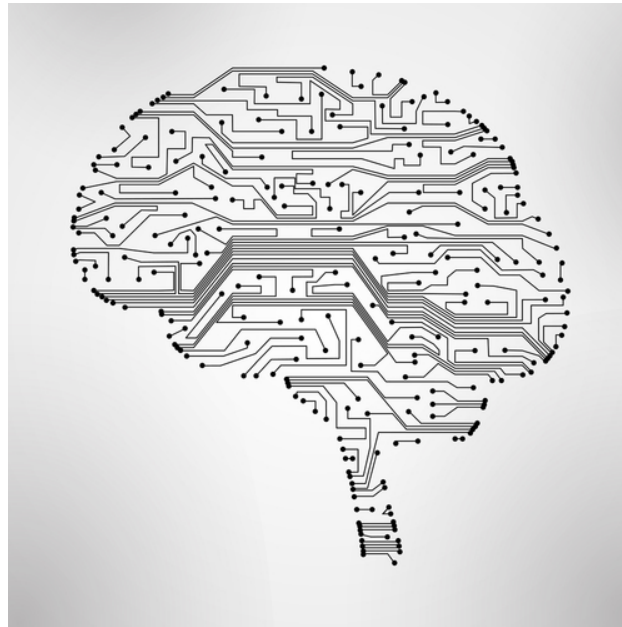


Computational Creativity:

A Philosophical Approach, and an Approach to Philosophy



Stephen McGregor, Geraint Wiggins, and Matthew Purver
Queen Mary University of London
School of Electronic Engineering and Computer Science
ICCC Ljubljana - June 12, 2014

Overview

- Evaluating Cartesian Dualism and Representations from a Computational Perspective
- Evaluating Computational Creativity from a Philosophical Perspective

Thesis: *The right approach to computational creativity is to build systems with internal states that an observer might consider to be akin to mental representations.*

- Examples of two computational approaches that might meet this criterion

Cartesian Dualism: Mind and Matter

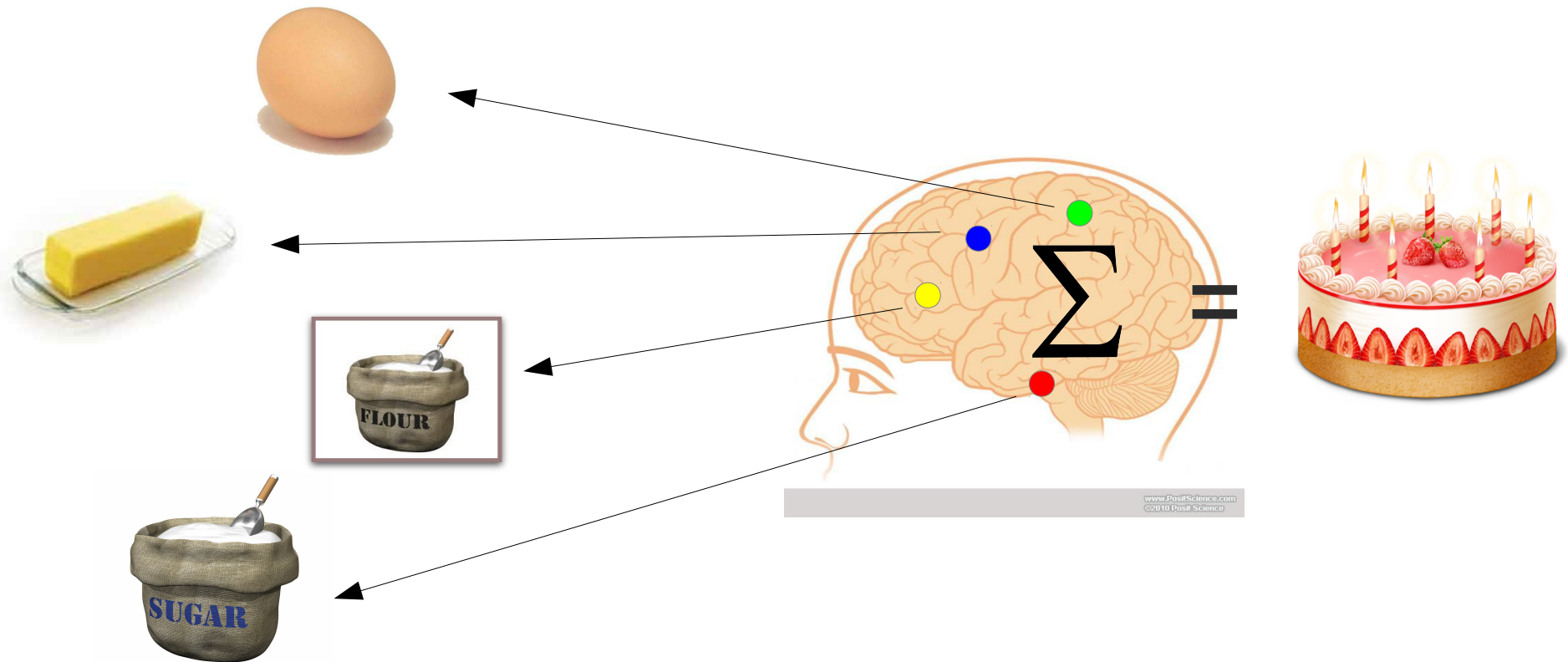
Descartes (1641/1911) proposes an unresolvable division between the mental and material spheres.



Representations are the stuff of the mental world, and they have structural properties that allow them to interact in the process of composing thoughts.

Mental Arithmetic

As Hobbes put it, “What It Is When a man Reasoneth, hee does nothing els but conceive a summe total, from Addition of parcels,” (1651).



The Downfall of Descartes

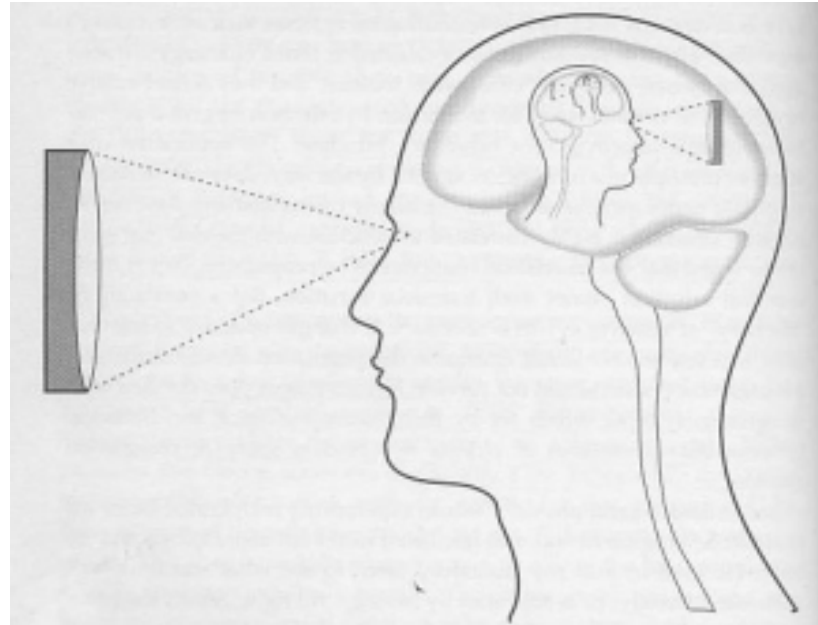
Descartes' assessment has proved contentious, however. In particular reductionist trends towards an environmentally situated approach to cognition have found mental representations untenable.



Today, “even the word ‘Cartesian’ is often used as a term of abuse,” (Rowlands, 2010, p 12).

The Homunculus Problem

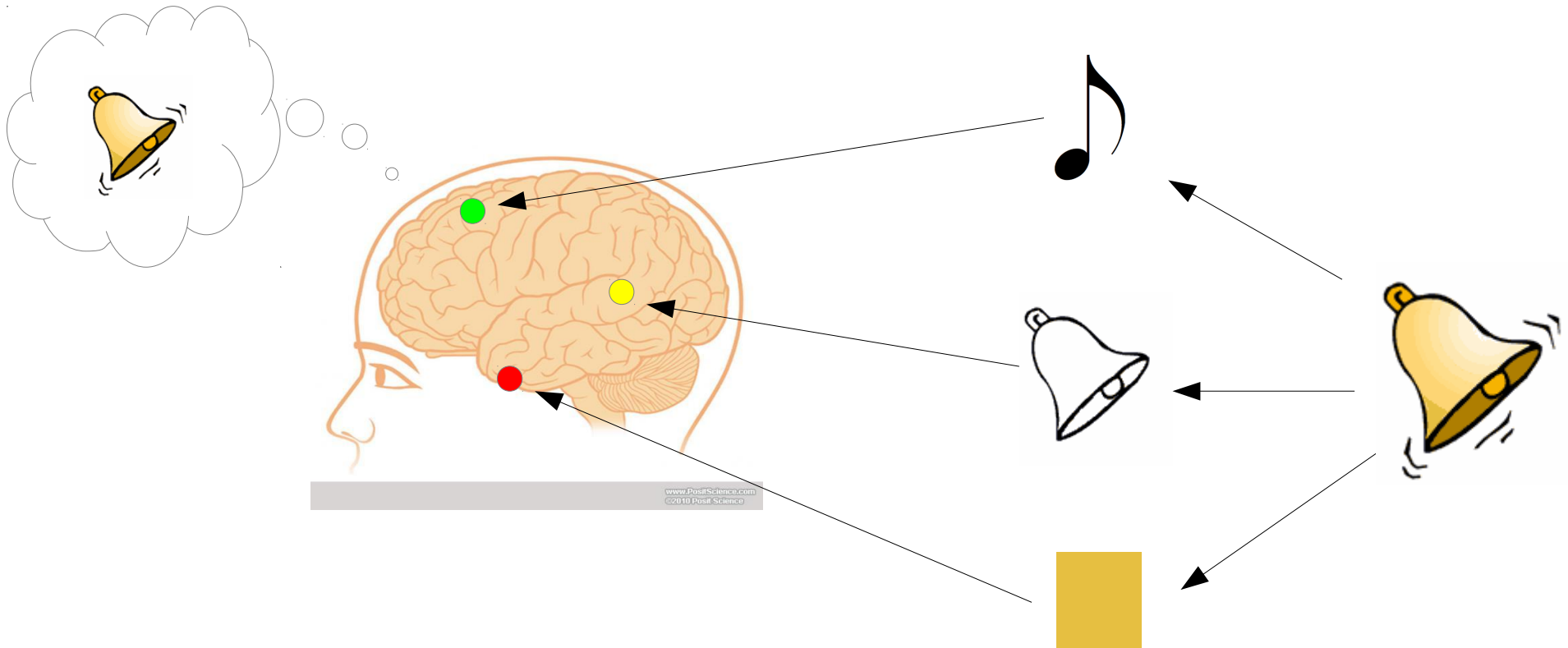
The representational stance does not solve the problem of how these mental entities themselves are experienced.



Dennett (1991) has called the infinite regress of mental representations the “Cartesian theatre”.

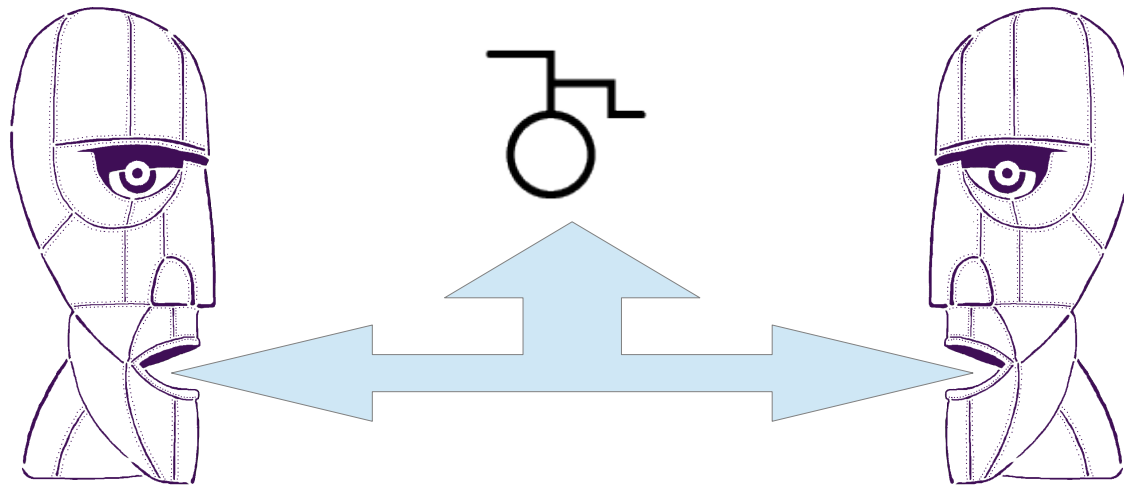
The Binding Problem

Likewise, it is unclear how the properties of a percept, processed diffusely, nonetheless come together to form a unitary representational entity.



Acts of Meaning

The binding problem is clearly somehow resolved in the course of cognition, as objects in the world are perceived as holistic entities.



This aspect of cognition has been described by Wittgenstein as an *act of meaning*: “Only the act of meaning can anticipate reality,” (1953/1967, p 76).

Reductionalist Creativity

In a similar vein, Wiggins (2012) has suggested that *creativity* is an emergent property of an agent's anticipation of action in an unpredictable environment.

Creativity is the process of meaning making, resulting in the generation of information from a universe of data

A description of creativity in terms of physical processes would seem to suggest a path forward for the reductionist project.

Computers and Creativity

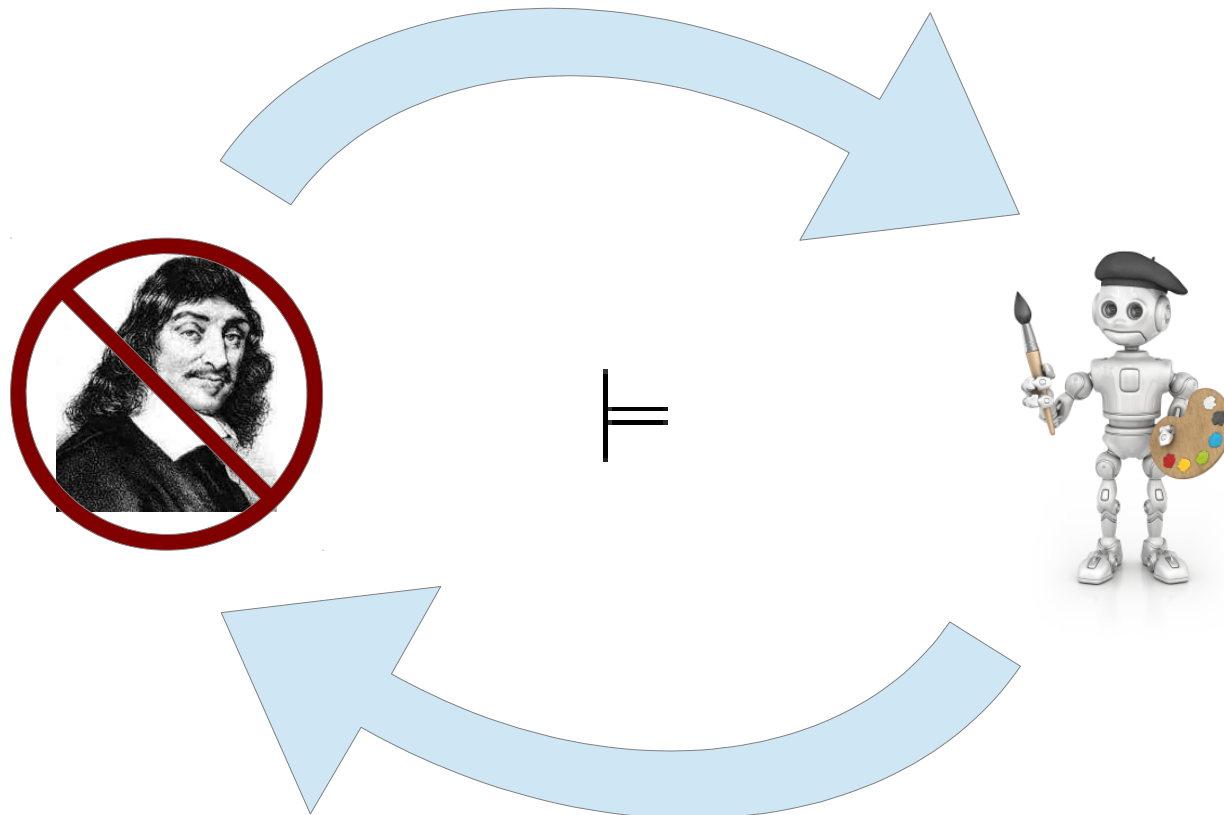
Computers are symbol manipulating machines: they use syntactic rules to perform operations on physically grounded representations.

Of course, the symbols that computers manipulate are somehow grounded in a system relative to some external observer—their meanings are established *a priori*.

A positive result for computational creativity would seem to be *de facto* a negative result for the Cartesian premise of a mental space populated by immaterial representations.

Tautological Trepidations

It is not tenable to establish computational creativity on the supposition of a reductionist world view, and then use this same outcome as proof of its own anti-Cartesian premise.



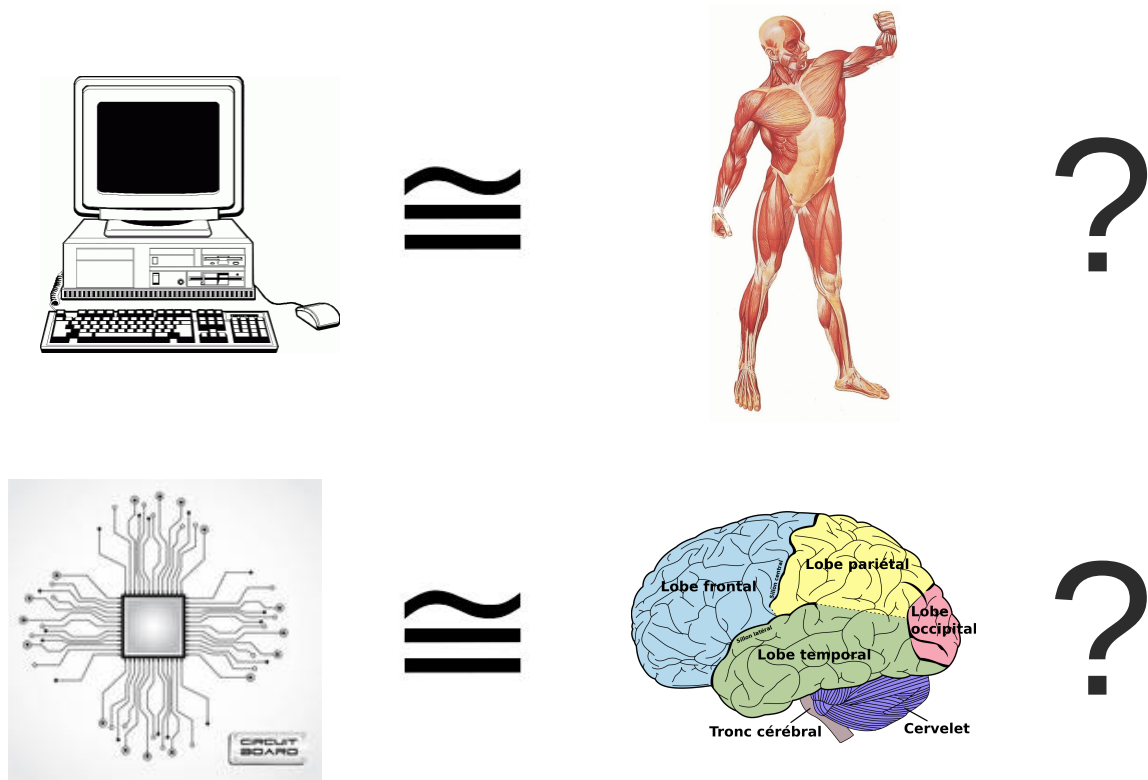
Evaluating Creativity

So if the creativity of symbol manipulating systems is to be used as the basis for drawing philosophical conclusions, it's necessary to consider the problem of how creativity is evaluated.

Computational creativity has typically been evaluated based on the novelty, the value, and the unexpectedness of the creative artefacts generated by a system (Boden 1990).

Wiggins has construed the recognition of creativity in terms of “behaviour exhibited by natural and artificial systems, which would be deemed creative if exhibited by humans,” (2006, p 210).

Two Axes of Evaluation



This is not to say, however, that creative systems must be humanlike at every level of abstraction, or that such systems can only be discussed in terms of their immediately observable operations.

Phenomenological Intimations

But symbol manipulating systems can only be considered in terms of input and output. How is it possible to talk about their behaviour in any other way?

Colton et al (2012) have implemented a system that offers as part of its output phenomenological justifications for creative decisions.

This move serves to create the impression of intentionality in the system—but this impression is still based on a symbolic indexing connecting input to representations of plausible mental states.

Reductionist Overkill?

Perhaps the reductionist approach to cognitive science has gone too far in its rejection of mental representations.

While the idea of a placeless mental space is untenable, representations have proved a useful tool for describing and understanding how minds work.

Perhaps a system featuring representations as an emergent rather than a causal phenomenon would have a better chance of being judged autonomously creative.

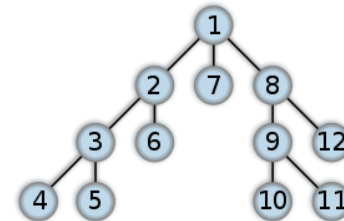
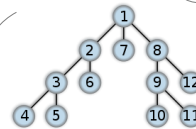
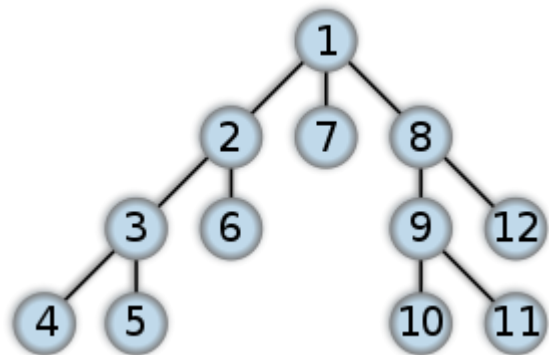
Spaces of Spaces of Spaces

Boden (1990) has described computational creativity in terms of a traversal of a space of potential creative artefacts.

At the highest level, creativity is “transformative”: rather than simply searching a defined space, the space itself is redefined in a novel way.

At the transformative level, a space of possible transformations of spaces exist, and there is an implicit space of possible transformation spaces, as well—a kind of regression emerges.

Digital Homunculus



Searching for Representations

By extending the parallel between mental and creative spaces, a way forward for computational creativity is indicated.

In both types of spaces, representations emerge, standing in for what at least appear to be inscrutable processes (ie, cognition and creativity).

The appropriate approach would therefore seem to be to design creative agents whose operations remit what appear to be representations.

Two Practical Approaches

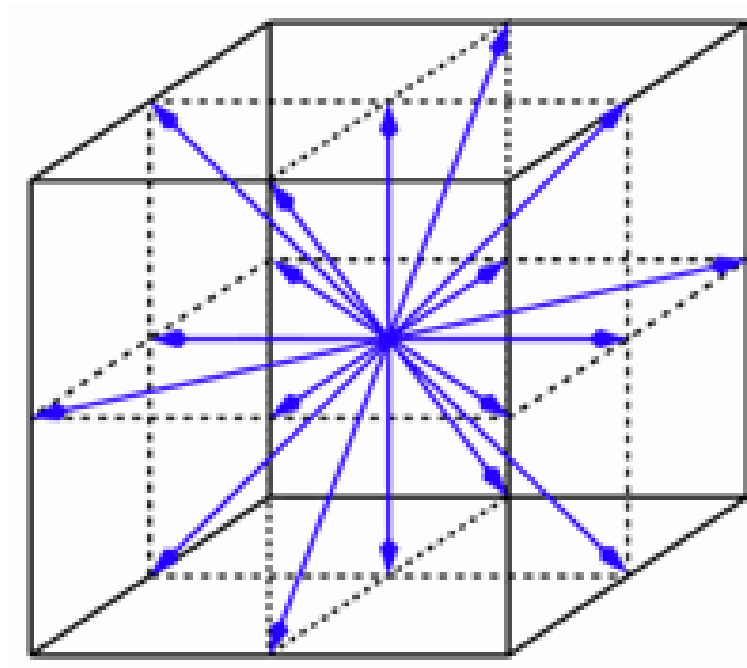
At least two state-of-the-art approaches to machine learning offer the potential to generate what might be considered representations in computational systems.

Vector space models represent objects in terms of their co-occurrence with a base vocabulary of other objects.

Deep belief networks are highly interconnected neural networks that process input over a large number of dense layers.

Vector Space Models

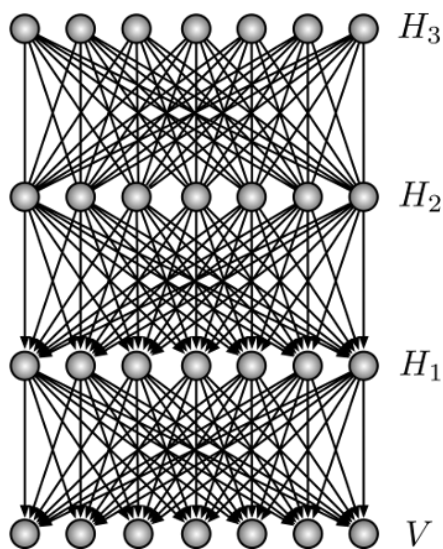
Vector space models represent objects as points in a high dimensional space.



The entities that emerge have properties of compositionality, by which they can be concatenated through mathematical operations.

Deep Belief Networks

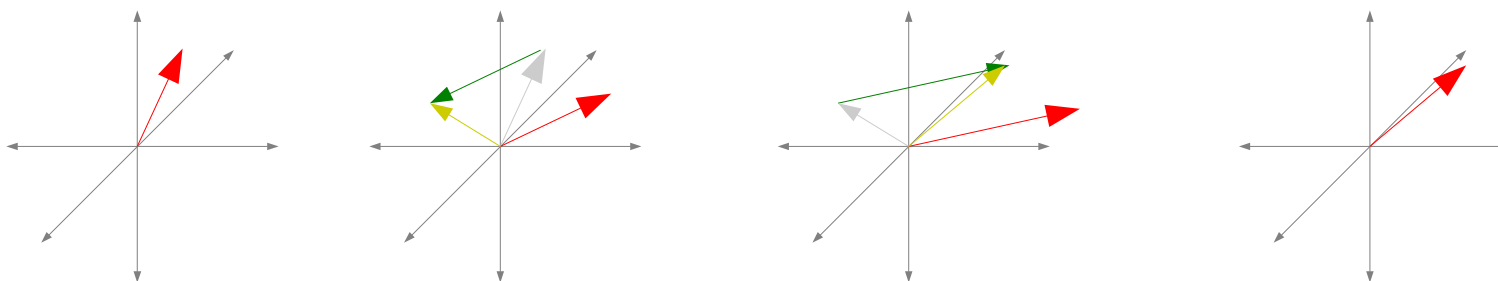
The hierarchical structure of deep belief networks means that a single node on a higher level can represent the input from various lower nodes.



Hinton (2006) has shown that in DBNs trained on visual input, progressively more complex representations of features such as colours, edges, and contours can be detected layer by layer.

Putting the Systems Together

Most recently, Mikalov et al (2013) have worked on building vectors representing word with recurrent neural networks.



King - Man + Woman = Queen

It has been shown that with some basic linear algebra, these vectors can be manipulated to make semantically significant inferences.

Acknowledgement

This research has been supported by EPSRC grant EP/L50483X/1.



Engineering and Physical Sciences
Research Council



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