

# Bayesian inference & visual processing in the brain

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# Paradoxes in perception

- Perception seems
  - effortless
  - straightforward
  - objective

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- Perception seems
  - effortless
  - straightforward
  - objective
- In reality
  - it cannot be easily programmed in a computer
  - it seems to require complicated processing
  - it can be fooled

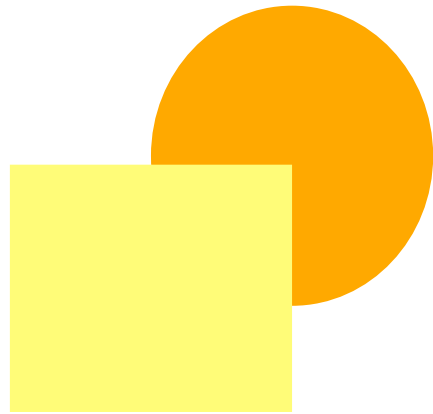
# Example: Illusory motion



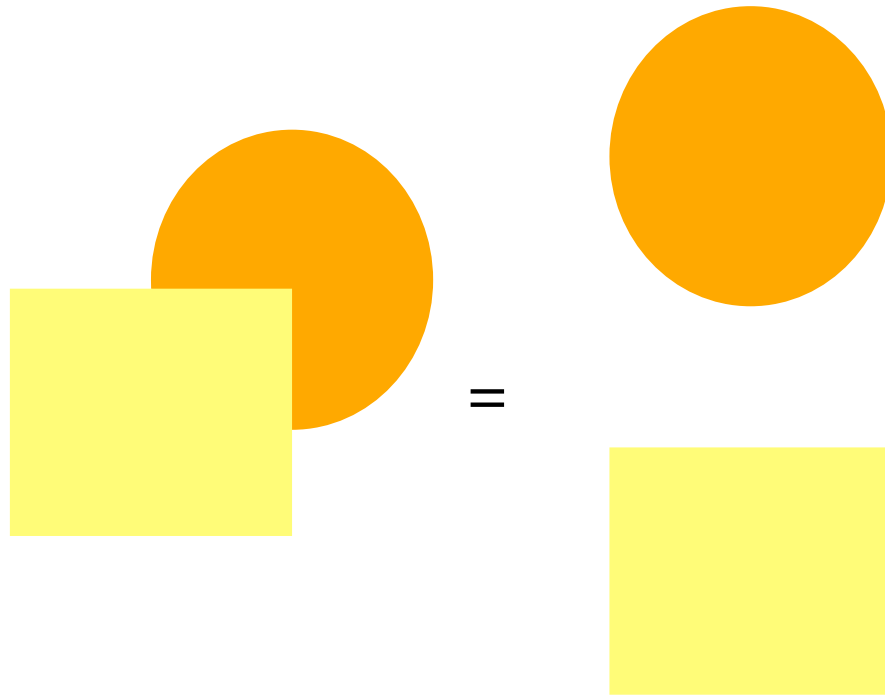
# Example: Illusory motion



# Example 2: completion

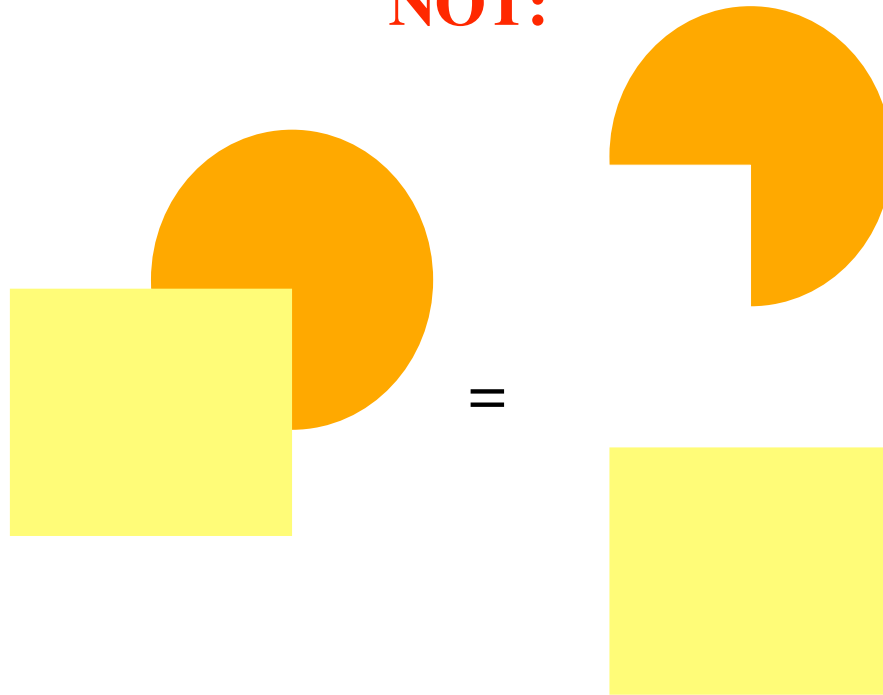


# Example 2: completion



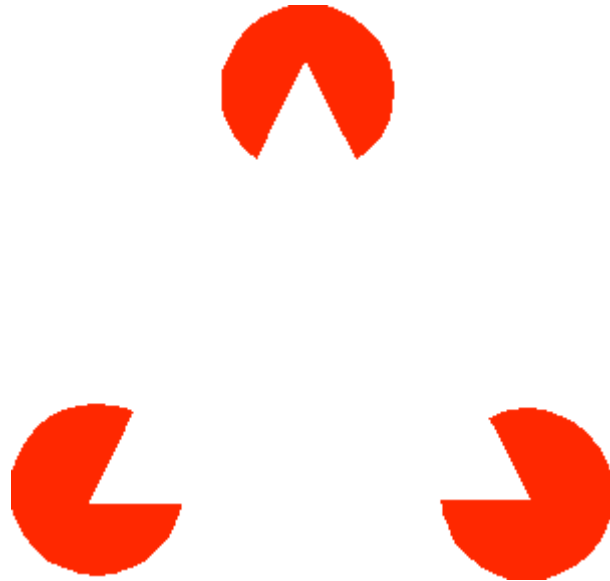
# Example 2: completion

**NOT:**





# Example 3: illusory contours

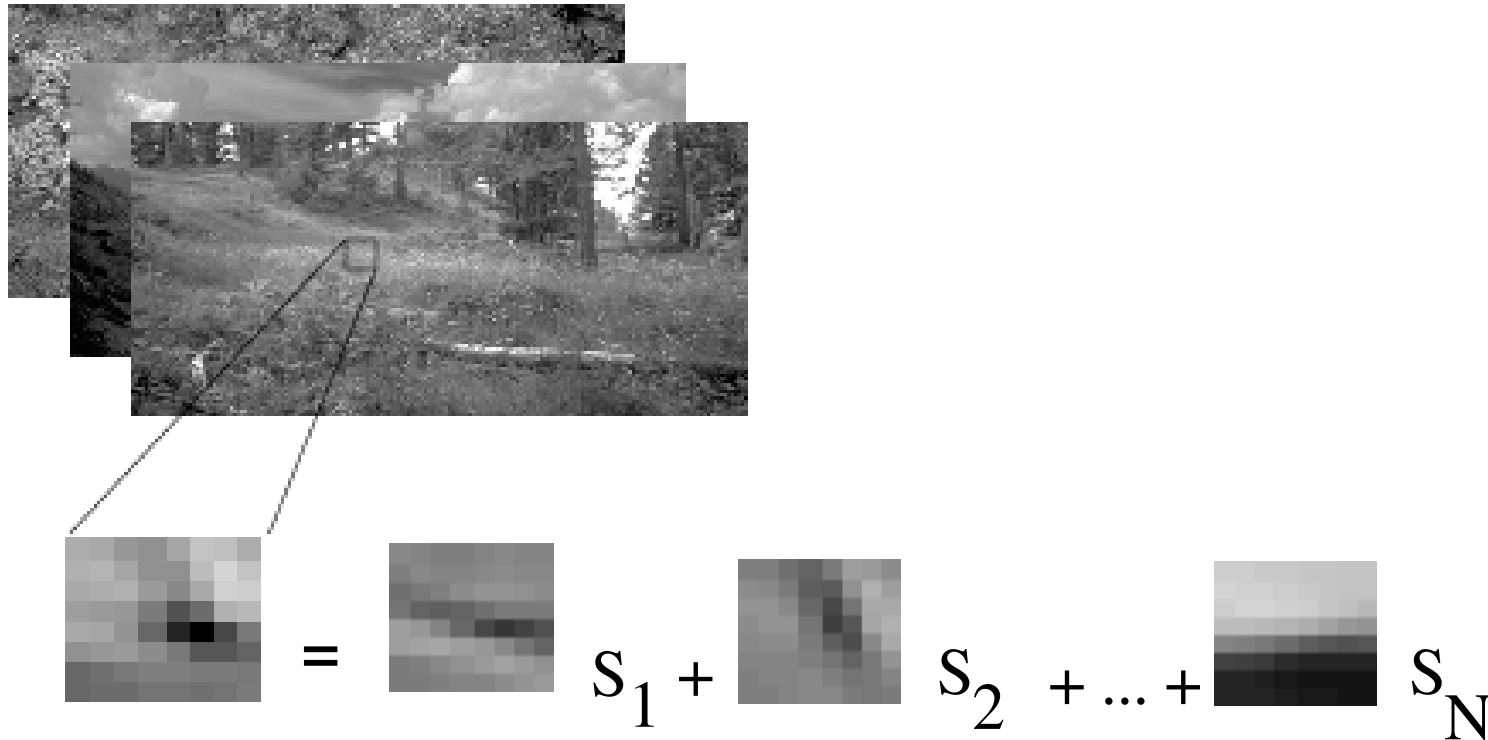


# Visual processing as inference

- Dominant school in vision research: **constructivism**
- Perception is **unconscious inference**
  - Combine
    - Hidden assumptions (priors)
      - given by internal models
    - Incoming sensory information
  - to reach conclusions about the environment.  
(Helmholtz, late 19th century)
- Formalized as Bayesian inference

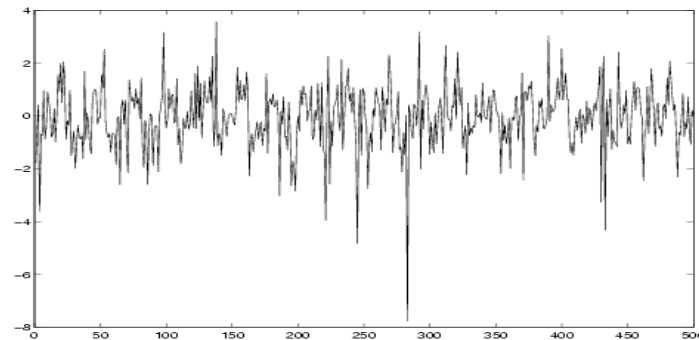
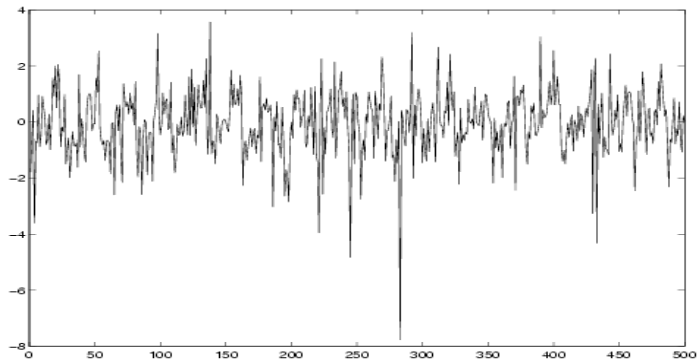
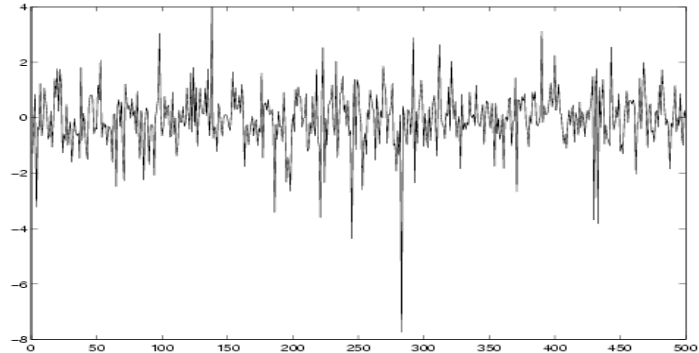
# Our approach:

## Linear models of natural images



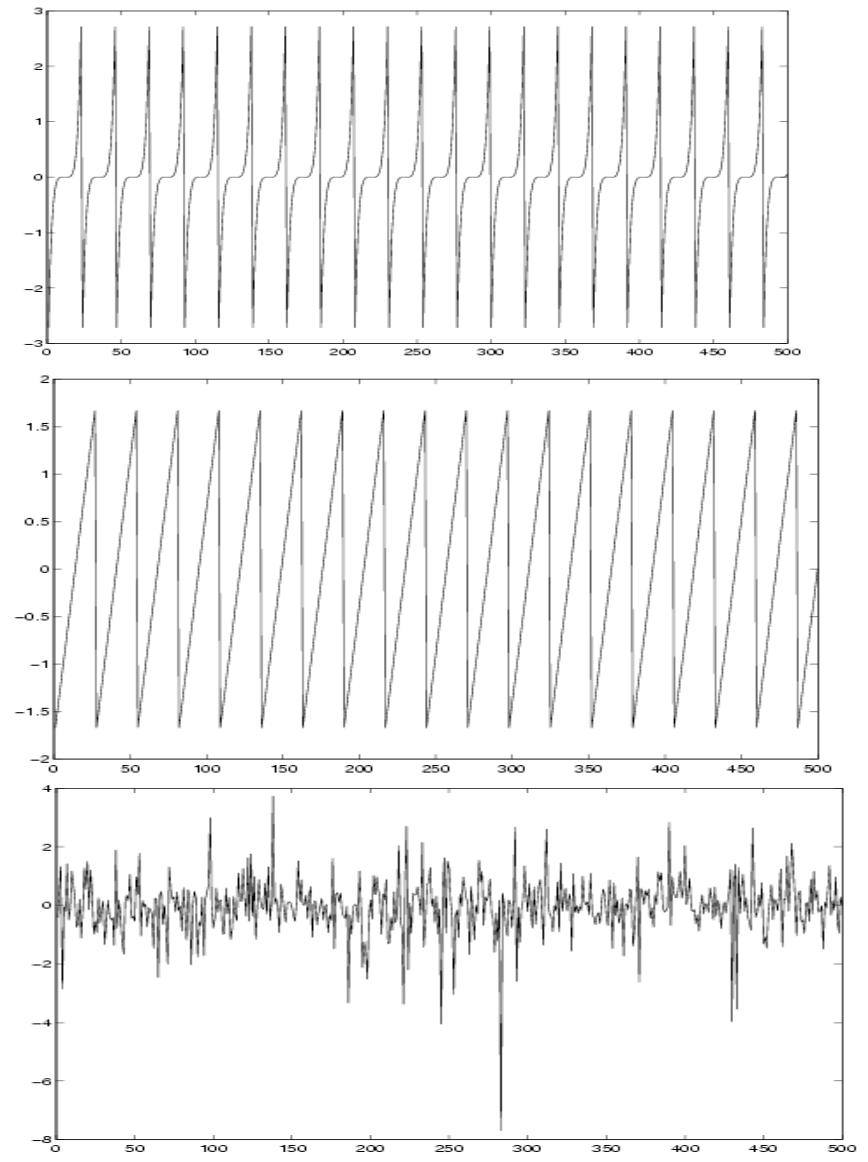
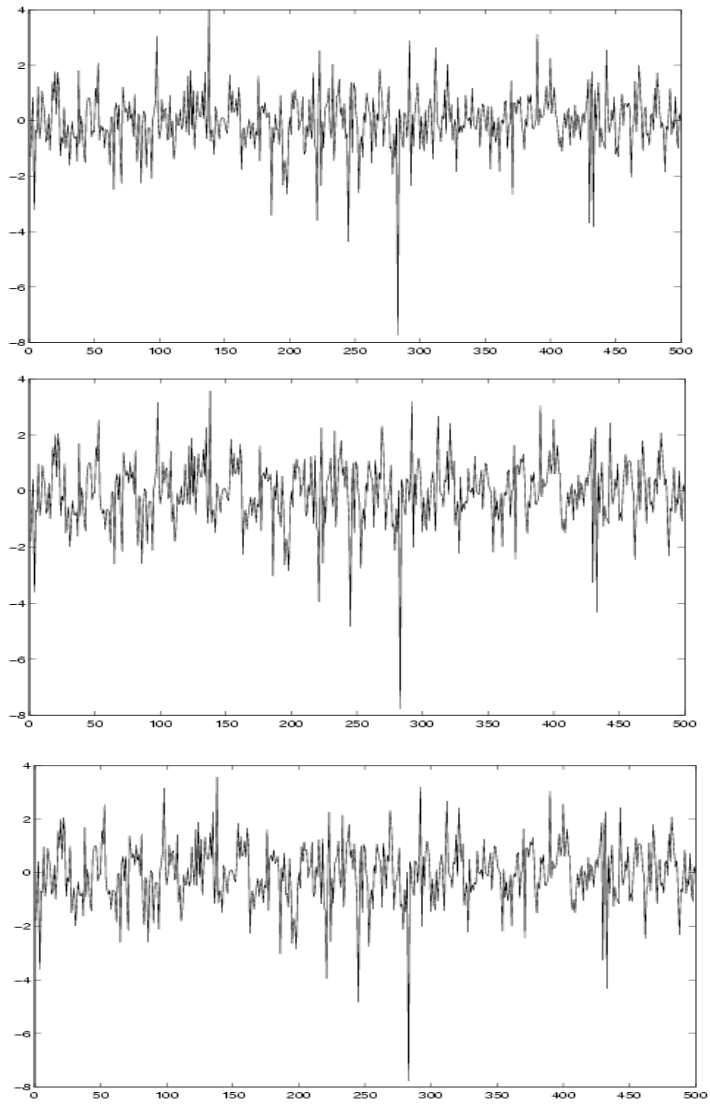
What are the best linear features for natural images?

# Independent component analysis

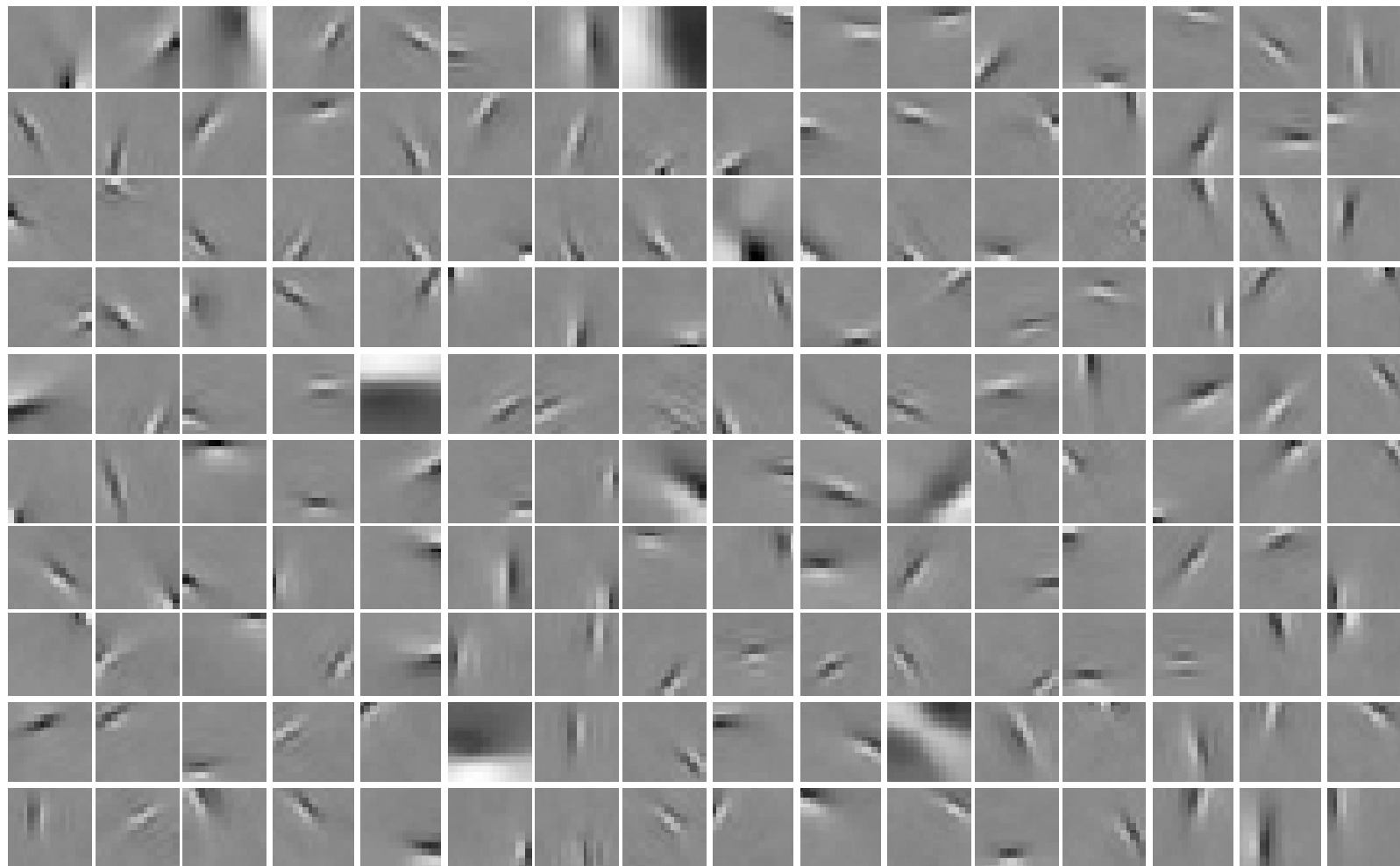


Linear mixtures of source signals:  
can we find the original ones?

# Independent component analysis



# Independent component analysis of natural images



Low-level statistical prior

Similar to what is found in the visual brain areas