

Analysis of Language Resources

Third Lecture
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History of Conflict in Semantics between...(Review)

- **Logic**

→Amodal Symbol Theory, Vector Space Model, **Latent Semantic Analysis (LSA) using Singular Value Decomposition (SVD)**, Hyper Space Analogue to Language (HAL) using Multidimensional Scaling (MDS)..

And

Red gothic characters indicating “the most radical contradiction”

- **Bio**

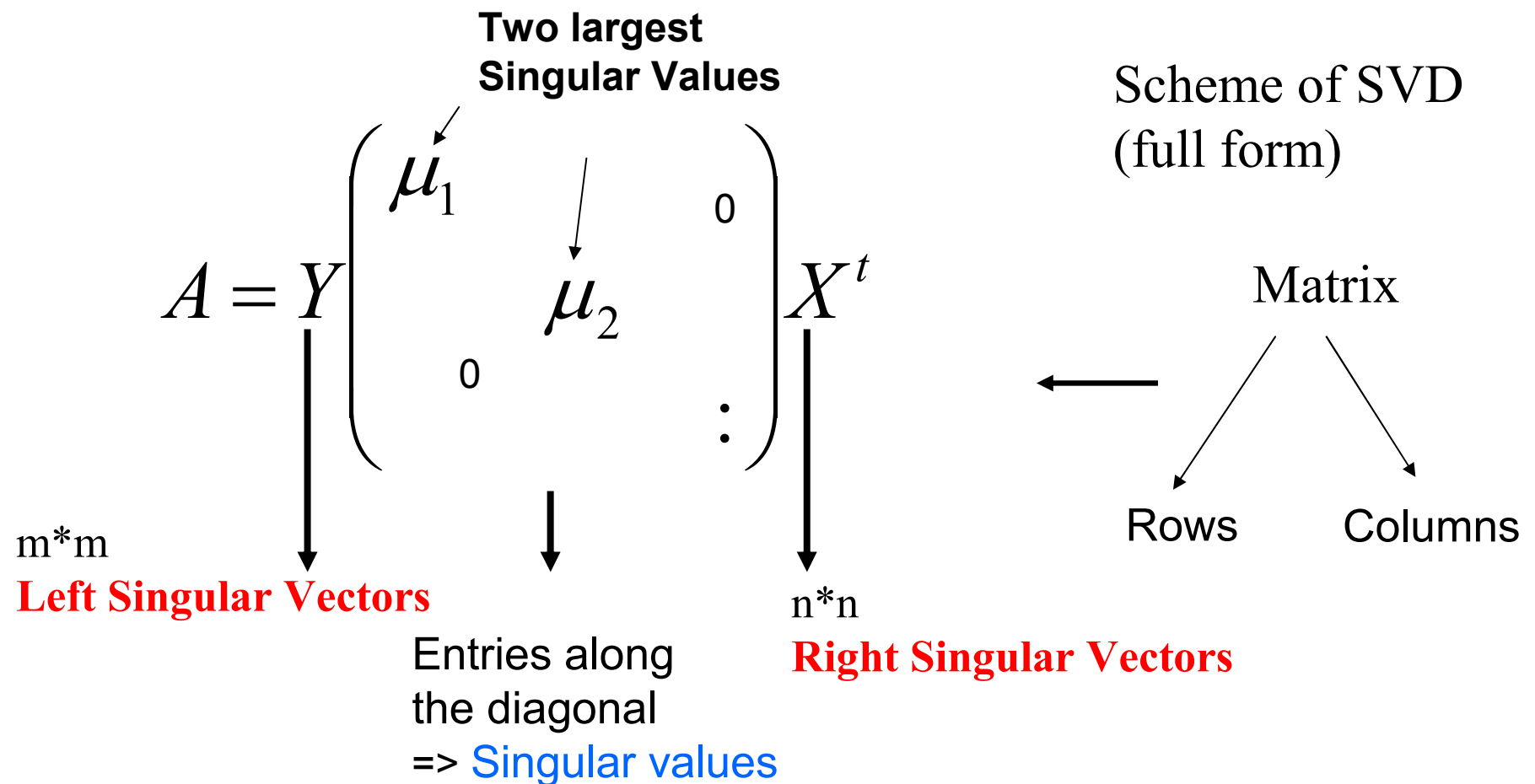
→Embodiment Theory, Perceptual Symbol Theory, (Modal or Multi-modal Symbol Theory), Simulation Semantics, Mirror System Theory, **Affordance**, Spatial Indexing...

The Most Important Point of Conflict

- Calculated Meaning versus Embodied (Situated) Meaning
- Amodal theory: The LSA allows us to gain access to the context-sensitive meaning of terms and thus to simulate human inference by applying the SVD to the lexical association (co-occurrence) data obtained from a large-scaled corpus.
- Embodiment theory : The simulation provided by the LSA is far from being satisfactory because it cannot treat the *situated* meaning that is concretely generated from our actions in the world. The LSA is helpless to resolve the Symbol-grounding problem or to understand the Affordance.

What is SVD ?

- Purpose 1 : Decomposition of Information



What is SVD ?

- Purpose2 : Compression of Information (for LSA)

The **two largest Singular Values** kept for the most important part of information (*The others are discarded*)

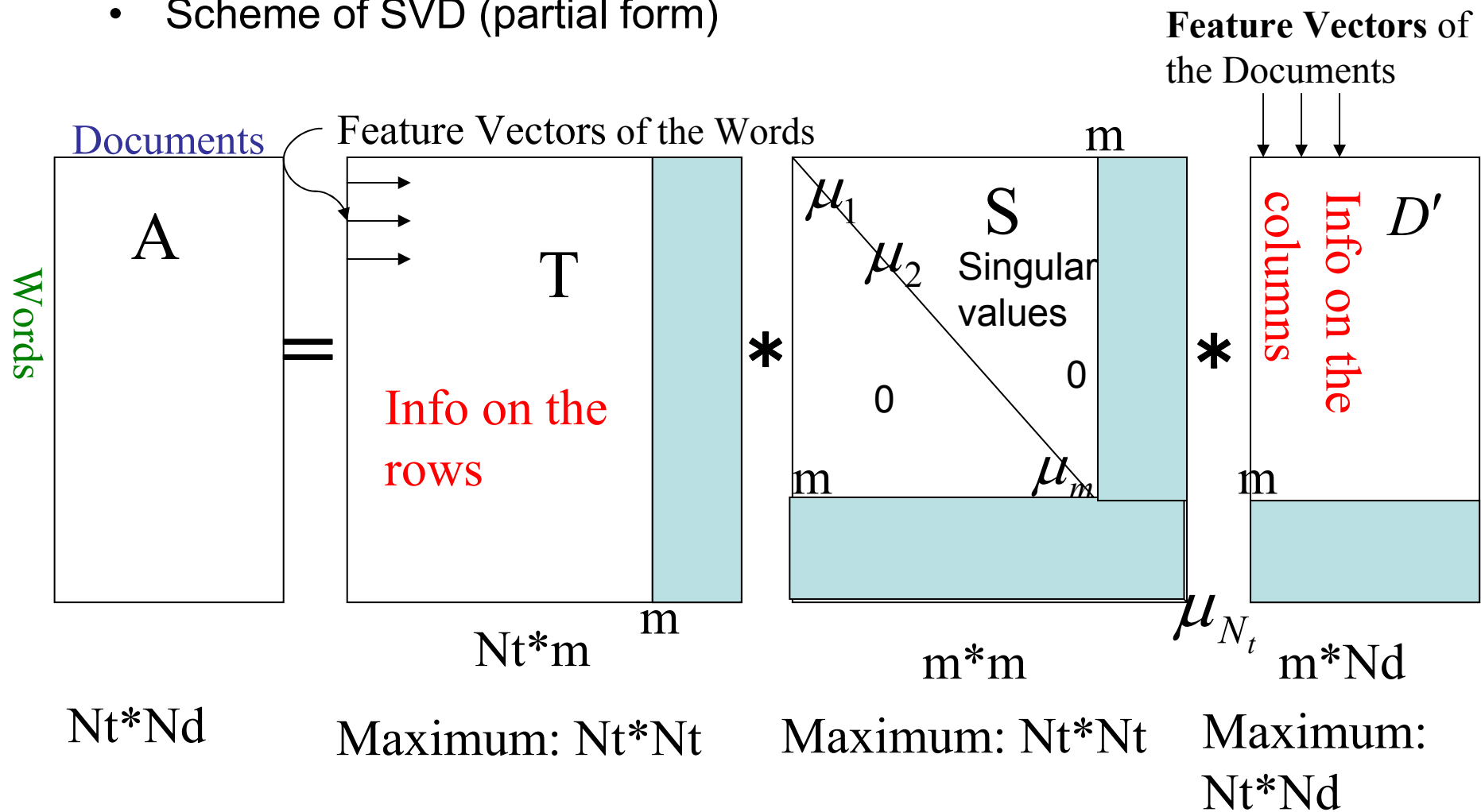
$$\hat{A} = \begin{pmatrix} & & & \\ & & & \\ & & & \\ & & & \end{pmatrix}_{m \times 2} \begin{pmatrix} \mu_1 & 0 \\ 0 & \mu_2 \end{pmatrix}_{2 \times 2} \begin{pmatrix} & & & \\ & & & \\ & & & \\ & & & \end{pmatrix}_{2 \times n}$$

Compressed Information (on the **rows**)

Compressed Information (on the **columns**)

Calculated Meaning by SVD

- Scheme of SVD (partial form)



Calculated Meaning vs. Embodied Meaning

- According to **the amodal theory** (LSA, SVD), the meanings of the words, the sentences and the documents can be generally qualified (or *quantified*) as corresponding **values or vectors** in the mathematical space.
- According to **the embodiment theory**, the vector space model is completely irrelevant to the physical space from which the *situated* meanings are derived through the interactions between our body and the neighboring objects, and has limits caused by **the symbol-grounding problem** or **the affordance**.
- Meaning of **Affordance** in this case : whether an instrument found by chance in one's situation is well adapted to his or her body conditions and useful to the particular purpose intended.

Failure of a LSA simulation

- Evidence provided by the experiment of Glenberg and Robertson
<http://www.uic.edu/classes/psych/psych454/glenberg.pdf>
- Example of Sentence: (Marissa forgot to bring her pillow on her camping trip.) ← **Case of emergency !**
- **Afforded**: “As her substitute for her pillow, she filled up her own sweater with **leaves**.” (**LSA value**: **0.58**) ← Calculated from a corpus
- **Non-Afforded**: “As her substitute for her pillow, she filled up her own sweater with **water**. “??? (**LSA value**: **0.55**) ← Calculated from a corpus
- The affordance (the embodied meaning) cannot be simulated by the amodal methods.

What is the Embodied Meaning?

- The MEANING originally comes from our physical activities (not from the computer system).
- The MEANING signifies at the first instance,
 - the concrete meaning that is particularly generated from a pressing situation.
 - the *means* that we use to survive by fulfilling the conditions of the “meshing *affordances* (Glenberg and Richardson)”.

Summary

- LSA, SVD (Vector Space Model):
 - Decomposition and Compression of Information
 - Calculation based upon the word-association
- **Affordance** : the battle field of the amodal theory and the embodiment theory
- Contradiction between the calculated meaning and the embodiment meaning
- Is there no way of reconciliation?