

Data science and analysis in Neuroscience

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Machine learning and DeepLabCut

1. Brief review of last lecture
2. Introduction of DeepLabCut
3. Example of how to use DeepLabCut

Review

Machine learning is the field of study that gives computer the ability to learn without being explicitly programmed.

– Arthur Samuel, 1959

Examples : A program learns to decide whether an email is spam or not based on training set.

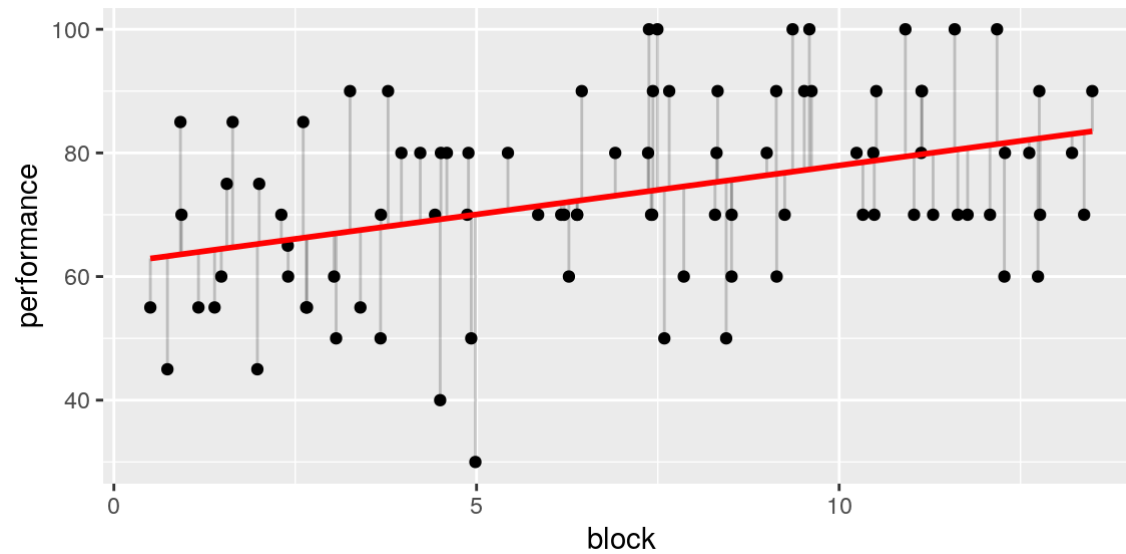
Definition of machine learning

- Prediction versus inference
- Supervised versus unsupervised
- Regression versus classification

Linear regression

- One of the simplest model to explain your data.
- $Y = aX + b$
- Y : target
- X : features (inputs)
- a is the slope and b is the intercept.
- Find the parameters a and b that minimize a cost function.

Measuring the fit of different models



```
lm(performance~block, data=df1)
```

```
##
```

```
## Call:
```

```
## lm(formula = performance ~ block, data = df1)
```

```
##
```

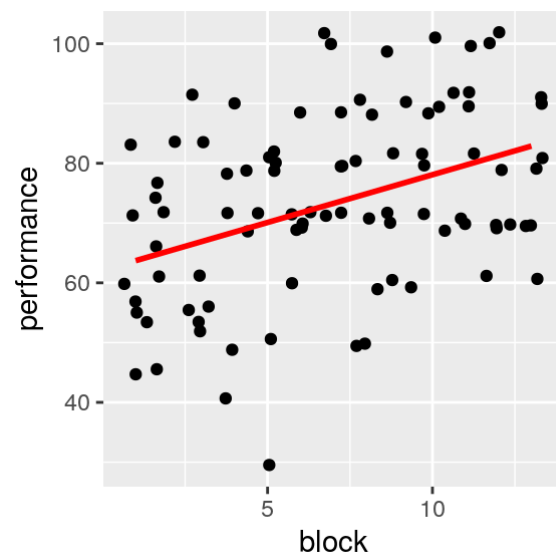
```
## Coefficients:
```

```
## (Intercept)      block
```

```
##      62.115      1.597
```

Display the results of lm()

```
ggplot(data=df1,mapping=aes(x=block,y=performance)) +  
  geom_point(position="jitter") +  
  geom_smooth(method = "lm", se = FALSE, color = "red")
```



DeepLabCut

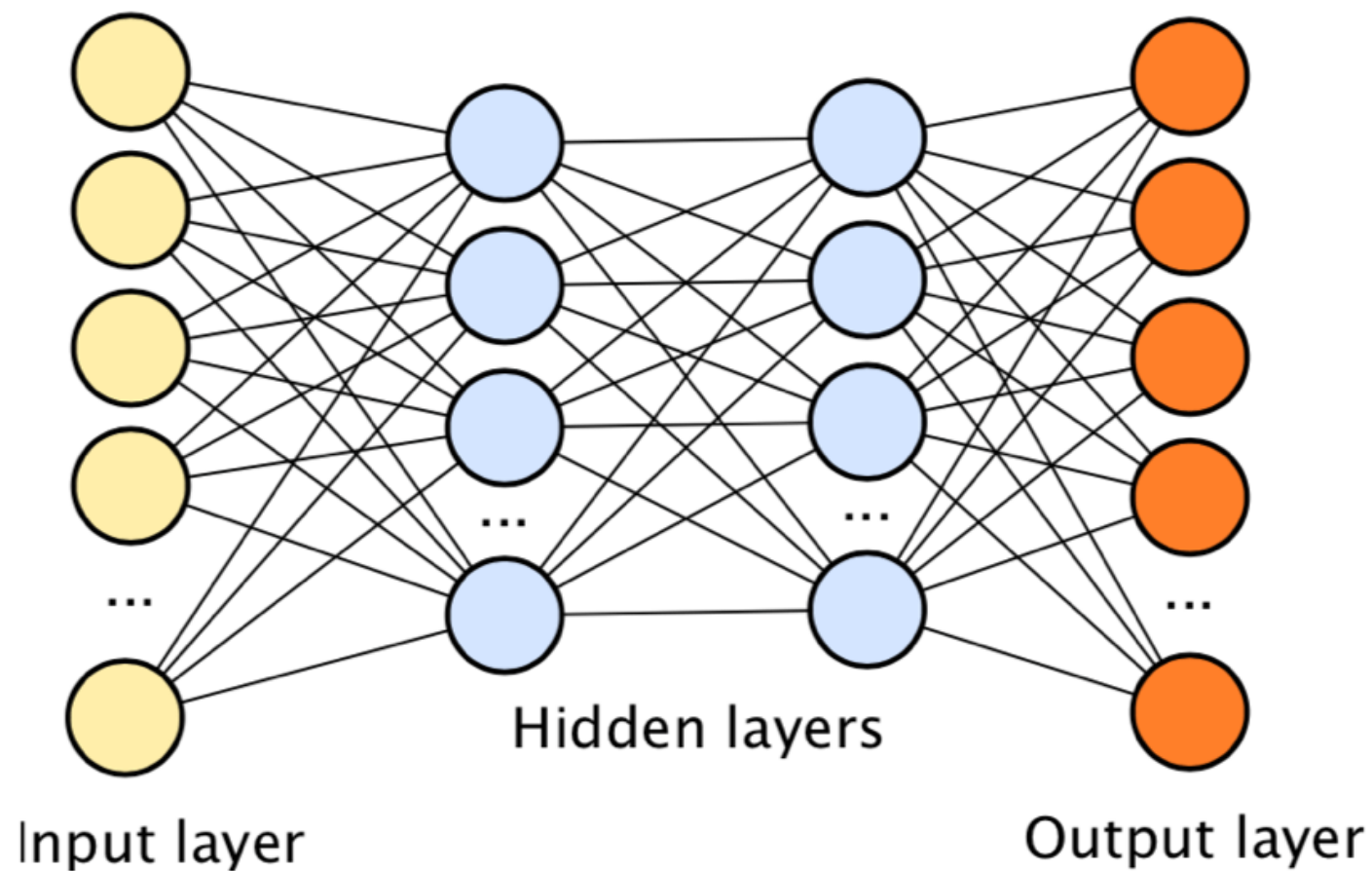
<https://www.mousemotorlab.org/deeplabcut/>

DeepLabCut

- A method for 3D markerless pose estimation
- Quantifies behavior
- Uses deep neural networks
- Matches human accuracy, but is much faster
- Used more and more in behavioral experiments
- Open-source technologies (python, tensorflow, etc)
- Relatively easy to use, but you need access to a graphics card (graphics processing unit, GPU).

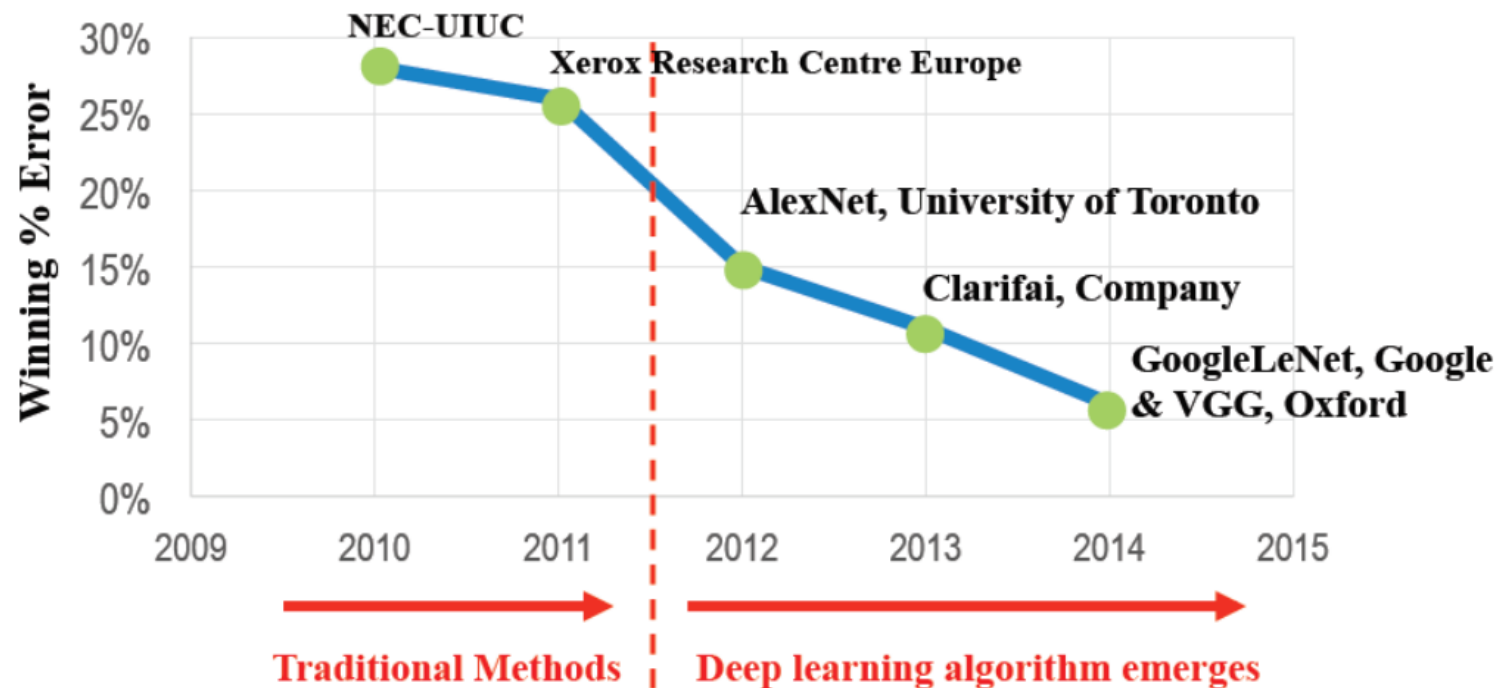
Previous alternative: video recordings with easily recognizable reflective markers on the animal.

Deep neural network



History

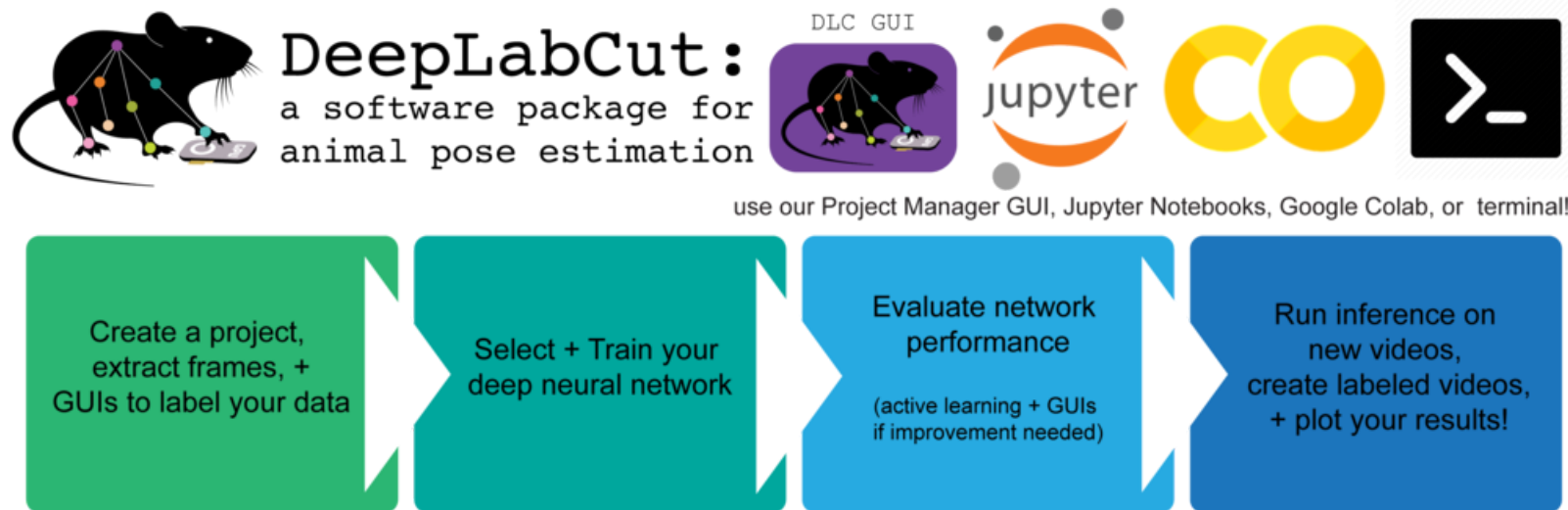
- Deep convolutional neural networks became able to detect objects and classify images (ImageNet).



Shawahna, Sait, El-Maleh (2018) IEEEAccess

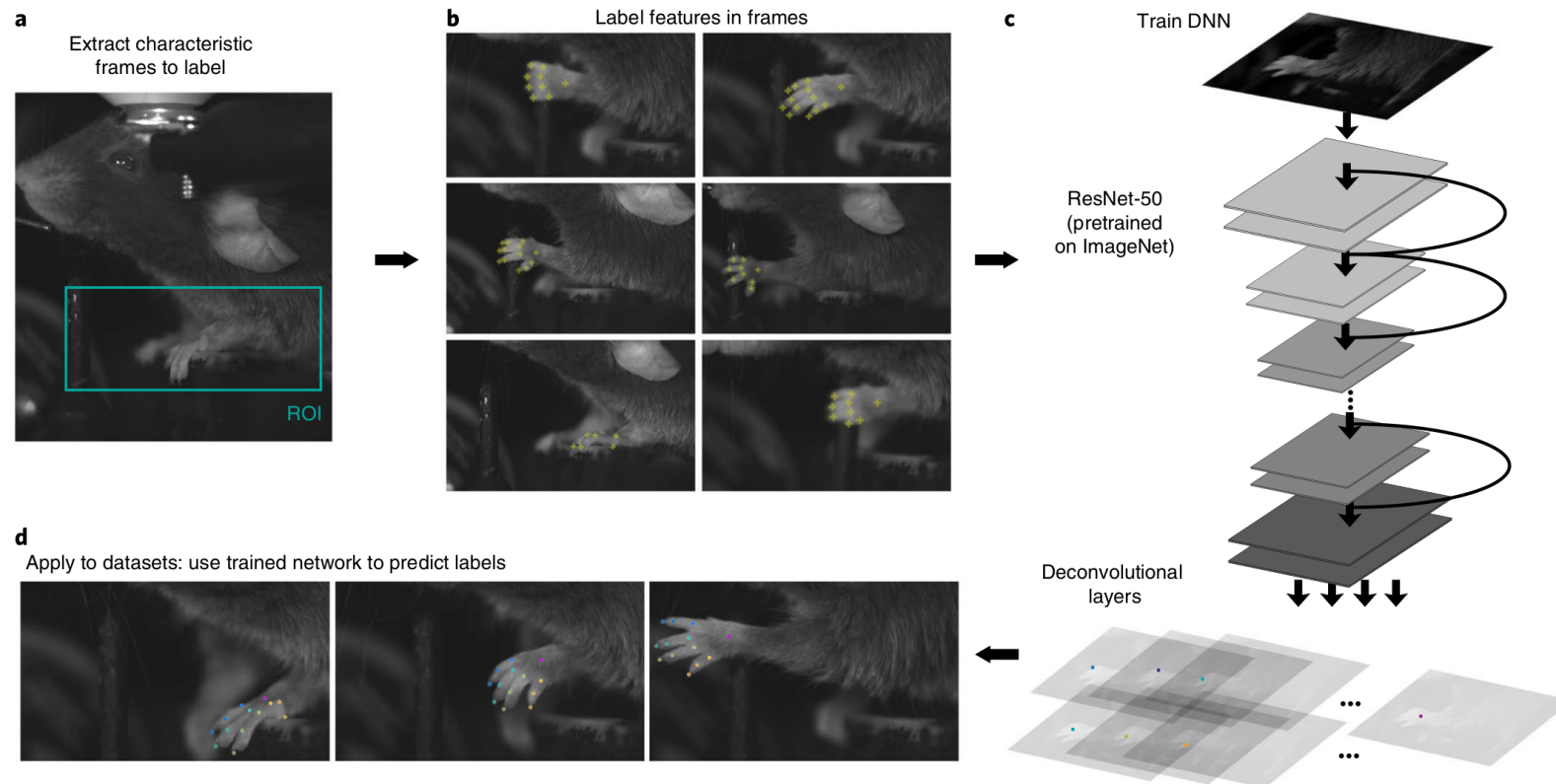
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DeepLabCut: the workflow

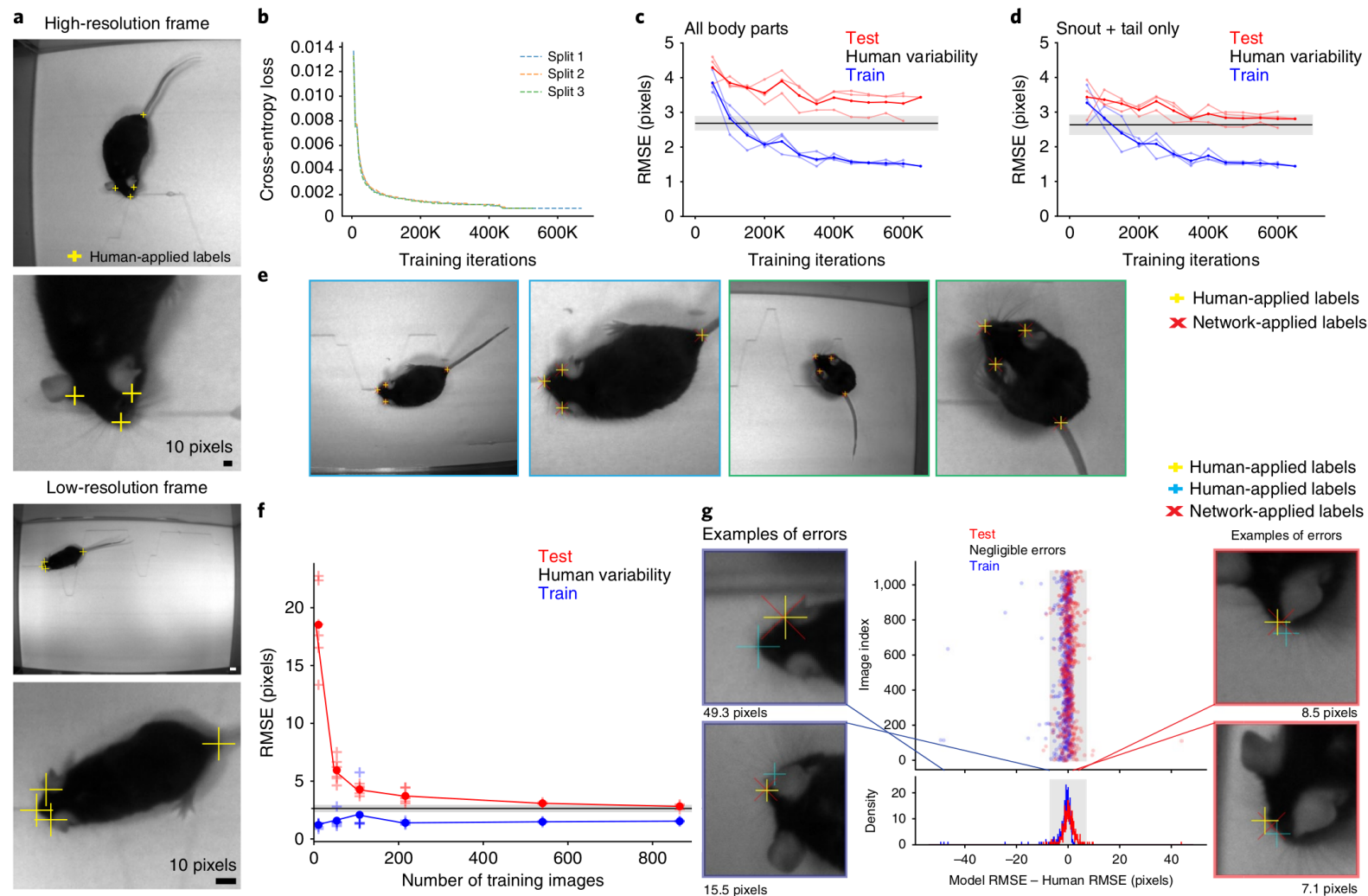


DeepLabCut: the workflow

DeepLabCut: markerless tracking toolbox



DeepLabCut: performance



Python and jupyter notebook

We need to use python instead of R to run DeepLabCut.

Have a look at the jupyter notebook called `d1cLaptop.ipynb` in the DeepLabCut directory of the course repository.

If you are new to jupyter notebook, you can install [Anaconda](#) on your computer. After installation, you should be able to start jupyter notebook on your computer.

The [Jupyter Notebook](#) is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text.