The Language Organism
Lecture 5: From evolution to learning

Simon Kirby

simon@ling.ed.ac.uk

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- Evolution by natural selection can lead to *adaptation* of these genes
- Research question: under what condition will genes giving optimal signalling evolve?

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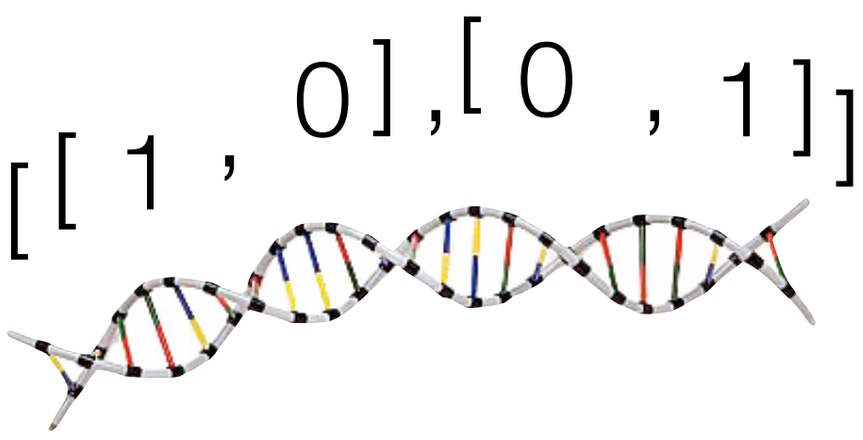
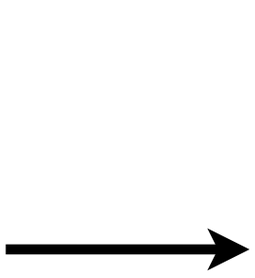
- What relation does a model like this have to human language?
- Are there ways of getting “good numbers” other than by natural selection?

- We have equated genes and phenotype, but is this justified? If not, then what’s missing?





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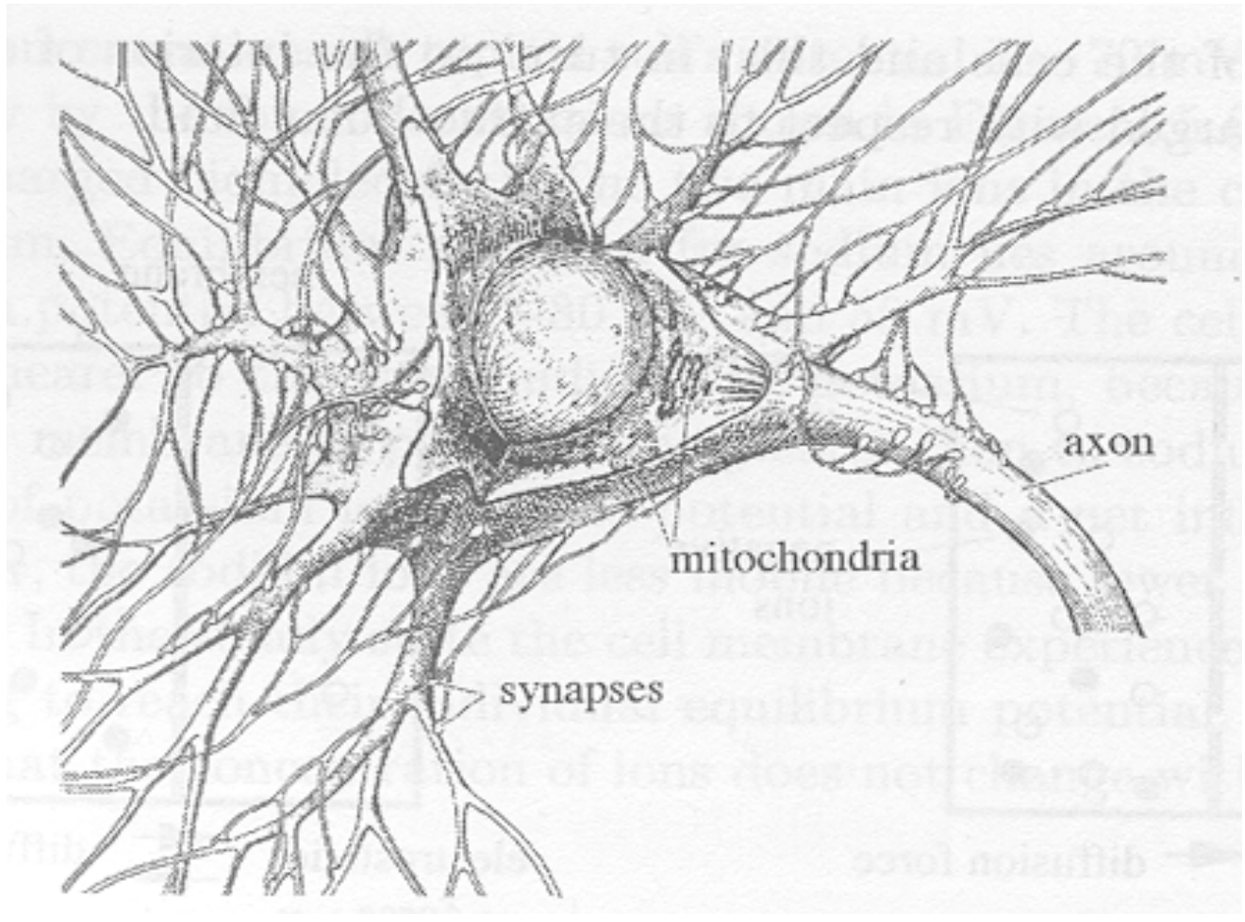

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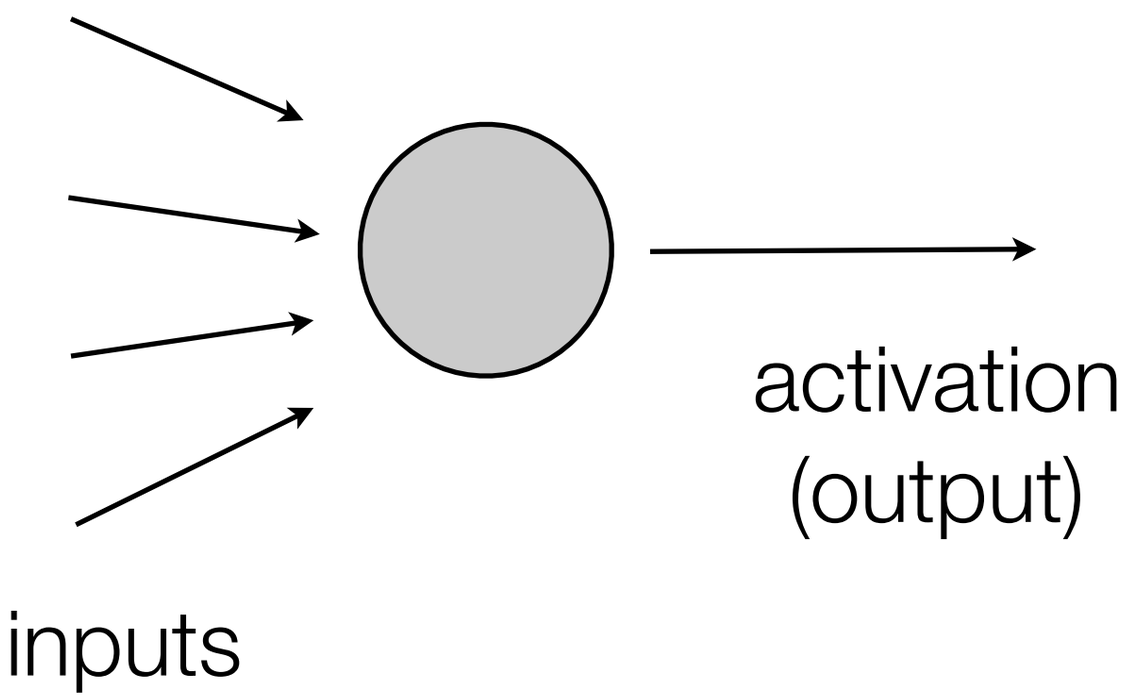
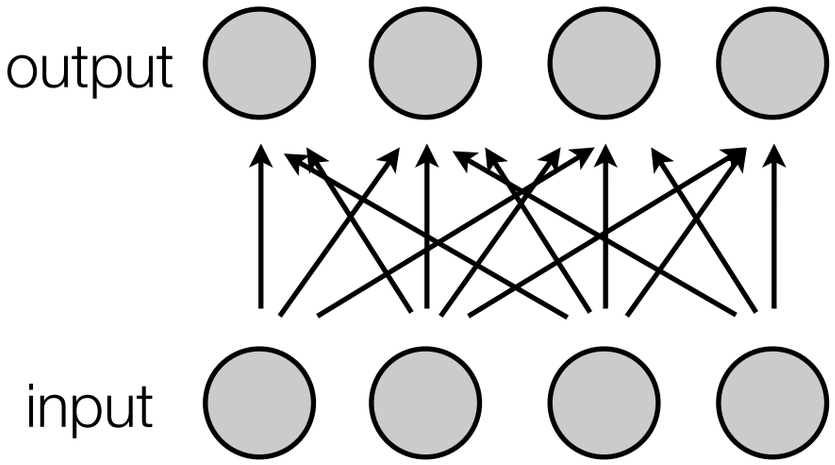


Neural networks

- Typically these “neurons” are nodes in a network (just like in the brain...)

- Many neural network models have nodes arranged in layers, with some layers interfacing with “input” and/or “output”



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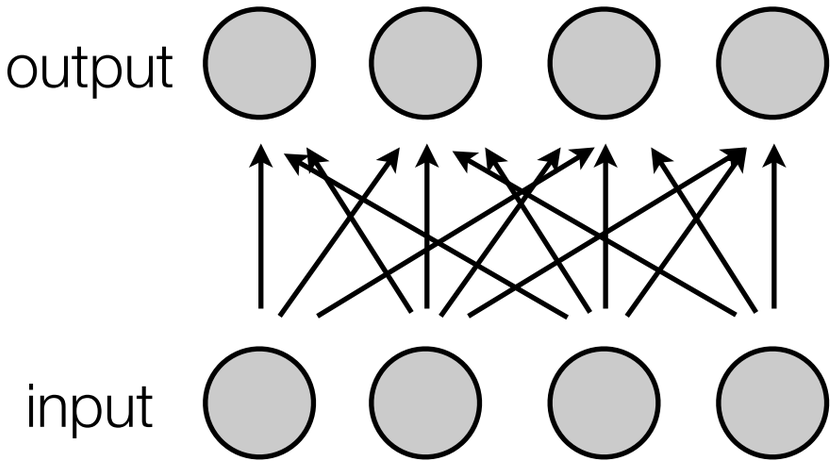

- Connections are *weighted*. In other words, they modify the signals passing along them. Think of this as representing the knowledge encoded by the network

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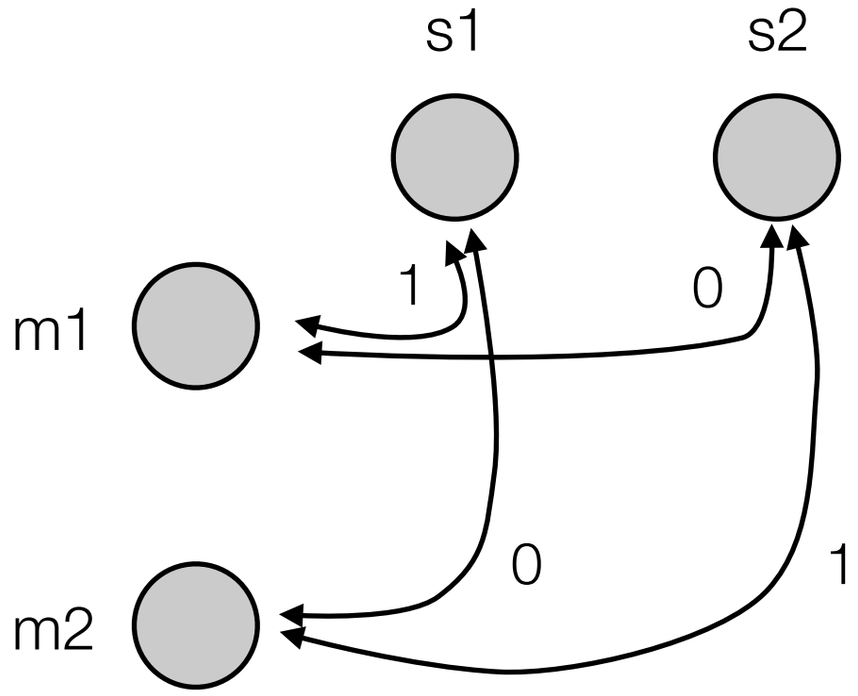

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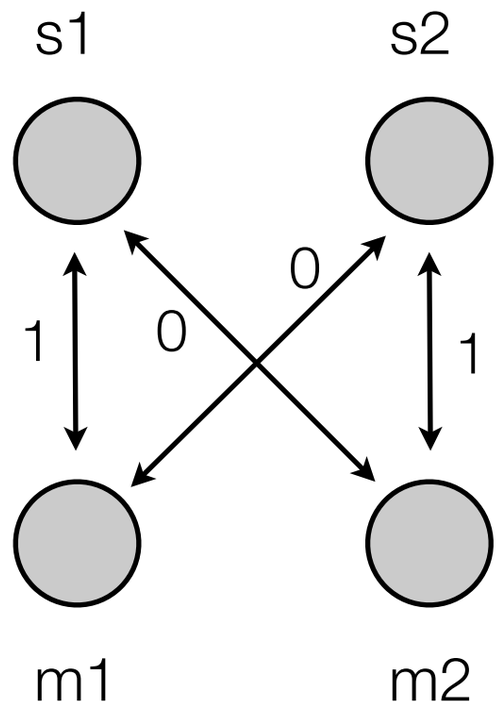
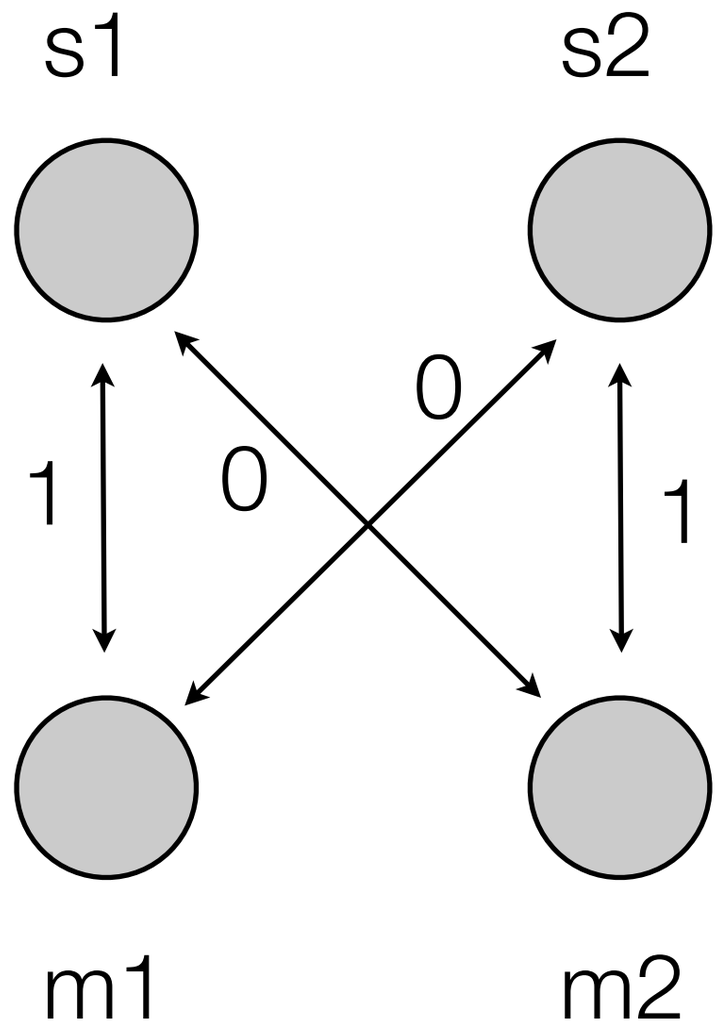


How the network works

- Input nodes are “activated”, and activation flows through the connections, modified by the weights and is summed up at the output nodes



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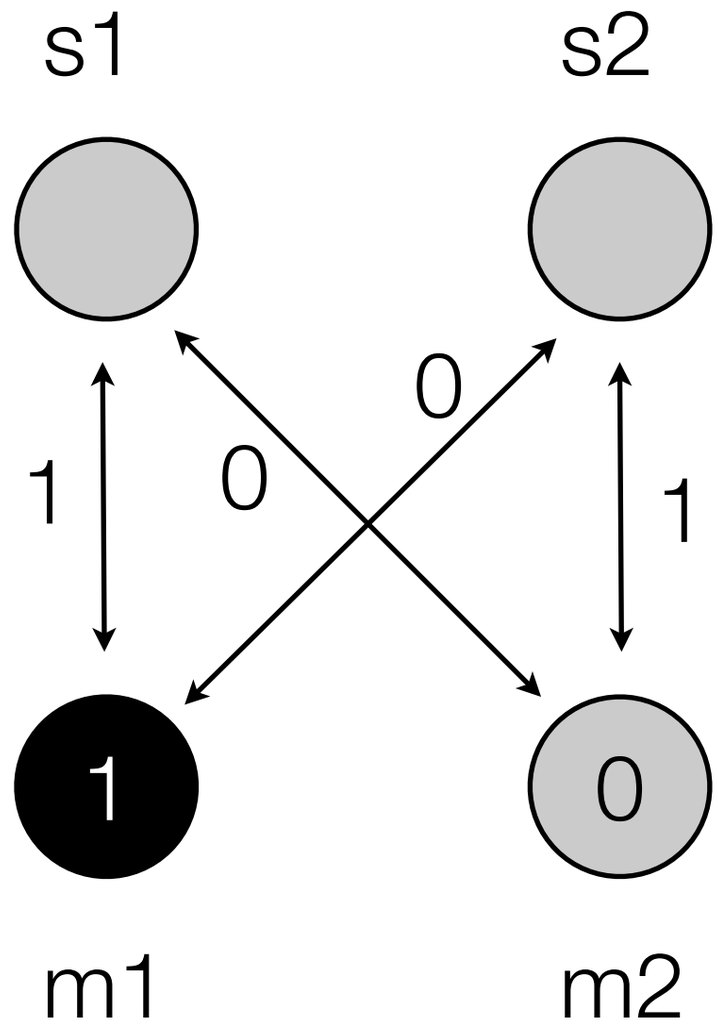

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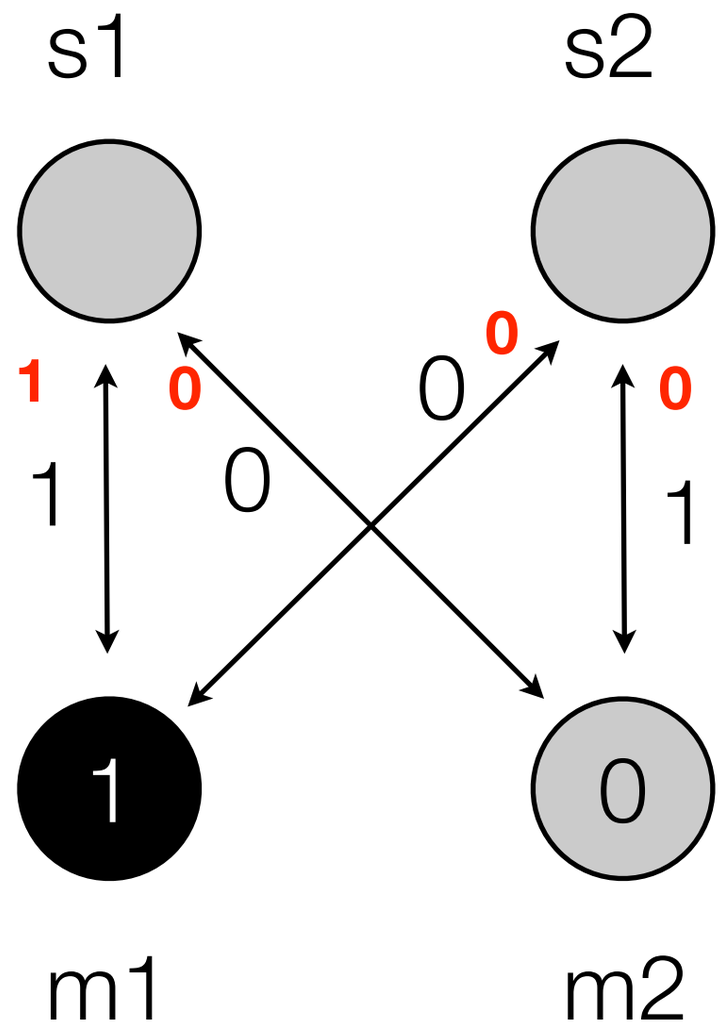

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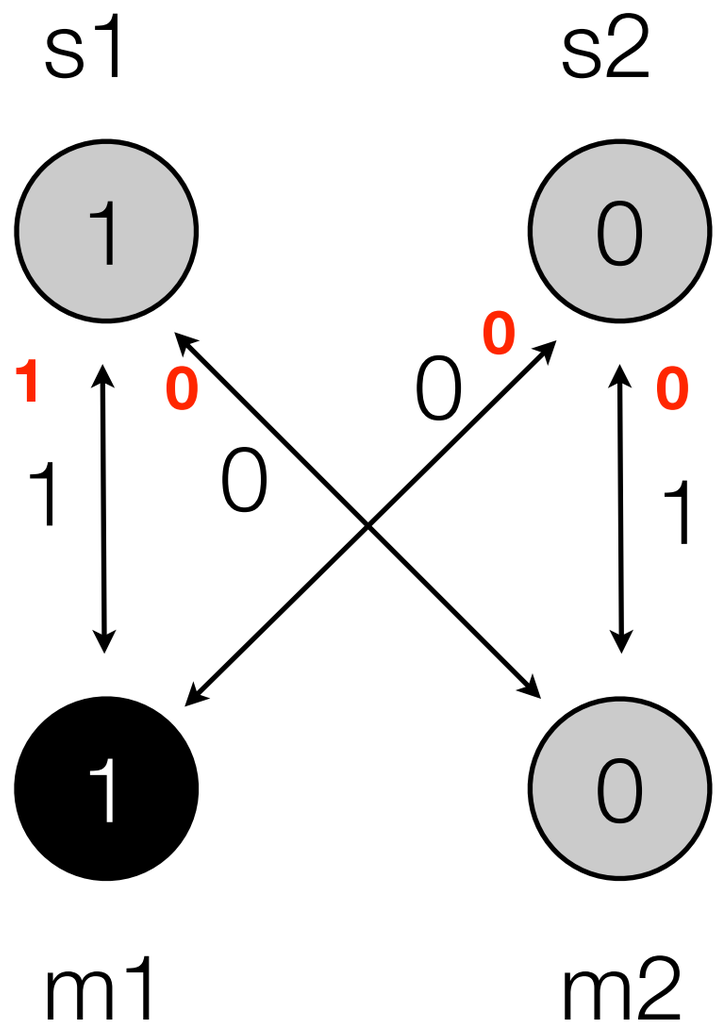

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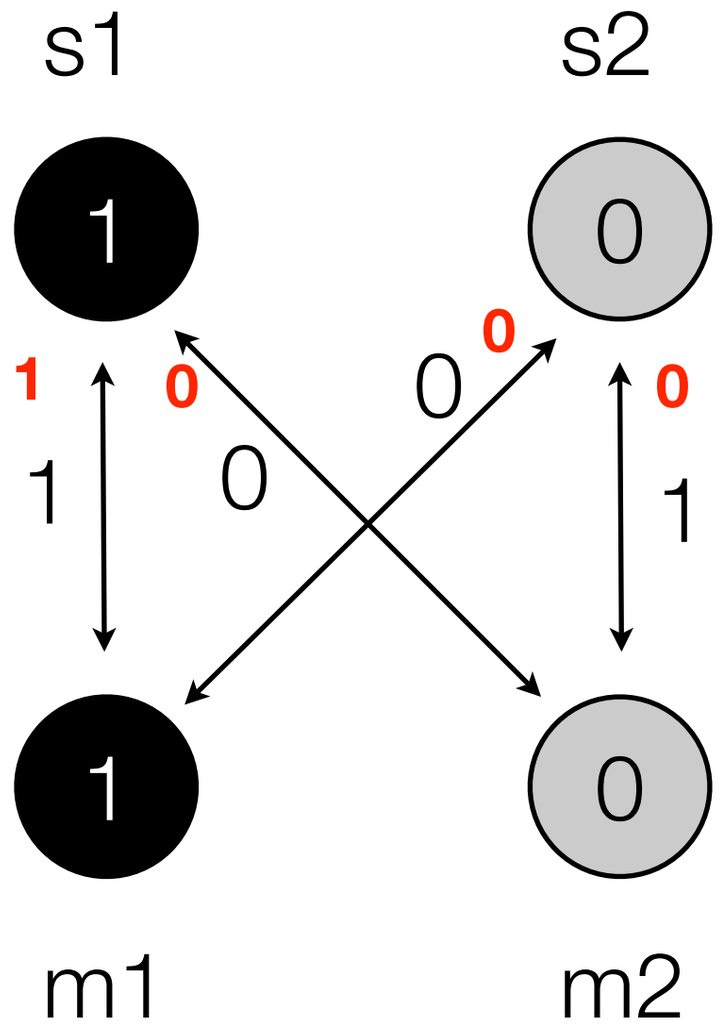
- Signal activations converted into an actual signal output (e.g. pick the most activated node)



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- Neural networks (and brains!) are designed so that connections change with experience. Learning breaks the simple connection between genes and phenotype.

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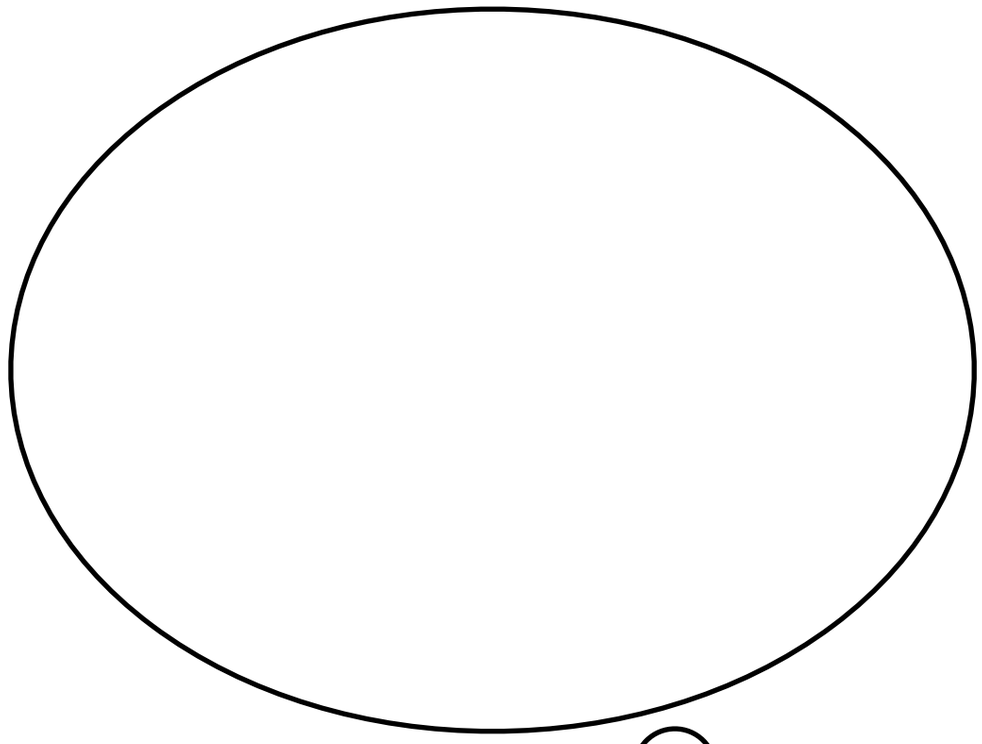
- Simple approach:
  Start with all weights zero, and increase connection weight whenever two nodes fire together

Example



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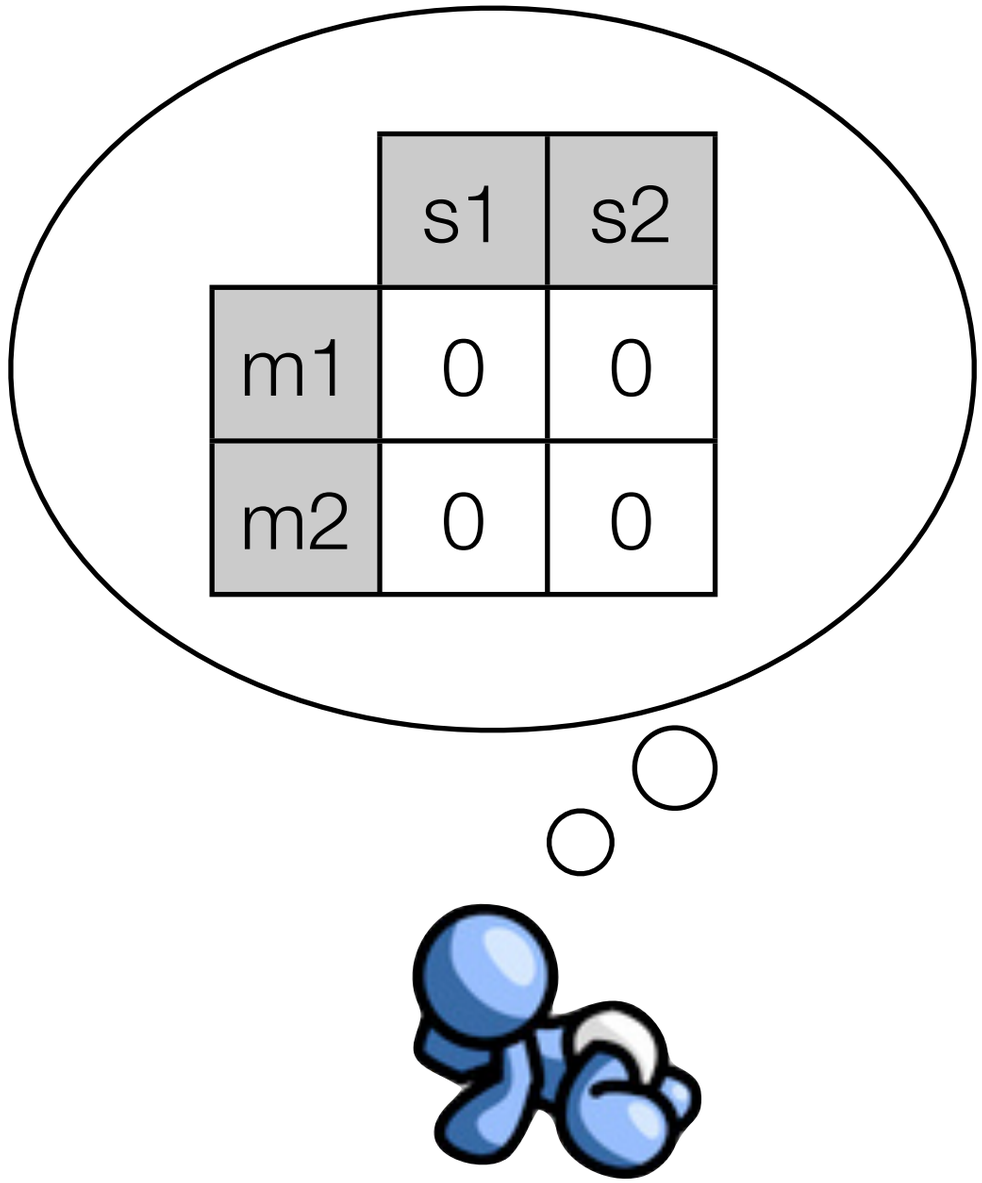
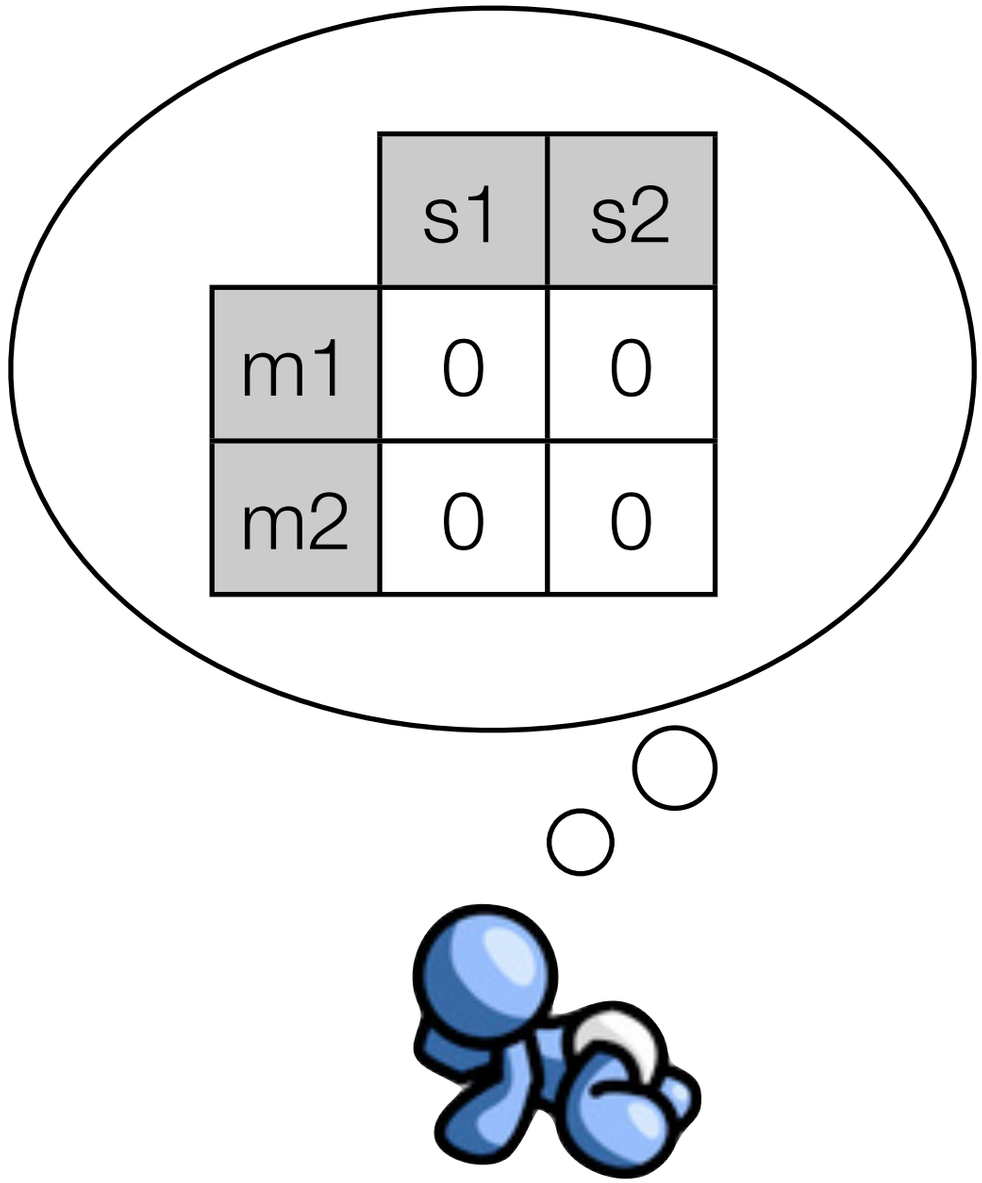


Example

m1



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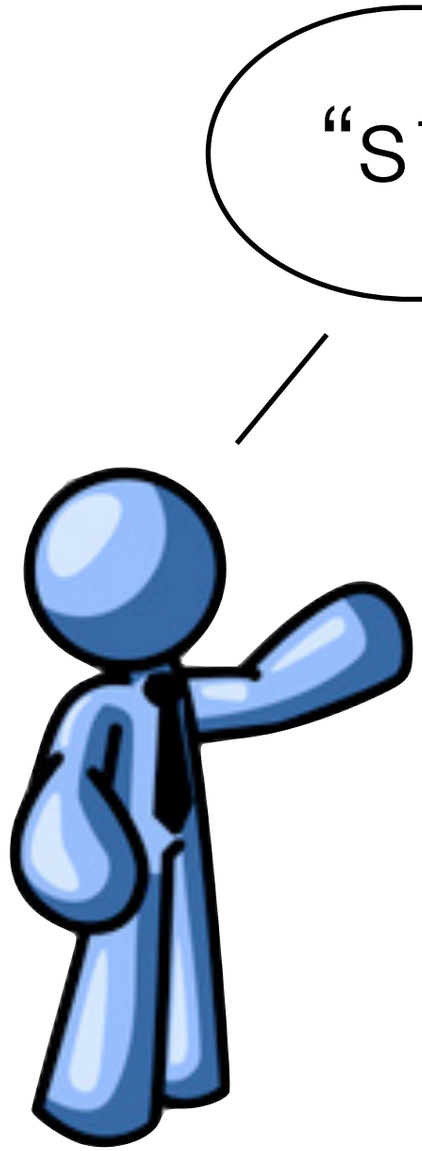

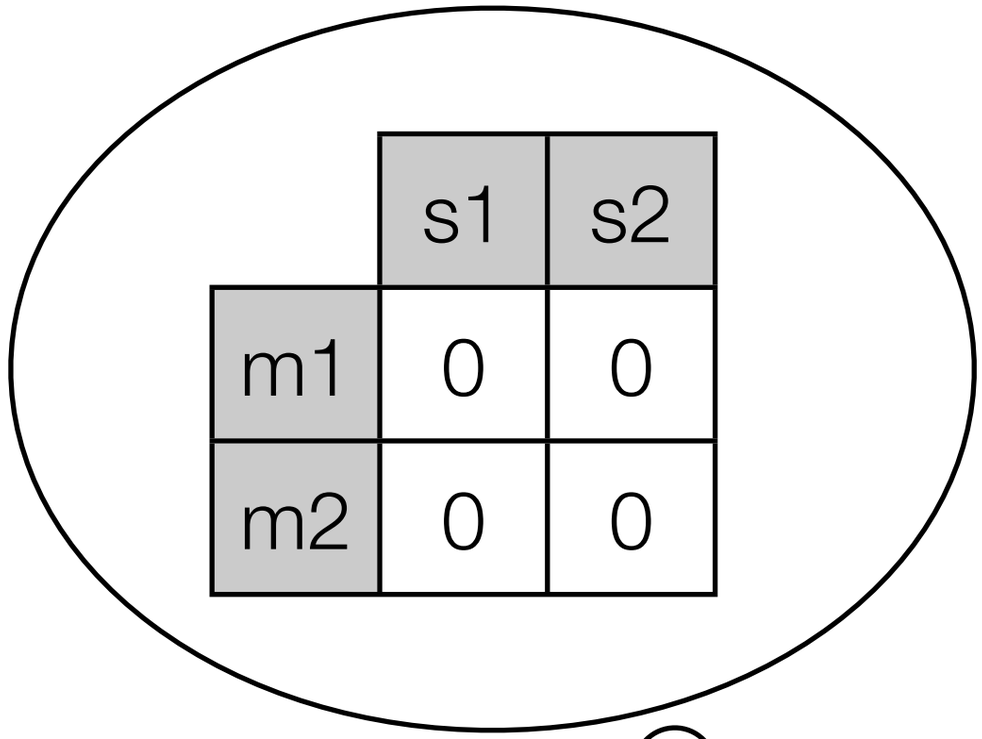

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m2	0	0

m1

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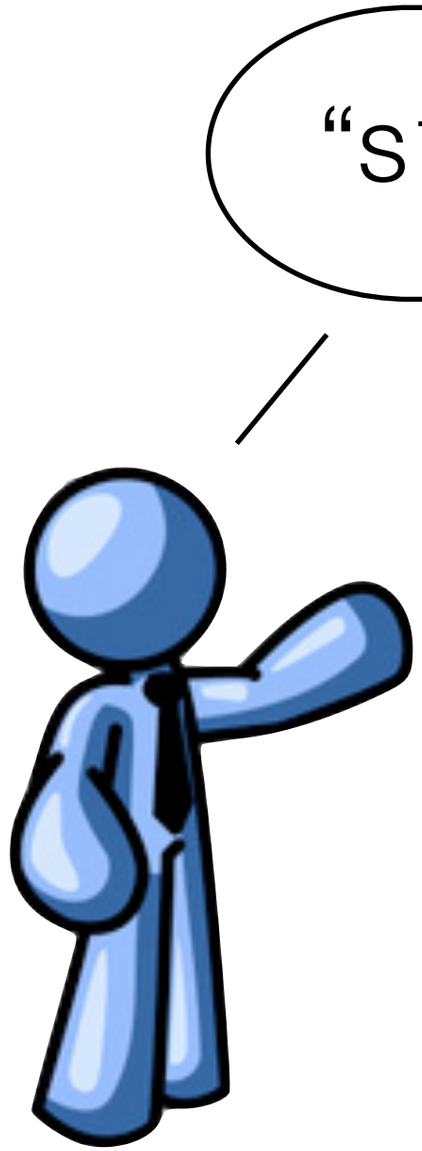

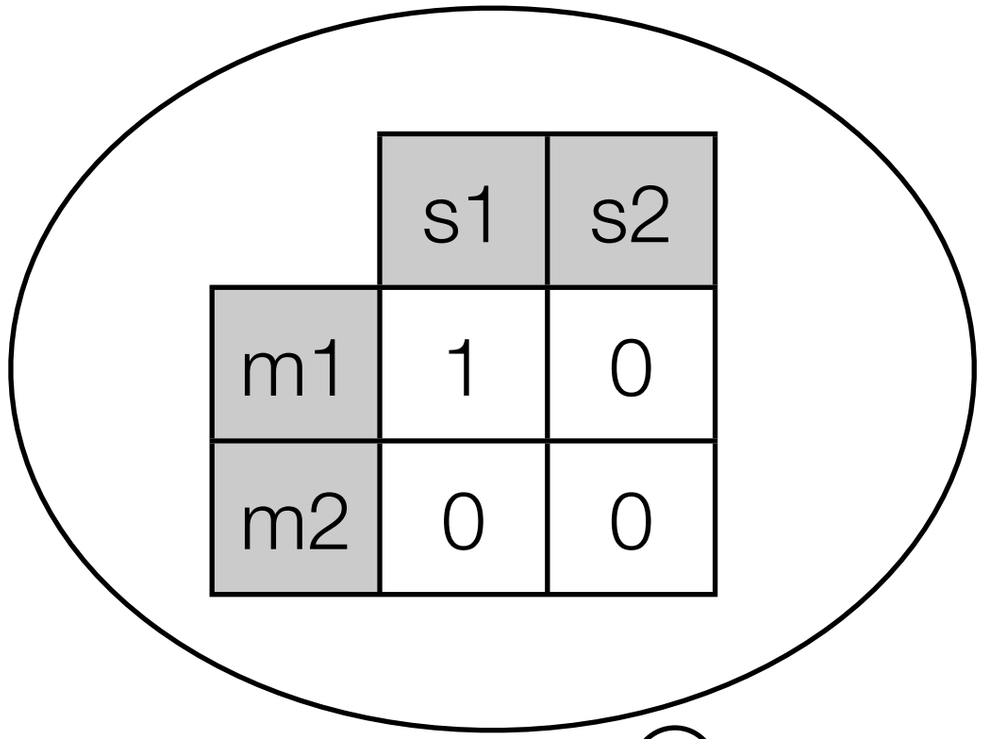

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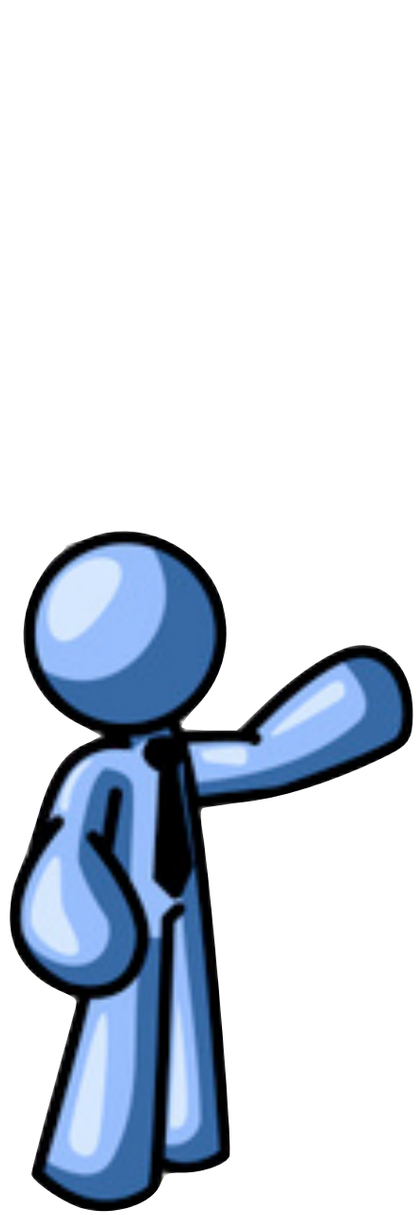
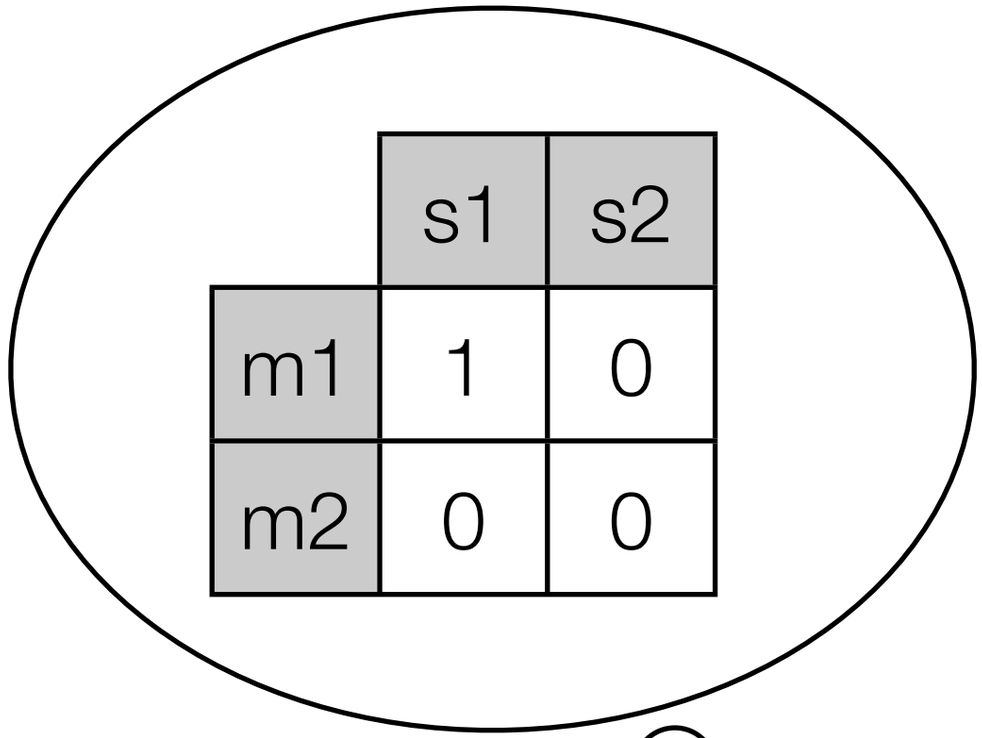


m2



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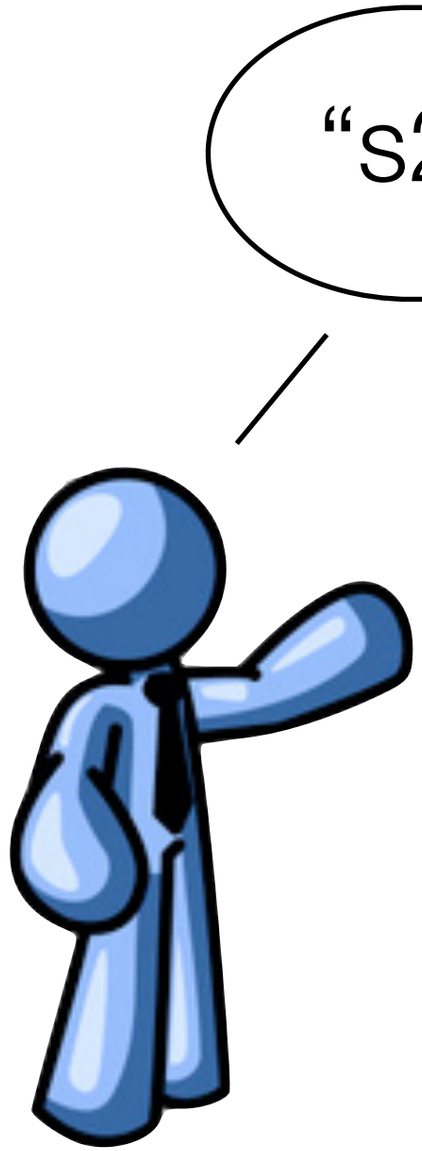

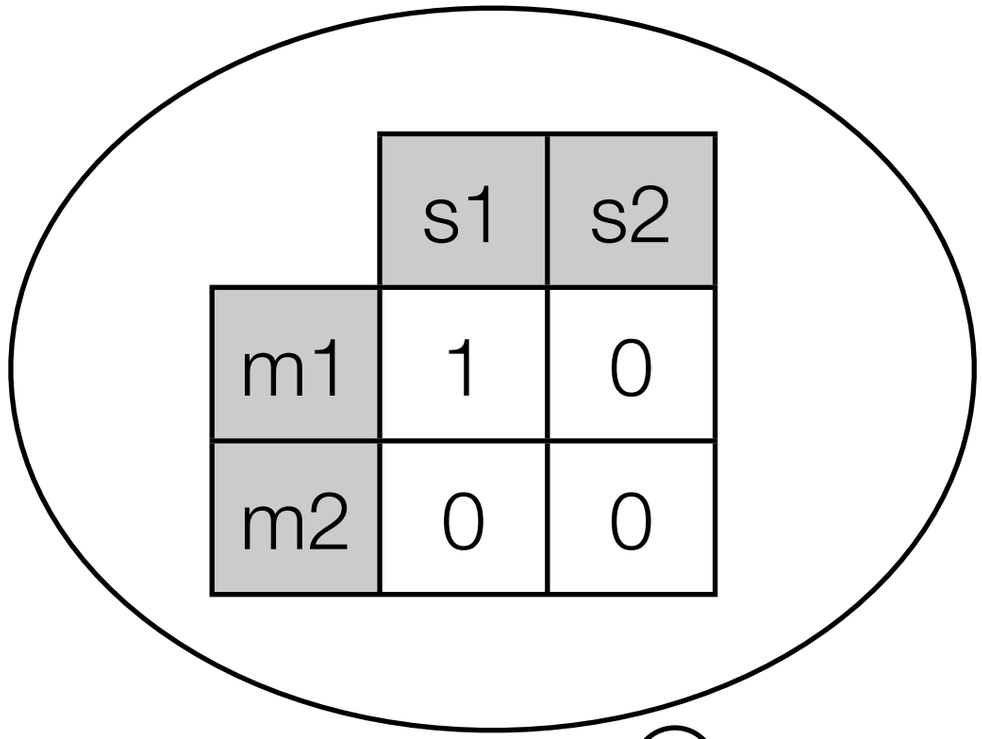

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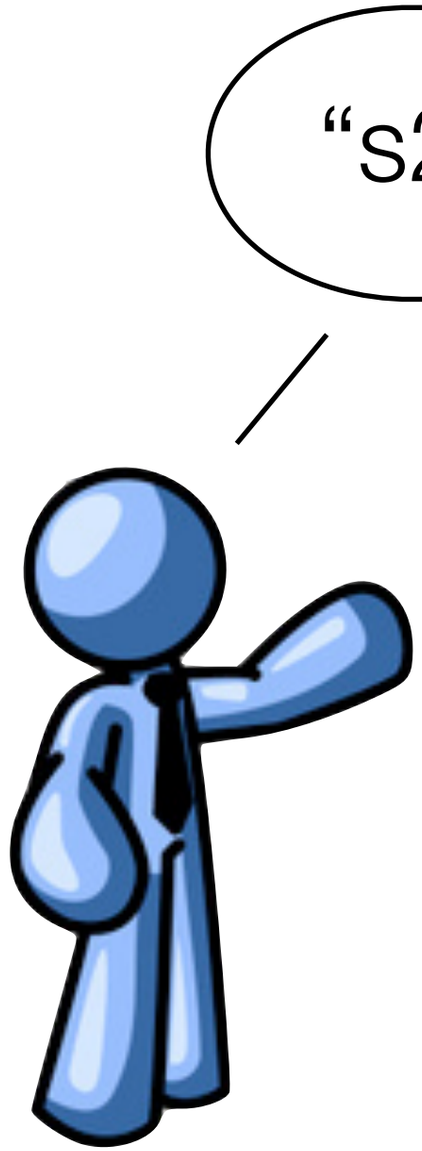

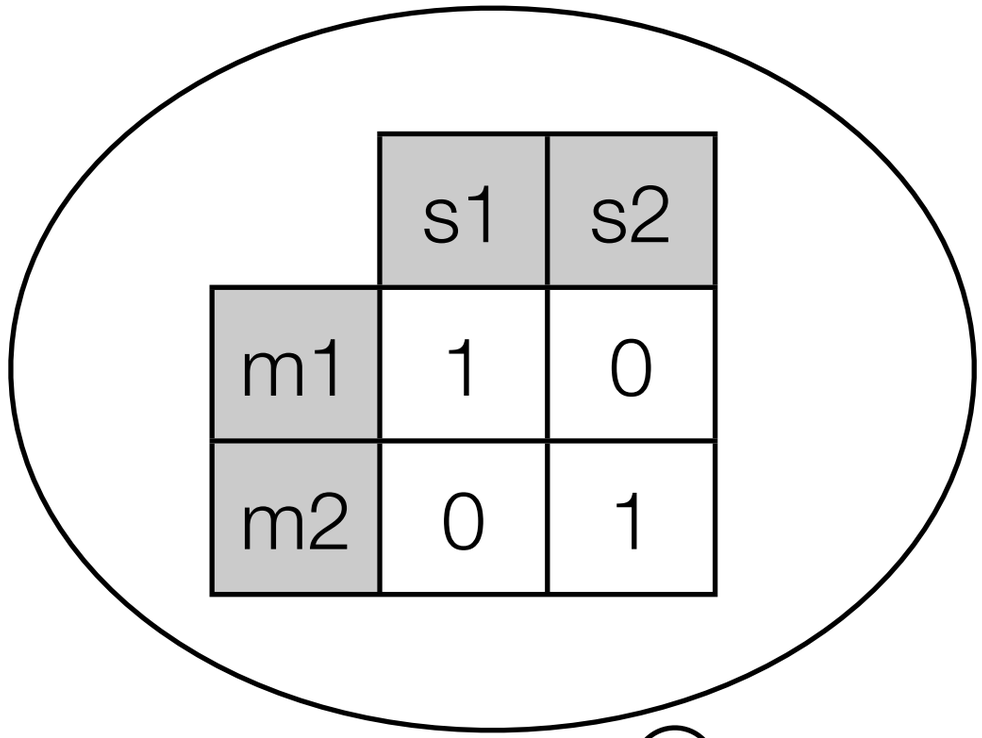

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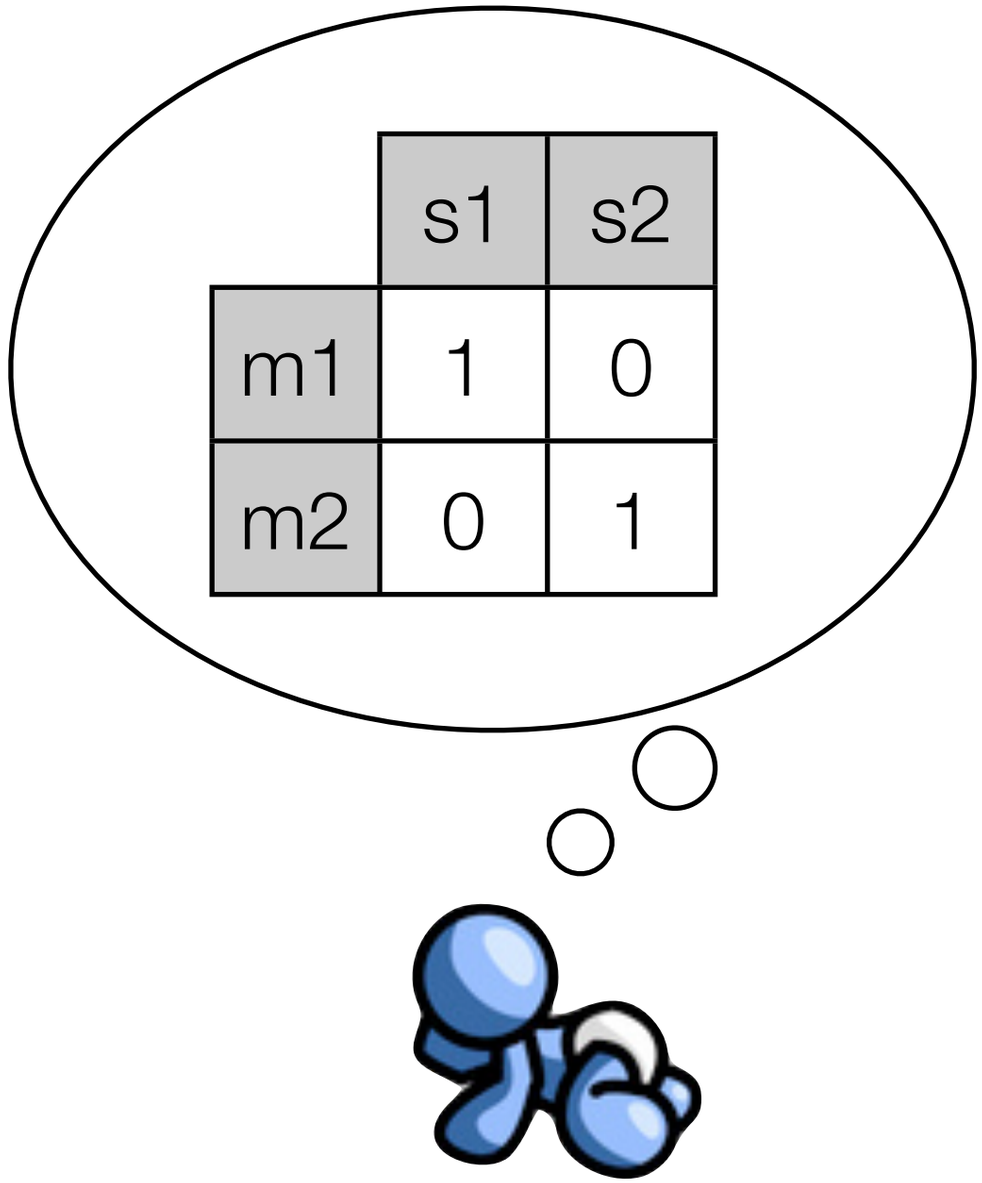

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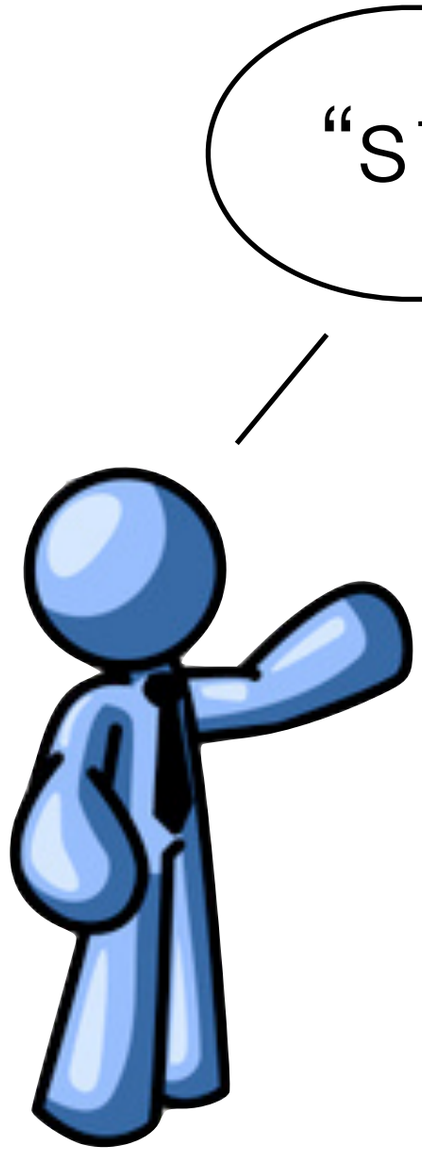

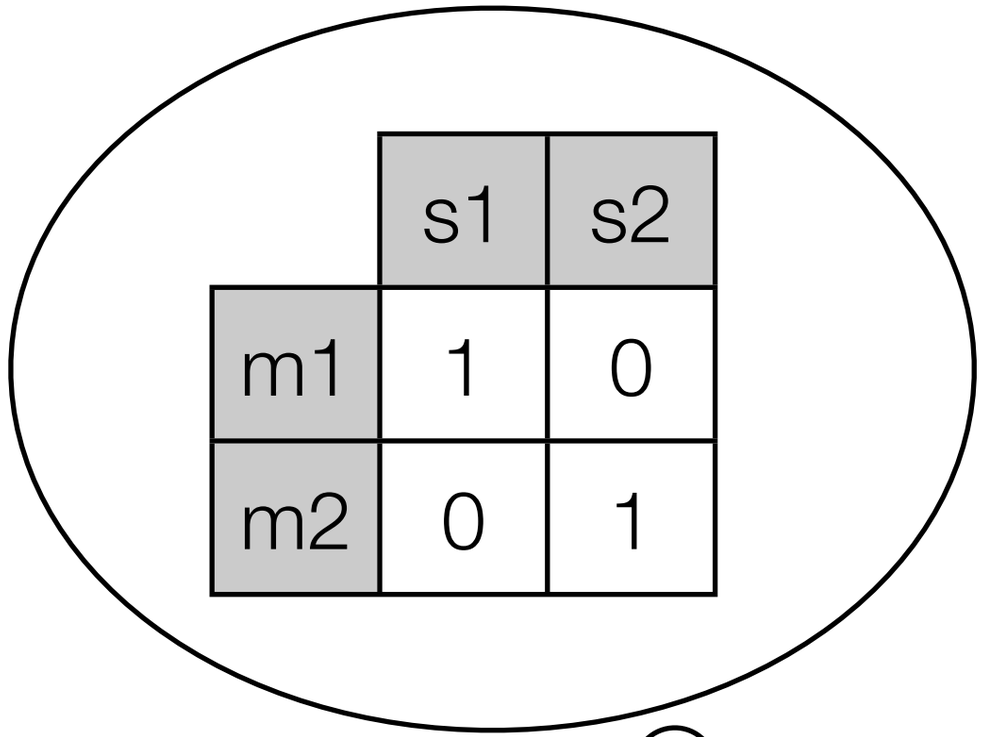

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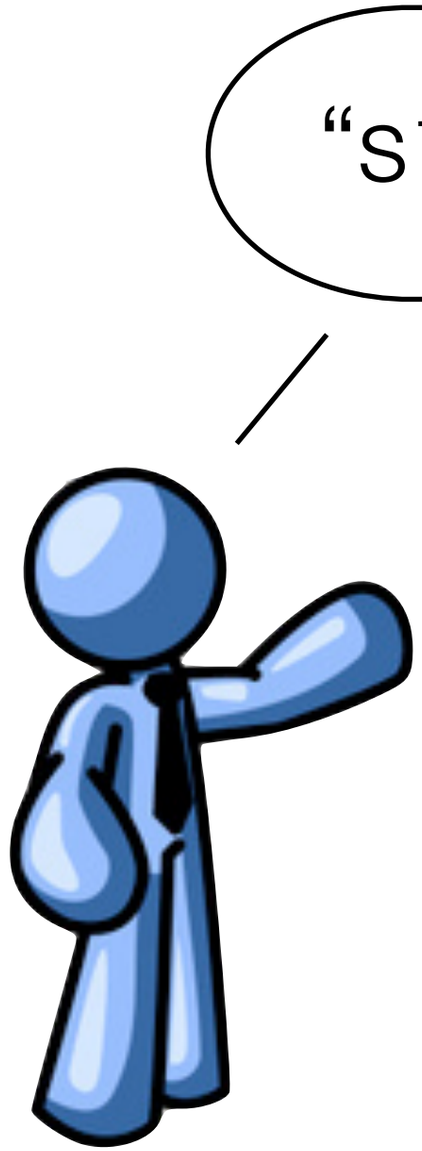

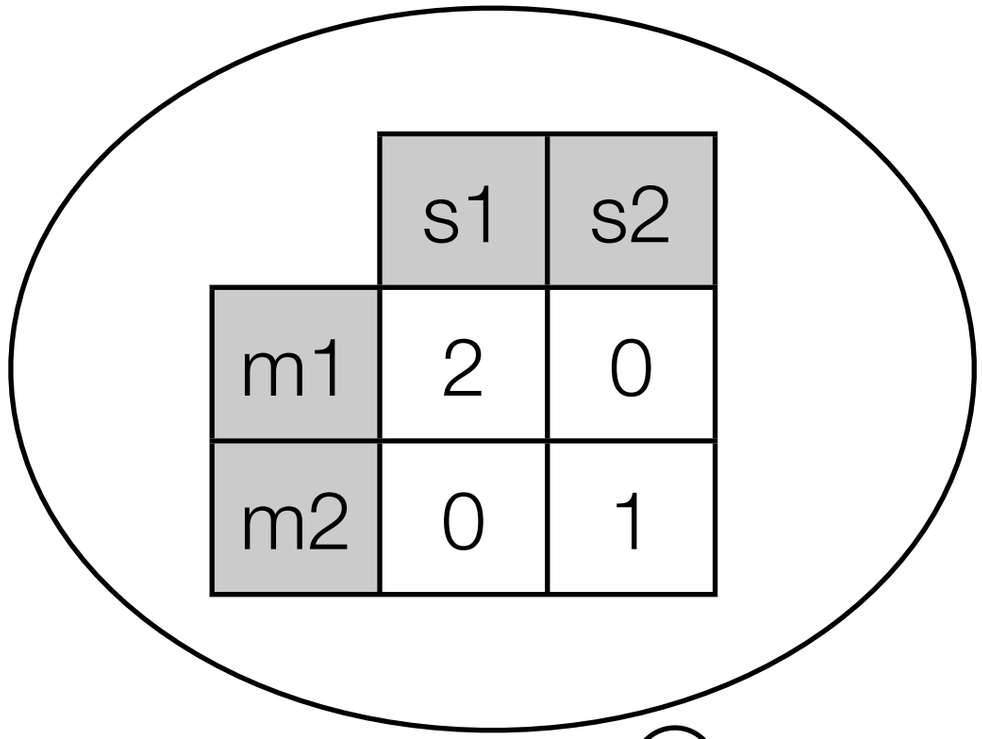

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    - Plus a little bit of other stuff to go to a single-matrix model of production/reception
- Key questions: is this model of learning sufficient? What can an agent with this learning algorithm actually acquire? Does it give another route to explaining where optimal signalling comes from?