models and algorithms #2

MGMT|from text analysis to actionable knowledge

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the goal of **statistical learning** is to build a machine that can learn from data and automatically make the right decisions

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unsupervised
identify latent classes in the data $\rightarrow$ lack theoretical 'ground truth'

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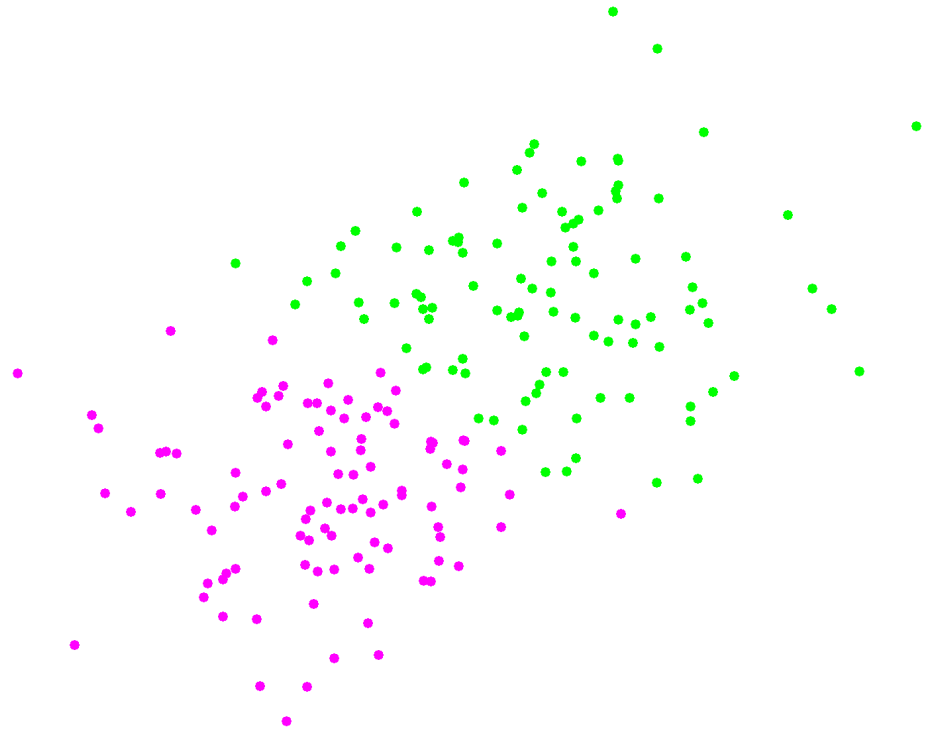
supervised
infer mapping between data & class-information $\rightarrow$ theoretical 'ground truth'

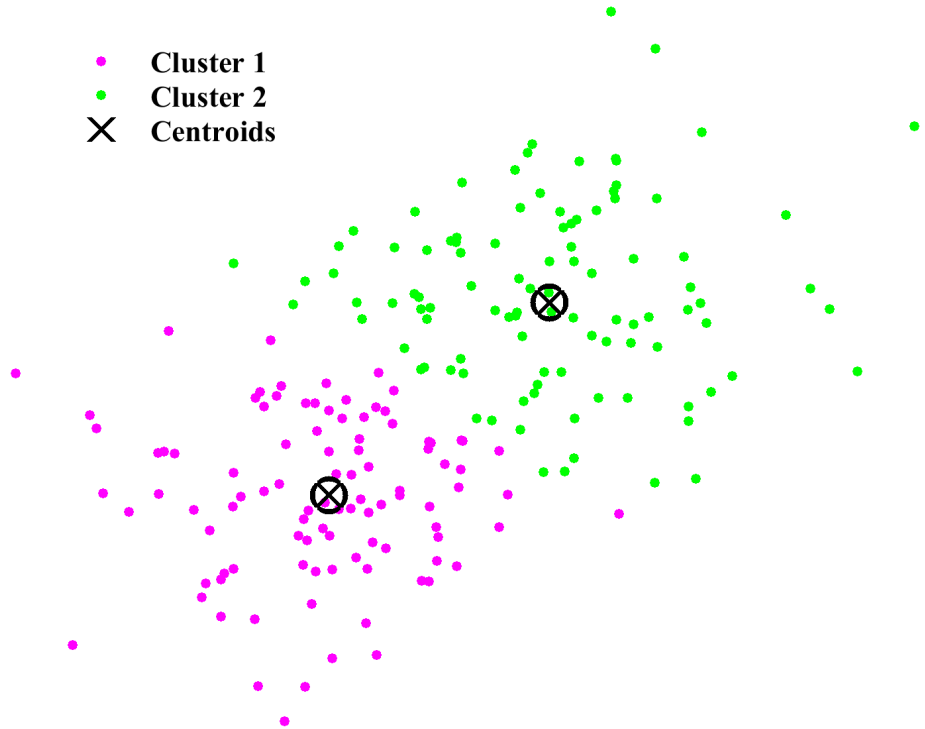
unsupervied learning|clustering
groups of features or latent variables often identity non-random subsets in a collection of documents

these subsets or 'clusters' can be used for understanding document content (e.g., thematic analysis) and computational utility (e.g., identification of prototype documents)

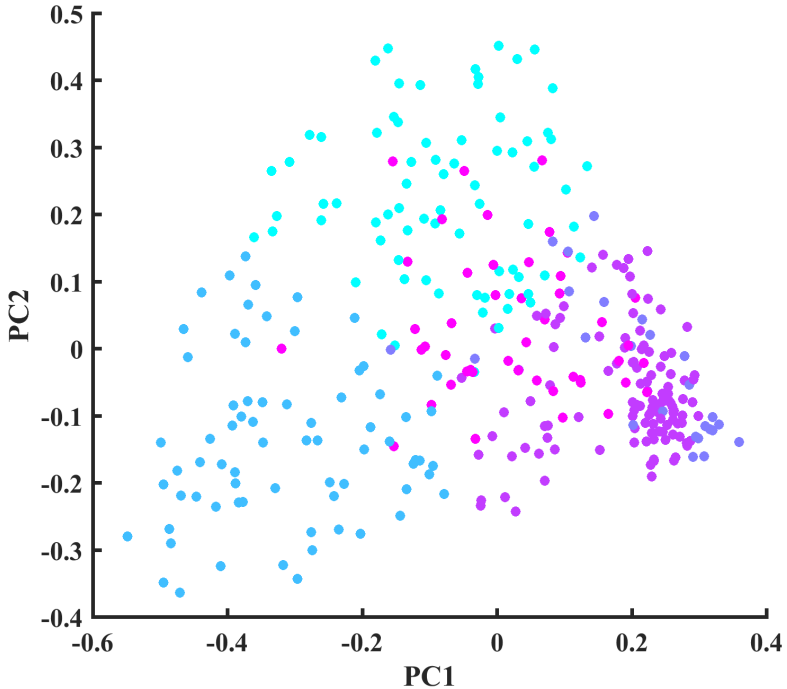
implicit assumption that we study differences in variables (e.g., terms) between homogeneous objects (e.g., documents)

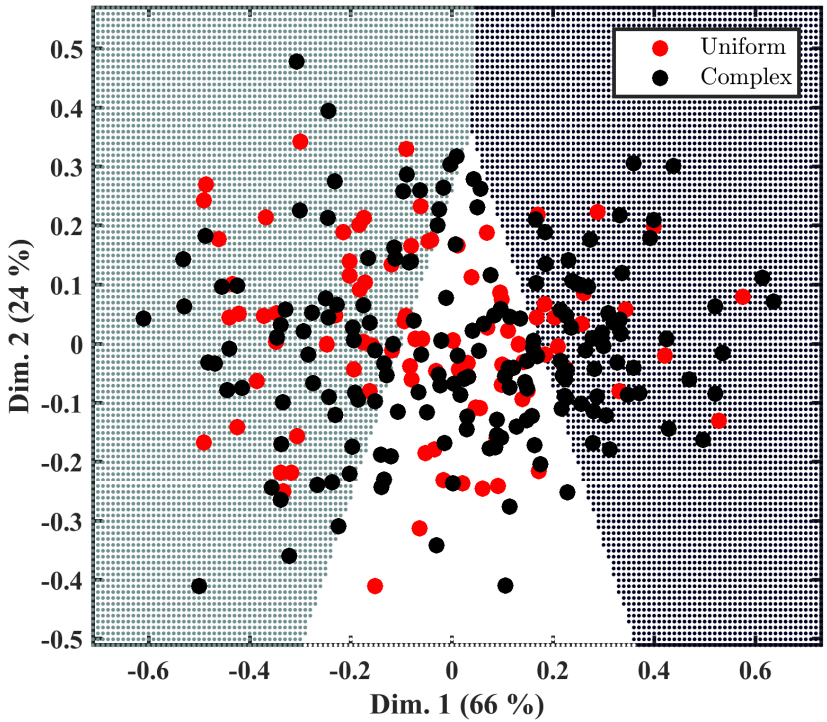


systematic differences between documents result in sub-corpora (e.g., genre, author characteristics, community effects)

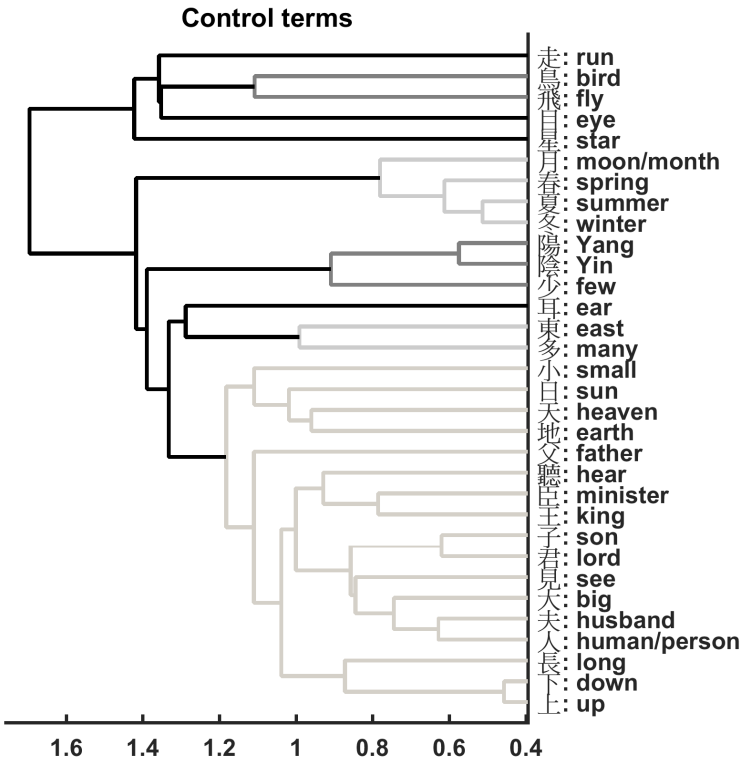


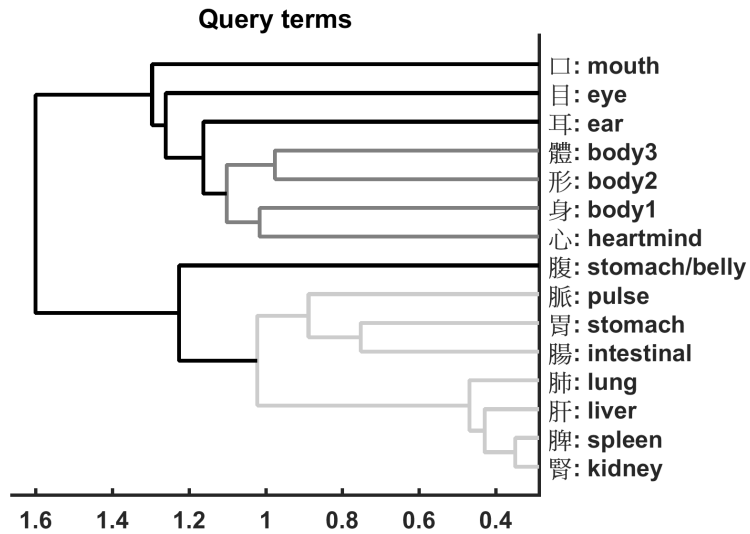
partition documents (or other objects) into homogeneous subsets using document similarity/distance


0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
PC2
-0.6
-0.4
-0.2
0
0.2
0.4
PC1
KEYWORDS
brother
fight
mujahidin
ummah
women
abu
brother
children
love
people
Al Qaeda
AQAP
Inspire
issue
magazine
America
attack
bomb
people
world
Allah*
Islam
message
Muslim
time



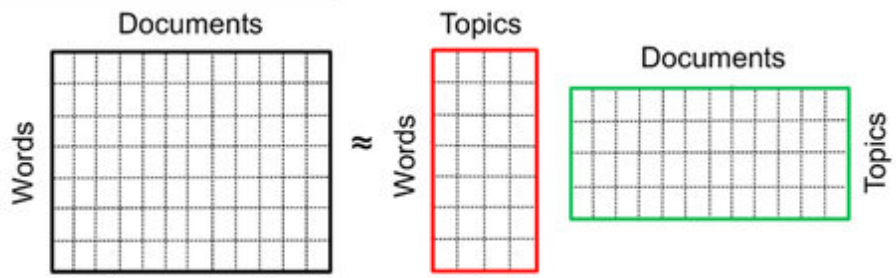
Causal relationship	LRD in *ads* + *articles*	LRD in *ads*	LRD in *articles*	no LRD
Uniform (*ads* ⇒ *article*)	cigarettes	∅	LIFESTYLE sweater flanel cocker spaniels parakeet bikes	ENTERTAINMENT cinema restaurent
Complex (*ads* ⇔ *article*)	PRODUCE potatoes apples beans lettuce cauliflower	∅	INTERIOR couch dressoir carpet	TECHNOLOGY tape-recorder radio television





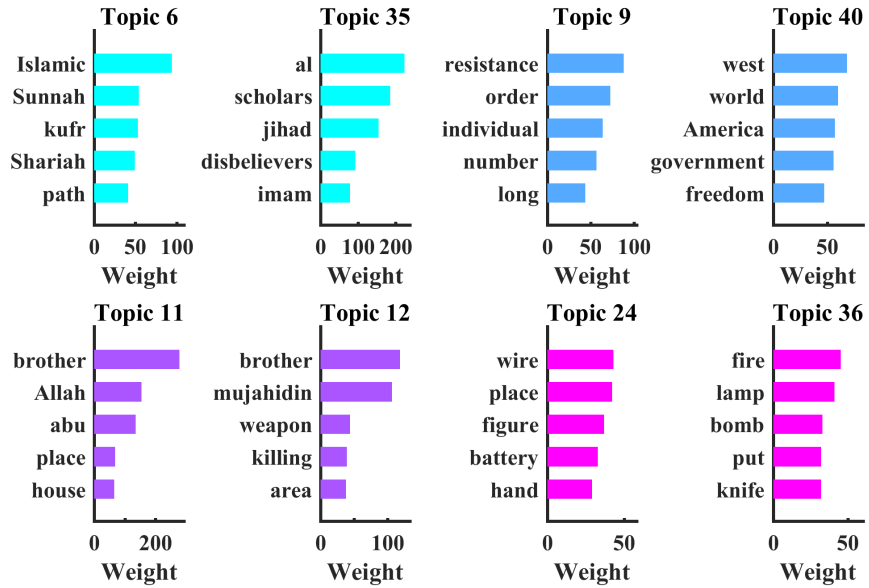
– with hierarchical clustering you cut or prune the tree at some level to define clusters

we can extract latent semantic variables that generated the documents by reverse engineering the process *words* & *doc* $\Rightarrow$ *topics*



topic modeling a set of unsupervised mixed models where each document is more or less likely within each clusters

1. **discover** thematic structure
2. **annotate** documents
3. **use** the annotations to visualize, organize, summarize, ...


Topic 6
Islamic
Sunnah
kufr
Shariah
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Topic 35
al
scholars
jihad
disbelievers
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Topic 9
resistance
order
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number
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Topic 40
west
world
America
government
freedom
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Topic 11
brother
Allah
abu
place
house
0 200
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Topic 12
brother
mujahidin
weapon
killing
area
0 100
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Topic 24
wire
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figure
battery
hand
0 50
Weight
Topic 36
fire
lamp
bomb
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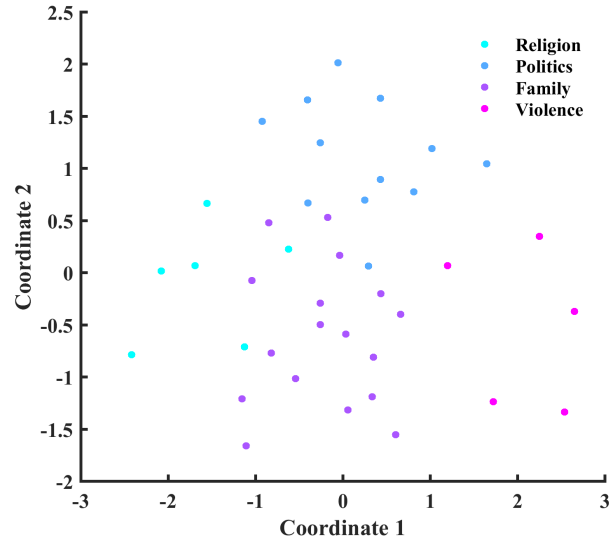
knife
0 50
Weight


Religion
Politics
Family
Violence
Coordinate 2
Coordinate 1
2.5
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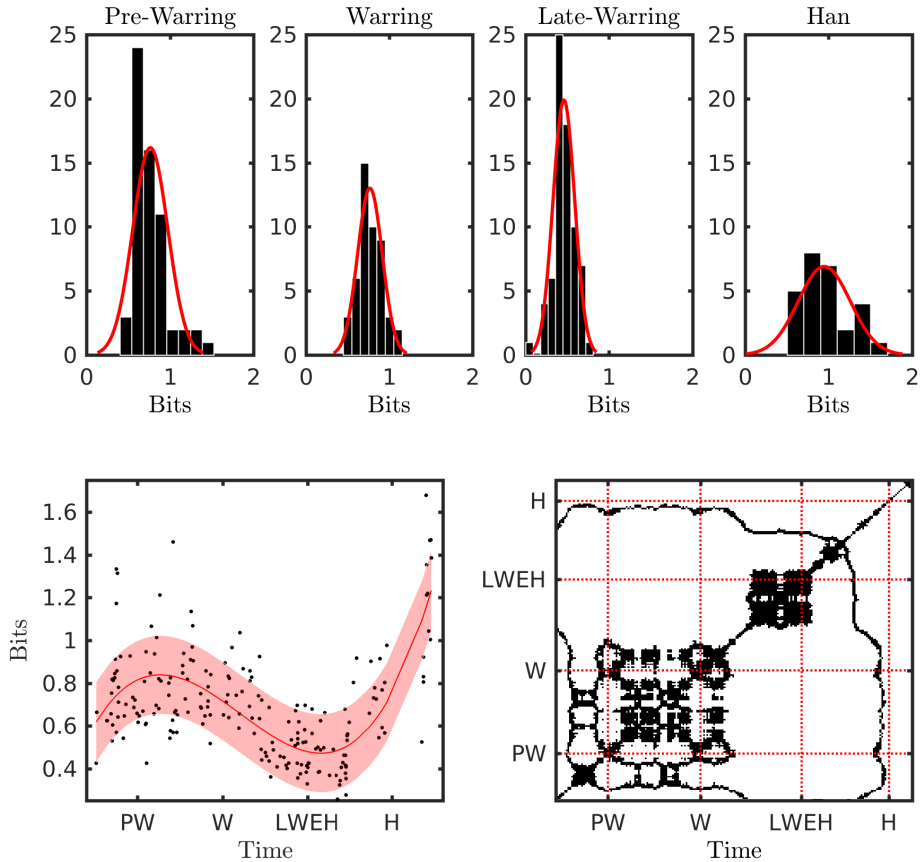


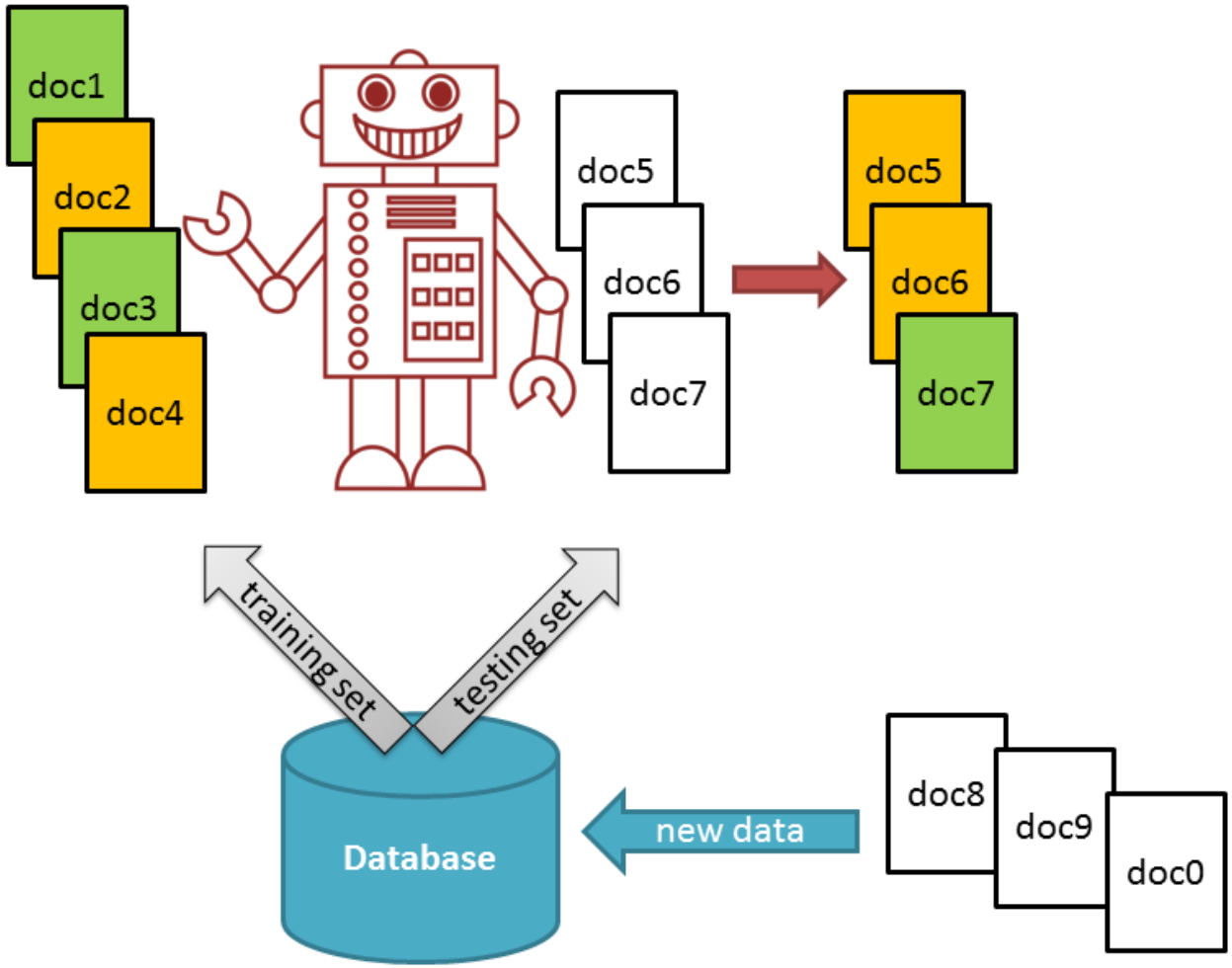
represent each document as a distribution on topics: $\theta_{d=1\ldots M}$

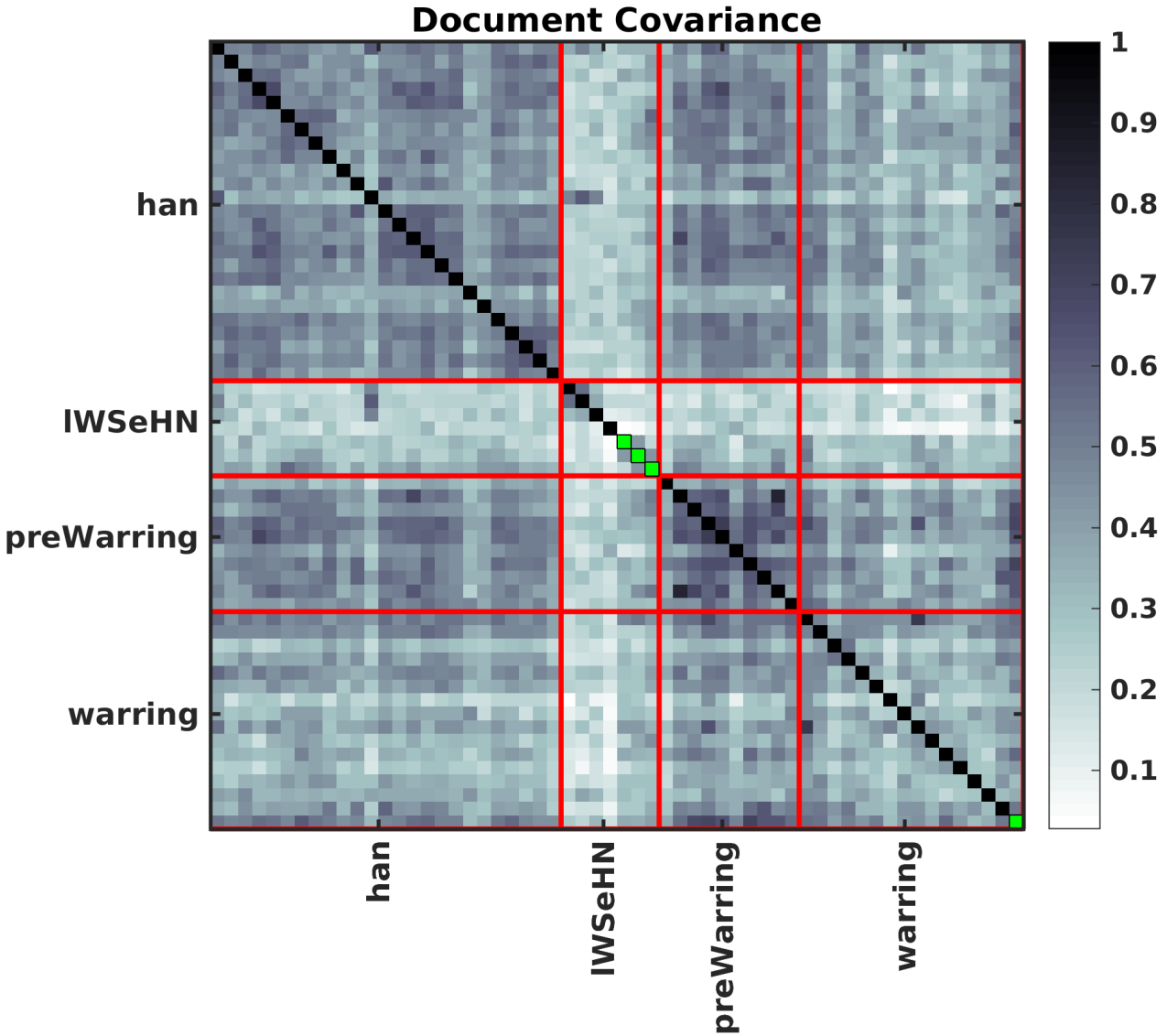
semantic innovation $\sim$ relative entropy between documents:
$D_{KL}(P \parallel Q) = \sum_i P(i) \log \frac{P(i)}{Q(i)}$

supervised learning|classfication
documents often come with associated metadate in the form of classes or labels (e.g., genres, departments, companies) $\rightarrow$ approximate a function that can map document features onto class information

train a classifier on labeled documents, test on unseen documents, and generalize to new instances

while clustering (unsupervised learning) searches for groups within the corpus, classification learns to map a collection of documents onto a categorical class values


doc1
doc2
doc3
doc4
doc5
doc6
doc7
doc5
doc6
doc7
training set
testing set
Database
new data
doc8
doc9
doc0



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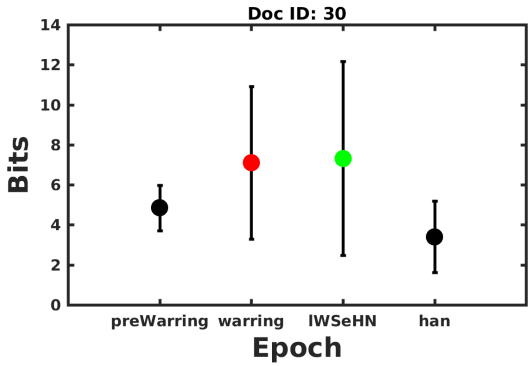
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Bits
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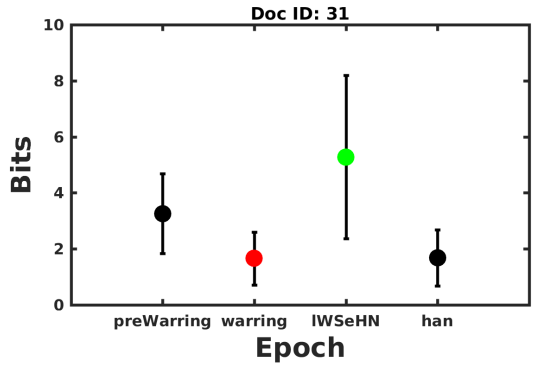
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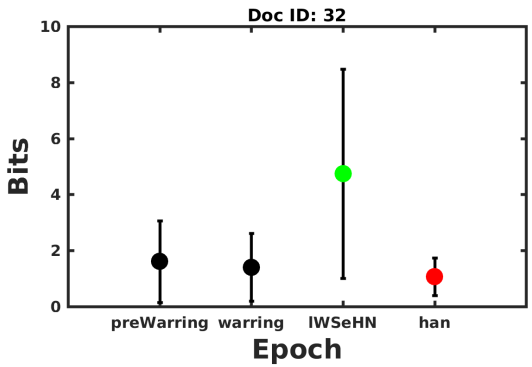
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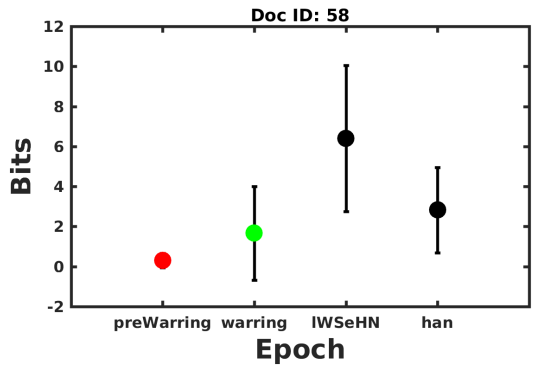
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