MACHINE LEARNING TO MONITOR COGNITIVE STATE OF PERSONS

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CONTENT

1. Cognitive state of persons
2. Bio-signals
3. Example 1: Recognition of emotions from speech
4. Example 2: Detection of Parkinson’s disease using handwriting
5. Example 3: Detection of Parkinson’s disease using Gait
6. Other examples and future vision

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1. COGNITIVE STATE OF PERSONS

Emotions

Neurological disorders

Depression

Work load

Social impairments

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1. COGNITIVE STATE OF PERSONS

What if doctors could objectively measure how you are feeling?

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1. COGNITIVE STATE OF PERSONS

What if Technology could identify emotions as human can?

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1. COGNITIVE STATE OF PERSONS

What if the cars knew if we were getting angry or stressed and adapt the music or the lights?

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1. COGNITIVE STATE OF PERSONS

If live broadcasters could identify an audience’s emotion in real time and adapt their stream according to the response?

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1. COGNITIVE STATE OF PERSONS

Personalized suggestions based on tour mood?

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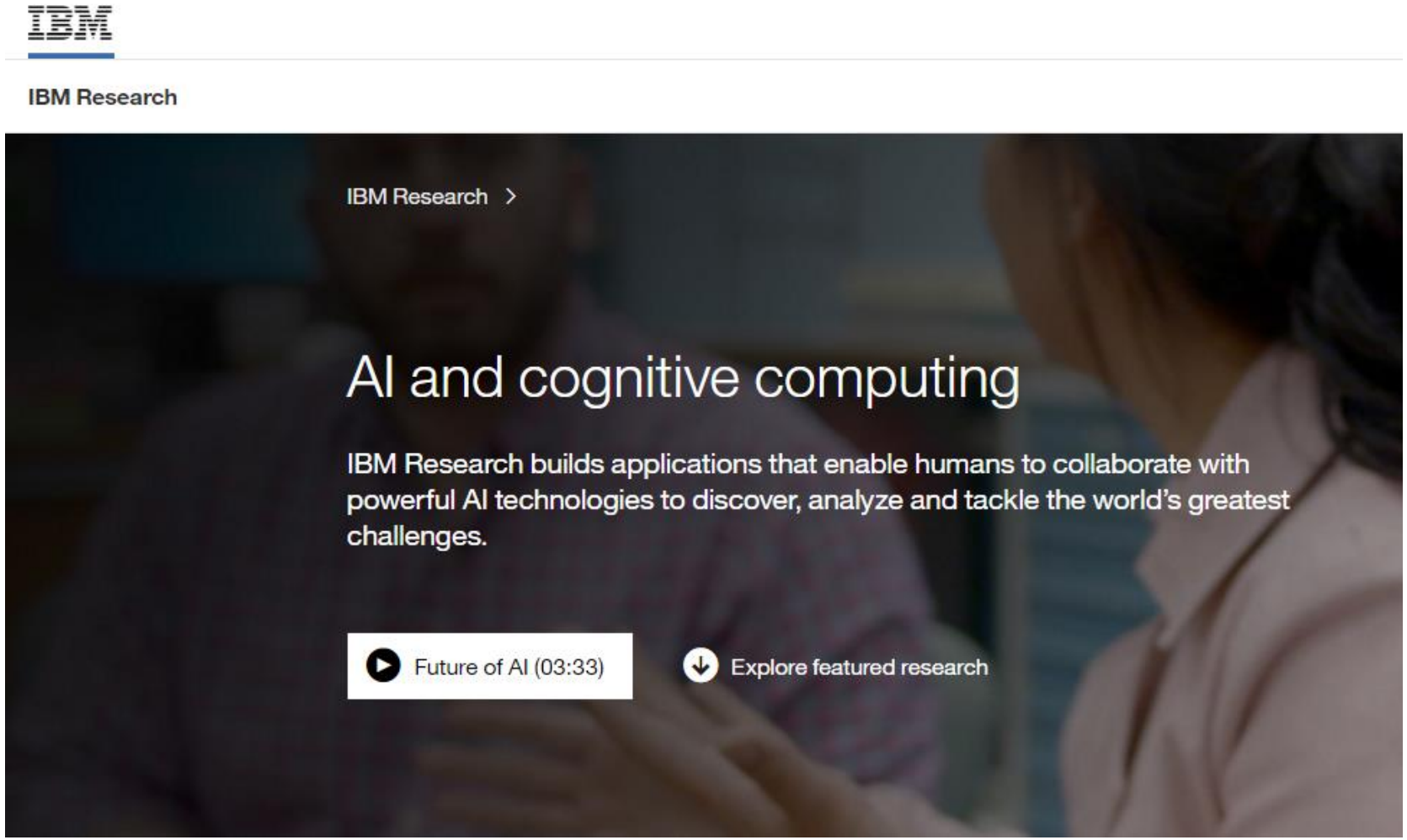
1. COGNITIVE STATE OF PERSONS



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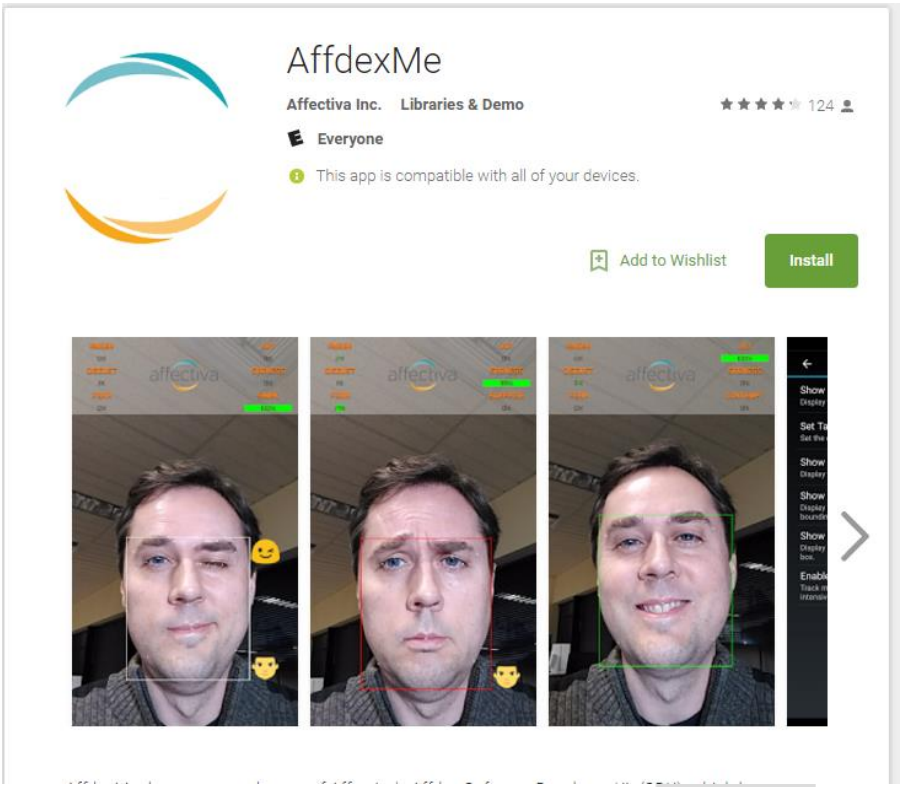
1. COGNITIVE STATE OF PERSONS

:) Affectiva WHAT HOW WHO BUZZ EXPERIENCE IT

HOW IT WORKS

Emotion recognition. Our technology analyzes subtle facial expressions to identify human emotions.

LEARN MORE + OUR PRODUCTS +



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1. COGNITIVE STATE OF PERSONS

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2. BIO-SIGNALS

Speech

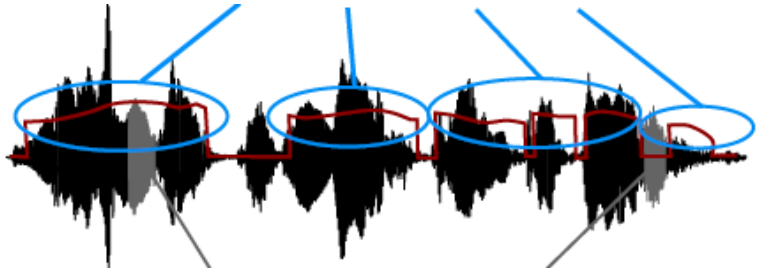
Handwriting

Gait

EEG

ECG

Facial expression



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3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH

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3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH

Call center monitoring

Emergency services

Depression assesment

Intelligent vehicles

Public surveillance

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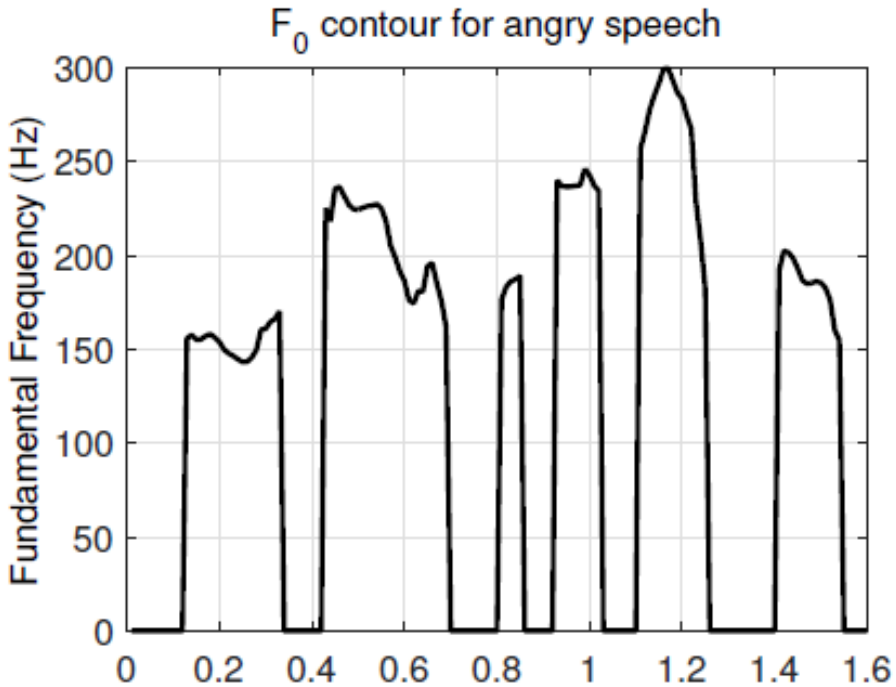
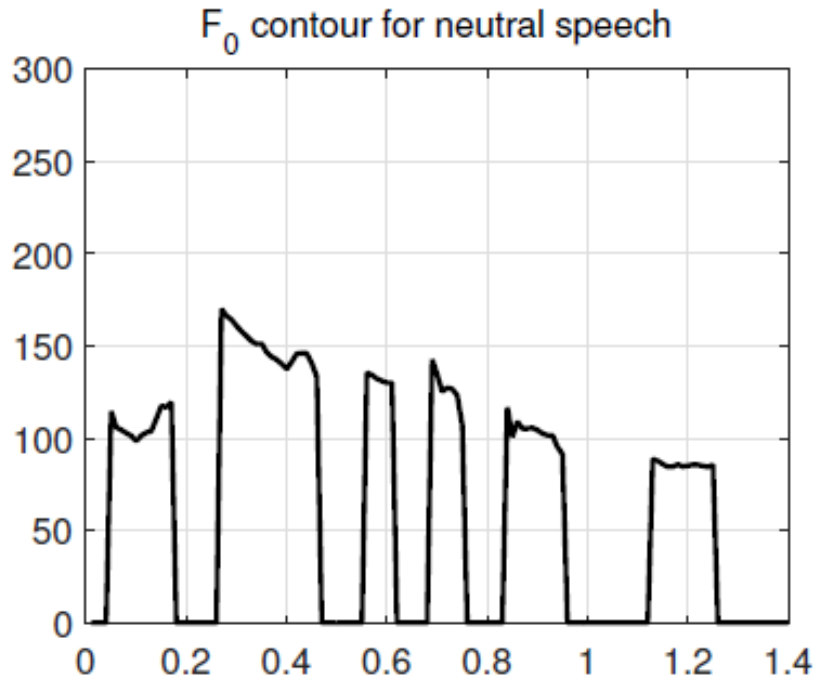
3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH





happiness anger fear disgust

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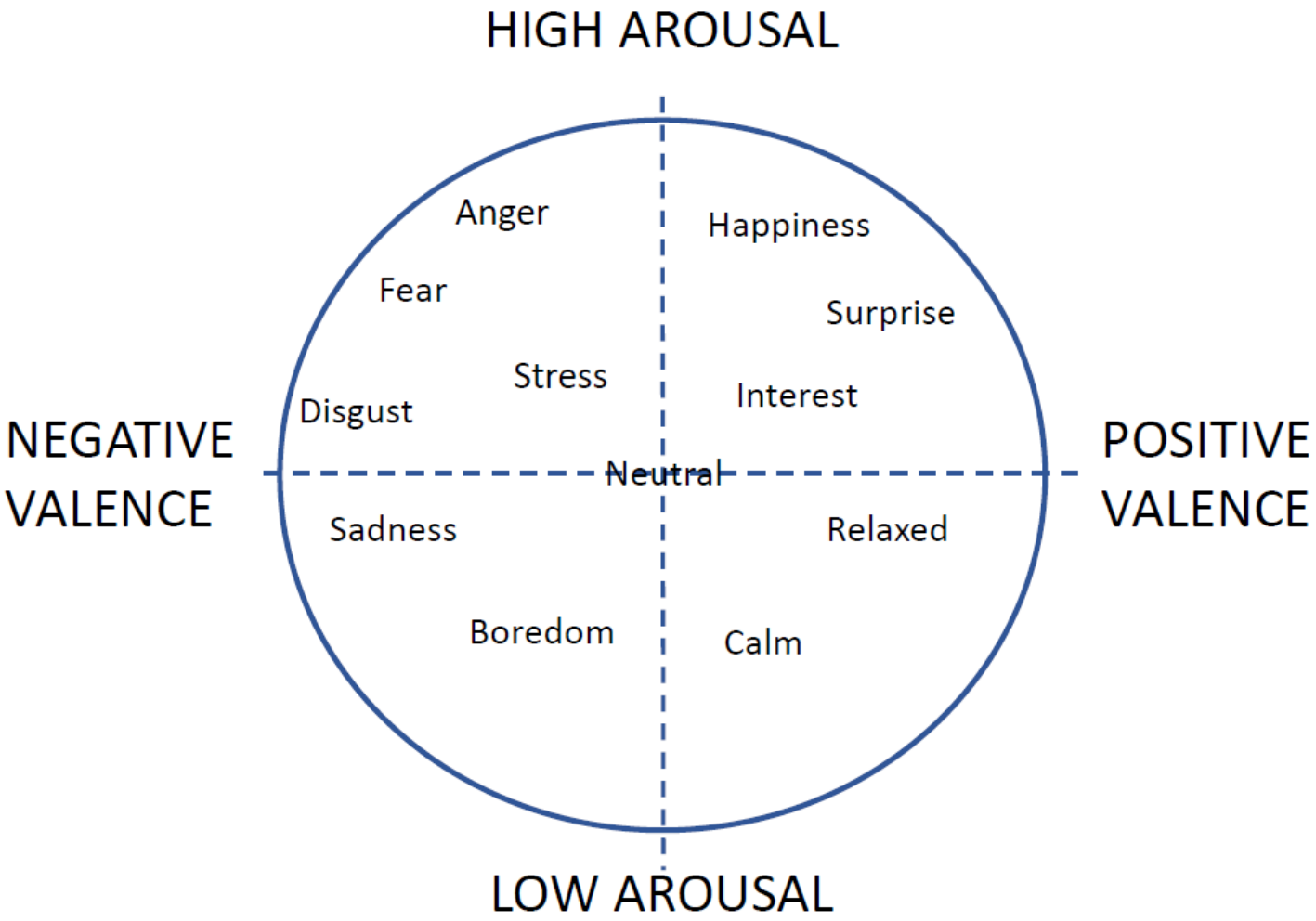
3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH



3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH

Tools

audEERING™
intelligent Audio Engineering

openSMILE:)
by audEERING™

KALDI

https://github.com/kaldi-asr/kaldi

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The INTERSPEECH 2016 Computational Paralinguistics Challenge: Deception, Sincerity & Native Language

Björn Schuller[1,2], *Stefan Steidl*[3], *Anton Batliner*[2,3], *Julia Hirschberg*[4], *Judee K. Burgoon*[5], *Alice Baird*[4], *Aaron Elkins*[5], *Yue Zhang*[1], *Eduardo Coutinho*[1,6], *Keelan Evanini*[7]

[1]Department of Computing, Imperial College London, UK
[2]Chair of Complex & Intelligent Systems, University of Passau, Germany
[3]Pattern Recognition Lab, FAU Erlangen-Nuremberg, Germany
[4]Department of Computer Science, Columbia University, New York, USA
[5]Center for the Management of Information, University of Arizona, Tucson, USA
[6]Department of Music, University of Liverpool, UK
[7]Educational Testing Service, USA
schuller@IEEE.org

The INTERSPEECH 2013 Computational Paralinguistics Challenge: Social Signals, Conflict, Emotion, Autism*

Björn Schuller[1,2], *Stefan Steidl*[3], *Anton Batliner*[2], *Alessandro Vinciarelli*[4,5], *Klaus Scherer*[1], *Fabien Ringeval*[6], *Mohamed Chetouani*[7], *Felix Weninger*[2], *Florian Eyben*[2], *Erik Marchi*[2], *Marcello Mortillaro*[1], *Hugues Salamin*[4], *Anna Polychroniou*[4], *Fabio Valente*[5], *Samuel Kim*[5]

[1]Université de Genève, Swiss Center for Affective Sciences, Switzerland
[2]TU München, Machine Intelligence & Signal Processing group, MMK, Germany
[3]FAU Erlangen-Nuremberg, Pattern Recognition Lab, Germany
[4]University of Glasgow, School of Computing Science, Scotland
[5]IDIAP Research Institute, Martigny, Switzerland
[6]Université de Fribourg, Document Image and Voice Analysis group, Switzerland
[7]Université Pierre et Marie Curie, ISIR, Paris, France
schuller@tum.de

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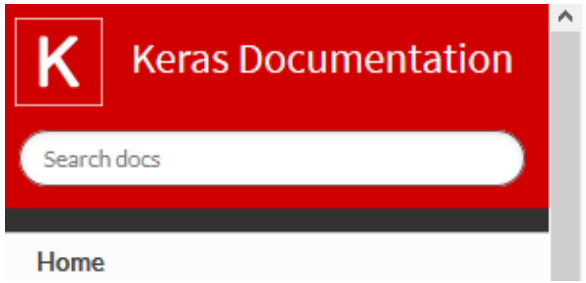
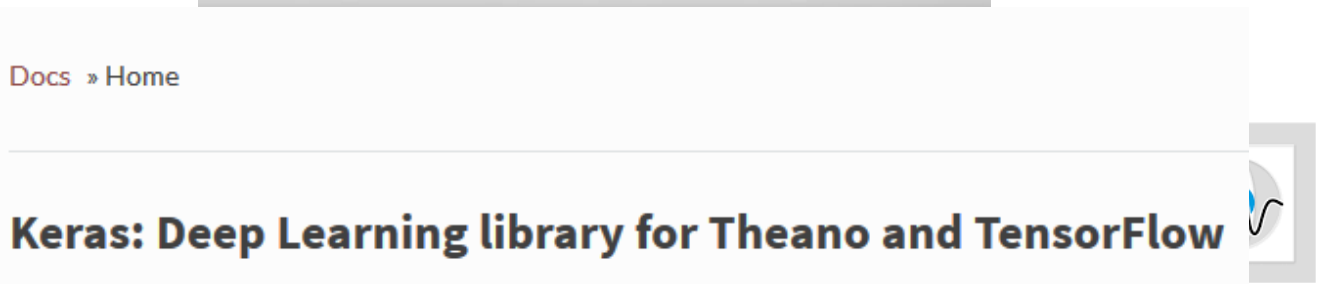
3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH

Tools





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3. EXAMPLE 1: RECOGNITION OF EMOTIONS FROM SPEECH

Demo

Emotions.ipynb

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EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING HANDWRITING

- Characterized by the progressive loss of dopaminergic neurons of the midbrain
- Second most prevalent neurological disorder worldwide
- Affects about 2% of people older than 65 years
- Patients develop several motor and non-motor impairments

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EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING HANDWRITING

Rigidity

Slow movement

Resting tremor

Micrographia

Speech impairments

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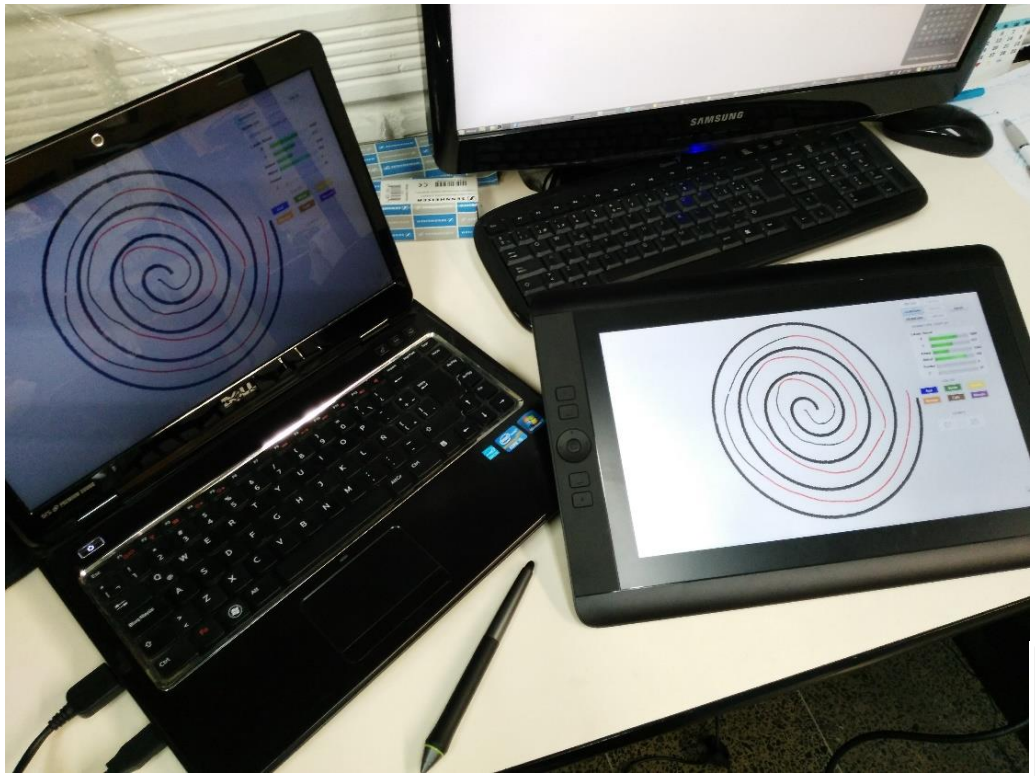
EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING HANDWRITING

- Unobtrusive screening of patients
  - Dementia
  - Parkinson's Disease
  - Depression
- Evaluate the neurological state
- Update treatment and medication
- Develop computer aided tools for patients and specialist



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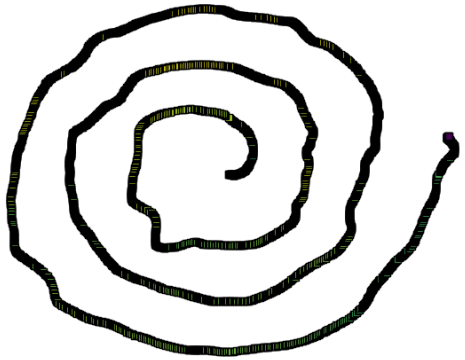
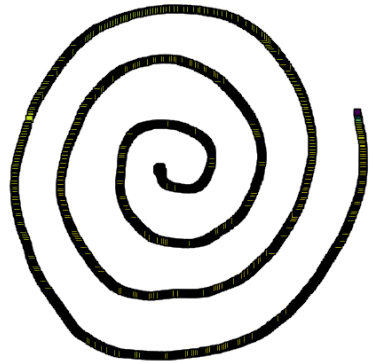
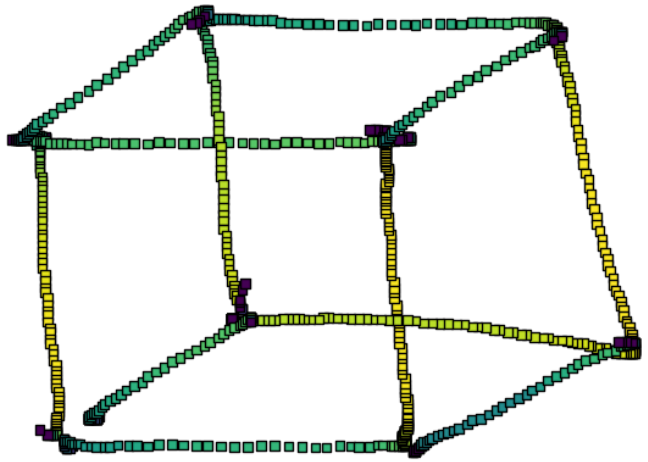


Patient





Healthy person

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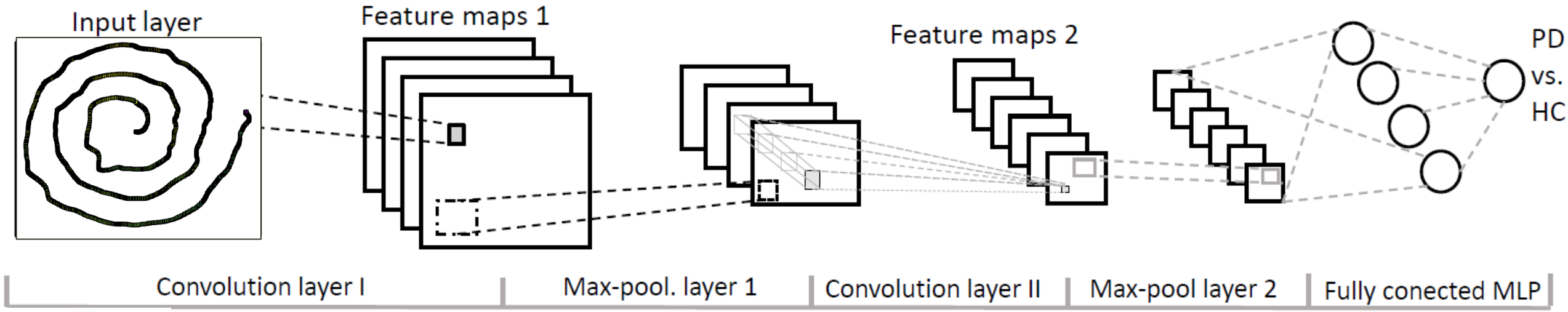
EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING HANDWRITING

Convolutional neural network (CNN) to detect Parkinson's disease



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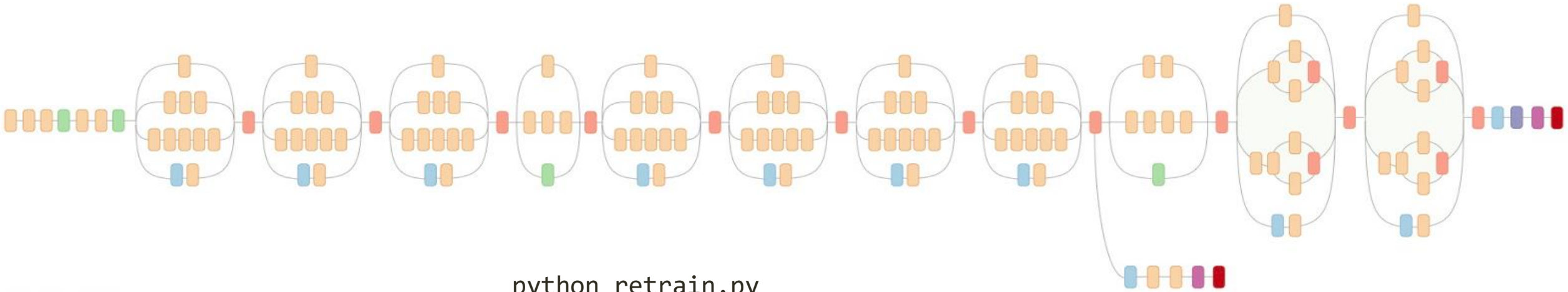
EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING HANDWRITING

Convolutional neural network (CNN) to detect Parkinson's disease

Retrain Inception V3 network (Transfer learning)



Convolution
AvgPool
MaxPool
Concat
Dropout
Fully connected
Softmax

```
python retrain.py
        --bottleneck_dir=./ HandwritingCNN/inception/bottlenecks
        --model_dir=./HandwritingCNN/inception/
        --output_graph=./HandwritingCNN/retrained_graph.pb
        --output_labels=./HandwritingCNN/laball.txt
        --image_dir ./HandwritingCNN/data/images/all/400_300jpg/
```

3. EXAMPLE 1: DETECTION OF PARKINSON'S DISEASE USING HANDWRITING

Demo

handwriting.ipynb

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EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING GAIT

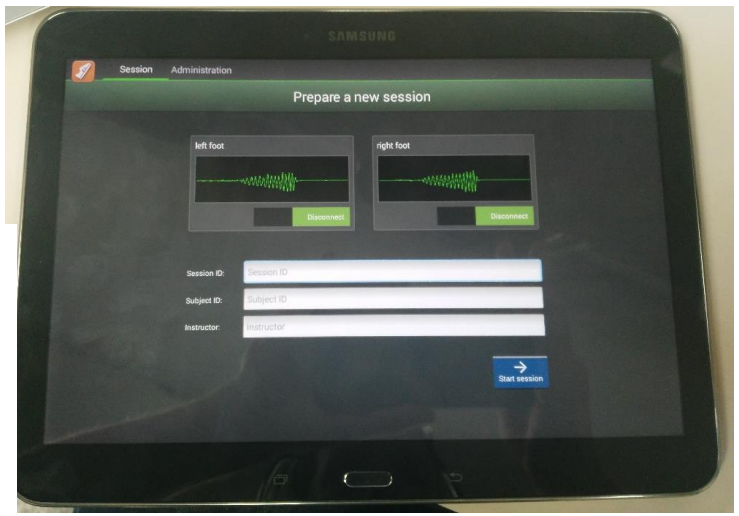
MoveME

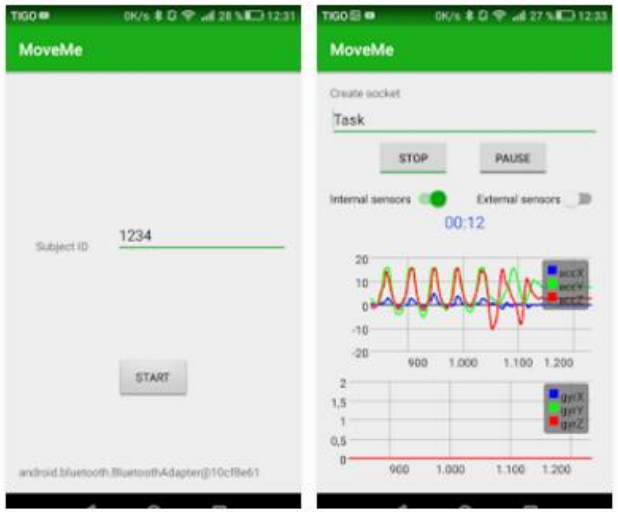
J. C. Vasquez-Correa Salud y bienestar

Todos

Esta aplicación es compatible con todos tus dispositivos.

Instalada





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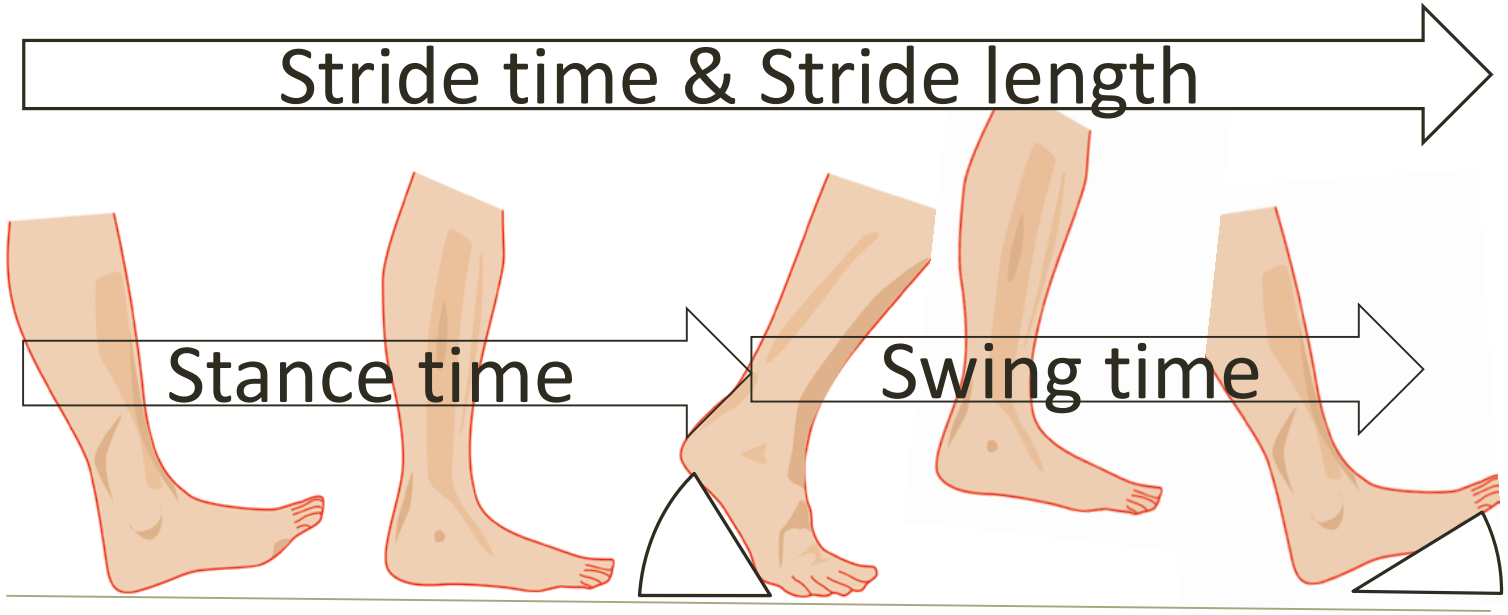

Toe off / Heel strike angles

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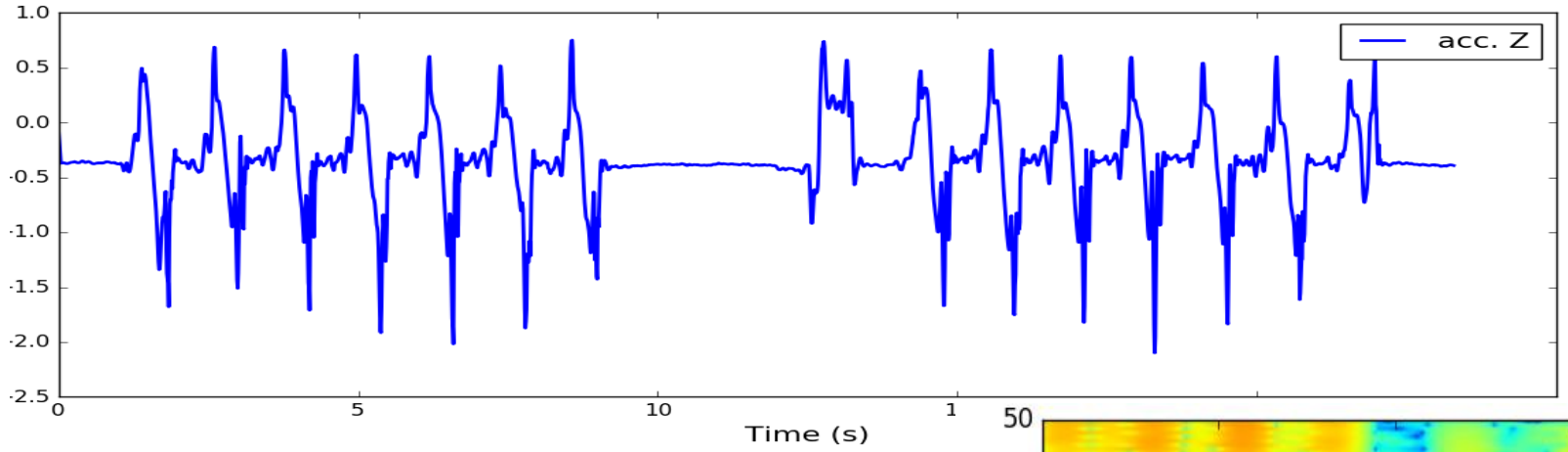
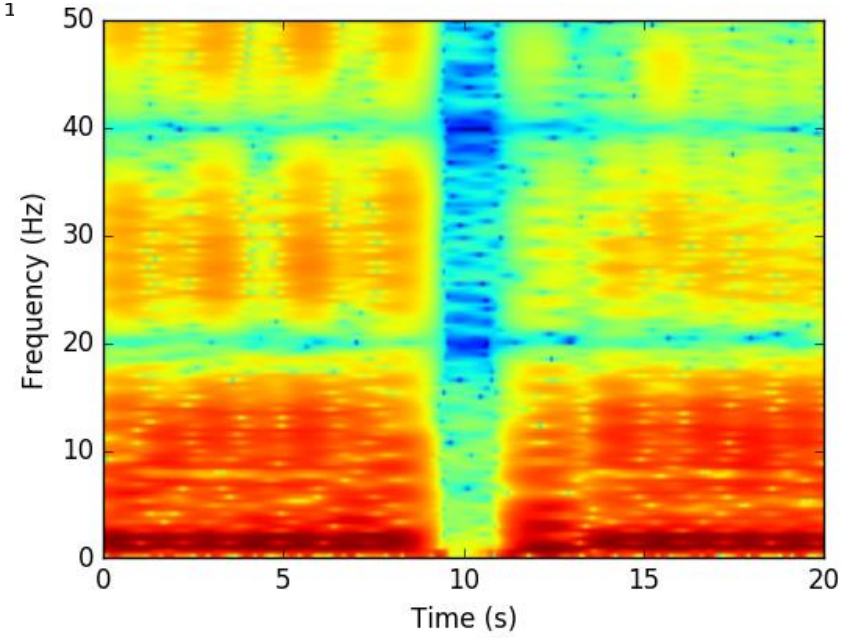
EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING GAIT



- End to end analysis
- Time-frequency representations
  - Short time Fourier Transform
  - Wavelet transform
  - Modulation spectra
  - Wigner Ville distribution



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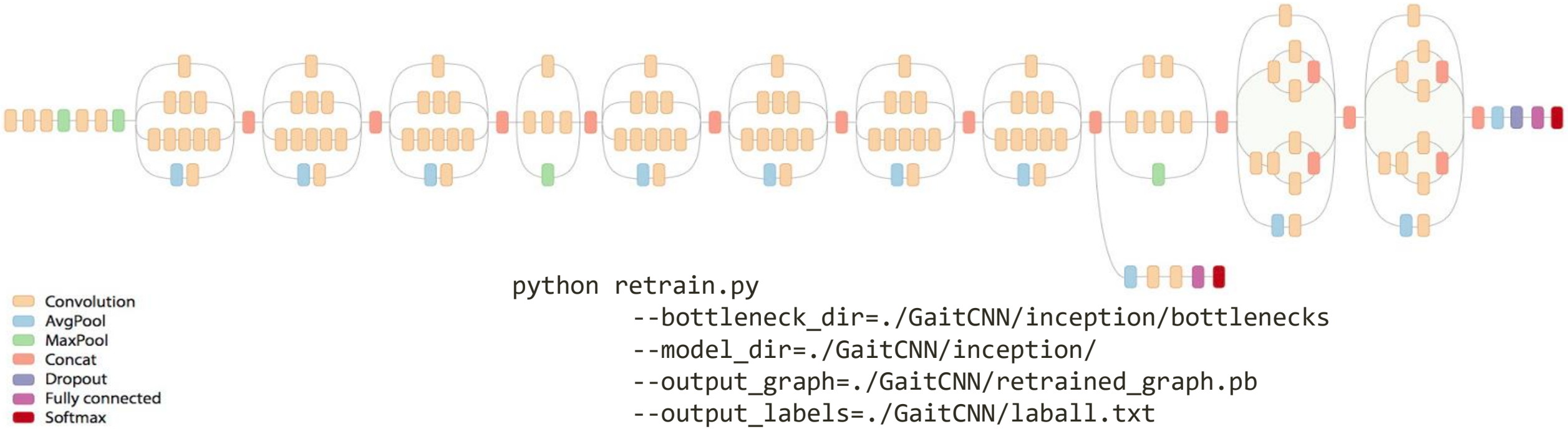
EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING GAIT

Convolutional neural network (CNN) to detect Parkinson's disease

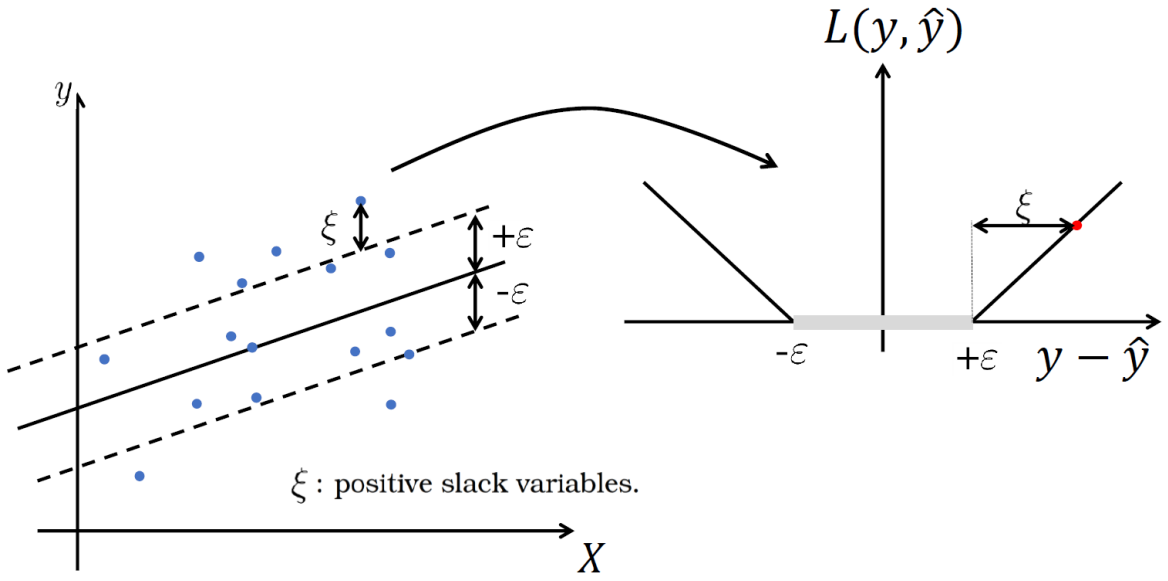
Retrain Inception V3 network (Transfer learning)

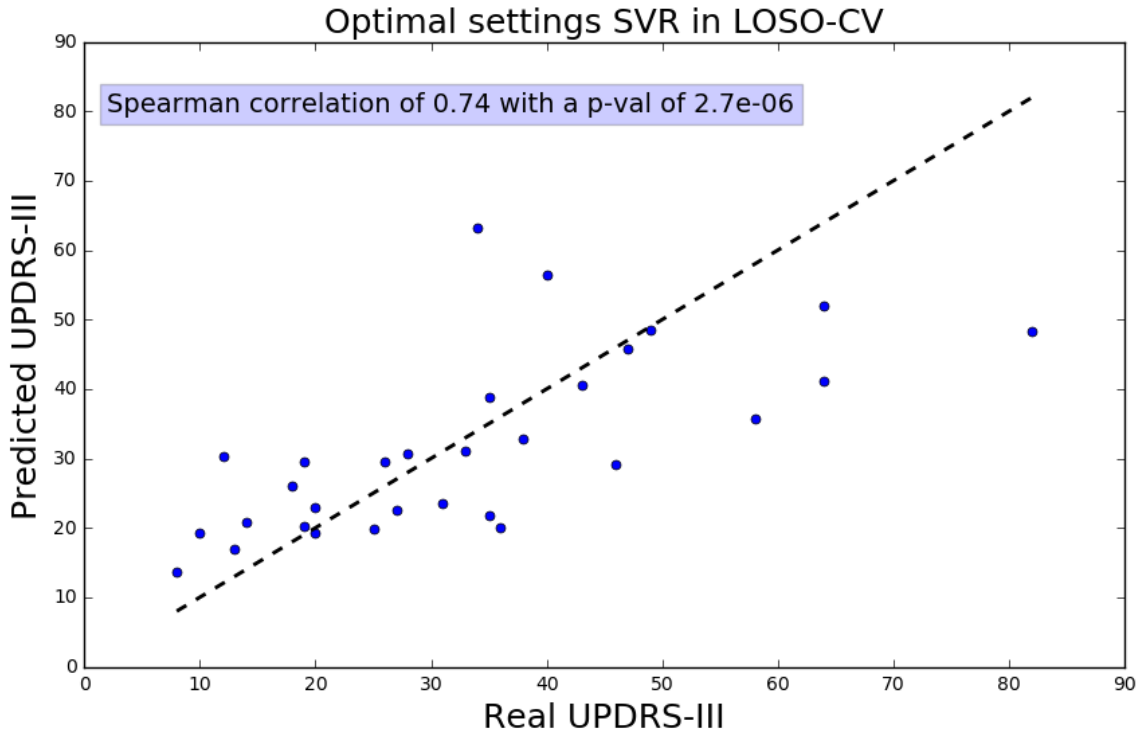



```
python retrain.py
        --bottleneck_dir=./GaitCNN/inception/bottlenecks
        --model_dir=./GaitCNN/inception/
        --output_graph=./GaitCNN/retrained_graph.pb
        --output_labels=./GaitCNN/laball.txt
        --image_dir ./GaitCNN/data/images/
```

EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING GAIT

Support vector regression to predict the neurological state of the patients





EXAMPLE 2: DETECTION OF PARKINSON'S DISEASE USING GAIT

Demo

gait.ipynb

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OTHER EXAMPLES AND FUTURE VISION

Predicting suicide risk by social media

Sentiment analysis from twitter

Social inclusion in re-inserted persons from conflict

Diagnosis and assessment of rare diseases

Market analysis according to emotions from speech and facial expression

Computer aided tools for psychological therapy

Multimodal analysis of bio-signals

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THANK YOU FOR YOUR ATTENTION

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MACHINE LEARNING TO MONITOR COGNITIVE STATE OF PERSONS

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Pattern recognition Lab. Friedrich Alexander University, Erlangen-Nuremberg, Germany

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