

Categorization

- Categorization is the basis of structure and meaning in our world.
- We cannot interact with things in the world until we categorize them.



Categorization

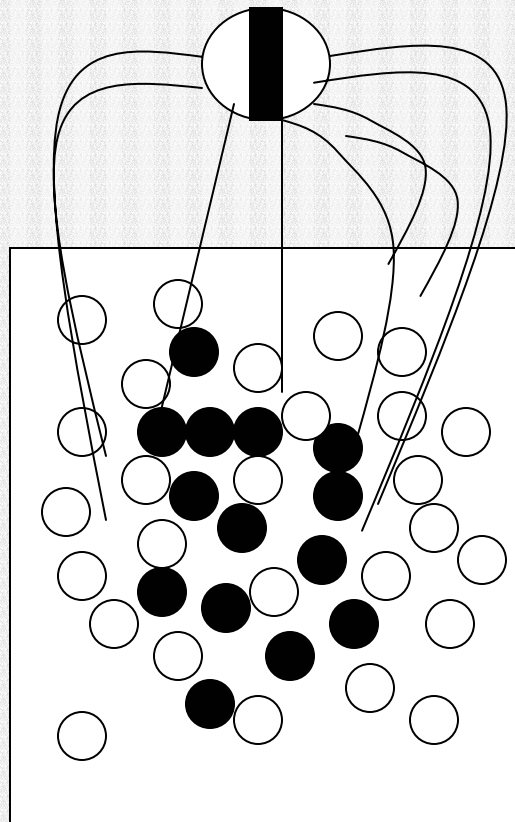
- Categorization is our biological imperative
- Even amoebas must distinguish food from non-food
- Animals with brains can have many more categories, and there can be hierarchical category structure
- A huge amount of categorization goes on at the subconscious level

Edge Detection

Retinal ganglion cells perform an early stage of *Information processing*

The receptive field of each ganglion cell has a characteristic *center-surround* property. That is, one portion of the receptive field will be excitatory, and the other inhibitory. These regions are organized in a circularly symmetric fashion so that either the excitatory region is surrounded by the inhibitory region, or vice-versa

Edge detection



Edge detection

- Edge detection represents low level categorization process
- Reduction in detail
- Increase in information

Association

- Brains are massive associators
- Experiencing 2 stimuli simultaneously causes synaptic changes

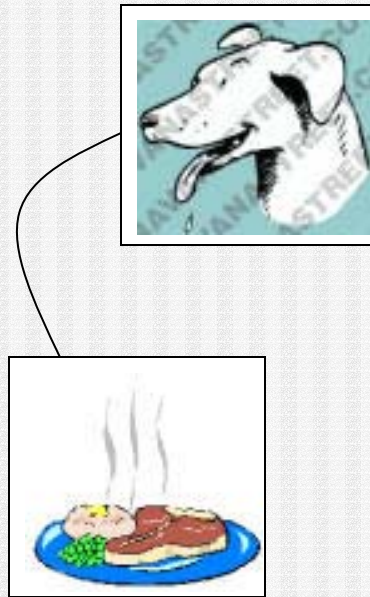
Hebbian Learning Rule

When neuron A repeatedly participates in firing neuron B, the strength of the action of A onto B increases.

Association

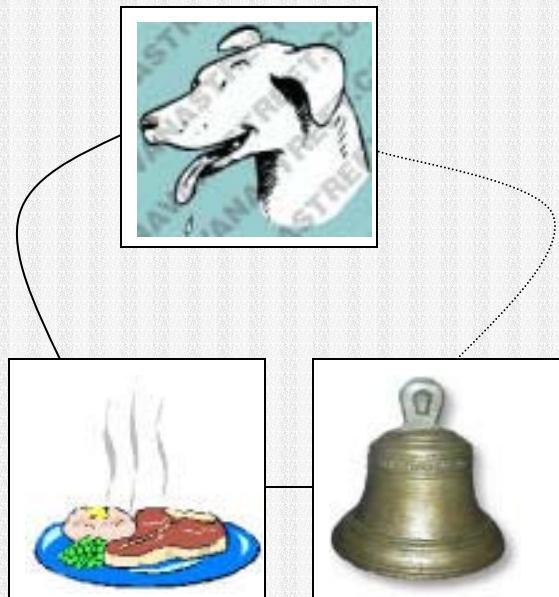
Example: classical conditioning

Initial state: smell of food triggers salivation



Association

If a bell sounds every time food is presented, salivation response co-occurs with bell



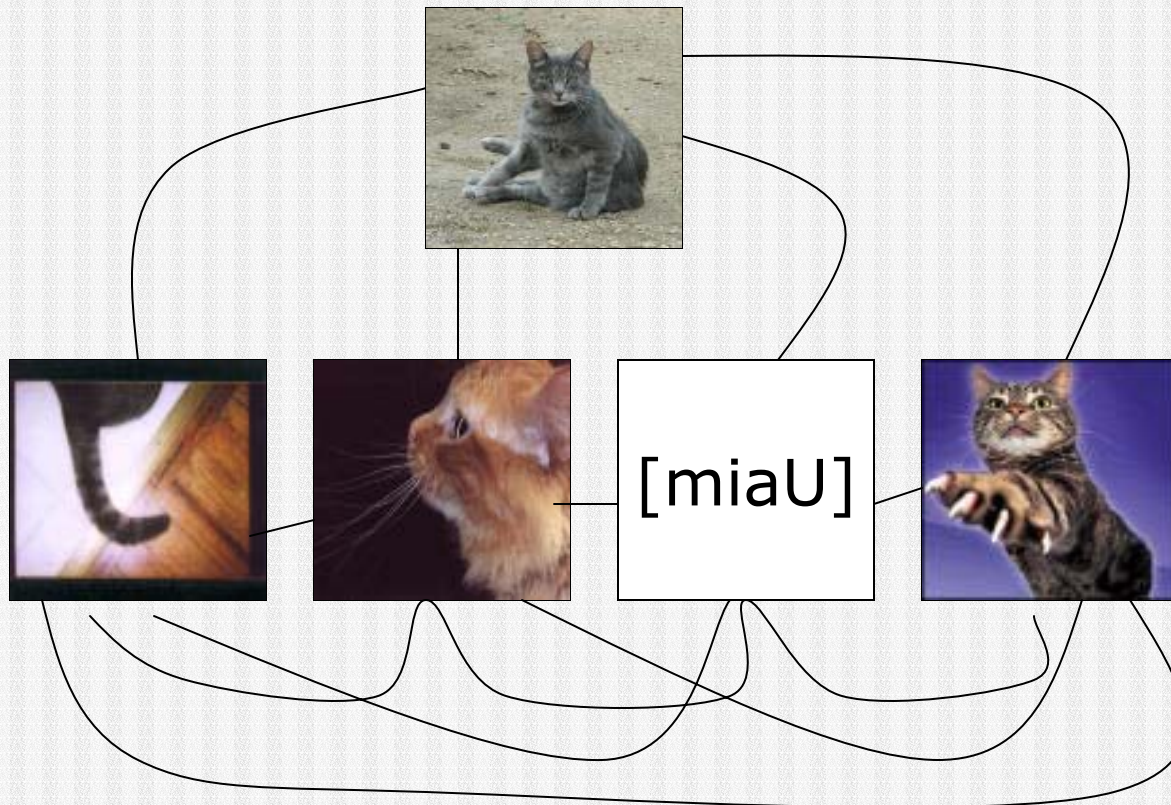
Association

After some number of co-occurrences, connection strength increases so that bell alone induces salivation



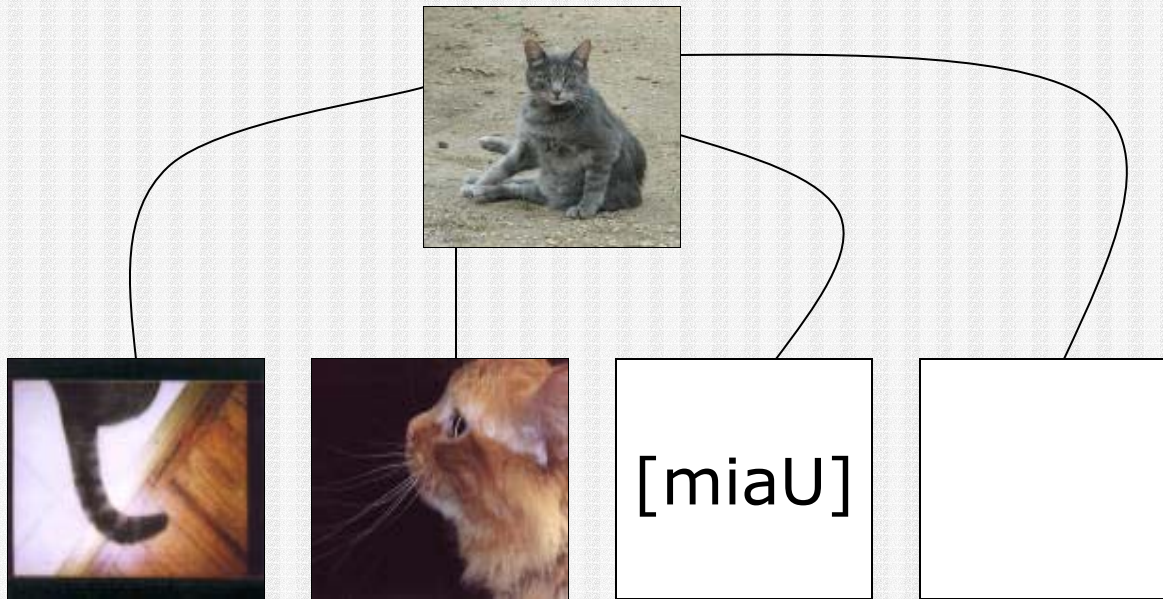
Association

Co-occurrence of features facilitates category formation



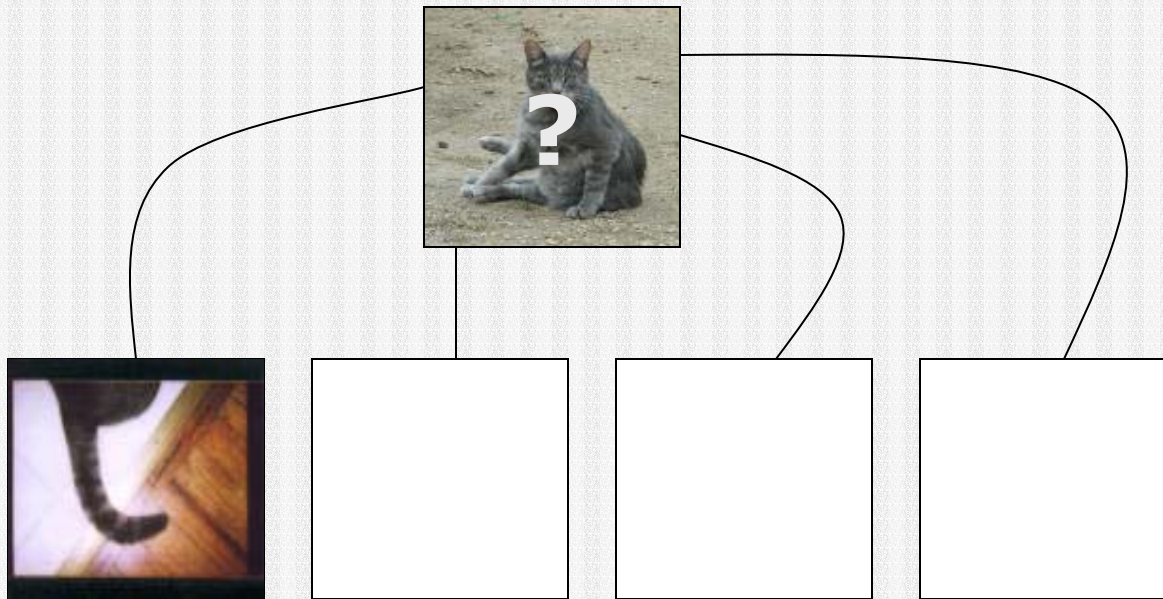
Association

Some feature may be absent, still trigger cat recognition



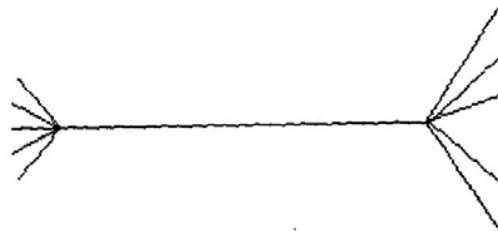
Association

Too few features present, may not recognize cat



categorization

- Zwaan & Madden's referent representation vs. linguistic representation
 - Referent representations – traces (firing patterns) occurring as a result of exposure to objects/events in the world
 - Linguistic representations – traces occurring as a result of exposure to linguistic input (including production experiences)
 - High interconnectedness within and between each type



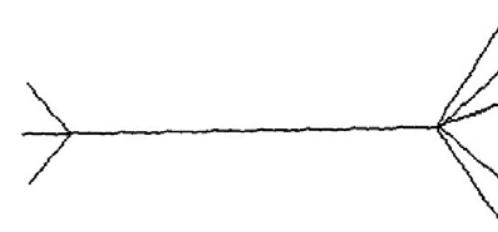
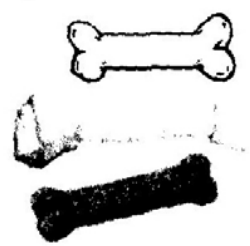
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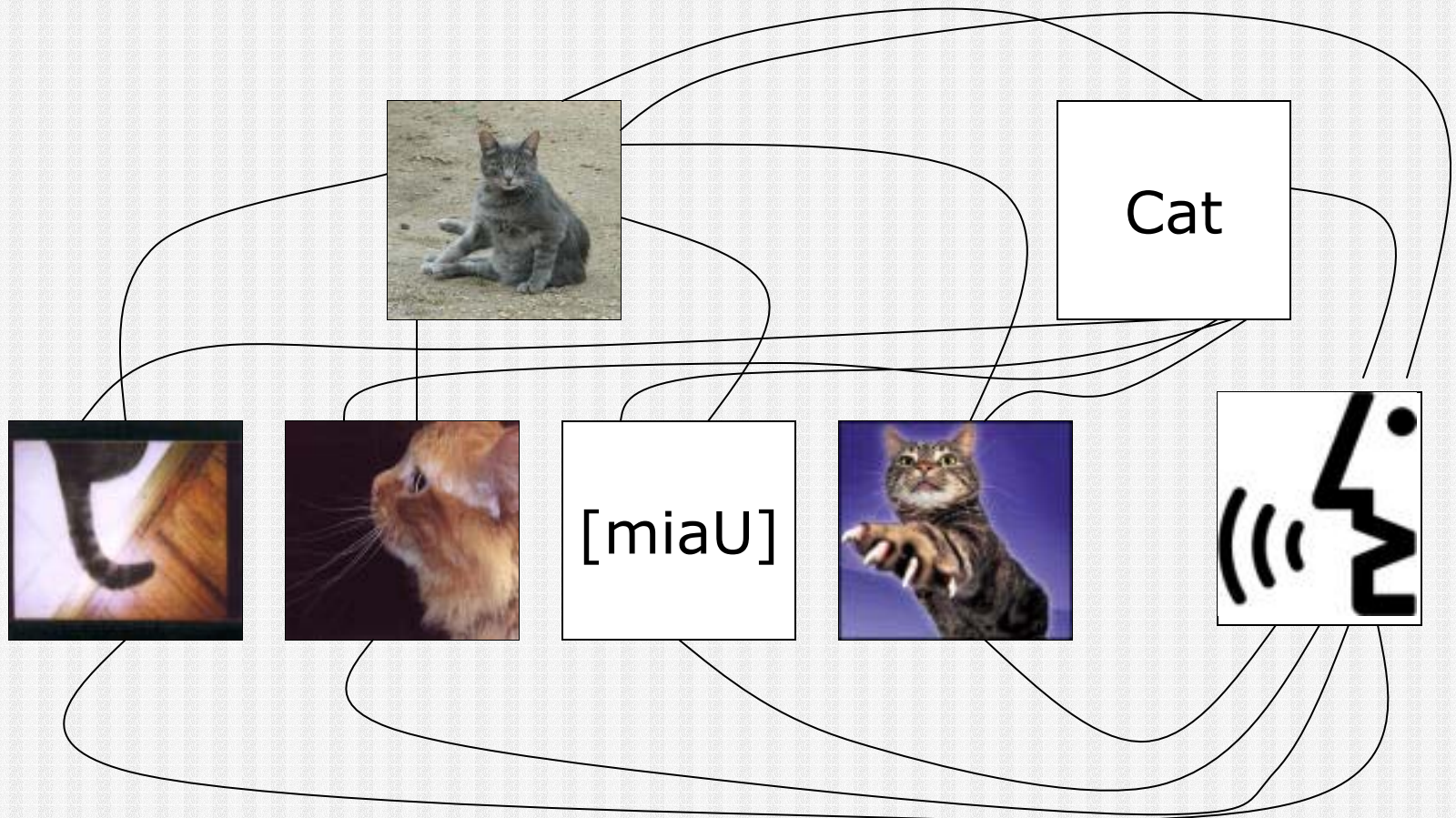


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Association

Referent and linguistic representations associated



Association

- Category recognition can be triggered by different feature patterns
- Features are also categories

Classical model of categorization

Aristotle

Every category has its *essence*, that which defines it

Ex. *Man* is a two-footed animal

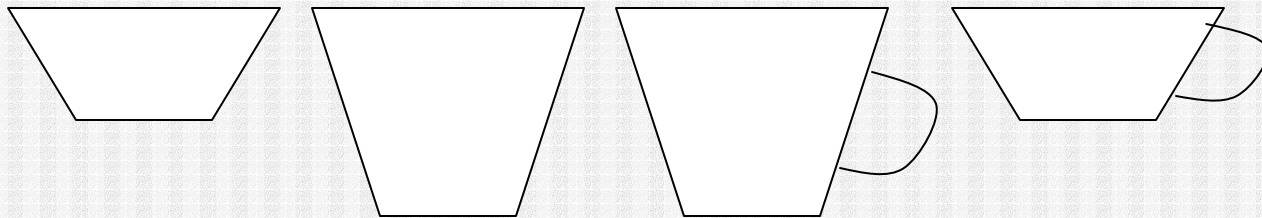
- Categories are defined in terms of necessary and sufficient features
- Features are binary
- Categories have clear boundaries
- All members of a category have equal status

Categorization - Wittgenstein

- Wittgenstein
 - Category boundaries are fuzzy
 - Members of a category do not always share a set of common properties
 - Ex. *Game*
 - Winning/losing – part of some games but not all (game of catch)
 - Skill involved
 - Luck involved
 - Family resemblances
 - Categories must be learned by exemplars

Categorization - Labov

- Labov
 - Categorization study for household containers (cup, mug, bowl, etc.)



Categorization - Labov

- Features can be gradient
 - Depth/width ratio continuous
 - Handle not just present or absent
- Function important
 - Mashed potatoes inside → bowl
 - Coffee inside → cup/mug
- Presence of features does not determine category membership but rather influences probability of categorization

Categorization – prototype theory

- Certain members of a category are prototypical – or instantiate prototype
- Categories form around prototypes; new members added on basis of resemblance to prototype
- No requirement that a property or set of properties be shared by all members
- Category membership a matter of degree
- Categories do not have clear boundaries