Mining Image Features for Efficient Query Processing

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ICDM 2001 (pp: 353 –360)

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Preliminaries

- **Perception-Based Image Retrieval [SIGMOD01]**
  - Query concept learner
  - Multi-resolution image characterization
- **Learning Image Query Concepts via Intelligent Sampling [ICME01]**
  - Select samples by MEGA
  - Solicit user feedback
  - Refine QCS by Vote
  - Refine CCS by Vote
Problems

- **Query Concepts: k-CNF**
  - \( C_1 \land \ldots \land C_\theta \), where \( C_i = (x_1 \lor \ldots \lor x_j) \) for \( j \leq K \)
  - Scalability of MEGA
    - Dimensionality-curse: number of disjunctions
    - Divide-and-conquer: trade precision for speed
      - Speed up of \( O(G^{k-1}) \) folds: \( M=144, k=3, G=12 \) \( \rightarrow \) 140 times
  - Genetic algorithm for mining feature groupings
    - Mapping between groupings and individuals
    - Genetic operators: *selection, crossover, mutation*
    - Fitness function

Solutions (1/2)

- **A Feature Grouping**
  - Exactly \( M \) features and no feature is replicated
- **Genetic Operators**
  - Tournament selection without replacement
  - Randomly exchange two features from two different feature groups for a given grouping
  - Randomly move a feature from one to another feature group according to a given probability
Solutions (2/2)

- **Fitness Function** \(=\) **Search Accuracy**
  - 51000 images of 18 categories (concepts)
  - Use the learned concepts for top-n image retrieval
- **Mining Algorithm**
  - Initialize N groupings
  - Compute the fitness value for each grouping
  - Apply the genetic operators in series
  - Continue the next generation if necessary

Experimental Results (1/3)

- **Tradeoff between Learning Time and Accuracy**
  - Find moderate G=20
Experimental Results (2/3)

- Discovering Optimal Groupings
  - Low intra-group correlation leads to high search precision

![Graphs showing experimental results]

Experimental Results (3/3)

- Feature - Concept Associations

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Concluding Remarks

- **Solving Two Mining Problems**
  - Learning query concepts from user feedback
  - Discovering optimal feature groupings
- **Goodness**
  - Identify feature - concept associations
- **Weakness**
  - Genetic algorithm is not efficient but effective
  - No measure for missing concepts

Paper Scoring

- **Scores {bad, marginal, good, excellent}**
  - Originality: good
  - Technical Depth: marginal
  - Impact/Practicability: good
  - Readability: marginal
  - Overall: good