Image Representation for Visual Pattern Discovery

❑ An image can be characterized by visual primitives, e.g., interest points

   ❑ Each visual primitive can be described by visual feature, e.g., a high-dimensional feature vector

   ❑ Each image is a collection of visual primitives
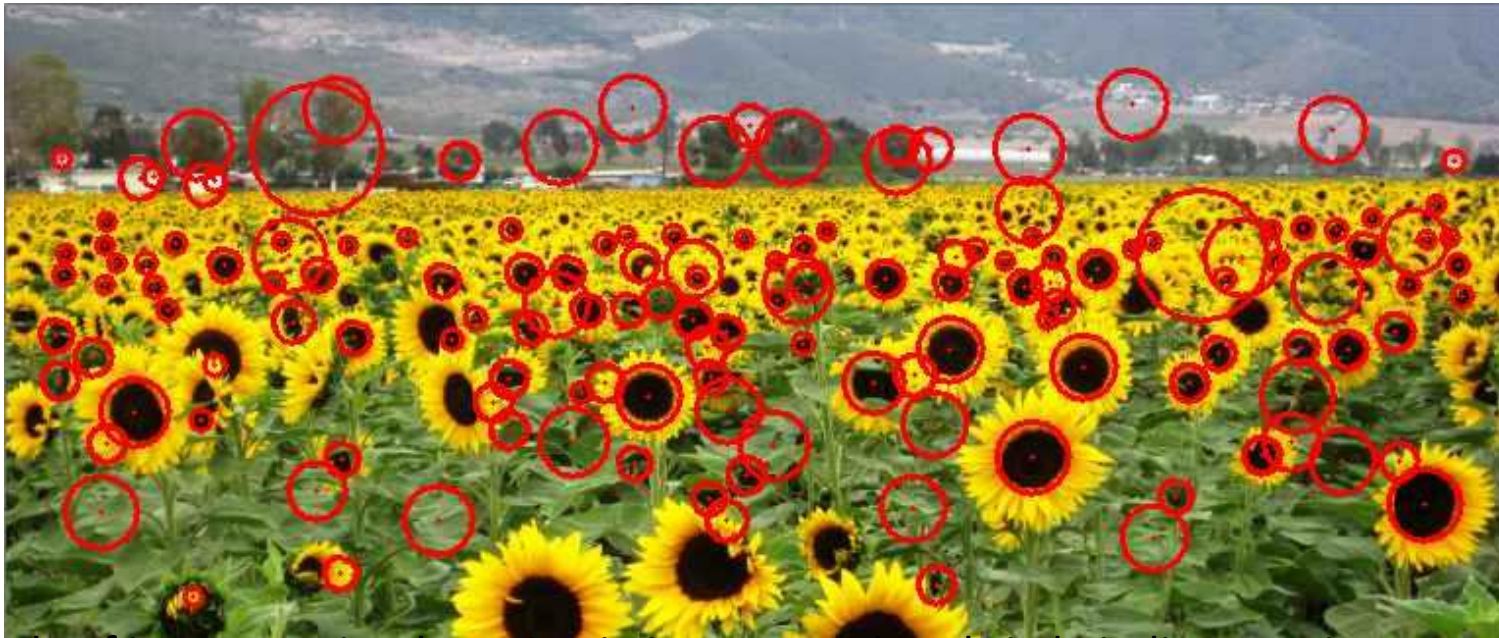
An example of interest point detection in images. Each red circle indicate an interest point.
Image courtesy from boofCV http://boofcv.org/index.php?title=Example_Detect_Interest_Points

Courtesy of Junsong Yuan @ NTU.SG, Ying Wu @Northwestern

Visual Patterns Discovery

Images

Feature Extraction

Visual Primitives

Feature Quantization

Induced Visual Transactions

Pattern Discovery

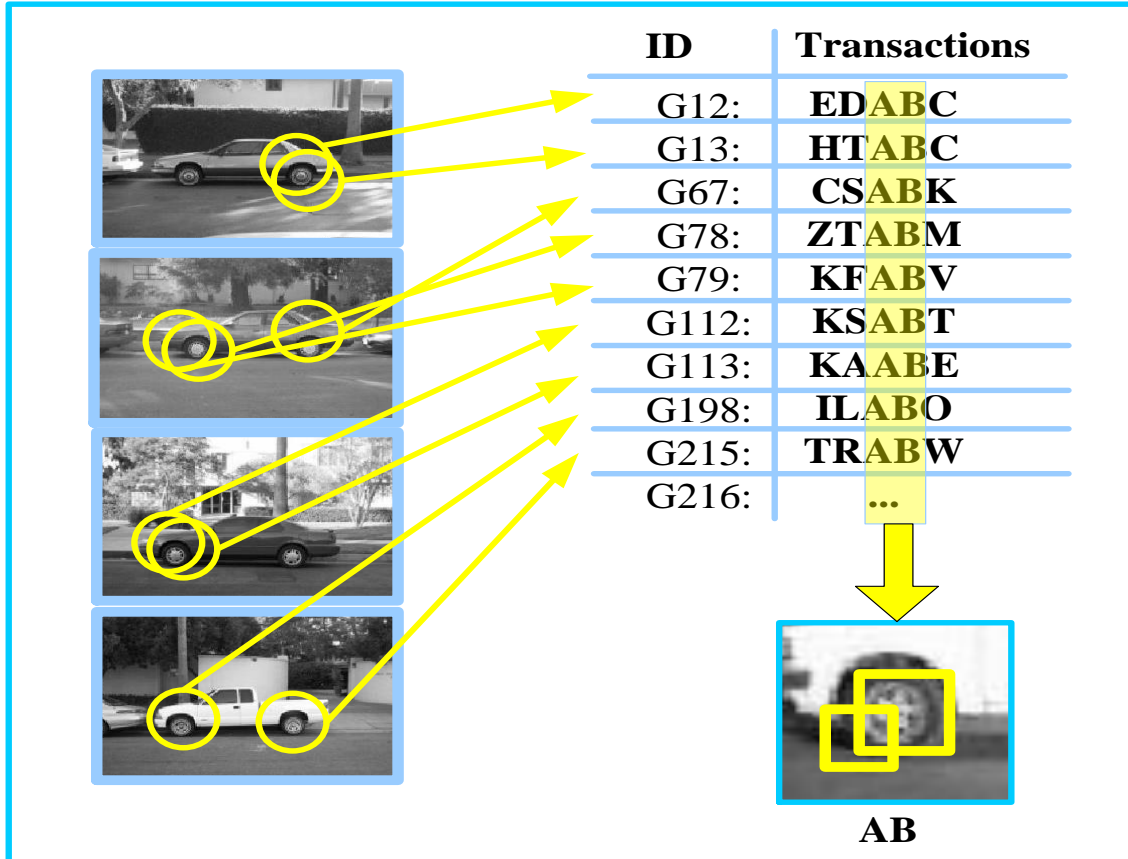Visual Patterns
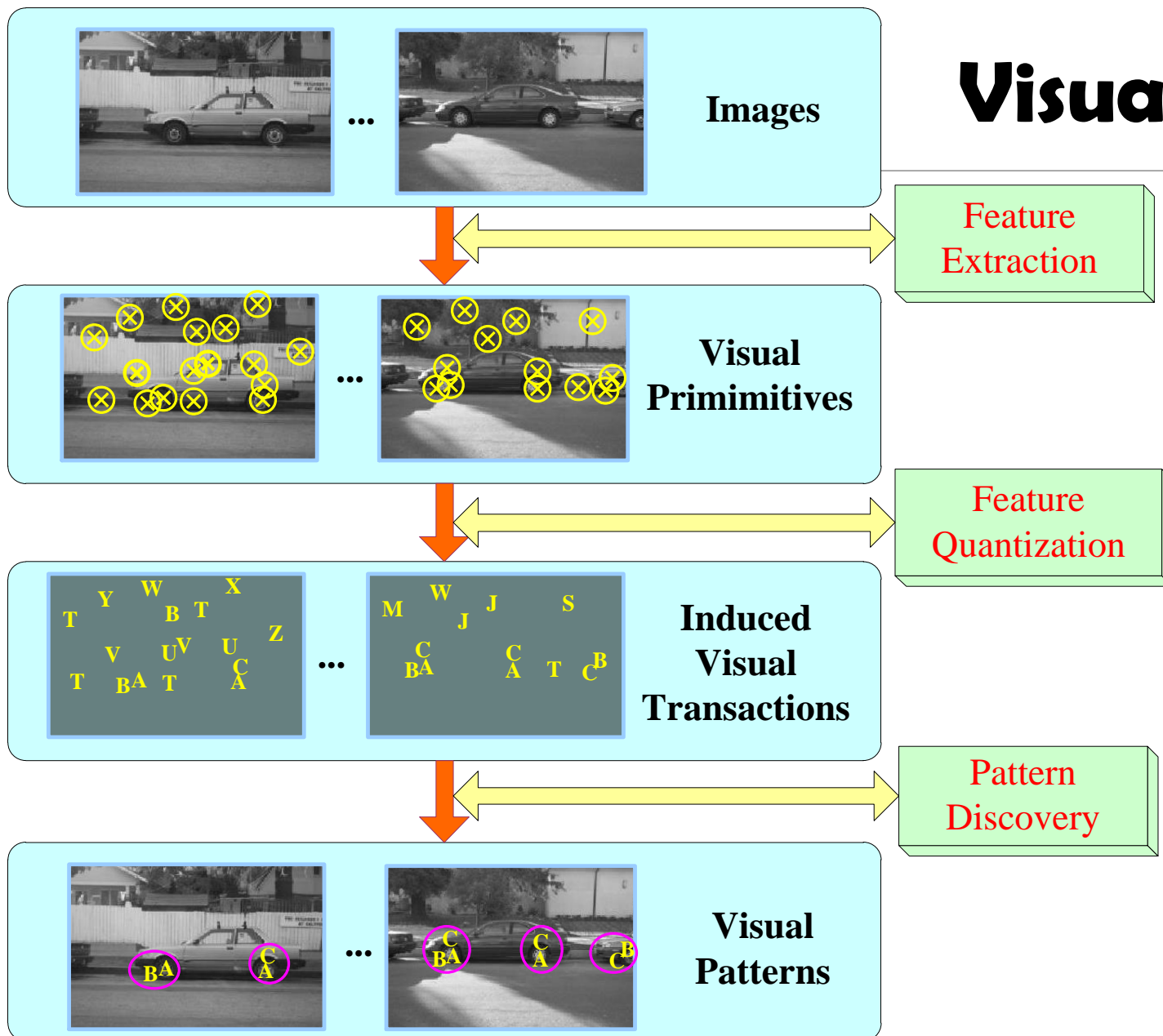
- ❑ Visual primitives can be clustered into visual "items"
  - ❑ Similar visual primitives belong to the same item
- ❑ Each visual primitive finds its k-nearest-neighbor in the image to form a visual "transaction"
  - ❑ An image can generate a number of transactions, i.e., induced visual transactions
- ❑ Mining "frequent itemsets" leads to semantically meaningful visual patterns

Courtesy of Junsong Yuan @ NTU.SG, Ying Wu @Northwestern

Challenges of Visual Pattern Discovery

ID	Transactions
G12:	ED**AB**C
G13:	HT**AB**C
G67:	CS**AB**K
G78:	ZT**AB**M
G79:	KF**AB**V
G112:	KS**AB**T
G113:	KA**AB**E
G198:	IL**AB**O
G215:	TR**AB**W
G216:	...

AB

- ❑ Images are spatial data
  - ❑ Spatial configuration among the visual items matters
  - ❑ Induced transactions may overlap with each other, thus one needs to address the over counting problem
- ❑ Uncertainties of visual items and patterns
  - ❑ Noisy clustering of visual primitives into visual items affects visual pattern discovery
  - ❑ Visual synonym and polysemy

Recommended Readings

❑ Hongxing Wang, Gangqiang Zhao, Junsong Yuan, Visual pattern discovery in image and video data: a brief survey, Wiley Interdisciplinary Review: Data Mining and Knowledge Discovery 4(1): 24-37 (2014)

❑ Hongxing Wang, Junsong Yuan, Ying Wu, Context-Aware Discovery of Visual Co-Occurrence Patterns. IEEE Transactions on Image Processing 23(4): 1805-1819 (2014)

❑ Gangqiang Zhao, Junsong Yuan, Discovering Thematic Patterns in Videos via Cohesive Sub-graph Mining. ICDM 2011: 1260-1265

❑ Junsong Yuan, Ying Wu, Ming Yang, From frequent itemsets to semantically meaningful visual patterns. KDD 2007: 864-873