

### Segmentation

# Segmentation

Semantic Segmentation: by class

Instance Segmentation: by object •

- Panoptic Segmentation: mixed •
  - Instance segmentation of "things"
  - Semantic segmentation of "stuff"





Cat



• MS COCO

• Driving Datasets

• Simulated Datasets

# Applications

• Driving

MS Kinect

• Graphics



## FCN

- Upsampling
  - Linear
  - Upconvolutions
- Offset predictions
  - NaN testing
- Pre-trained classifiers



Jonathan Long, Evan Shelhamer, Trevor Darrell. 2015. Fully Convolutional Networks for Semantic Segmentation. CVPR 2015.

# Improving FCN: Dilation

- Dilated convolutions
  - Pre-trained models still work
- Context module
  - Dilated layers on top of a complete network
  - Finer detail in segmentation



Liang-Chieh Chen, George Papandreou, Iasonas Kokkinos, Kevin Murphy, Alan L. Yuille. 2015. Semantic Image Segmentation with Deep Convolutional Nets and Fully Connected CRFs. ICLR 2015

Fisher Yu, Vladlen Koltun. 2016. Multi-Scale Context Aggregation by Dilated Convolutions. ICLR 2016.



## Improving FCN: Deformable Conv.

# Train network to predict locations of the dilated kernel pixels









Jifeng Dai, Haozhi Qi, Yuwen Xiong, Yi Li, Guodong Zhang, Han Hu, Yichen Wei. 2017. Deformable Convolutional Networks. ICCV 2017.

## Mask RCNN



2017. Mask R-CNN. ICCV 2017.

#### **Object Representation: Box**

Simple

Easy to label

Compact



Occlusion

Too big

Not enough information

### **Object Representation: Mask**

More detail

Better with occlusion and partial objects



Hard to label

Still not that much information

### **Object Representation: Keypoint**

Low dimensional

Can have useful information



**Class specific** 

## **Object Representation: 3D model**

- Inverse graphics
- Lots of detail
- Too much detail
- Labeling is extremely hard
- (Sometimes) Surprisingly little information for all that detail