9.65 March 10, 2004 Memory V: AssociativeMemory HANDOUT

NOTE: that LAB 2 IS ON WEDNESDAY NEXT WEEK. Pick up a
copy of the Anderson reading for next Monday.

Assigned: Chap. 8.

Outline:

1. Meaning and Long-term Memory

2. Network Models of Semantic Memory
a. Quillian's network model of semantic memory
b. Spreading activation
c. Anderson's ACT
-the fan effect and the paradox of the expert

3. Nodes, Links, and Connectionism

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1. Meaning and Long-term Memory

To review: Much of memory seems to be structured associatively. In the next lecture on
learning, you'll read about the conditions under which associative links are formed.
Today, we focus on the way associations are STRUCTURED. It turns out that, in general,
multiple links to already well-structured information gives the greatest chance of
retaining the information. How do we knowthat?

Earlier in the course we discussed Craik and Lockhart's theory that Depth of Processing
determines LTM. Another experiment, by Craik and Tulving (1975) on the effect of
different tasks to be performed on a series of words.

-decide whether the test word would fit in a sentence, such as "He met a
_____ on the street": FRIEND (versus TABLE)

-is this word in capital letters? friend

-does this word rhyme with WEIGHT? FRIEND

Differential later memory for the words. INTENTION to remember the words doesn't
matter much.

SUMMING UP THE ROLE OF MEANINGFULNESS IN LT MEMORY: What gets linked up
during encoding determines what gets remembered. And coding in terms of meaning
provides the most distinctive encoding, the largest set of connections to already-known
information, and therefore the most RETRIEVAL ROUTES.
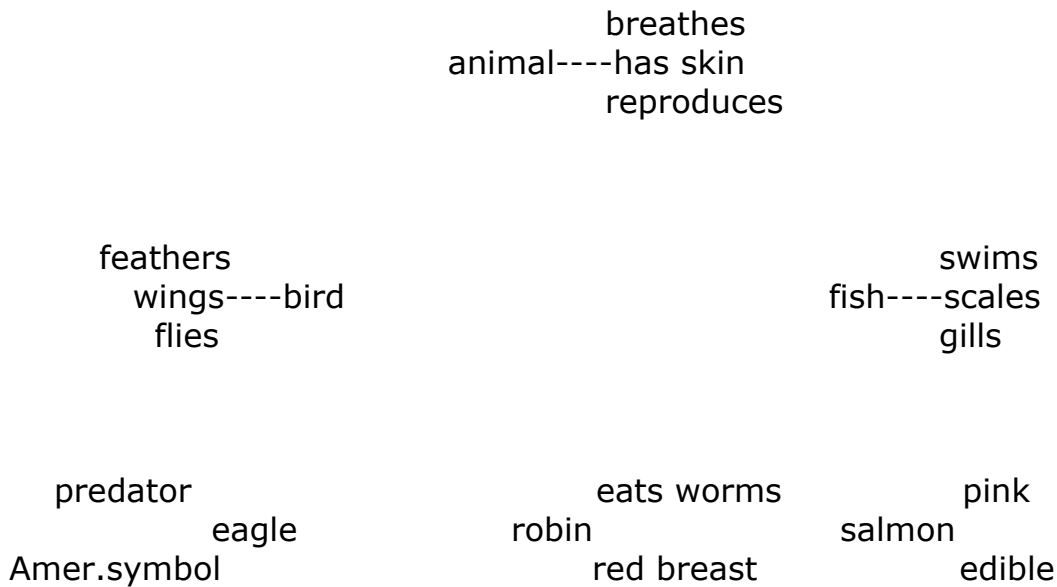
Content-addressing:

Some kinds of information CANNOT BE USED EFFECTIVELY as a retrieval address, even though the information is in memory. E.g., word for a family relationship (for example, **grandmother**, **cousin**) that ends with **w**?

2. Network models of semantic memory

The idea that memory consists of associations between mental entities underlies **associative models** of human memory. In such models the contents of memory consist of mental representations of items and their associative connections.

a. Quillian's network model of semantic memory

Using the terminology of graph theory, items are commonly called **nodes** and connections between them are called **links**.

```
                              breathes
                   animal----has skin
                              reproduces


     feathers                                    swims
       wings----bird                     fish----scales
         flies                                   gills


   predator                 eats worms            pink
         eagle          robin                salmon
Amer.symbol                  red breast            edible
```

From Quillian (1966) and Collins & Quillian (1969).

has (or **hasa**) links (features or properties), **isa** links (superordinate, subordinate)

b. Spreading activation

Experiments by Collins and Quillian (1969)

Hierarchical structure

Economy of storage

Problems:

c. Anderson's ACT:

Propositions, not just single concepts.

>From Anderson, 2000:

John bought some candy because he was hungry.

The fan effect

Paradox of the expert

Networks connecting concepts? E.g., Anderson, certain labelled links:

-**isa**

-**has**

-**relation:** verbs/actions as relations between an **agent** and an   **object**.

-**time** and **location** make a proposition an episode, rather than a semantic "fact"

Processing assumptions

Needed: more complex accounts of the structure of information.

3. Nodes, Links, and Connectionism

Background: Perceptrons:

No way to represent "exclusive OR" (XOR):

Need **hidden units**

Connectionism or Parallel Distributed Processing (PDP)

Units and associative links (**connections**)

Distributed information

PDP framework:

1. Set of processing units

2. State of activation over these units

3. Pattern of connectivity among units

4. An activation function for each unit--either a threshold (fires or doesn't), or a smooth, continuous function such as a sigmoid.

5. Learning rule: modification by experience, by changes in weights that connect processing units, as a result of FEEDBACK (BACKPROP).

6. Environment of the system (e.g., where do the inputs come from, what sorts of outputs).

Many differences between the real CNS and the PDP models

The two most important advances of the PDP models are:

(a) the demonstration that one can get "intelligent" performance out of simple units in a network just by adjusting the strength (weight) of the connection of one to another.

(b) the very same units can participate in representing many different pieces of information.
Vital to this kind of model are HIDDEN UNITS.

Frequency