Project 4: Machine Learning

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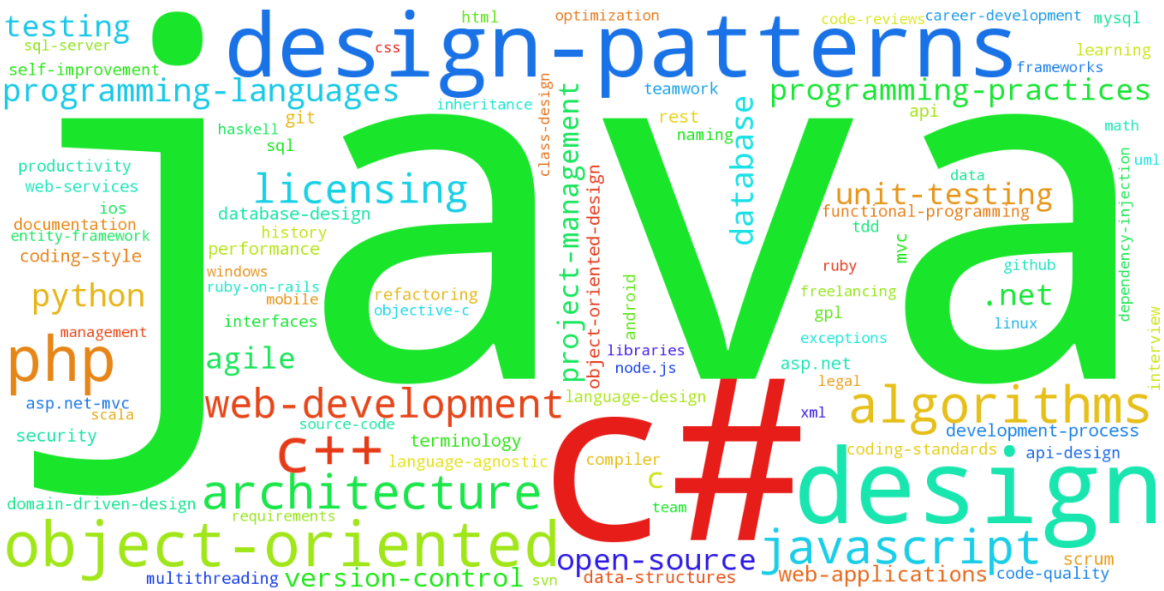
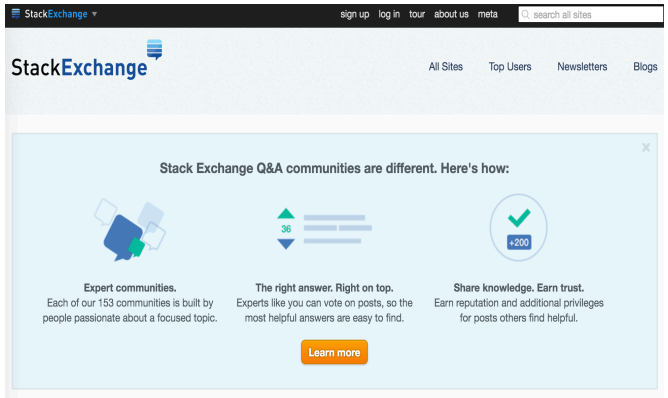


Motivation

Stack Exchange:

- Experts can subscribe to tags
- ➢ Mandatory to assign proper tags to questions

- Users can create new or use existing tags
- Manual tagging may be challenging (e.g. “.Net” and “DotNet")
- ➢ Suggesting tags for new questions is crucial



Task

- Given: new question containing a title and a body

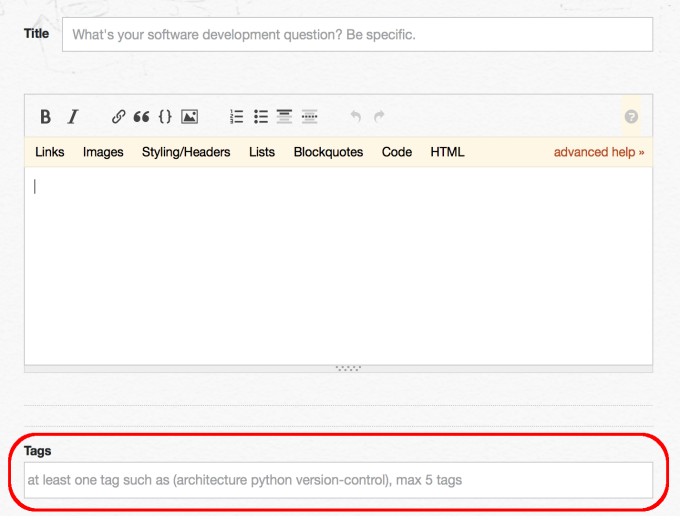
➢ Goal: suggest/assign up to 5 tags from a limited list of tags

- Analyse given data set

- Supervised:
  Train classifier on data set

- Unsupervised:
  Find patterns in data (e.g. groups)

- Evaluate results and compare both approaches



Data Set

- Stack Exchange Data Dump from March 1st, 2016
- Subgroup: programmers.stackexchange.com
- Packed size: 179.5 MB
- Post, tags and users are stored in separate XML files
- Tags consist of 1-5 words separated by "." and "-"


```xml
<?xml version="1.0" encoding="utf-8"?>
<posts>
  <row Id="1" PostTypeId="1" AcceptedAnswerId="13"
CreationDate="2010-09-01T19:34:48.000" Score="100" ViewCount="25786"
Body="&lt;p&gt;A coworker of mine believes that &lt;em&gt;any&lt;/em&gt; use c
in-code comments&lt;/p&gt;&#xA;" OwnerUserId="6" LastEditorUserId="226"
LastEditDate="2011-11-25T22:32:41.300"
LastActivityDate="2012-11-27T19:29:27.740" Title="&quot;Comments are a code
smell&quot;" Tags="&lt;java&gt;&lt;python&gt;" AnswerCount="34"
CommentCount="10" FavoriteCount="49" ClosedDate="2012-11-27T20:11:51.580"
CommunityOwnedDate="2011-01-31T09:04:54.130" />
```

Characteristics of Data Set

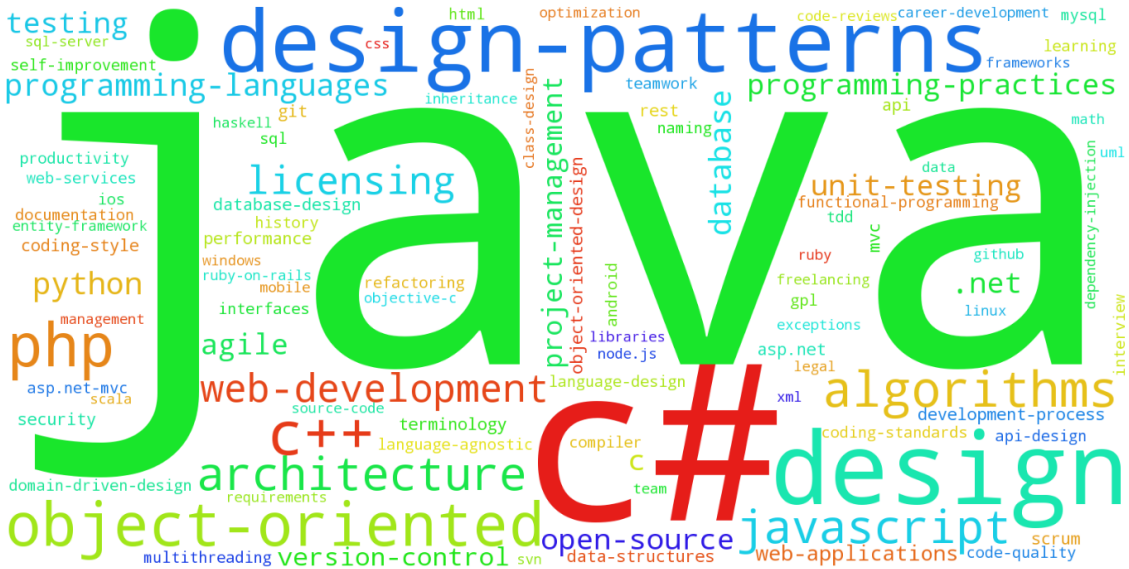
Total number of …	
Posts	38,315
Tags	1,614

Tags per post	
Min	1
Max	5
Average	2.68

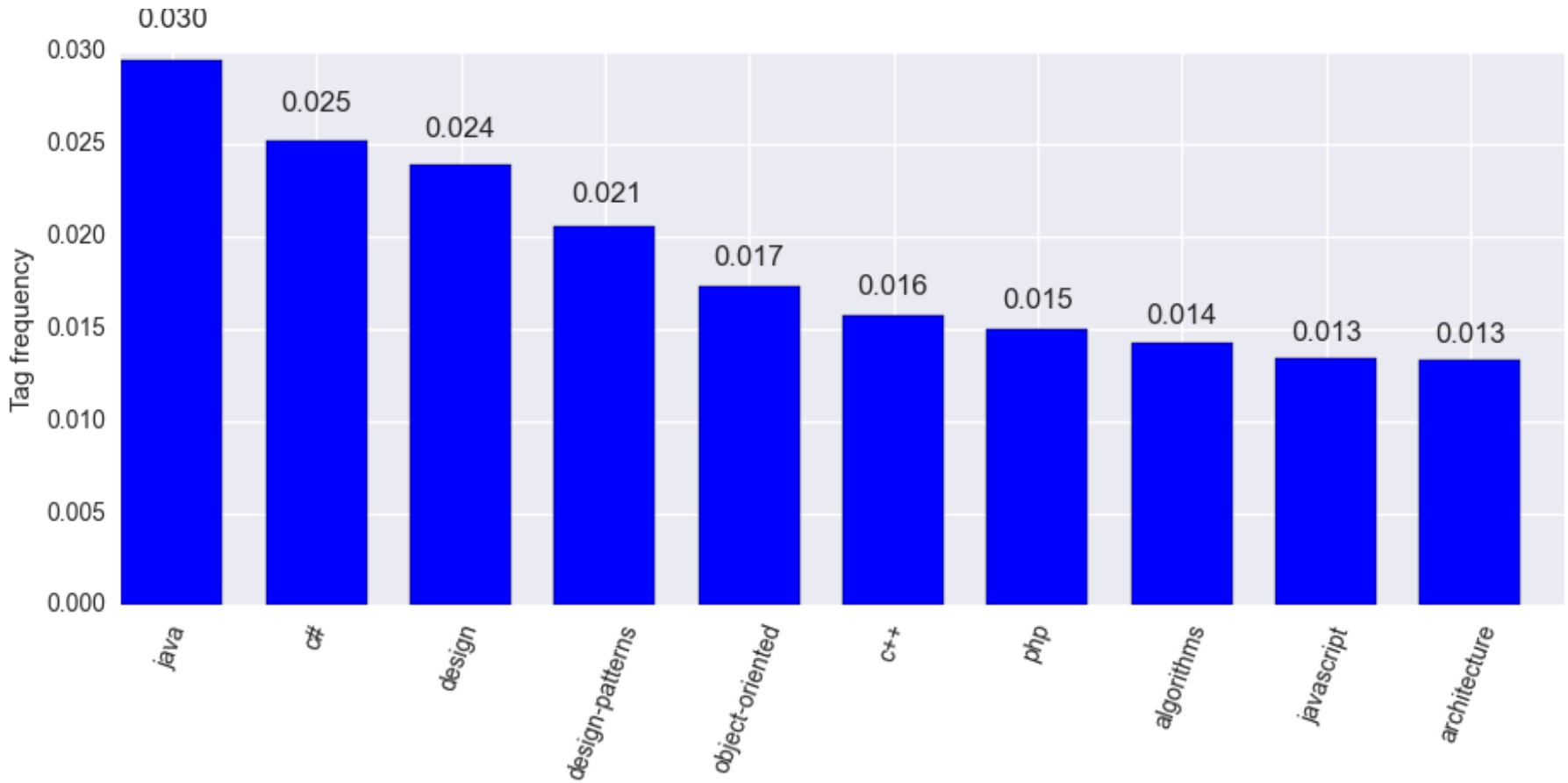
Post length (words)	
Min	6
Max	3,348
Average	178.65

Top 10 Tags

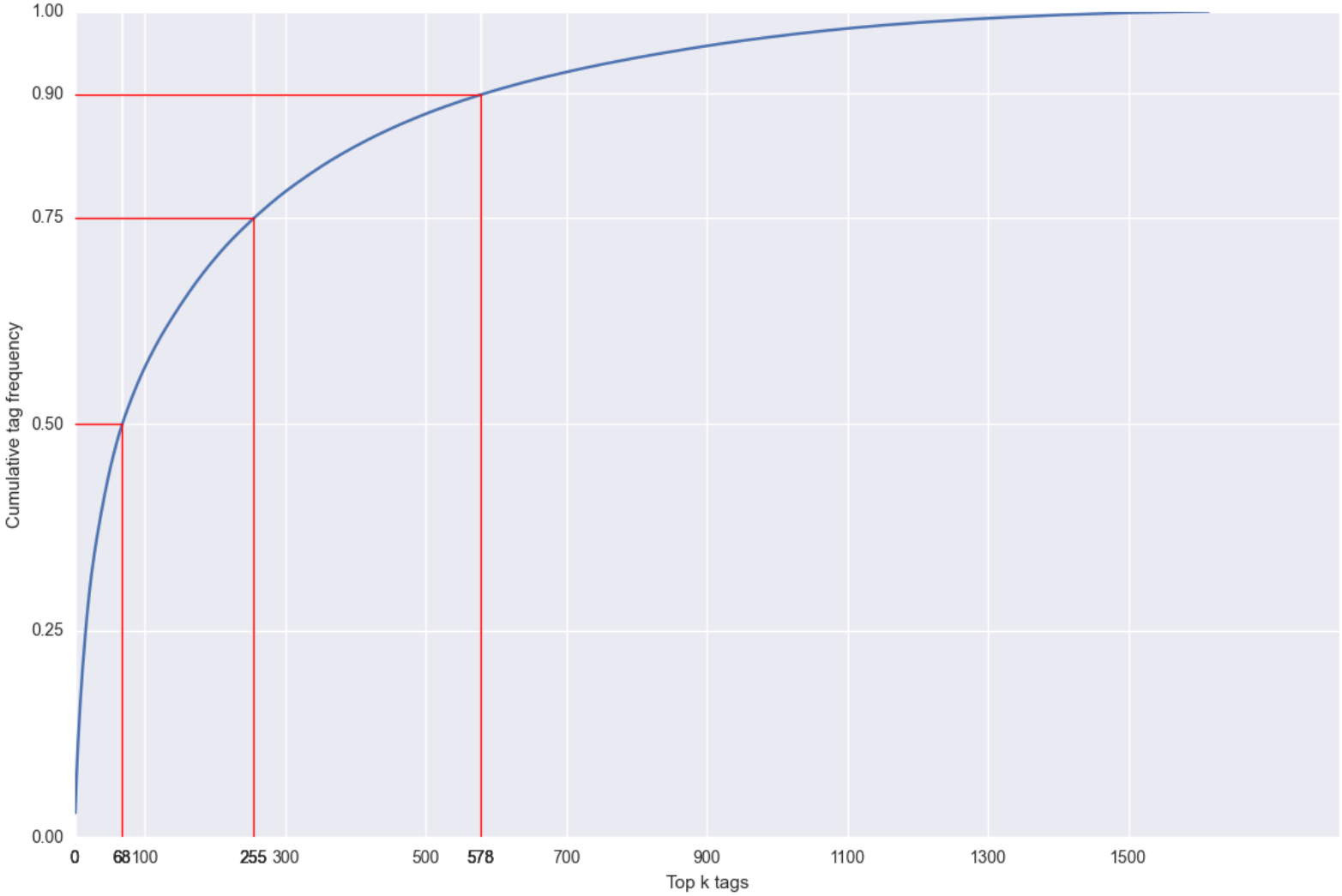
#	Tags
1	java
2	c#
3	design
4	design-patterns
5	object-oriented
6	c++
7	php
8	algorithms
9	javascript
10	architecture



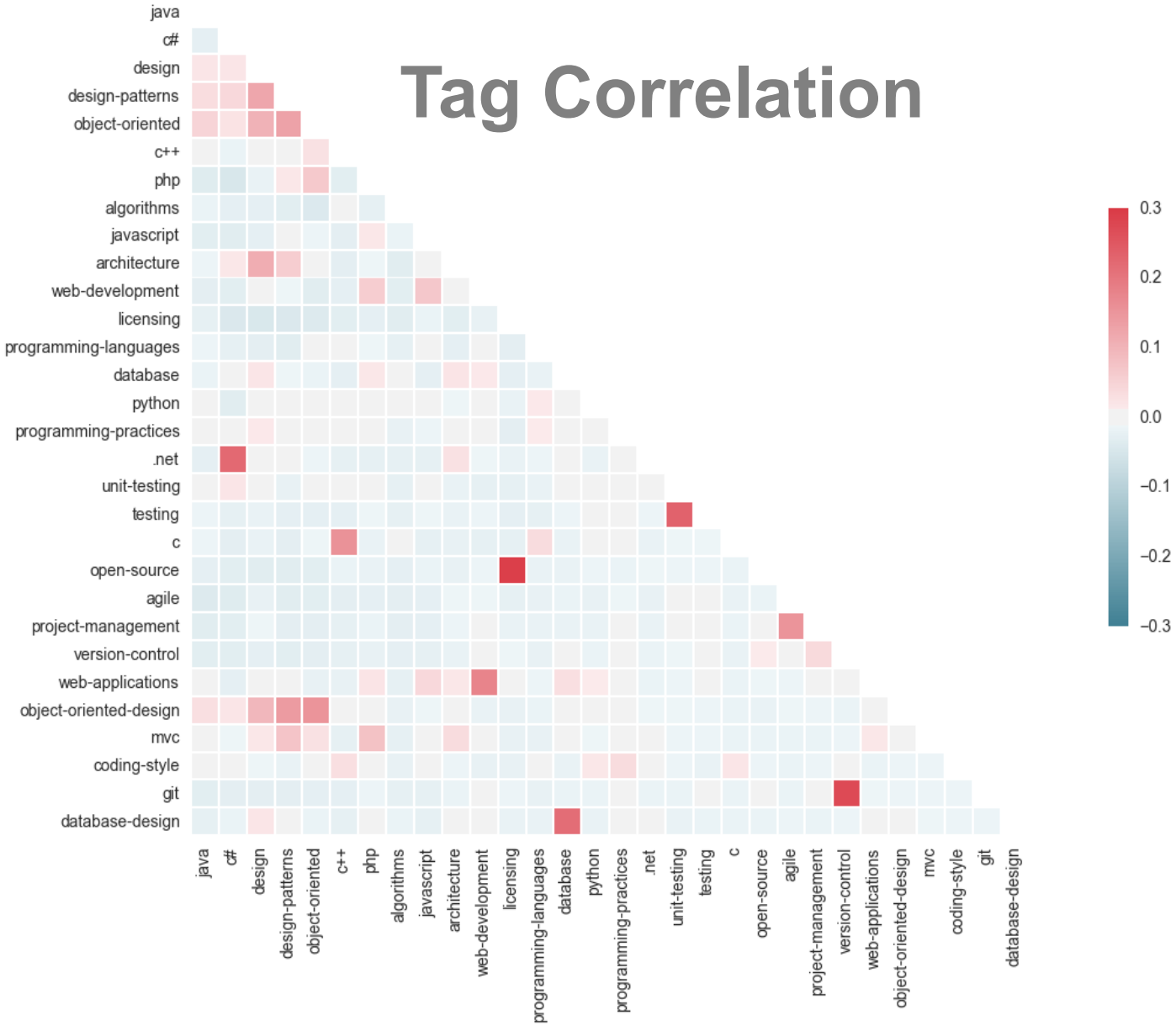
Top 10 Tags


0.030
0.025
0.024
0.021
0.017
0.016
0.015
0.014
0.013
0.013
Tag frequency
0.030
0.025
0.020
0.015
0.010
0.005
0.000
java
c#
design
design-patterns
object-oriented
c++
php
algorithms
javascript
architecture

Cumulative Tag Frequency



Tag Correlation



Outlook

1. Preprocessing

- Parse XML from Stack Exchange Data Dump (title, body, tags)

Content

- Strip html code from body
- Tokenize title + body (be careful: “C++” != “C” != “C#”)
- Stop word removal
- Stemming
- Lemmatization (be careful: “Windows” (OS) != “window”)
- POS-tagging

Tags

- Filter “rare”/”unique” tags ➔ reduce dimensionality
- Structure related tags (synonyms from Stack Exchange Data Explorer)

Outlook

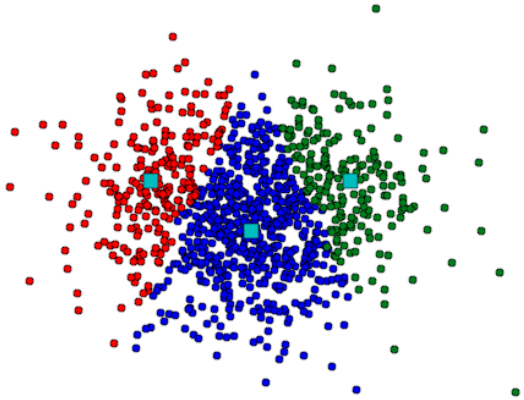
2. Supervised learning

- Separate data into test & training data
- Fit a supervised learning model
  - Naïve Bayes
  - Support Vector Machines (SVM)
  - k-Nearest Neighbors
- Evaluate best model
  - Precision
  - Recall
  - F1 measure

Outlook

3. Unsupervised learning

- Fit a model
  - k-means clustering
  - Hierarchical Agglomerative Clustering (HAC)
- Calculate TF--IDF (weighting)
- Evaluate best model
  - Precision, Recall, F1 measure
  - Rand Index



4. Compare both approaches

Thank you for your attention.

Attachment 1: Tag Correlation (zoomed)