

# CSE 515 Multimedia and Web Databases

## Phase #3

(Due November 24th 2020, midnight)

**Description:** In this project, you will experiment with

- indexing,
- classification, and
- relevance feedback.

This project will build on the deliverables of the previous phase. Consider the data that was provided to you in the previous phase.

- **Task 1: Representative gesture identification** Implement a program which, given a value  $k$ , creates a gesture-gesture similarity graph, such that from each gesture, there are  $k$  outgoing edges to  $k$  most similar/related images/gestures to it. Given  $n$  user specified gestures on the graph, the program identifies and visualizes  $m$  most dominant gestures using Personalized Page Rank (PPR) for a user supplied  $m$ . See
  - “J.-Y. Pan, H.-J. Yang, C. Faloutsos, and P. Duygulu. Automatic multimedia cross-modal correlation discovery. In KDD, pages 653-658, 2004”

for a personalized PageRank formulation based on RandomWalks with re-start.

- **Task 2: Gesture classification:** Implement
  - a  $k$ -nearest neighbor based classification algorithm,
  - a PPR based classifier, and
  - a decision tree based classification algorithm.

which takes a set of labeled gestures and associates a label to the rest of the gestures in the database.

- **Task 3: Multi-dimensional index structures and nearest neighbor search task:**
  - Implement a Locality Sensitive Hashing (LSH) tool, which takes as input (a) the number of layers,  $L$ , (b) the number of hashes per layer,  $k$ , and (c) a set of vectors as input and creates an in-memory index structure containing the given set of vectors. See
    - “Near-Optimal Hashing Algorithms for Approximate Nearest Neighbor in High Dimensions” (by Alexandr Andoni and Piotr Indyk). Communications of the ACM, vol. 51, no. 1, 2008, pp. 117-122.
  - Implement similar gesture search using this index structure: for a given gesture and  $t$ , outputs the  $t$  most similar gestures (also outputs the numbers of buckets searched as well as the unique and overall number of gestures considered).

- **Task 4: Probabilistic relevance feedback:** Implement a probabilistic relevance feedback system to improve nearest neighbor matches, which enables the user to label some of the results returned by the search task as relevant or irrelevant and then returns a new set of ranked results, either by revising the query or by re-ordering the existing results. You can consider,
  - the relative importances of sensors,
  - the relative importances of the X,Y,Z, and W components,
  - the relative importances of the different words.

The system should output the revisions it suggests in the relative importances of different features in the query. See

*Gerard Salton and Chris Buckley. Improving retrieval performance by relevance feedback Journal of the American Society for Information Science. 41, pp. 288-297, 1990.*

- **Task 5: Classifier-based relevance feedback:** Implement a PPR based relevance feedback system to improve nearest neighbor matches, which enables the user to label some of the results returned by the search task as relevant or irrelevant and then returns a new set of ranked results, either by revising the query or by re-ordering the existing results.
- **Task 6: Query and feedback interface:** Implement a query interface, which allows the user to provide a query, relevant query parameters (including how many results to be returned). Query results are presented to the user in decreasing order of matching.

The result interface should also allow to user to provide positive and/or negative feedback for the ranked results returned by the system.

User feedback is than taken into account (*either by revising the query or by re-ordering the results as appropriate*) and a new set of ranked results are returned.

#### **Deliverables:**

- Your code (properly commented) and a README file.
- Your outputs for the provided sample inputs.
- A short report describing your work and the results.

Please place your code in a directory titled “Code”, the outputs to a directory called “Outputs”, and your report in a directory called “Report”; zip or tar all off them together and submit it through the digital dropbox.