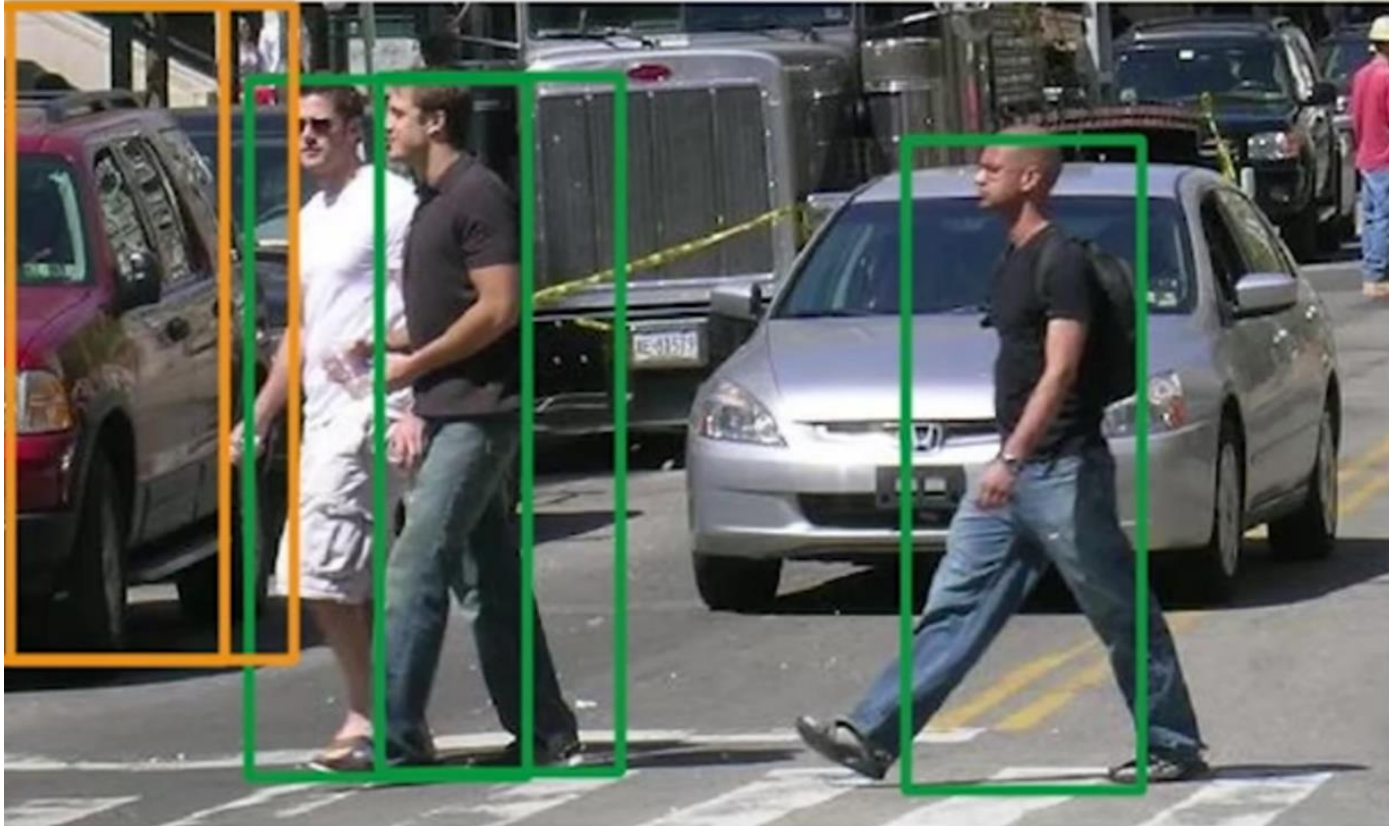# 3D Object Recognition with Deep Networks

3D Vision – CVG – ETH Zurich

Instructors: *Prof. Marc Pollefeys, Dr. Torsten Sattler*

Teaching Assistant: *Yagiz Aksoy, Johnasses Schönberger, Thomas Schöps, Peidung Liu*
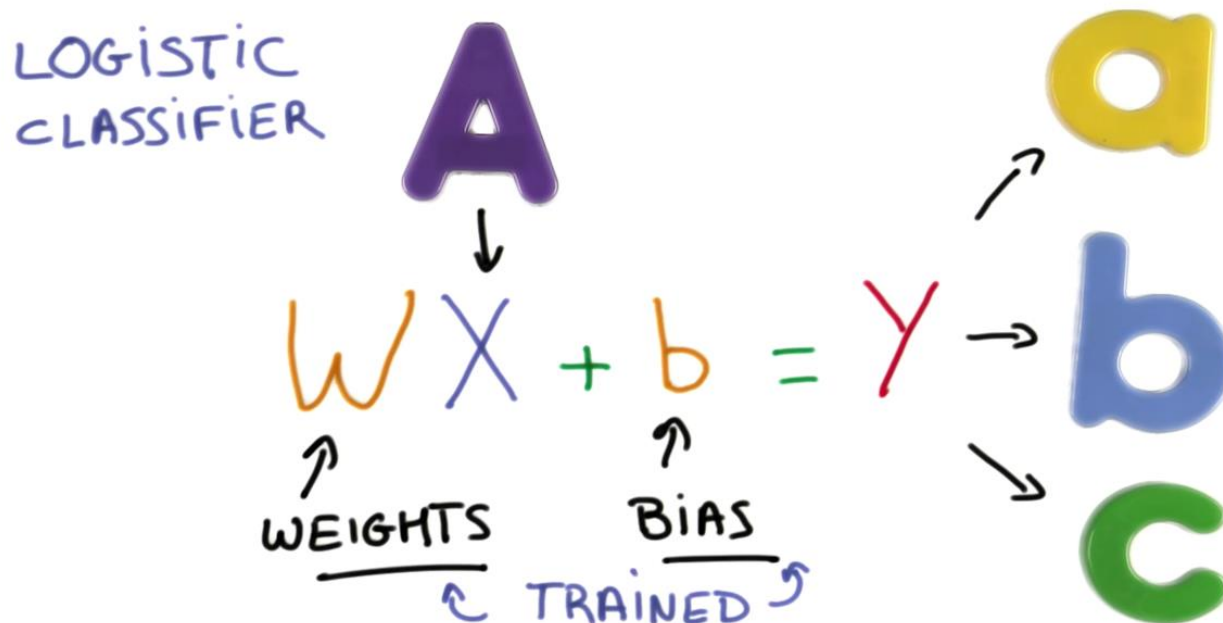
Supervisors: *Martin Oswald, Pablo Speciale*

Students: *Adrian Schneuwly, Johannes Oswald, Tobias Grundmann*

Computer Vision
and Geometry Lab

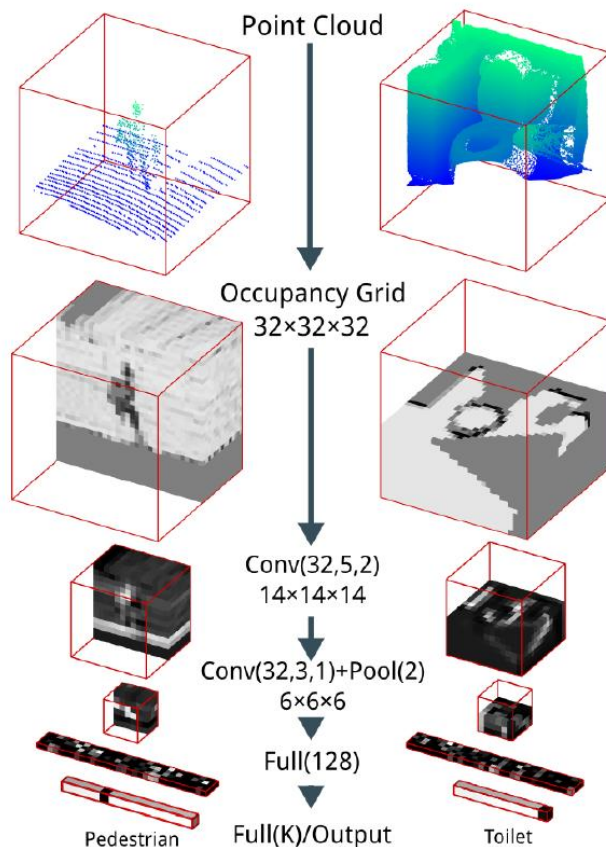**To understand the world autonomous systems need to recognize Objects**

Source: Udacity – Deep Learning

Object Recognition as a Classification Problem
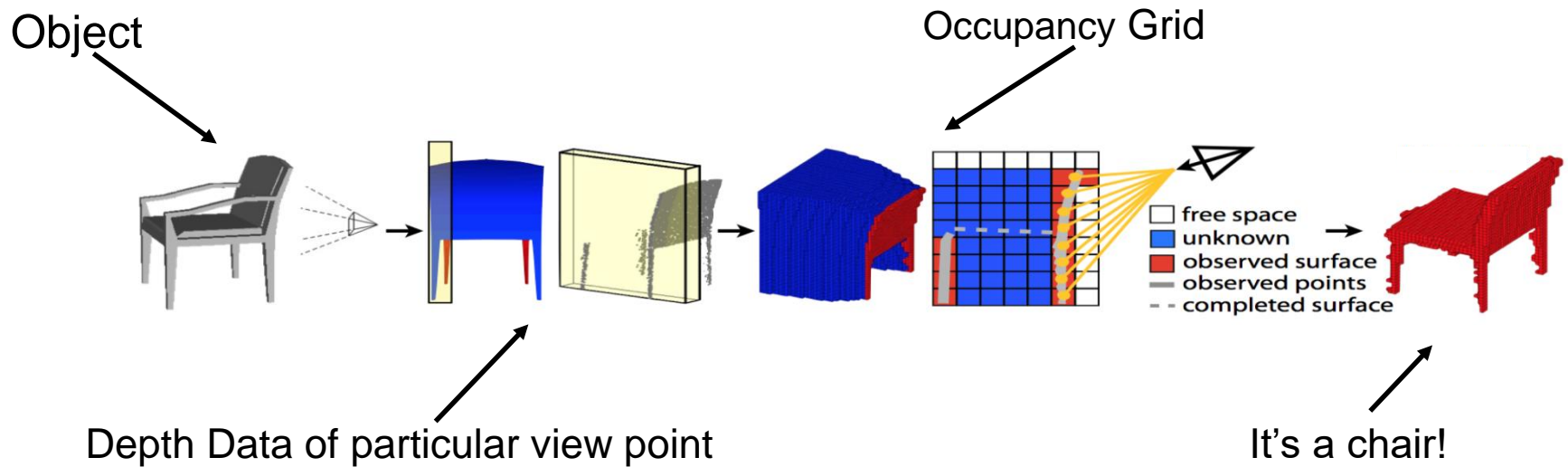

Source: Udacity – Deep Learning

3D Convolutional Neural Network - VoxNet

- Occupany Grid
  - Density Grid
- Convolutional Layers
  - Convolution Through Feature Maps
  - Leaky rectified linear units(ReLU)
- Pooling Layers
  - Down sampling by keeping max value
- Fully Connected Layers
 - Linear combination through(ReLU)
  - Softmax

Source: Daniel Maturana and Sebastian Scherer; VoxNet: A 3D Convolutional Neural Network for Real-Time Object Recognition; IEEE/RSJ International Conference on Intelligent Robots and Systems; September; 2015

3D Objects in Voxilized Format (32x32x32)

Object

Occupancy Grid

free space
unknown
observed surface
observed points
completed surface

Depth Data of particular view point

It's a chair!

Source: Z. Wu, S. Song, A. Khosla, F. Yu, L. Zhang, X. Tang and J. Xiao; 3D ShapeNets: A Deep Representation for Volumetric Shapes; Proceedings of 28th IEEE Conference on Computer Vision and Pattern Recognition

Training, Test Data - ModelNet
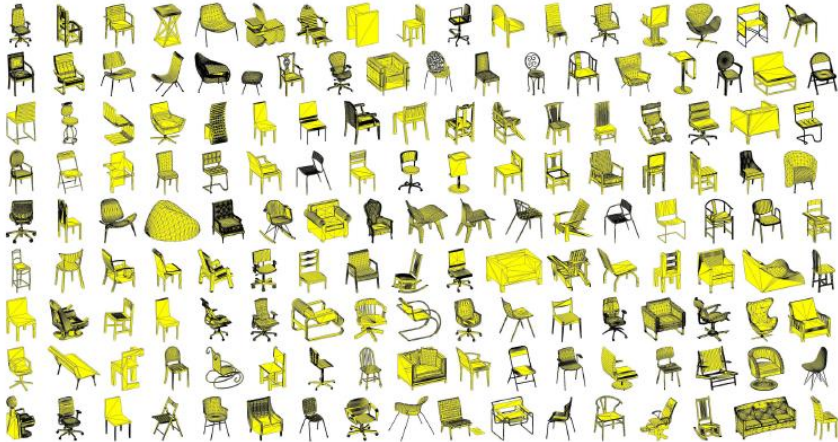
Source: Z. Wu, S. Song, A. Khosla, F. Yu, L. Zhang, X. Tang and J. Xiao; 3D ShapeNets: A Deep Representation for Volumetric Shapes; Proceedings of 28th IEEE Conference on Computer Vision and Pattern Recognition

- ModelNet
  - 660 Objects
  - 151128 CAD Models
- ModelNet40
  - 40 Objects
  - 100 CAD Models per Object
- Rotational Invariance through Data Augmentation
- CNN Training through Stochastic Gradient Decent with Momentum

Timeline

March

- Understand 2D Object Recognition with Deep Networks
- Get familiar with Machine Learning, Tensorflow, Papers' Approaches

April

- Implement Neural Network
- Turn 2D into 3D, Achieve Rotational Invariance

May/June

- Train Neural Network (Time Intensive)
- Fine Tuning & Evaluation
- Build Application for Live Demo (Project Tango Data)