



# Computational approaches to Semantics

Pierluigi Cassotti, [pierluigi.cassotti@gu.se](mailto:pierluigi.cassotti@gu.se)

# Word-in-Context (WiC)

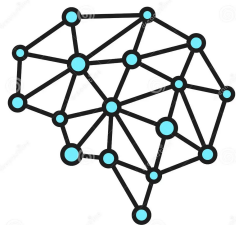
*Provide a large table; this is a horizontal **plane**, and will represent the ground plane, viz.*

*The President's **plane** landed at Goose Bay at 9:03 p.m..*

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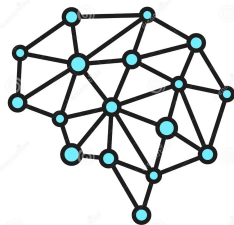
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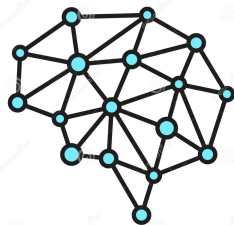
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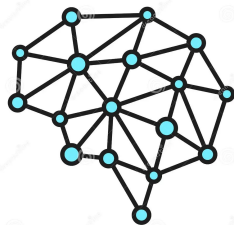


**Different  
Meaning**

# Word Sense Disambiguation (WSD)

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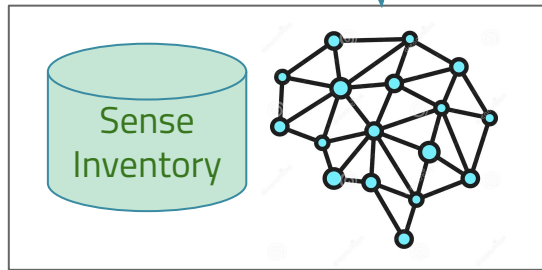
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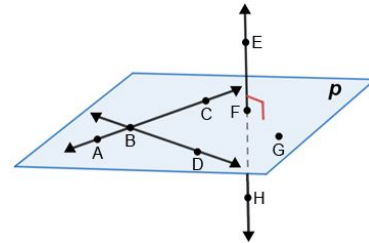
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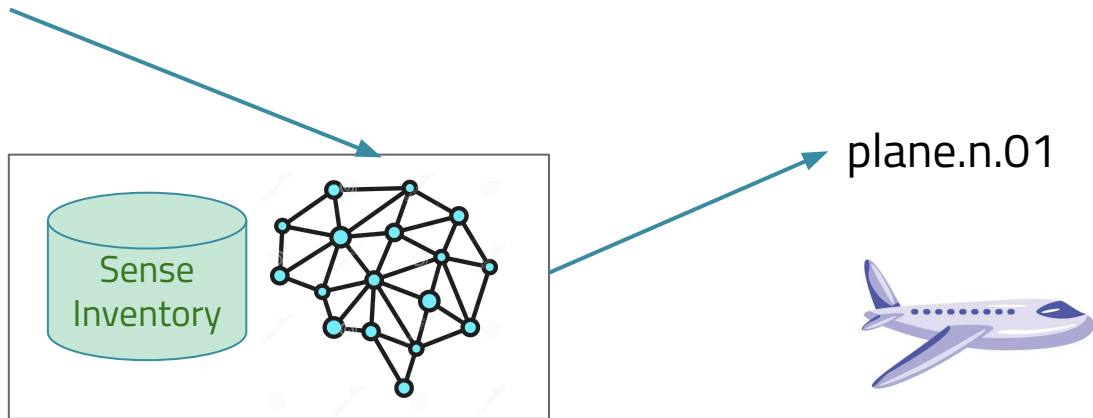
plane.n.01



# Word Sense Disambiguation (WSD)

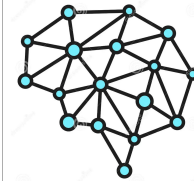
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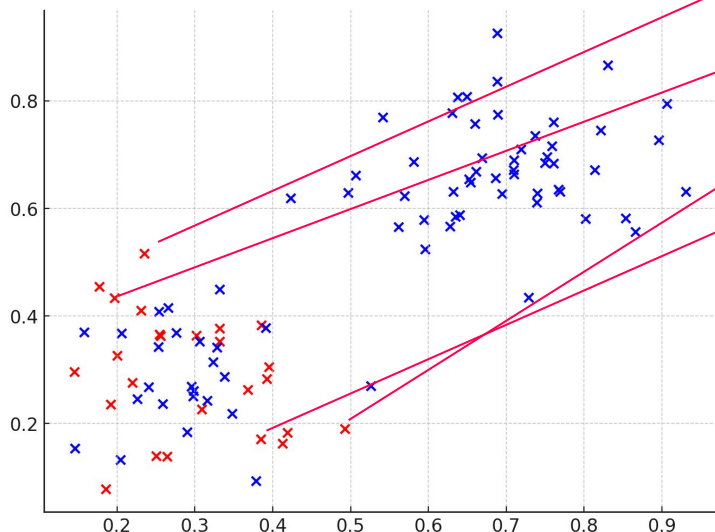




# Word Sense Induction (WSI)



Representation



If the sun's rays be parallel to any **plane**, that plane to which they are parallel, is called a plane of shade.

its angles upon a given point A, in the **plane**, on which the ichnography is to be described;

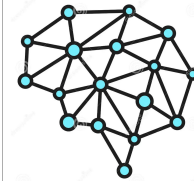
will be no difference between the shadow on the **plane**, and the side of the prism which projects that shadow;

There are other kinds of **planes** besides the above; as the plough, for sinking a groove to receive a projecting tongue;

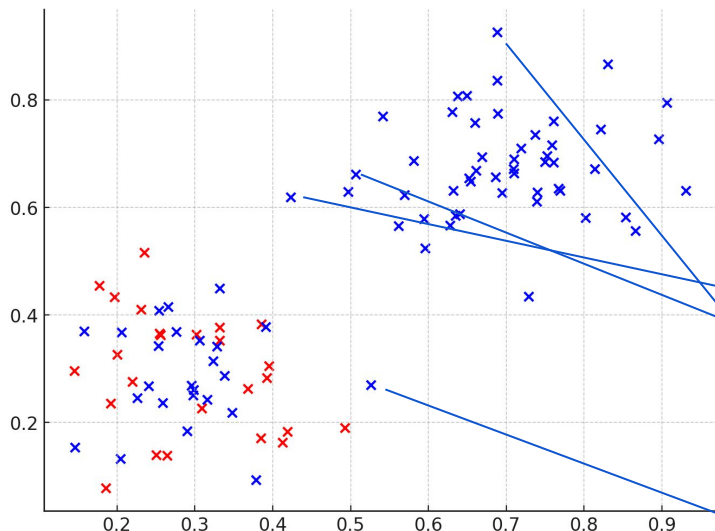
Troy turned it to the right, and the **plane** turned to the right, just  
They had been making good progress, in spite of their greenness; next day Mr. Fulton was planning to stretch the silk over the **planes**;  
In the meantime, most of the troops and 25% of the supplies flying to Saudi Arabia are traveling on wide- body **planes** leased from commercial airlines.

Reduction is only needed in patients near skeletal maturity whose fracture has more than 50-70 degrees of angulation in either the sagittal or coronal **plane** (Rab &; Grottkau, 2001).

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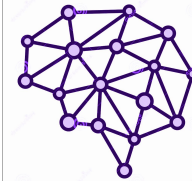
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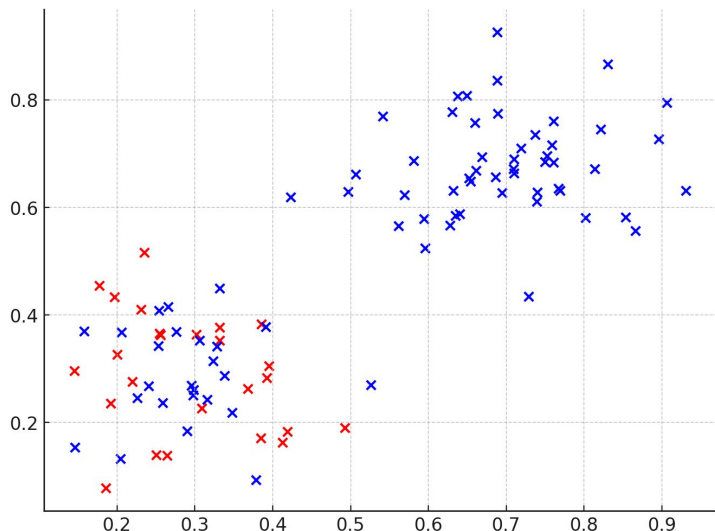
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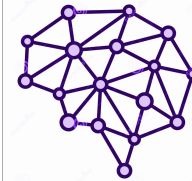
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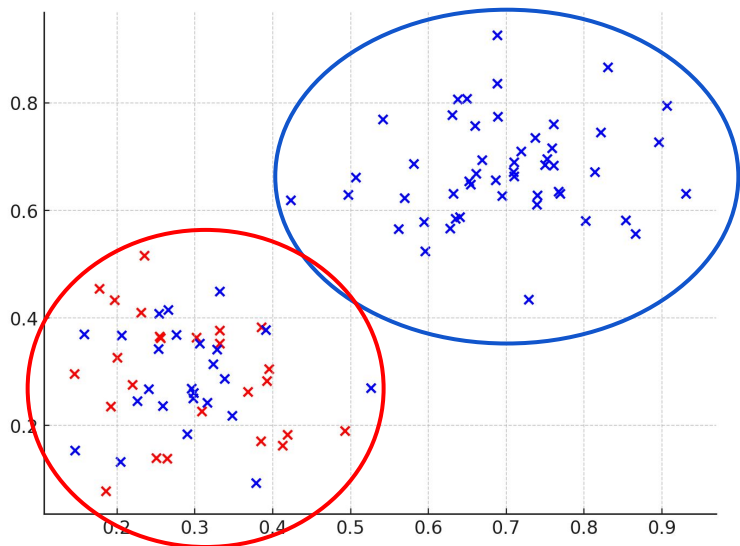
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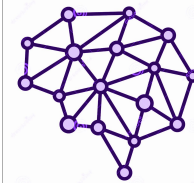
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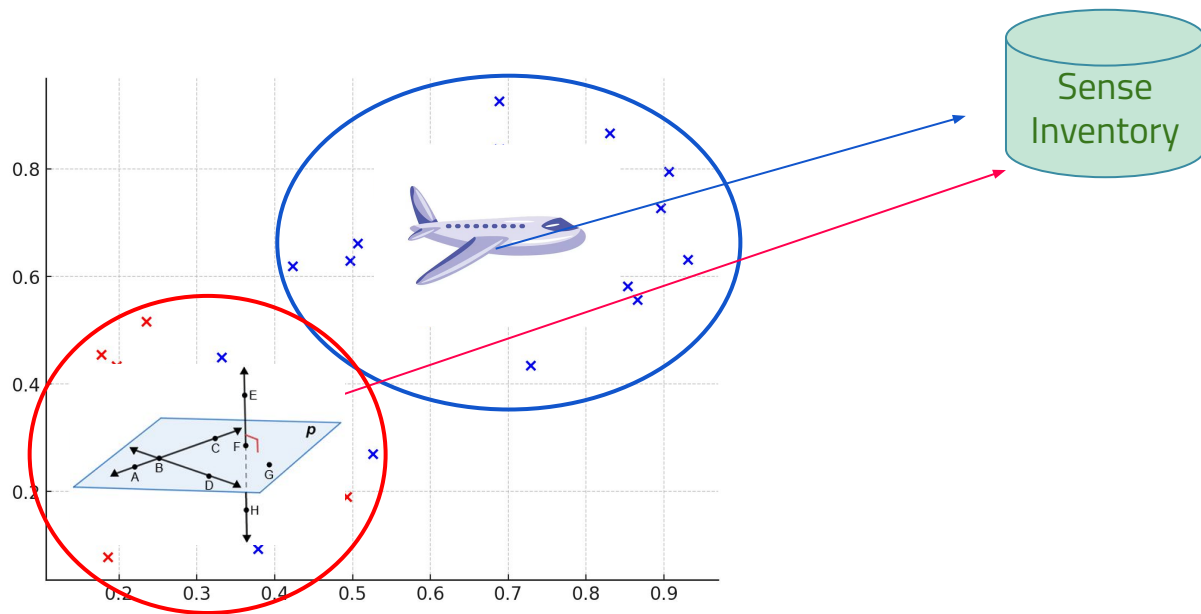
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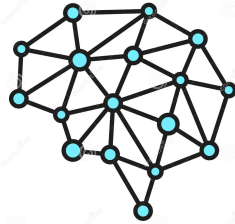
Sense Induction



# Definition Modeling

Provide a large table; this is a horizontal **plane**, and will represent the ground plane, viz.

The President's **plane** landed at Goose Bay at 9:03 p.m..

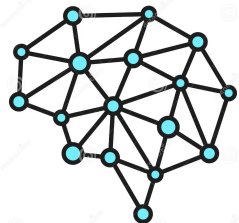


A flat or level surface of a material body

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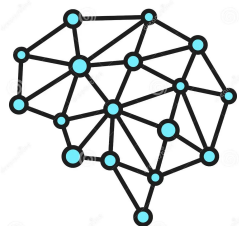


An aeroplane.

# Lexical Substitution

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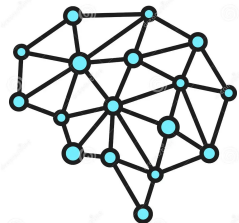
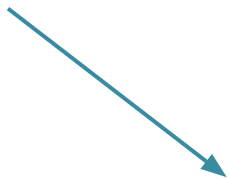
level  
surface  
flat plane  
horizontal plane



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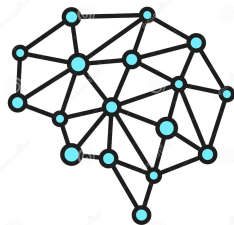
aircraft  
airplane  
jet  
propeller-driven vehicle

## Approach properties: Sense Discrimination

**Word-in-Context (WiC)** do **NOT explicit** assign sense labels

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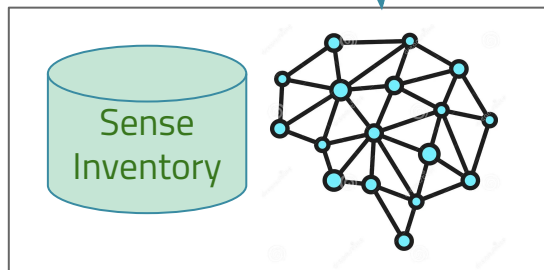
**Different  
Meaning**

# Approach properties: Sense Discrimination

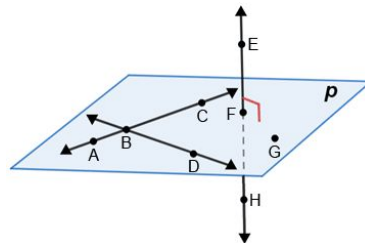
Word Sense Disambiguation (WSD) **explicitly** assign sense labels

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plane.n.01

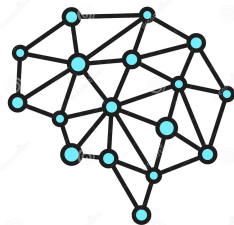


# Approach properties: Interpretability

Word-in-Context (WiC) is **NOT interpretable**

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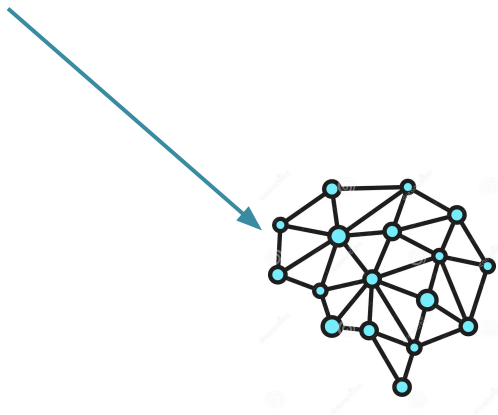
Different  
Meaning

## Approach properties: Interpretability

**Lexical substitutions** can be used to **interpret the results**

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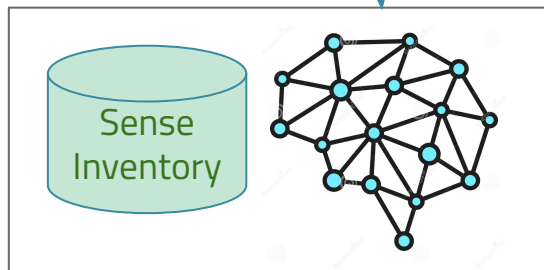
aircraft  
airplane  
jet  
propeller-driven vehicle

# Approach properties: Sense Inventory Independent

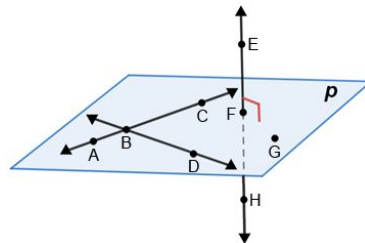
Word Sense Disambiguation (WSD) rely on a **specific** sense inventory

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plane.n.01



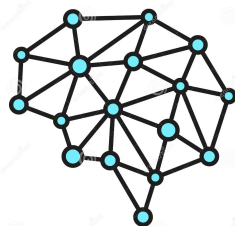
## Approach properties: Sense Inventory Independent

### Definition Modeling

generate sense definitions that are sense inventory **independent**

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A flat or level surface of a material body

# Approach properties: Parameter free

WSI is **sensitive** to parameters tuning in the sense induction phase

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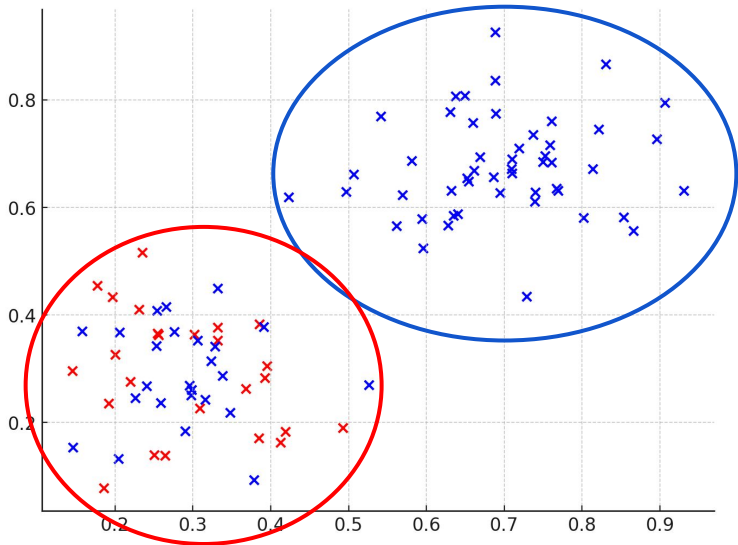
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# Summary

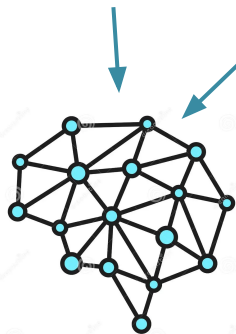
|                                 | <i>Sense Differentiation</i> | <i>Interpretability</i> | <i>Sense Inventory independent</i> | <i>Parameter free</i> | <i>Explicit Granularity tuning</i> | <i>Analysis Level</i> |
|---------------------------------|------------------------------|-------------------------|------------------------------------|-----------------------|------------------------------------|-----------------------|
| Word-in-Context (WiC)           | NO                           | NO                      | YES                                | YES                   | NO                                 | Pair                  |
| Word Sense Induction (WSI)      | YES                          | YES                     | YES                                | NO                    | NO                                 | Corpus                |
| Word Sense Disambiguation (WSD) | YES                          | YES                     | NO                                 | YES                   | YES                                | Sentence              |
| Target Sense Verification (TSV) | YES                          | YES                     | NO                                 | YES                   | NO                                 | Sentence              |
| Lexical Substitution            | NO                           | YES                     | YES                                | YES                   | NO                                 | Sentence              |
| Definition Modeling             | NO                           | YES                     | YES                                | YES                   | YES                                | Sentence              |

# Semantics in Diachrony

# Diachronic Word-in-Context (DWiC)

December 15th 1836 Provide a large table; this is a horizontal **plane**, and will represent the ground plane, viz.

June 2th 1999 The President's **plane** landed at Goose Bay at 9:03 p.m..

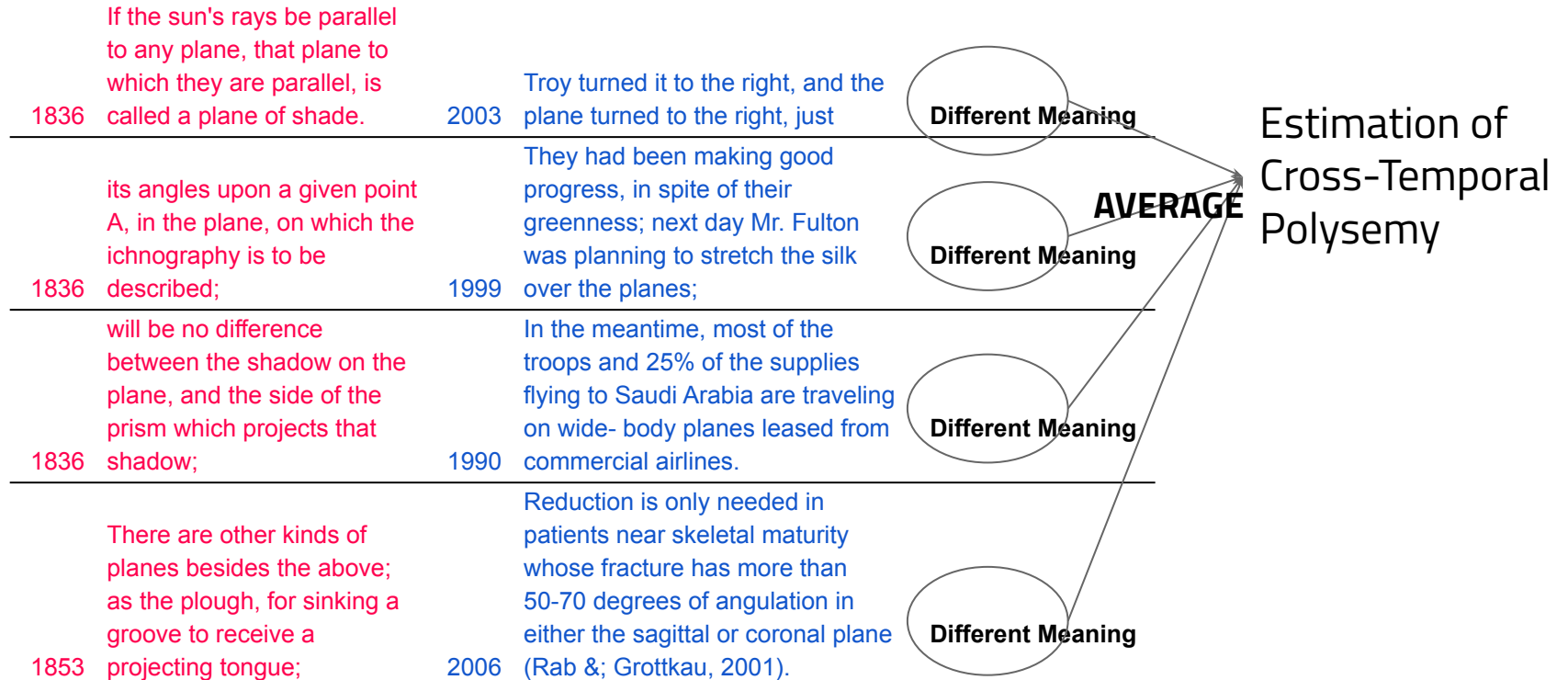


**Different  
Meaning**

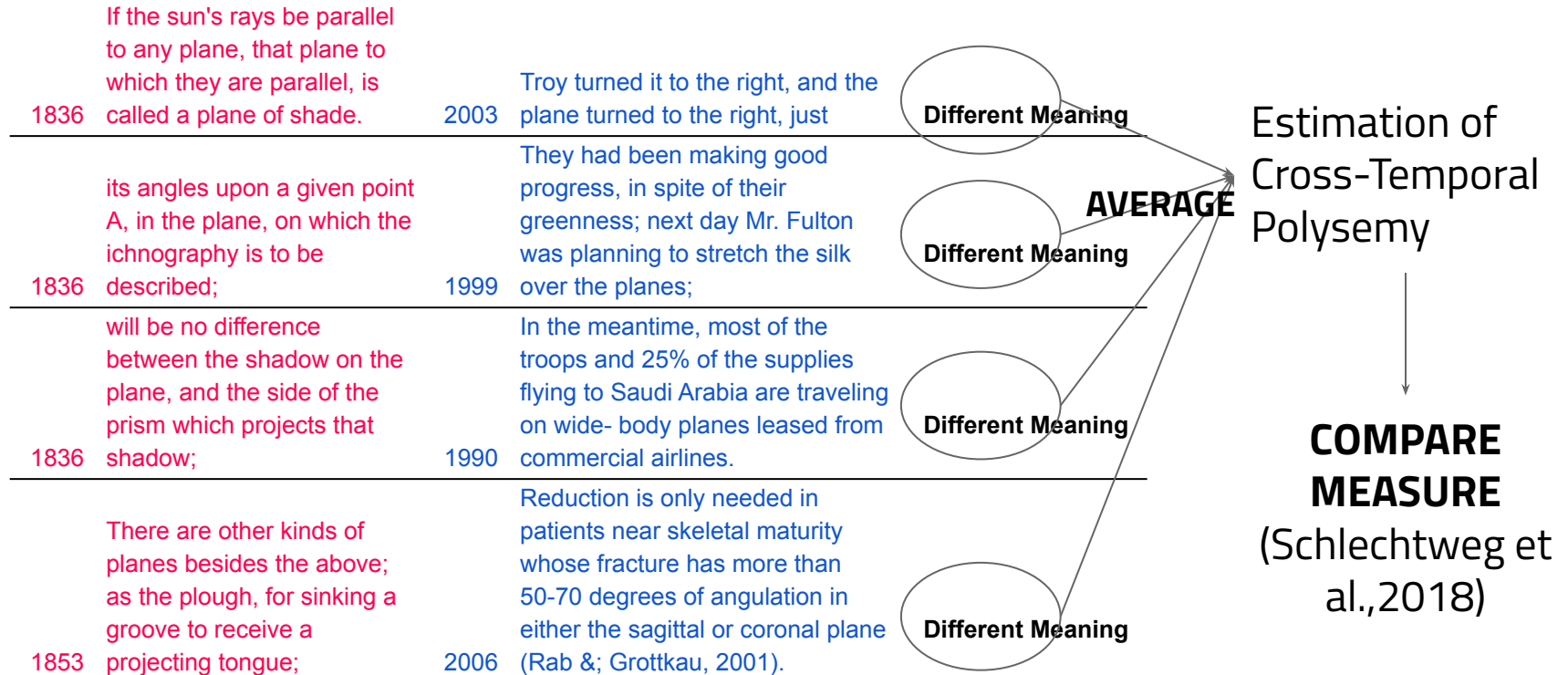
# Diachronic Word-in-Context (DWiC)

|      |  |      |   |                          |
|------|--|------|---|--------------------------|
| 1836 | If the sun's rays be parallel to any plane, that plane to which they are parallel, is called a plane of shade.         | 2003 | Troy turned it to the right, and the plane turned to the right, just  | <b>Different Meaning</b> |
| 1836 | its angles upon a given point A, in the plane, on which the ichnography is to be described;                            | 1999 | They had been making good progress, in spite of their greenness; next day Mr. Fulton was planning to stretch the silk over the planes;  | <b>Different Meaning</b> |
| 1836 | will be no difference between the shadow on the plane, and the side of the prism which projects that shadow;           | 1990 | In the meantime, most of the troops and 25% of the supplies flying to Saudi Arabia are traveling on wide- body planes leased from commercial airlines.                                | <b>Different Meaning</b> |
| 1853 | There are other kinds of planes besides the above; as the plough, for sinking a groove to receive a projecting tongue; | 2006 | Reduction is only needed in patients near skeletal maturity whose fracture has more than 50-70 degrees of angulation in either the sagittal or coronal plane (Rab &; Grottkau, 2001). | <b>Different Meaning</b> |

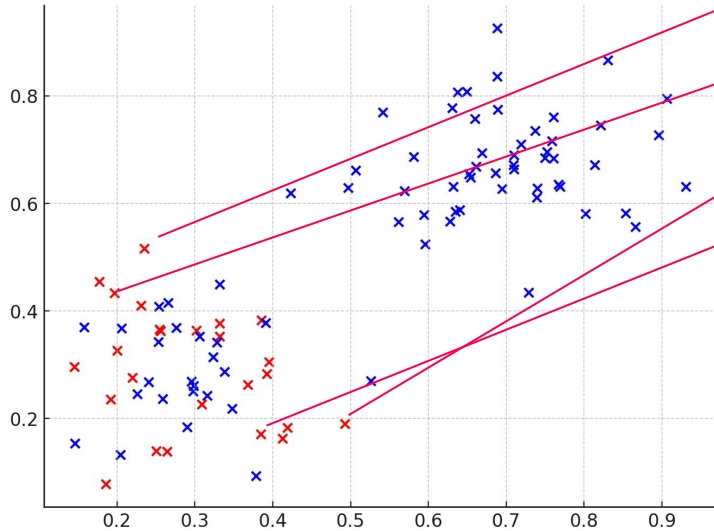
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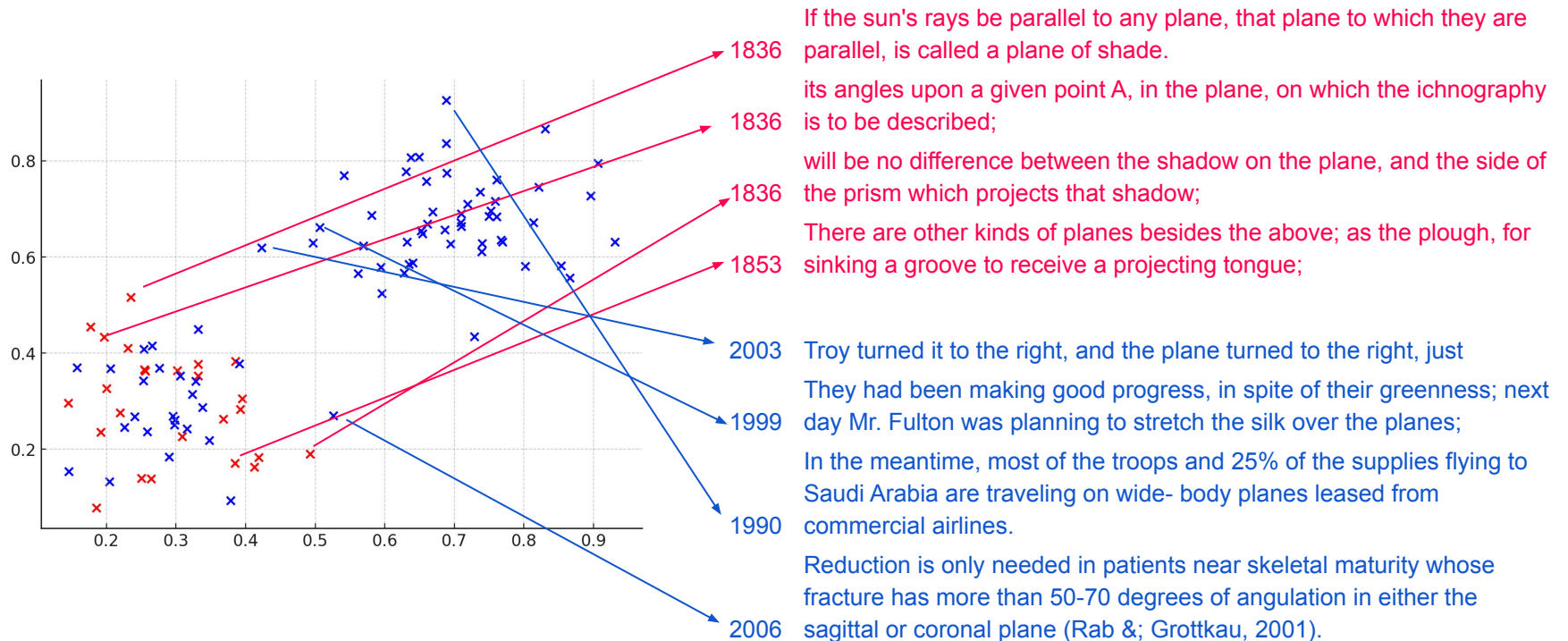


# Diachronic Word Sense Induction



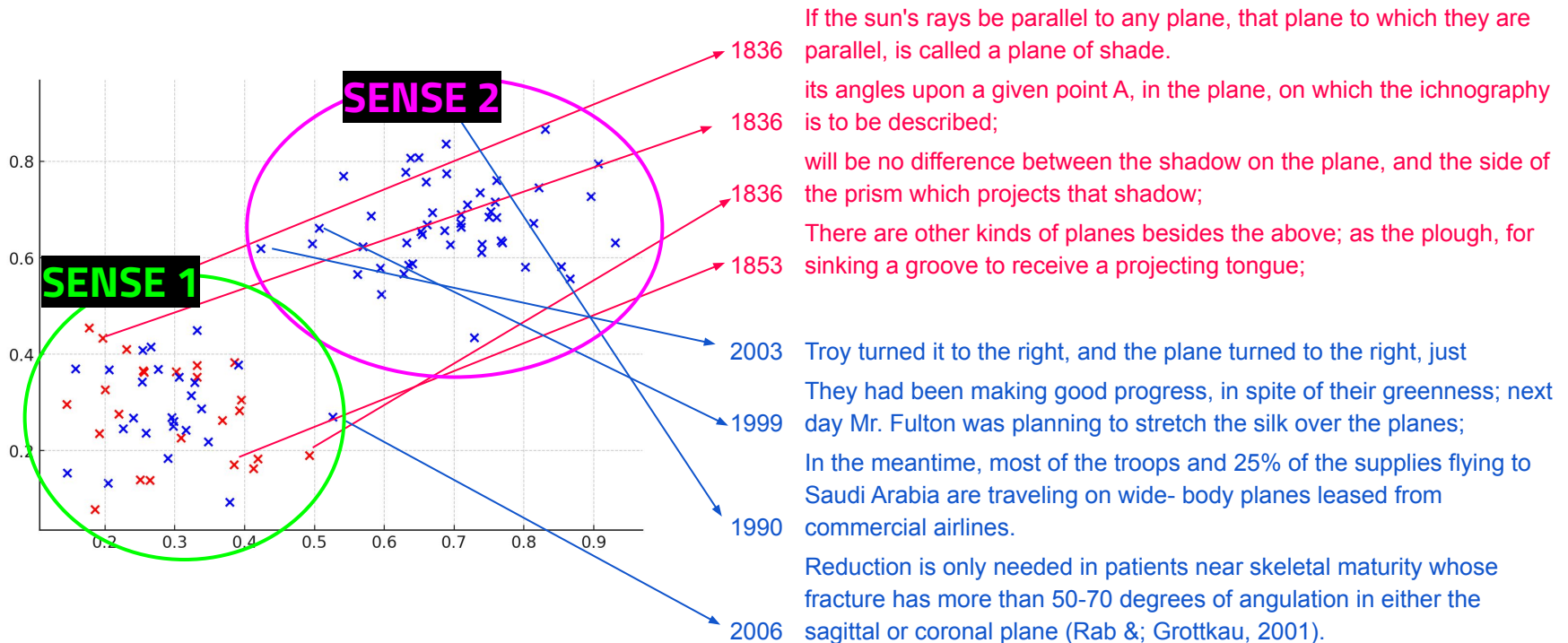
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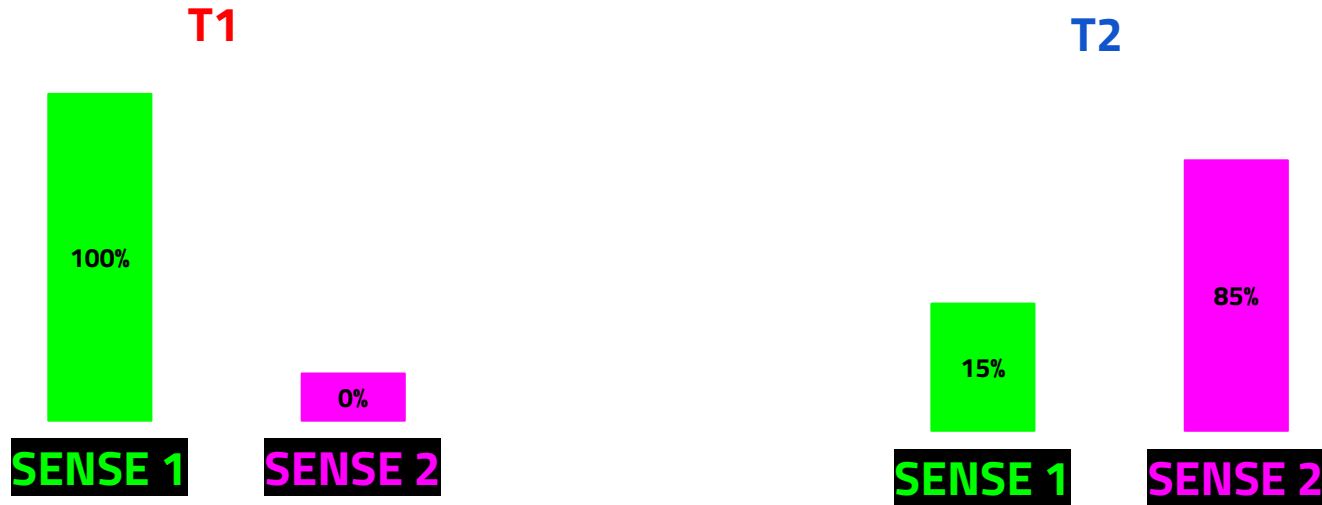




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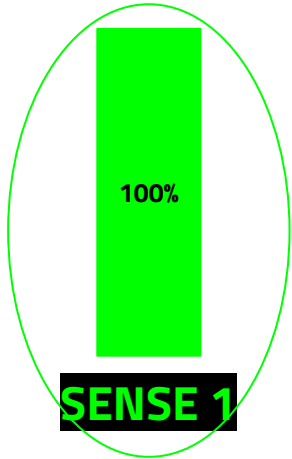


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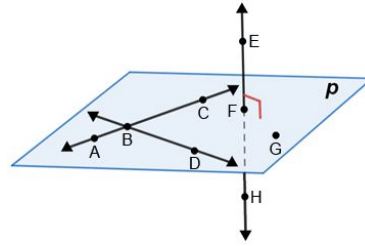


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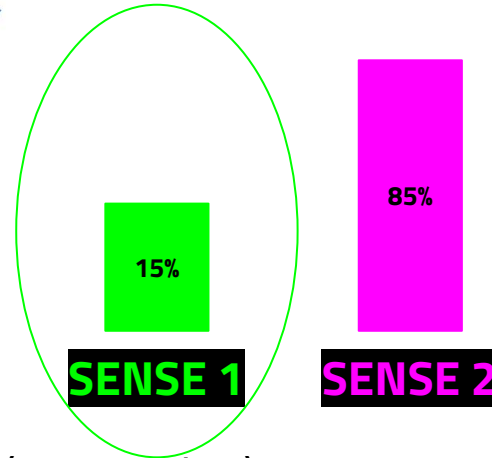
T1



$$P(\text{SENSE1}|\text{T1}) = 1$$

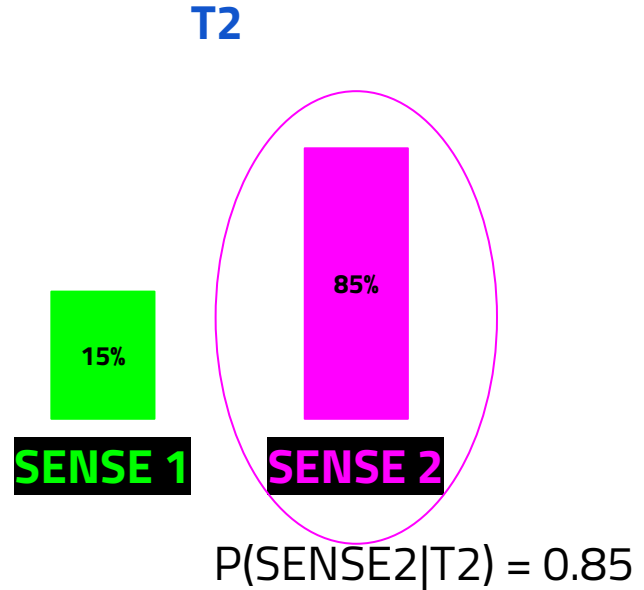
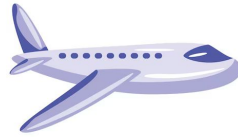
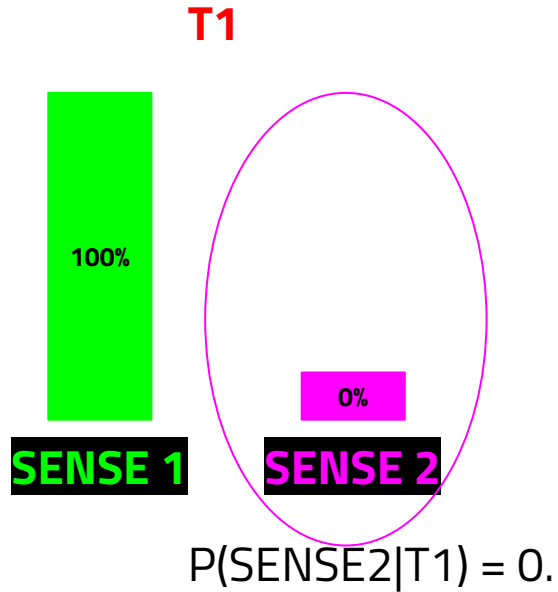


T2

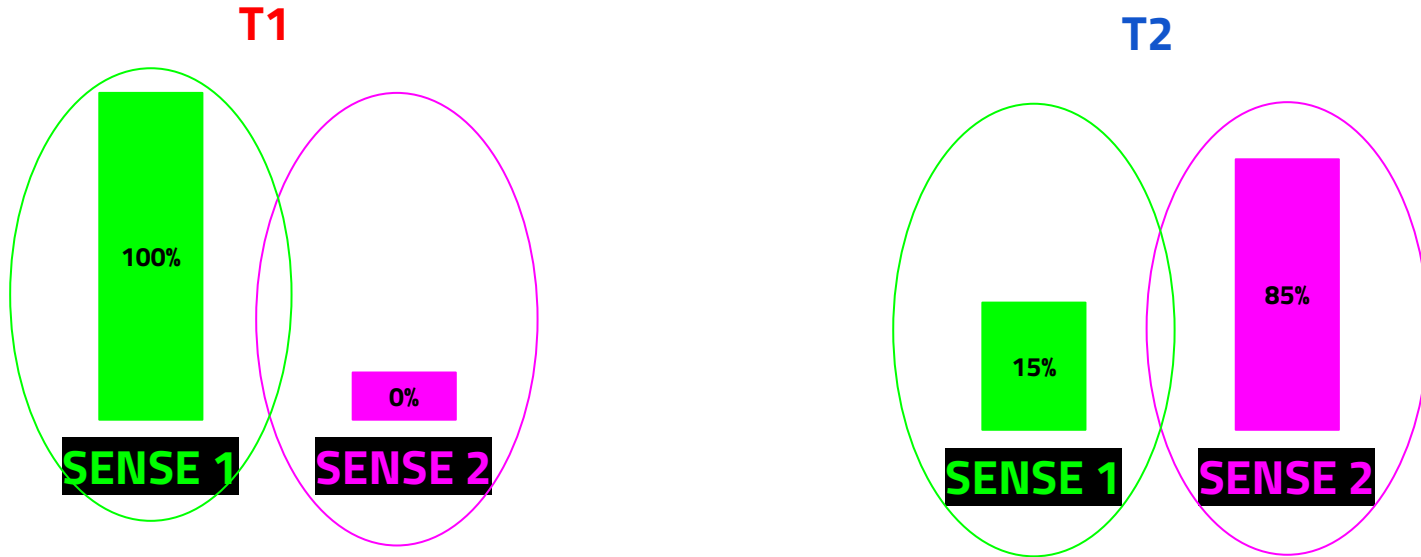


$$P(\text{SENSE1}|\text{T2}) = 0.15$$

# Diachronic Word Sense Induction

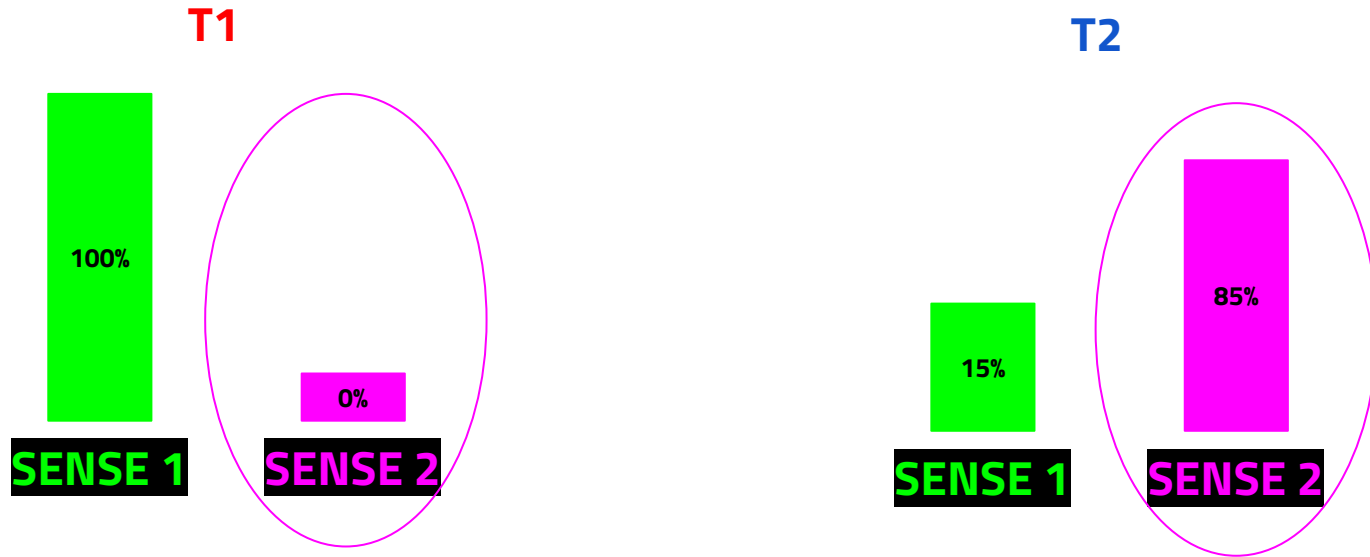


# Graded Score of Semantic Change



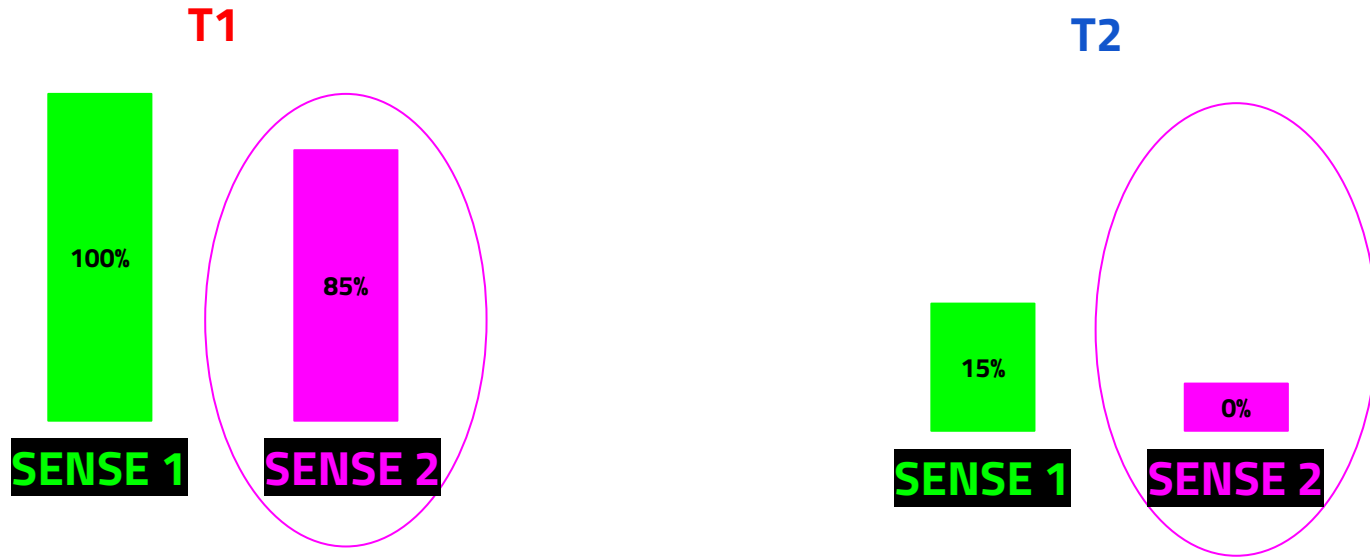
Distance between probability distributions

# Binary Label of Semantic Change



If the sense probability < of the threshold in **T1** and > of the threshold in **T2** the sense is gained

# Binary Label of Semantic Change



If the sense probability  $>$  of the threshold in **T1** and  $<$  of the threshold in **T2** the sense is lost