

CVPR 2021

BRIDGING THE GAP BETWEEN SUBJECTIVE AND COMPUTATIONAL MEASUREMENTS OF MACHINE CREATIVITY

CMMC-CVPR21.COM

WELCOME! :D

WE UNDERSTAND WE CANNOT MEASURE EVERY
ASPECT OF CREATIVITY BUT WE WANT TO FIGURE
OUT THE MEASURABLE ASPECTS OF CREATIVITY

WE ARE HERE FOR

- Collectively brainstorming evaluation metrics and producing a set of metrics.
- Creating a map of metrics to help us have a better view on the problem
- Building a community that contributes to this difficult task

OUR SCHEDULE TODAY IS

| Time | Activity | Location |
|---------------|--|----------------|
| 11:00 - 11:20 | Introduction (20 min) | main room |
| 11:20 - 11:50 | Discussion 1 - Elements of Creative AI (30 min) | breakout rooms |
| 11:50 - 12:05 | Q & A (15 min) | main room |
| 12:05 - 12:35 | Discussion 2 - Evaluating ML/Art Projects (30 min) | breakout rooms |
| 12:35 - 12:50 | Q & A (15 min) | main room |
| 12:50 - 13:30 | Guest Speaker Panel (40 min) | main room |
| 13:30 - 14:00 | Discussion 3 - Revising Metrics, Evaluation 2 (30 min) | breakout rooms |
| 14:10 - 14:30 | Presentation of Results and Wrap up | main room |

INTERACTIVE WORKSHOP RUNS

Interactive Workshop on Computational Measurements of Machine Creativity June 20, 2021, CVPR'21

| | | <u>Group 1</u> | <u>Group 2</u> | <u>Group 3</u> | <u>Group 4</u> | <u>Group 5</u> |
|--------------|--|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Discussion 1 | <u>Elements of Creativity</u> | Elements - G1 | Elements - G2 | Elements - G3 | Elements - G4 | Elements - G5 |
| | With your group, create a list of the key elements of computational creativity. Summarize those elements (with their longer definitions) in the sheet for your group. (30 minutes) | | | | | |
| | Nominate a presenter to present results in main room (1 minute) | | | | | |
| Discussion 2 | <u>Evaluating Artworks</u> | Evaluating - G1 | Evaluating - G2 | Evaluating - G3 | Evaluating - G4 | Evaluating - G5 |
| | Using the elements of creativity described in the previous section, assess examples of art made with creative AI. We have provided a list of artworks to choose from. (30 minutes) | | | | | |
| | Nominate a presenter to present results in main room (1 minute) | | | | | |
| Discussion 3 | <u>Revise and Reflect</u> | Revise - G1 | Revise - G2 | Revise - G3 | Revise - G4 | Revise - G5 |
| | After hearing from other groups, revisit and revise your metrics. Reflect on which metrics were successful, which were not. Combine redundant metrics. Complete a final set of metrics with definitions, and then apply those metrics to a new set of artworks. (30 minutes) | | | | | |
| | Nominate a presenter to present results in main room (1 minute) | | | | | |
| CVPR'21 | cmmc-cvpr21.com | Ahmed Elgamal, Hyeju Jang, Eunsu Kang, James McCann, Jean Oh, Devi Parikh, Peter Schaldenbrand, Robert Twomey, Jun-Yan Zhu | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

INTERACTIVE WORKSHOP RUNS

| | A | B |
|----|---|------------|
| 1 | Step 1 - Please list the your proposed creativity metric elements below, and fill in a description for each one | |
| 2 | Creativity Metric Element | Definition |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |
| 18 | Please add any comments, notes, discussion and discussion on the process below: | |
| 19 | | |
| 20 | | |
| 21 | | |
| 22 | | |
| 23 | | |
| 24 | | |
| 25 | | |
| 26 | | |
| 27 | | |
| 28 | | |
| 29 | | |

INTERACTIVE WORKSHOP RUNS

| | A | B | C | D |
|----|---|---|---|---|
| 1 | <p>For the evaluation stages, please choose 2-3 artworks from the list below. Mark your group number in the first column.</p> <p>NOTE: you may also add your favorite AI artwork at bottom and evaluate that.</p> | | | |
| 2 | | | | |
| 3 | Evaluated By (Group #) | Project | URL | Instruction for Participants |
| 4 | | The Ear by Esteban Y Agosin | http://cmmc-cvpr21.com/artworks#agosin | |
| 5 | | Zen Machine by Neo Christopher Chung | http://cmmc-cvpr21.com/artworks#chung | |
| 6 | | Jungle in the Tiger by Chrisantha Fernando | http://cmmc-cvpr21.com/artworks#fernando | |
| 7 | | Furry Cars by Utkarsh Ojha | http://cmmc-cvpr21.com/artworks#ojha | |
| 8 | | In The Bleak Midwinter by Glenn Marshall | http://cmmc-cvpr21.com/artworks#marshall | |
| 9 | | Models for Environmental Literacy by Tim Marshall | http://cmmc-cvpr21.com/artworks#marshall | |
| 10 | | Permanent Visibility by Nica Ross | http://cmmc-cvpr21.com/artworks#ross | |
| 11 | | Tunes from the AI Frontiers by Bob L. T. Sturn | http://cmmc-cvpr21.com/artworks#sturm | |
| 12 | | AI Helper 002 by Maksim Surguy | http://cmmc-cvpr21.com/artworks#sturm | |
| 13 | | Synthetic Still Life by Ivona Tautkute | http://cmmc-cvpr21.com/artworks#sturm | |
| 14 | | Mezs by Rihards Vitols | http://cmmc-cvpr21.com/artworks#sturm | |
| 15 | | | | |
| 16 | | PlantConnect | https://ccastellanos.com/projects/plantconnect/ | This webpage describes the project. |
| 17 | | Libratus poker playing system | https://science.sciencemag.org/content/359/6374/418 | This article describes the Libratus poker playing system. This video from CMU also provides information https://www.youtube.com/watch?v=CRiH8yCskAE |
| 18 | | Voidopolis | https://www.instagram.com/kmustatea/ | The instagram page shows a digital performance Voidopolis. From the last page, it shows generated texts and accompanying images as an artwork all together. Please see and read from the bottom image. |
| 19 | | Baxter learns to dance | https://www.youtube.com/watch?v=PNzeT8ZsyfM | |
| 20 | | Untitled poetryAI from Foresta Inclusive | http://janetingley.com/foresta-inclusive/ | https://vimeo.com/428570144 See the "Untitled poetryAI" section, part 2 on the project webpage. |
| 21 | | Switch Jockey | https://www.alexmaclean.ca/switch-jockey/ | See the project description on the github page: https://github.com/amaclean199/switch-jockey#switchjockey |
| 22 | | 404 Not Found | https://github.com/ucsd-dsc-arts/dsc160-final-404-not-found | |
| 23 | | | | Project about editing NN weights in real-time for abstract artefacts in the generated imagery (repositioning, reinterpretation). See video demo at the bottom of the |

INTERACTIVE WORKSHOP RUNS

Step 1 - Choose 2 - 3 artworks. Please list the metric elements below, and fill in evaluations (with project names) for each column. Please use a -5 to 5 scoring system to assess a numerical evaluation of each project based on the metric. If the element is irrelevant to the project, please give a score of 0 (neutral).

[illegible]

Please add any comments, notes, discussion and discussion on the process below:

DAVID BAU, KAZJON GRACE, ALI JAHANIAN, KRISTEN GRAUMAN,
ELLEN PEARLMAN, MARK RIEDL, CAROLYN ROSE, KENNETH STANLEY



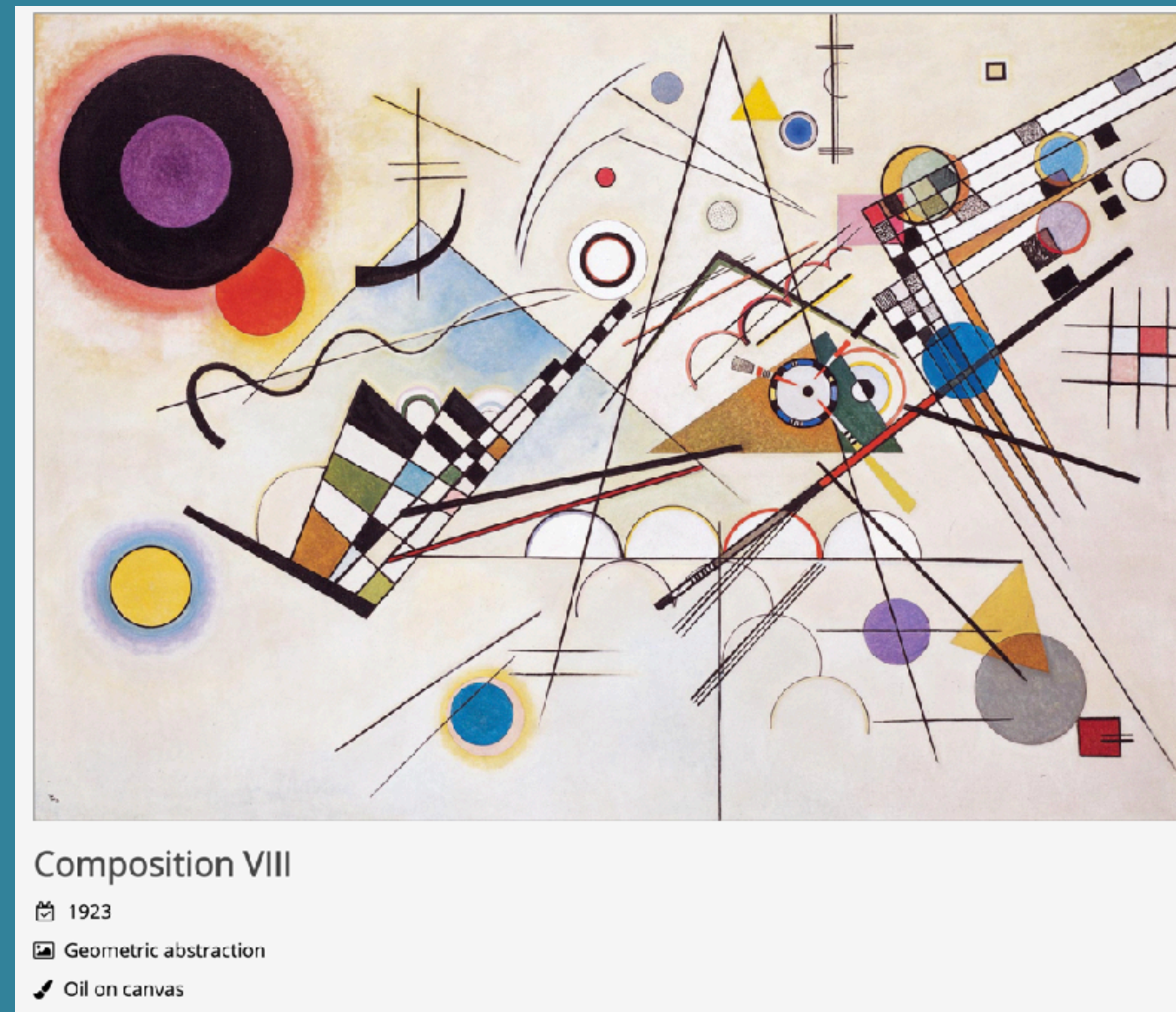
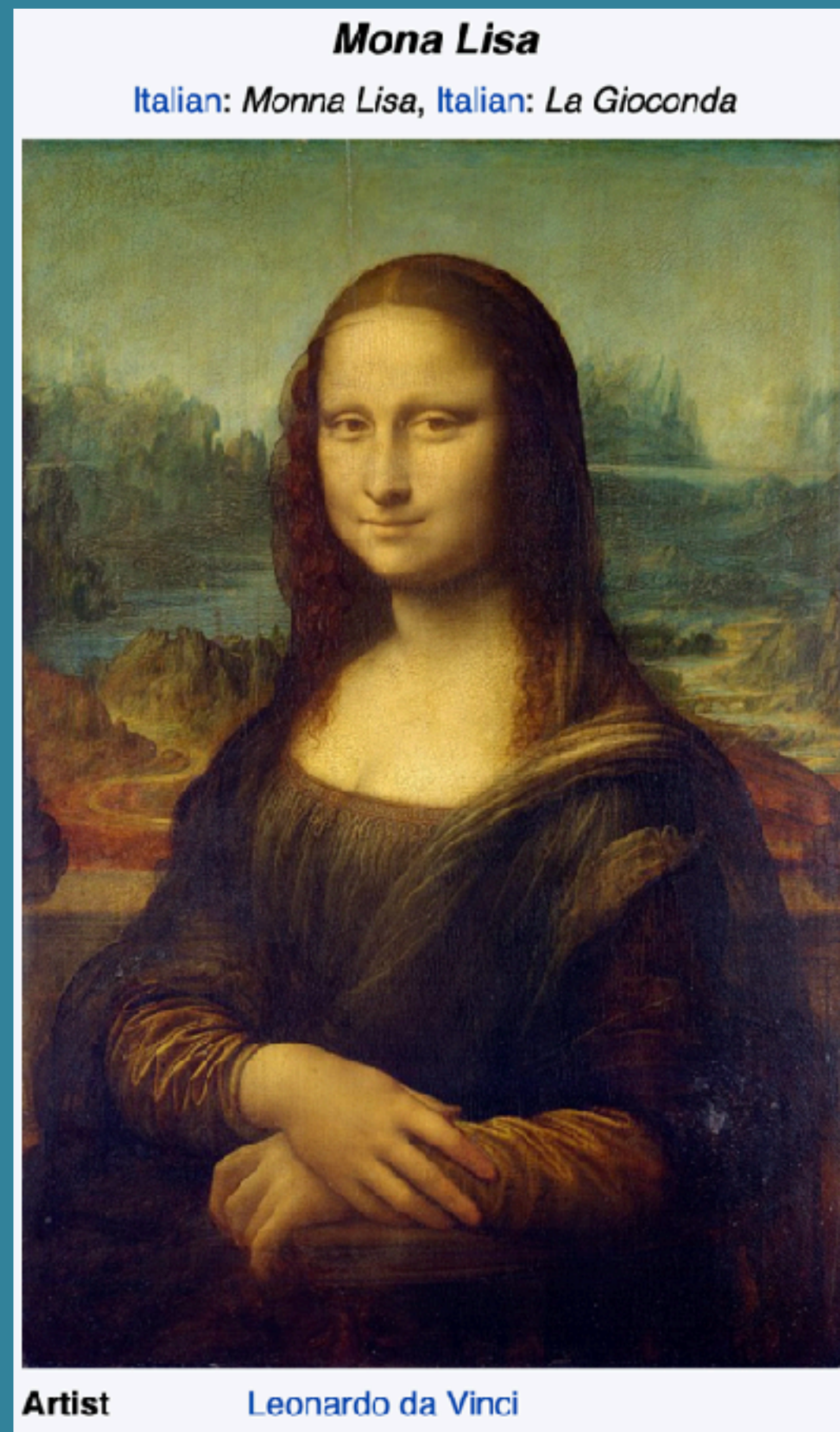
QUESTIONS

- What are your methods and metrics for evaluating the creativity of artificial or human intelligence that you and your colleagues have developed?
- Do you think that it is valuable to measure creativity? In what ways has measuring creativity helped creative output?
- [For Artists] How does the study of creative AI systems inform human creative practice? [For Engineers] How does human creativity influence computational models of creativity?
- Do you think there is an inherent difference between creative AI and human creativity? What would be the difference? If not, why not.
- Are all generative systems "creative"? or... Is there a meaningful distinction between generativity and creativity?
- How do we attribute (who is responsible for) the creativity in collaborative creative systems?

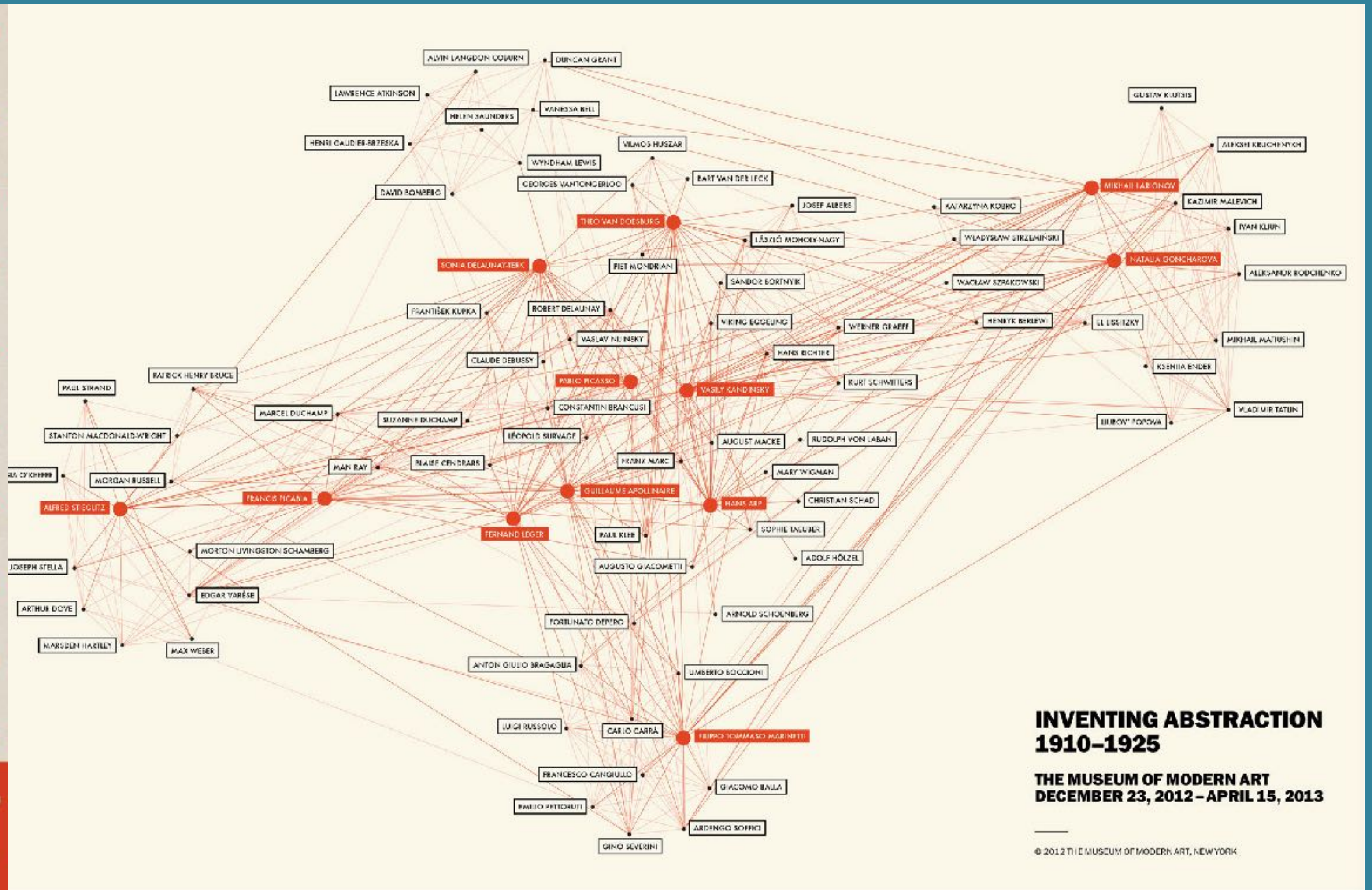
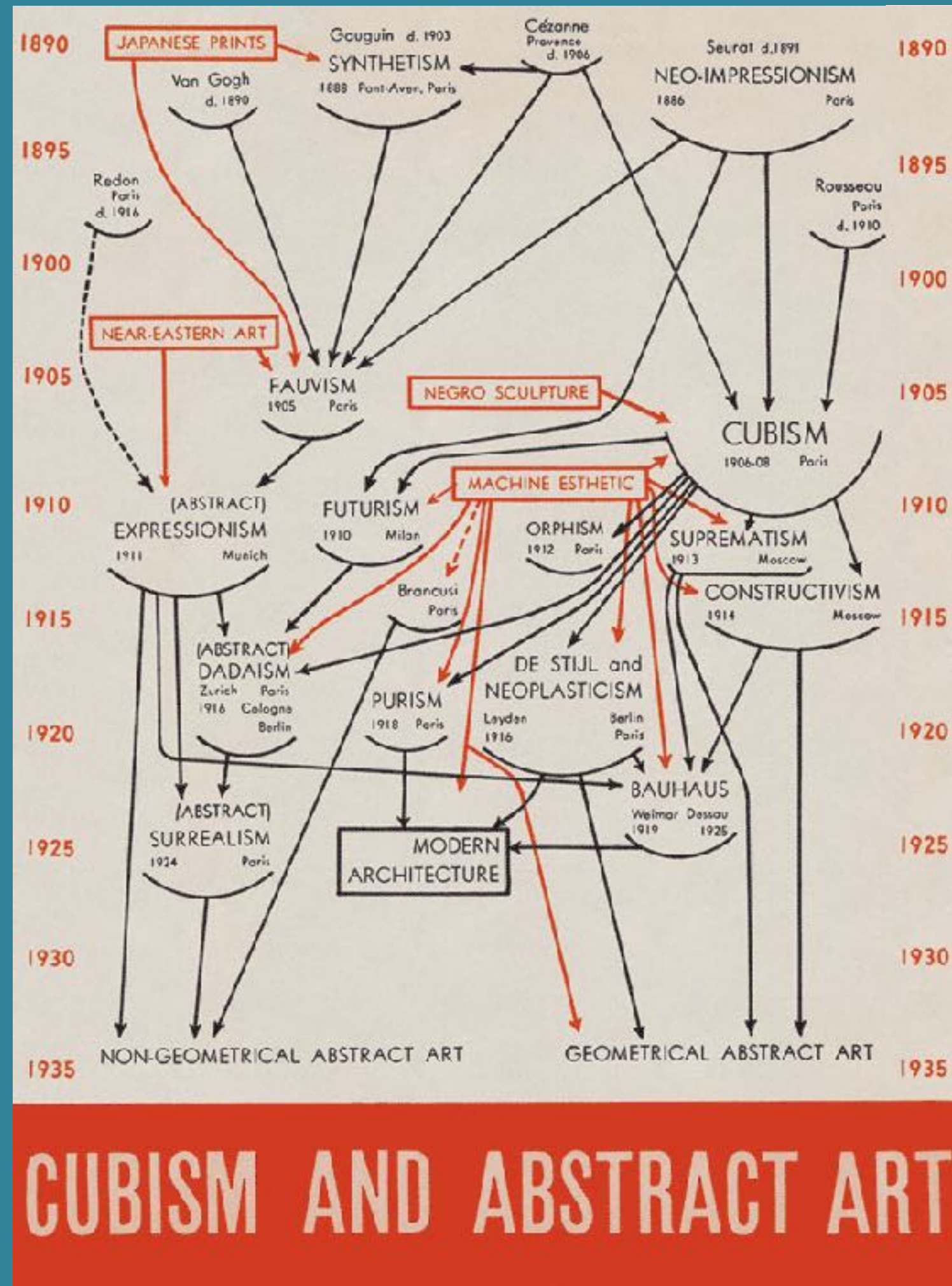
IS THIS CREATIVE?



CREATIVITY IS NOT A SUDDEN BURST OUT OF BLANK SPACE: FROM REPRESENTATIONAL(FIGURATIVE) ART TO ABSTRACT ART



CREATIVITY IS NOT A SUDDEN BURST OUT OF BLANK SPACE: CUBISM AND ABSTRACT ART



CREATIVITY THEORY

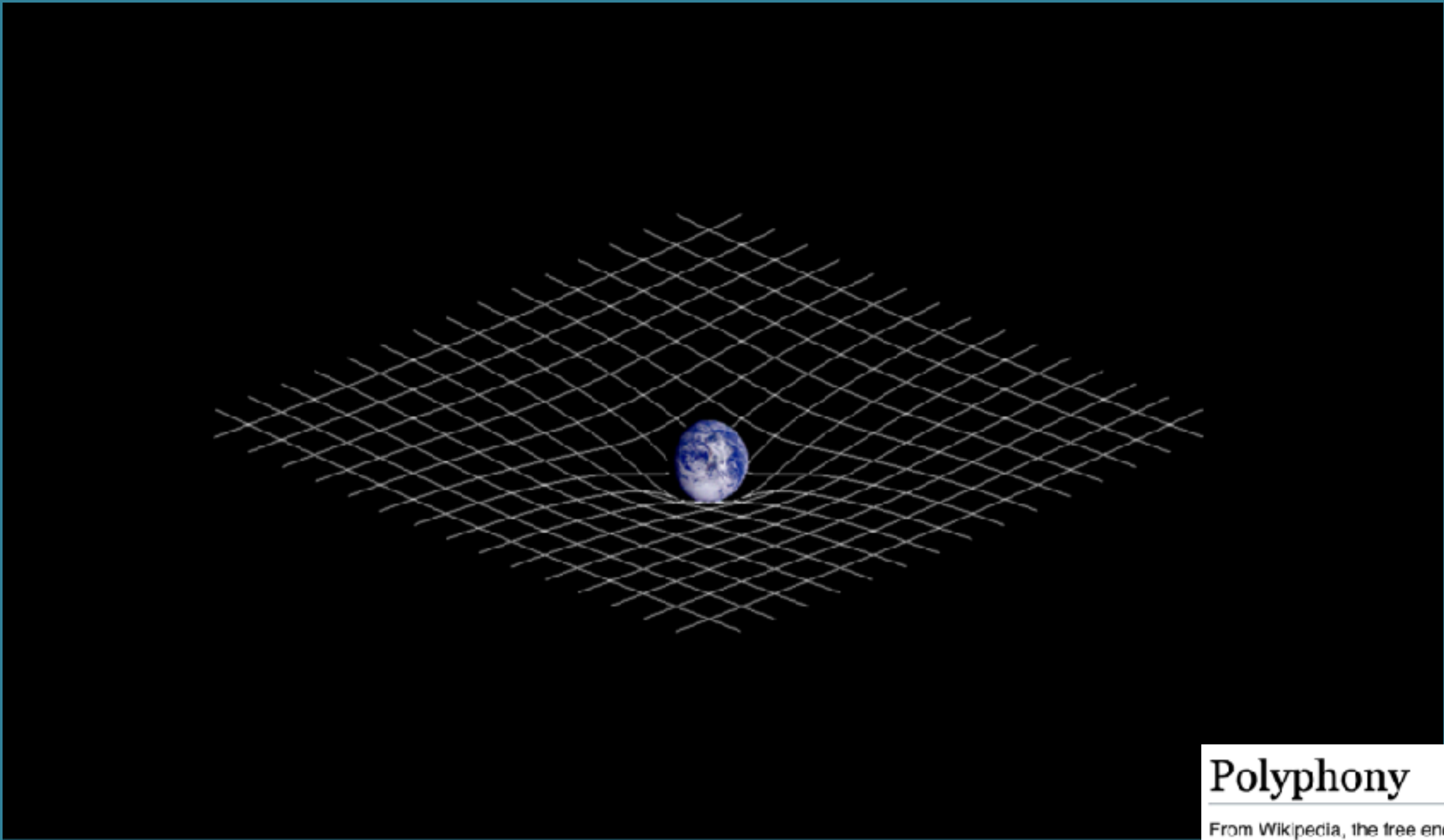
CREATIVITY

- “creativity involves a multitude of definitions, conceptualizations, domains, disciplines that bear on its study, empirical methods, and levels of analysis, as well as research orientations that are both basic and applied - and applied in varied contexts.”

CATEGORIES OF CREATIVE MAGNITUDE

- **Eminent creativity:** “**Big-C** Creativity refers to unambiguous examples of creative expression.
- **Everyday creativity:** “**Little-c** creativity focuses on the creativity of everyday life - experiences and expressions accessible to most anyone, for example, the novel way a home cook includes ingredients in a recipe, which is later. Praised by family and friends.
- “The **mini-c** category helps differentiate the subjective and objective forms of little c creativity; making room for the more subjective or personal, internal, or mental or emotional forms of creativity.
- “**Pro-c** makes room for professional-level creators like professional artists who have not yet attained eminent status, but who are well beyond little-c creators in knowledge, motivation, and performance.”

EMINENT CREATIVITY EXAMPLES



Polyphony

From Wikipedia, the free encyclopedia

This article is about the musical texture. For other uses, see [Polyphony \(disambiguation\)](#).

In **music**, **polyphony** is one type of musical [texture](#), where a texture is, generally speaking, the way that melodic, rhythmic, and harmonic aspects of a musical composition are combined to shape the overall sound and quality of the work. In particular, **polyphony** consists of two or more simultaneous lines of independent melody, as opposed to a musical texture with just one voice, [monophony](#), or a texture with one dominant melodic voice accompanied by [chords](#), which is called [homophony](#).

Within the context of the Western musical tradition, the term polyphony is usually used to refer to music of the late [Middle Ages](#) and [Renaissance](#). [Baroque](#) forms such as [fugue](#), which might be called polyphonic, are usually described instead as [contrapuntal](#). Also, as opposed to the *species* terminology of counterpoint, ^[*clarification needed*] polyphony was generally either "pitch-against-pitch" / "point-against-point" or "sustained-pitch" in one part with [melismas](#) of varying lengths in another.^[1] In all cases the conception was probably what Margaret Bent (1999) calls "dyadic counterpoint",^[2] with each part being written generally against one other part, with all parts modified if needed in the end. This point-against-point conception is opposed to "successive composition", where voices were written in an order with each new voice fitting into the whole so far constructed, which was previously assumed.

The term *polyphony* is also sometimes used more broadly, to describe any musical texture that is not monophonic. Such a perspective considers homophony as a sub-type of polyphony.^[3]



A bar from [J.S. Bach's "Fugue No.17 in A flat", BWV 862](#), from [Das Wohltemperierte Clavier](#) (Part I), a famous example of **contrapuntal polyphony**. [Play](#) ^(help·info)

RELEVANT THEORIES OF CREATIVITY (4 OUT OF 10)

- **Problem Solving & Expertise-Based:** Creative solutions to ill-defined problems result from a rational process, which relies on general cognitive processes and domain expertise (Little-c to Big-C)
- **Problem Finding:** Creative people proactively engage in a subjective and exploratory process of identifying problems to be solved (Primarily Mini-C)
- **Evolutionary** (Darwinian): Eminent creativity results from the evolutionary-like processes of blind generation and selective retention (Primarily Big-C)
- **Typological:** Creators vary along key individual differences, which are related to both macro- and micro-level factors and can be classified via typologies. (Little-c to Big-C)

COMPUTATIONAL CREATIVITY

COMPUTATIONAL CREATIVITY: GENERAL (AND ARGUABLE) PERSPECTIVE FROM THE ASSOCIATION FOR COMPUTATIONAL CREATIVITY

“The goal of computational creativity is to model, simulate or replicate creativity using a computer, to achieve one of several ends:

- to construct a program or computer capable of human-level creativity

- to better understand human creativity and to formulate an algorithmic perspective on creative behavior in humans

- to design programs that can enhance human creativity without necessarily being creative themselves”

COMPUTATIONAL CREATIVITY BY NEWELL, SHAW, SIMON (1958, CARNEGIE INSTITUTE OF TECHNOLOGY)

“we call problem solving creative when the problems solved are relatively new and difficult”

COMPUTATIONAL CREATIVITY BY NEWELL, SHAW, SIMON (1958, CARNEGIE INSTITUTE OF TECHNOLOGY)

"1. Completely operational specifications (programs) for the behavior of mechanisms (or organisms) that, with appropriate initial conditions, would in fact think creatively; "

"2. a demonstration that mechanisms behaving as specified (by these programs) would exhibit the phenomena that commonly accompany creative thinking (e.g., incubation, illumination, formation and change in set, etc.);

"3. a set of statements - verbal or mathematical - about the characteristics of the class of specifications (programs) that includes the particular examples specified."

COMPUTATIONAL CREATIVITY BY NEWELL, SHAW, SIMON (1958, CARNEGIE INSTITUTE OF TECHNOLOGY)

“Problem solving is called creative to the extent that one or more of the following conditions are satisfied:

1. The product of the thinking has novelty and value (either for the thinker or for his culture).
2. The thinking is unconventional, in the sense that it requires modification or rejection of previously-accepted ideas.
3. The thinking requires high motivation and persistence: either taking place over a considerable span of time (continuously or intermittently), or occurring at high intensity.
4. The problem as initially posed was vague and ill-defined, so that part of the task was to formulate the problem itself. ”

COMPUTATIONAL CREATIVITY BY NEWELL, SHAW, SIMON (1958, CARNEGIE INSTITUTE OF TECHNOLOGY)

- “Is Unconventionality Enough?”
- “If unconventionality simply means rejecting some of the heuristics that restrict search to a limited subspace, then the effect of unconventionality will generally be a return to relatively inefficient trial-and-error search in a very much larger space.”
- “attention to the richness of their systems of heuristics (that makes any particular piece of heuristic dispensable, and to their learning processes that generate new heuristics to fill the vacuums created by the rejection of the ones previously used.)”

MODELING CREATIVITY

COMPUTER MODELS OF CREATIVITY

BY MARGARET A. BODEN (2009)

“Creativity isn’t magical. It’s an aspect of normal human intelligence, ... Whether computers could “really” be creative isn’t a scientific question but a philosophical one, to which there’s no clear answer. But we do have the beginnings of a scientific understanding of creativity.”

COMPUTER MODELS OF CREATIVITY

BY MARGARET A. BODEN (2009)

- “**Combinational creativity** produces unfamiliar combinations of familiar ideas, and it works by making associations between ideas that were perviously only indirectly linked”
- “**Exploratory creativity** rests on some culturally accepted style of thinking, or “conceptual space. ...The space is defined and constrained by a set of generative rules.”
- “**Transformational creativity** ... it can give rise to ideas that are not only new but fundamentally different from any that went before.”

EXAMPLES FROM VISUAL ART



Nam June Paik
Zen for TV
1963



Meret Oppenheim
Object
Paris, 1936

The Listening Room



Artist [René Magritte](#)
Year 1952
Medium [Oil on canvas](#)
Dimensions 45 cm x 54.7 cm (18 in x 22 in)
Location [Menil Collection, Houston, TX](#)



The Starry Night, June 1889. [Museum of Modern Art](#), New York

MODELING CREATIVITY

- “both novel as well as high-quality in the domain”

MODELING CREATIVITY IN AI

- How do we computationally model ambiguity?
- Would a novelty search result in valuable discoveries?
- Where is the threshold between randomness and creativity?
- How do we evaluate the creativity of an algorithm?