Deep condolence to Professor Mark Everingham

PASCAL2
Pattern Analysis, Statistical Modelling and Computational Learning

Towards VOC2012 Object Classification Challenge

Generalized Hierarchical Matching for Sub-category Aware Object Classification

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Framework – NUS_PSL_2010

Visual Features

Local Feature Extraction

Feature Coding
VQ

Feature Pooling
SPM

Detection Results

Max pooling

Kernel

Nonlinear Kernel

Linear Kernel

Classification

SVM

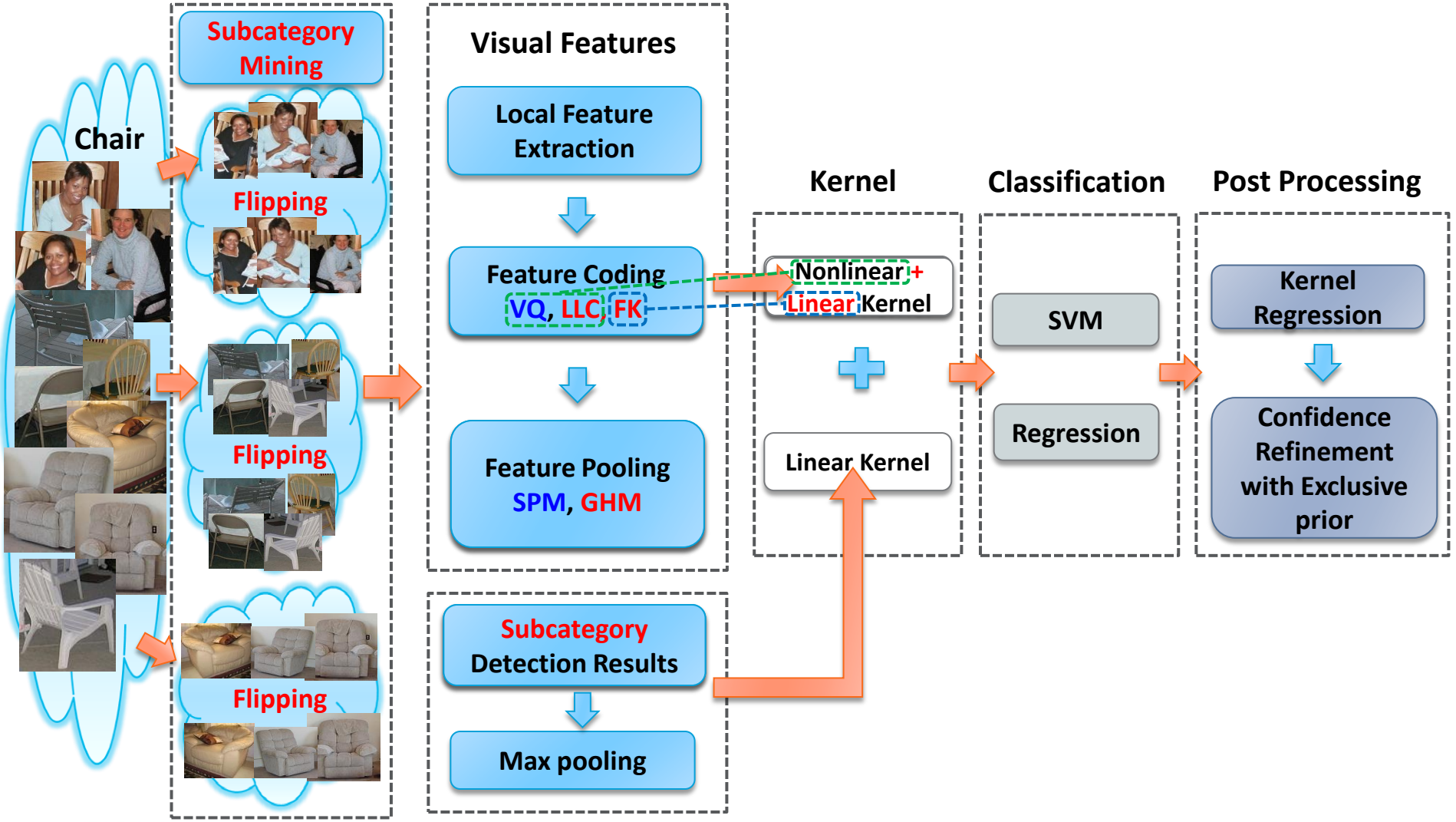
Regression

Post Processing

Kernel Regression

Confidence Refinement with Exclusive prior

Framework – NUS_PSL_2012



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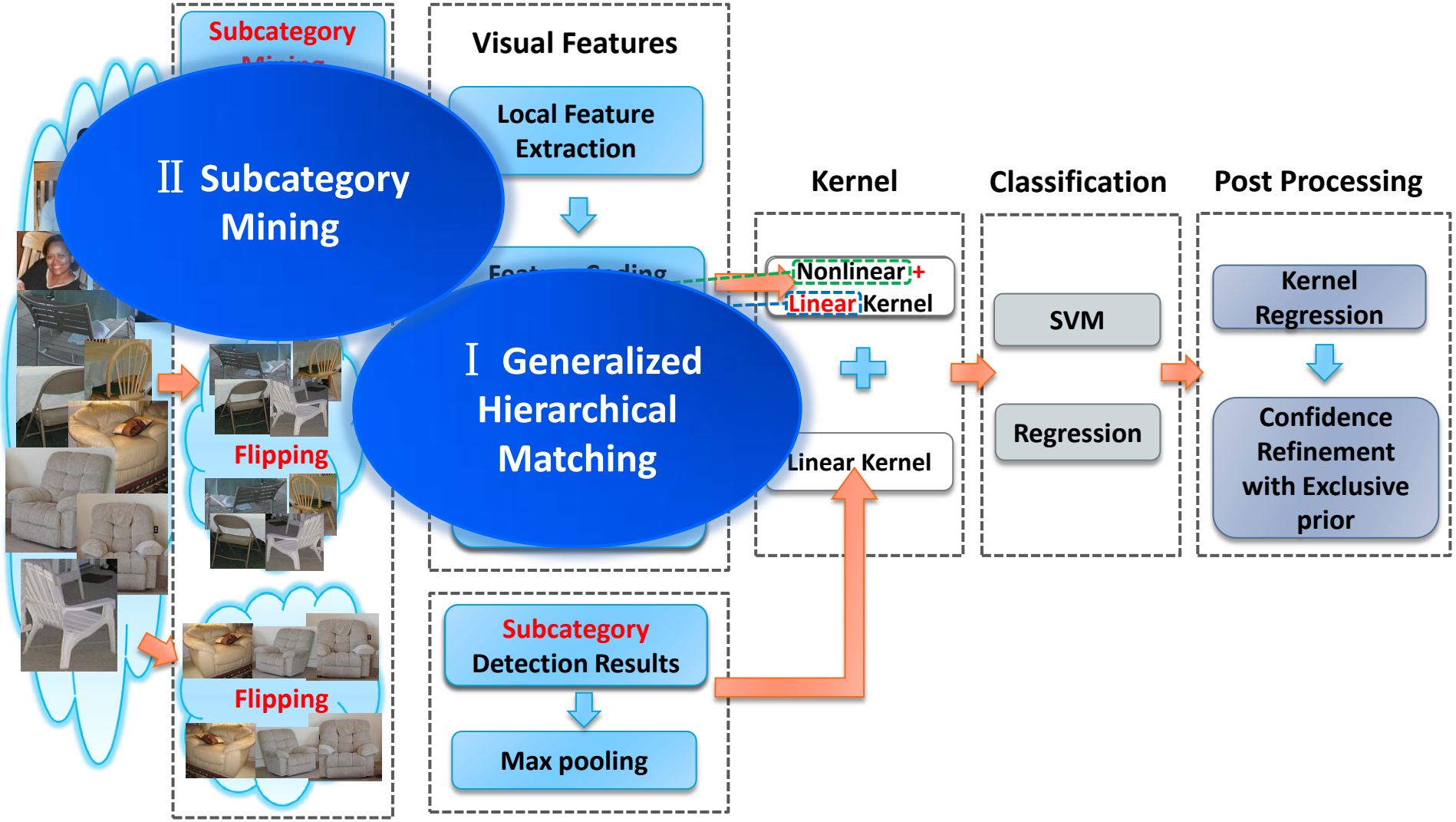
Framework – NUS_PSL_2012

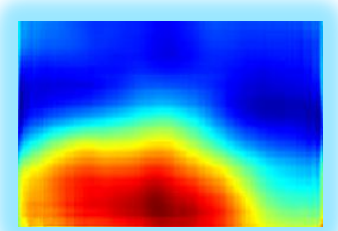


Ⅰ Generalized Hierarchical Matching

- Traditional Pooling: SPM = approximate geometric constraint
- Not optimal for object recognition due to misalignment

(a) Images **(b) SPM partitions** **(c) Object Confidence Map partition**

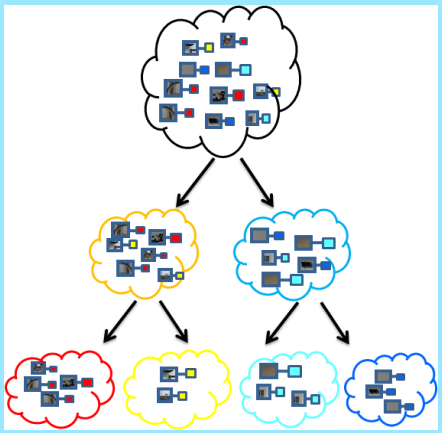
I Generalized Hierarchical Matching



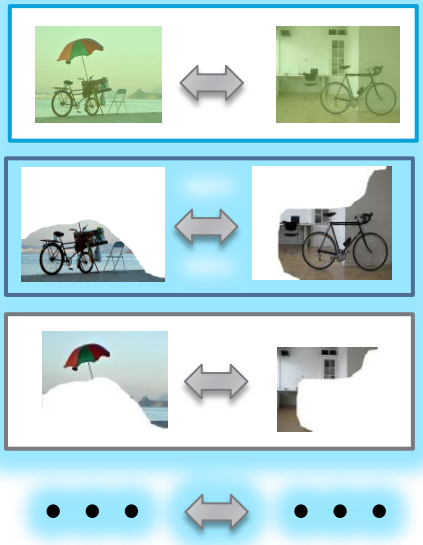
(a) Side information and Image

(b) Hierarchically cluster by side information.
Level 1 (top),2 (mid),3 (bottom)

Encoded local feature vs. side information



(c) Hierarchical structure representation



(d) Matching/pooling within each cluster

Utilize side information to hierarchically pool local features

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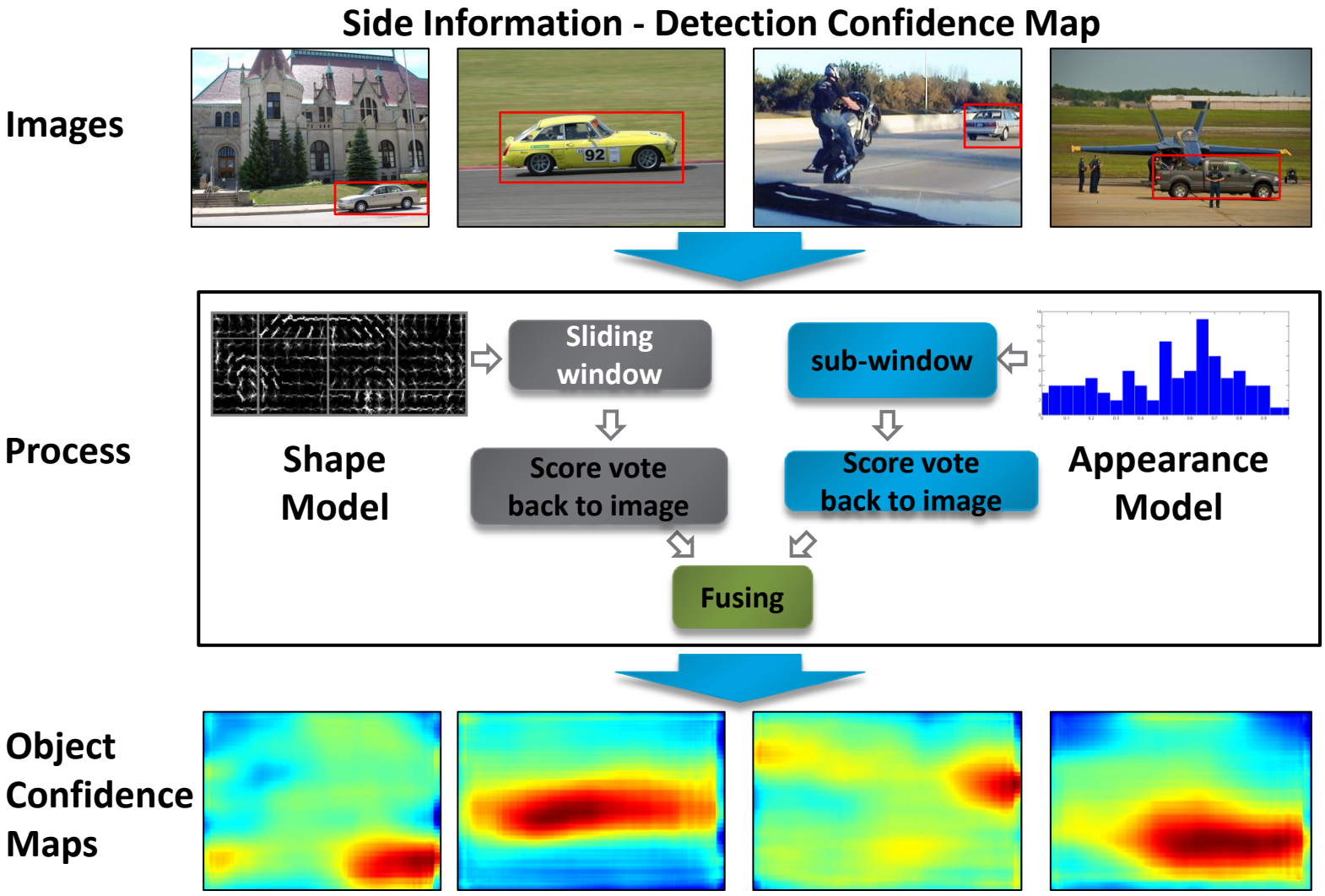
I Generalized Hierarchical Matching



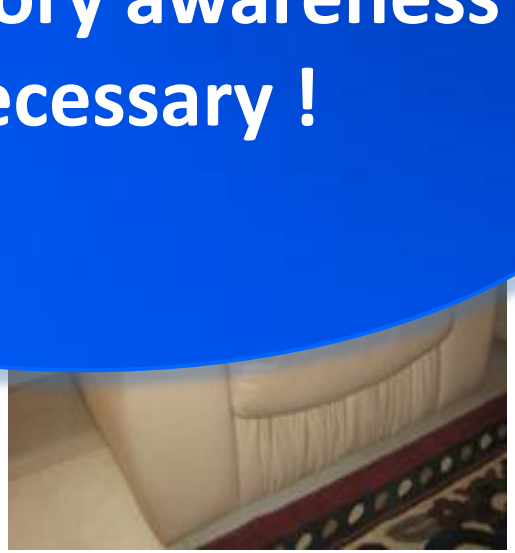
II Sub-Category Mining

- Intra-class diversity:
  - Foreground distribution is diverse due to **appearance**, **occlusion** variance
  - Aspect ratio is not enough to grasp these types of variance

II Sub-Category Mining

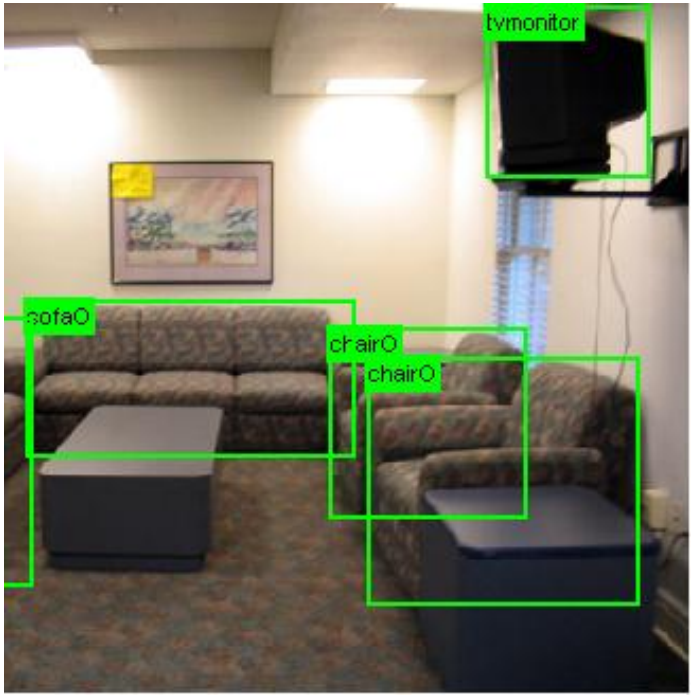
- Intra-class diversity:
  - Foreground distributi… to **appearance, occlusion** va…
  - Aspect … variance

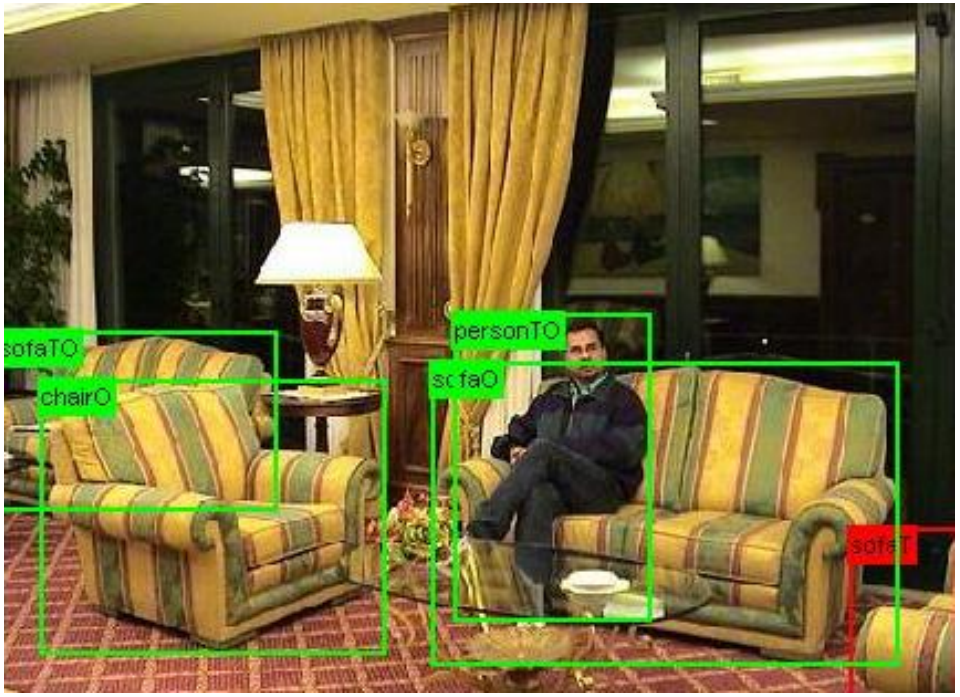
Subcategory awareness is necessary !



II Sub-Category Mining

- Inter-class ambiguity:

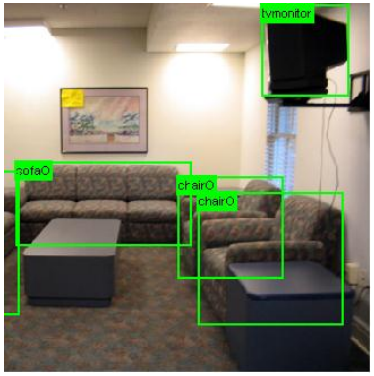


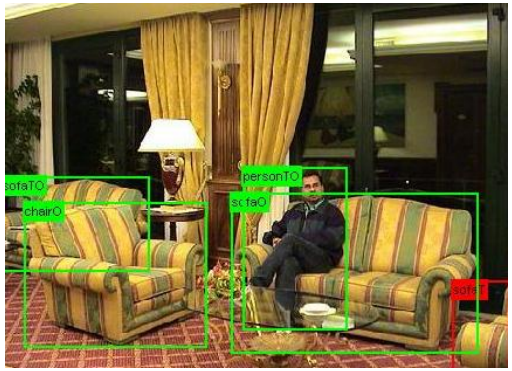


Chairs are ambiguous with sofas

II Sub-Category Mining

- Inter-class ambiguity:
  - Some sub-categories may be ambiguous with certain specific object categories





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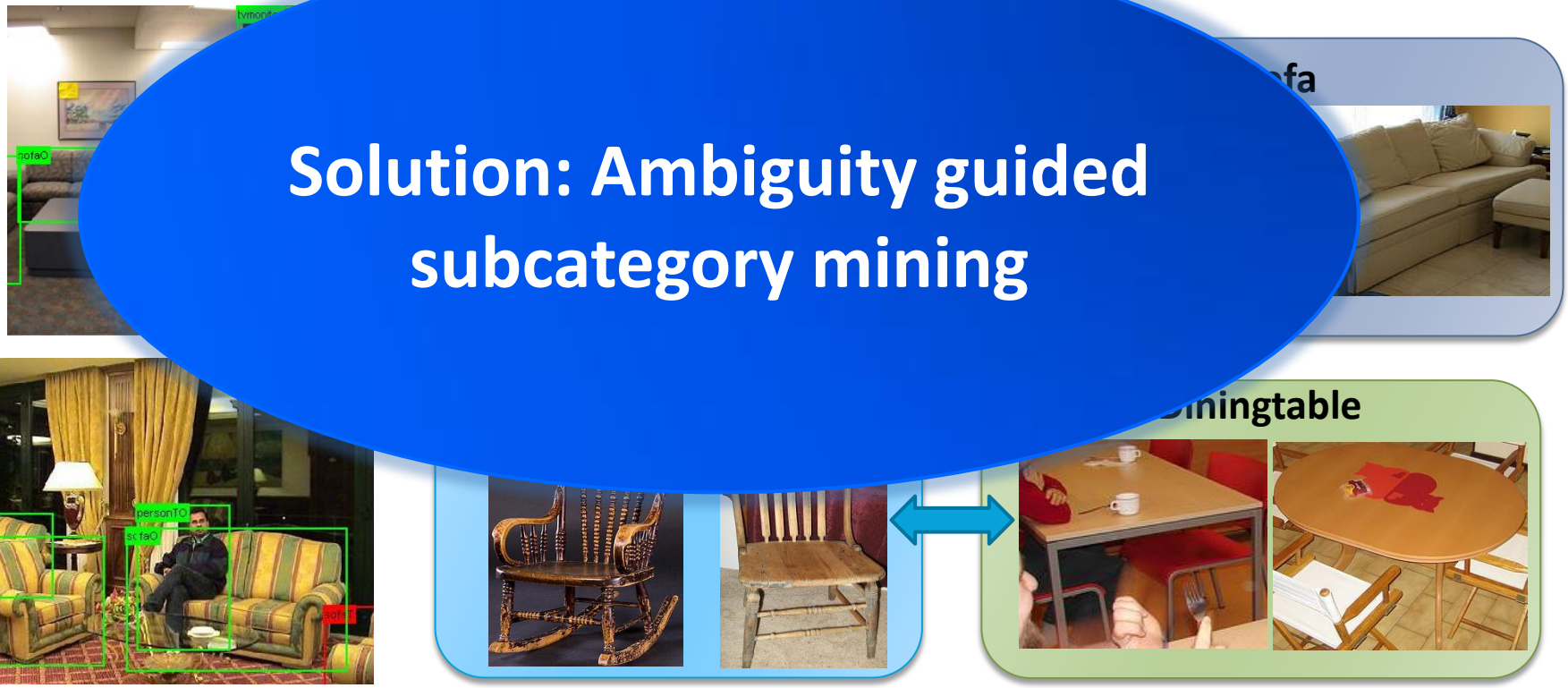
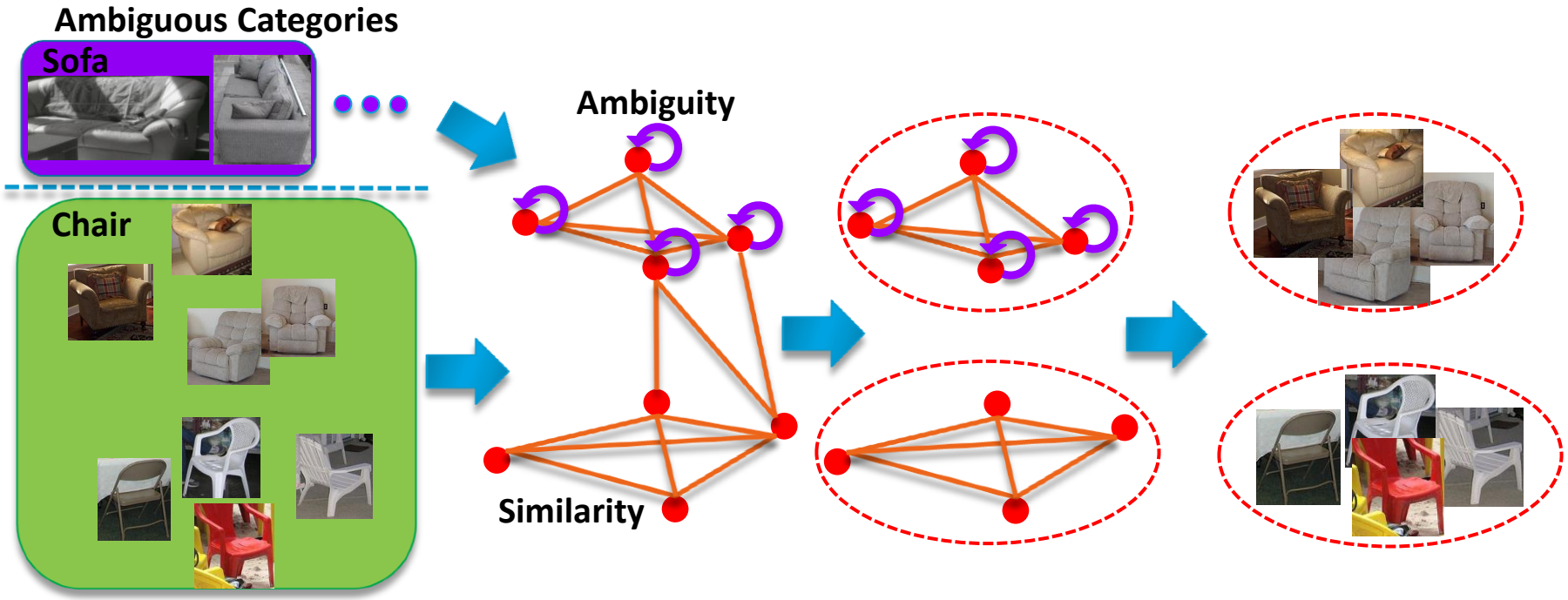


II Sub-Category Mining



Subcategory Mining based on both Similarity & Ambiguity

- Calculate the sample intra-class similarity
- Calculate the sample inter-class ambiguity
- Detect dense subgraphs by graph shift algorithm [1]
- Subgraphs to subcategories.

[1] Hairong Liu, Shuicheng Yan. Robust Graph Mode Seeking by Graph Shift. ICML 2010

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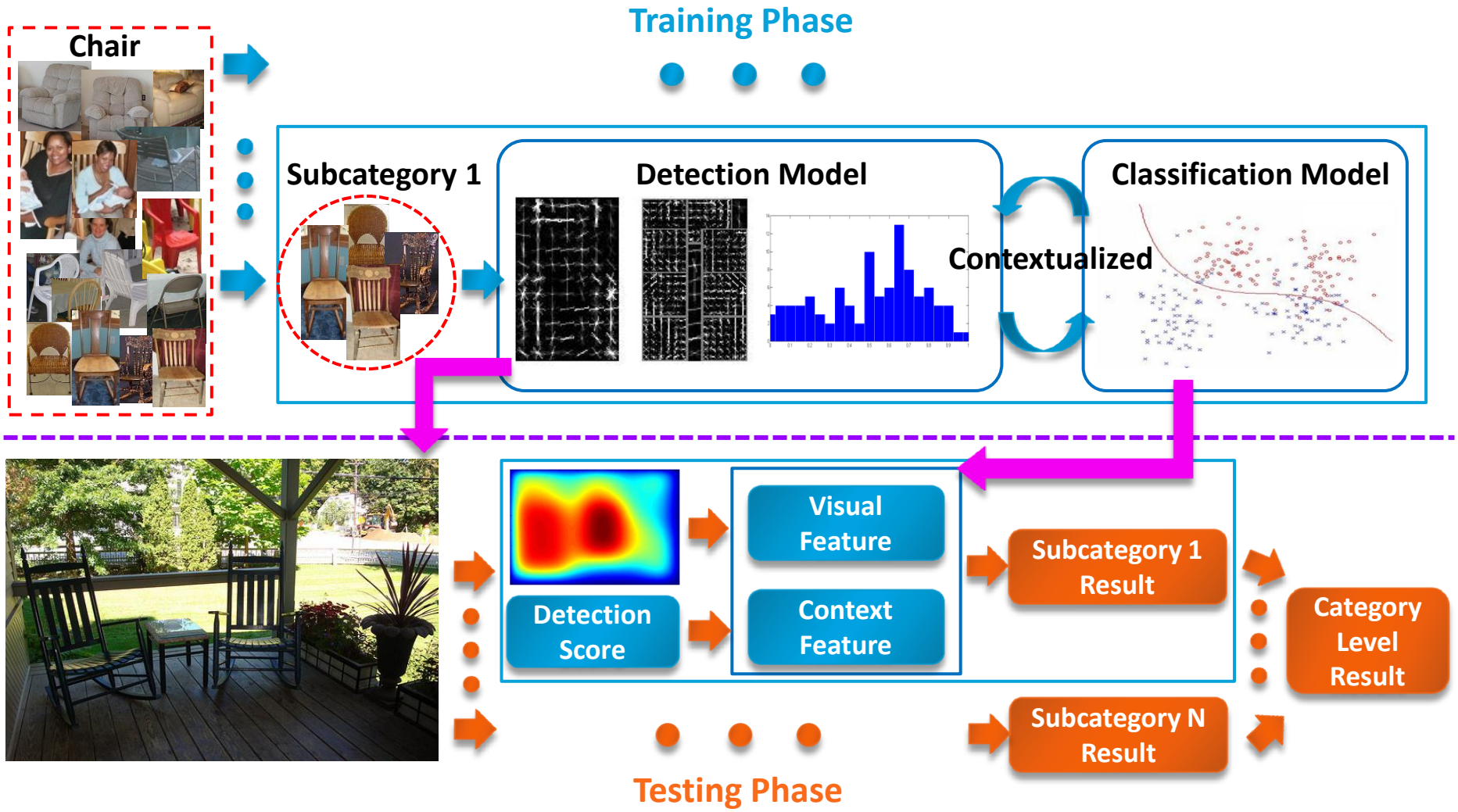
Sub-Category Aware Detection & Classification



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The results

	2010		2011		2012	
	Our Best	Other's Best	Our Best	Other's Best	Our Best	Other's Best
aeroplane	93	93.3	95.5	94.5	97.3	92
bicycle	79	77	81.1	82.6	84.2	74.2
bird	71.6	69.9	79.4	79.4	80.8	73
boat	77.8	77.2	82.5	80.7	85.3	77.5
bottle	54.3	53.7	58.2	57.8	60.8	54.3
bus	85.2	85.9	87.7	87.8	89.9	85.2
car	78.6	80.4	84.1	85.5	86.8	81.9
cat	78.8	79.4	83.1	83.9	89.3	76.4
chair	64.5	62.9	68.5	66.6	75.4	65.2
cow	64	66.2	74.7	74.2	77.8	63.2
diningtable	62.9	61.1	68.5	69.4	75.1	68.5
dog	69.6	71.1	76.4	75.2	83	68.9
horse	82	76.7	83.3	83	87.5	78.2
motorbike	84.4	81.7	87.5	88.1	90.1	81
person	91.6	90.2	92.8	93.5	95	91.6
pottedplant	48.6	53.3	56.5	58.7	57.8	55.9
sheep	65.4	66.3	77.7	75.5	79.2	69.4
sofa	59.6	58	67	66.3	73.4	65.4
train	89.4	87.5	91.2	90	94.5	86.7
tvmonitor	77.2	76.2	77.5	77.2	80.7	77.4
MAP	73.8		78.7		82.2	

+4.9 +3.5

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Discussions

- Classification, detection and segmentation are essentially closely related problems. It is predictable that these three problems shall be explored within a unified framework in the near future!

- Effectiveness seems fine now, how about efficiency?

Acknowledgement

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