# How to define creativity

There are many aspects of intelligence. Psychologist Dr. Howard Gardner claims humans have eight different types of intelligences. However, due to research suggesting that a high intelligence in one of those eight usually correlates to a high or low intelligence in another area, this would make it difficult to implement these intelligences in a computer.

Sticking with the modular approach to intelligence, psychologist Dr. Robert Sternberg reduces these different intelligences to three, called the Triarchic Theory of Intelligence. Sternberg’s three intelligences are Analytical, creative and practical. Analytical intelligence is the ability to solve problems. Practical intelligence is the ability to read and adapt to everyday life. Finally, Dr. Sternberg defines creative intelligence is the ability to adapt to new situations.

Across many disciples creativity is defined in various ways. Some definitions try to distinguish between creating things new to the individual vs. human history vs. the universe. Other definitions attempt to quantify the uniqueness of the creation, whether or not the idea inspires other new ideas. However, there is a common element to all the definitions. That is, creativity is the ability to produce ideas that are new, novel and valuable.

# Evaluating creativity

David Cropley is a professor of Engineering Innovation. He has developed the creative solution diagnosis scale. This scale is used to grade innovation based on four criteria:

* Relevance/effectiveness – does it solve the problem
* Novelty – is the idea unique, original, surprising
* Elegance – does the idea look finished
* Genesis – does this idea inspire new ideas

Obviously these four criteria are highly subjective, but the fact they allow some comparative measure between new produces is useful. Particularly, this scale is useful in answering the question “Could computers themselves ever really be creative?”

# Human Creativity

Currently the creative solution diagnosis scale is used to score innovation, the synthesis of new products created by humans. However it tells us nothing about how humans create new ideas. Prof. Mark Beeman has developed a series of tests, and using MRI scans during the test, has identified parts of the brain active in creativity. Prof. Beeman has categorized two creative pathways: Analytical and insightful. Analytical creativity is solving problems through logic. I.e. testing all possibilities one by one until a solution is found. The prefrontal cortex, it the part of the brain associated with analytic creativity. Insightful creativity is an “ahh-ha” moment. In the past it has be commonly called divine inspiration or “ex nihilo”, due to the fact the idea pops into the persons mind. The right temporal lobe is the part of the brain associated with insight creativity.

# Computational Creativity

Joanna Misztal and Bipin Indurkhya have used a Blackboard system in combination with four search techniques, to make a poetry generation algorithm. A blackboard system is designed as a group of experts or knowledge sources, in various disciplines are given access to a blackboard. A problem is written on the blackboard and each expert writes parts of a solution on the board (Knowledge Source Instance) using what previous experts have written.

Each expert used one or a combination of the following search algorithms to find solutions in their knowledge base:

* Depth first search – search along one path choosing the next node based on a heuristic function.
* Breadth first search – useful for gathering many alternative solutions
* Incremental search – there is some prior knowledge of the search space, therefore the search space can be expanded as needed
* Differential diagnostic search – directed differentiation among alternatives, process by elimination

The algorithm guiding the poem generation is seven steps:

1. User inputs the text and constraints.

2. Repeat Steps 3-6 until the termination condition is fulfilled.

3. Blackboard monitor monitors the blackboard to see when something has changed or if one of the following termination criteria is satisfied:

 (a) The target number of poetry lines has been produced.

 (b) There are no pending KSIs in the agenda. If either of these conditions is satisfied, the generation process is stopped.

4. As a new event occurs on an abstraction level A, experts interested in this level are triggered by the monitor.

(a) Each triggered expert provides the monitor with its list of preconditions.

(b) The monitor checks if the preconditions are satisfied.

(c) If the expert’s preconditions are satisfied, a knowledge source instance (KSI) is produced, containing expert’s name and the part of blackboard to which it will contribute (for example: “Collocation Expert: epithet” ).

(d) KSI is added to the agenda.

5. Control component schedules the KSIs on the agenda according to the following rules:

(a) KSIs contributing to lower levels of abstraction are executed first.

(b) For levels 1-6: KSIs working on one level are scheduled according to the size of the subareas they want to contribute to (KSIs pending to contribute to “emptier” subareas will be executed first)

(c) For level 7: Control-level experts are scheduled according to a predefined order.

6. KSIs on the agenda are executed sequentially according to their order.

7. If a new KSI is produced, all KSIs on the agenda are rescheduled.

When presented with the problem:

main focus: rhythmical measure.

form template: five syllables in each line.

Inspiration:

 At the edge of Ecuador sits a rickety tree house (casa del rbol) overlooking an active volcano in the near distance. With it comes a swing with no harnesses, inviting only the bravest of risk-takers to experience a killer view.

The following poem was generated:

Edge

I like the border

Mexican border

Mexican border

O edge the stiff bound

Southern border!

What is the edge?

Southern border!

Stiff dramatic edge

Southern border!

The weepiness waits

O edge the great bounds

Some people may argue this is not true creativity. There is a very clear step by step process. And presented with the same problem, there is nothing to suggest the computer with generate different poem. BHowever, as shown by Prof. Beeman, humans also use this step by step analytic approach to being creative.

# References

Dr. Michael Merzenich – neuroscience

Dr James C. Kaufman – creativity

Prof. Mark Beeman – cognative nuero science – creativity’s path way in the brain

“our brain operate by finding shortcuts to solutions = shortest path in a graph

Dr. David Cropley – innovation

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Savants – a condition in which a person (AI) otherwise limited in metal ability (graphics) has an exceptional specific skill such as in computation

Creativity – ability to create ideas that are novel and valuable.

Expertise – knowing a lot about a lot – Wikipedia

Imaginative thinking – see things in new ways see patterns make connections – semantic network

Venturesome personality – seek new experiences over come risk and see new solutions to obstacles – looking at other programs running

Intrinsic motivation – some sort of reward for doing the task – computers don’t have feeling or desires yet but Asimov’s laws apply here

Creative environment – an environment that sparks supports and refines the ideas – humans need to give AI problems and actively work with them to make them more creative

## Working definition of creativity