

LING5702: Lecture Notes 5

A Model of Complex Ideas in Associative Memory

We have seen how interconnected neurons can define mental states and cued associations.

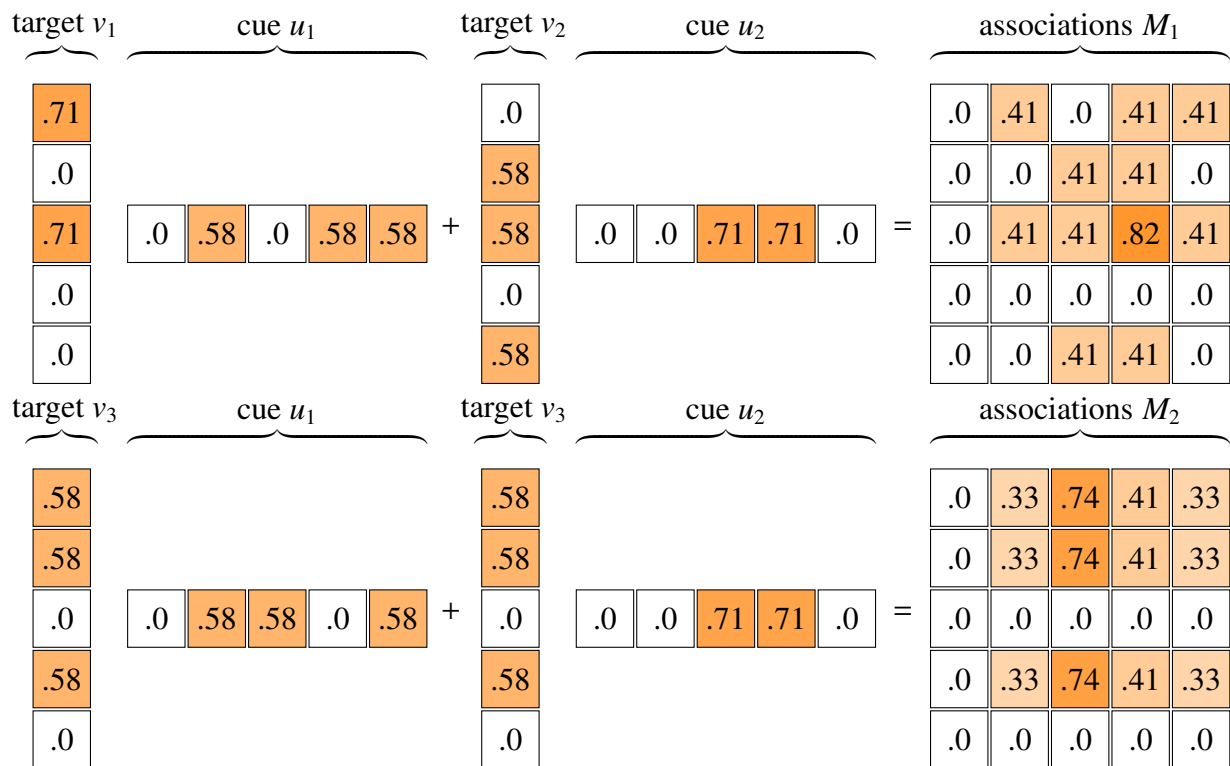
This lecture will describe how mental states and cued associations can define complex ideas.

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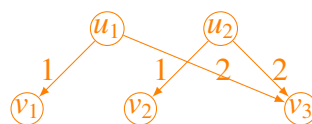
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5.1 Previously: mental states and cued associations

Recall neural activation patterns and potentiated connection weights:



define coordinates of points (mental states) in mental space, linked by cued associations:



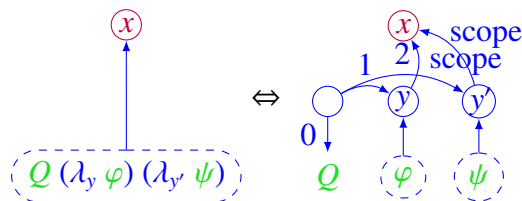
5.2 Cued associations represent lambda calculus [Schuler & Wheeler, 2014]

Mental states mostly correspond to lambda calculus variables, and directly cue the following:

1. **function arguments**: cued associations from function to argument, **numbered** by position
2. **scope**: association from a quantifier's argument variables to its immediate outscoper

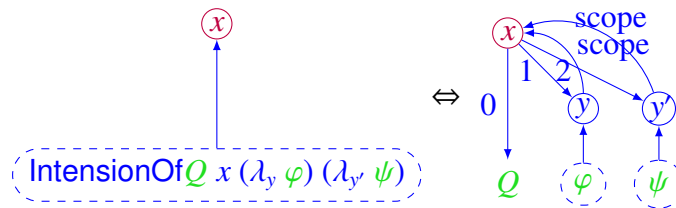
We can use cued associations to build complex ideas, equivalent to lambda calculus expressions (define cued associations via recursive mappings, in context of a **most recently bound variable x**):

1. **generalized quantifications** (unlabeled circles) cue restrictor and nuclear scope variables:

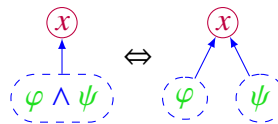


A 'scope' association cues the **most recently bound variable** as immediately outscoping.

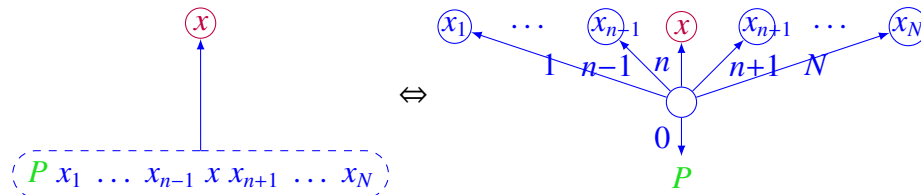
2. **intensions** of generalized quantifiers use the **most recently bound variable** as quantification:



3. **conjunctions** are represented as independent graphs sharing a **most recently bound variable**:

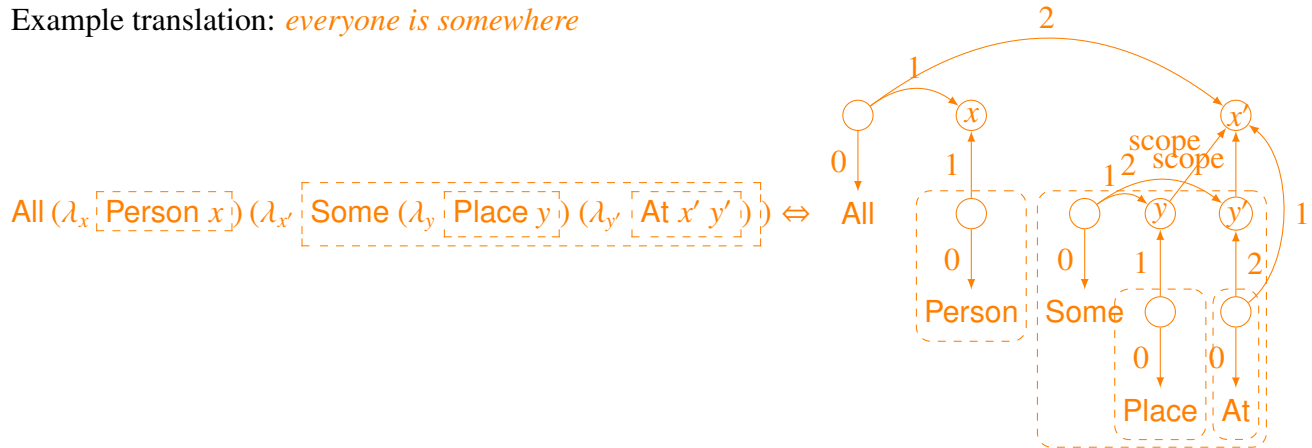


4. **predications** (unlabeled circles) directly cue a predicate type and arguments:



Note that the **most recently bound variable** is typically one of the arguments.

Example translation: *everyone is somewhere*



In this manner, any complex idea may be stored as cued associations in associative memory. (Here, unlike other possible representations, all variables are unique, so may be cued by content.) We'll assume a representation like this is formed incrementally during sentence comprehension.

5.3 How are complex ideas experienced?

In this model a complex idea is a collection of cued associations in associative memory. The entire idea is not all active at the same time.

How is such an idea experienced?

Just as we apprehend visual scenes by saccading from one physical fixation point to another, in this model we apprehend complex ideas by **transitioning** from one referential state to another, via cued associations.

So, as we think about people and places, there is always a 'you-are-here pointer' in the graph.

References

[Schuler & Wheeler, 2014] Schuler, W. & Wheeler, A. (2014). Cognitive compositional semantics using continuation dependencies. In *Third Joint Conference on Lexical and Computational Semantics (*SEM'14)*.