CMSC 491/691: Computer Vision **Spring 2024**

Lecture 1: 2024-02-19 Features 2

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1.1 Scale Invariant Feature Transform

Algorithm 1: SIFT

1. Take 16x16 window around detected feature
2. Divide window into 4x4 grid of cells
3. Compute an orientation histogram for each cell.
4. 16 cells * 8 orientations = 128 descriptors

1.1.1 Feature Distance

L2 Distance:

$$||f_1 - f_2|| \tag{1.1}$$

Ratio distance:

$$||f_1 - f_2|| \div ||f_1 - f_2'|| \tag{1.2}$$

1.1.1.1 Evaluating the results

- Utilize ROC curve ("Receiver Operator Characteristic") to evaluate results.

1.2 Machine Learning for Computer Vision

Motivations

- Image Classification

Challenges with feature detection:

- Viewpoint variation
- Illumination
- Background clutter

- Occlusion
- Pose and Deformation
- Inter-Class Variation
- Illusions

Answer to challenges: **Data Supervised Learning**: Learning from examples (training data).

Questions on how to implement Machine Learning in Computer Vision:

- How to represent images for classifications?
  - Matrix
- How to represent class labels?
  - Integers *(i.e. 1 = Fish, 2 = Grizzly)*
  - *Strings (i.e. "Fish", "Grizzly", etc.)*
  - *One hot vectors (i.e. [0, 0, 1] = Fish, [0, 1, 0] = Grizzly)*
- What should loss be?
  - 0-1 loss (Number of misclassifications)
  - Cross entropy (Approximation of 0-1 loss)
- What is the output?
  - Probability from 0 - 1 of predicted classes

Generalization: The central challenge in machine learning is that our algorithm must perform well on new, previously unseen inputs—not just those on which our model was trained.