Applied AI

brought you by:
inzva, Bev Foundation

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This Course: Learnings

- Different fields of AI
  - Computer Vision
  - Natural Language Processing
  - Anomaly Detection
  - Recommender Systems

- Widely used frameworks
  - Tensorflow 2
  - Keras Func & Seq
  - PyTorch / Torchvision

- Creating models and using algorithms
  - ANNs
  - CNNs
  - Sequential Models (RNN, GRU, LSTM)
  - Attention Based Models
  - Autoencoders
  - Boosting Algorithms
  - Traditional techniques

- Additional Skills
  - Problem identification and formulation
  - Exploratory data analysis
  - Preprocessing and dataset preparation
  - Transfer learning
  - Experiment Tracking
  - Working with Imbalanced Datasets
  - Model Deployment

This Week: Computer Vision

- Five Problems:
  - Classification +
  - Localization +
  - Segmentation +
  - Object Detection +
  - Image Generation

- Four model types:
  - Dense (Fully-Connected) Networks +
  - Convolutional Neural Networks +
  - Autoencoders
  - Generative Adversarial Networks

- Four Frameworks
  - Tensorflow 2 +
  - Keras Functional +
  - Keras Sequential +
  - Pytorch & torchvision +

- Six Datasets:
  - MNIST +
  - CIFAR-10 +
  - Kaggle Face Keypoint Detection +
  - Segmentation +
  - COCO for Object Detection +
  - Occlusion Dataset

Today’s Schedule

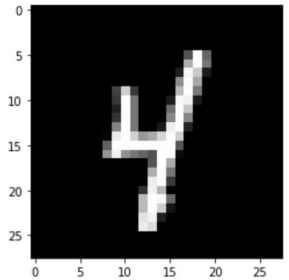
Introduction	11.00 - 11.15
MNIST Classification with Dense Nets on Tensorflow 2	11.15 - 11.45
MNIST Classification with Conv Nets on Keras Functional	11.45 - 12.15
Lunch Break	**12.15 - 13.00**
CIFAR-10 Classification and Transfer Learning with Conv Nets on Keras Sequential	13.00 - 13.40
Kaggle Facial Keypoints Detection with Conv Nets on PyTorch	13.40 - 14.20
Break	**14.20 - 14.35**
Segmentation with a Pre-Trained model from Torchvision	14.35 - 14.55
Object Detection with a Pre-Trained model from Torchvision and model inspection	14.55 - 15.30
Homework Description	15.30 - 16.00

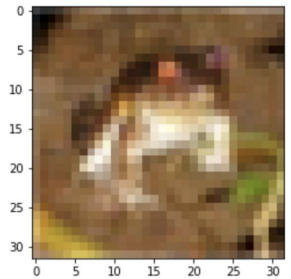
Computer Vision

- Humans can retrieve basic information and many more from looking an image.
  - Four people, many cars, street, etc.
  - People are walking, one of them is barefoot, etc.
  - Their clothes, danger of getting hit by a car, etc.
- Thus, we aim to reach at least this level using Computer Vision algorithms.
- A system must recognize these examples we talked above and more to provide a description as complete as possible of the image.

Classification

- Classification of a given image as belonging to one of a set of predefined categories.





- MNIST Dataset:
  - Handwritten digit classification
  - 60000 training, 10000 test examples
  - Supervised problem
- CIFAR-10 Dataset:
  - Image classification
  - 50000 training, 10000 test examples
  - 32x32x3 images, supervised problem
  - 10 classes, 5000 training, 1000 test each
- CIFAR-100 Dataset:
  - Same settings as CIFAR-10
  - 500 training and 100 test per class
  - 100 classes

Tensorflow 2

- API Cleanup
- Eager execution
  - TF1 requires manually construction of an abstract syntax tree by making API calls.
  - TF2 more Python-like.
- No more Globals
  - TF1 relies heavily on implicitly global namespaces.
  - Can lose track of variables.
  - TF2 controls every variable, garbage collector removes if you lose track!
- Functions, not sessions
  - TF1 requires of session.run() to execute functions.
  - TF2 more like Python calls -> f(input), etc.

Keras Functional

- Create more flexible models than Keras Sequential!
  - Functional API can handle models with non-linear topology, shared layers, and multiple inputs & outputs.
- DL models -> Directed Acyclic Graphs (DAG). Functional is a way to build graphs of layers.
- Training, evaluation, inference, and saving models are exactly same for both Functional and Sequential API.
- Can use same layers for multiple models!

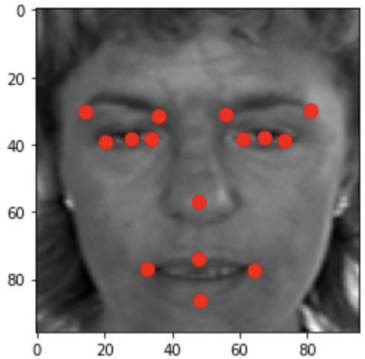
Keras Sequential

- Use when a model is appropriate for **a plain stack of layers** where each layer has **exactly one input tensor and one output tensor**.
- Once a Sequential model is built, it behaves like Functional API model.
  - Each layer has input and output.
  - Can create a new model to observe the output of each layer, etc.

Localization

- Goal is to learn where the objects are in given images.
- Standard way to identify localization in images using bounding boxes to encapsulate localized objects.

- Kaggle Facial Keypoints Dataset
  - Predict keypoint positions on face images.
  - 7049 training, 1783 test images
  - 96x96x1 images
  - Supervised problem
  - 2D 15 features



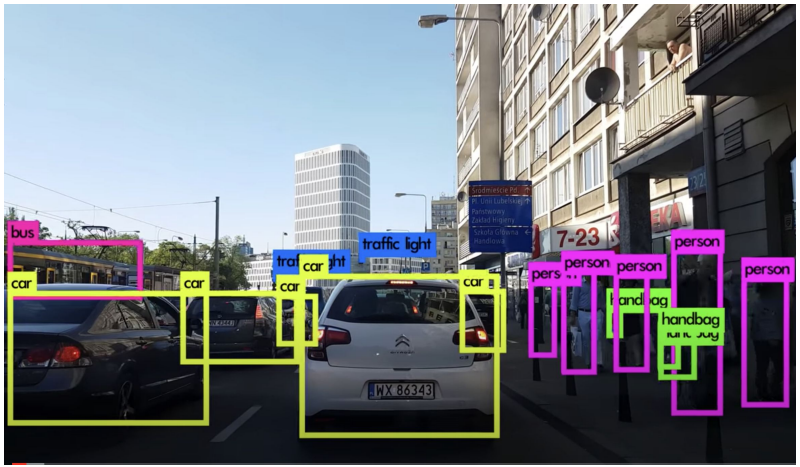
PyTorch

- Optimized tensor library for deep learning using GPUs and CPUs.
- Many libraries are part of PyTorch project for many tasks such as audio, text, vision, etc.
- Ease-of-use and flexible.

Object Detection

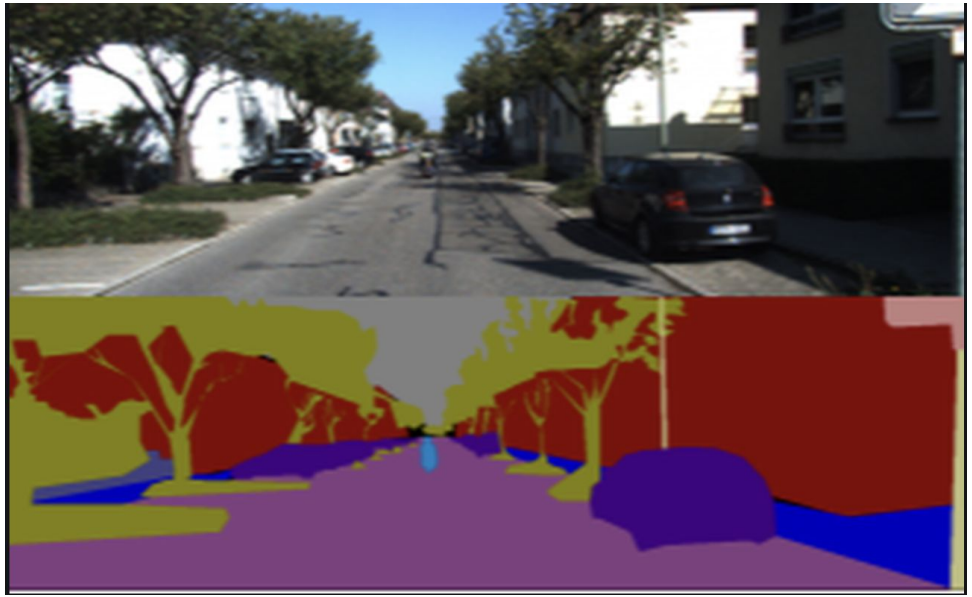
- Localization and classification of all objects present in a given image.
- Can be multiple classes.
- Bounding boxes to localize and classification to understand what object is in the bounding box.
- Complex Problem
    - Some objects are occluded, partially visible, etc.

- COCO Dataset
    - There are images for all tasks
        - Object detection, segmentation, etc.
    - 330k images (>200k labeled)
    - 80 object, 91 stuff categories



Segmentation

- Kind of a next step after object detection.
- The aim is to create masks as accurate as possible for each object detected in a given image.



Torchvision

- Part of PyTorch project.
- The torchvision package consists of popular datasets, model architectures, and common image transformations for computer vision.