DARWIN IN THE CITY

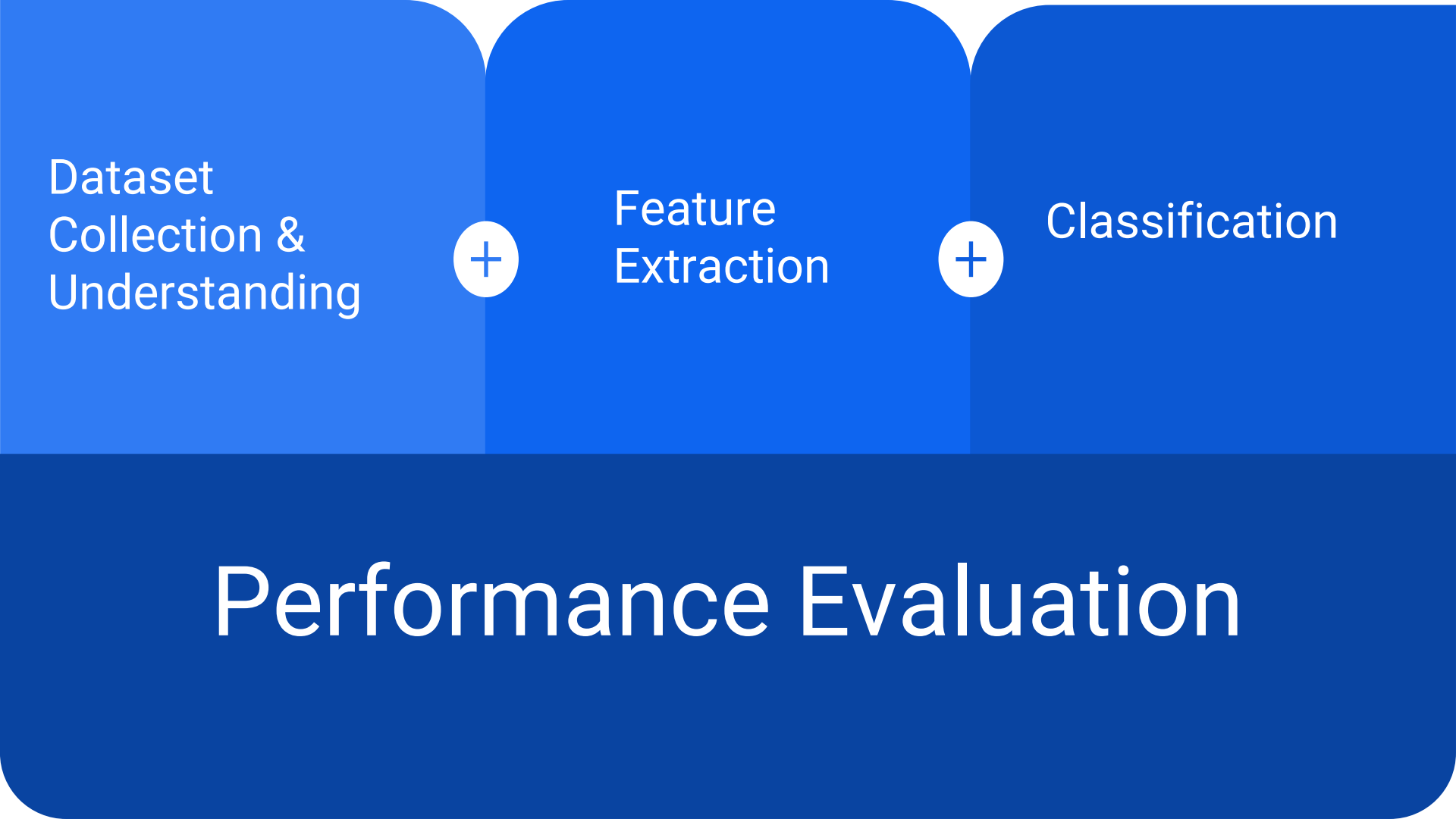
Cityscape Image Processing - Urban Life Quality

Introduction

- Physical appearance of cities
- Education, mobility, health, criminal behaviour
- Processing substantial amount of data
- Human efforts >> impractical and infeasible
- Computer vision
- Human labeled data
- Task: Implement urban image processing for city shaping

Areas of Use

- City and urban planning
- Crowd management
- Social and economic effects
- Transportation solutions
- Crime prevention - Broken Windows Theory
- App


Dataset Collection & Understanding
+
Feature Extraction
+
Classification
Performance Evaluation

Dataset Collection & Understanding

- Collection of data
- Gathering images & labeling
- Training the neural network
- Test Set / Training Set
- Place Pulse 1.0 & 2.0

Place Pulse

- Web interface: http://pulse.media.mit.edu
- Pairwise image comparisons
- 6 labels: safe, lively, boring, wealthy, depressing, beautiful
- PP 1.0: 200000 comparisons, 4109 images, 4 cities
- No significant cultural bias or any other bias caused by age, gender, location
- Global dataset is still necessary for global accuracy
- PP 2.0: 1.17 million comparisons, 110988 images, 56 cities
- Higher visual diversity >> improved accuracy by 7.2%

Why not Satellite Images?

- Covers larger area >> more efficient and practical
- Labeling done by humans
- Cross correlation between the labels

Feature Extraction

- What does a feature mean for an image?
- obtain the most relevant information from the original data
- features vector includes information in the form of isolated points, continuous curves or connected regions
- low level algorithm

Taxonomy of the topics in computer vision

- Image processing
  - Feature detection
    - Recognition
  - Difference between Feature Description and Extraction

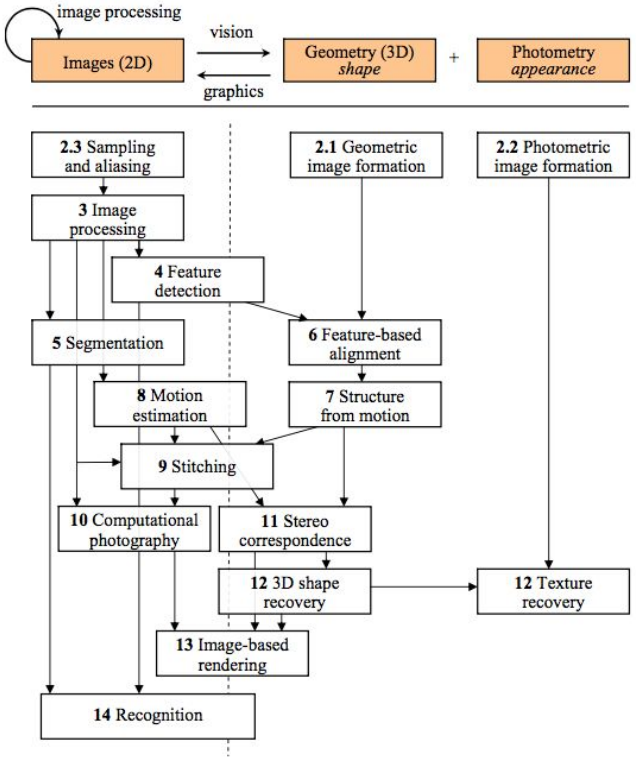


Figure 1.11 Relationship between images, geometry, and photometry, as well as a taxonomy of the topics covered in this book. Topics are roughly positioned along the left–right axis depending on whether they are more closely related to image-based (left), geometry-based (middle) or appearance-based (right) representations, and on the vertical axis by increasing level of abstraction. The whole figure should be taken with a large grain of salt, as there are many additional subtle connections between topics not illustrated here.

types of image features

- Interest points / Keypoint Features
- Edges
- Blobs/ regions of interest points
- Ridges
- Ideal Feature Description
    - What points to choose if you want to extract extract your feature vector
    - gradients, patches with large contrast changes
    - compact, effective, distinctive, robust, invariant

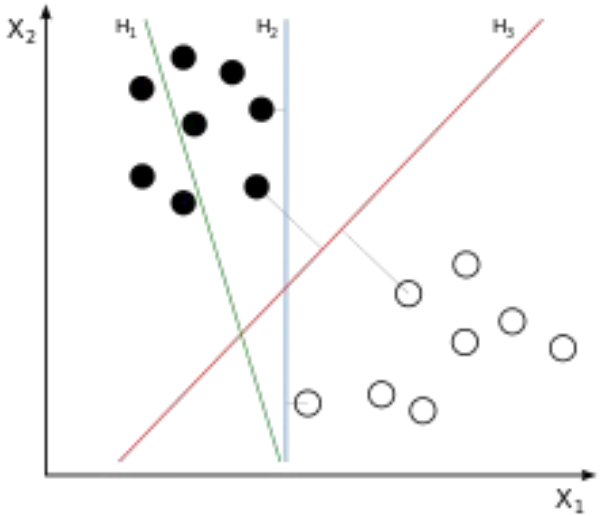
Algorithms

- SIFT (Scale Invariant Feature Transform)
    - keypoints extracted and stored in database
    - regarding euclidean distance of feature vectors compare each feature
    - location, scale and orientation of object mathching the keypoints filtered out
    - further verification and passing all these tests leads to confident match
- HOG(Histogram of oriented gradients)
    - divide into cells, compile its gradient histogram
    - contrast-normalizing for better accuracy and invariance
    - HOGs invariant to geometric transformations

Bag of Words(BoW) Model

- treat image features as words
- 3 step process
    - feature detection
    - feature description
    - codebook generation
  - After assigning codewords represent the image by the histogram of the codewords

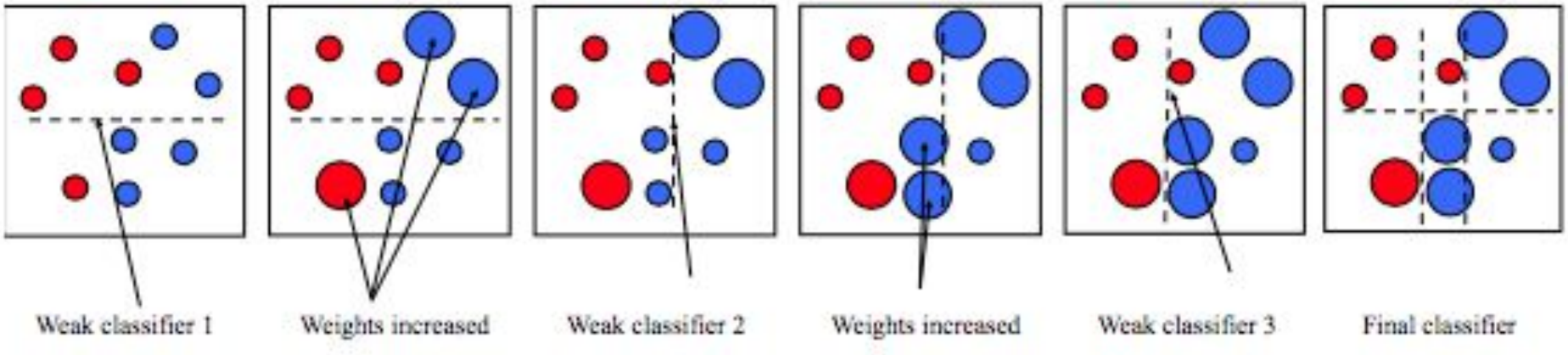
Classification

- CNNs
    - relatively little pre-processing compared to other image classification algorithms
    - learn very fast, major advantage
- Support Vector Machine (SVM)
- 

- many hyperplanes
- achieve largest separation between two classes
- ex : face and nonface patches
- maximum margin hyperpleane

Boosting

- constructing a classifier as a sum of simple weak learners
- each weak learner simple fnc. of input, hence not expected to contribute much to classification



final classifier is a linear combination of the simple weak classifiers

AdaBoost

- incrementally select weak learners, reweighting and training of examples after each stage ——— key of success
- resulting classifier very fast, but training takes some time
- a lot of things to examine at each stage

Performance Evaluation

- the algorithm itself
- the nature of images used to measure the performance of the algorithm
- the algorithm parameters used in the evaluation
- the method used for evaluating the algorithm

Performance of the Implementation

6 different scales

1. accuracy
2. robustness
3. sensitivity
4. adaptability
5. reliability
6. efficiency

Presentation

Maybe the most important part !!

Discussion and Future Work

Future Works could be on improving

1. Security,
2. Mobility,
3. Social, Economic, Architectural Studies,
4. Daily Life.