# CS826 Deep Learning Theory and Practice

University of Strathclyde Glasgow

## Deep Learning in Practice

Edited by Nur Naim, Sept 2021

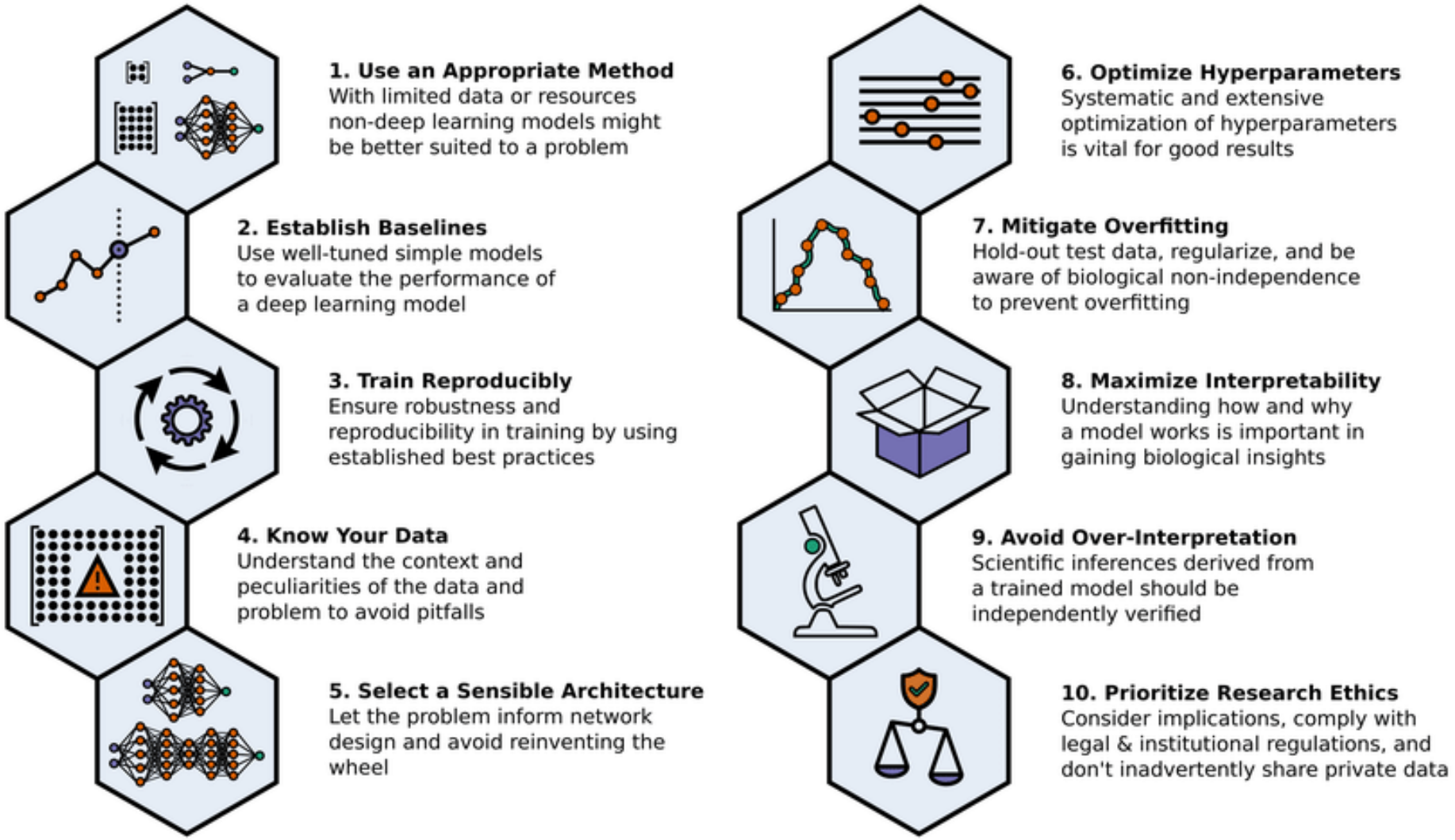
# Learning objectives

- Introduce to deep learning practices in different applications
- Different types of architectures from different deep learning algorithms.
- Real world challenges
- Keras, Tensorflow and PyTorch

# Deep Learning Practices

- Industrial project
- Academic research
- Data
- Algorithms
- Flexibility

# Ten Quick Tips for Deep Learning in Biology

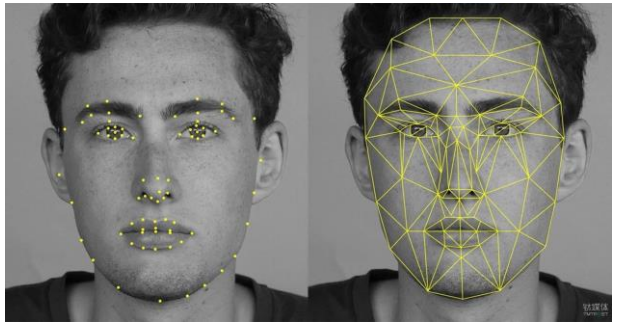



Resource: https://www.researchgate.net/figure/A-summary-overview-of-the-10-tips-for-using-deep-learning-in-biological-research_fig1_352016504

| Type | Example references | Variants | Network structure | Applications |
|---|---|---|---|---|
| BP | Rumelhart[33] | RBF<br>GRNN | Input layer<br>Output layer<br>Hidden layer | Data fitting<br>Pattern recognition<br>Classification |
| CNN | LeCun[34]<br>Krizhevsky[35] | LeNet,<br>AlexNet<br>VggNet | Input layer<br>Convolution layer<br>Pooling layer<br>Full connected layer | Image processing<br>Speech signal<br>Natural Language<br>Processing |
| RNN | Mikolov[36]<br>Sundermeyer[37] | LSTM | Input layer<br>Hidden layer<br>Output layer | Time series analysis<br>Emotion analysis<br>Natural Language<br>Processing |
| GAN | Goodfellow[28] | DCGAN | Discrimination model<br>Generation model | Image generation<br>Video generation |

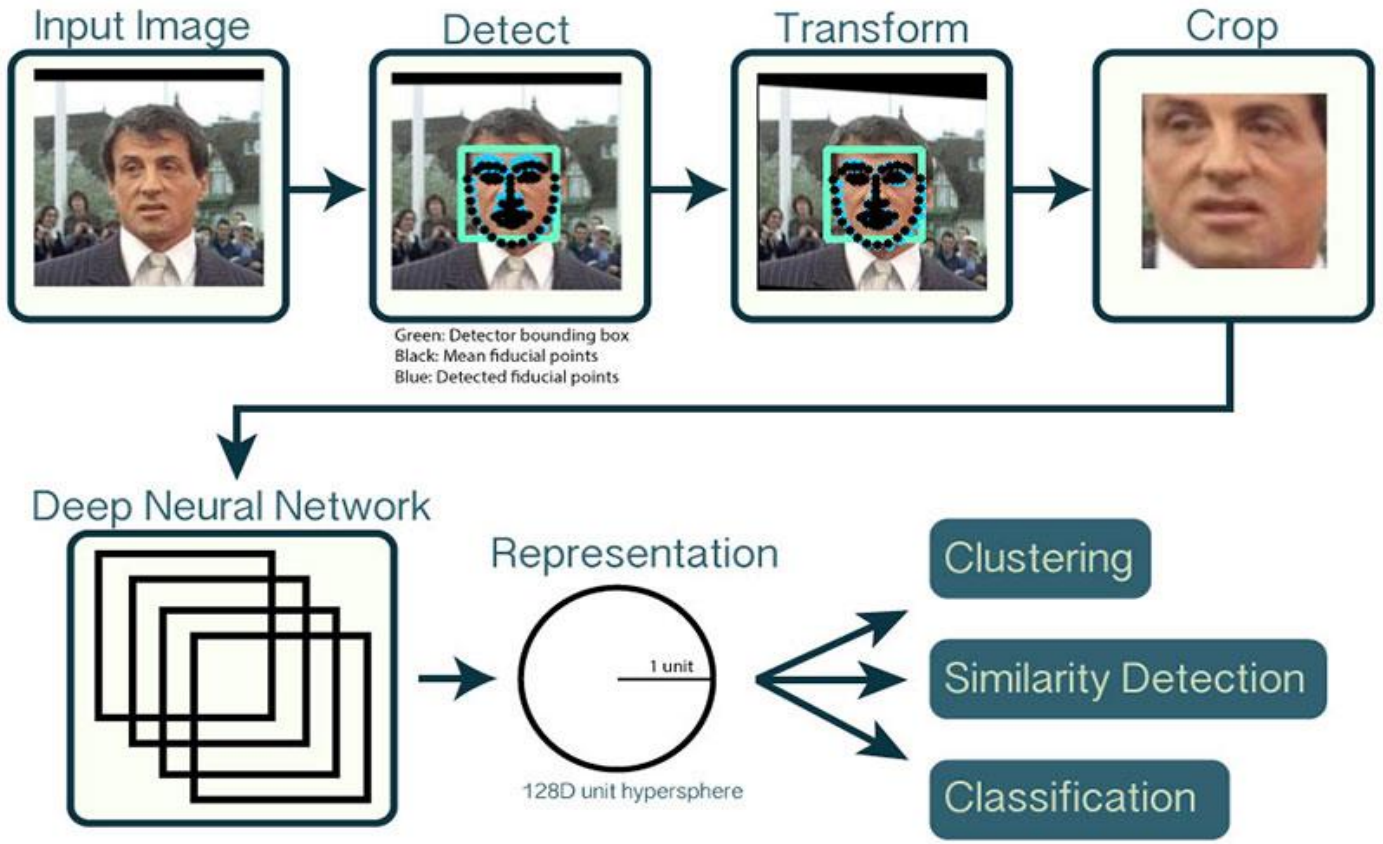
Source: https://www.researchgate.net/figure/Summary-of-BP-CNN-RNN-and-GAN_tbl1_327019925

# Face Recognition

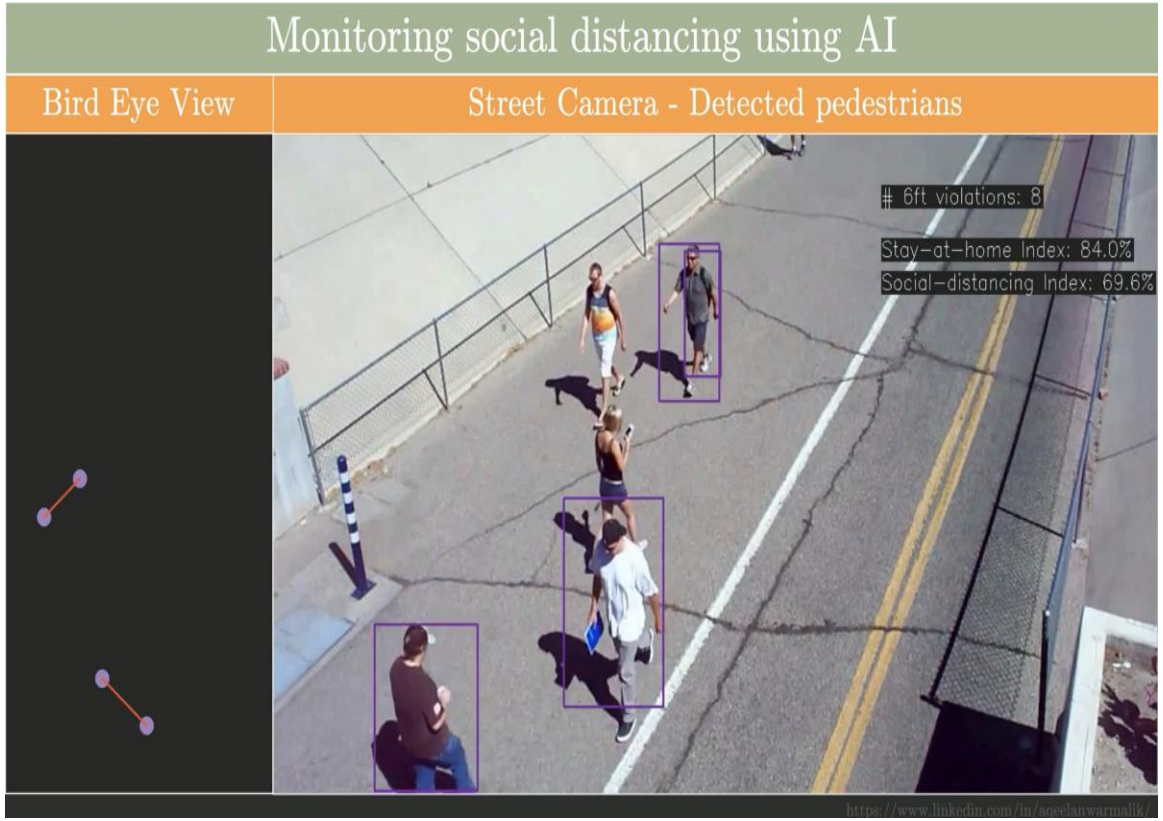


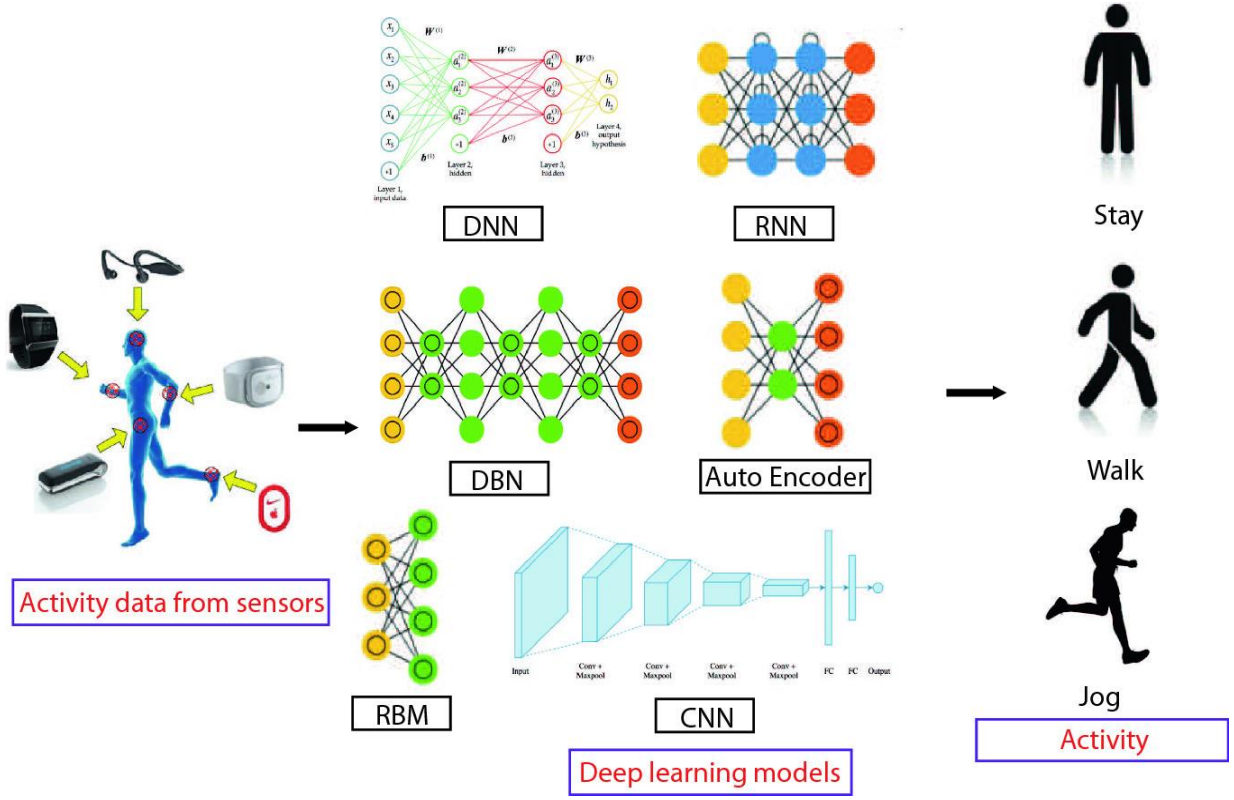
- Detect faces
- Recognise the face
- Challenges:

Illumination. Illumination stands for light variations. ...
Pose. Facial Recognition Systems are highly sensitive to pose variations. ...
Expressions. ...
Low Resolution. ...
Ageing. ...
Model Complexity. ...
Conclusion
Algorithms: dlib, cvlib, mtcnn, vgg16, etc.



# Activity Detection




- Challenges ~ labelling, high uncertainty, large dataset
- Algo - Yolo

# How a driverless car sees the road?

- Self-Driving Car

https://www.youtube.com/watch?v=tiwVMrTLUWg

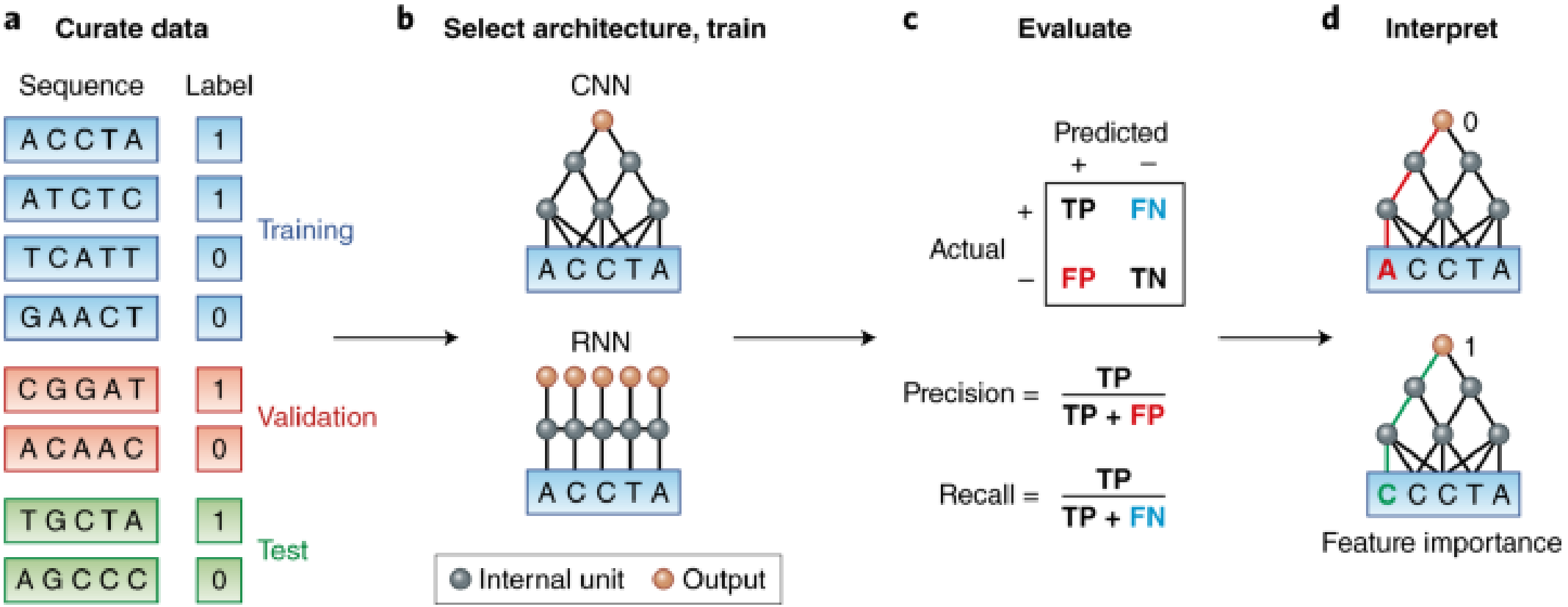
Algo - Yolo

# Real-life Sequence Learning Applications

- RNNs can be applied to various type of sequential data to learn the temporal patterns.
  - Time-series data (e.g., stock price) → Prediction, regression
  - Raw sensor data (e.g., signal, voice, handwriting) → Labels or text sequences
  - Text → Label (e.g., sentiment) or text sequence (e.g., translation, summary, answer)
  - Image and video → Text description (e.g., captions, scene interpretation)

| **Task** | **Input** | **Output** |
|---|---|---|
| **Activity Recognition (Zhu et al. 2018)** | Sensor Signals | Activity Labels |
| **Machine translation (Sutskever et al. 2014)** | English text | French text |
| **Question answering (Bordes et al. 2014)** | Question | Answer |
| **Speech recognition (Graves et al. 2013)** | Voice | Text |
| **Handwriting prediction (Graves 2013)** | Handwriting | Text |
| **Opinion mining (Irsoy et al. 2014)** | Text | Opinion expression |

# Genomic Analysis



| | Keras | TensorFlow | PyTorch |
|---|---|---|---|
| **Level of API** | high-level API[1] | Both high & low level APIs | Lower-level API[2] |
| **Speed** | Slow | High | High |
| **Architecture** | Simple, more readable and concise | Not very easy to use | Complex[3] |
| **Debugging** | No need to debug | Difficult to debugging | Good debugging capabilities |
| **Dataset Compatibility** | Slow & Small | Fast speed & large | Fast speed & large datasets |
| **Popularity Rank** | 1 | 2 | 3 |
| **Uniqueness** | Multiple back-end support | Object Detection Functionality | Flexibility & Short Training Duration |
| **Created By** | Not a library on its own | Created by Google | Created by Facebook[4] |
| **Ease of use** | User-friendly | Incomprehensive API | Integrated with Python language |
| **Computational graphs used** | Static graphs | Static graphs | Dynamic computation graphs[5] |

Resource: https://medium.com/analytics-vidhya/ml03-9de2f0dbd62d

# Resources

- Google (image) – face recognition, activity detection, self-driving car, genomic analysis.