Learning Examples

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Adaptron Inc.

Learning is a process that results in the acquisition and improvement of perception, action and thinking habits.

Contents

- Binon types
- Representing independent properties
- Magnitude and symbolic examples

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This presentation describes 4 types of recognition binons.
It then explains how to represent independent properties.
And then provides some magnitude and symbolic examples of binons being used for recognition..

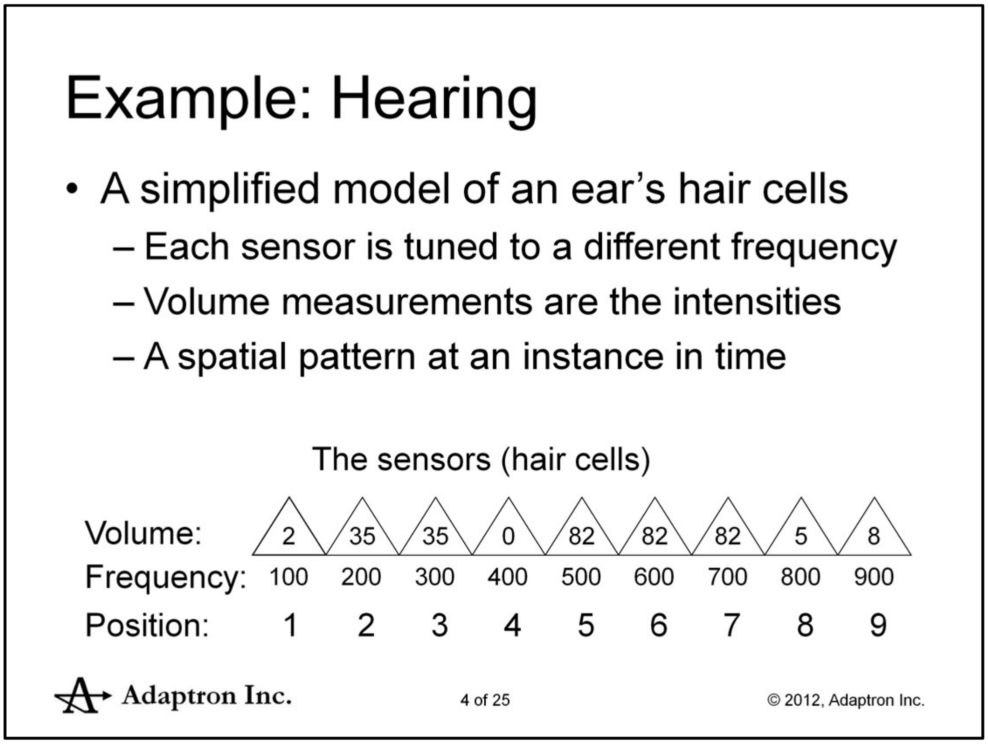
Binon Types

- Independent property binon types
  - Quantity ratio
  - Shape
  - Separation
- Class binons
  - Represent things
  - Aggregation / composition of
    - Class binons
    - Property binons

For each type of sensor there are four binon types, the three property binons (Quantity ratio, Shape and Separation) and the class binon.

The class binon is the combination of the three properties and a class binon.

As an example consider hair cells in the ear.



1/ Relative Quantity can be determined by counting repeating patterns. E.g. 35, 35. This is done at every level of complexity by counting repeating binons.

For an overlapping binon structure the quantity ratio is always 1/1. However when a pattern repeats adjacently the counts are greater than one and

the quantity ratio becomes an important property in identifying the thing.

2/ Shape is relative widths. And width is a magnitude value so ratios can be calculated. Width is the difference between two positions.

Position ratios are not possible because positions are an interval scale and can not be used to produce ratios. Position is not zero based.

However position must be known for paying attention. Position information is kept in the configuration tree and explained in the Experiences presentation.

3/ Separation is the third property. It is the distance from the first to the second pattern relative to the width of the first pattern.

Distances are based on positions and positions are the edges where there is a Just Noticeable Difference (JND) in intensity.

What about recognizing things based on relative intensity? Relative intensity is contrast.

Our eyes and ears use the differences in intensity to determine edge positions using a center surround process.

In the following examples I use the edge as the class binon at the first binon level.

I am still not sure if relative intensity or relative contrast or contrast per width (spectral frequency) is used in object identification.

This is currently one of my ongoing areas of research.

Intensity has a gradient, a change in intensity per distance or spectral frequency. When an image is out of focus the edge has a low spectral frequency.

Sharp edges have a high spectral frequency. So the question is, do we or can we use this information?

The simple fact that we can recognize how blurry an image is, would seem to imply the answer is yes.

Independent Properties

- Representation Process
  1. Order the properties
  2. Represent all possible pairs
  3. Combine overlapping source binons at all higher levels

To obtain all the possible combinations of independent properties:

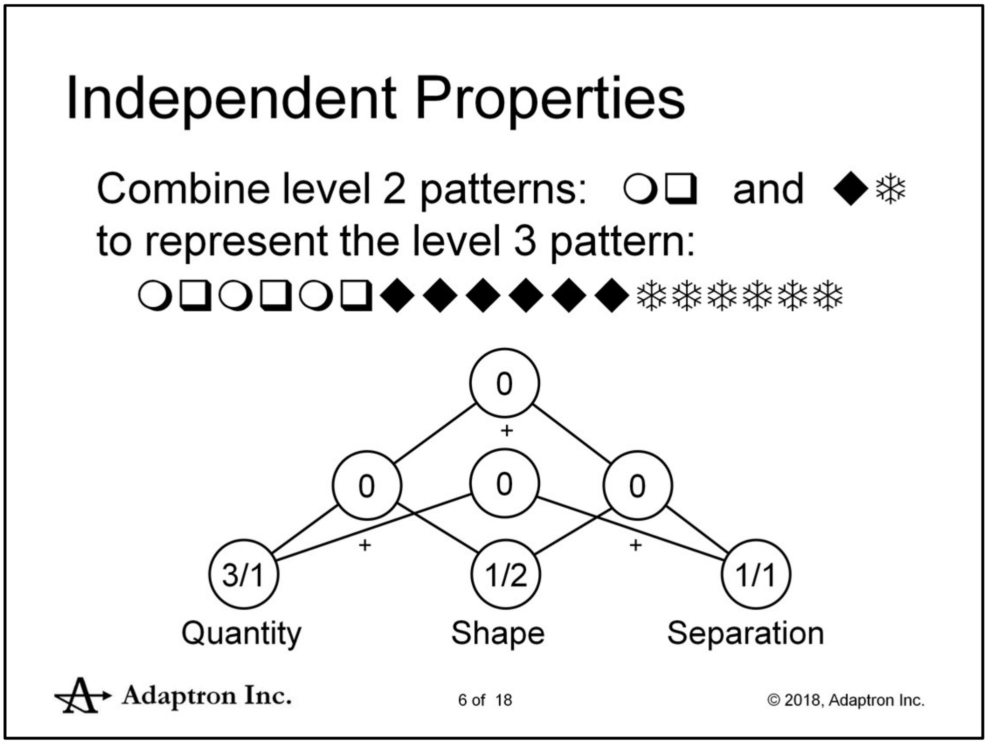
1/ order the properties.

2/ create all possible pairs of the level 1 binons maintaining this left to right order as in the first row or symbolic binons.

3/ for each higher level of complexity combine the lower level ratios that have an overlapping subpart.

If properties are independent then the number of possible combinations is (2^N)-1 – N where N is the number of properties.

N=3 gives 4 combinations.



The properties are independent.

1/ Order them – Quantity, Shape, Separation.

2/ Create all possible pairs, Quantity / Shape, Quantity / Separation, and Shape / Separation.

3/ Combine the pairs that overlap. Quantity / Shape / Separation represents the pattern.

All possible combinations must be representable but whether they are represented or not will depend on how often they occur.

One Dimension Spatial Example

- A Black / White pattern at complexity level 1

Sensors: 

Experience values			Property ratios
Intensity:	B	W	B/W – Edge
Quantity:	2	1	2/1
Size:	1	1	
Width QxS:	2	1	2/1 – Shape
Distance:		2	2/2 – Separation

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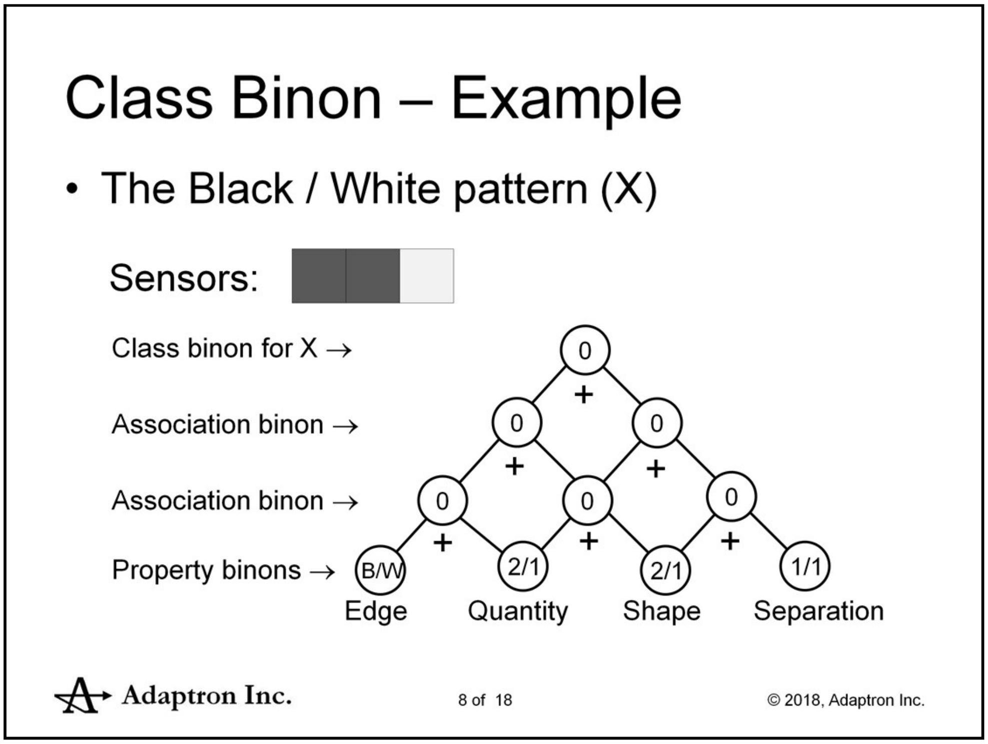
Two black sensors and one white sensor produce a black / white edge.
The sensors are adjacent and dependent parts. The properties are independent of each other.
Quantity is the number of sensors which contain the same intensity reading.
Each sensor is of size one.
The separation is the distance from the start of the black sensors to the start of the white sensors (2) divided by
the width of the black sensors (2).



Each property is independent of the other so the binary tree provides a unique representation of the black / white pattern.
It's a compositional tree / hierarchy. Also called aggregation in software development.
It has been named X for reference to the next slide.
The class binon only represents what the thing is.
It gets combined with the sense information (Where) that identifies the source such as vision, hearing etc. when the activation tree combines the recognition-action binons with the configuration tree information.

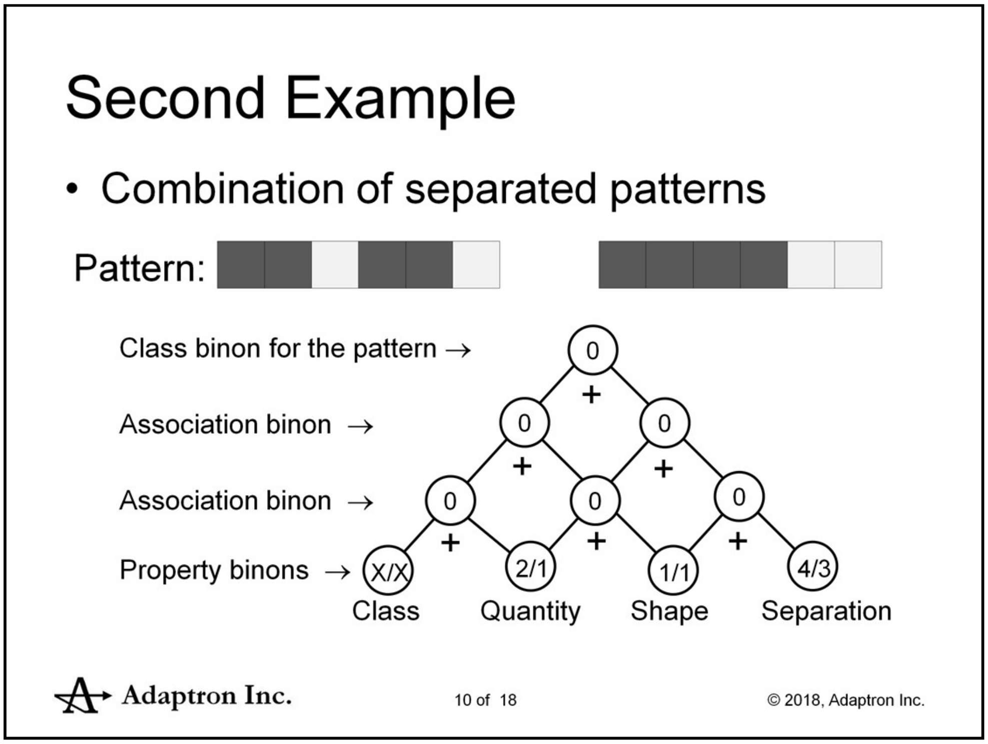
Second Example

- A pattern at complexity level 2

Pattern: 

Experience values			Property ratios
Class:	X	X	X/X
Quantity:	2	1	2/1
Size:	3	6	
Width QxS:	6	6	6/6 – Shape
Distance:		8	8/6 – Separation

The black/white pattern (X) repeats twice at size 3 and then occurs again once at size 6.
The Xs are adjacent and dependent parts. The properties are independent of each other.
The separation is the distance from the start of the repeating X to the start of the larger single X (8) divided by
the width of the repeater (6)



Each property is independent of the other so the binary tree provides a unique representation of the repeating X pattern.

Symbolic Values

- Symbolic (nominal) values produce symbolic patterns
  - E.g. letters produce words
- Represented as symbolic binons
  - Level 1 = Sensor level for symbolic values
    - Symbols identify things
  - Level 2+ = Combinations
    - More complex patterns

What happens if the values are symbolic rather than magnitude scale?

Symbolic values already represent a thing so symbolic sensors produce level 1 binons directly.

The same Quantity, Size and Separation property binons are needed.

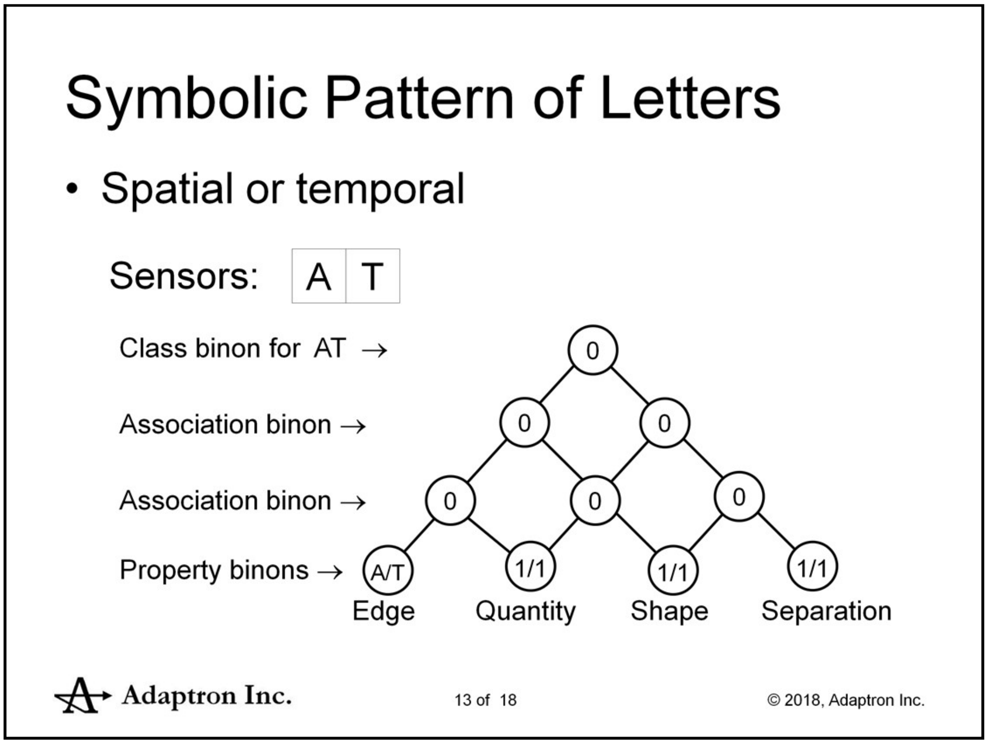
Symbolic Pattern of Letters

- Combination of adjacent letters

Sensors: | A | T |

Experience values			Property ratios
Symbols:	A	T	A/T – Class
Quantity:	1	1	1/1
Width:	1	1	1/1 – Shape
Distance:		1	1/1 – Separation

The letters are adjacent and dependent parts. The properties are independent of each other.



The same hierarchy is produced to represent the pattern spatially or temporally. For temporal binons the quantity would be relative repetitions and shape would be relative duration.

Symbolic Pattern of Letters

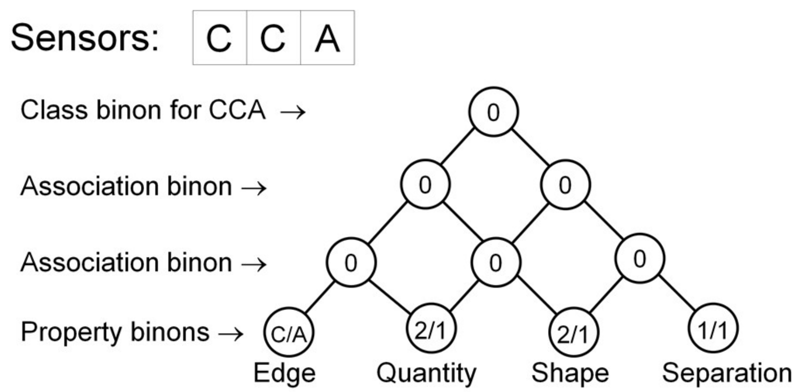
- Combination of adjacent letters

Sensors: | C | C | A |

<u>Experience values</u>			<u>Property ratios</u>
Symbols:	C	A	C/A – Class
Quantity:	2	1	2/1
Width:	2	1	2/1 – Shape
Distance:		2	2/2 – Separation

Symbolic Pattern of Letters

- Spatial or temporal



Symbolic Pattern of Letters

- Combination of overlapping letter patterns

Sensors:

C	C	A	T

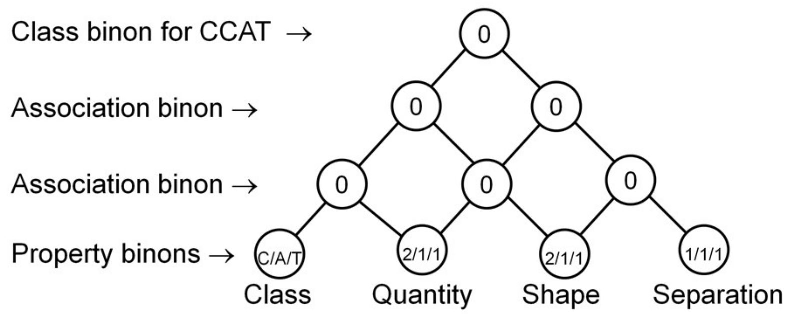
Experience values			Property ratios
Classes:	C/A	A/T	C/A/T – Class
Quantity:	2/1	1/1	2/1/1
Shape:	2/1	1/1	2/1/1
Separation:	1/1	1/1	1/1/1

CCAT is an object – a pattern of parts. The parts overlap.

Symbolic Pattern of Letters

- Spatial or temporal

Sensors: | C | C | A | T |



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.

