

IAT 811: Metacreation

Machines endowed with creative behavior

Elements on creativity

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Elements of a theory of creativity

- The focus of this course is on:

“Machines endowed with **creative** behavior”

We will focus on software (formally Turing Machines).
No hardware/physical machines, no biological machines, ...

External manifestation (given some internal or external stimuli)

It is now time to see what can be said on that notion

Defining creativity

- There are many definitions of creativity, here are some:
 - Common definition from Webster's - Creativity is marked by the ability or power to create—to bring into existence, to invest with a **new** form, to produce through imaginative skill, to make or bring into existence something **new**.
 - Carl Rogers (psychologist and writer) -- The emergence of a **novel**, relational product, growing out of the **uniqueness of the individual**.
 - Henry Miller (writer) -- The occurrence of a composition which is both **new** and **valuable**.
 - John Haefele (CEO and entrepreneur) -- The ability to make **new** combinations of social **worth**.
 - Newell, Simon, & Shaw (logic theorists) -- A special class of **problem solving** characterized by **novelty**.
 - H. H. Fox (scientist) -- Any thinking process in which **original** patterns are formed and expressed.
 - E. Paul Torrance (educator, academic, creativity investigator) -- Fluency , flexibility, **originality**, and sometimes elaboration.
 - Rollo May (writer, philosopher) - Creativity is the process of bringing something **new** into being...
 - Roger von Oech - Creative thinking involves imagining familiar things in a **new** light, digging below the surface to find previously undetected patterns, and finding connections among unrelated phenomena.
 - Carnevale, Gainer, Meltzer - ... the ability to use different modes of thought to generate **new** and dynamic ideas and **solutions**

Defining creativity

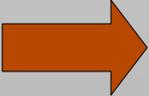
- The UK National Advisory Committee's report (1999) entitled: “All our futures: Creativity, culture and education”, states that:
 - We are all, or can be, creative to a lesser or greater degree if we are given the opportunity.
- The definition of creativity in the report (page 29) is broken down into four characteristics:
 - First, they [the characteristics of creativity] always involve thinking or behaving **imaginatively**.
 - Second, overall this imaginative activity is **purposeful**: that is, it is directed to achieving an objective.
 - Third, these processes must generate something **original**.
 - Fourth, the outcome must be of **value** in relation to the objective.

Defining creativity

- **Let go through these four attributes:**
 - **Imagination:** “creative ability of the mind”
(Merriam-Webster dictionary)
 - **Purposeful:** The imaginative activity is directed at achieving an objective, e.g. AARON is doing a painting.
 - **Original:** A production is as original as:
(from Wilson, Guilford and Christensen, *Psychological Bulletin*, 50, 1953)
 - It is rare
 - It is judged as such by a group of judges
(see T. M. Amabile, *Social Psychology of Creativity: A consensual assessment technique*, *Journal of Personality and Social Psychology*, 1982, 43(5), p. 997-1013.)
 - It associates pieces of knowledge that are distant
 - **Valuable:** it has to have some value in relation to its purpose. AARON paintings are valuable (bought by the Tate Gallery, ...)

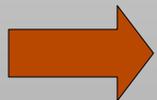
Situating creativity

- All good except for the mind thing!
- From Aristotle to Stenberg, creativity has been associated to **intelligence** as being one of three main components:
 - **Analytic intelligence**: analyse, critique, judge, compare, evaluate, assess, ...
 - **Practical intelligence**: apply, use, put into practice, implement, employ, ...
 - **Synthetic (or creative) intelligence**: create, invent, discover, imagine if, suppose that, predict, ...

 We will be looking at “intelligent behavior”, through the use of AI/A-life techniques. (AARON is one example!)

Background

- Short history of creativity:
 - In industrialised countries, it has been institutionalised as an attribute of the citizen in the middle of the 20th century in order to consider **everyone as a potential source of originality, change and progress.**
 - This was associated with a triple gain:
 - **Identity:** differentiation vs uniformity in contemporary societies (Cf. Toqueville, Democracy in America, 1835)
 - **Productivity:** if every citizen is incited to be creative and inventive, one can aim at a global increase in productivity.
 - **Social recognition:** creativity as a way to get a social status. Ex. “Art brute” in which productions by handicapped and marginals have been used to rehabilitate them.



The socio-political dimension of creativity will bring us to consider the status of metacreation

Background

- **The invention of brainstorming:**
 - **Introduced by Osborn** (Osborn, Applied Imagination, New York, Scribner, 1957)
 - **The idea is to dissociate generation/production (imagination, novelty) and evaluation/selection (value) when searching for solutions**
 - **It has been shown experimentally that: people working under the constraints of “finding good ideas” (of solutions) produce less and less interesting ideas than people using brainstorming** (Parnes and Meadow, Development of individual creative talent, in Scientific Creativity: its recognition and development, New York, Wiley, 1963)

Creativity and Cybernetics

- Theoretical perspective on creativity common to AI, epistemology and philosophy of mind:
 - Initiated by Marvin Minsky (Minsky, M., Steps toward Artificial Intelligence, Proceedings IRE, 49, 1961, p.8-30.)
 - A **problem** (and creativity is seen as a problem solving enterprise) is well defined iff a given **solution** candidate can be associated with true or false.
 - Is there as systematic way to decide if a candidate solution is acceptable?
 - When a problem does not have this property (which is very common), then it is said to be **ill-defined**.
E.g. Composing music, painting, choosing clothes to wear, cooking a good meal, writing a contract, ... everything that can be discussed really.
 - Criticised as being too restrictive by Herbert Simon (Simon, H. A., The structure of ill-structured problems, Artificial Intelligence, 4, p.181-201. 1973)

Creativity and Cybernetics

- For Simon, a **problem is well structured** if at least one of the following holds:
 1. Minsky's criteria holds
 2. The **search space** can be defined (initial state, final state, transition function) and
 1. Transitions are direct (no miracle)
 2. All the knowledge used for the resolution can be symbolically represented
 3. If the problem imply acting on the world, then state changes have to conform to natural laws
 4. The resolution should be computationally tractable.
- This is very demanding and Simon concludes that there is no such problems in nature or society and that these are always artificially prepared, “defined”.

Creativity and Cybernetics

- **Let's take an example: Constructing a house**
 - This depends on a variety of parameters: budget, number of persons, topology of the place, lifestyle, weather and region, laws, personal tastes, ... the problem is ill-defined.
 - Once we have fixed the number of rooms, the nature floor, a budget bracket, ... the uncertainty is reduced...we have progressed in defining the problem.
 - Every subsequent decision (compatible with the previous ones) will go in that direction

Creativity and Cybernetics

- **Four situations:**
 - **Search space and solution well defined:** Sudoku, encrypted additions (DONALD + GERALD = ROBERT), playing chess, playing GO, ...
 - **Only the solution(s) is specified:** How can we incite more people to vote? What argument to use to convince the judge? How to reduce the feeling of insecurity in poor suburbs? How to construct a bottle opener in one piece that is not dangerous for kids?
 - **Only the search space is specified:** What old tires can be used for? What new function can we add to mobile phones? What would entertain us on a rainy Sunday afternoon? (Often used in so-called creativity tests)
 - **Nothing is specified:** The empty form of all possible problems. It does not have any practical use. What can we do to do what?

Typology of Creativity

- Margaret Boden distinguishes between:
 - **P-creativity**: psychological creativity (novel and valuable for the individual)
 - **H-creativity**: historical creativity (novel and valuable for the group)
- Her typology elaborates on:
 - **C-creativity**: Combinatory creativity (novel combination of familiar ideas)
 - **E-creativity**: exploratory creativity (novel and valuable points of the conceptual space)
 - **T-creativity**: transformational creativity (involves transformation of some dimensions of the conceptual space itself)

Creativity in AI

- Some more resources on creativity in AI (it is a topic on its own):
 - Video: <http://www.vega.org.uk/video/programme/81>
 - Papers from Margaret Boden
 - <http://www.aai.org/AITopics/html/create.html>
- The difficulty to define creativity entails the very problem of the **evaluation of metacreation**:
 - In science there is often an optimal solution
 - Evaluation of a solution has to do with its distance to the optimal
 - Computational creativity addresses those problems for which the optimal solution is not (clearly) defined.
 - Consequently the above mentioned metrics do not apply.



“Creativity is allowing yourself to make mistakes. Art is knowing which ones to keep.”

Scott Adams (American Cartoonist, b.1957)

For next Week

- **Submit a proposal for the theoretical research:**
 - **The proposal (1 page) should:**
 - **Name the Metacreation you will focus on**
 - **Name the tools used (should be in the list of topics)**
 - **Include the proper bibliographic references (send me the PDF/scanned texts or links if available)**
 - **Example:** I will present AARON by Harold Cohen and detail the underlying expert system. In order to do so, I will read:
 - Cohen, Harold. "The further exploits of AARON, Painter" Stanford Electronic Humanities Review. volume 4, issue 2: Constructions of the Mind. Updated July 22, 1995.
 - McCorduck, Pamela. AARON's Code: Meta-Art, Artificial Intelligence, and the Work of Harold Cohen, New York: W.H. Freeman and Company, 1991
 - Cohen, H. (1999). Coloring Without Seeing: a Problem in Machine Creativity. Available from the author's webpage.
 - **I will decide if your proposal is accepted or not**
- **Start thinking about your project (I will ask you a developed description in two weeks)**

For next week

- **Send me your answers to the questions about your background, “a little bit about you” (Maximum 2 pages)**
- **Readings:**
 - Stephen Wilson, Artificial intelligence research as art, SEHR, volume 4, issue 2: Constructions of the Mind, Updated July 22, 1995 (available at: <http://www.stanford.edu/group/SHR/4-2/text/wilson.html>)
 - M. Wooldridge and N. R. Jennings. Intelligent Agents: Theory and Practice. In Knowledge Engineering Review 10(2), 1995. (Available from the authors' webpage). Section 4 can be skipped (deprecated).
 - Russel and Norvig (“the bible”), Artificial intelligence: A modern approach (second ed.). Upper Saddle River, NJ: Prentice Hall. Chapters 1&2.

