Basic Clustering

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Outline

1. Introduction

What is cluster analysis?

- grouping objects by similar features
- often unsupervised analysis of a dataset into "natural" groupings
- explorative
- See http://en.wikipedia.org/wiki/Cluster_analysis

Clustering

- Many different techniques
  - group by
    - connectivity
    - centroids: (the centers of a cluster)
    - distributions
    - densities
    - features

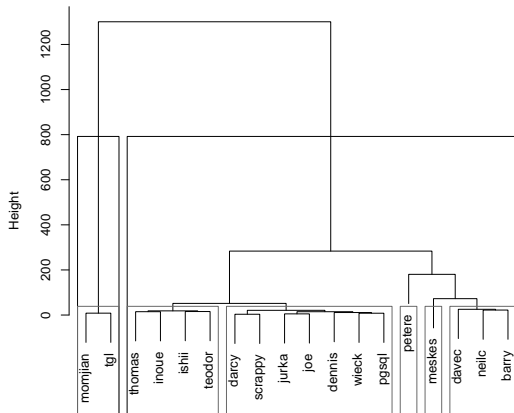# Clustering as labelling?

- Single label
  - Hierarchical clustering
  - K-means
- Multilabel
  - LDA
  - LSI

Hierarchical clustering

- show connectivity and distance
- partner or pair elements and then cluster these pairs
- hierarchical grouping
- the plot is called a Dendrogram
- The distance metric matters
- Distance Metric: Euclidean Distance
  - $\sqrt{\sum_{i=1}^{n} (p_i - q_i)^2}$
  - $\sqrt{p \cdot p}$

Cluster Dendrogram

PostgreSQL Authors
Organized into 2 and 6 clusters

R code

```
v <- read.csv("Author_NFRs.csv"); vv <- v[1:18,]
for (i in 2:17) { vv[,i] <- as.numeric(vv[,i]) }
tv <- t(vv[,2:8])
authors <- matrix(tv,nrow=7,
                dimnames=list(labels(tv)[[1]],vv[,1]))
pdf("postgresql-author-cluster.pdf")
hc <- hclust(dist(t(authors)),method="ward")
plot(hc,sub="Organized into 2 and 6 clusters",
  xlab="PostgreSQL Authors")
rect.hclust(hc,k=2,border="black")
rect.hclust(hc,k=6,border="dimgrey")
dev.off()
```

Distance Functions

- Magnitude (Size)
  - Euclidean $\sqrt{p} \cdot p$
  - More so about size in space
  - Less concerned about membership
- Angular (Proportional)
  - Cosine $1 - \frac{A \cdot B}{\|A\|\|B\|}$
  - Correlation - $1 - cor(A, B)$
  - These methods are about content
  - Popular in IR

R code: Pearson Similarity/Distance

```
pdf("oldpostgresql-author-cluster.pdf")
hc <- hclust(as.dist(1-cor(authors)),method="ward")
plot(hc,sub="Organized into 2 and 6 clusters",xlab="Postg
rect.hclust(hc,k=2,border="blue")
rect.hclust(hc,k=6,border="purple")
dev.off()
```

Hierarchical Clustering Dendrogram: Pearson Distance

Cluster Dendrogram

PostgreSQL Authors
Organized into 2 and 6 clusters
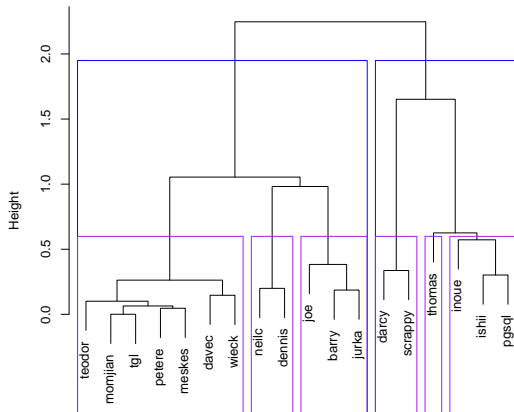
```
library(lsa)
pdf("postgresql-author-cluster-cosine.pdf")
hc <- hclust(as.dist(1-cosine(authors)),method="ward")
plot(hc,sub="Organized into 2 and 6 clusters",xlab="Postg
rect.hclust(hc,k=2,border="blue")
rect.hclust(hc,k=6,border="purple")
dev.off()
```

Cluster Dendrogram