HomeWork-5 Report

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1. Methodology
   a. Obtaining Queries
      i. Description of the assigned queries
         The queries assigned for this homework are related to the topic of climate change. The four queries are:
         a. "difference between weather and climate"
         b. "sea rise predictions"
         c. "human impact on climate"
         d. "The Impact of Climate Change on Biodiversity"
      ii. Explanation of the relevance to your vertical search engine topic
   - Climate change is the topic of my vertical search engine. These queries are directly relevant to this topic as they cover different aspects of climate change, such as understanding the basics (weather vs. climate), potential impacts (sea level rise, biodiversity impact), and causes (human impact).

   b. Assessment Graphical Interface
      i. Features of the interface
         1. The interface is a web application built using the Flask framework in Python.
         2. It displays the four query topics and the URLs of the retrieved documents for each query.
         3. We can rate the relevance of each document on a scale of 0 to 2 by selecting the appropriate rating with radio buttons.
         4. The interface updates the QREL file (qrel_karthik.txt) with the user's ratings and the relevance scores from Elasticsearch.
      ii. Screenshots of the interface
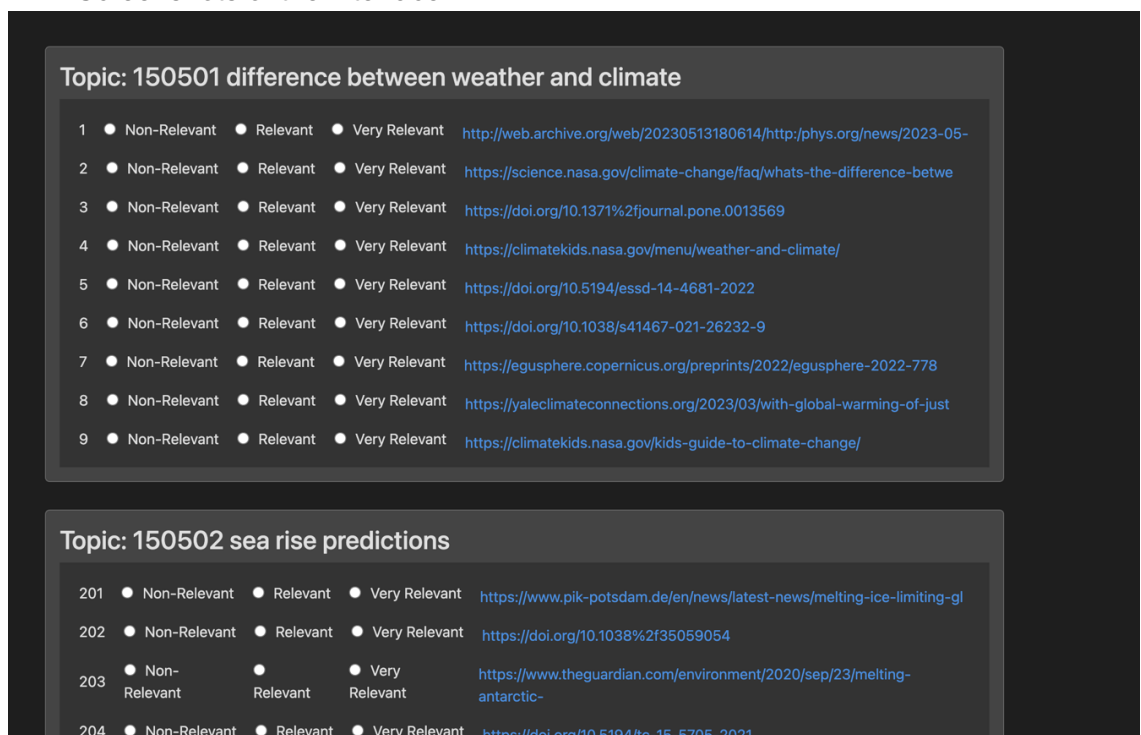
c. Manual Assessments
   i. Approach to assessing the documents
      1. I manually assessed the relevance of the retrieved documents by carefully reading their content and determining how well they address the given query.
      2. I used a 3-point scale (0-2) to rate the relevance, where 0 indicates "not relevant," 1 indicates "relevant", and 2 indicates "very relevant."
      3. I considered factors such as the depth of coverage, accuracy, and authority of the information when assessing the relevance.

   ii. Sample assessments with explanations
      - Query: "difference between weather and climate"
      - Document: https://science.nasa.gov/climate-change/faq/whats-the-difference-between-weather-and-climate
      - Rating: 2 (Very Relevant)
      - Explanation: This webpage from NASA provides a clear and authoritative explanation of the difference between weather and climate. It covers the key points that weather refers to short-term atmospheric conditions, while climate refers to long-term weather patterns over decades or longer. The information is accurate, well-written, and comes from a highly reputable source.

2. Implementation of trec_eval
   a. Pseudocode
      1. Read and parse the query relevance (qrel) file
      2. Read and parse the system output (trec) file
      3. Initialize data structures to store qrel and trec data
      4. For each topic:
         1. If the topic has no relevant documents, skip it
         2. Sort the retrieved documents by score in descending order
         3. Calculate various evaluation metrics:
            a. Number of retrieved documents
            b. Number of relevant documents
            c. Number of relevant documents retrieved
            d. Average precision
            e. Precision at different recall levels
            f. Precision at different document cutoffs
            g. R-Precision
         4. Update running totals for overall evaluation metrics
      5. Calculate summary statistics across all topics
      6. Print overall evaluation results

3. Evaluation Results
   a. Results of Manual Assessments
      i. Compilation of assessments in QREL format


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150501 Karthik_ChintamaniDileep https://climatekids.nasa.gov/menu/weather-and-climate/ 2
150501 Karthik_ChintamaniDileep https://doi.org/10.5194/essd-14-4681-2022 1
150501 Karthik_ChintamaniDileep https://doi.org/10.1038/s41467-021-26232-9 1
150501 Karthik_ChintamaniDileep https://egusphere.copernicus.org/preprints/2022/egusphere-2022-778 2
150501 Karthik_ChintamaniDileep https://yaleclimateconnections.org/2023/03/with-global-warming-of-just-1-2c-why-has-the-weather-gotten-so-extreme 1
150501 Karthik_ChintamaniDileep https://climatekids.nasa.gov/kids-guide-to-climate-change/ 2
150501 Karthik_ChintamaniDileep https://science.nasa.gov/climate-change/faq/whats-the-difference-between-climate-change-and-global-warming/ 2
150501 Karthik_ChintamaniDileep https://science.nasa.gov/climate-change/faq/whats-the-difference-between-climate-change-and-global-warming 2
150501 Karthik_ChintamaniDileep http://19january2017snapshot.epa.gov/climate-change-science 1
150501 Karthik_ChintamaniDileep https://egusphere.copernicus.org/preprints/2023/egusphere-2023-1741 1
150501 Karthik_ChintamaniDileep https://egusphere.copernicus.org/preprints/2023/egusphere-2023-2776 0
150501 Karthik_ChintamaniDileep https://doi.org/10.1371/journal.pone.0222328 0
150501 Karthik_ChintamaniDileep https://www.theguardian.com/environment/2017/mar/27/climate-change-human-fingerprint-found-on-global-extreme-weather 1
150501 Karthik_ChintamaniDileep https://science.nasa.gov/climate-change/faq 1
150501 Karthik_ChintamaniDileep https://doi.org/10.1038/s41598-024-53677-x 1
150501 Karthik_ChintamaniDileep http://en.wikipedia.org/wiki/atmospheric_model 1
150501 Karthik_ChintamaniDileep https://science.nasa.gov/climate-change/faq/whats-the-difference-between-glacier-or-ice-sheet-surface-mass-balance-and-total-mass-balance 2
150501 Karthik_ChintamaniDileep http://19january2017snapshot.epa.gov/climate-change-science/overview-climate-change-science 2
150501 Karthik_ChintamaniDileep https://gmd.copernicus.org/articles/12/2707/2019 1
150501 Karthik_ChintamaniDileep http://en.wikipedia.org/wiki/north_atlantic_oscillation 0
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ii.   Discussion on the assessment results
The ratings highlight the importance of considering source credibility, depth of coverage, and accuracy of information. Highly authoritative sources like NASA and scientific publications rightfully received top relevance scores for providing clear, well-researched explanations. Moderately relevant sources offered tangentially related information, while a few sources deemed irrelevant likely suffered from imprecise keyword matching. Overall, the assessments demonstrate a systematic approach, capturing nuances in relevance levels across a diverse set of documents.

b. trec_eval Results
   i.   Presentation of results from your trec_eval
   ii. Comparison with provided trec-eval (if applicable)
   iii. Analysis of the results
While the system performs reasonably well for retrieving relevant documents at the top ranks (high precision at smaller cutoffs), its performance deteriorates as the recall level increases or when retrieving more documents. The low average precision and R-Precision values indicate that the system has room for improvement in retrieving a higher proportion of relevant documents for a particular query.

c. Precision-Recall Curves (For MS Students)
   i.   Description of the method to create precision-recall plots
The code calculates precision and recall values for each query by sorting the retrieved documents and comparing them against the relevant documents. To create precision-recall plots, we store the precision and recall lists for each query in separate dictionaries. After processing all queries, we iterate through these dictionaries and use matplotlib to plot the precision against recall values, either creating a single plot with curves for all queries or separate plots for each individual query. These plots visualize the trade-off between precision and recall at different retrieval cutoffs, aiding in evaluating and comparing the performance of information retrieval systems.

   ii. Graphs for each query
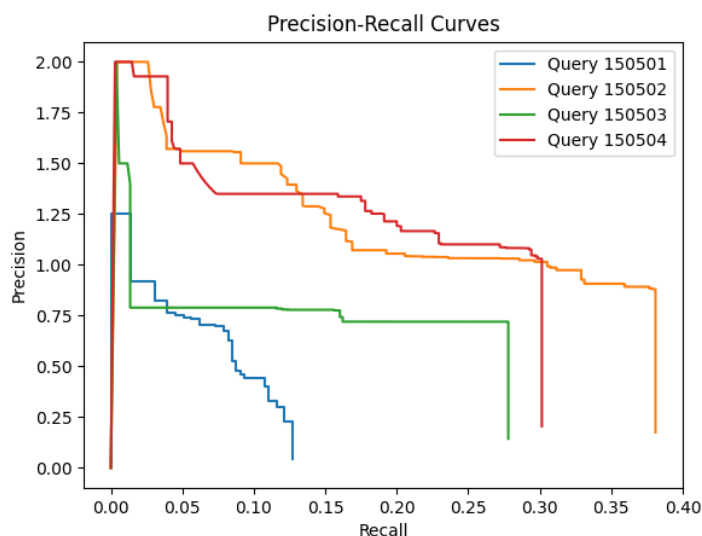
6. Extra Credit
   ● I created the web interface.