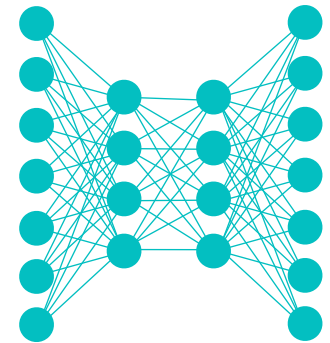


# Lecture Notes for **Neural Networks and Machine Learning**



Fully Convolutional Learning



# Logistics and Agenda

- Logistics
  - Lab one grading...
- Agenda
  - Town Hall
  - Paper Presentation: Group Normalization
  - Segmentation
    - ◆ Semantic (this time)
    - ◆ Object (partially this time, maybe)
    - ◆ Instance (next time)



# Circuits Lab Town Hall



**Tamás Görbe** @TamasGorbe · 8h  
student: how do i become a grad.student?

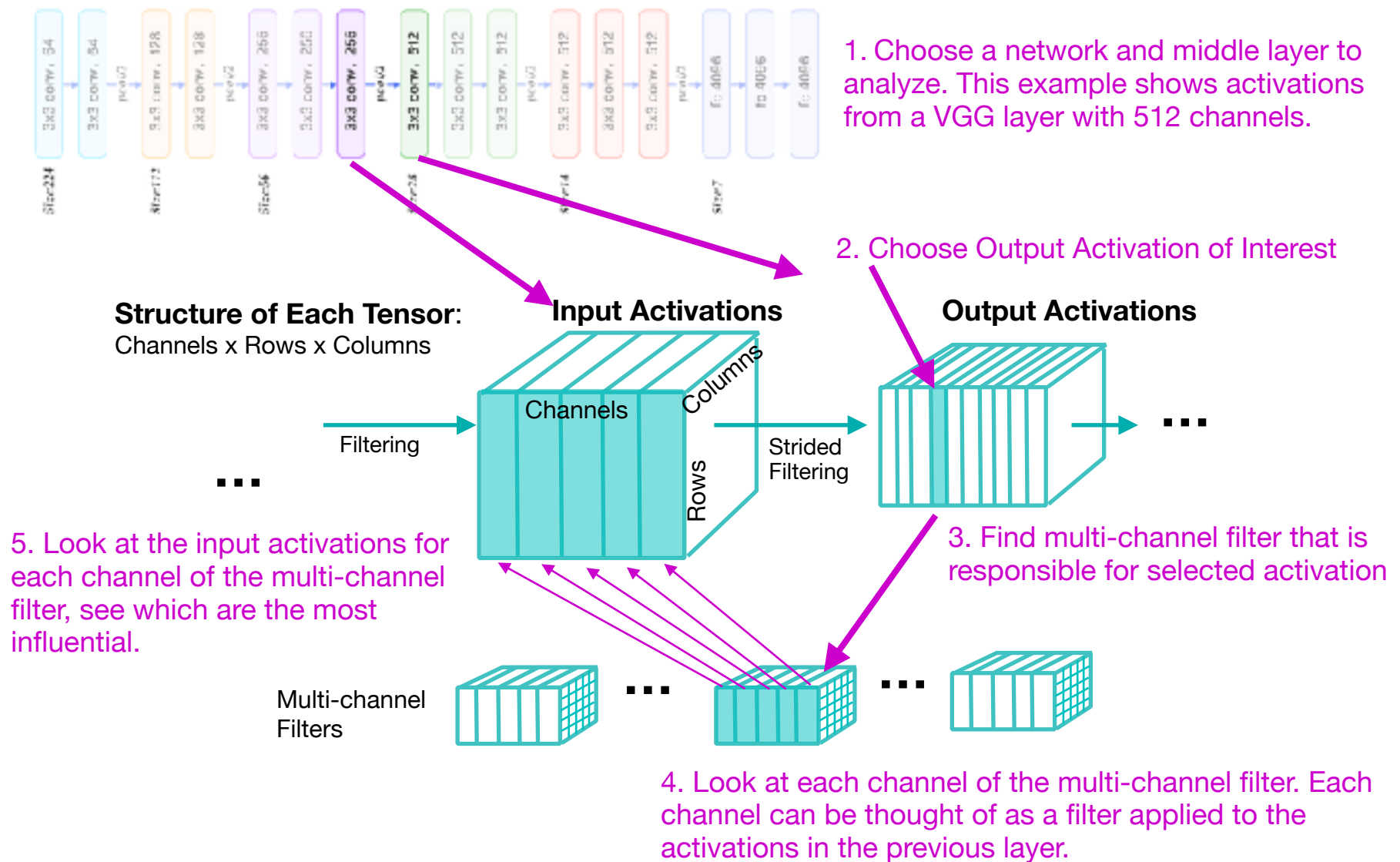
me: here \*hands them a nabla  $\nabla$ \*

$\nabla$ student

@TamasGorbe



# Figure for Circuits Lab



# Student Paper Presentation

## Group Normalization

Yuxin Wu

Kaiming He

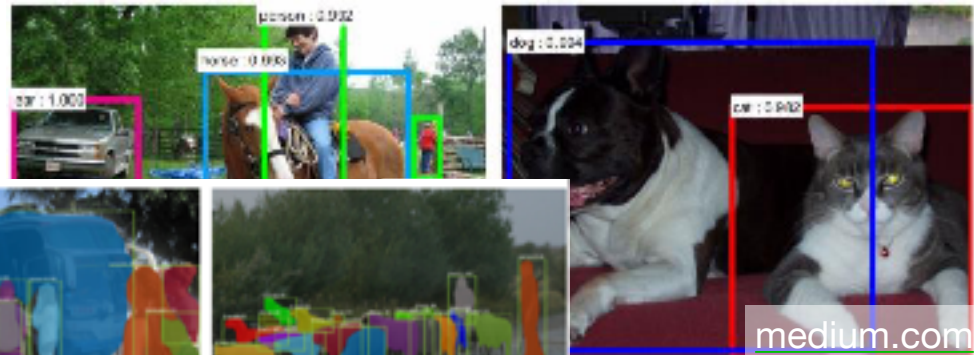
Facebook AI Research (FAIR)

**Abstract** Batch Normalization (BN) is a milestone technique in the development of deep learning, enabling various networks to train. However, normalizing along the batch dimension introduces problems — BN's error increases rapidly when the batch size becomes smaller, caused by inaccurate batch statistics estimation. This limits BN's usage for training larger models and transferring features to computer vision tasks including detection, segmentation, and video, which require small batches constrained by memory consumption. In this paper, we present Group Normalization (GN) as a simple alternative to BN. GN divides the channels into groups and computes within each group the mean and variance for normalization. GN's computation is independent of batch sizes, and its accuracy is stable in a wide range of batch sizes. On ResNet-50 trained in ImageNet, GN has 10.5% lower error than its BN counterpart when using a batch size of 2; when using typical batch sizes, GN is comparably good with BN and outperforms other normalization variants. Moreover, GN can be naturally transferred from pre-training to fine-tuning. GN can outperform its BN-based counterparts for object detection and segmentation in COCO, and for video classification in Kinetics, showing that GN can effectively replace the powerful BN in a variety of tasks. GN can be easily implemented by a few lines of code.



# Types of Fully Convolutional Problems

- Semantic Segmentation
- Object Detection
- Instance Segmentation



He et al., Mask r-cnn, 2018



# Semantic Segmentation



Karandeep Singh @kdpsinghlab · 10h ...

Statistician: Do you ever use statistics?

ML researcher: Nope. Never.

Statistician: What about when reading a paper?

ML: Nope. Never.

Statistician: Ok. So if you're reading an ML paper comparing lots of models, how do you know which one is the best?

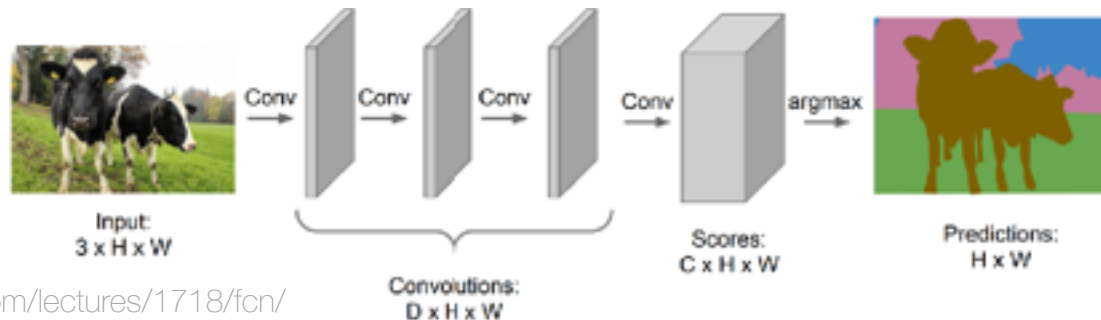
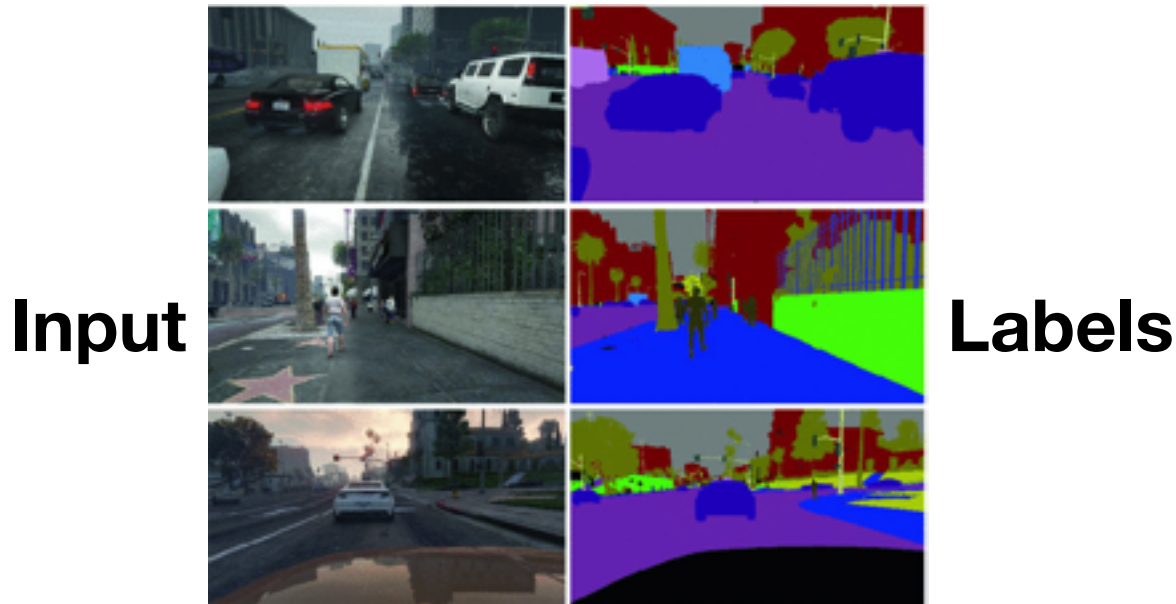
ML: **Bold font.**





# Semantic Segmentation

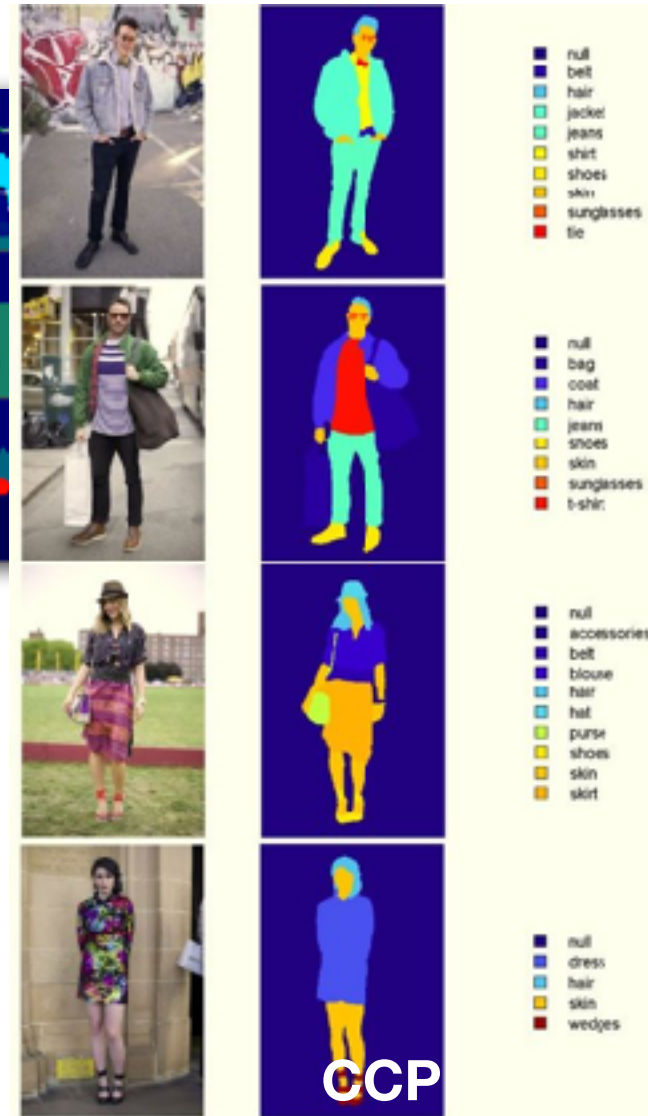
- Given a set of pixels, classify each pixel according to what instance it belongs





# Popular Semantic Segmentation Datasets

**COCO** <http://cocodataset.org/>



# Lecture Notes for Neural Networks and Machine Learning

FCN Learning

**Next Time:**  
Fully Convolutional Objects  
**Reading:** None

