CSE 515 Multimedia and Web Databases

Phase #1

(Due Oct 20th 2019, midnight)

Description: In this project, you will experiment with

- image features,
- vector models, and
- dimensionality reduction

All the following tasks will be implemented on a given data set.

- **Task 1:** Implement a program which (a) lets the user to chose among one of the four feature models from Phase 1 and (b) given a positive integer value, k, identifies and reports the top-k latent semantics in the corresponding vector space using (c) one of the following techniques chosen by the user:
  - principal component analysis (PCA),
  - singular value decomposition (SVD),
  - non-negative matrix factorization (NMF) or
  - latent dirichlet analysis (LDA).

  -> Print the symmetrical matrix values?
  -> What is data matrix? Entire dataset?

  Each latent semantic should be presented in the form of term-weight pairs, ordered in decreasing order of weights.
- **Task 2:** Implement a program which (a) lets the user to chose among one of the four feature models and (b) given the top-k latent semantics for that feature model, created using (c) a dimensionality reduction technique chosen by the user, and given (d) an image ID, the system identifies the most related m images in the k-dimensional latent space (list also the matching scores).

  -> How to represnt the query image in latent space?
- **Task 3** Implement a program which (a) lets the user to chose among one of the four feature models and (b) given one of the labels,
  - left-hand,
  - right-hand,
  - dorsal,
  - palmar,
  - with accessories,
  - without accessories,
  - male, or
  - female

  -> All the images of the given metadata?

  identifies (and lists) k latent semantics for images with the corresponding metadata using (c) one of the following techniques chosen by the user:

  - principal component analysis (PCA),
  - singular value decomposition (SVD),
  - non-negative matrix factorization (NMF), or
  - latent dirichlet analysis (LDA).

- **Task 4** Implement a program which (a) lets the user to chose among one of the four feature models and (b) one of the four techniques (PCA, SVD, NMF, or LDA) and (c) given the k latent semantics associated with one of the labels,

  - left-hand,
  - right-hand,
  - dorsal,
  - palmar,
  - with accessories,
  - without accessories,
  - male, or
  - female

  -> How to decide the threshold for distance between the images once they are represented in given latent space?

  and (d) given an image ID, identifies the most related m images using these k latent semantics (list also the matching scores).

- **Task 5** Implement a program which (a) lets the user to chose among one of the four feature models and (b) one of the four techniques (PCA, SVD, NMF, or LDA) and (c) given the k latent semantics associated with one of the labels,

  - left-hand,
  - right-hand,
  - dorsal,
  - palmar,
  - with accessories,
  - without accessories,
  - male, and
  - female

  -> How to decide the class after representing them in the given latent space?

  and (d) an unlabeled image ID, the system labels it as

  - left-hand vs right-hand,
  - dorsal vs palmar
  - with accessories vs. without accessories
  - male vs. female

- **Task 6** Implement a program which given (a subject ID, identifies and visualizes the most related 3 subjects (you are free the use any feature model and latent semantics).

- **Task 7** Implement a program which, given a value k,

  - creates a subject-subject similarity matrix,
  - performs NMF on this subject-subject similarity matrix, and

  - reports the top-k latent semantics.

  Each latent semantic should be presented in the form of a subject-weight pairs, ordered in decreasing order of weights.

- **Task 8** Implement a program which, given a value k,
  - creates a binary image-metadata matrix,
  - performs NMF on this image-metadata matrix, and
  - reports
    - top-k latent semantics in the image-space.
    - top-k latent semantics in the metadata-space.

    Each latent semantic should be presented in decreasing order of weights.

  You can use existing libraries for PCA, SVD, NMF, and LDA decompositions.

  Deliverables:

  - Your code (properly commented) and a README file.
  - Your outputs for the provided sample inputs.
  - A 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.