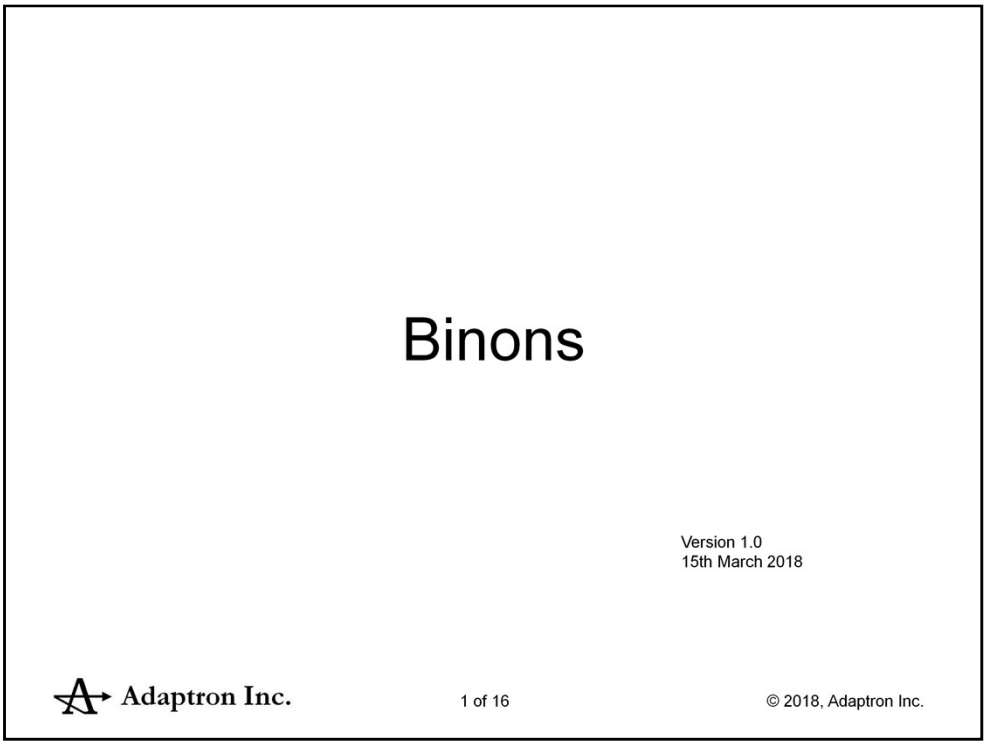


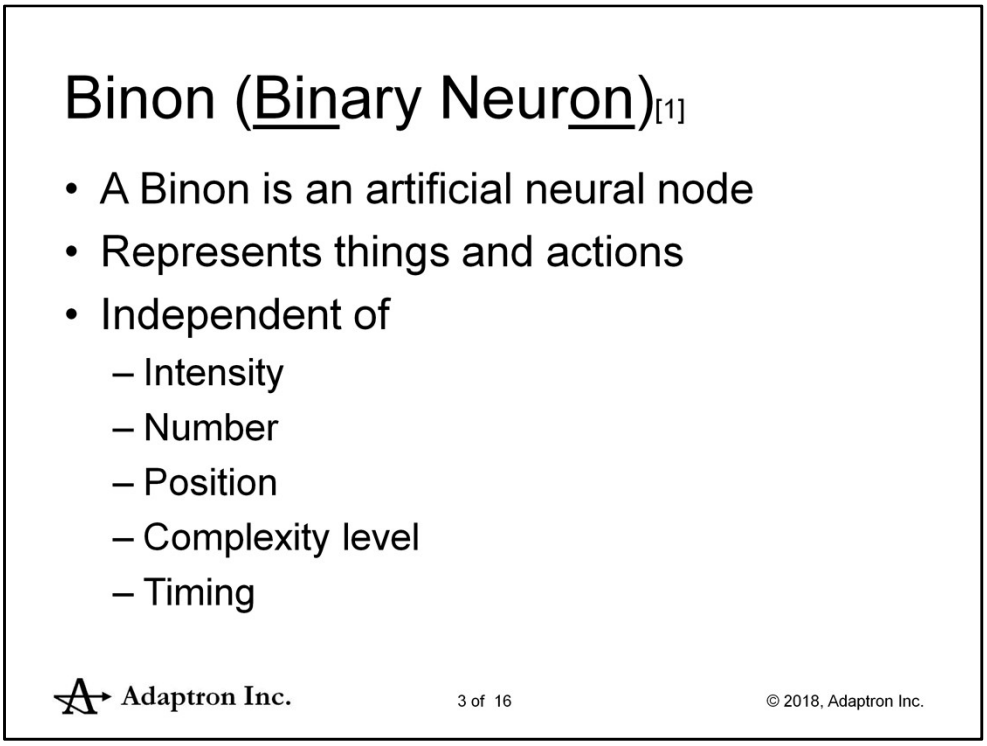
Binons represent things that are learnt and can be performed.
That means they are not only used to represent spatial and temporal patterns for object recognition, but also for performing actions.

Contents

- Binon's structure
- Spatial & Temporal Binons
- Calculating ratio values
  - Using logarithms based on JND*
- Magnitude versus symbolic values
- Multiplicity

* JND: Just Noticeable Difference

This presentation describes the structure of binons and the values they contain.
How binons are structured into a network is explained in the next presentation – Hierarchies.
How the network grows is explained in the Learning presentation.

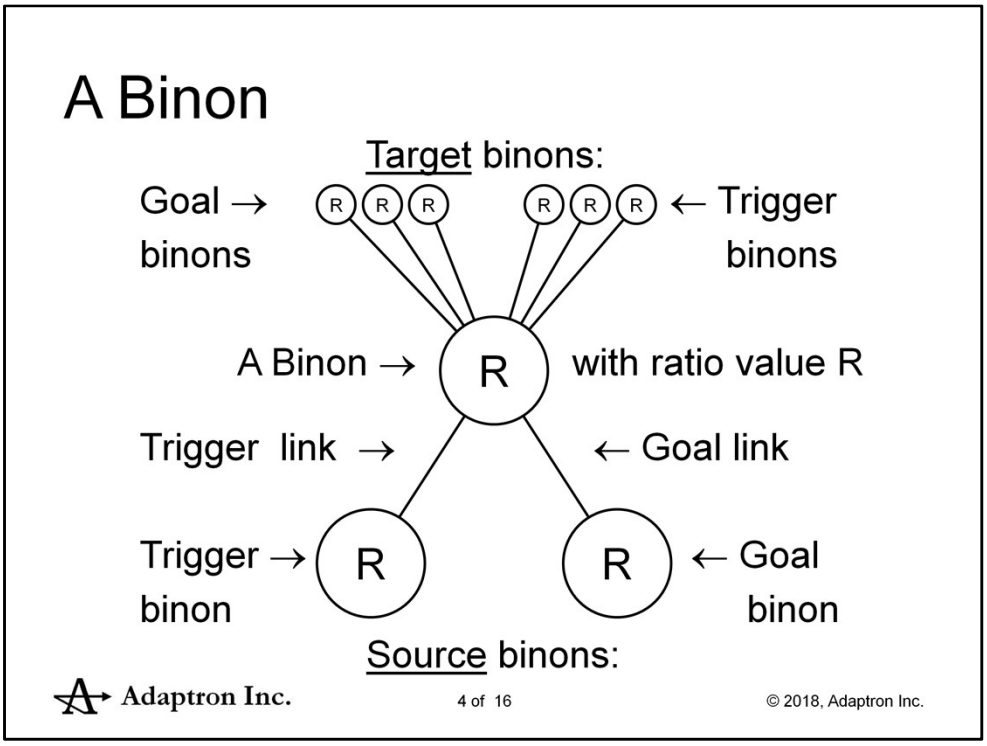


We recognize things independently of position, size etc. and therefore binons that represent things must also be independent of these properties.

If we take the software engineering approach to developing Adaptron, the requirements are What you want the software to know and do while the design describes How it is structured and how it will work.

Our Habits are at the requirements / What level.

And Binons are the design / How level.



Source binons are closer to sensors and thus more general.

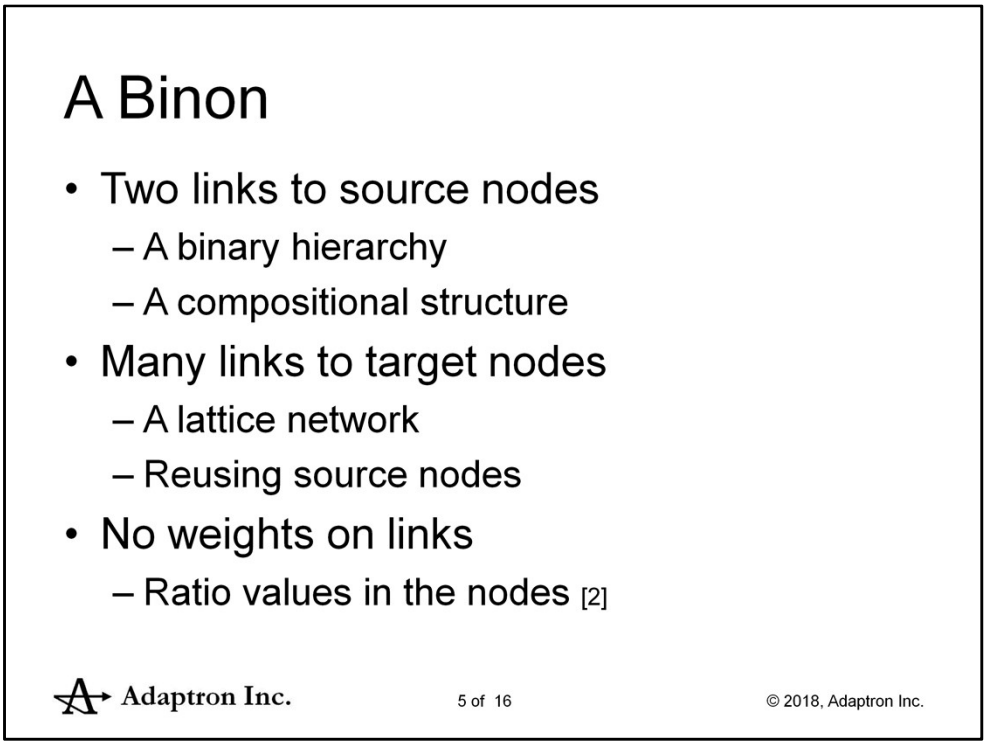
Source binons are combined to form a target binon. This is a compositional structure, binons are added together.

Using two source binons results in a binary hierarchy.

But multiple target binons produces a lattice network.

Trigger source binons are on the left and Goal source binons are on the right.

Trigger and goal make the binon sound like a temporal thing, however it is spatial if the two source binons occur simultaneously.

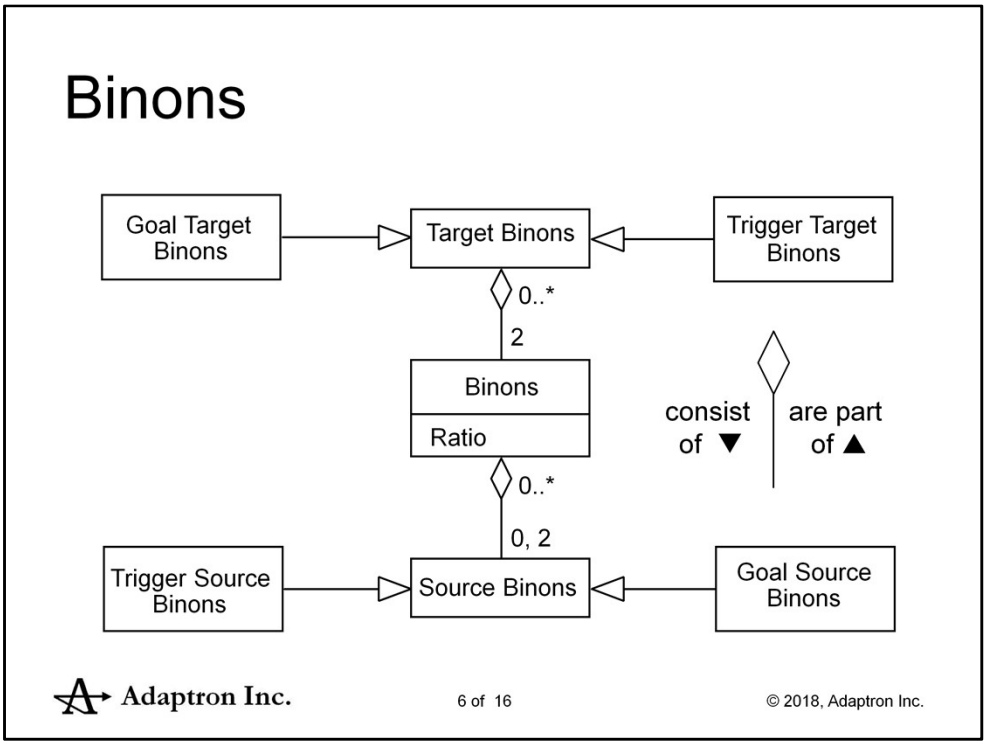


[]These are the words to go with the previous slide.]

A binon is composed of two source binon – results in a compositional binary tree structure.

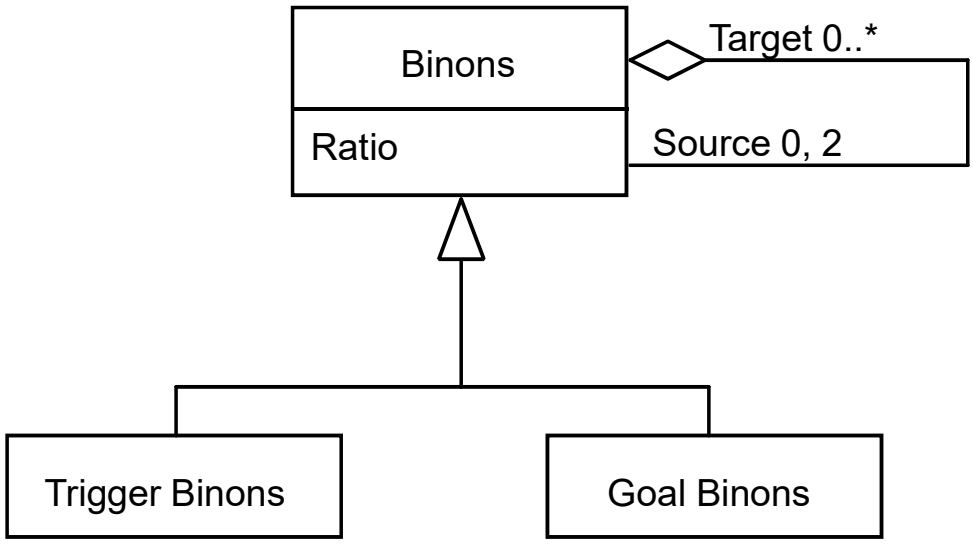
There are no weights on the links or in ANN terms the activation function is a step function, the weight is 1 if the link exists and zero if there is no link.

The weights are in the nodes and they represent ratios. Like McCulloch-Pitts neurons [2].



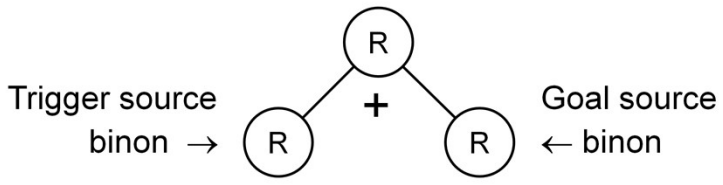
A binon at level 1 consists of no source binons. The ratio value in a level 1 symbolic binon is the symbol.

A more accurate description is that Binons play the roles of Source and Target Binons. It would look better with a recursive aggregation relationship on Binons and the role names of Target and Source. Then a generalization to Trigger and Goal Binons.



Spatial Recognition

- Source binons recognized simultaneously
- Shown using the plus sign (+)



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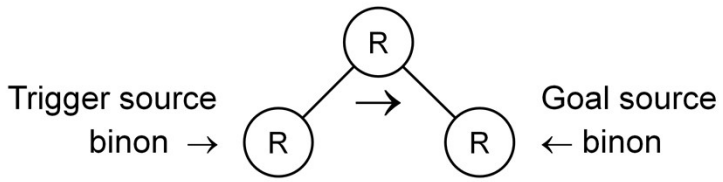
The plus sign indicates the parallel or simultaneous recognition of the source binons.

Temporal Recognition

- Trigger source binon activates the binon
- Goal source binon fires the binon
- Shown using the arrow sign ($\rightarrow$)



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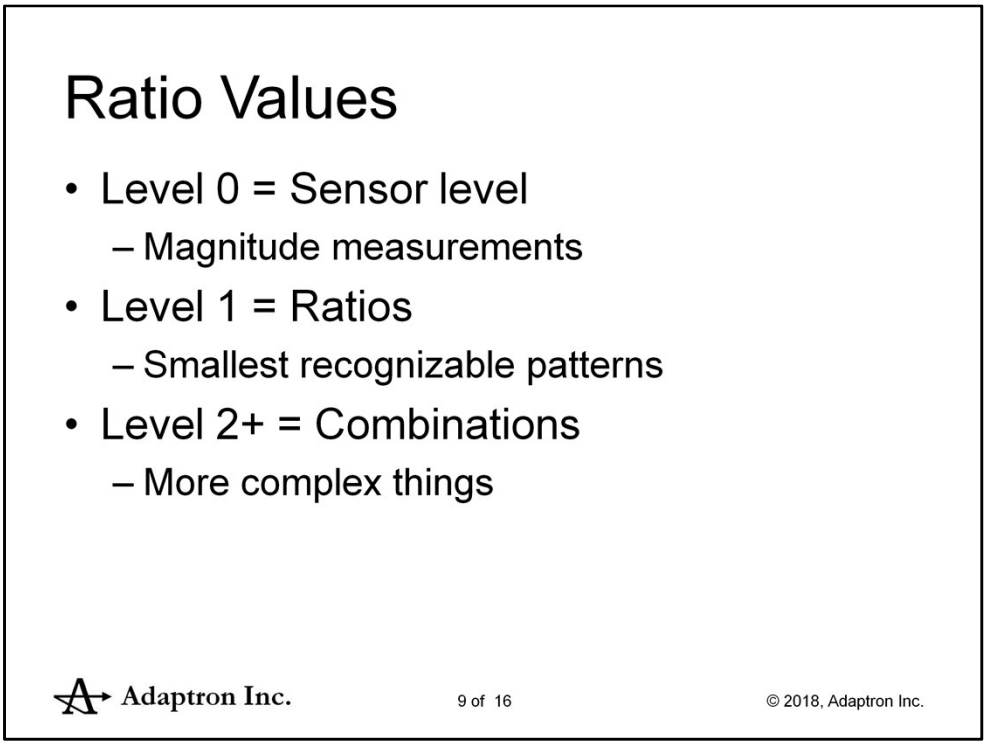
The plus sign and arrow will only be used on diagrams where the principle applies to that type of recognition.

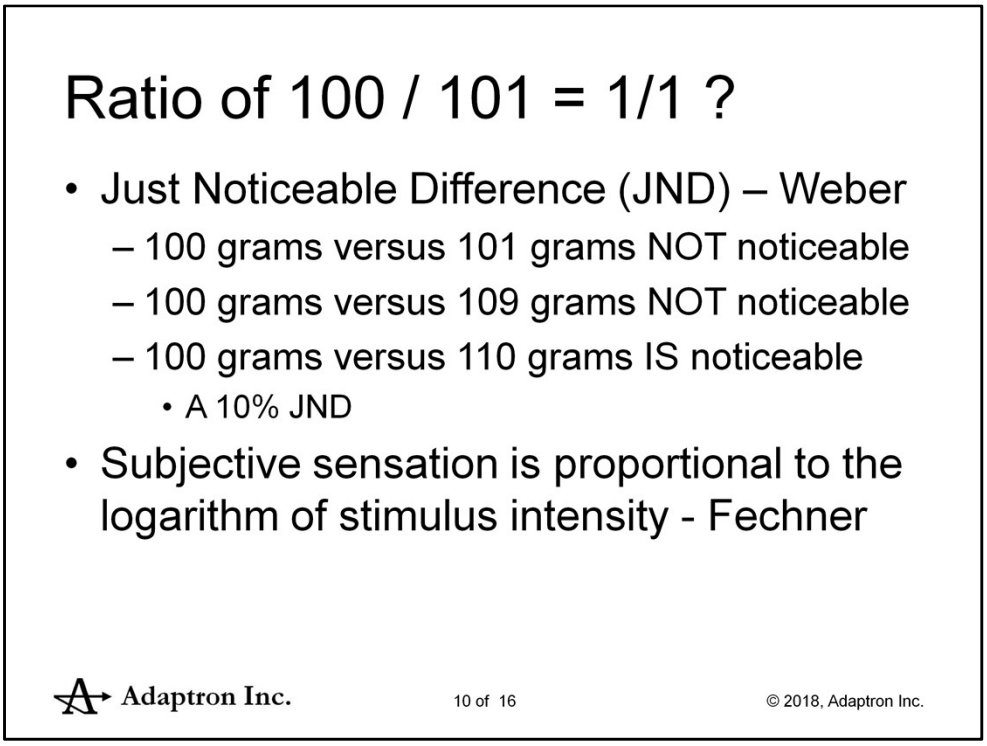
If there is no symbol then the diagram applies to both spatial and temporal recognition.



Binons come into existence at level 1, where something can be represented and recognized.

The ratio in the binon gives the binon a value.

By combining the value and the links to the two source binons it uniquely identifies something.



Psychophysical principles from Weber and Fechner.

JND is the resolution that sensors can detect. It changes based on the log of the intensity if the intensity is a magnitude scale.

Be careful about what units are being used to measure the intensity. For sound levels, decibels are already logarithmic readings.

But the unit of sound pressure is the Pascal which is not a logarithmic scale.

Candela are the units of luminous intensity and are not logarithmic.

JND example, humans require a JND of 4.8% in loudness to detect a change; a 7.9% JND in brightness is necessary.

Read more: Just Noticeable Difference - Change, Stimuli, Detect, and Weight - JRank Articles

At: http://psychology.jrank.org/pages/353/Just-Noticeable-Difference.html#ixzz4fHv7U5An

Logarithms

- Log(A/B) = Log(A) – Log(B)
- Use the integer value of the difference as binon ratio values
- Just noticeable when >= 1 or <= -1
- For a 10% JND use a log base of 1.1
  - Use log base 1.2 for a 20% JND
  - Use log base 1.3 for a 30% JND

A nice feature about logarithms of ratios is that the calculation is replaced by subtraction.

Another nice feature is that if the base used in the logarithm is 1 plus a percentage (10% = 0.1) then

when the logarithmic values are truncated or rounded to integers a difference of one is equivalent to the JND % between two ratios.

Ratio Example

- $\text{Log}_{1.2}(100 / 101) = \text{Log}_{1.2}(100) - \text{Log}_{1.2}(101)$
  $= 25.259 - 25.313 = \text{Int}[-0.054] = 0$
  - It's NOT noticeable

- $\text{Log}_{1.2}(100 / 120) = \text{Log}_{1.2}(100) - \text{Log}_{1.2}(120)$
  $= 25.259 - 26.259 = \text{Int}[-1.000] = -1$
  - It's just noticeable

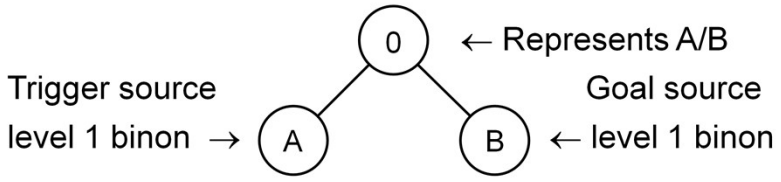
As an example using a 20% JND = a log base of 1.2

So all the ratios of 100/101 up to 100/119 give the same ratio result of zero.

The ratio 1/1, 10/10, 10/11, 50/50, 50/51, 50/52, and 50/53 up to 50/59 will also result in zero

Symbolic values

- Level 1 source binons
  - Smallest possible patterns



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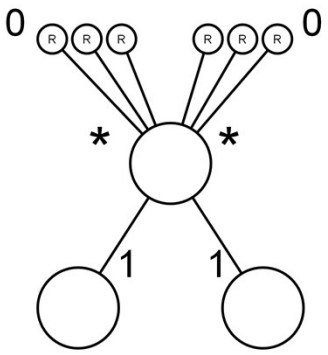
Symbolic values are self identifying and therefore are represented as level 1 binons. Higher levels represent combinations of symbols, spatial or temporal.

Multiplicity

- Number of trigger and goal target binons
- Zero, one or many(*)



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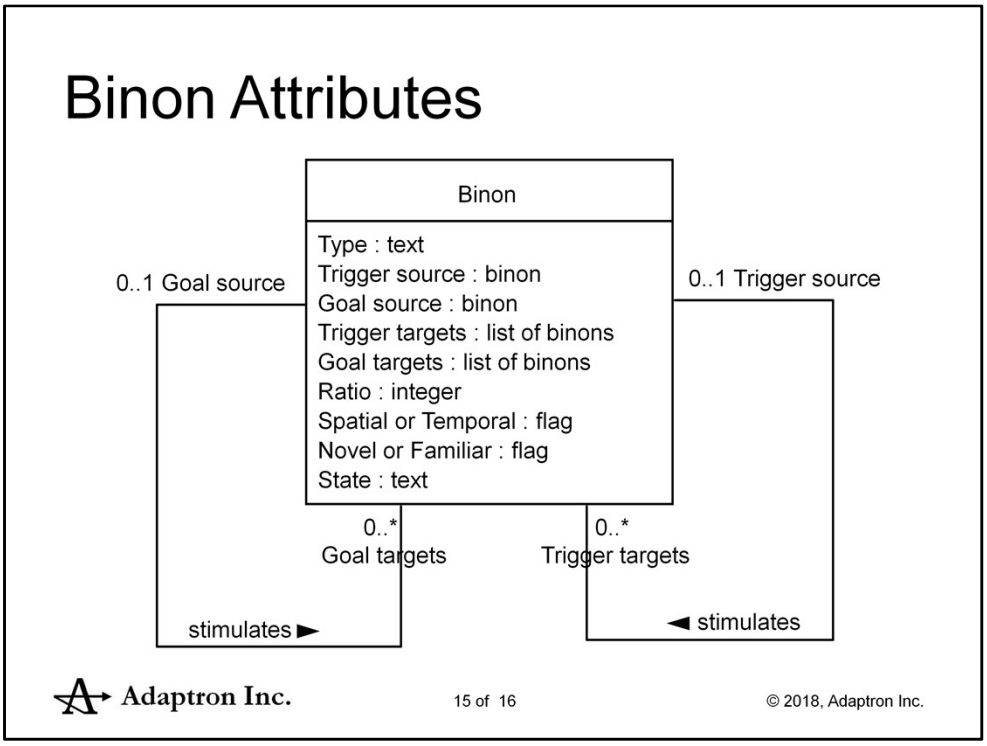
A multiplicity of zero indicates it's a brand new binon. It's not part of any more complex binon.

A multiplicity of one indicates you can predict the associated binon in that direction.

In English words QU is a good example. The Q predicts the U.

A multiplicity of more than one indicates the binon is being reuses many times and there are multiple expectations.



The sizes of the trigger and goal target lists are the multiplicities.

State is either Idle, Triggering or Expecting. It is further described in the presentation on Temporal recognition.

References

[1] Martensen, B. N. (2013). Perceptra: A New Approach to Pattern Classification Using a Growing Network of Binary Neurons (Binons). In R. West & T. Stewart (eds.), Proceedings of the 12th International Conference on Cognitive Modeling, Ottawa: Carleton University.

[2] Warren S. McCulloch and Walter Pitts, (1990). A Logical Calculus of the Ideas Imanent in Nervous Activity, Bulletin of Mathematical Biology Vol. 52, No. l/2. pp. 99-115. 1990. Pergamon Press plc. Society for Mathematical Biology