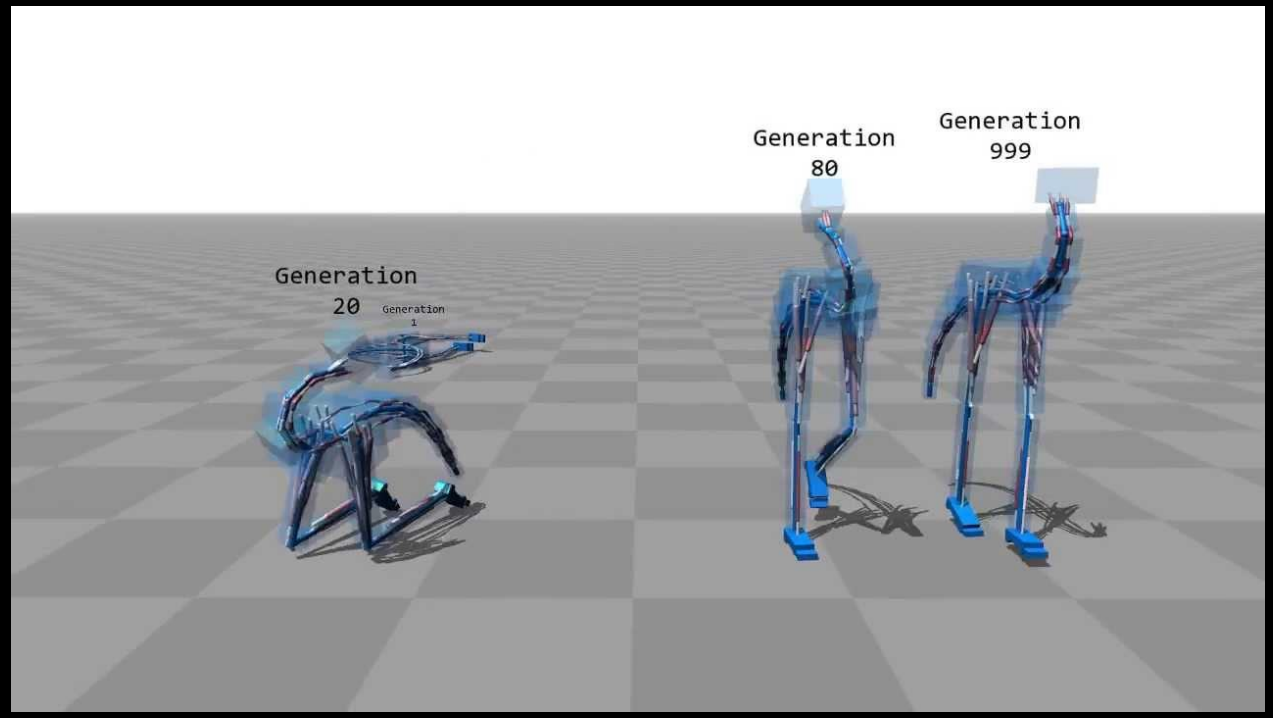
https://www.youtube.com/watch?v=RZtZia4ZkX8

Example: **Framsticks** experiment with genetic algorithms



https://www.youtube.com/watch?v=SoZguPlXGPA

Example: **Flexible Muscle-Based Locomotion for Bipedal Creatures**



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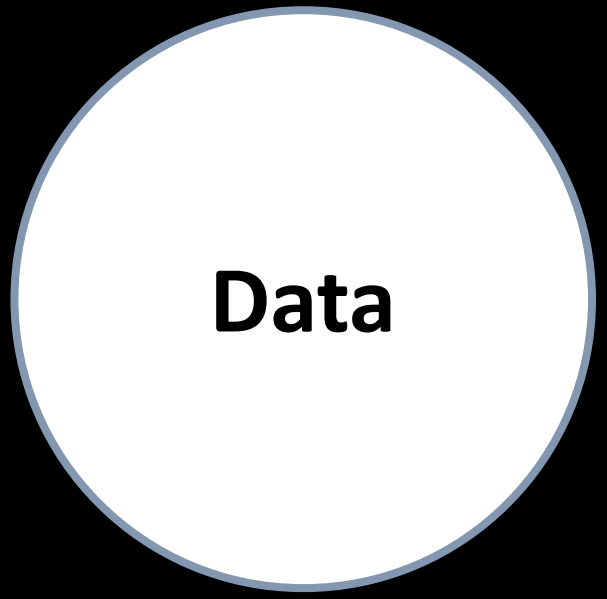
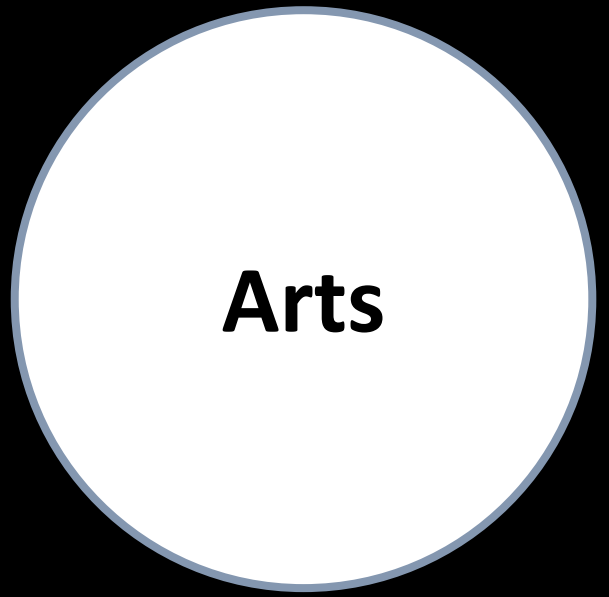


- Information (theoretically absolutely anything more *interesting* than noise)
- Why would we care? (Fair question, *data is just data*!)
  - Large quantities (“Big Data”) and smart methods and algorithms (Machine Learning ;-))
- Visualization
- Modelling, learning to understand, generate

- Exploration of the unknown!
- Through displaying, comparison, criticism, self-reflection, self-self-reflection, provocation, joke, … Creation, showing off.
- Trying to portray the **complexity? Complicatedness? Messiness?**

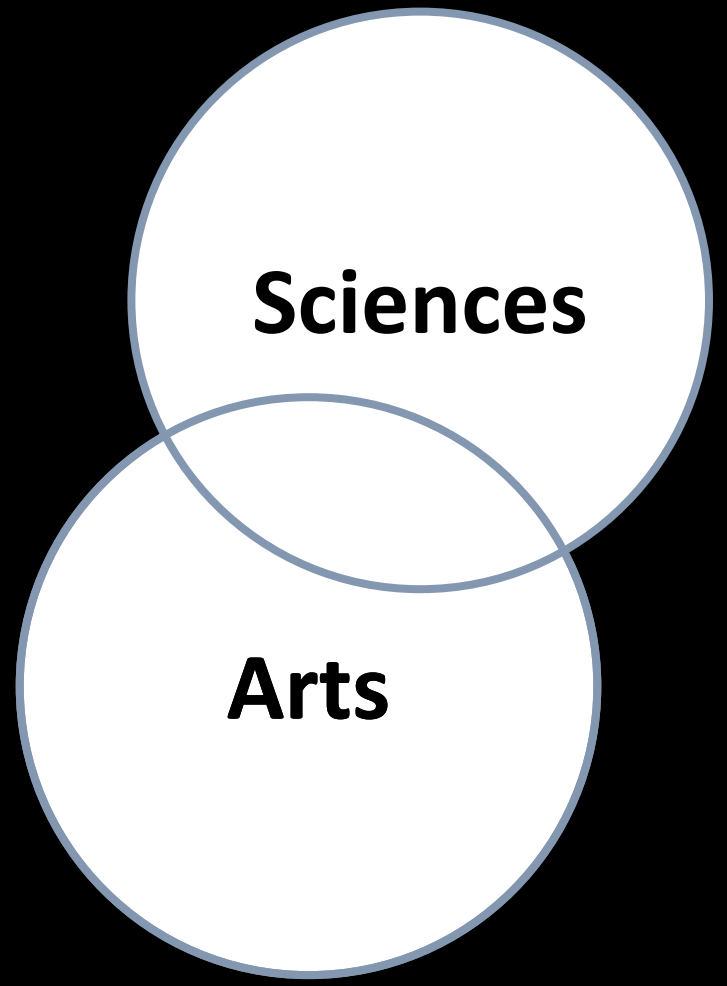


- Exploration of the unknown!
- **Explainability? Clarity?**

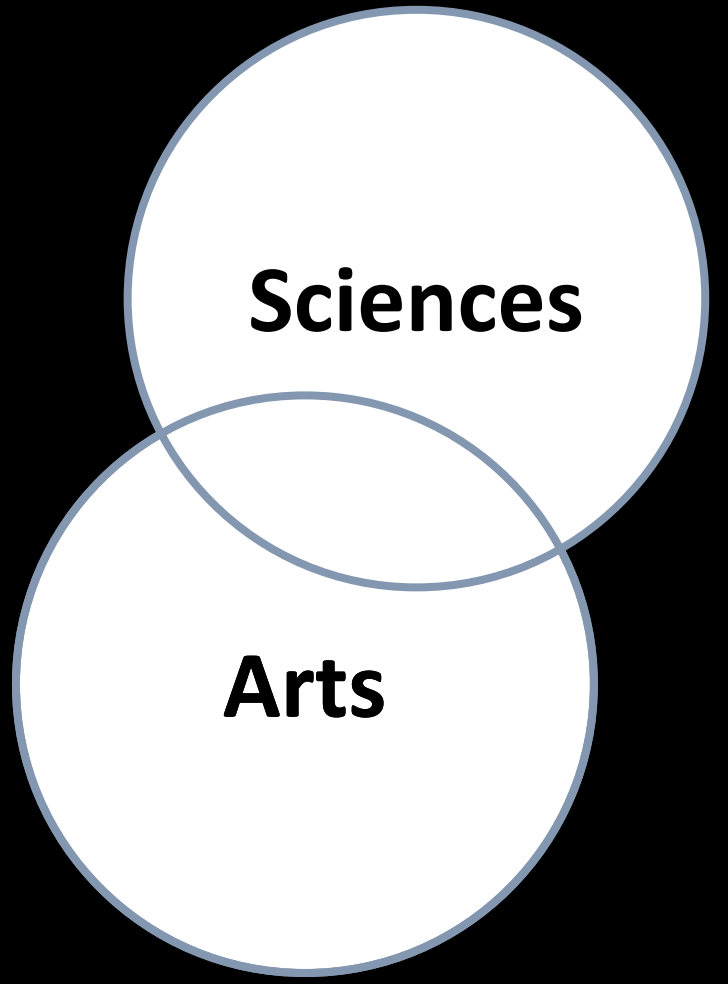
- Exploration of the unknown!

- Through displaying, comparison, criticism, self-reflection, self-self-reflection, provocation, joke, … Creation, showing off.

- Trying to portray the **complexity? Complicatedness? Messiness?**



- **Exploration of the unknown!**



  - Science -> Arts:
    - Modernism
    - Abstraction
    - (via theories of Systems)
  - Art -> Sciences:
    - Complicatedness?

Example: **When Science Meers Art** **(8 minutes podcast sample)**

- Marcus Du Sautoy & Conrad Shawcross RA in conversation

https://soundcloud.com/previtus/class-1-sample-marcus-du-sautoy-conrad-shawcross-when-science-meers-art/s-4kfnv

Pause 1

Play

- **Game of Chess / GO / Prisoner's dilemma**
- Two players making decisions depending on the state of the "board", trying to win. (**Zero Sum Game**)

Play

- **Chess =>** http://plainchess.timwoelfle.de/
- **GO**
- **Prisoner's dilemma**

- Describe:
  - What do you need for the game? Board? Players? Can you describe that?
- Action:
  - What can you do each "turn"?
- Decision:
  - How do you decide? (with the most possible detail) (strategy?)

Pause 2

Task

- Online platforms to model formulas, plots, etc.
  - Wolfram Alpha
    - all examples: https://www.wolframalpha.com/
    - https://www.wolframalpha.com/examples/society-and-culture/arts-and-media/
    - Vaguely similar to the Hitchhiker's guide to the Galaxy!
  - GeoGebra - https://www.geogebra.org/materials
  - Google Colab demos, usually machine learning (reason being access to GPU's)
  - www.gasp.gallery Pattern creator
  - p5.js demos at http://www.generative-gestaltung.de/2/

Bonus links

- Videos of simulations:
  - Game theory (“evolution of aggression”) https://www.youtube.com/watch?v=YNMkADpvO4w