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Outline

- Approach
- Subsystems and features
- Fusion strategies
- Results
- Conclusion

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Approach

- fully automatic
- set of independent subsystems, using different features
- query each sample of a topic independently
- each subsystem returns a ranked result list for each sample
- research focus: fusion strategies

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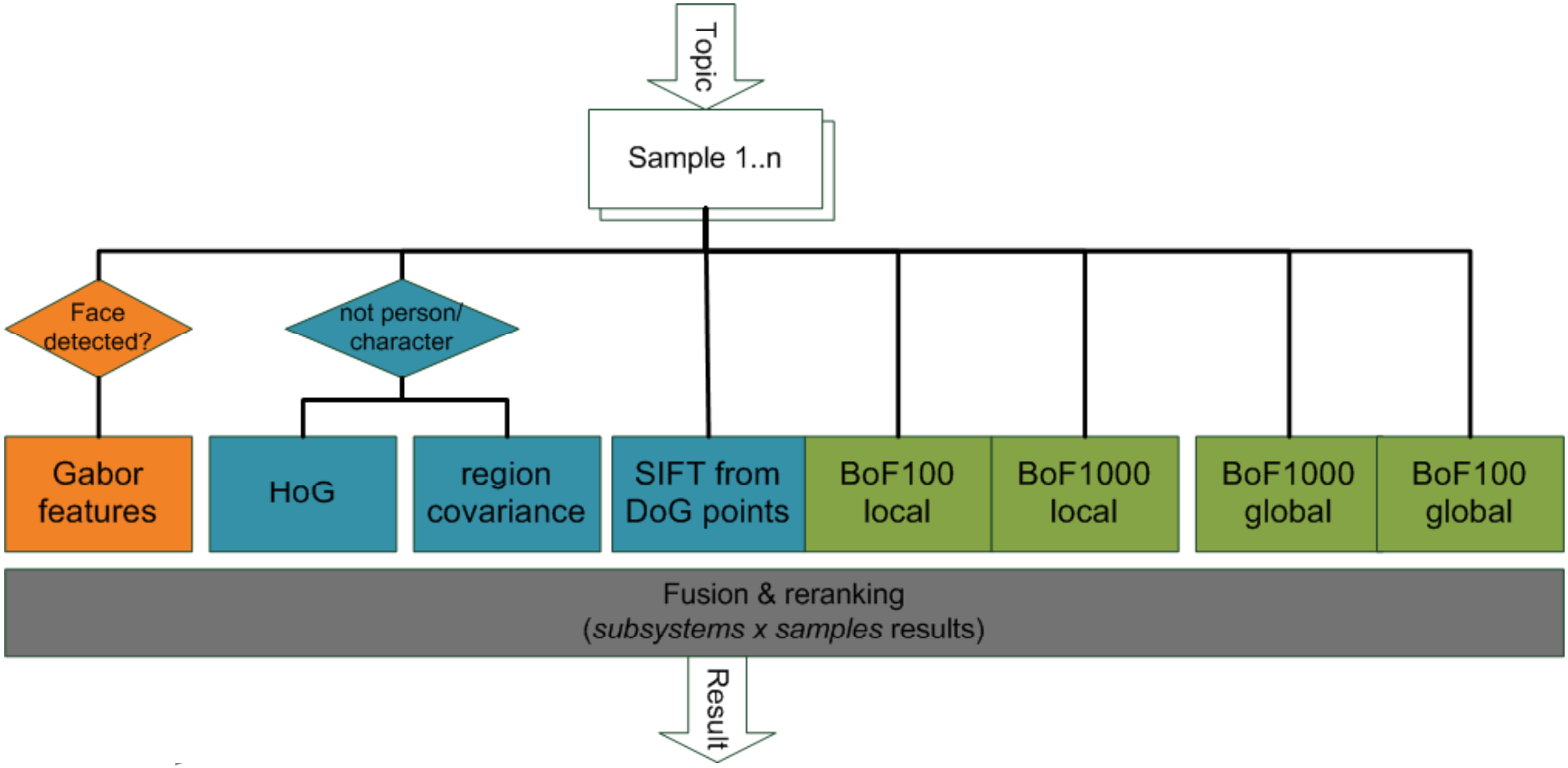
System Overview



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Subsystems (1)

- Gabor feature
  - perform face detection (Viola-Jones)
  - if face detected, extract Gabor wavelet descriptor from face region
  - match against descriptors of all face regions in database
  - k-NN search
- Histogram of gradients
  - not used for person/character
  - descriptor with 36 bins (9 orientations, 4 cells)
  - cell layout is adapted to aspect ratio of query object: 2x2 or 1x4 cells
  - search window is shifted ¼ cell size
  - 3 scales: 1x, 1.5x and 2x initial size

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Subsystems (2)

- Region covariance
  - covariance of rectangular region (can be determined efficiently using integral images)
  - from RGB and first-order derivatives of intensity
  - same cell sizes/scales as for HoG
- SIFT
  - from DoG points
  - matching: voting in a position histogram (1/10 of image size), report match for bins with 5+ votes
- Bag of visual features (BoF)
  - SIFT descriptors from DoG points and global
  - codebook sizes 100 and 1000 for both

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Pre-computed features

- Pre-computed for database
  - face detection + Gabor descriptor
  - global SIFT extraction
  - BoF codebook generation
- At query time
  - interest point detection + SIFT extraction
  - HoG
  - Region covariance

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Fusion strategies (1)

- Two simple methods, not making use of query samples
- Max-max
  - For each shot in the results, take maximum scope of all samples and features
- Top-k
  - For each feature, take for each shot the maximum of all samples
  - Rerank per feature
  - Take the top-k per feature (k=1000/no. features used)

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Fusion strategies (2)

- Two methods using query samples
  - idea: weight features by their relative performance
  - for each sample, determine where the other samples would be ranked in the result if they were in the database
- best rank
  - determine mean best rank over all samples for each feature
  - calculate feature weight as $w_{bestR}(f_i) = \frac{\max_{\forall f_j}(\bar{r}_j) - \bar{r}_i}{\sum_{\forall f_k} \max_{\forall f_j}(\bar{r}_j) - \bar{r}_k}$
- top 100
  - determine how many samples are in the top 100 results
  - calculate feature weight as $w_{t100}(f_i) = \frac{\bar{n}100_i}{\sum_{k=1}^{N} \bar{n}100_k}$

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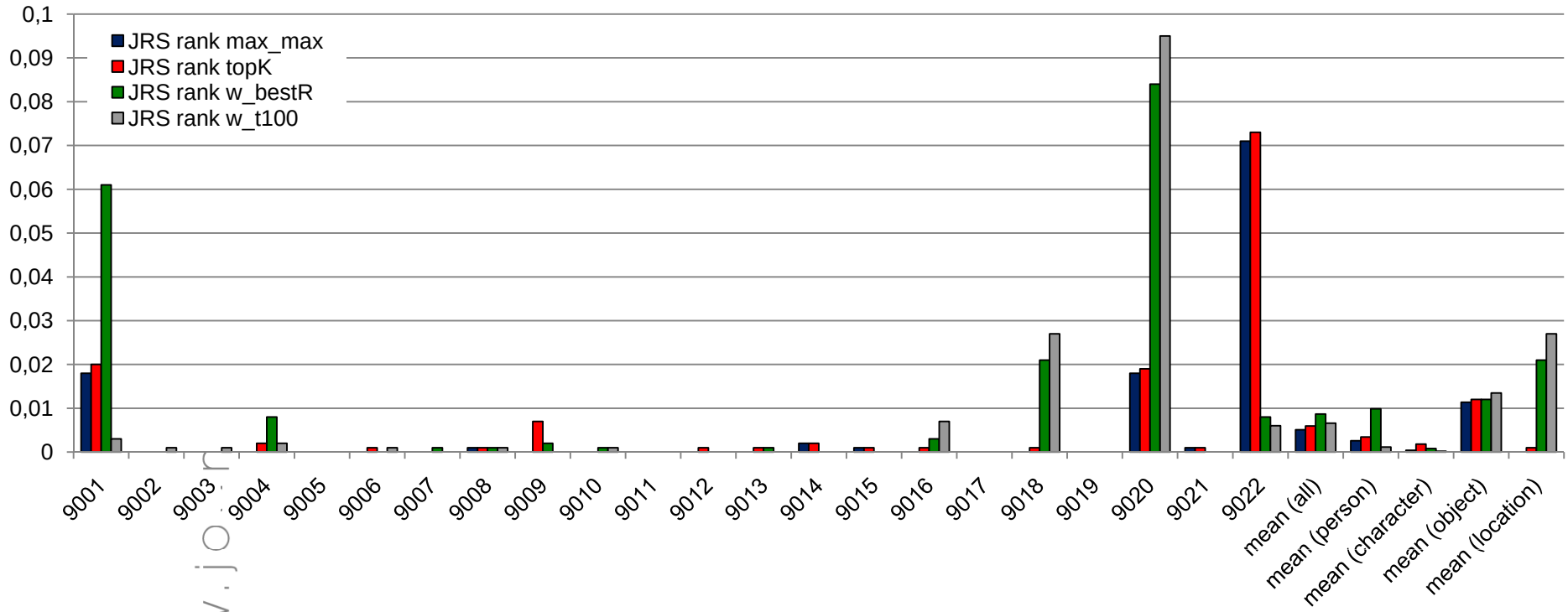
Results per topic/type



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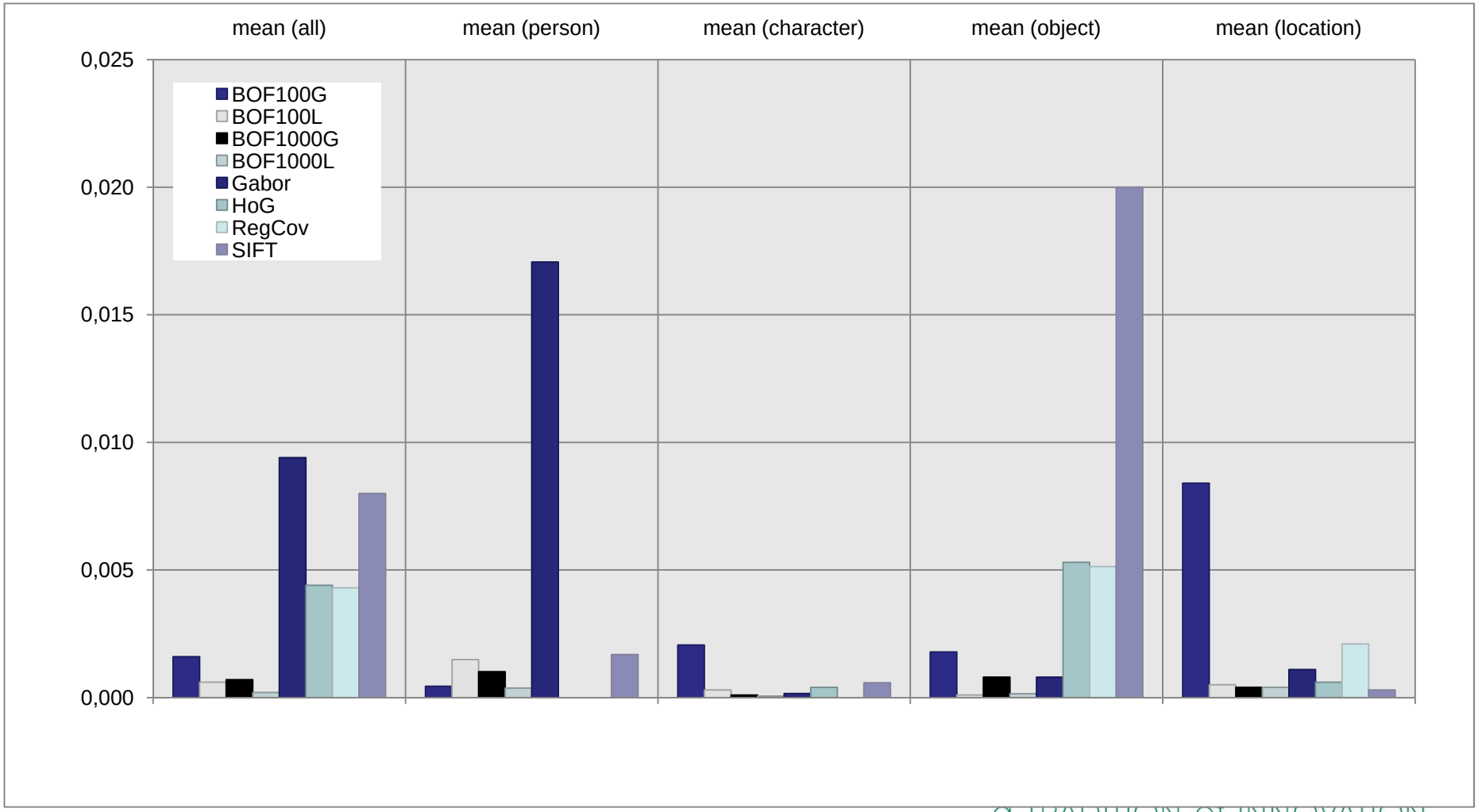
Results per feature



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Conclusion (1)

- Task is difficult, results for automatic system poor
  - different sizes, lighting, perspectives, …
  - “needle in a haystack”: very few relevant results in a large set with many similar objects (e.g. pedestrian crossing, blinds)
- Features
  - as expected, our features perform best for object queries
  - better results could be possible for some of the features, but would make matching process more costly

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Conclusion (2)

- Fusion methods
  - Overall, the fusion methods using information from query samples perform better
  - Only slight difference for object queries
- To fuse or not to fuse?
  - for person and object queries, a single feature outperforms the best fused results
  - few topics for the other query types, thus difficult to say if fusion is actually useful in these cases

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