Unsupervised Learning

By Andrew Ng

기초 1팀

Reference

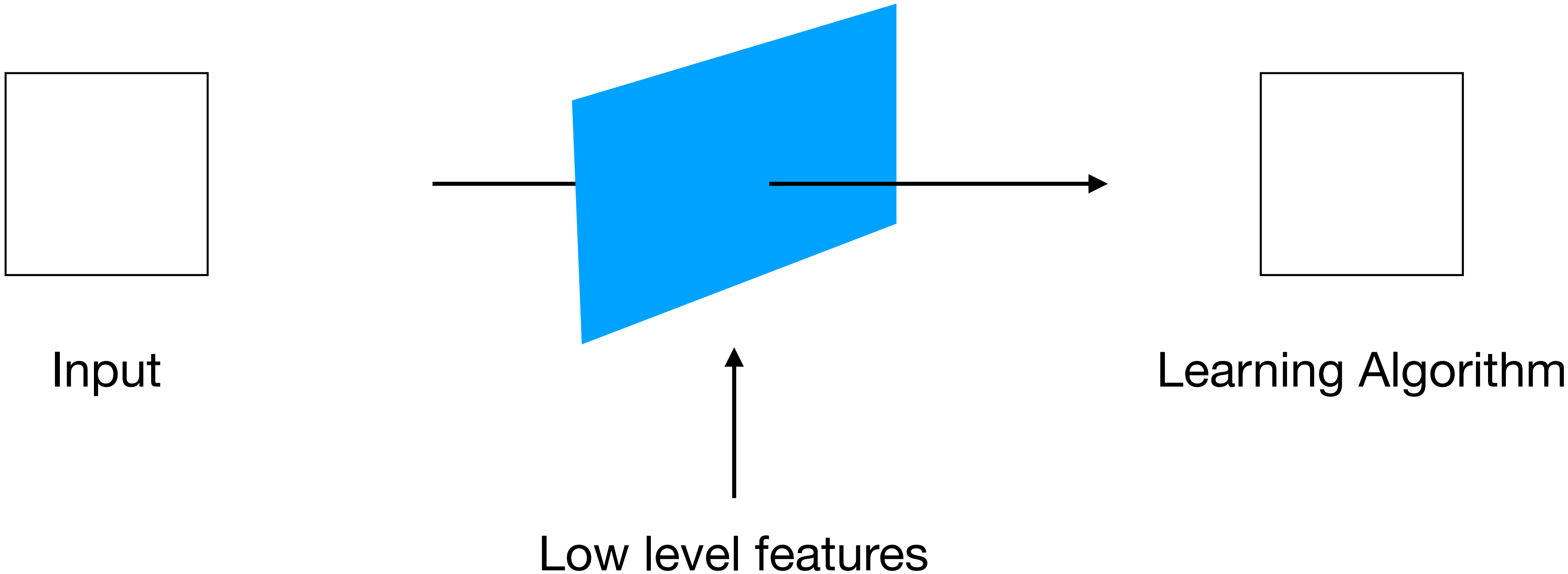
Bay Area Vision Meeting: Unsupervised Feature Learning and Deep Learning

https://www.youtube.com/watch?v=ZmNOAtZIgIk&t=1833s

Neural networks [8.1] : Sparse coding - definition

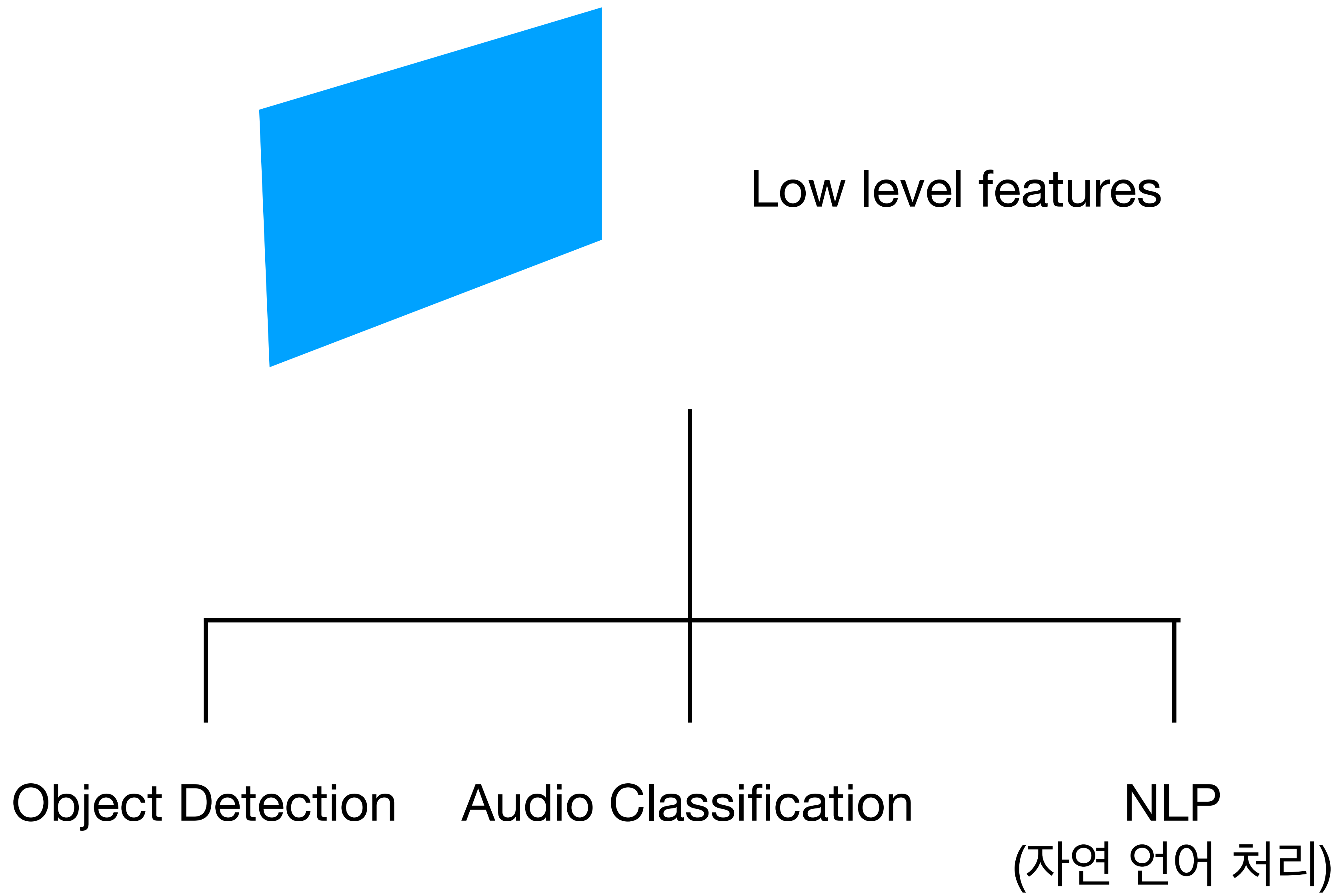
https://www.youtube.com/watch?v=7a0_iEruGoM&t=5s

Feature extraction



“알고리즘이 세상을 보는 렌즈”

Low level feature



There are some issues..

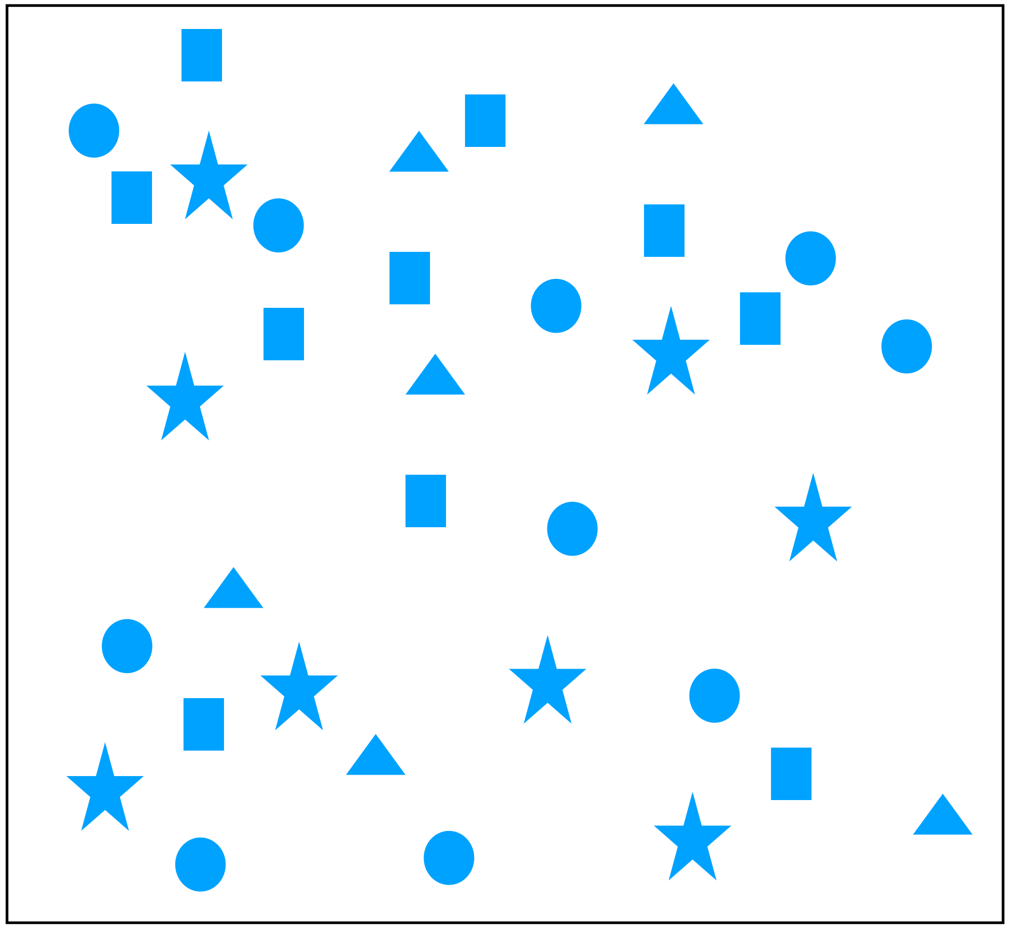
14 x 14
image patch

can represent it using
196
real numbers

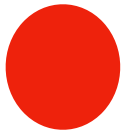
Can we find a learn a better feature vector
to represent this?

Unsupervised Learning

UnSupervised Learning
(Self-thought learning)



What is this?



Sparse coding : one of neural networks for unsupervised learning

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SPARSE CODING

Topics: sparse coding

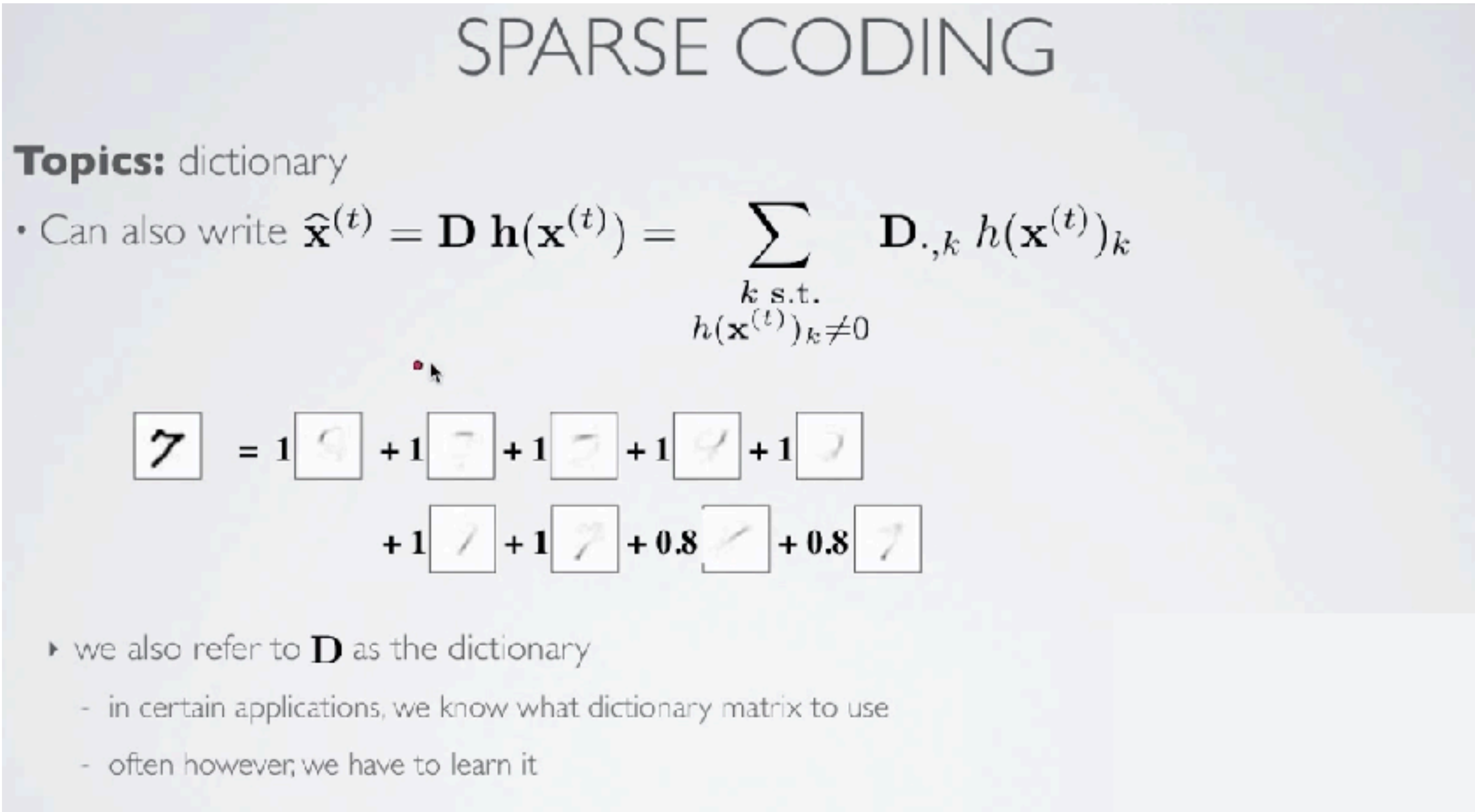
- For each $\mathbf{x}^{(t)}$ find a latent representation $\mathbf{h}^{(t)}$ such that:
  - it is sparse: the vector $\mathbf{h}^{(t)}$ has many zeros
  - we can reconstruct the original input $\mathbf{x}^{(t)}$ as well as possible
- More formally:

$$\min_{\mathbf{D}} \frac{1}{T} \sum_{t=1}^{T} \min_{\mathbf{h}^{(t)}} \frac{1}{2} \overbrace{\|\mathbf{x}^{(t)} - \underbrace{\mathbf{D}\,\mathbf{h}^{(t)}}_{\text{reconstruction } \widehat{\mathbf{x}}^{(t)}}\|_2^2}^{\text{reconstruction error}} + \underbrace{\lambda}_{\substack{\text{reconstruction vs.}\\ \text{sparsity control}}} \overbrace{\|\mathbf{h}^{(t)}\|_1}^{\text{sparsity penalty}}$$

  - we also constrain the columns of $\mathbf{D}$ to be of norm 1
    - otherwise, $\mathbf{D}$ could grow big while $\mathbf{h}^{(t)}$ becomes small to satisfy the prior
  - sometimes the columns are constrained to be no greater than 1

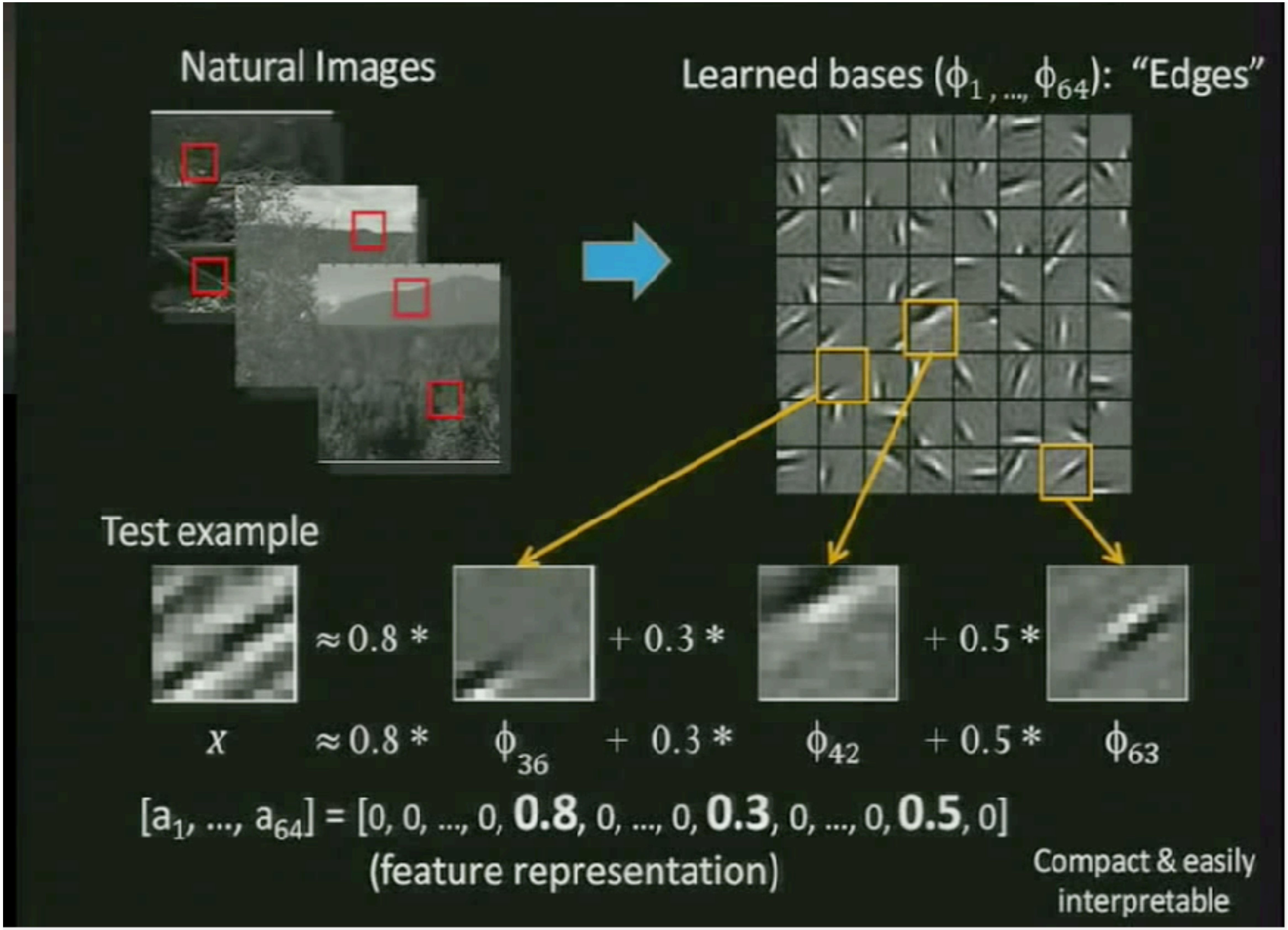
https://www.youtube.com/watch?v=7a0_iEruGoM

Sparse coding



https://www.youtube.com/watch?v=7a0_iEruGoM

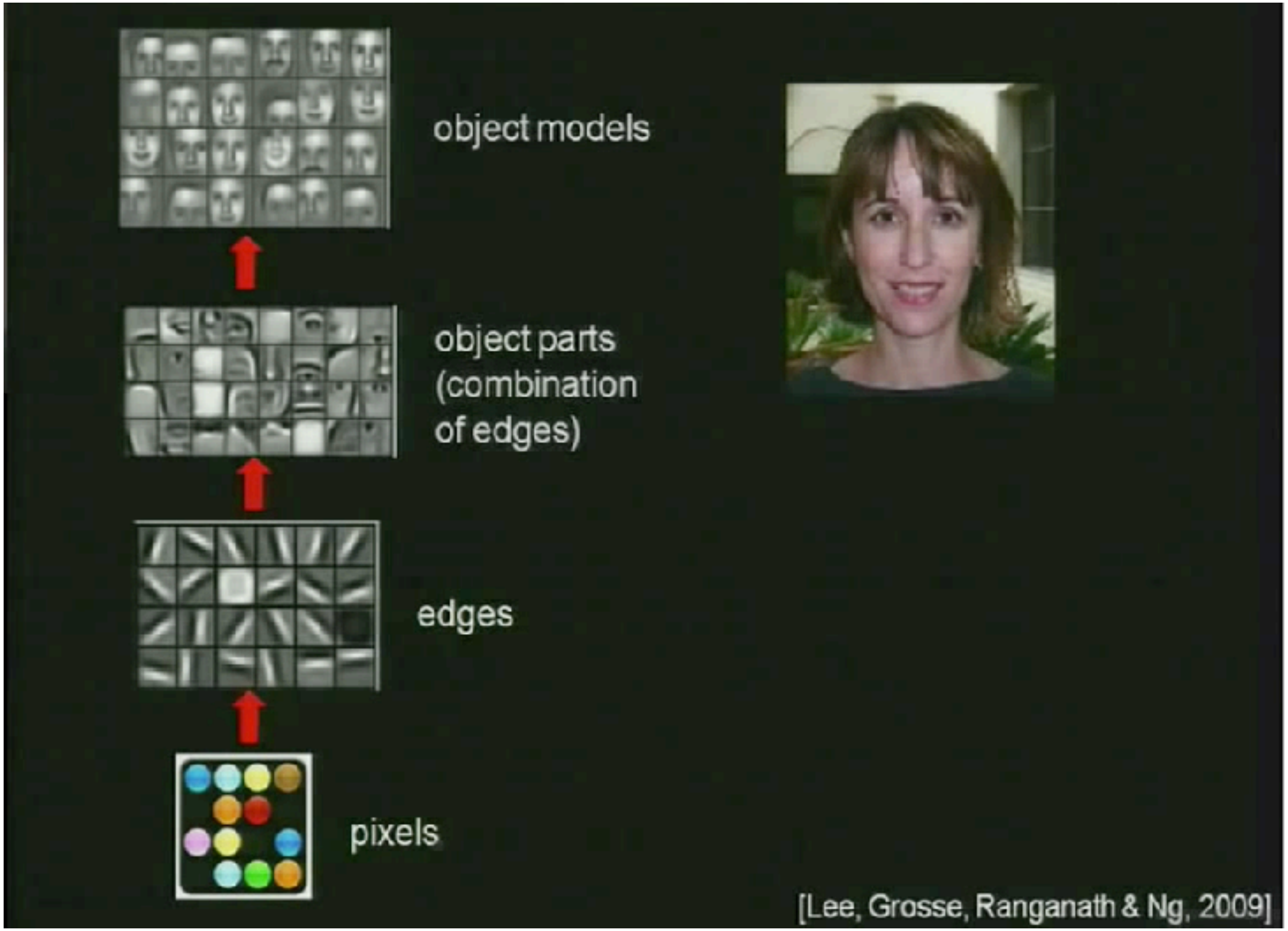
Sparse coding



https://www.youtube.com/watch?v=ZmNOAtZIgIk

Sparse DBN(Deep Learning Network)

Training on face images

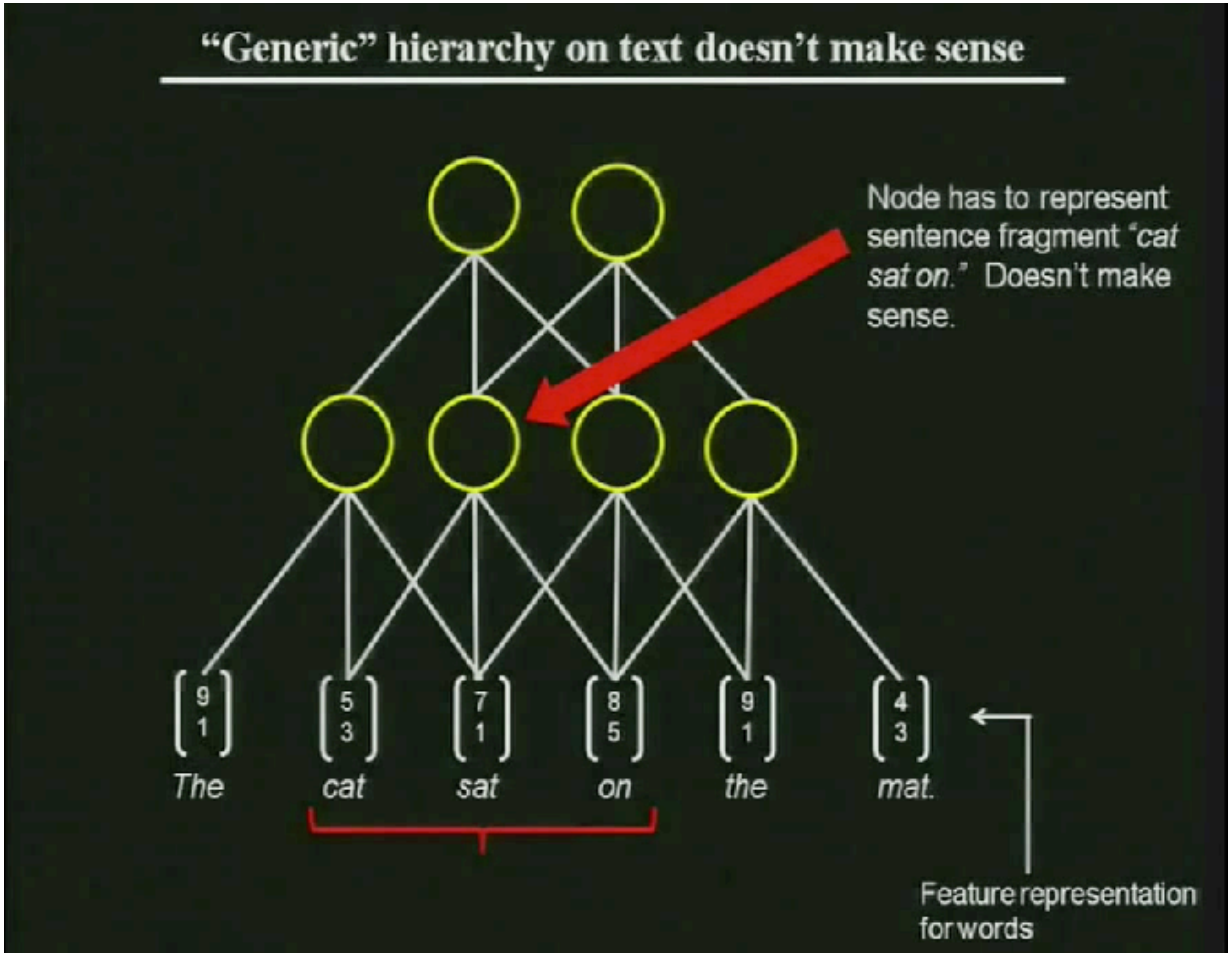


https://www.youtube.com/watch?v=ZmNOAtZIgIk

Scaling up, Accuracy up

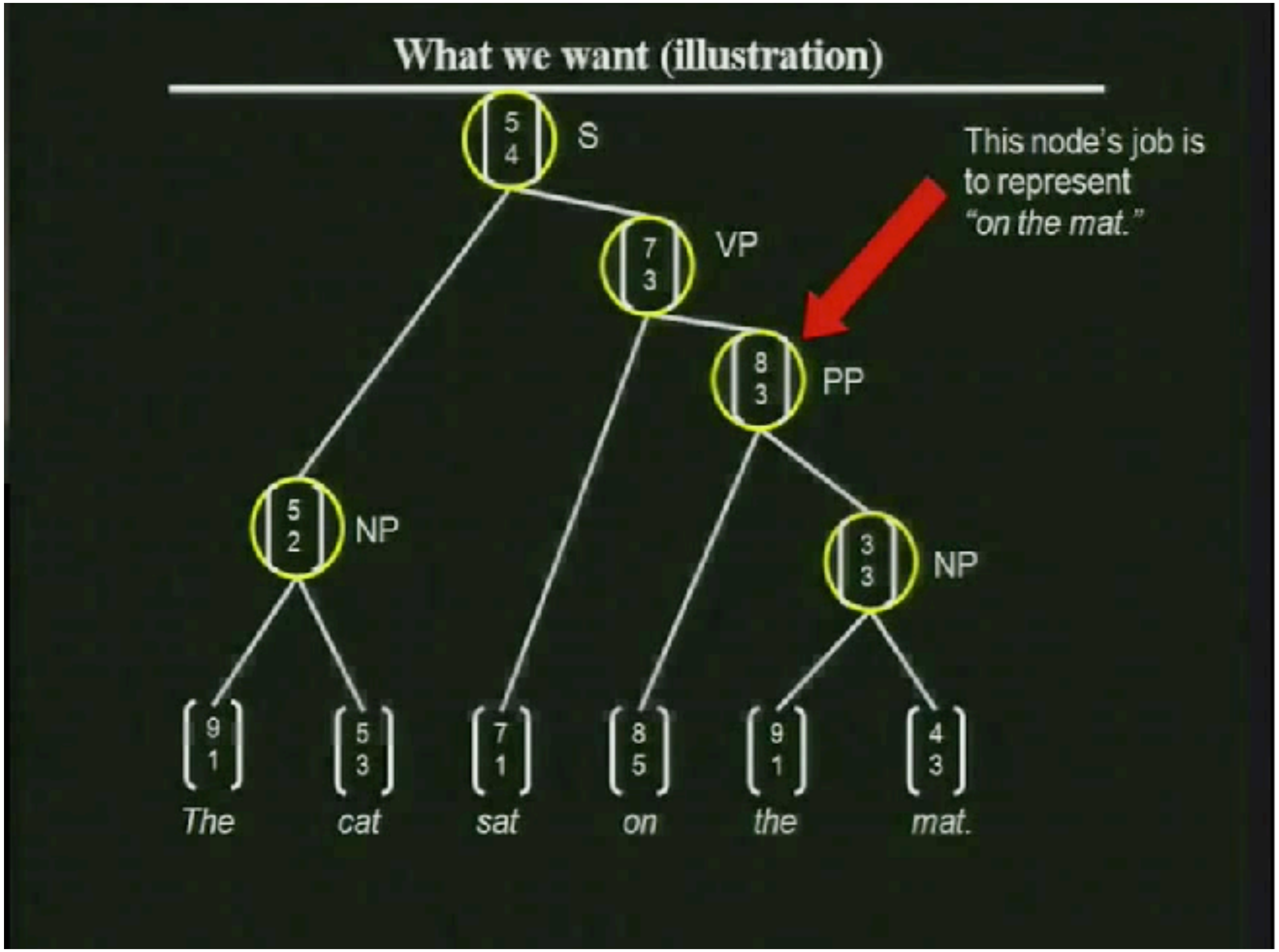
- 효율적인 Sparse coding algorithms
- GPUs for 딥러닝
- Convolutional network
- ….

Learning recursive representation



https://www.youtube.com/watch?v=ZmNOAtZIgIk

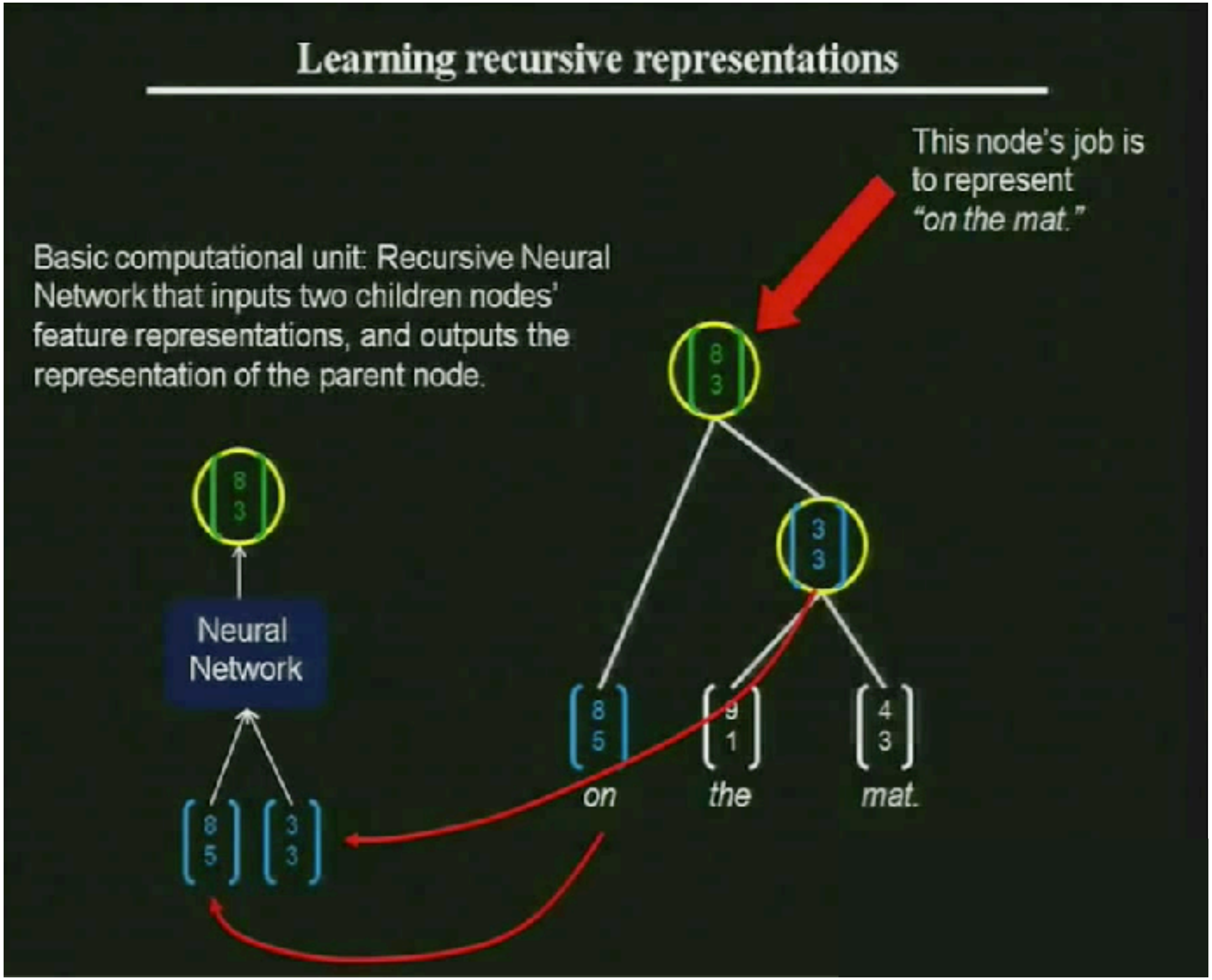
Learning recursive representation



learn to follow 'natural hierarchy' of English

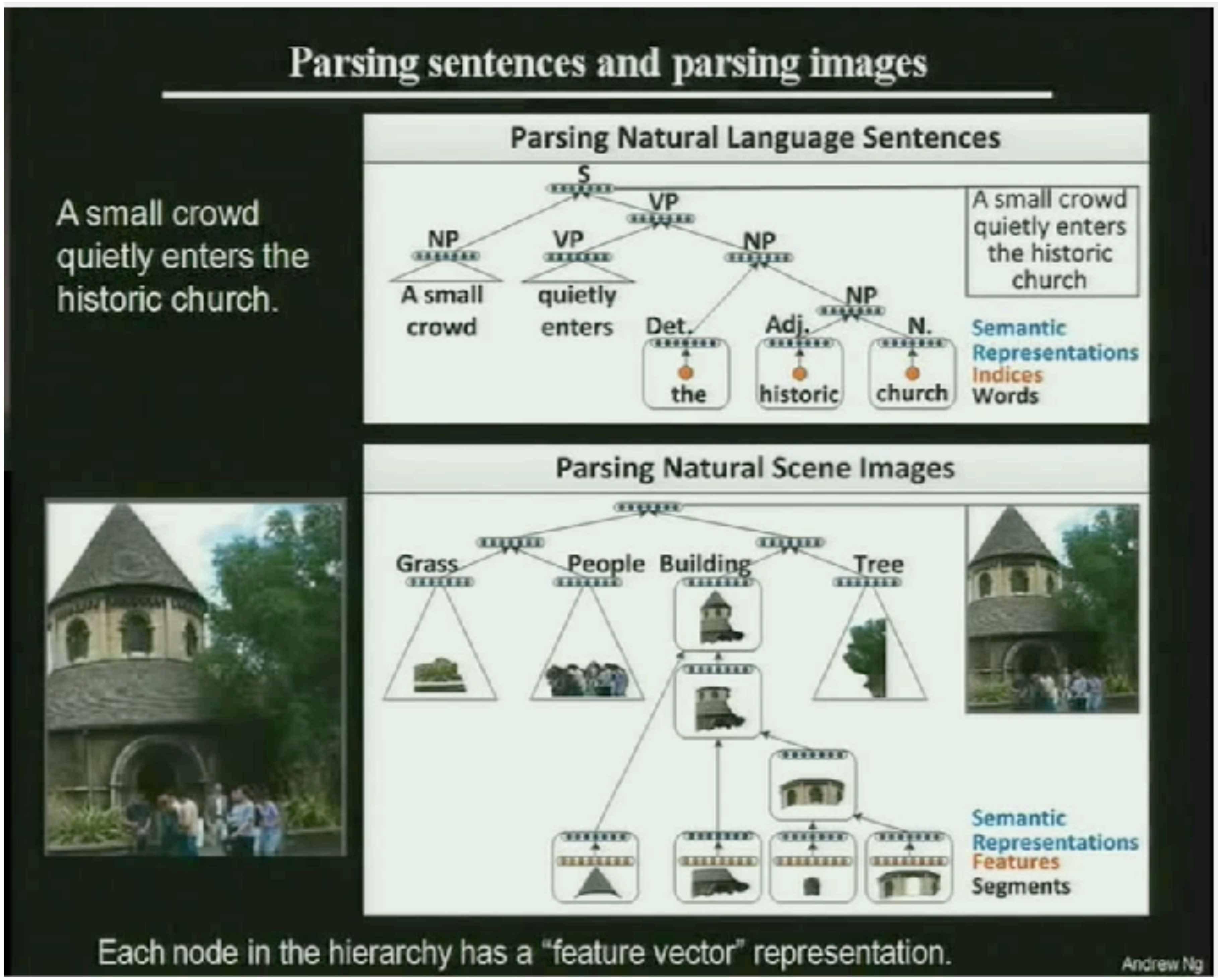
https://www.youtube.com/watch?v=ZmNOAtZIgIk

Learning recursive representation



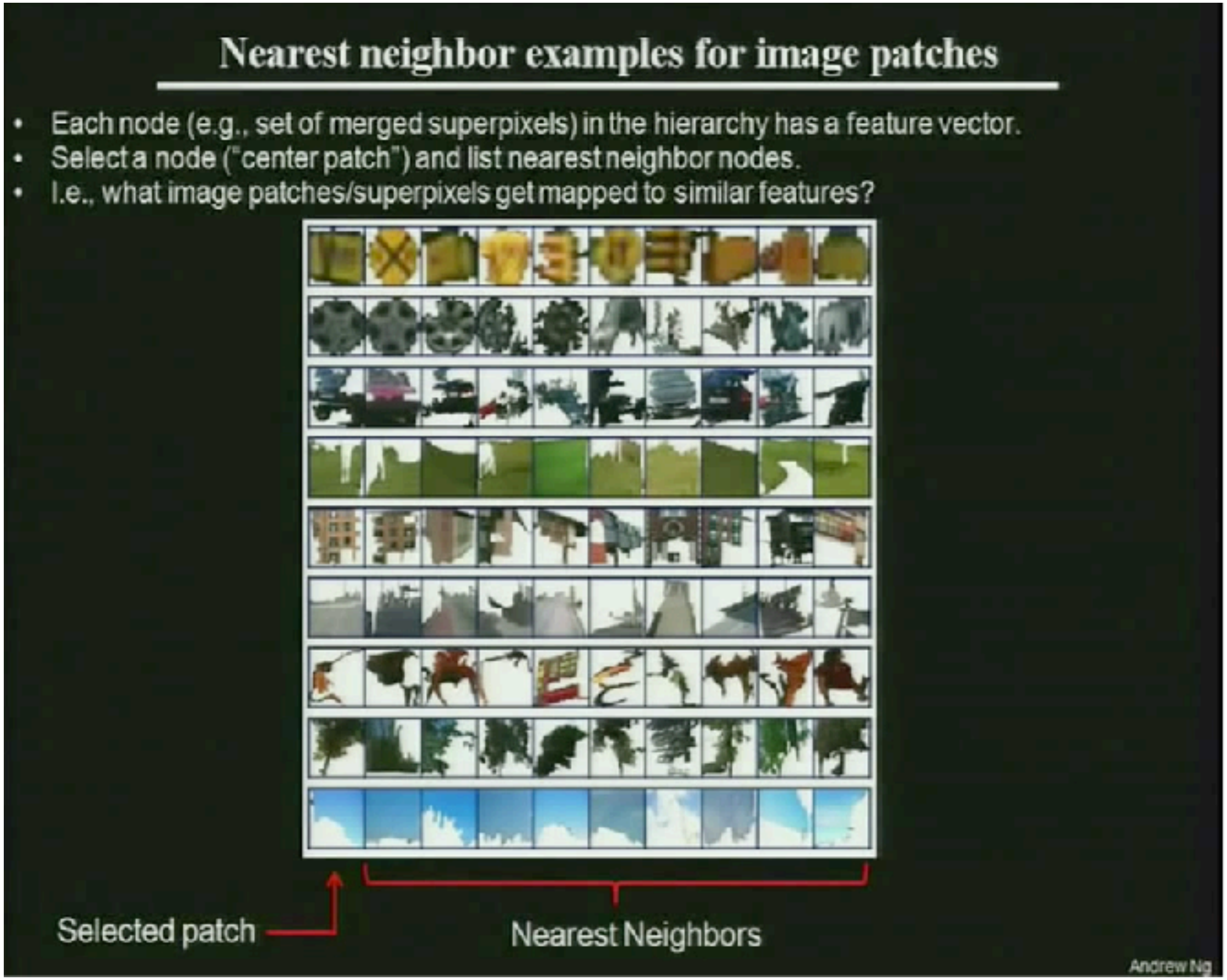
https://www.youtube.com/watch?v=ZmNOAtZIgIk

Example



Parsing sentences and parsing images
A small crowd quietly enters the historic church.
Parsing Natural Language Sentences
S
VP
NP
VP
NP
NP
A small crowd
quietly enters
Det.
Adj.
N.
the
historic
church
A small crowd quietly enters the historic church
Semantic Representations
Indices
Words
Parsing Natural Scene Images
Grass
People
Building
Tree
Semantic Representations
Features
Segments
Each node in the hierarchy has a "feature vector" representation.
Andrew Ng

Example 2


Nearest neighbor examples for image patches
Each node (e.g., set of merged superpixels) in the hierarchy has a feature vector.
Select a node ("center patch") and list nearest neighbor nodes.
I.e., what image patches/superpixels get mapped to similar features?
Selected patch
Nearest Neighbors
Andrew Ng