# UNCONVENTIONAL APPROACHES TO AI

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# Insights from the past

- Unconventional approaches in AI: complex systems perspectives, cognitive psychology, social sciences, computational models of creativity and other unconventional models
- This is AI or classical AI before big data. The time is now ripe to revisit these wonderful ideas and think about how to incorporate them in modern AI/deep learning. Insights from the past can inform future approaches to AI, especially in the age of big data.
- Looking at the heritage of computing and its interdisciplinary past can inspire new approaches for the future. We need to learn lessons from the history of AI, what approaches worked and did not work in the past and how AI went through multiple winters.
- These approaches can be used to develop techniques that can inspire explainable AI.

# Insights from the past

- We are told of eureka moments (Archimedes, newton, …)
- In reality we always build on the work of others
- There is a preparation stage
- Incubation stage
- Retrieval/indexing (kekule dreaming of a snake and then linking it to benzene rings)

# Insights from the past

- Unconventional approaches in AI: complex systems perspectives, cognitive psychology, social sciences, computational models of creativity and other unconventional models
- Perceptrons
- Cognitive psychology

# Approaches

- Narratives and stories
- Computational models of creativity and insight
- Analogies
- Dreams
- Commonsense reasoning

# APPROACHES

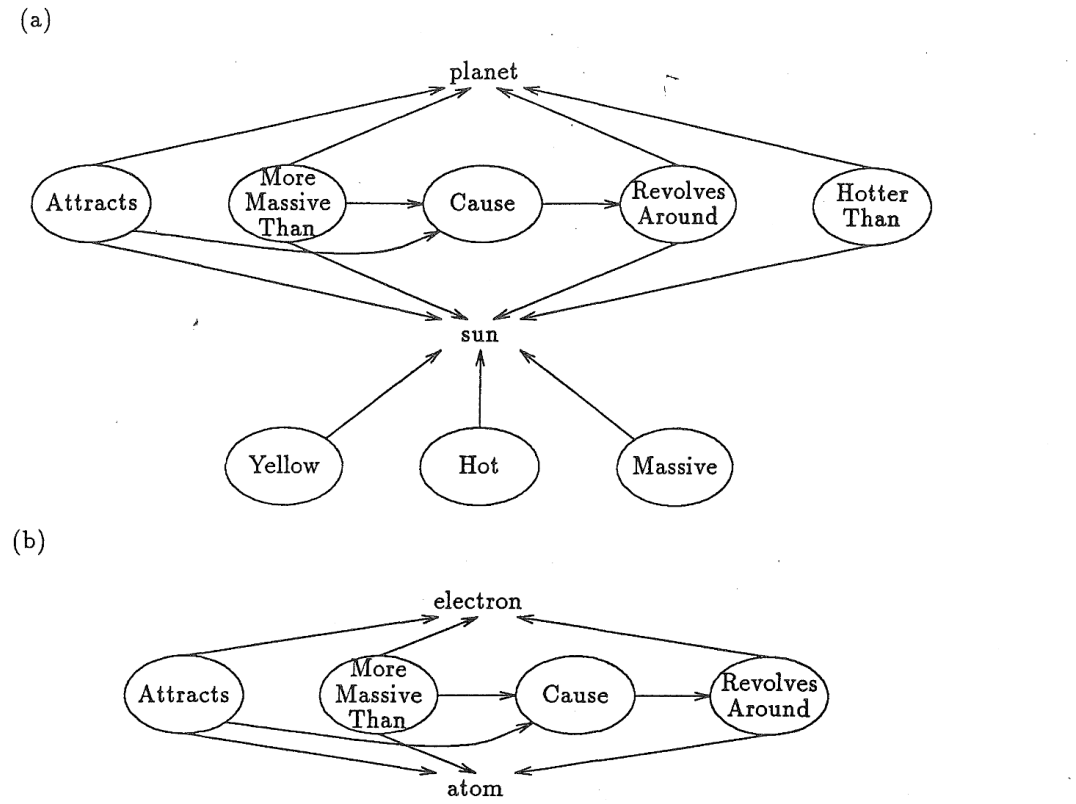


**Figure 2.** Creating a representation for the atom from the statement, "The atom is like the solar system." Higher order relations are carried over and simple attributes are ignored.

A COMPUTATIONAL MODEL OF SCIENTIFIC INSIGHT, 1986, LANGLEY ET AL.

# APPROACHES

**1. In Search of the Bull**

In the pasture of the world,
I endlessly push aside the tall
grasses in search of the Ox.
Following unnamed rivers,
lost upon the interpenetrating
paths of distant mountains,
My strength failing and my vitality
exhausted, I cannot find the Ox.

**2. Discovery of the Footprints**

Along the riverbank under the
trees,
I discover footprints.
Even under the fragrant grass,
I see his prints.
Deep in remote mountains they
are found.
These traces can no more be
hidden
than one's nose, looking
heavenward.[web 8]

**3. Perceiving the Bull**

I hear the song of the nightingale.
The sun is warm, the wind is mild,
willows are green along the shore
-
Here no Ox can hide!
What artist can draw that massive
head,
those majestic horns?[web 8]

ZEN KOAN, TEN BULLS, WIKIPEDIA

# Approaches

- Explainability (insights from social sciences)
  - Miller, 2019
- How do you generate explainable models by working with domain experts
  - Rudin, 2019
  - Important for high stakes decisions in domains like healthcare, recidivism prediction
- Case based reasoning
  - How humans reason
- We can take inspiration from other disciplines and develop new xAI approaches

# Approaches

- Abstraction and reasoning
- Psychology of invention
  - Kekule
  - poincare

# APPROACHES

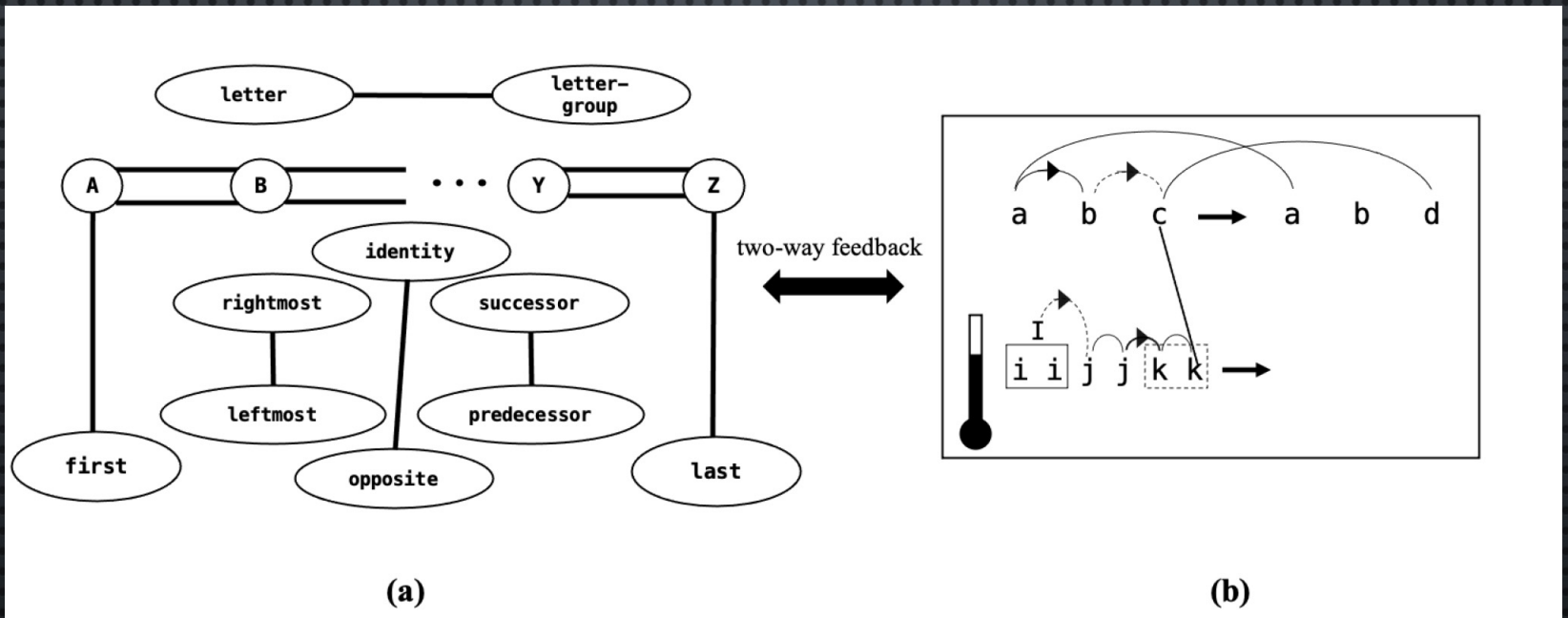


**Figure 1:** (a) Illustration of part of Copycat's concept network. (b) Illustration of Copycat's workspace, during a run of the program.

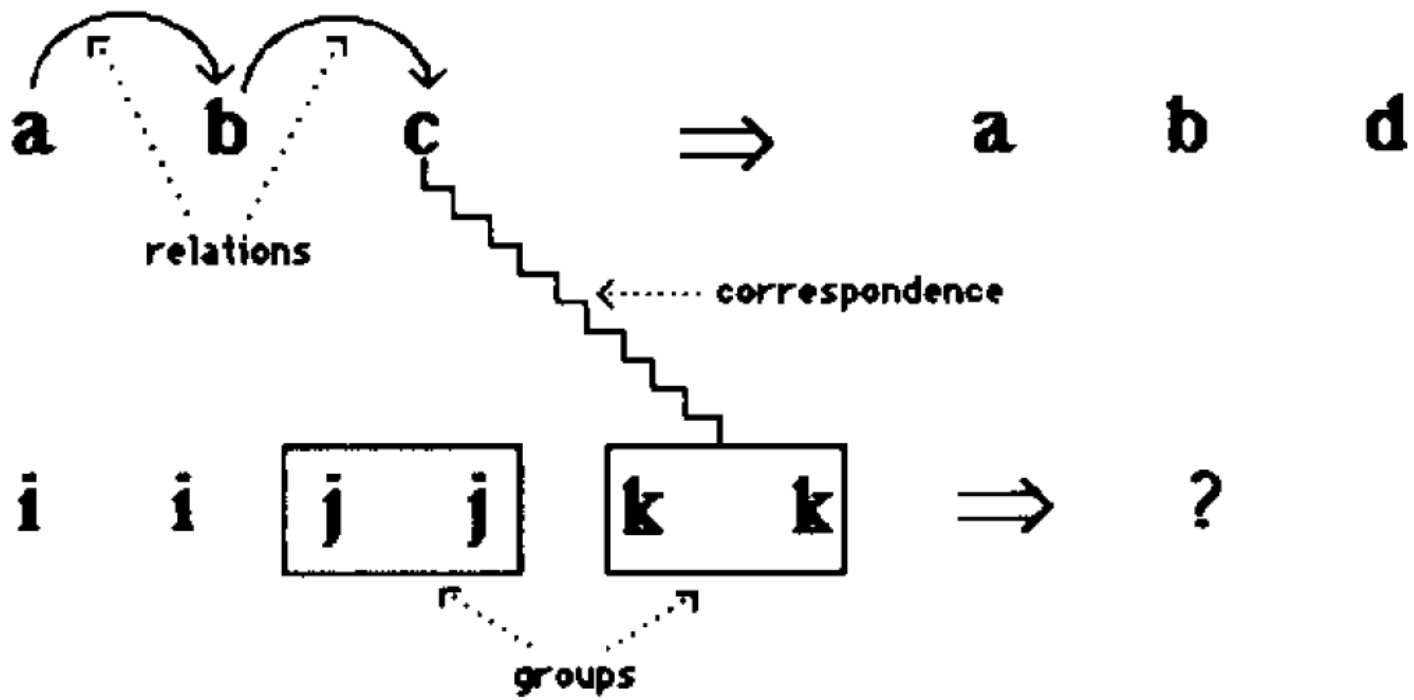


Fig. 2. Perceptual structures, including relations, groups, and a correspondence.

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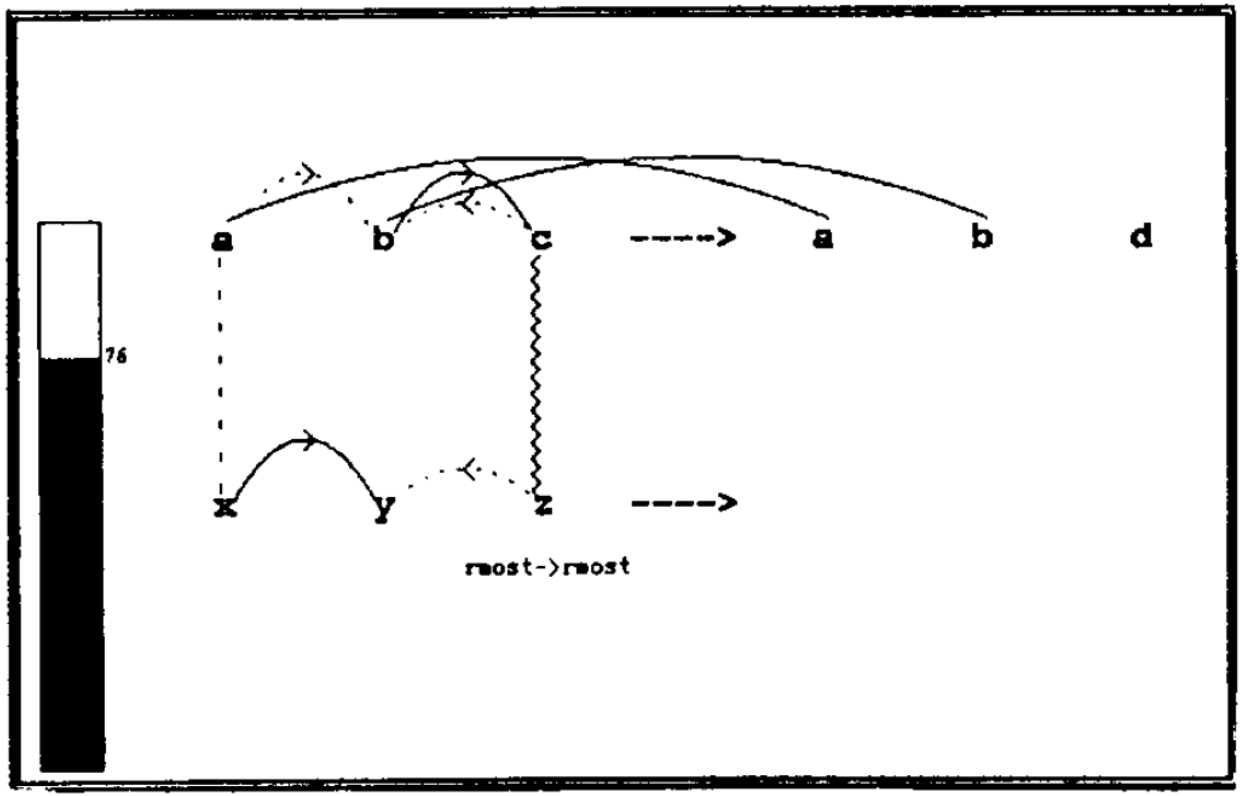
Fig. 2 shows examples of perceptual structures that could be built in the process of solving the problem "***abc*** ⇒ ***abd***, ***iijjkk*** ⇒ ?". The types of structures built by the program include *descriptions* of objects (e.g. the ***C*** in ***abc*** is the string's *rightmost* letter), *relations* between objects (e.g. the ***B*** in ***abc*** is the *successor* of its left neighbor, the ***A***), *groups* of objects (e.g., ***jj*** is a group of adjacent identical letters; the entire string ***abc*** could be seen as a group of adjacent letters that increase alphabetically), and *correspondences* between objects (e.g. the ***C*** in ***abc*** corresponds to the group ***kk*** in ***iijjkk***). (See section 5 for examples of these structures in a run of the program.)




3. Some relations between letters within each string have been built and others continue to be considered. Copycat, unlike people, has no left-to-right or alphabetic-forwards biases, and in general is equally likely to perceive relations in either direction, although here, *successor* tends to be activated early when the ***C***-to-***D*** change is noticed, causing the system to tend to perceive the letters as having left-to-right successor relations rather than right-to-left predecessor relations. A correspondence between the ***C*** and the ***Z*** (jagged vertical line) has been built. Both letters are *rightmost* in their respective strings: this underlying concept mapping is displayed beneath the correspondence. In response to the growing amount of structure, the temperature has dropped to 76.

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# APPROACHES

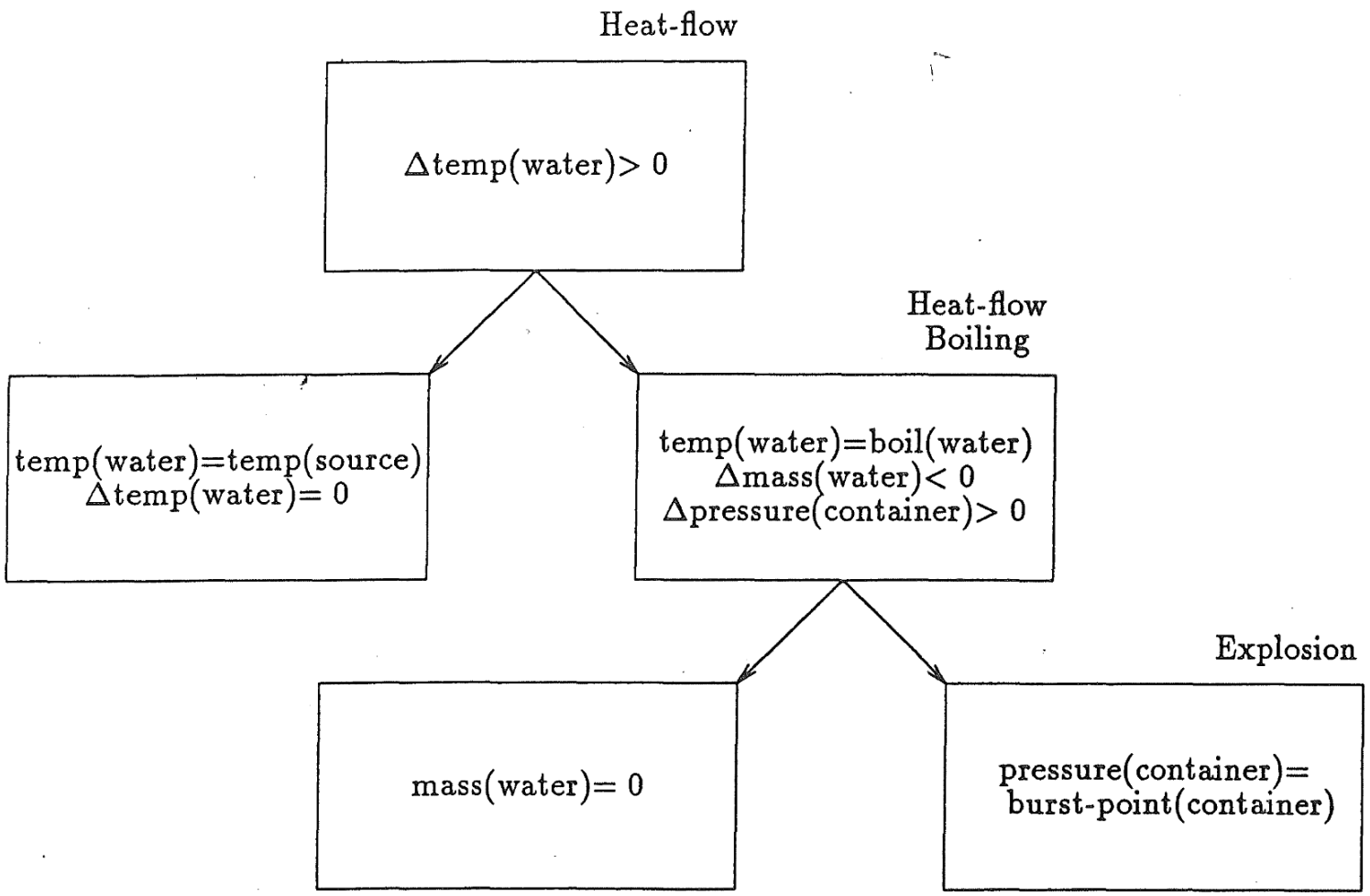


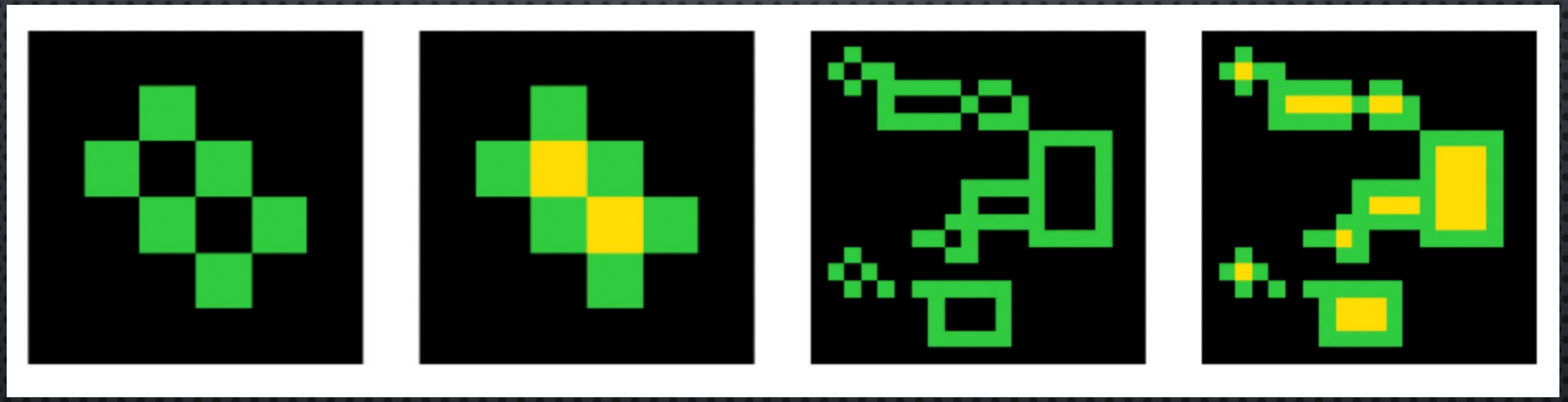

**Figure 3.** An envisionment for boiling water.

QUALITATIVE PROCESS MODELS

# Approaches

- Other ideas
  - Other paths to intelligence (in other species)
  - Collective intelligence
  - Abstraction and reasoning corpus and challenges

# APPROACHES



ABSTRACTION AND REASONING CORPUS

# RESOURCES

- https://github.com/neelsoumya/special_topics_unconventional_AI

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