Knowledge

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The Organization of Knowledge

- How is knowledge represented?
- How can we call up a particular piece of information at any given moment?

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How is Knowledge Organized?

Alphabetically	Associations
Doctor	**Doctor**
Doctrine	Nurse
Docket	Hospital
Document	ER

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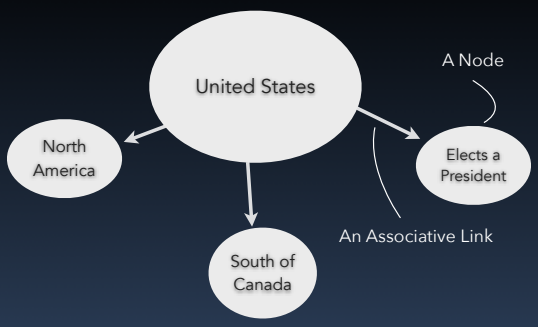
Is there some type of 'order' used to organize knowledge?

- Alphabetical, Association, etc?

Associative Network



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The way an association network works is usually via a single greater topic in which smaller pieces of associated information, called 'nodes'.

How does the network work?

- Each node represents an individual idea/ concept.
- Nodes are connected to each other via associative links.
- In this view, searching through memory is equivalent to activating nodes via spreading activation.

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Assoication network searching - equivalent to activating nodes via a spreading activation.

Spreading Activation

- How does spreading activation work?
- When a node is activated, it spreads its activation to its connected nodes.
- Some associative links are stronger than others (e.g., doctor - nurse vs. doctor - lock). But why?
- Co-activation

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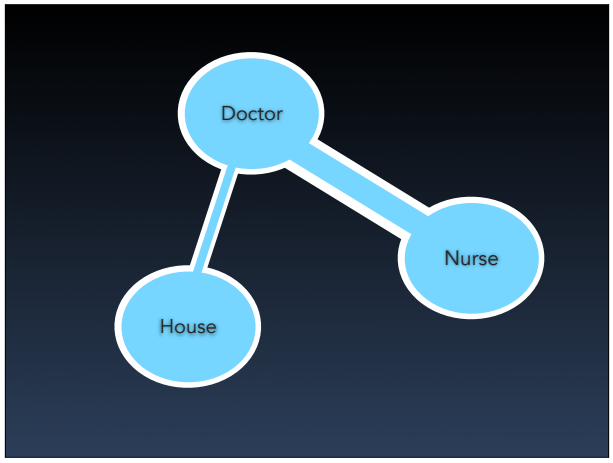
Nodes are activated by one another via their connections to one another. Think of Christmas lights, for example.

"Items/words/etc used in the same context / same time, they become more strongly associated with one another".



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Application of Spreading Activation

- What is the capital of USA?
- Hint: It is also the name of a president...
- Washington, D.C.!!!
- Hints help us remember. But how do they work?

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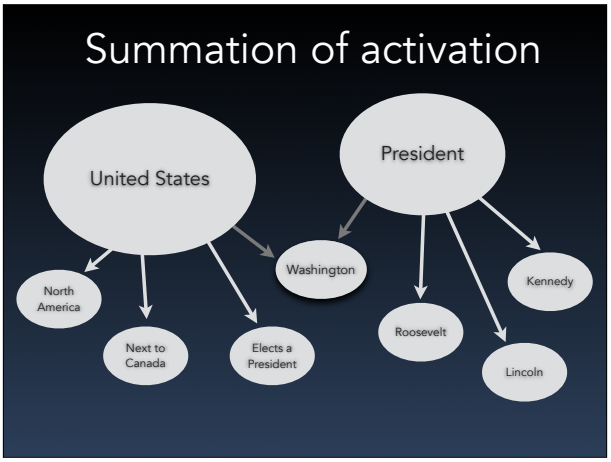

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Nodes can be shared via several different topics.

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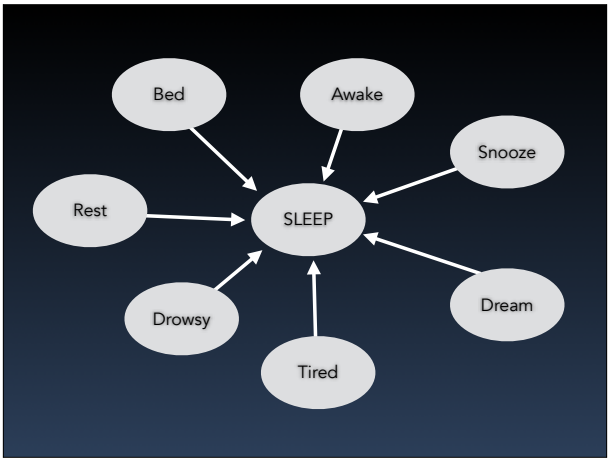

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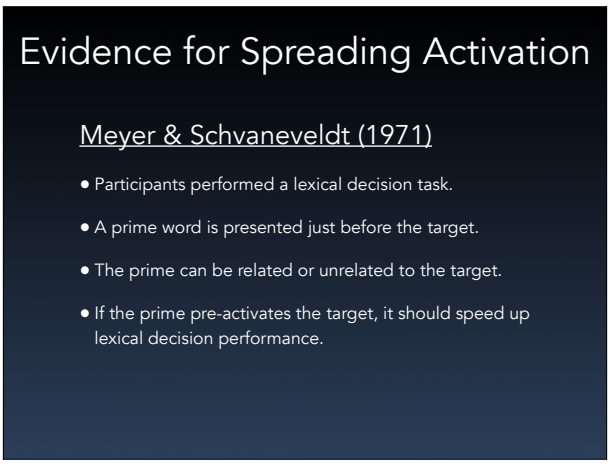
Roediger and McDermott (1995) used to organize knowledge.



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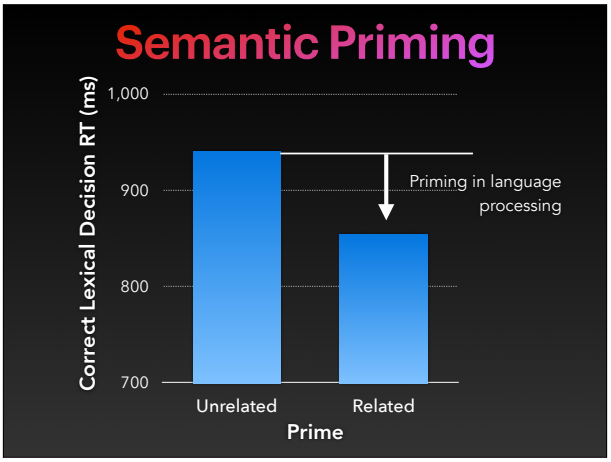
Meyer & Schvanevelt (1971).

Participants performed a lexical decision task. A prime word was right before the target word was shown. However, the prime word had the chance of being unrelated to the target. If the prime pre-activated the target, then it should speed up lexical decision performance.



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When a prime is related to the target, the response is approx.

90 ms faster.

What is the structure of semantic memory (knowledge)? How is it organized in the brain?

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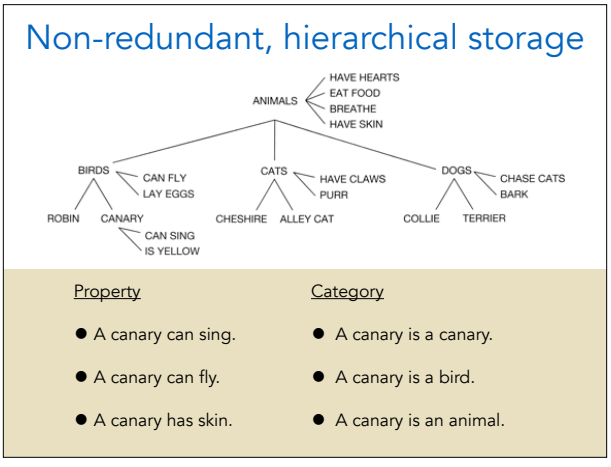

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We only need to store one copy of things that are redundant / used

across multiple different things.

Sentence Verification

Collins & Quillian (1969)

- They proposed that searching through the network is like traveling.
- The further away the nodes, the longer it takes to travel.
  - "A robin is a bird." True or False?
  - "Cats have eyes." True or False?
- Verification time should be shorter for directly-linked concepts than for indirectly-linked concepts.

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The fruther away the nodes, the longer it takes to travel.

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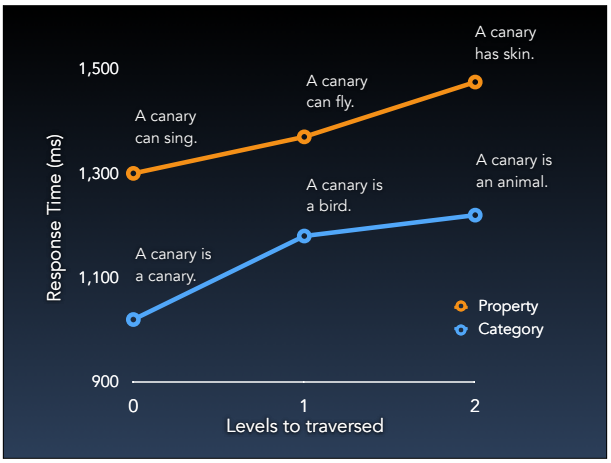

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Limitations with Collins and Quillian's Model

Typicality Effect

People are much faster to verify that "A robin is a bird" than "A peacock is a bird".

Absolute Nonredundancy

"Pigeons have feathers" is slower than "Pigeon is a bird". But…

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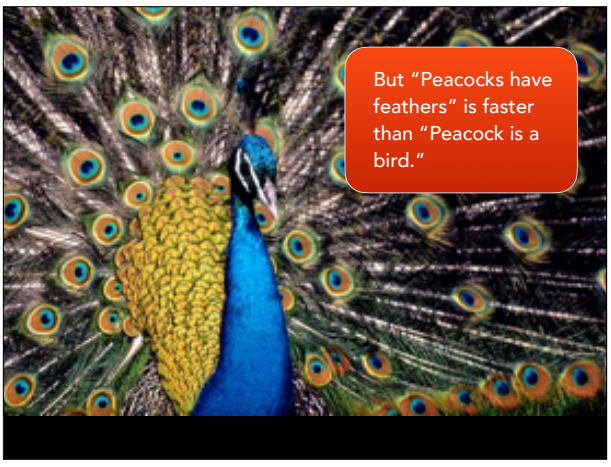

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How to deal with this?

- Allow redundant storage.
- Relax the hierarchical structure and allow cross-level connection.

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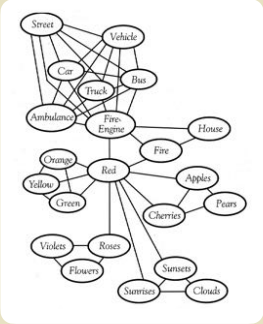
Spreading Activation and Semantic Priming

- Example of a spreading activation model in which the length of the connections represents the strength of association between concepts - with shorter length meaning a stronger association.
- Note that information is not organized simply by meaning.



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Knowledge Acquisition

Given that knowledge is organized in a primarily nonredundant structure. What are the consequences of having such a knowledge structure?

When you add new information to an existing network, what happens to that network?

How does this network support learning?

The more you know, the better you get?

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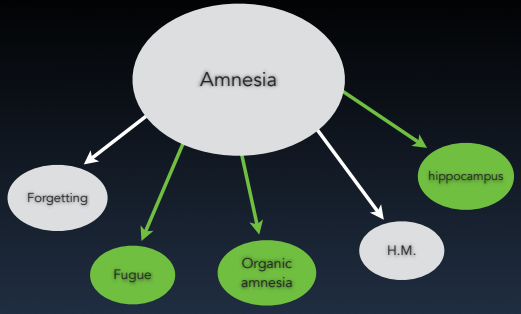

What happens to an existing network when you add new information to it?

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Expanding a Network

Degree of fan describes how many links are connected to a particular node.

What's the difference between activation spreading from a node that has only a few links and activation spreading from a node that has many links?

Holding the level of activation constant between two nodes, the nodes with more links must divide its activation among more links, so each link should receive less activation.

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The more links that a node has, the less activation each node requires.

Degree of fan - how many links are connected to a particular node.

Spreading activation should be stronger for nodes that have few connections than for nodes with many connections -- all else being equal.

Holding all else constant, there should be a negative relation between degree of fan and strength of spreading activation, with higher degree of fan = weaker spreading activation.

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Higher degree of fan => weaker spreading activation.

Lower degree of fan => stronger spreading activation.

But strength of association is difficult to hold constant in real life, so it is hard to know the true effects of fan.

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The Fan Effect

Anderson (1974) taught subjects new facts so that strength of association could be held constant. He then manipulated the degree of fan.

- The doctor is in the bank.
- The fireman is in the park.
- The lawyer is in the church.
- The lawyer is in the park.

John Anderson

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- The doctor is in the bank.
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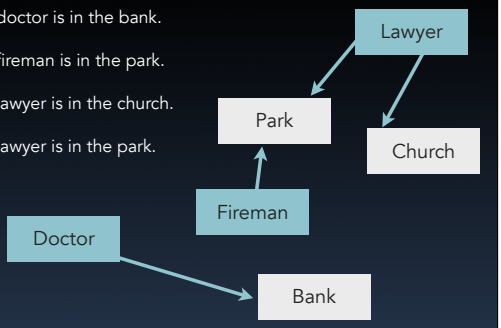

After learning, Anderson gave subjects a recognition test.

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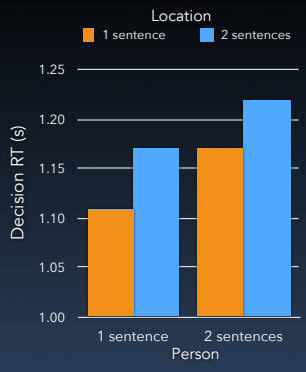
Influence of Degree of Fan on Decision Time

Degree of fan matters!

Greater degrees of fan = Slower verification



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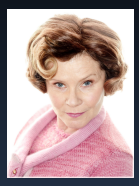
Potential Problems with Spreading Activation

- In Harry Potter, what is the name of the mean teacher from the ministry of magic who took over Hogwarts?
- Tip-of-the-Tongue
- People often know the number of syllables in the word, the letter that the word begins with, what it sounds like, etc.
- In network terms, what does TOT represent?



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Here's another problem... basically the flip side of TOT.

So much activation happens in the network, how do we know which activated node to pick?

How many associations does one have about... say, water?

How about JUST the strong associations? Ones that we assume to have direct links to water? How about just 10?

Limiting activation

- If I ask you to think of the chemical constituents of water, and you have a direct link between water and H_2O, then you're just picking 1 node out of 10... not so bad.
- What if I ask you this... "What is the name of the phenomenon that is created by large amounts of water rushing to land?'
- Water --> Ocean --> Waves --> Tsunami?
- How many nodes are activated here?

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Winner takes all

Every activated node also sends out an inhibitory signal to its surrounding nodes.

Inhibition is proportional to activation.

Say you're activating the concept "Apple" by 2 units of strength and "Orange" by 1 unit of strength. If there is no inhibition, then the ratio of activation between Apple and Orange is 2:1. What if there is inhibition?

Let's assume that inhibition = 1/3 the strength of activation.

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Every activated node also sends out an inhibitory signal to its surrounding nodes.

Importance of Inhibition

From 2:1 to 5:1

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Inhibition leads to TOT

- Think about the example of Harry Potter...
- You have activated the name of Harry Potter, Hogwarts, and probably even the other main characters like Ron Weasley, Hermione Granger, and Dumbledore. That's pretty close to the Umbridge node, but not quite.
- Now Harry and other dominant nodes are going to inhibit Umbridge, which will make activating Umbridge particularly difficult.

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These inhibitory signals then lead to TOT (tip of the tongue), because other dominant nodes are going to inhibit the node you're searching for, which makes activating such node difficult.