

CREATIVITY

Group 2

Vinod Kumar

Ignatius Pereira

Prem Kumar



Agenda

- Definition of Creativity
- Motivation
- Human Creativity
- Different models proposed
- Relevance to AI

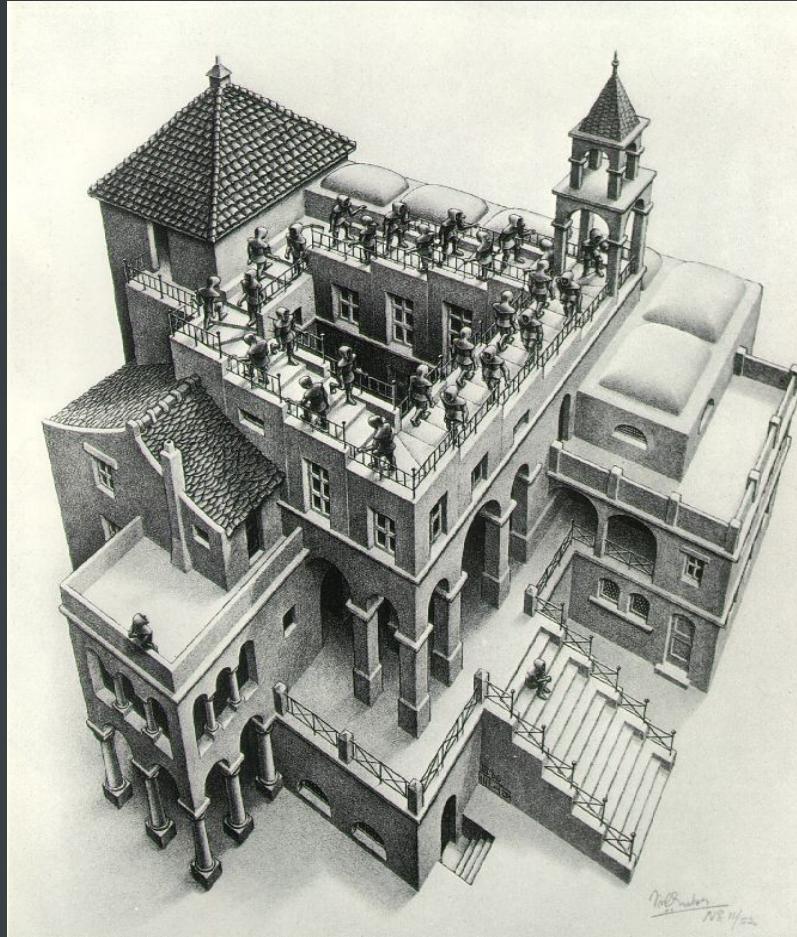


Definition of Creativity

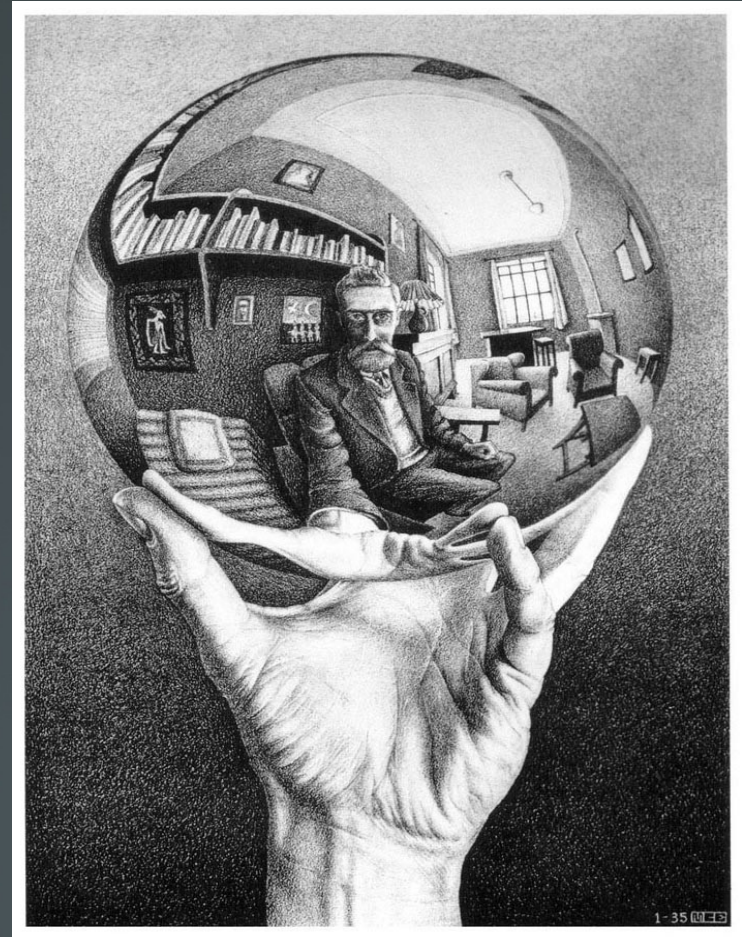
- Ability to come up with ideas that are *new*, *surprising* and *valuable*.
- Associated fields – artificial intelligence, cognitive psychology, philosophy, arts etc..
- Not a special faculty but is an aspect of general intelligence.
- Eg. Escher's drawings, Einstein's works, inventions, discoveries etc..



Escher's works

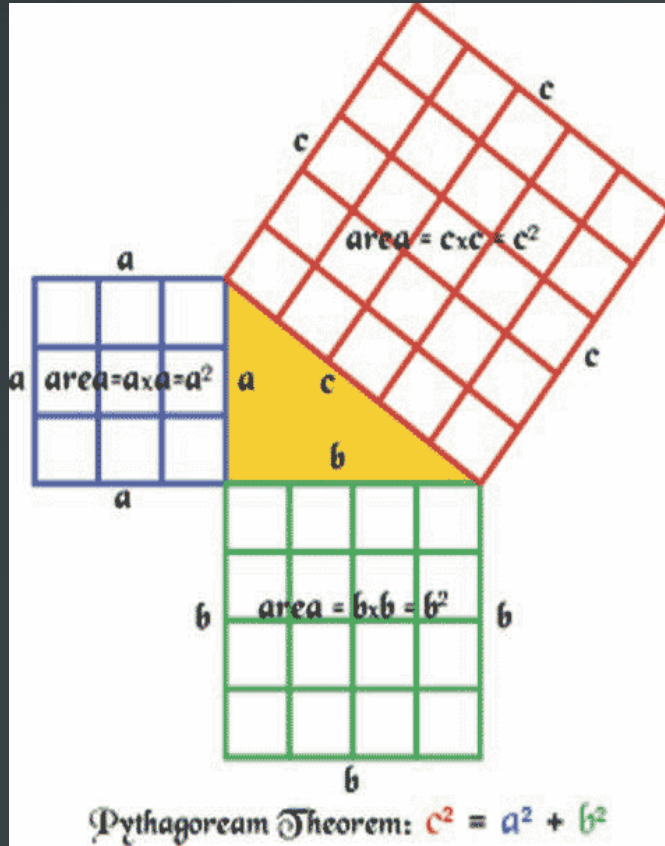


Source:
http://en.wikipedia.org/wiki/File:Ascending_and_Descending.jpg



Source: <http://www.mcescher.com/Gallery/ital-bmp/LW268.jpg>

Academic examples



Source:
<http://www.myastrologybook.com/PythagoreanTheorem16c.gif>



Source:
<http://www.success.co.il/knowledge/images/matter-and-energy-Physics-e=mc2.jpg>

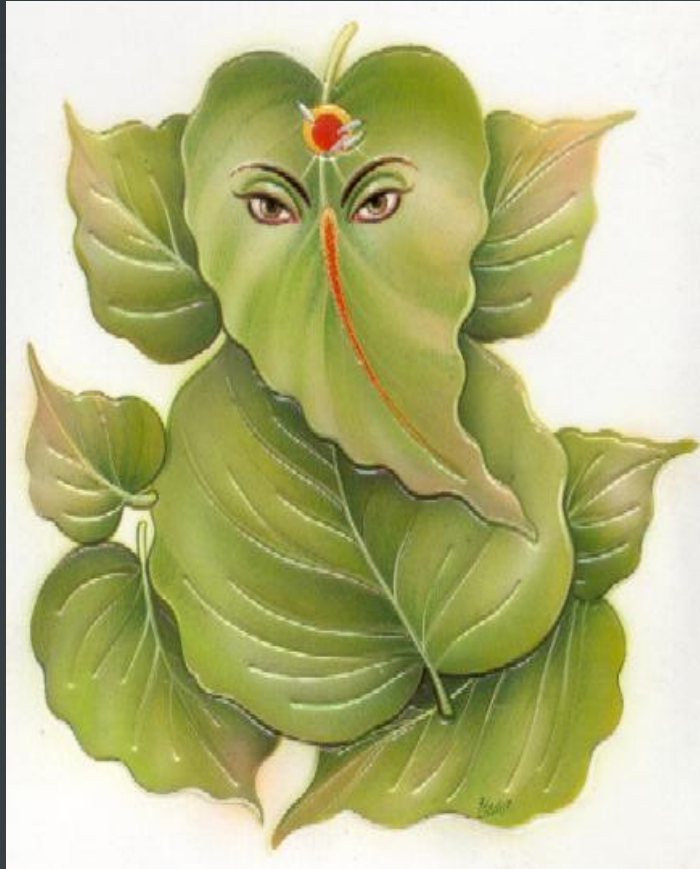
Business examples



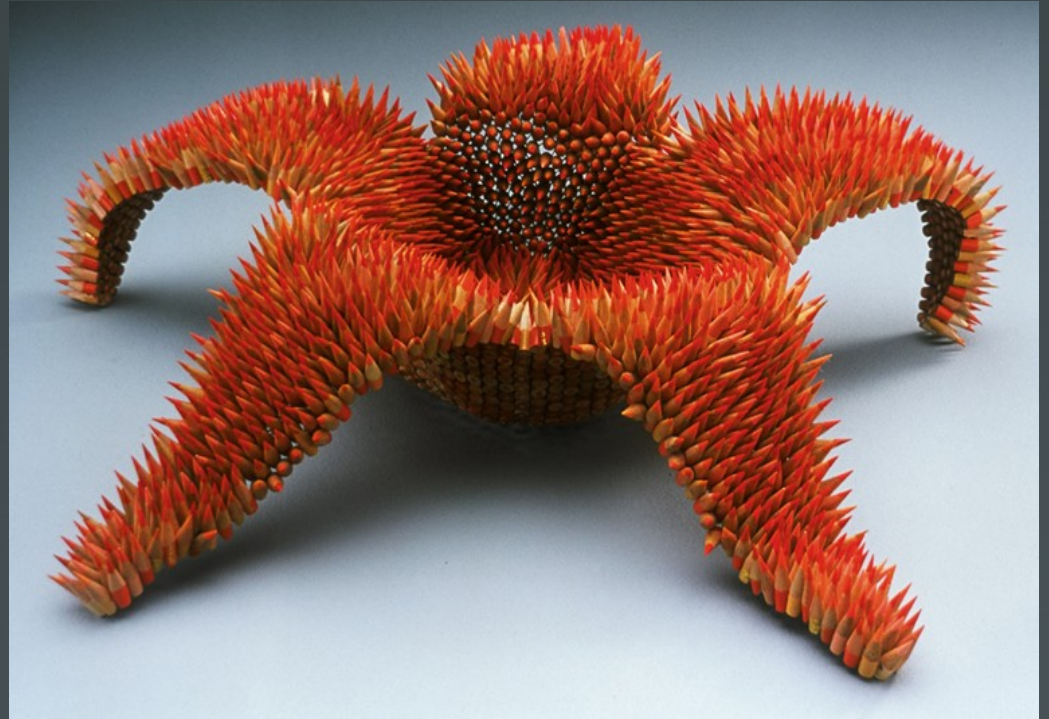
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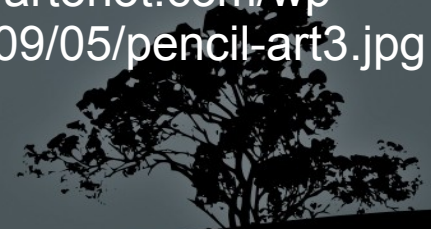
Other examples



Source: <http://www.bnaiyer.com/images/leaf-ganesh.jpg>



Source: <http://www.artnot.com/wp-content/uploads/2009/05/pencil-art3.jpg>



Motivation

- Creativity is more of a MYSTERY.
- Examples above are human creativity skills.
- Understand the process behind human creativity.
- Understand by simulating with machines.
- Better creative systems can be built.
- That will also reflect how much we have understood.



How to be creative

- Come up with many ideas. Then discard useless ones.
- "Assumptions-breaking process"
 - Discard the preconcieved assumptions.
 - Attempt a new approach
- Element of chance



Distinguishing creativity and Innovation

- Creativity is referred to the act of producing new and novel ideas.
- While innovation is referred to the act of producing a new and novel idea and the idea is applied in some specific context.
- Creativity is starting point for innovation
- Former necessary but not sufficient for latter.



Human Creativity

- Margaret Boden categorizes creativity into
 - P-creativity
 - H-creativity

P stands for psychological

H stands historical

Boden, M. (1991). *The Creative Mind: Myths and Mechanisms*.



P-creativity

- A novel idea that is new to person who comes up with it.
- Example – student coming up with an idea which is new to him even if it exists in literature
- This creativity interests to people like pyscologists, who wants to understand the process of creativity.

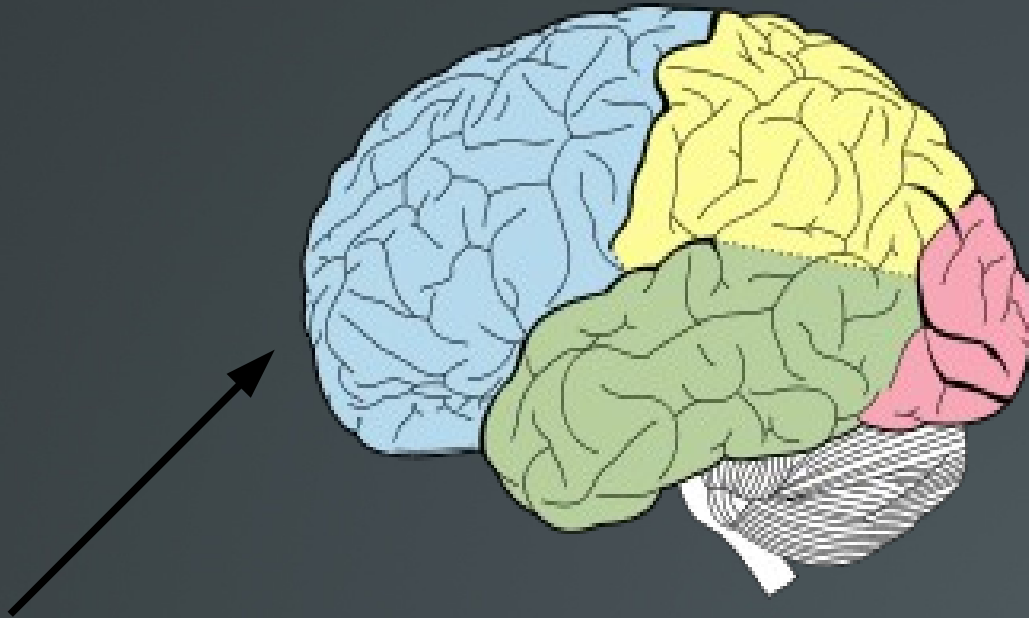


H-creativity

- A novel idea that is new to person who comes up with it and also new to everyone.
- Example – inventions, discoveries
- This creativity interests to people like general audience, historians, encyclopedia users etc..
- H-creativity is an instance of P-creativity.



Responsible part of the brain for creativity



Frontal lobe

Source: http://en.wikipedia.org/wiki/File:Lobes_of_the_brain_NL.svg



Creativity models

- Wallas model
 - In his book "Art of thought".
 - 4 stages
 - Preparation->Incubation->Illumination->Verification

Creativity models

- Wallas model(contd..)
- Preparation :- we define the problem, need, or desire, and gather any information the solution or response needs to account for, and set up criteria for verifying the solution's acceptability.



Creativity models

- Wallas model(contd..)
- Incubation :- we step back from the problem and let our minds contemplate and work it through. Like preparation, incubation can last minutes, weeks, even years.



Creativity models

- Wallas model(contd..)
- Illumination :- ideas arise from the mind to provide the basis of a creative response. These ideas can be pieces of the whole or the whole itself, i.e, seeing the entire concept or entity all at once. Unlike the other stages, illumination is often very brief, involving a tremendous rush of insights within a few minutes or hours.



Creativity models

- Wallas model(contd..)
- Verification :- the final stage, one carries out activities to demonstrate whether or not what emerged in illumination satisfies the need and the criteria defined in the preparation stage.



Creativity models

- Geneplore model
- Two phases
 - Generative phase :- one constructs mental representations called pre-inventive structures, having various properties that promote creative discovery.
 - Exploratory phase :- These properties are then exploited during an exploratory phase in which one seeks to interpret the pre-inventive structures in meaningful ways.

Computational Creativity

- Goal
 - Model
 - Simulate
 - Replicate human creativity



Computational Creativity

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

Defining creativity in computational terms

1. Novel and Useful

- important qualities of a creative product

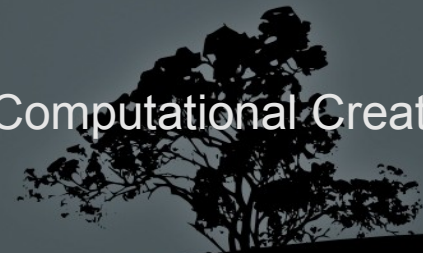
2. Demands that we reject ideas we had previously accepted

3. Results from intense motivation and persistence

4. Comes from clarifying a problem that was originally vague

- 2-4 characterize the attitude and actions of the producer of such a product

Source: Wikipedia – Computational Creativity.



Three Forms of creativity

- Combinational Creativity
- Exploratory Creativity
- Transformational Creativity

Source: Creativity and artificial
intelligence

-Margaret A. Boden



Combinational Creativity

- Unfamiliar combination of familiar ideas.
 - Eg. Journalist comparing a politician/terrorist with a deadly animal.
 - Requires rich store of knowledge.
 - Valued only if some link is found between them.



Combinational Creativity



Source: <http://tickledbylife.com/site/wp-content/uploads/2008/12/creativity.gif>

Exploratory Creativity

- Exploration within an established Conceptual space
- More likely to arise from a thorough and persistent search of a well-understood space (criterion 3 of Newell and Simon)



Transformational Creativity

- Arises from a deliberate transformation of the conceptual space
- Transformational creativity should involve the rejection of some of the constraints that define this space (criterion 2)
- Some of the assumptions that define the problem itself (criterion 4).




Artificial Creativity

- Artificial Creativity is concerned with producing behavior in machines, which if acted out by a human, would be deemed creative

So,

- One of the ultimate goals of artificial creativity research is to replicate creativity as it appears in humans

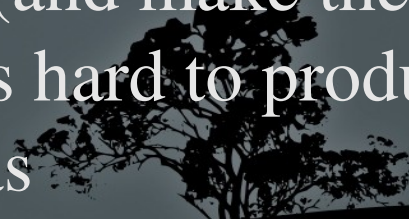
Artificial Creativity

- The complexity of human activities has led research to fragment into focus on specialized systems for particular activity, rarely encompassing systems integration to any significant extent.
 - This divide & conquer approach to human creativity has arguably proven limited for explaining the origins and nature of creativity, and how its multifaceted processes are intertwined with intelligence
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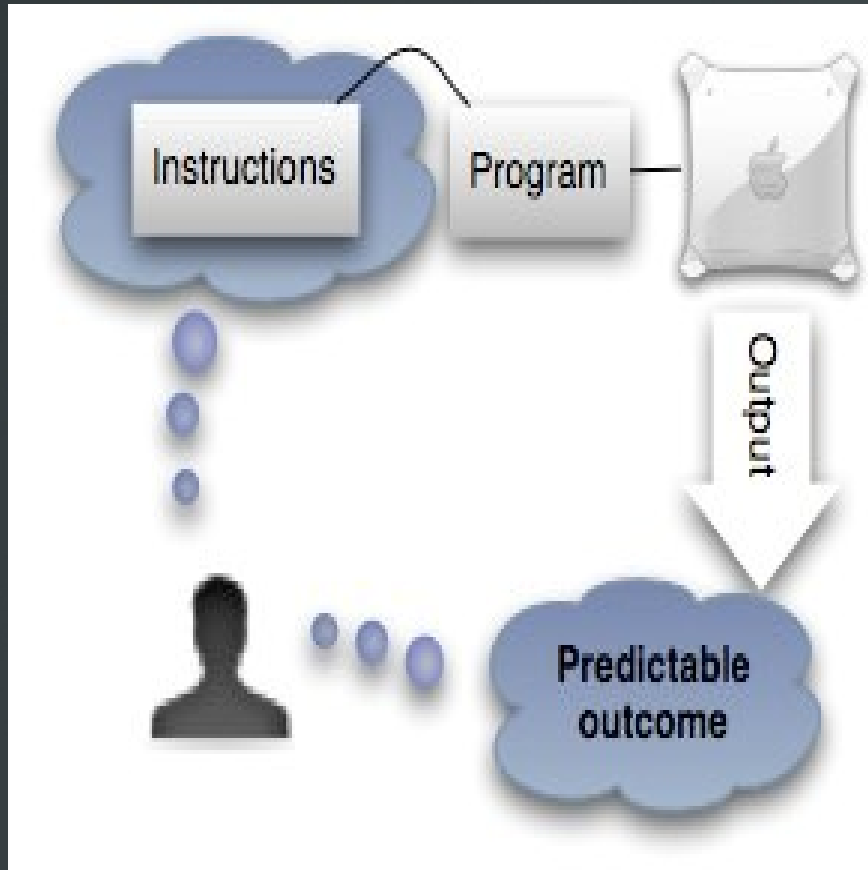
A fundamental problem in implementing creative systems

- Not only do we lack understanding of our own creative mechanisms, but the basics of computer programs seem to oppose the idea of achieving unbound originality

Fundamental Problem

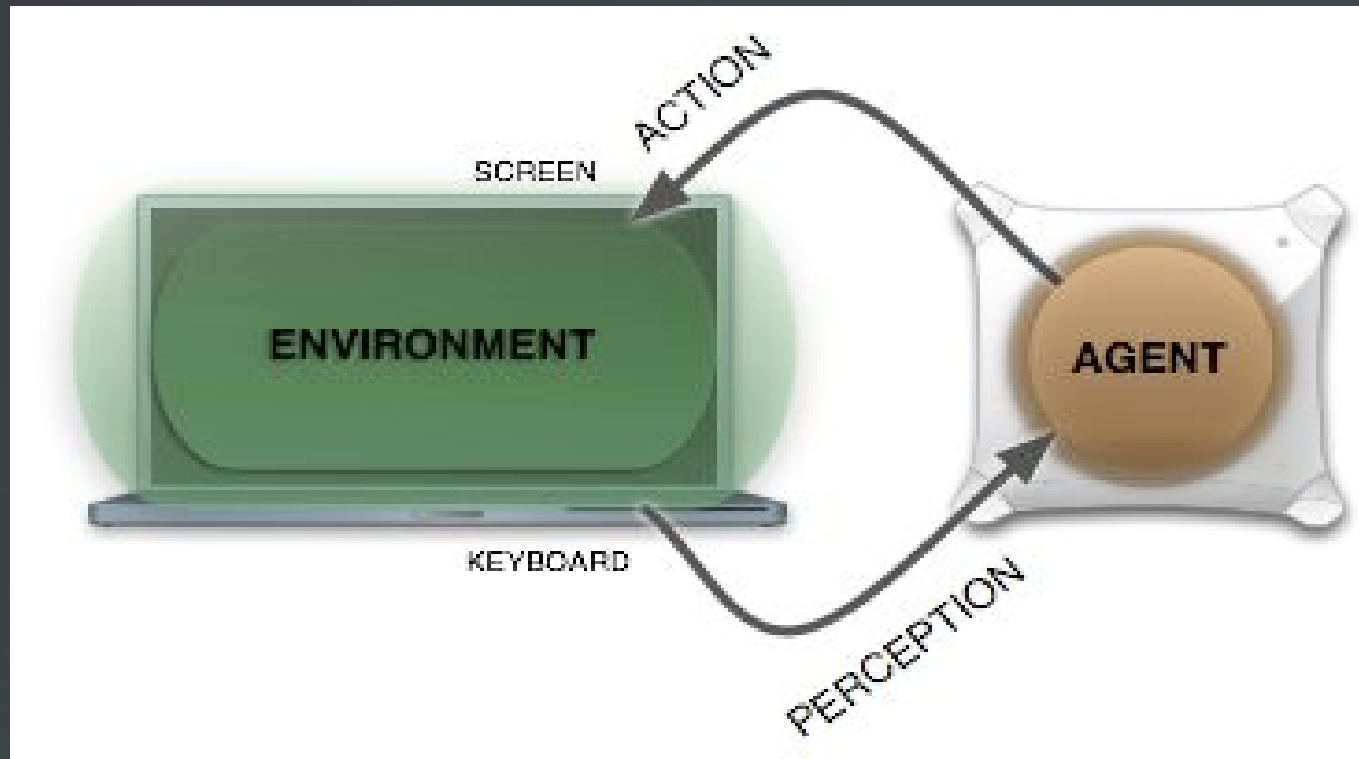
- Computer programs are Instructions
 - Programming require explicit designing of mechanisms that produce certain outcomes.
 - By giving these explicit instructions the potential of a program acting in novel ways is decreased, since clearly it means that it's known beforehand how the system will behave.
 - The instructions that define programs (and make them work) are in turn the exact reason it's hard to produce surprising, novel and interesting ideas
- 

Fundamental Problem



- Predictable Outcome!
- Is the system still considered to be creative

An example of a creative system



Source: <http://www.thinkartificial.org/artificial-creativity/>

An example of a creative system

- In between receiving input and presenting output is, of course, a program that maps the input to output
- In order to make our agent write something other than nonsense,
 - He must have a dictionary of words
 - He must know grammar
 - He must also have common sense



Instructions are limitations

- When we gave our agent a dictionary, a goal, grammar knowledge and common sense, we effectively restricted him:
 - He's not a painter
 - He's not a musical composer
 - He's not a programmer



Instructions are limitations

- A goal limits the objectives of a system and thereby helps us organize how the system will behave
- But these restrictions are necessary for him to do anything at all



Solution

- But how about a self-organizing program that writes its own code on the fly to overcome its restrictions?
- This problem is also being slowly overcome with the use of neural networks, genetic algorithms and other complex systems and complex adaptive systems.

Case Studies



AARON

- By Harold Cohen
- A program that creates original artistic images
- Triggered by scribbling behaviour
- The next step depends on the pre-existing core figure
- Initially drew black and white

Source: <http://en.wikipedia.org/wiki/AARON>



AARON

- Development began in C, later in Lisp (which added color)
- Each new style has to be hand coded.
- Can draw infinite distinct images.
- *If its not thinking, what exactly is it doing?*
 - Cohen



AARON



Source: <http://userwww.sfsu.edu/~infoarts/links/gen.art.res.present/otherartists.html>

RACTER

- by William Chamberlain and Thomas Etter
- Generates English language prose at random
- plays active role in conversation
- jumps from topics in a wild manner.
- *artificially insane* (as Tom Etter calls it)
- The book *The Policeman's Beard is Half Constructed* was written by Racter



RACTER

Bill sings to Sarah. Sarah sings to Bill. Perhaps they will do other dangerous things together. They may eat lamb or stroke each other. They may chant of their difficulties and their happiness. They have love but they also have typewriters. That is interesting.

- Interactive version - chatterbot
- Other chatting bots: Eliza, Parry.

Story Generation : TALE-SPIN

- Author (program) generates stories in pursuit of her own goals or
- Each character tries to accomplish its goal
- Based on the model of : the storyworld, the characters in it, their goals, personalities, and interpersonal relations.

Story Generation

- Three levels of simulation:

- Character intentionality

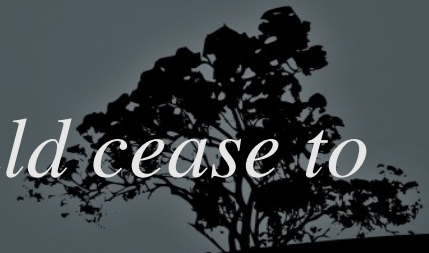
if Tom was hungry, he will search for food

- Social constraints

if John is Tom's friend, he will ask him a favour, if his best friend, he will return the favour

- Physical causality

If a snake ate a frog, the frog would cease to exist.



BRUTUS

- can understand self-deception and betrayal through formal definitions of the rules.
- mathematizing through a series of algorithms and data structures
- Cleverly programmed to *appear*, to be in case *literally creative*.
- dimension responsible for wide variability:
plot, characters, settings, literary themes, writing style, imagery, etc.

BRUTUS

- Brutus is designed to satisfy these seven characteristics:
 1. Strong creativity - capable of raw imagination
 2. Imagery generation
 3. Defining the mental state of the characters
 4. Mathematical formalization of themes
 5. Genuinely interesting stories
sex, money, death, betrayal, ruthless, etc.
 6. Structured stories
 7. Constrained prose



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Thank you



Questions

