



COMP47590

ADVANCED MACHINE LEARNING

DEEP LEARNING – IMAGE PROCESSING

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Information

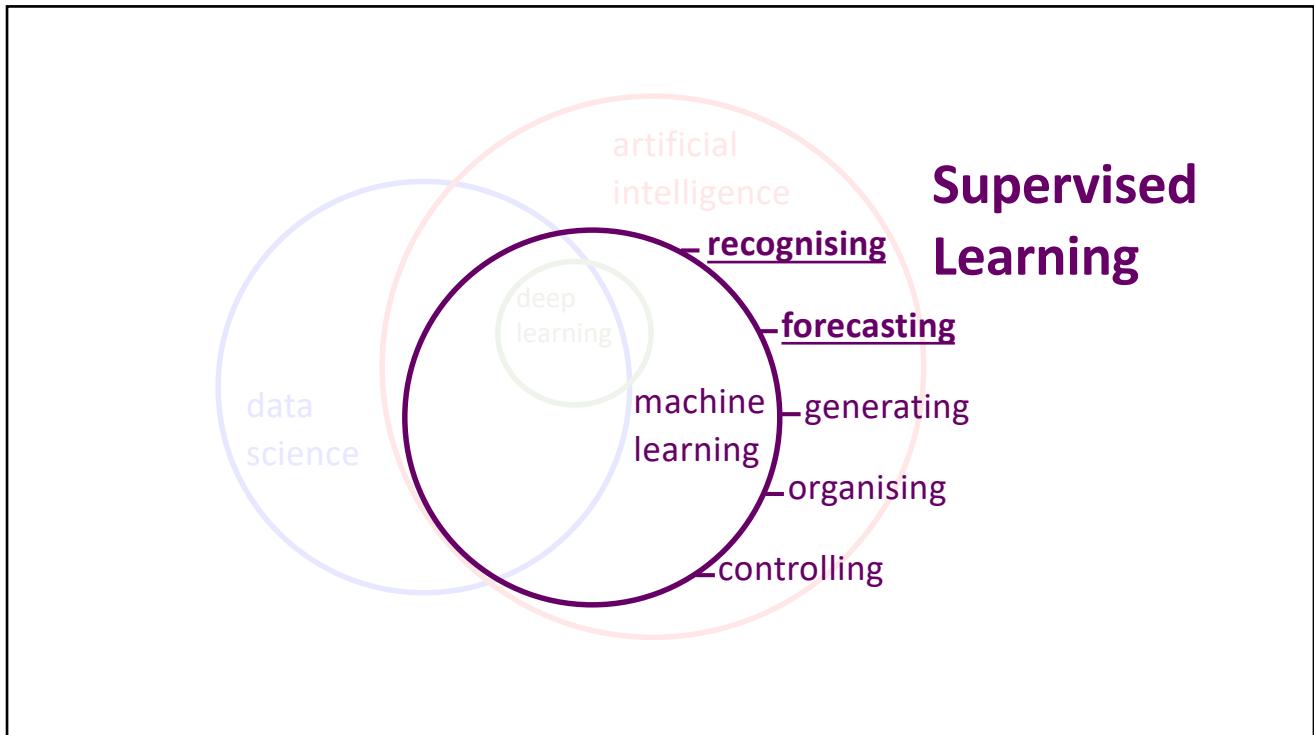
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Course Materials:

All material posted on UCD CS moodle <https://csmoodle.ucd.ie/moodle/course/view.php?id=663>

Enrolment key **UCDAvML2017**



Section Outline

In this section we will cover:

- Pre-trained models
- Image classification models

PRE-TRAINED MODELS

Pre-trained Models

Although ADAM and Dropout help in the optimization process, CNNs are still difficult to train

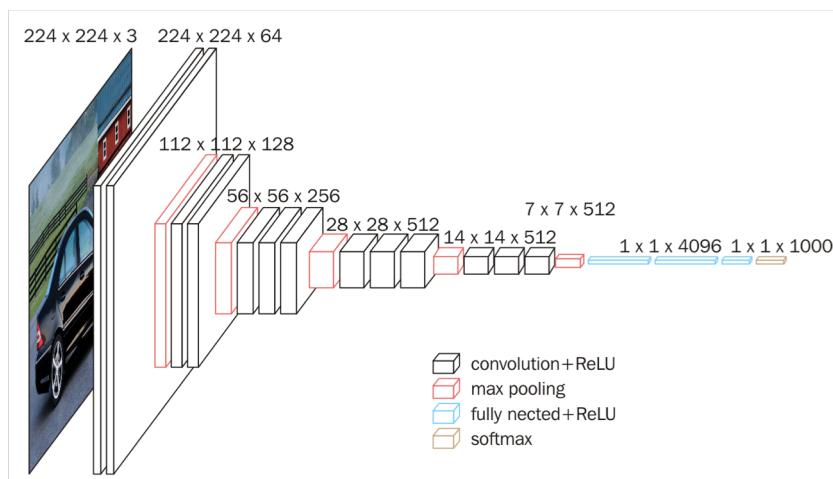
- Datasets with a large number of classes make the optimization difficult
- A lot of computer power is needed even to load such datasets

Pre-trained Models

It is common practice to use pre-trained models for image related tasks

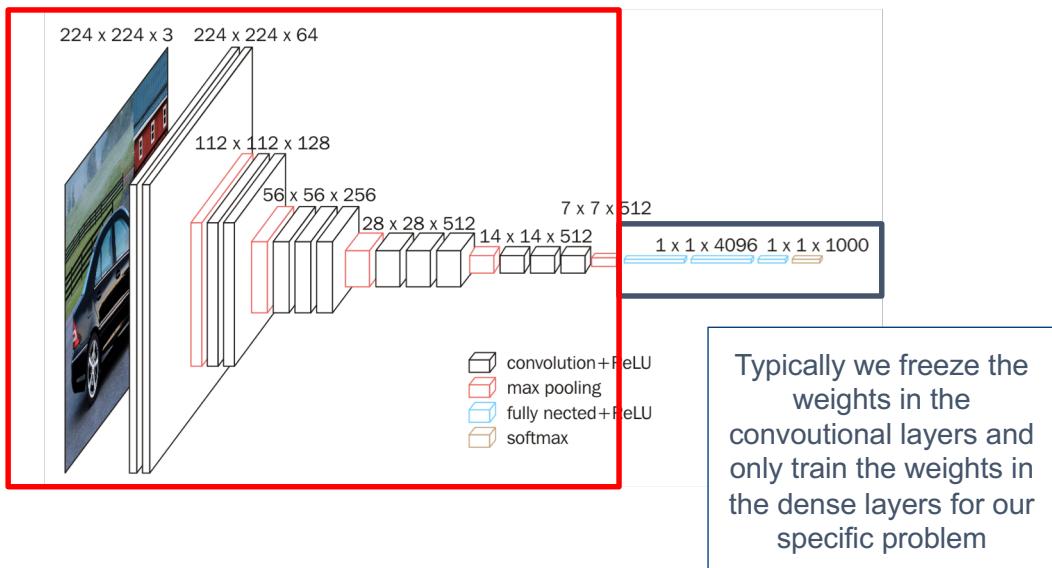
- Most successful CNNs networks are made available already optimized as open source
 - VGG-16
 - Inception v3
 - ResNet

VGG-16



Very Deep Convolutional Networks for Large-scale Image Recognition (Simonyan & Zisserman, 2014) <https://arxiv.org/pdf/1409.1556.pdf>

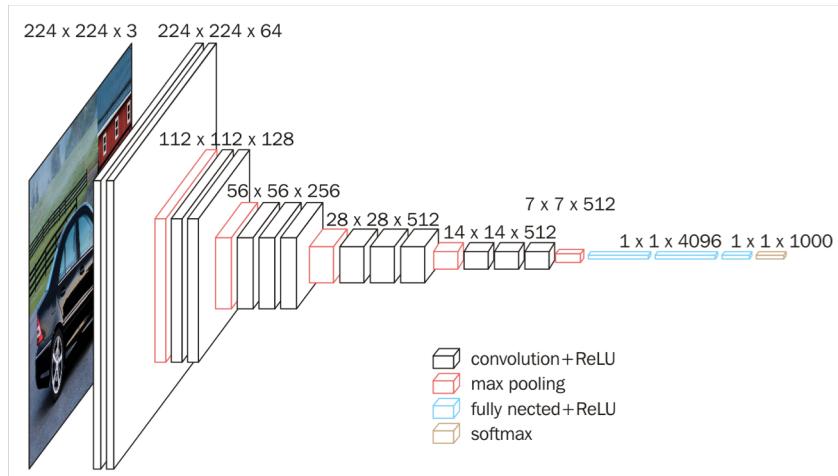
VGG-16



Very Deep Convolutional Networks for Large-scale Image Recognition (Simonyan & Zisserman, 2014) <https://arxiv.org/pdf/1409.1556.pdf>

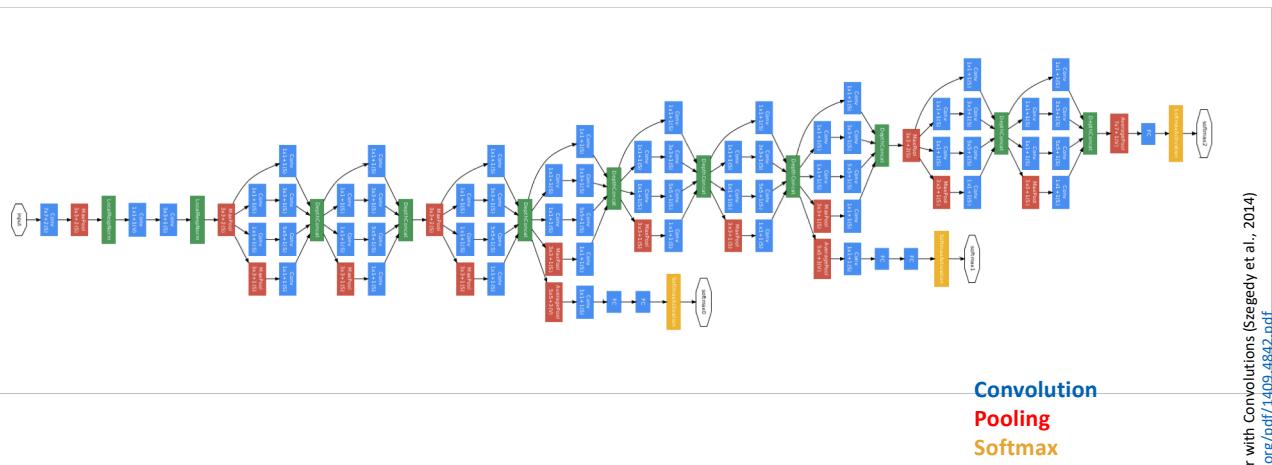
COMMON MODEL ARCHITECTURES

VGG-16



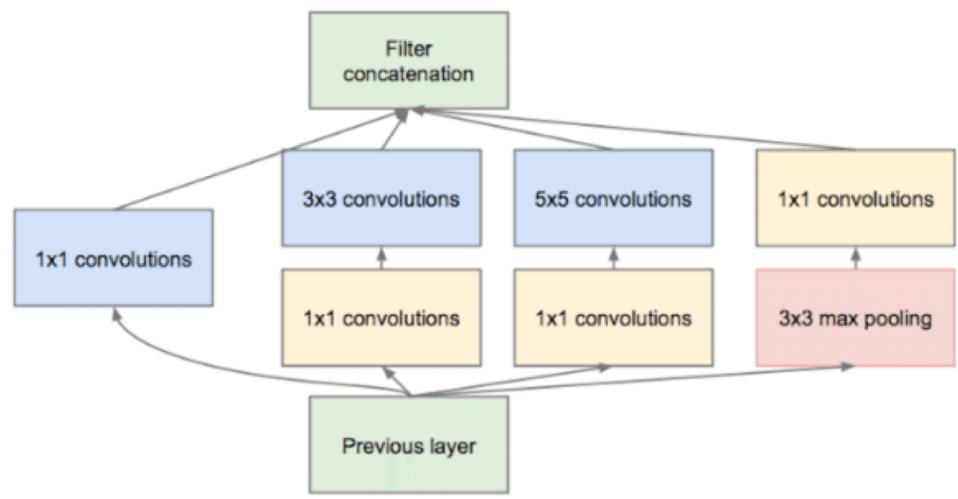
Very Deep Convolutional Networks for Large-scale Image Recognition (Simonyan & Zisserman, 2014) <https://arxiv.org/pdf/1409.1556.pdf>

Inception v3



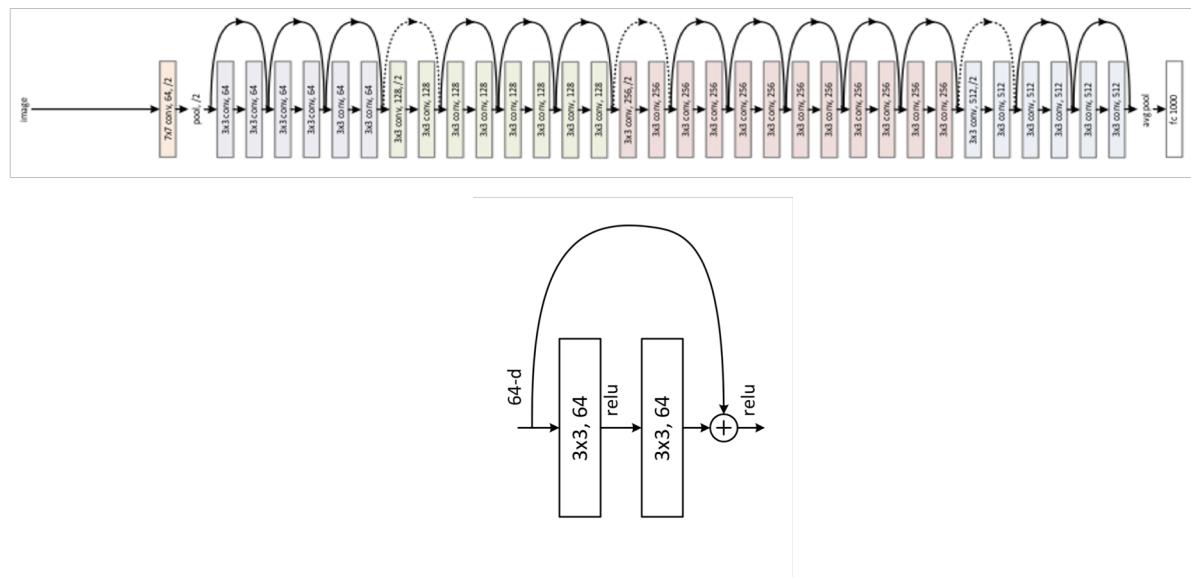
Going Deeper with Convolutions (Szegedy et al., 2014)
<https://arxiv.org/pdf/1409.4842.pdf>

Inception v3



Going Deeper with Convolutions (Szegedy et al., 2014)
<https://arxiv.org/pdf/1409.4842.pdf>

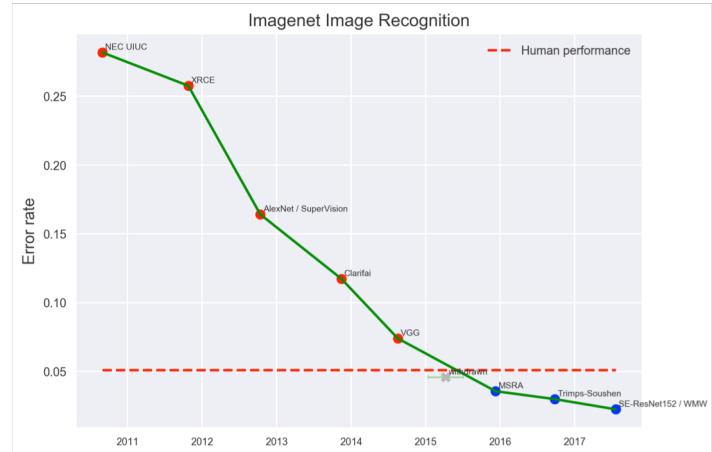
ResNet



Deep Residual Learning for Image Recognition (He et al., 2015)
<https://arxiv.org/pdf/1512.03385.pdf>

Large Models

Very large network architectures have been shown to perform very well on broad coverage object detection problems



<https://www.eff.org/ai/metrics>

IMAGE PROCESSING TASKS

Image Processing Tasks

We can divide image processing tasks into three types:

- Image classification
- Image segmentation
- Object detection

Image Classification

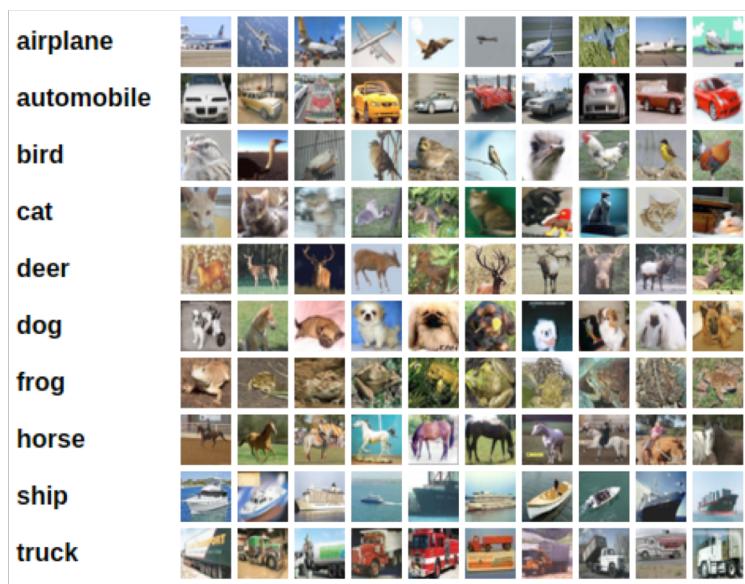


Image Classification

Image classification is the most mature image processing task

- The approaches we have looked at in detail relate to this
- These approaches underpin approaches to other tasks which are more complicated with less mature solutions

Object Segmentation



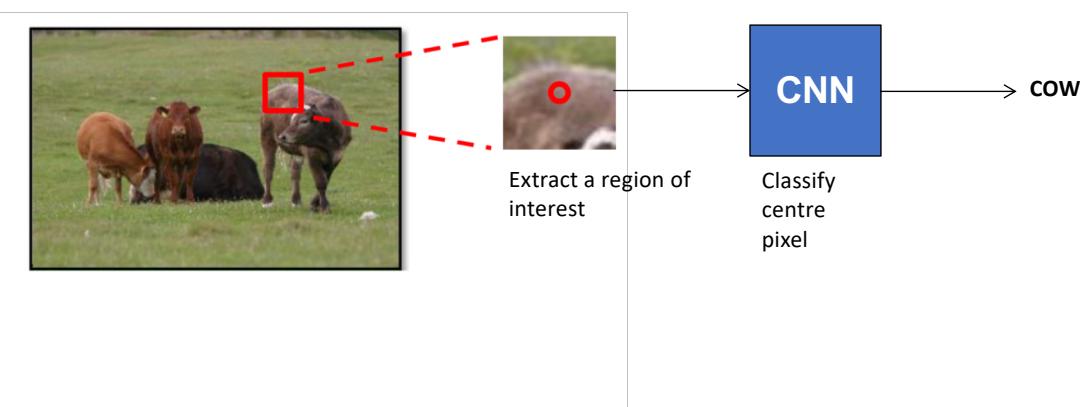
BoxSup: Exploiting Bounding Boxes to Supervise Convolutional Networks for Semantic Segmentation (Dai et al., 2015) <https://arxiv.org/pdf/1503.01640.pdf>

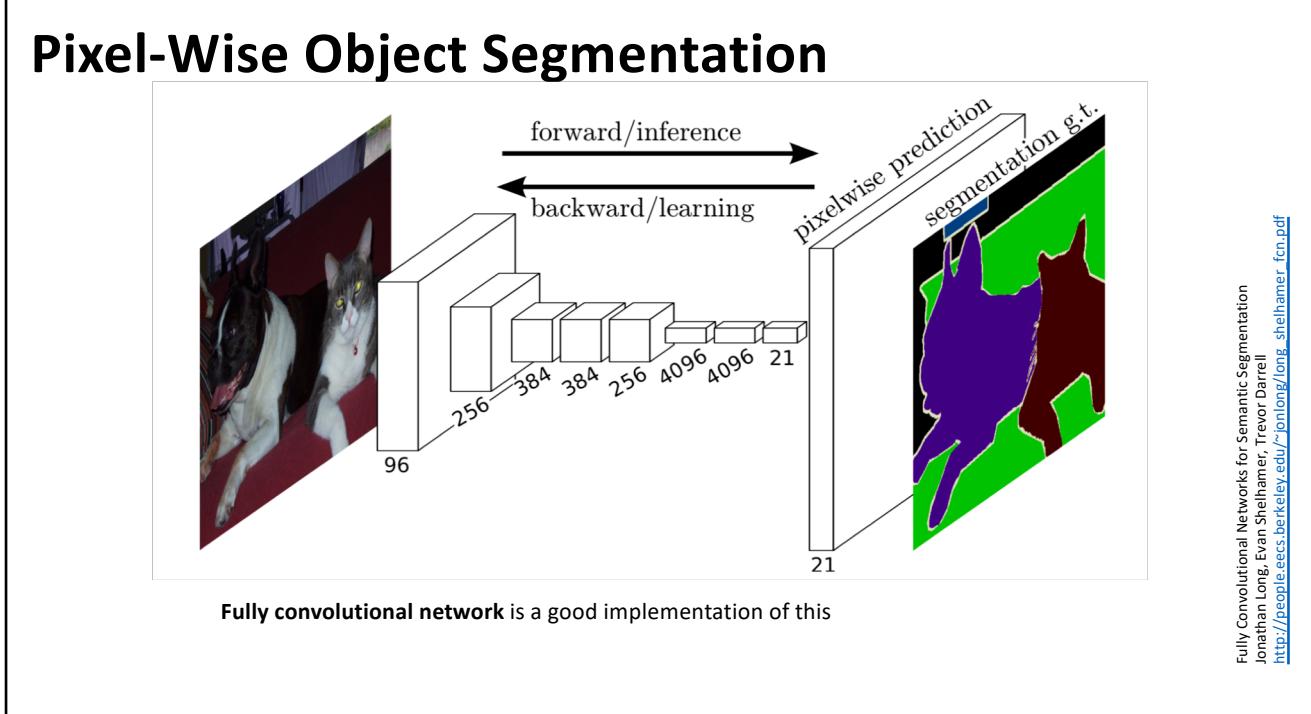
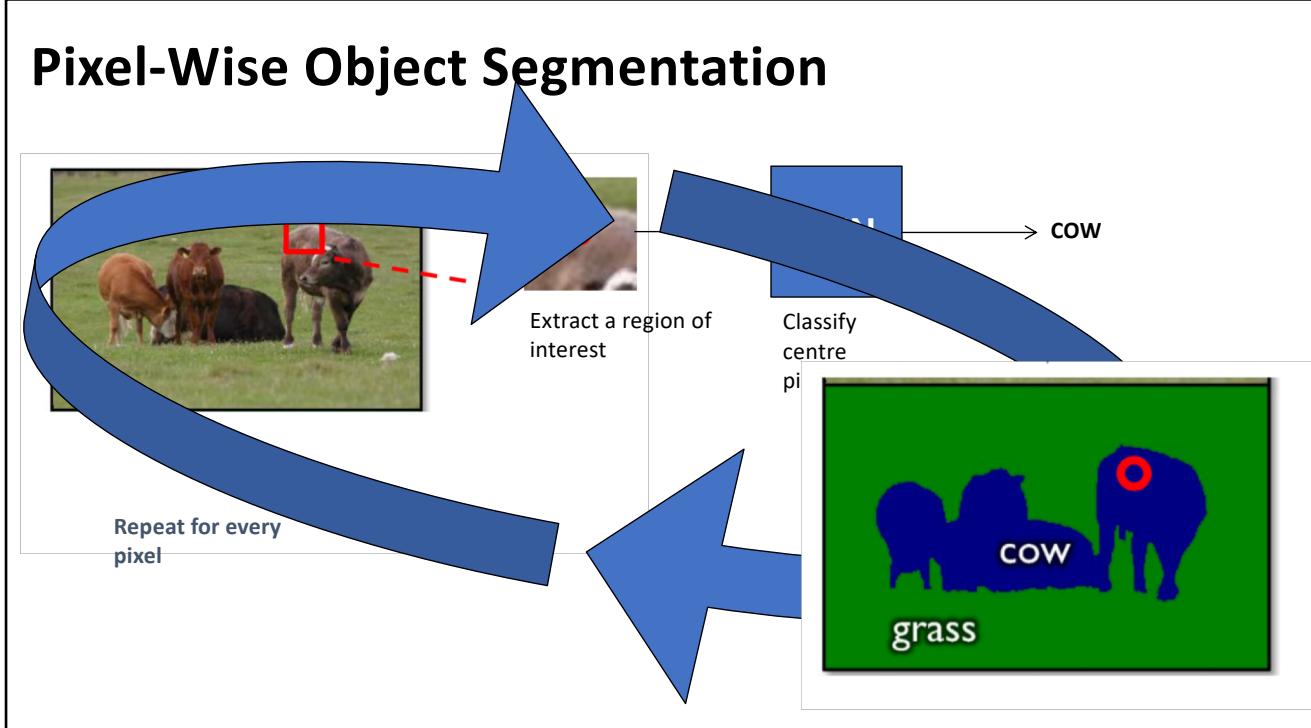
Object Segmentation

There are two main approaches

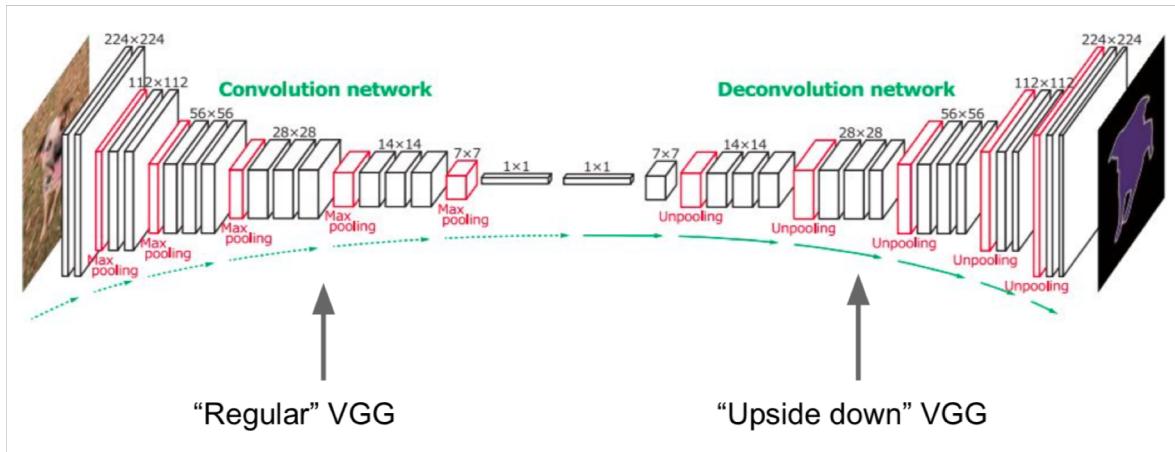
- Pixel-wise classification using CNNs
- Bespoke architectures, often implemented as encoder-decoder networks

Pixel-Wise Object Segmentation



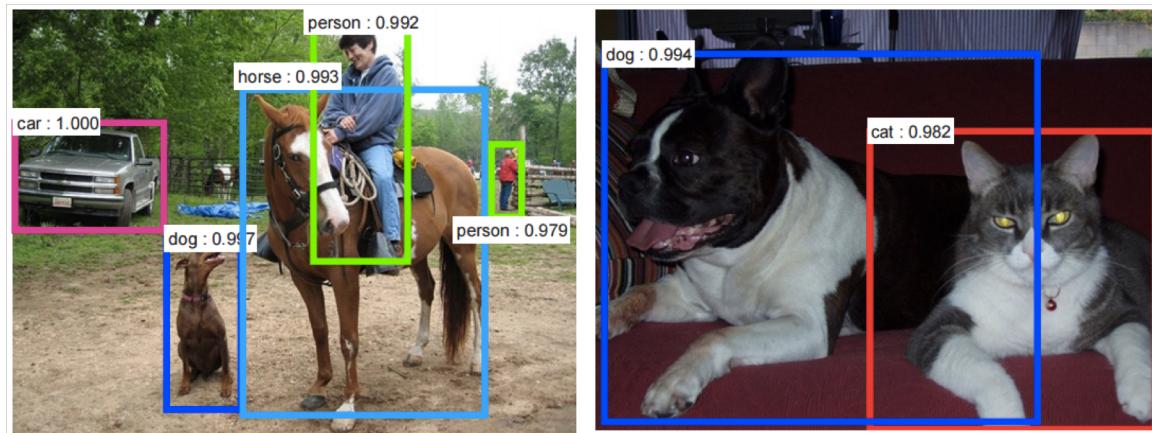


Encoder-Decoder Object Segmentation



Learning Deconvolution Network for Semantic Segmentation
 Hyenwoo Noh Seunghoon Hong Bonyoung
<https://bit.ly/2Kz8Bqg>

Object Detection



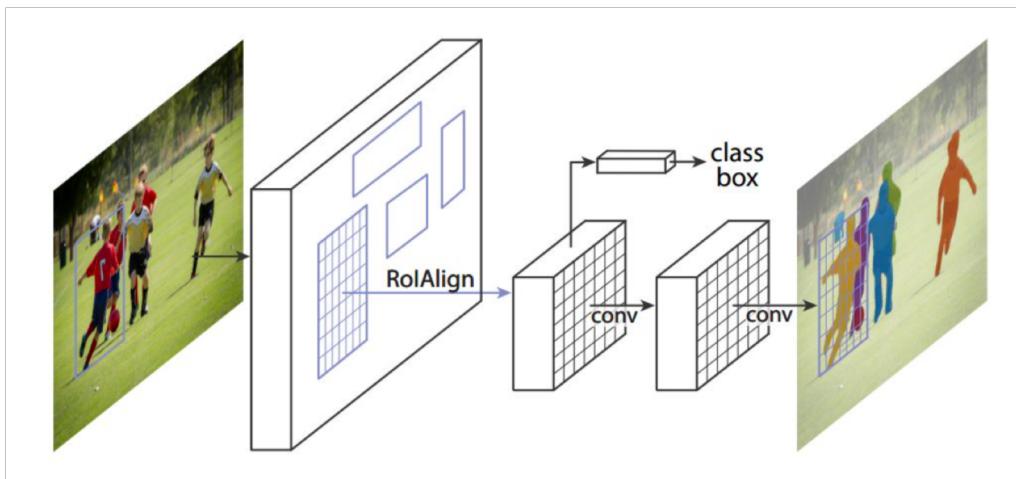
Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks (Ren et al., 2015) <https://arxiv.org/pdf/1506.01497.pdf>

Object Detection

A trickier problem than simple segmentation as it requires separating individual instances

- Proposal based approaches are popular - generate candidate bounding boxes and classify these as containing objects or not

Proposal-based Object Detection



Faster R-CNN is a good implementation of this

Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks (Ren et al., 2015)
<https://arxiv.org/pdf/1506.01497.pdf>

Summary

Summary

The main takeaway messages from this section are:

- For smaller sale problems incorporating a pre-trained model (e.g. inception or VGG-16) and only training the final layers has been shown to be effective for many problems
- Image classification is the basic image processing tasks performed using deep networks
- Image segmentation and object detection are higher level tasks the solutions to which are less mature