

# Semantics

- Lexical semantics — accessing the **mental lexicon**

- The dog chased the cat

- The man gave the woman a hand

- Time flies

- Phrase semantics

- brick house / rabbit house

=a house made of bricks / a house where rabbits live

- NOT a house where bricks live / a house made of rabbits



or



# Semantics

- Reference

- The man ate the sandwich that he made

*The man and he co-refer*

- The man looked at him in the mirror

*- The man and him refer to different people*

- Logical form

- The boss takes her coffee with sugar =

she is currently drinking coffee with sugar    or  
she habitually drinks coffee with sugar

- Everybody has a cell phone =

All people share one cell phone                      or  
Each person has their own cell phone

# Morphology

- Morphology is about pieces of words that carry **meaning** (or tense, number, gender, etc.).
- Roots, prefixes, suffixes, affixes
- Examples

cats = *cat* + *-s* [two morphemes]

potato [one morpheme]

repaints = *re-* + *paint* + *-s* [three morphemes]

# The war over the past tense

- The English past tense rule is a classical morphological **rule**: add the morpheme -ed .

talk → talked (/t/ sound)

aid → aided (extra syllable)

bug → bugged (/d/ sound)

# But it has lots of exceptions

go/went

is/was

bring/brought,

    sing/sang [not sought]

seek/sought, but

    [but leak/leaked, not lought]

feed/fed

read/read

    [but need/needed, not ned]

think/thought

    drink/drank

    [but blink/blinked, not blought]

bite/bit

light/lit [or lighted], but:

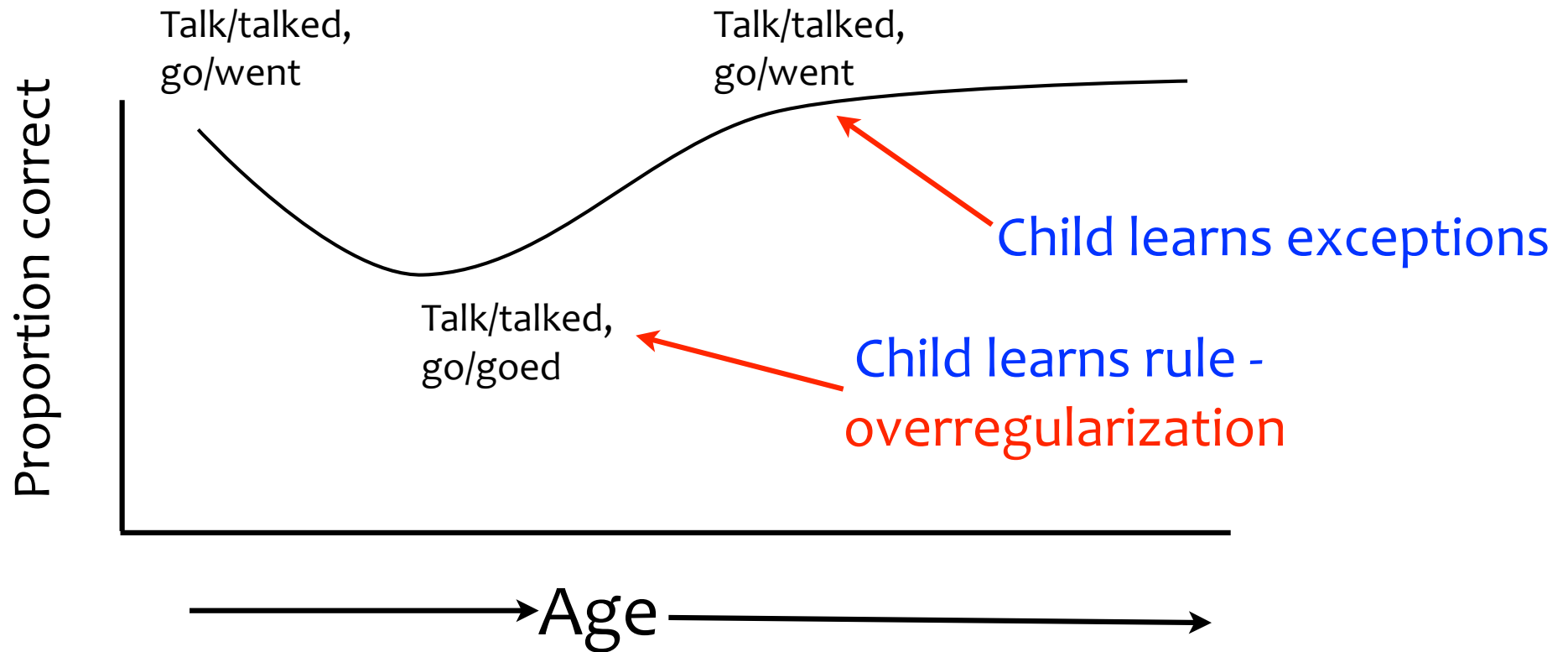
fight/fought

write/wrote

meet/met

    [but eat/ate]

# The U-shaped curve



The wug test: “Today I will wug, yesterday I \_\_\_\_\_”?

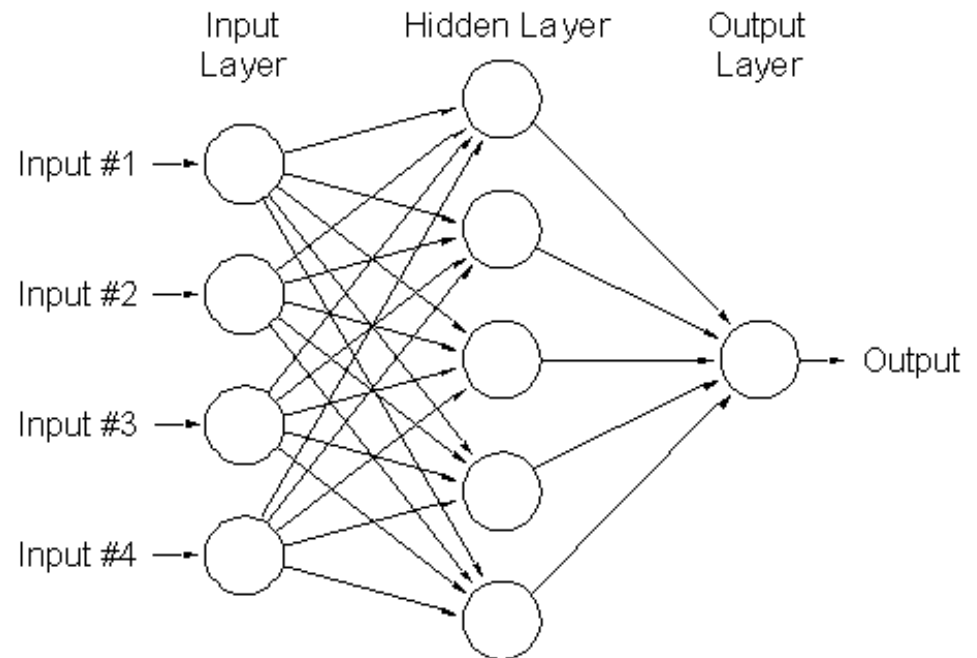
# Modern connectionism, aka Parallel Distributed Processing (1986)

*Parallel:* Many nodes that all run at the same time.

*Distributed:* Knowledge is represented as the **weights on the connections**

Back-propagation algorithm:

1. Feed an input through the network; obtain an output.
2. An “oracle” compares the actual output to the target output (**supervised learning**)
3. Using the “error” (discrepancy), update the weights on all the connections.

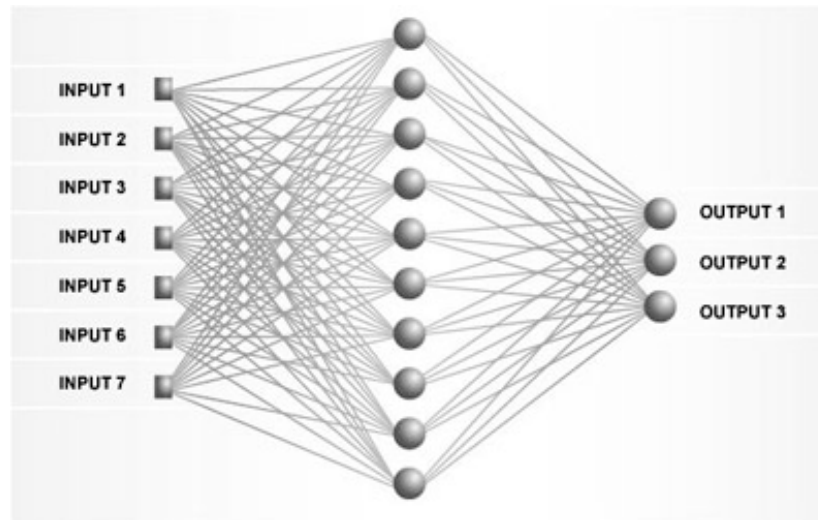


# Past tense neural network (McClelland & Rumelhart, 1986)

Learns the correct input-output by backpropagation

- in a parallel distributed fashion
- without rules
- without morphemes
- without any distinction between regulars and irregulars

talk  
go  
think  
wug



talked  
went  
thought  
wugged

# The war over the past tense

- McClelland & Rumelhart (1986) proposed to explain the most rule-like and symbolic phenomenon **without rules**

Thus past tense learning would be an application of **general learning mechanisms** not specific to language

Their network even replicates the **U-shaped learning curve**

- Pinker & Prince (now at Rutgers) argued

The network generalizes incorrectly

bear/bore but bare/bared; steal/stole but steel/steeled

fly/flew but fly out/flied out

U-shaped performance is rigged by input

# The connectionism wars (1980s - present)

- **Symbol systems** side (rationalist, nativist):

The brain uses **rules** operating on **symbols** to understand the world

Different learning mechanisms in different domains

Some knowledge is innate

Connectionist systems can't represent the full infinite productivity of human thought.

- **Connectionist** side (empiricist, associationist):

“Rules” and “symbols” are just **epiphenomenal** (side-effects)

All knowledge is implicit in the **connections** between neurons;

One **general mechanism** explains learning in all domains

Only connectionism systems are **biologically plausible**.