6.S079 Quiz 1 Sample Questions

Topics

- SQL
  - All concepts on PS 1, e.g., joins, aggregates, window functions, recursion
- Database Tuning
  - When to create & use indexes
- Pandas
  - Understanding python code & semantics of operations
- Regular Expressions
  - Sed, awk, grep
- Text processing
  - Stemming
  - Similarity metrics, e..g., cosine and jaccard similarity
- Missing Value Substitution
- Entity Resolution
- Outliers / Box Plots
- Feature engineering
- Clustering Algorithms
- Classification Algorithms
  - Decision Tree (ID3)
  - Differences of common algorithms
  - Decision boundaries
- EM algorithm
- Evaluation
  - Accuracy / Precision / Recall / F1
  - Cross-validation
  - Training vs Test vs Validation error
  - Bias vs Variance

SQL 1

Consider the following English language and corresponding SQL queries over a database recording books, authors, bookstores, stores, and sales

The tables in this database are:

Authors (a_id, name)
Books (b_id, title, b_a_id) % b_a_id references a_id
Stores (st_id, name, address)
BookStores (bs_st_id, bs_b_id) % bs_st_id references st_id,
% bs_b_id references b_id
Sales(s_b_id, s_st_id, date, price) %s_b_id references b_id
%s_st_id references st_id

Complete the query

```
Authors (a_id, name)
Books (b_id, title, b_a_id)  % b_a_id references a_id
Stores (st_id, name, address)
BookStores (bs_st_id, bs_b_id)  % bs_st_id references st_id,
                                %  bs_b_id references b_id
Sales(s_b_id, s_st_id, date, price)  %s_b_id references b_id
                                     %s_st_id references st_id
```

1. Find the stores that sell no books by the author 'John Smith'

```
WITH JSBookStores as (
        SELECT bs_st_id
        FROM BookStores JOIN Books ON bs_b_id = b_id
        JOIN Authors on b_a_id = a_id
        WHERE name = 'John Smith'
)
SELECT bs_st_id  FROM BookStores WHERE _____________________
```

```
SELECT bs_s_id  FROM BookStores WHERE bs_s_id NOT IN
(SELECT bs_s_id FROM JSBookStores)
```

Complete the query

```
Authors (a_id, name)
Books (b_id, title, b_a_id)  % b_a_id references a_id
Stores (st_id, name, address)
BookStores (bs_st_id, bs_b_id)  % bs_st_id references st_id,
                                %  bs_b_id references b_id
Sales(s_b_id, s_st_id, date, price)  %s_b_id references b_id
                                     %s_st_id references st_id
```

Find the number of books written by each author

```
SELECT name, count(*) FROM
_____________________
GROUP BY name
```

```
SELECT name, count(*) FROM
        Authors LEFT JOIN Books ON a_id = b_a_id
        GROUP BY name
```

Regular Expressions

Suppose you need to extract the month from a sequence of ID codes in a file 'input.csv', where each line is of the form:

N…CCCMMMDD

Where N… is one or more numerical digits, CCC is 3 characters, MMM is a 3 character month abbreviation, and DD is a 2 digit date.

Write a sed expression to output the MMM from a number of rows of this form, using the sed command:

s/pattern/replacement/g

Where pattern is a regular expression and replacement is the output of the pattern.

You can assume that you are using "extended sed" such that you don't need to escape the characters '{', '}', '+', '*', '(', and ')' when using them for counting and grouping in the regular expression.

Regular Expressions Solution

s/^[0-9]+[a-zA-Z]{3}([a-zA-z]{3})[0-9]{2}/\1/g

Explanation:

^ - newline
[0-9]+ - leading digits
[a-zA-Z]{3} - 3 characters
(…) - the backreferences we want to capture
[a-zA-Z]{3} - 3 character month
[0-9]{2} - trailing two digits

\1 is the value of captured backreference (3 character month), which we want to output

Text Similarity

Given the following two passages, compute their Jaccard and Cosine similarity

The quick brown fox runs
The beige slow fox runs hard

The	1	1
Quick	1	0
Brown	1	0
Fox	1	1
Runs	1	1
Beige	0	1
Slow	0	1
Hard	0	1

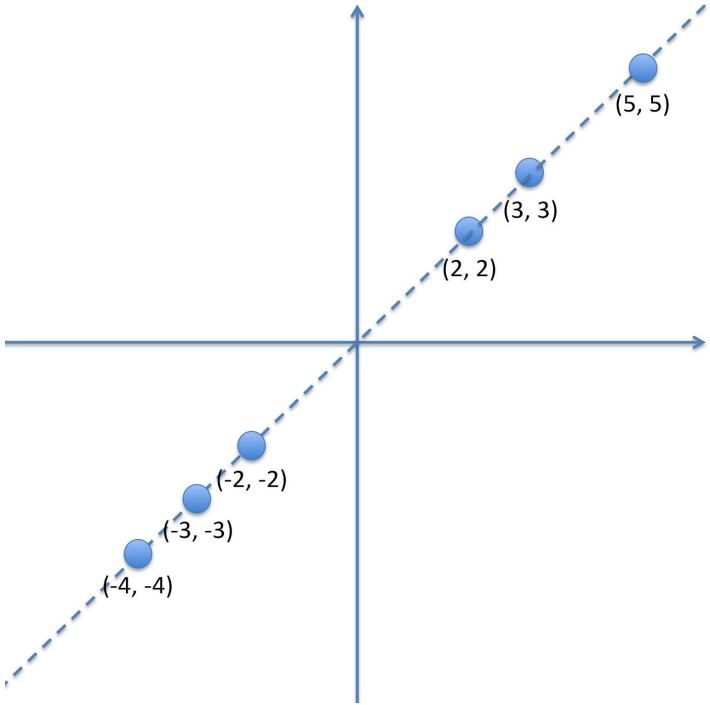
$$\text{Cos}(\Theta) = V1 \bullet V2 \,/\, ||V1|| \times ||V2||$$

3 / (sqrt(5) * sqrt(6)) = .55

$$sim(s1, s2) = \frac{s1 \cap s2}{s2 \cup s2}$$

3 / 8 = .375

Clustering



We have six data points in the euclidean plane, and we want to use k-means algorithm to cluster them.

Suppose we set K=2. If the initial position of the centroids are at (-4, -4) and (-3, -3), after running the algorithm for one iteration, what is the position of each centroid? Which centroid will each point be assigned to?

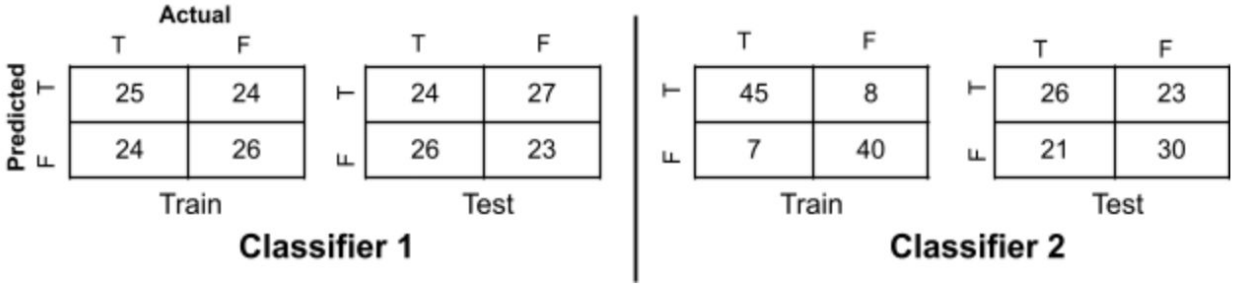
ID3

An online retailer Valmart wants to know if any of the product listings will run out of stock on Black Friday. As a machine learning engineer at the firm, your job is to build a classifier to predict whether a given product listing will go **Sold Out**. Show the **first** split for an ID3 decision tree on the following examples. (10 points)

Category	**On Sale**	**Price Range**	**Sold Out**
Home & Elec	Yes	$100 ~ $200	Yes
Home & Elec	No	$100 ~ $200	Yes
Books & Music	Yes	$5 ~ $25	Yes
Books & Music	No	$5 ~ $25	No
Books & Music	Yes	$5 ~ $25	No
Books & Music	No	$30 ~ $90	Yes
Clothing & Shoes	Yes	$30 ~ $90	No
Clothing & Shoes	No	$30 ~ $90	No

Evaluation

Suppose you have two classifiers (C1 and C2). For each classifier, we provide you with two confusion matrices: one for the the training set, the other one from the test set (you can assume it is based on the average of 10-fold cross-validation).



For Classifier 1: Is the classification accuracy good? Does the classifier suffer from high bias or high variance? Explain your answers. It is close to random guessing. It suffers from high bias. Error is high on training and test data.

For Classifier 2: Is the classification accuracy good? Does the classifier suffer from high bias or high variance? Explain your answers. High Variance