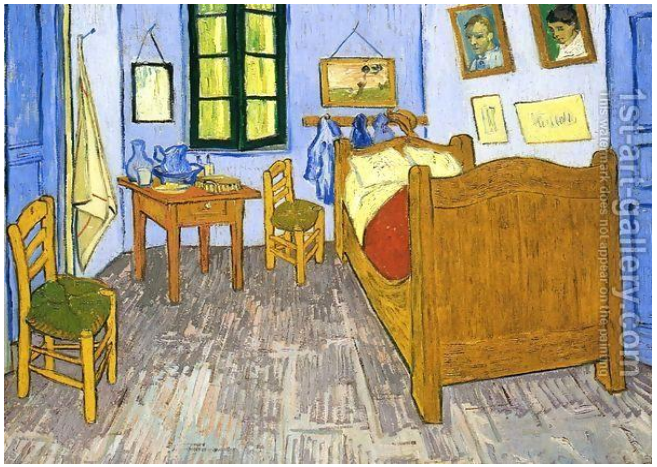
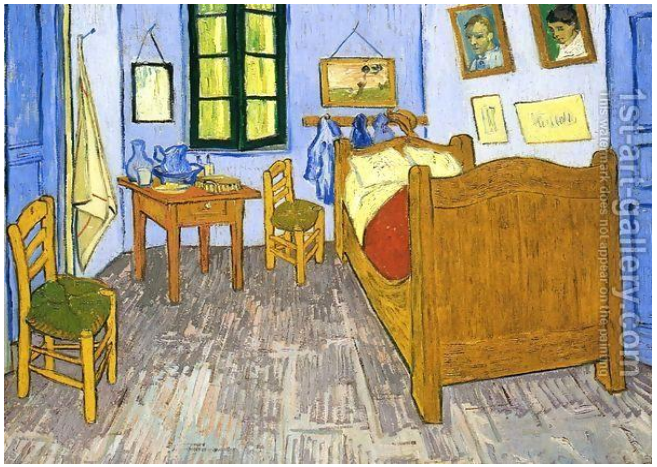


CS331B (3 units)

3dRR: Representation and Recognition

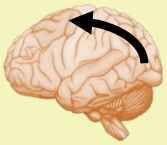


CS331B (3 units)

3dRR: Representation and Recognition

Announcements:

- Syllabus will be uploaded today
- Important dates (see also syllabus):
  - **10/17: project proposal is due**
  - **11/5: project mid-term report is due**
  - **12/13: final project report is due**
- After the syllabus is ready, pick up 3 papers you want to present and send your choice to Scott. Rank the papers based on your preference.
- Proposal: change class room to Gates



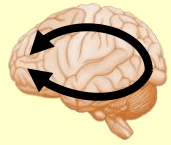
WHERE

- 3D shape modeling
- 3D scene reconstruction
- Camera localization

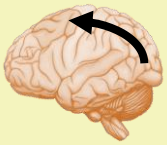
WHAT

- Material classification
- Object recognition
- Scene classification
- Target tracking
- Activity recognition

Understanding the 3D world



- 3D Object understanding
- 3D scene understanding
- Activity understanding



WHERE

- 3D shape modeling
- 3D scene reconstruction
- Camera localization

WHAT

- Material classification
- Object recognition
- Scene classification
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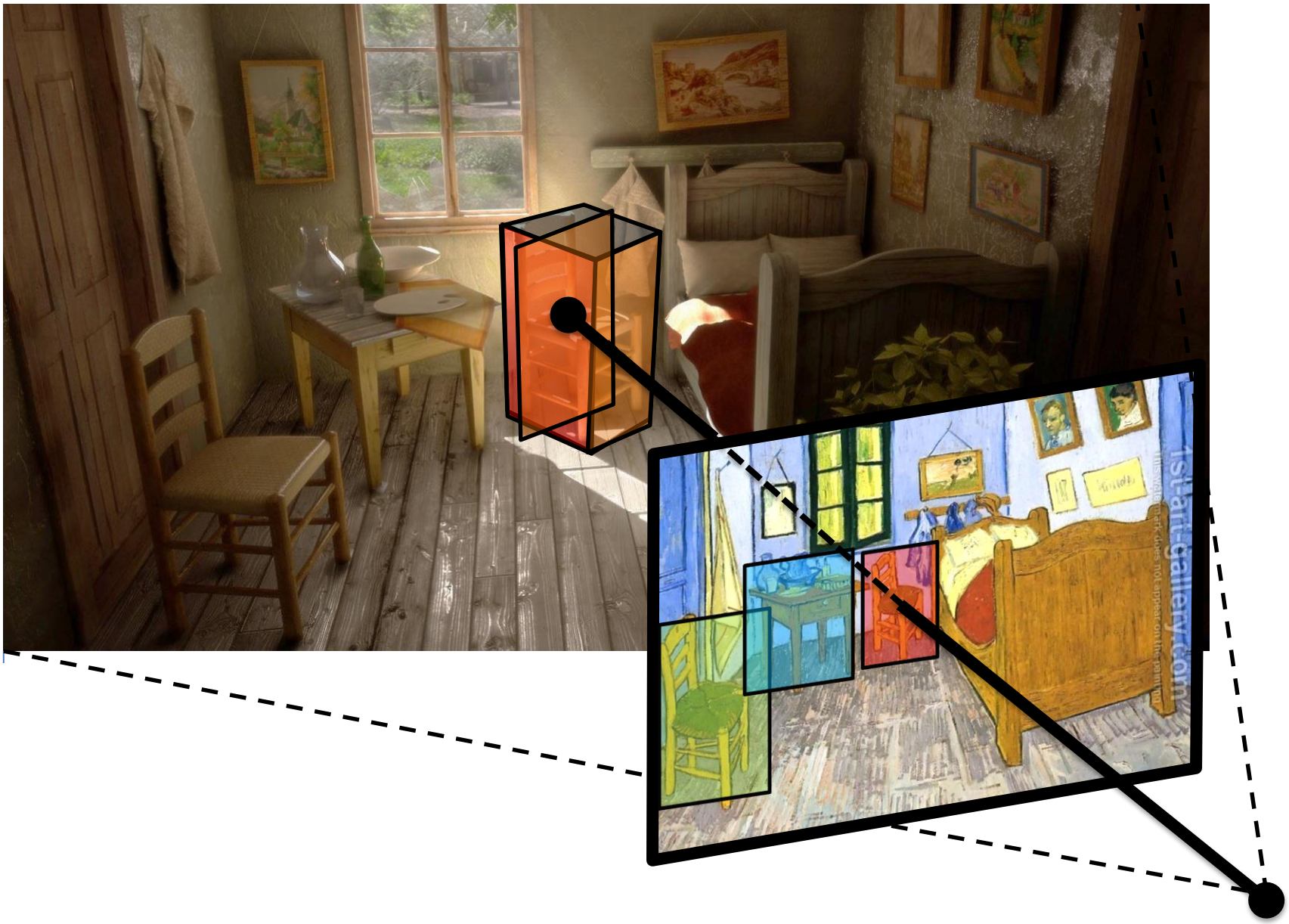
- Activity recognition

Understanding the 3D world

- 3D Object understanding
- 3D scene understanding
- Activity understanding

3D object understanding

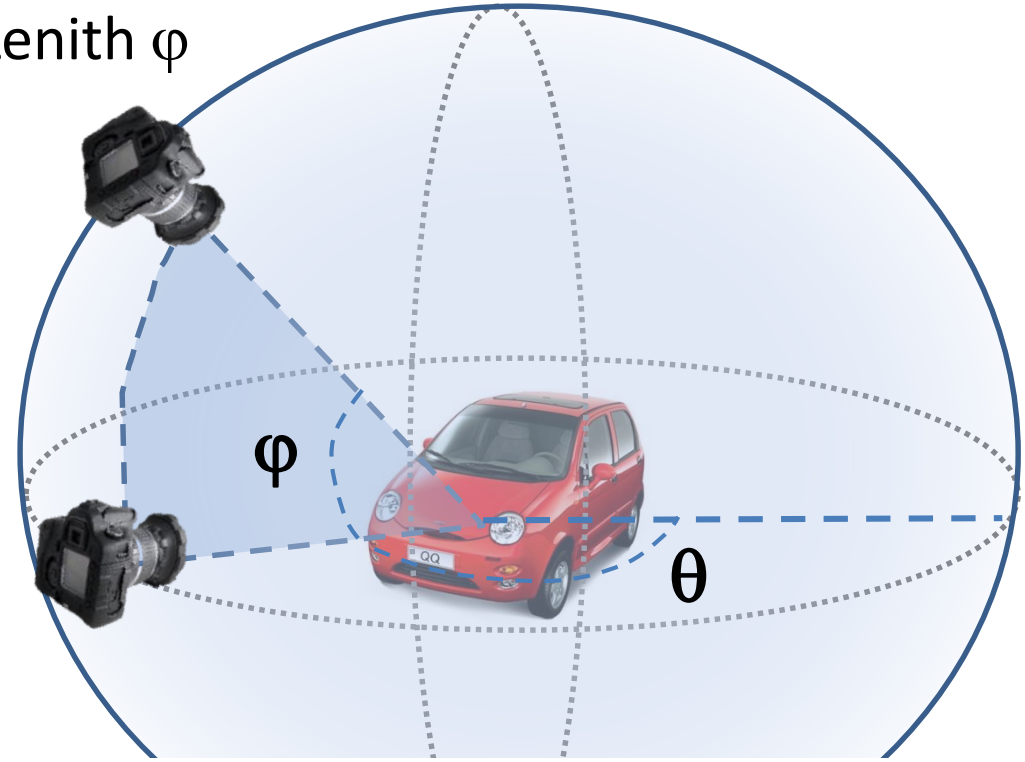


3D object understanding

Properties of a 3D object detector

Viewing sphere

Azimuth θ, Zenith φ

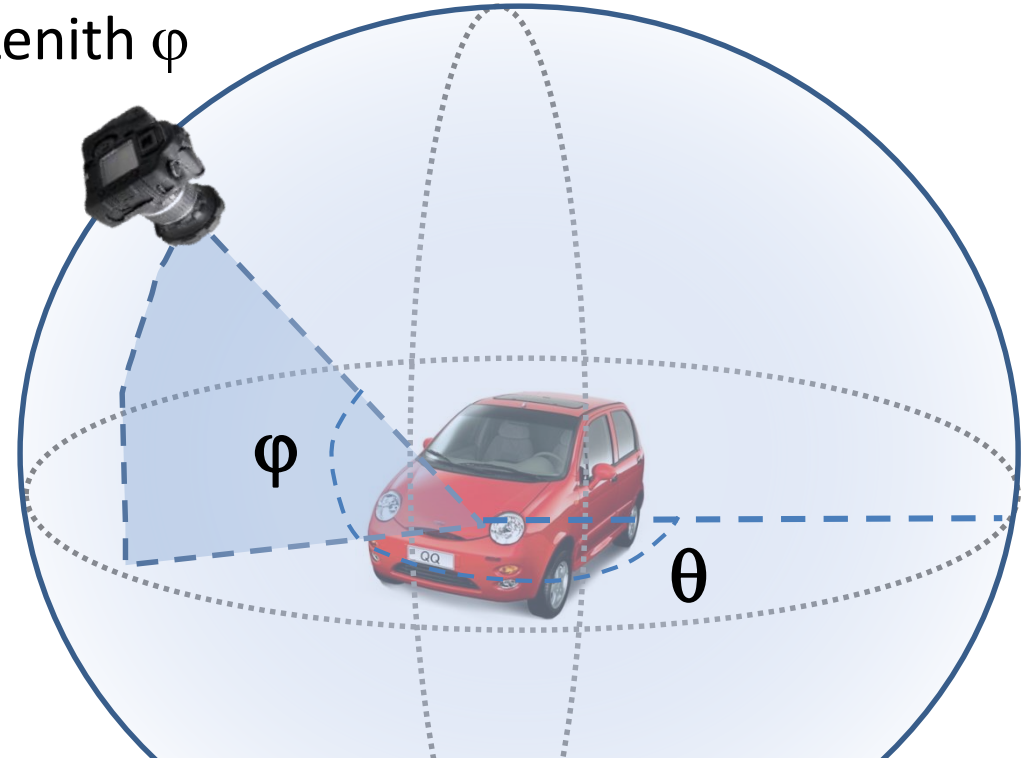


- Detect objects under generic view points
- Estimate object pose & 3D shape

Properties of a 3D object detector

Viewing sphere

Azimuth θ, Zenith φ

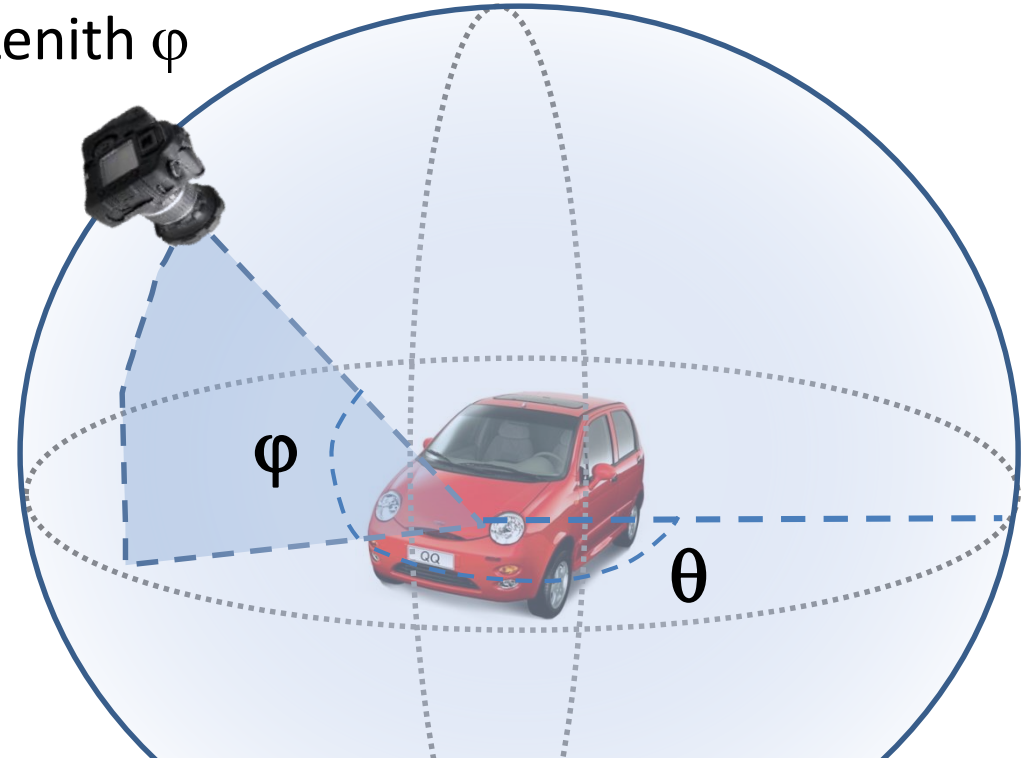


- Detect objects under generic view points
- Estimate object pose & 3D shape
- Work for object categories

Properties of a 3D object detector

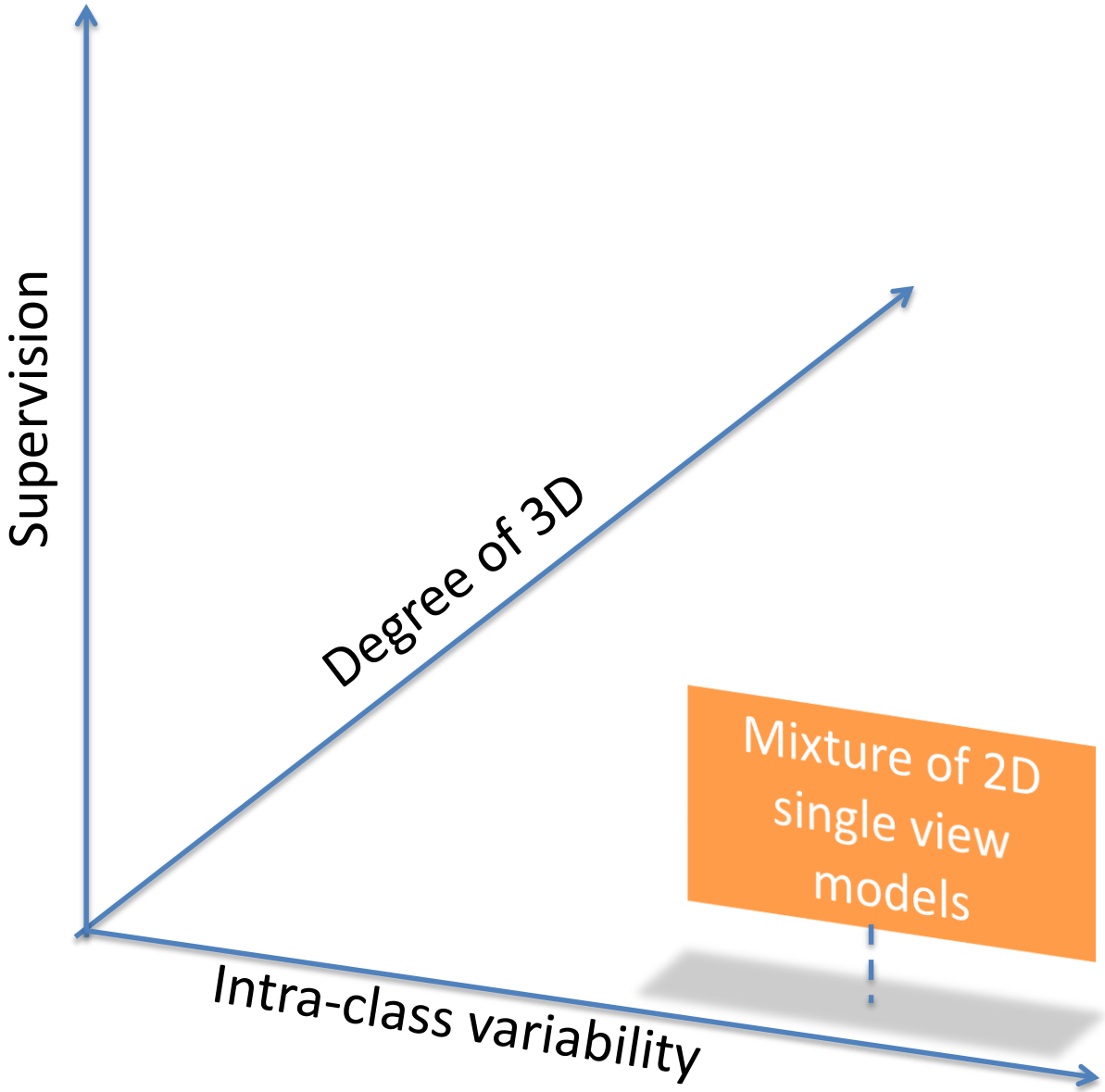
Viewing sphere

Azimuth θ, Zenith φ



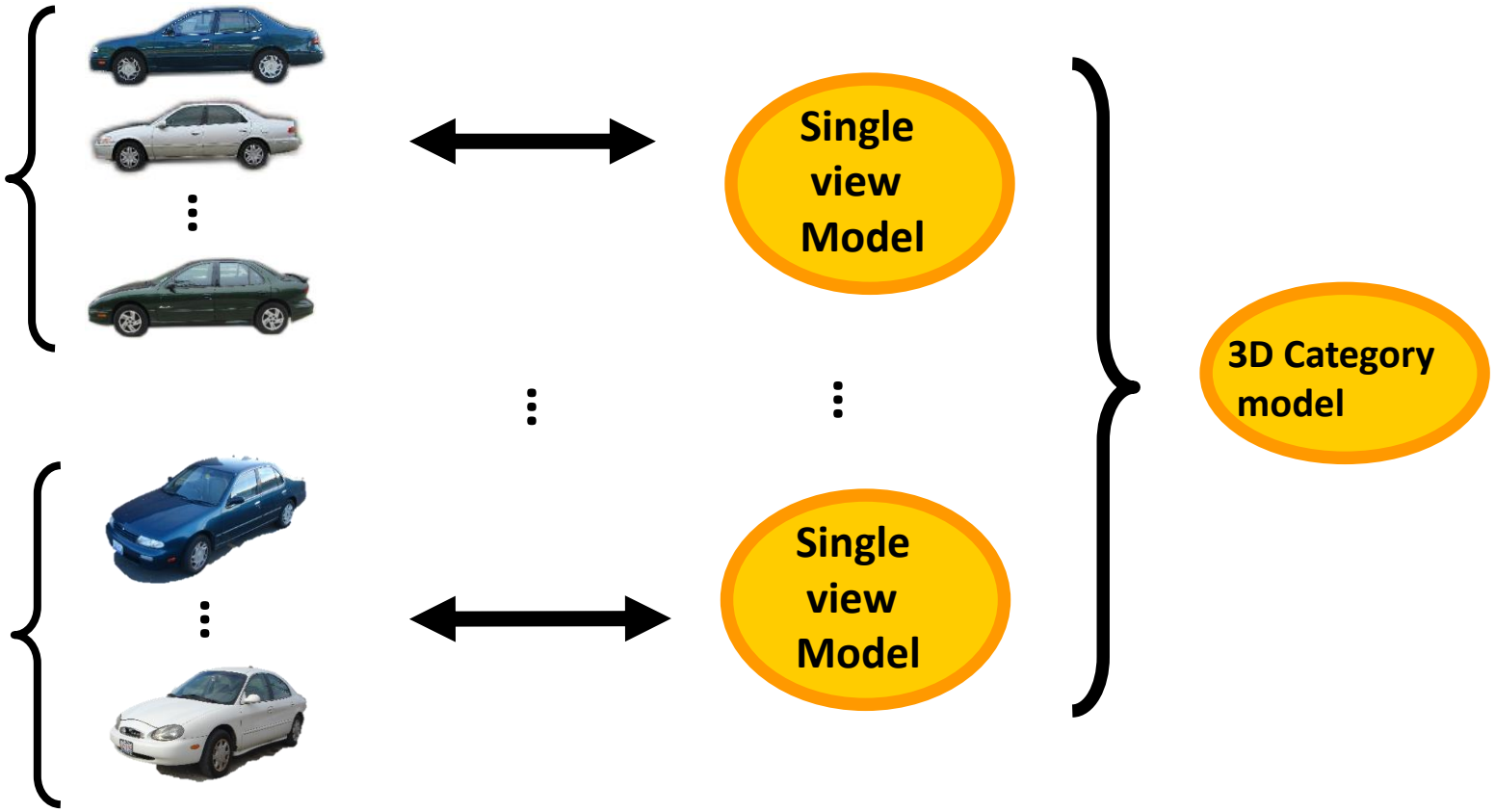
- Detect objects under generic view points
- Estimate object pose & 3D shape
- Work for object categories
- Limited amount of supervision

Models for 3d Object detection

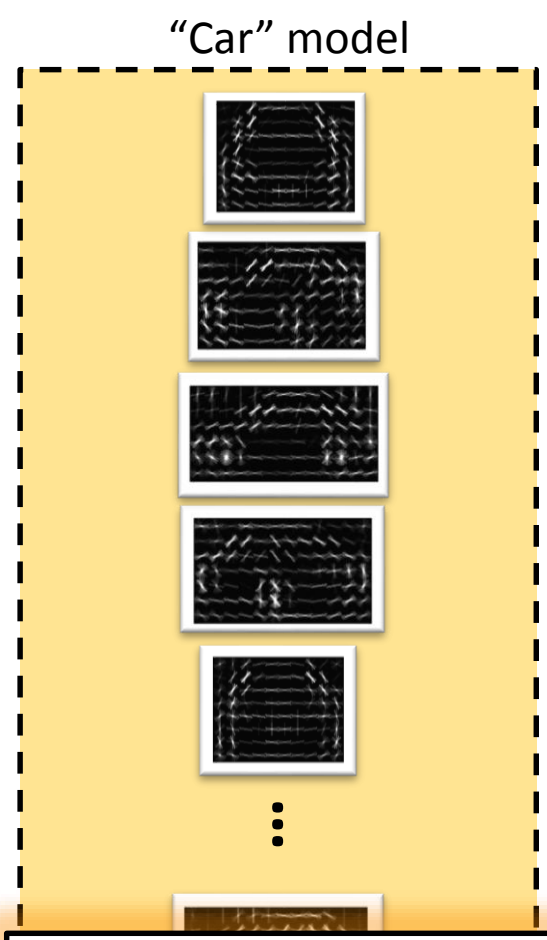


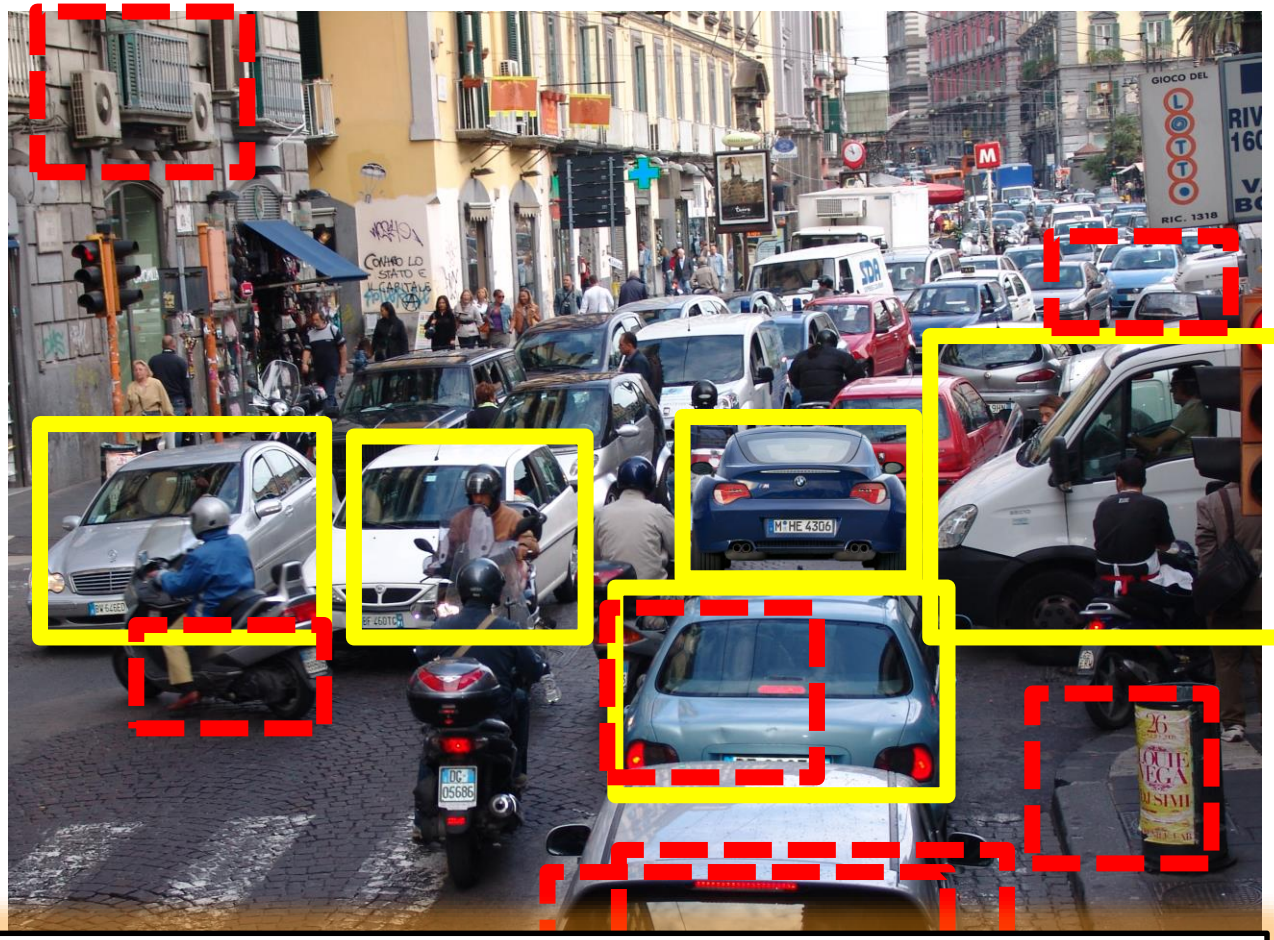
Mixture of 2D models

- Weber et al. ’00
- Schneiderman et al. ’01
- Ullman et al. 02
- Fergus et al. ’03
- Torralba et al. ’03
- Felzenszwalb & Huttenlocher ‘03
- Leibe et al. ’04
- Shotton et al. ‘05
- Grauman et al. ’05
- Savarese et al, ‘06
- Todorovic et al. ’06
- Vedaldi & Soatto ’08
- Zhu et al 08
- Gu & Ren, ‘10



State of the art object detection



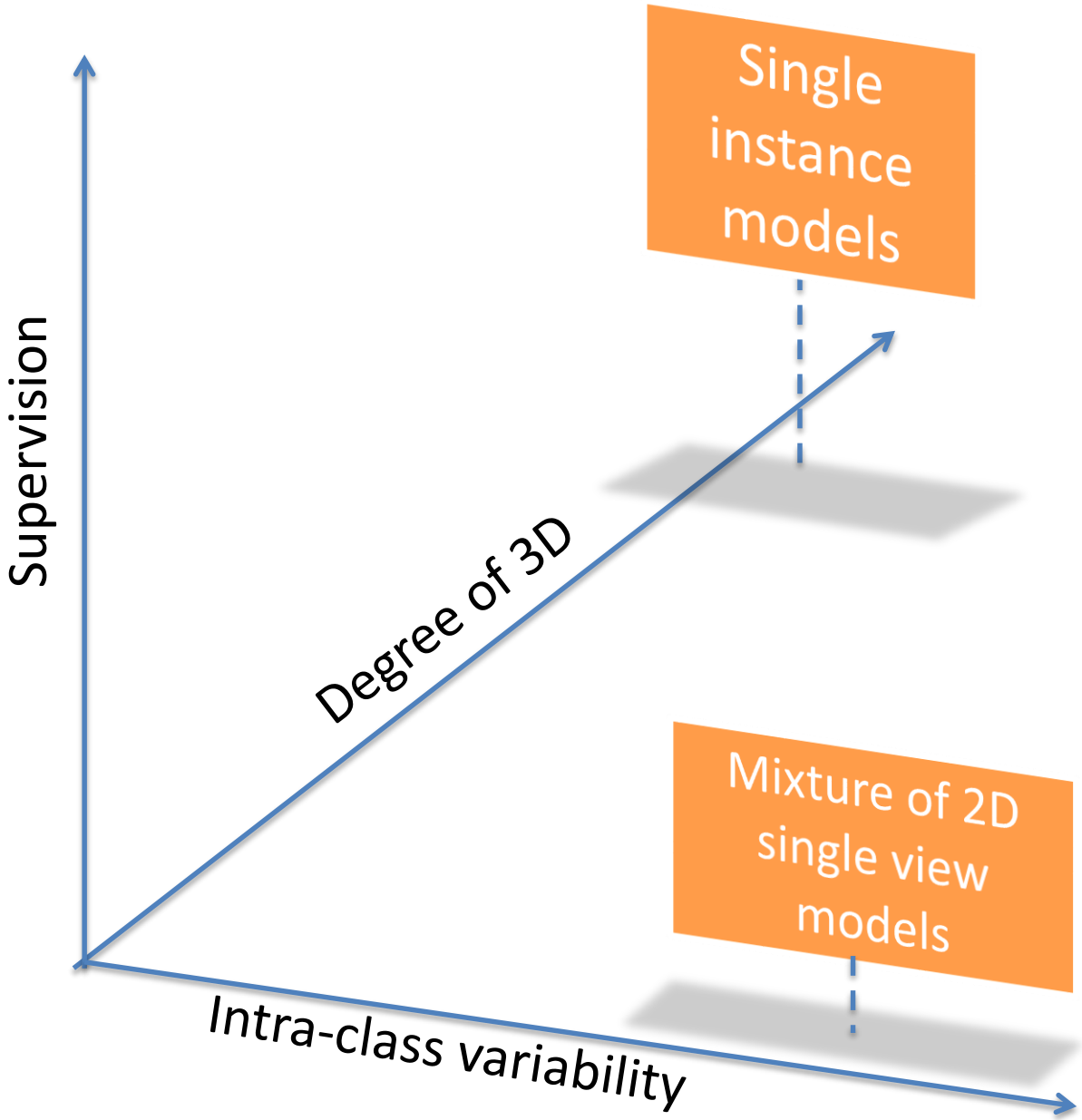


PROS: Flexible and easy to learn • Limited supervision • High accuracy

CONS: Single view models are independent • Many false alarms • Non scalable to large number of categories/view-points • Cannot estimate 3D pose or 3D layout

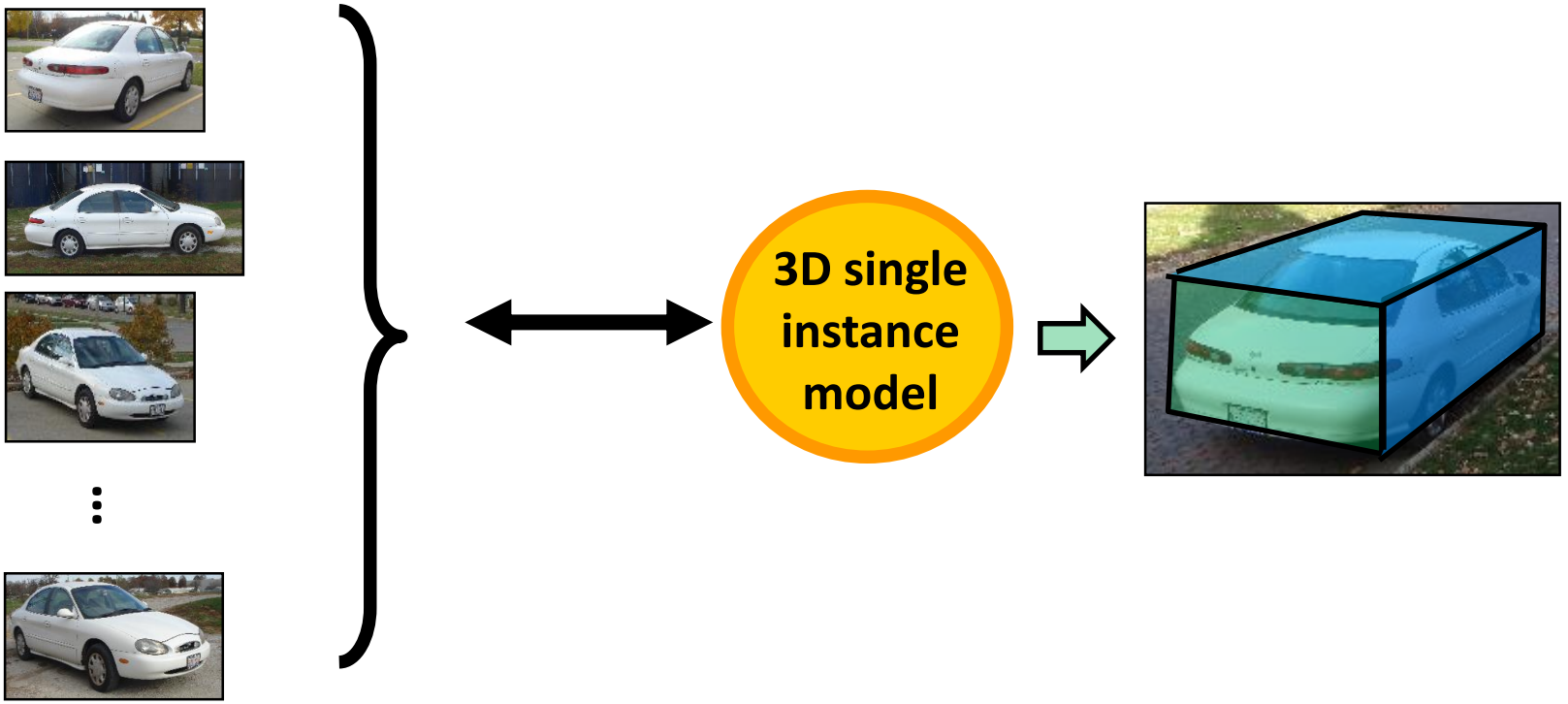
Felzenszwalb et al., 08

Models for 3d Object detection



Where is the crunchy nut?

Single instance of 3D models



- Ballard, ‘81
- Kanade ‘81
- Grimson & L.-Perez, ‘87
- Lowe, ’87

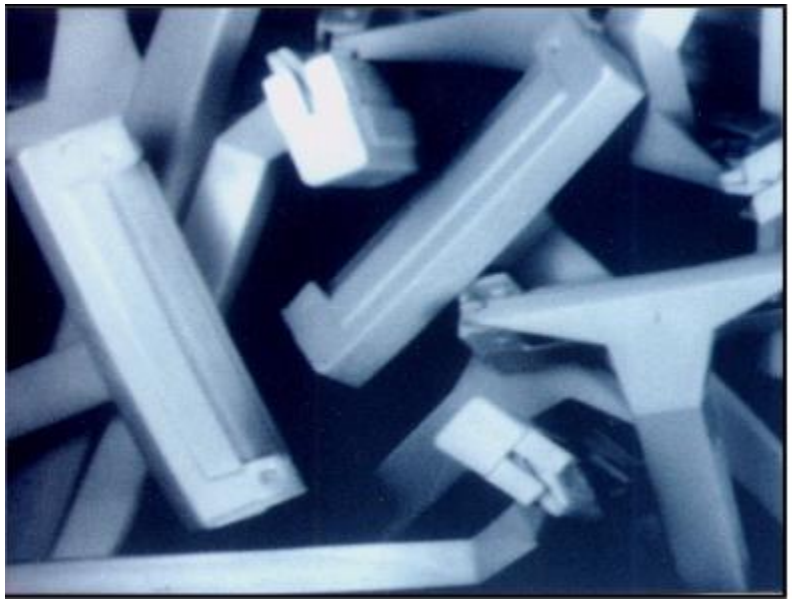
- Edelman et al. ’91
- Ullman & Barsi, ’91
- Rothwell ‘92
- Linderberg, ’94
- Murase & Nayar ‘94

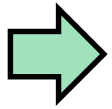
- Zhang et al ’95
- Schmid & Mohr, ‘96
- Schiele & Crowley, ’96
- Lowe, ‘99
- Jacob & Barsi, ‘99
- Rothganger et al., ‘04

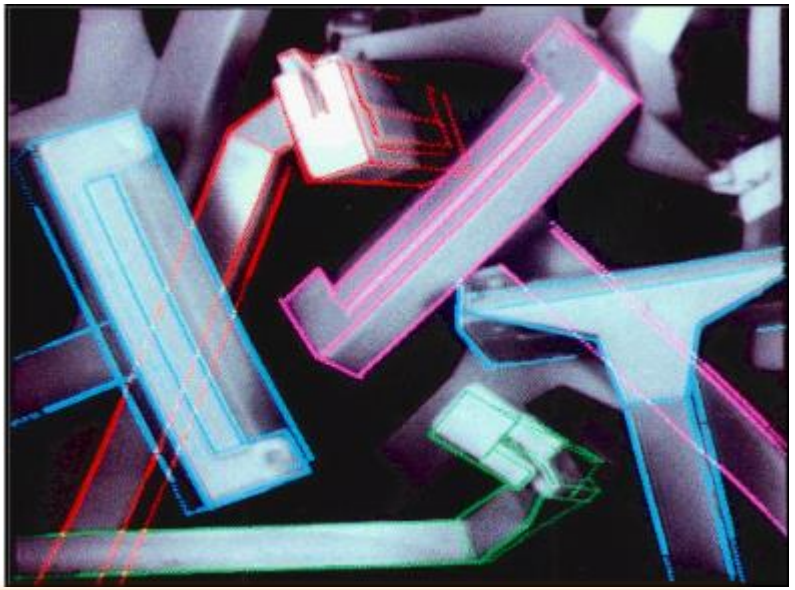
- Ferrari et al, ’05
- Brown & Lowe ’05
- Yin & Collins, ’07
- Collet et al. 09-11
- Hsiao et al. 10-12

Single instance of 3D models

Lowe, ’87

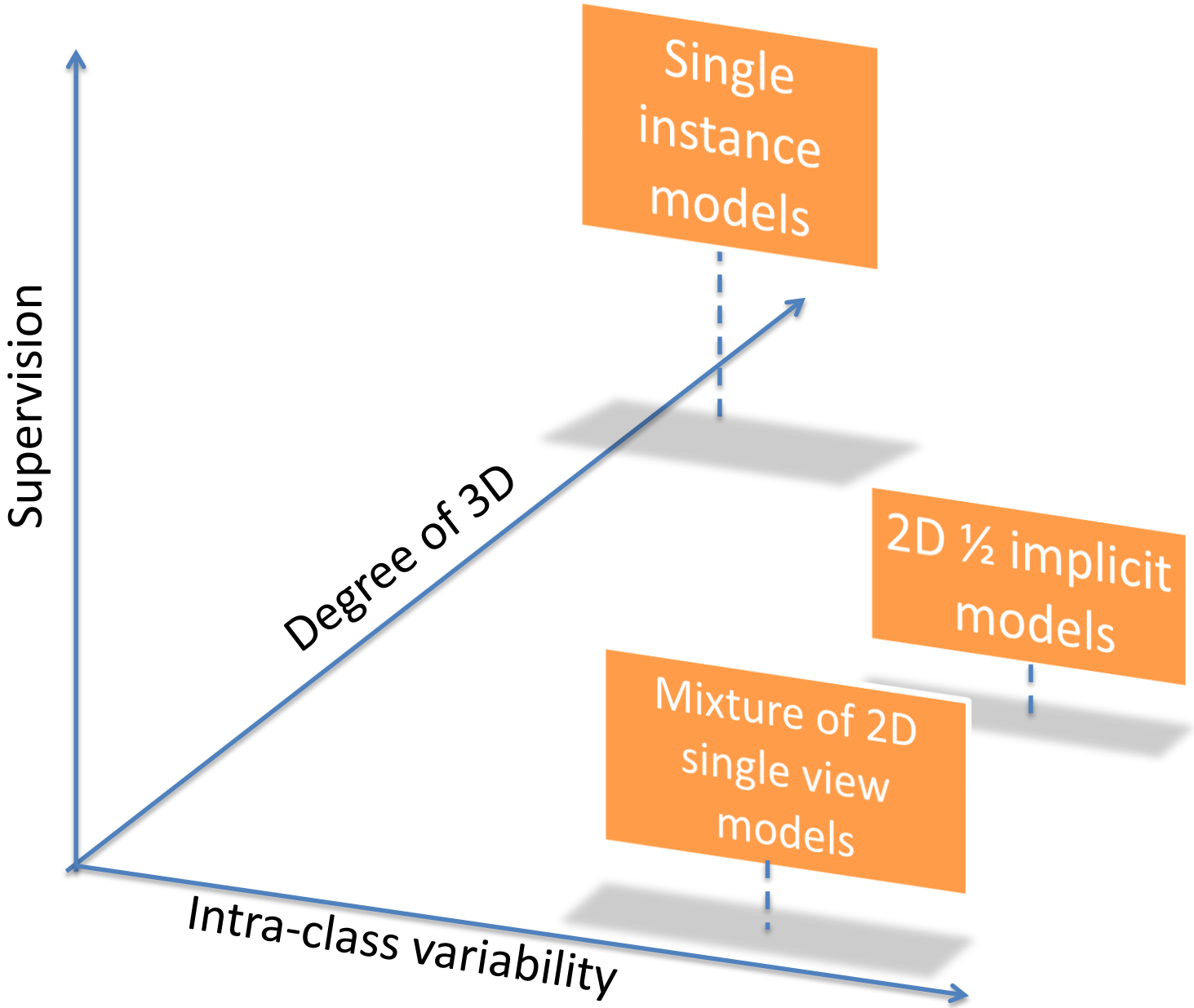






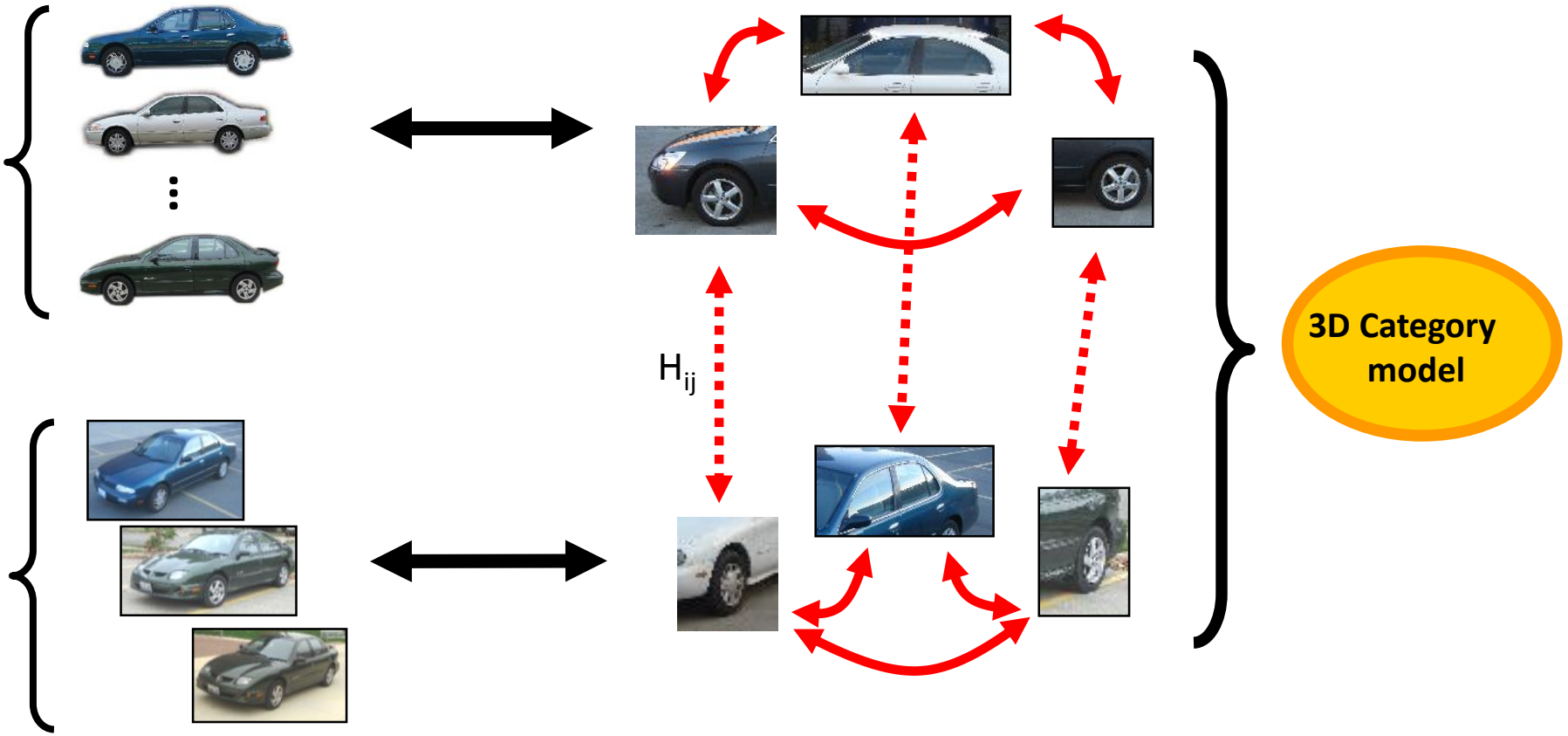
PROS: Accurate single instance detection results • Enable 6 DOF pose estimation;
CONS: Cannot generalize to categories • Require large degree of supervision

Models for 3d Object detection



2D ½ implicit models

- Savarese & Fei-Fei, ICCV 07
- Savarese & Fei-Fei, ICCV 07
- Su, Sun, Fei-Fei, Savarese., CVPR 2009
- Sun, Su, Fei-Fei, Savarese, ICCV 2009
- Thomas et al. '06-09
- Kushal, et al., '07
- Farhadi '09
- Zhu et al. '09
- Ozuysal et al. '10
- Stark et al.'10
- Payet & Todorovic, 11
- Glasner et al., '11



2D ½ implicit models

- Savarese & Fei-Fei, ICCV 07
- Savarese & Fei-Fei, ECCV 08
- Su, Sun, Fei-Fei, Savarese., CVPR 2009
- Sun, Su, Fei-Fei, Savarese, ICCV 2009

- Thomas et al. '06-09
- Kushal, et al., '07
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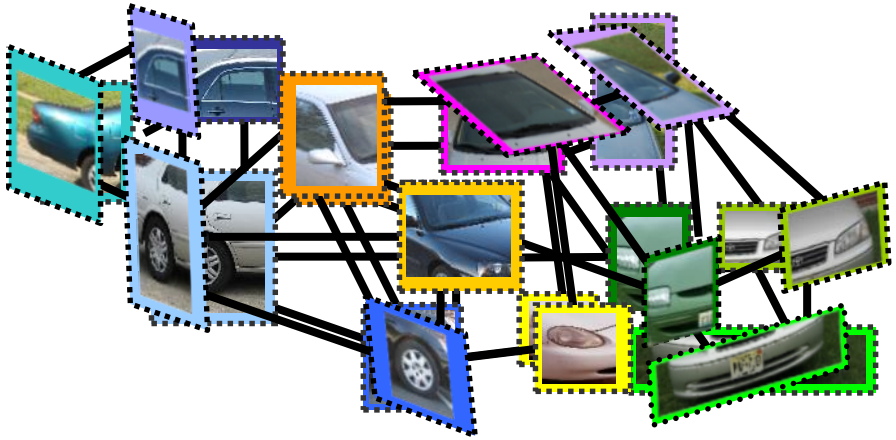
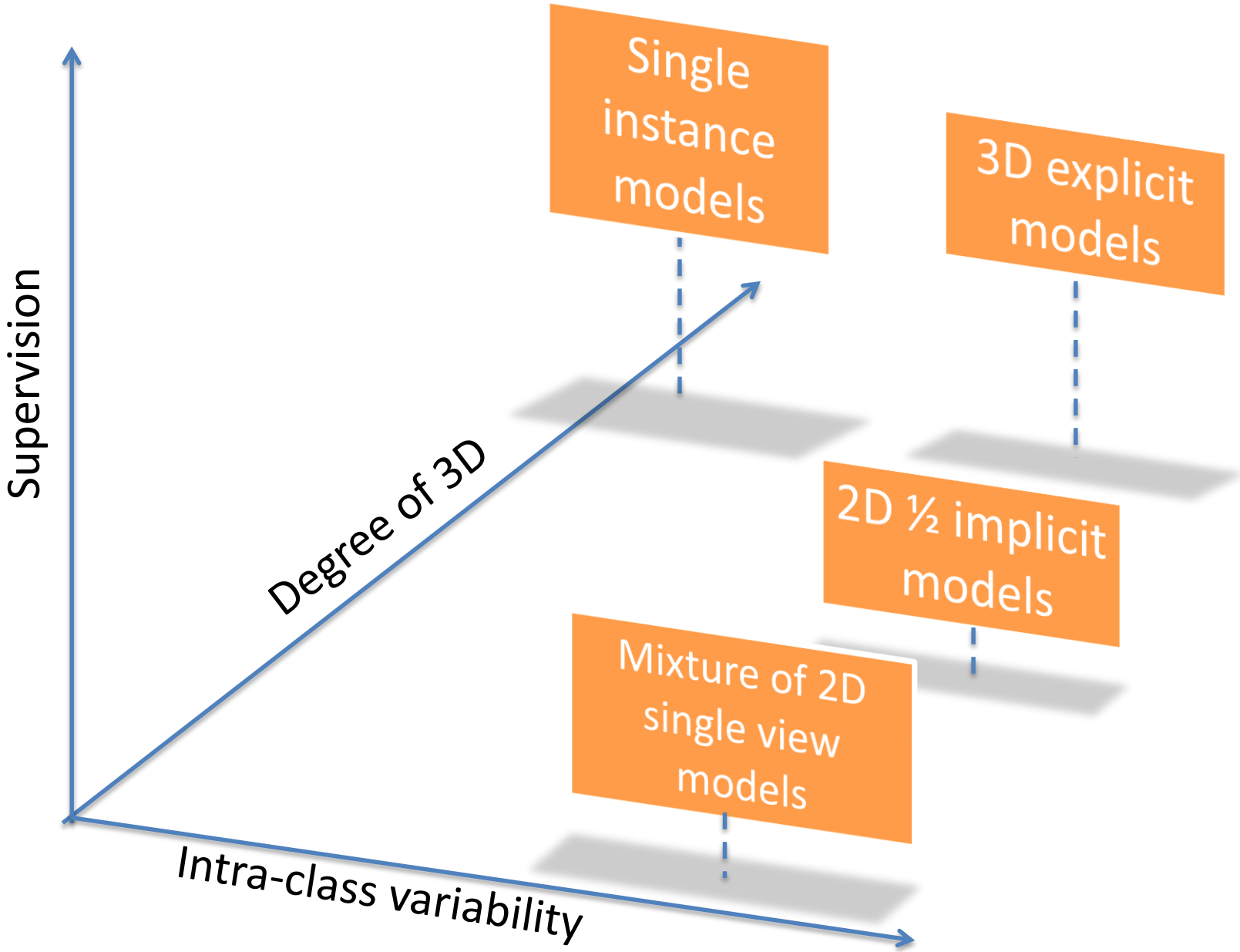


Savarese & Fei-Fei, ICCV 07
Savarese & Fei-Fei, ICCV 08
Sun et al., ICCV 09
Su et al.. CVPR 09

- Object is represented by a collection of parts
- Parts relationship are learnt from training images with little supervision

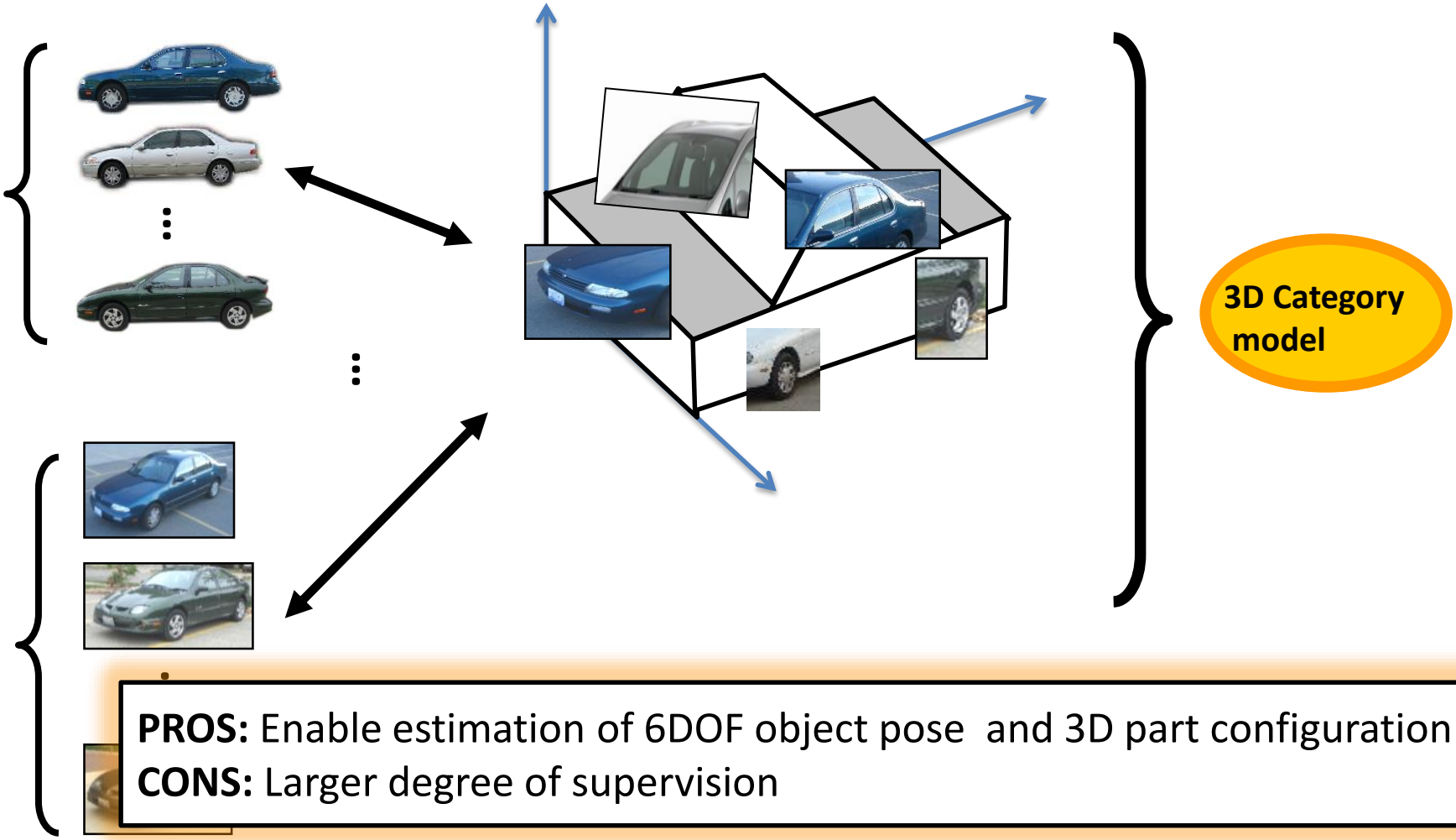
PROS: Generalize well to categories • Little supervision
CONS: 2D ½: cannot easily infer 3D part configurations

Models for 3d Object detection



3D explicit models

- Sun, Xu, Bradski, Savarese, ECCV 2010
- Sun, Kumar, Bradski, Savarese, 3DIM-PVT 2011
- Kumar, Sun, Savarese, CVPR 12
- **Xiang & Savarese, CVPR 12**
- Hoiem, et al. , '07
- Chiu et al . '07
- Liebelt et al. '08, 10
- Xiao et al . '08
- Yi et al. 09
- Arie-Nachimson & Barsi '09
- Sandhu et al . '09
- Hu & Zhu '10



PROS: Enable estimation of 6DOF object pose and 3D part configuration
CONS: Larger degree of supervision