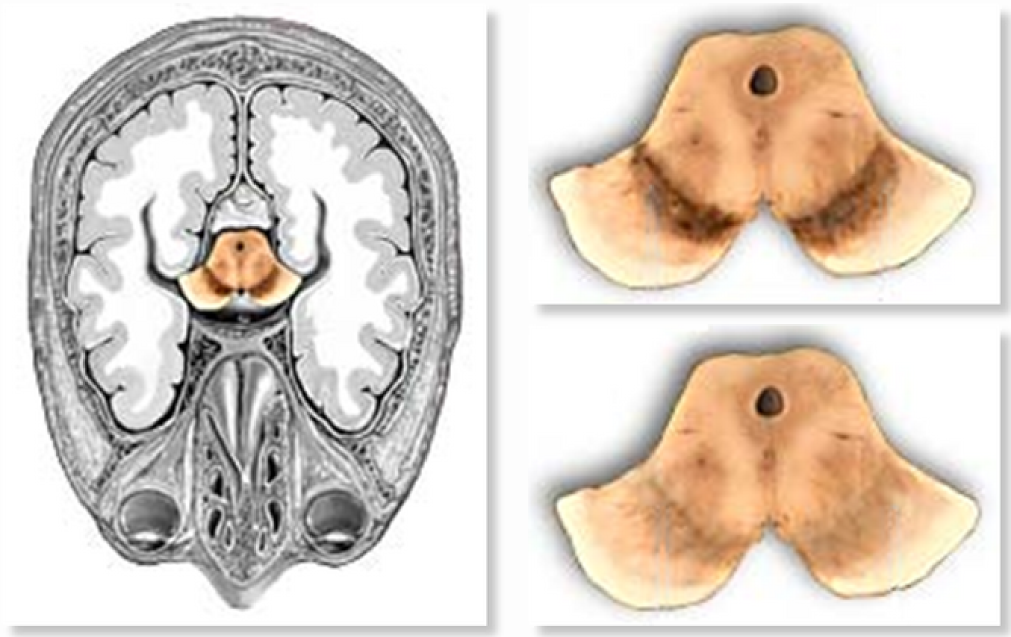
# AI guided analysis of behavioural phenotypes

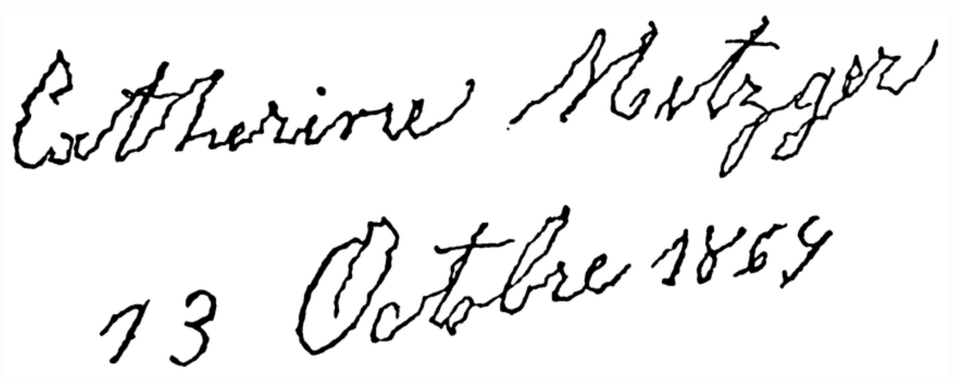
STUDENT: RUOYI ZHAO
SUPERVISOR: ANDREAS HEUER

# Background - Parkinson's Disease

## Symptoms

- Tremor
- Slowed movement (Bradykinesia)
- Rigid Muscles
- Impaired posture and balance






## Core Pathology

- a loss of cells in the brain which produce the neurotransmitter dopamine

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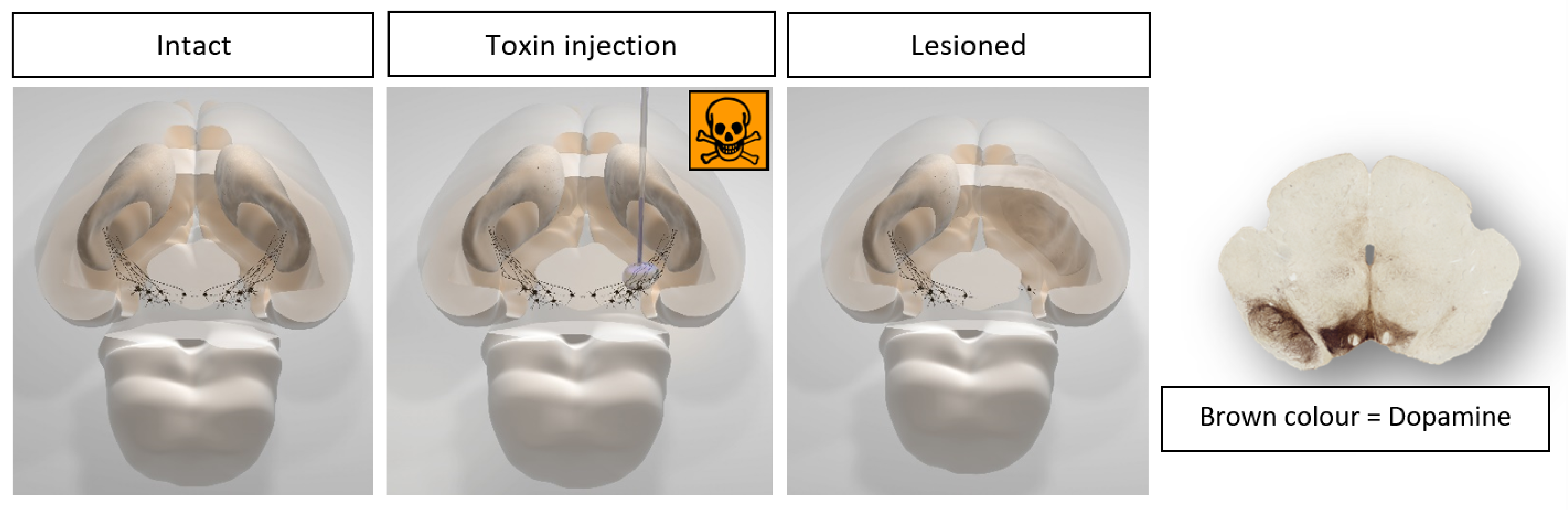


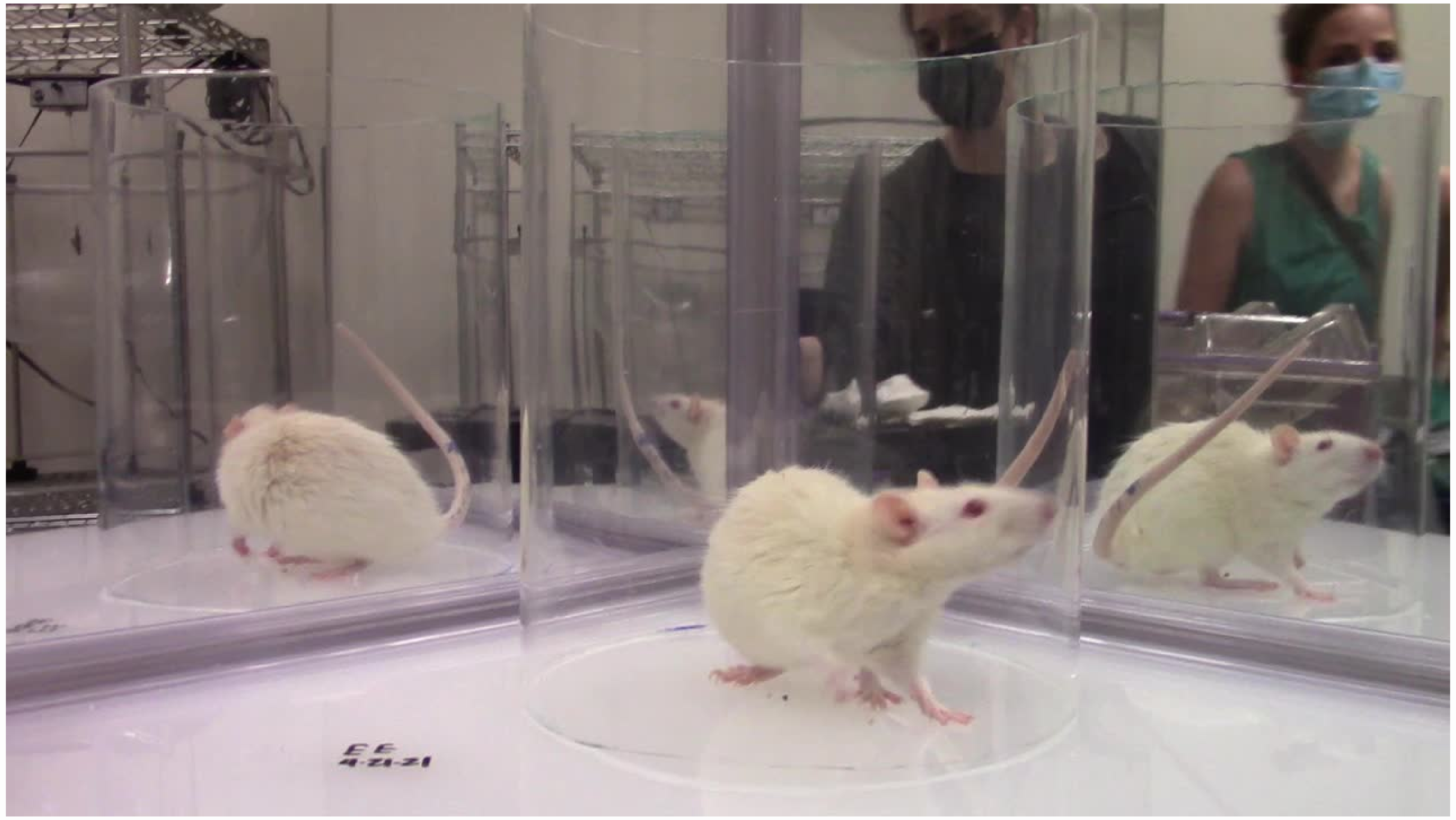

## Core Pathology

- a loss of cells in the brain which produce the neurotransmitter dopamine

# Main Purpose of AI Guided Analysis

## Manual Scoring - Cons

- Time-consuming and Exhausting
- Error-prone
- Lack of concentration
- Expertise Requirements

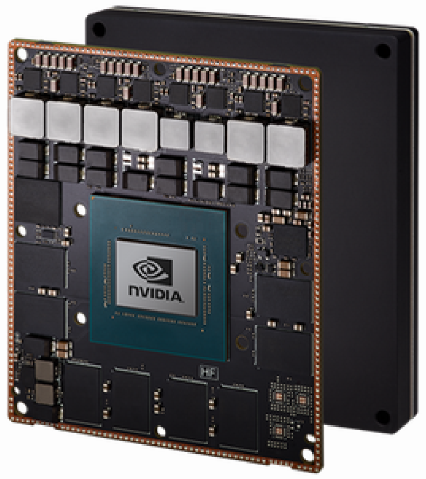


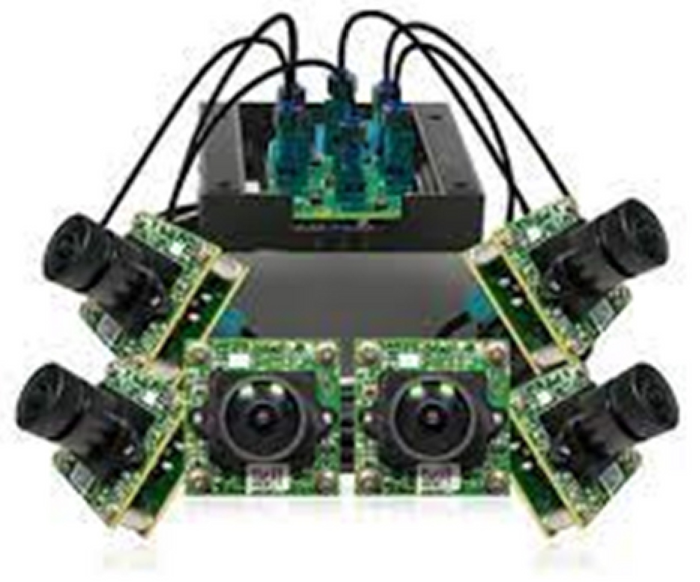
## AI Guided - Pros

- Fully Automatic
- Higher Accuracy
- Results Visualization

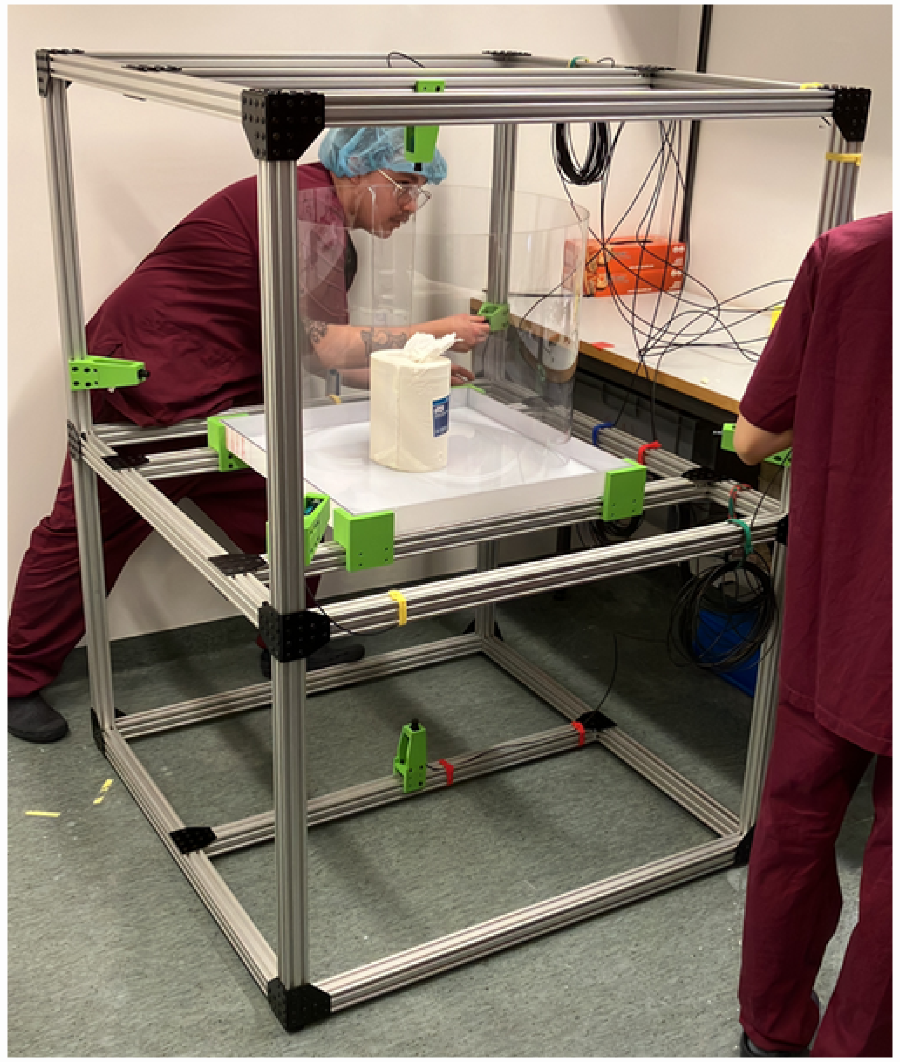
# Project Overview

Core Processor
&
Cameras



Experiment Platform



Core Processor & Cameras:

- **NVIDIA Jetson AGX Orin Developer Kit**
- **NileCAM25 - 1920x1200 60/120fps**

Platform:

- **6 cameras from the top, bottom, and four square corners**
- **Frames - Vertical 1.5m / Horizontal 1.0m**
- **With the experimental observation platform**

# Datasets - Captured Videos from Multi-angles

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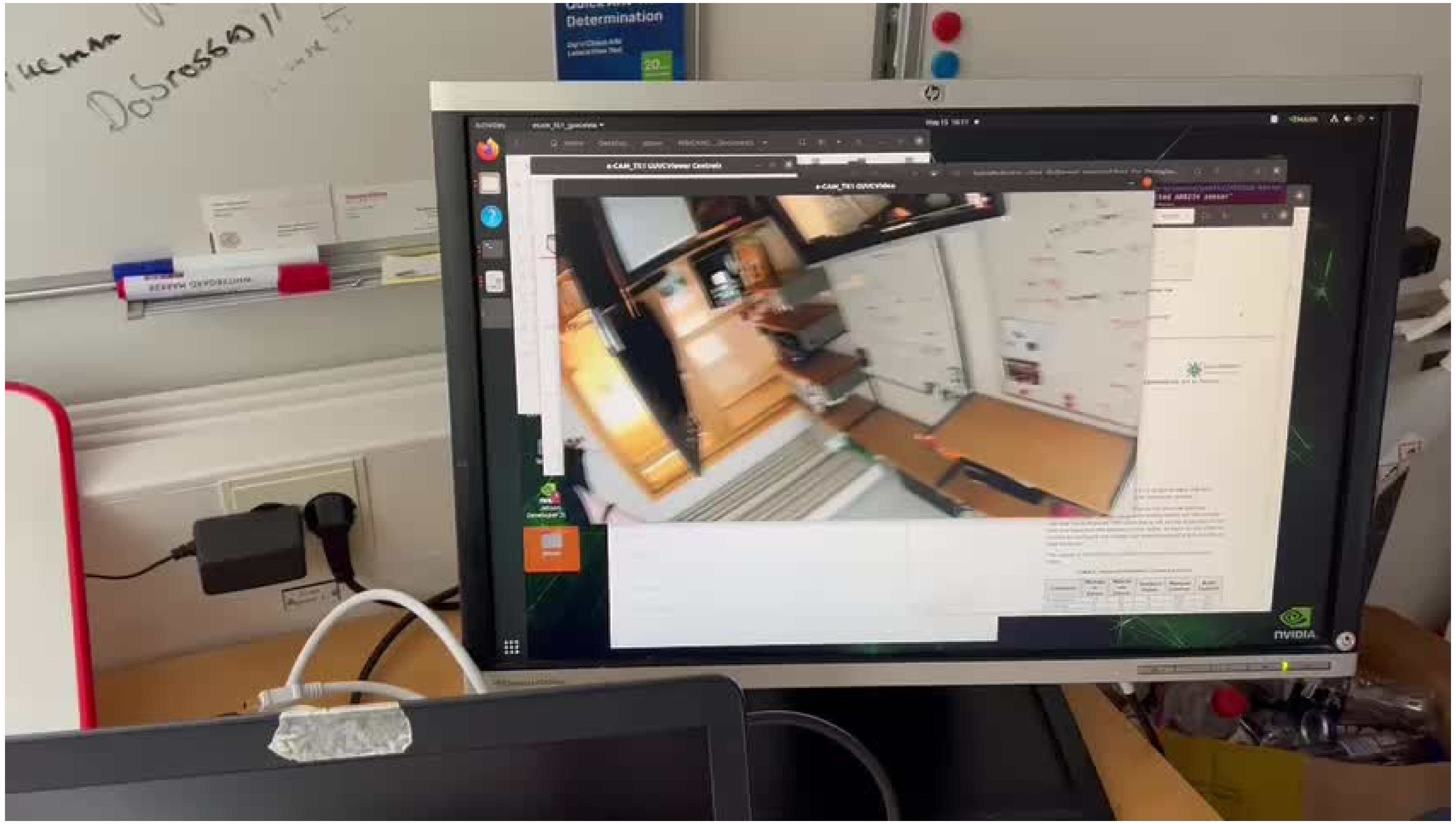

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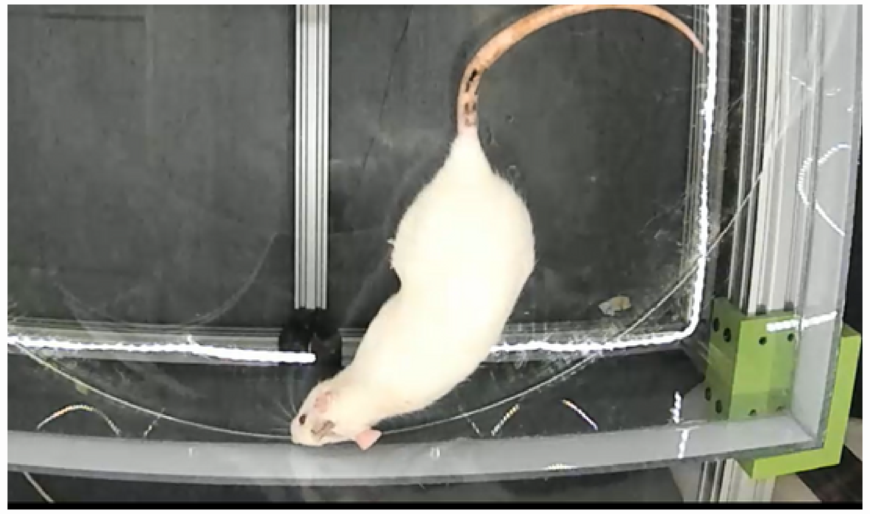
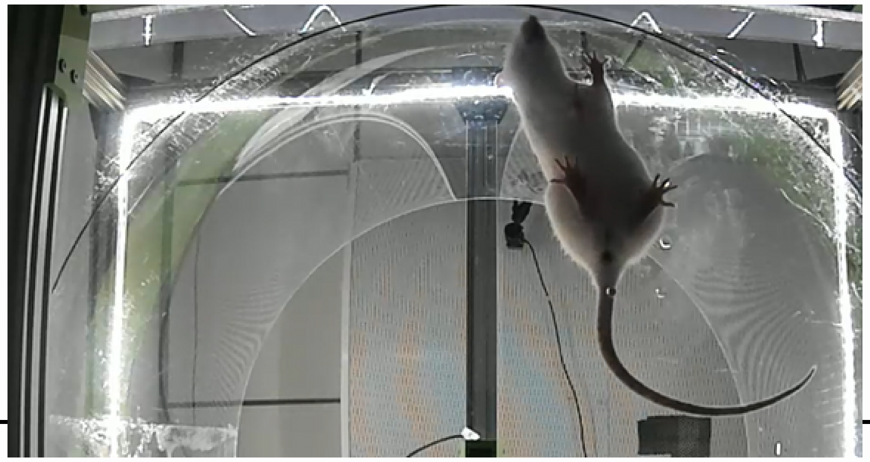


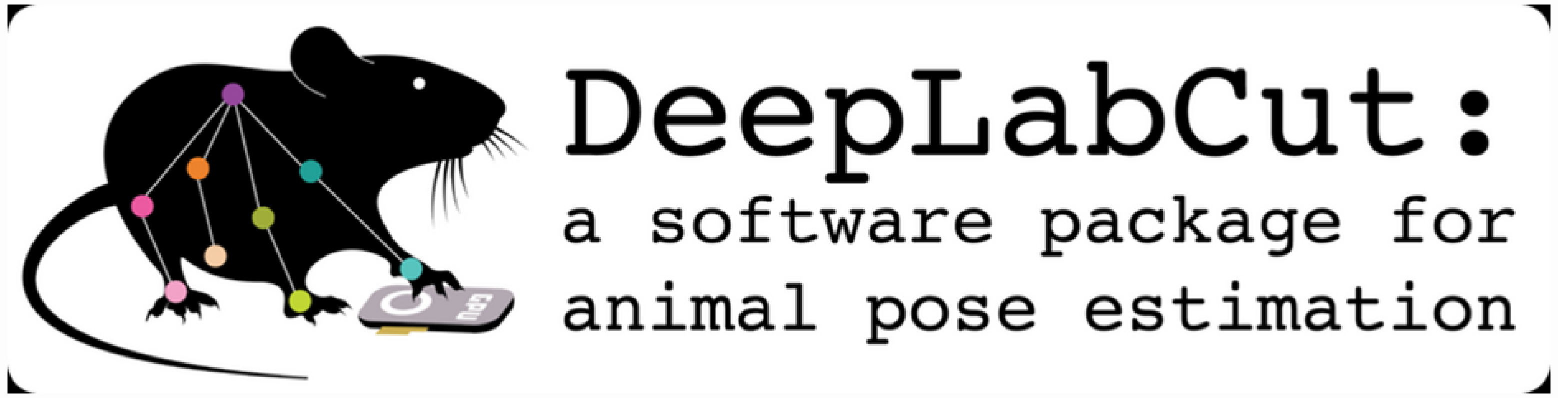


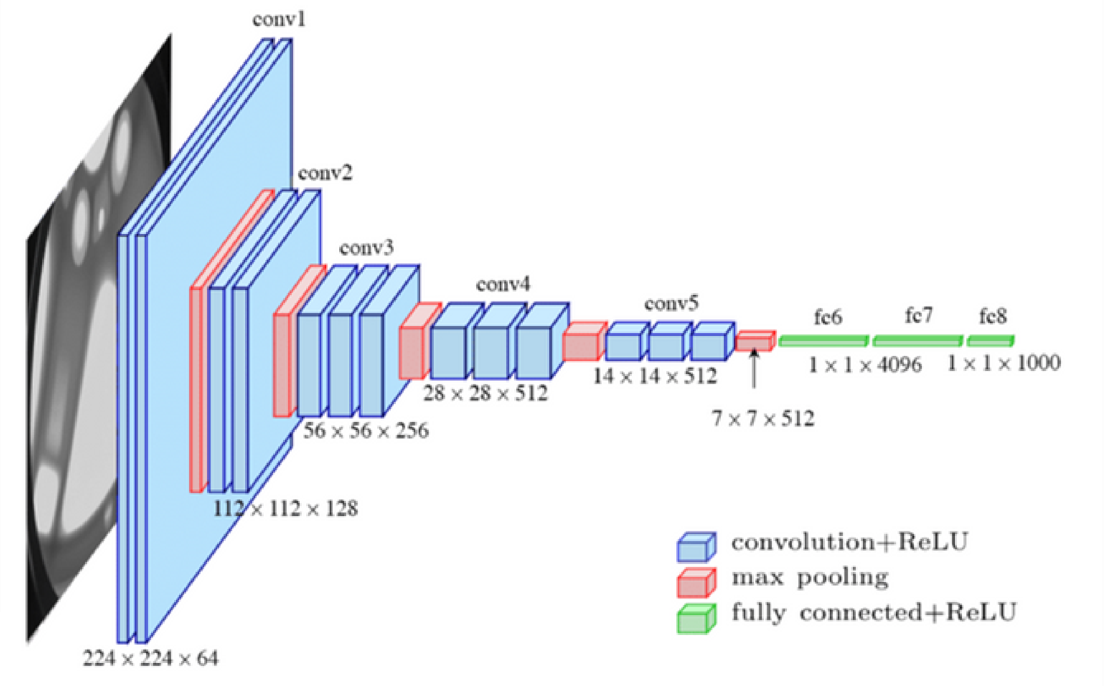
# Datasets - Captured Videos from Multi-angles

By cropping it into four individual videos as a whole dataset from one rodent models

# Tools - DeepLabCut




- An efficient method for 2D/3D markerless **pose estimation** based on deep neural networks
- With the **pre-trained models**, based on the **IMAGENET** dataset.
- Capable of **making predictions** for each frame

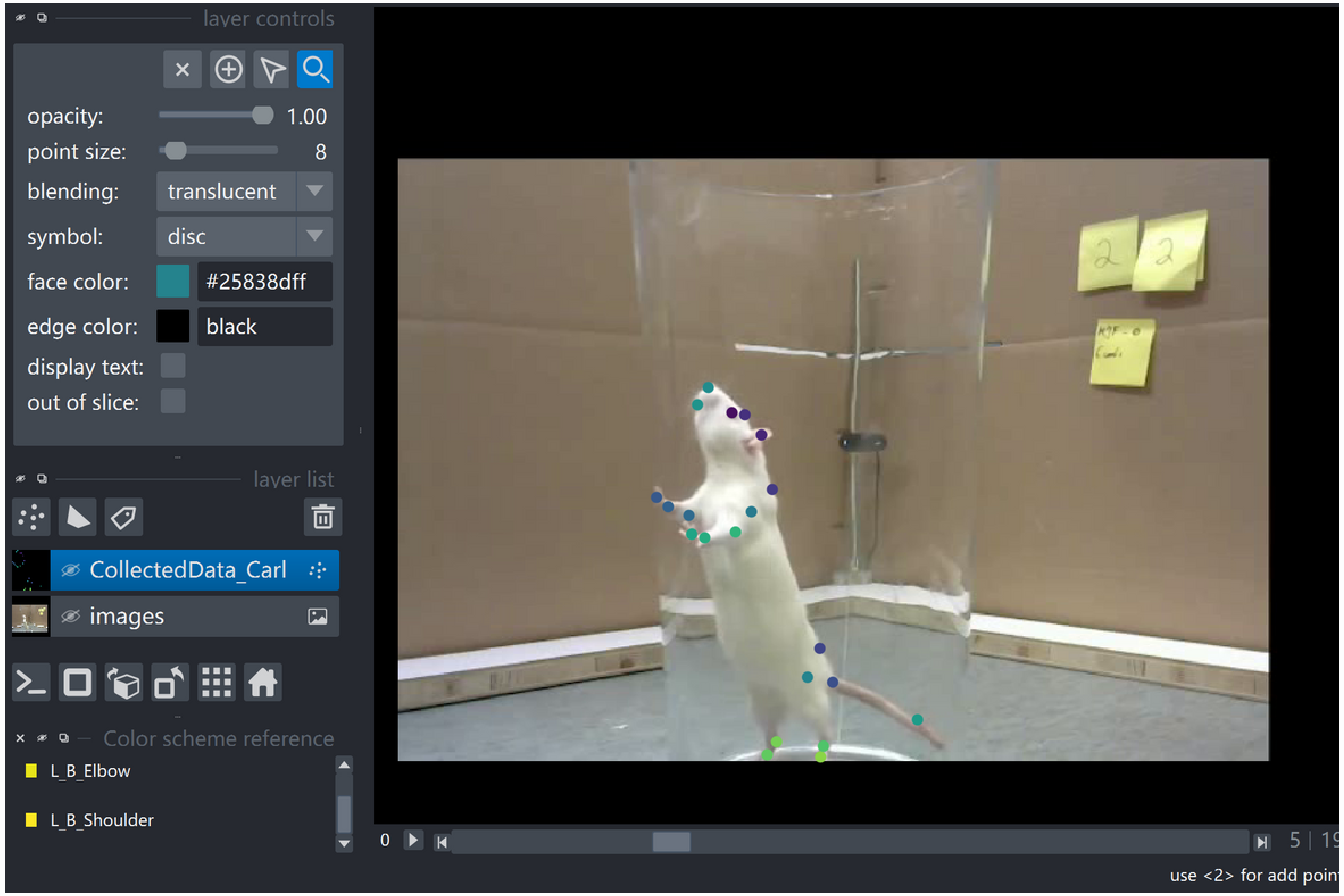



Convolutional Neural Networks


IMAGENET

# Modeling - Cylinder Test

## Frame Extraction and Labeling Design

# Modeling - Cylinder Test

## Training and Building the Skeleton

- **10 rats, 4 videos, 5 mins, 30 frames**
- **Create training dataset - 0.95**
- **Based on ResNet**
- **Evaluate models**
- **Connect specific key points as a skeleton**

| layer name | output size | 18-layer | 34-layer | 50-layer | 101-layer | 152-layer |
|---|---|---|---|---|---|---|
| conv1 | 112×112 | 7×7, 64, stride 2 | | | | |
| conv2_x | 56×56 | 3×3 max pool, stride 2 | | | | |
| | | [3×3, 64; 3×3, 64] ×2 | [3×3, 64; 3×3, 64] ×3 | [1×1, 64; 3×3, 64; 1×1, 256] ×3 | [1×1, 64; 3×3, 64; 1×1, 256] ×3 | [1×1, 64; 3×3, 64; 1×1, 256] ×3 |
| conv3_x | 28×28 | [3×3, 128; 3×3, 128] ×2 | [3×3, 128; 3×3, 128] ×4 | [1×1, 128; 3×3, 128; 1×1, 512] ×4 | [1×1, 128; 3×3, 128; 1×1, 512] ×4 | [1×1, 128; 3×3, 128; 1×1, 512] ×8 |
| conv4_x | 14×14 | [3×3, 256; 3×3, 256] ×2 | [3×3, 256; 3×3, 256] ×6 | [1×1, 256; 3×3, 256; 1×1, 1024] ×6 | [1×1, 256; 3×3, 256; 1×1, 1024] ×23 | [1×1, 256; 3×3, 256; 1×1, 1024] ×36 |
| conv5_x | 7×7 | [3×3, 512; 3×3, 512] ×2 | [3×3, 512; 3×3, 512] ×3 | [1×1, 512; 3×3, 512; 1×1, 2048] ×3 | [1×1, 512; 3×3, 512; 1×1, 2048] ×3 | [1×1, 512; 3×3, 512; 1×1, 2048] ×3 |
| | 1×1 | average pool, 1000-d fc, softmax | | | | |
| FLOPs | | $1.8\times10^9$ | $3.6\times10^9$ | $3.8\times10^9$ | $7.6\times10^9$ | $11.3\times10^9$ |

| Model | Train Acc. | Loss | Time |
|---|---|---|---|
| ResNet18 | 0.83 | 1.0436 | 2701s |
| ResNet34 | 0.8651 | 1.5983 | 4800s |
| ResNet50 | 0.8662 | 4.3967 | 5580s |
| ResNet101 | 0.8594 | 8.4274 | 6112s |
| ResNet152 | 0.8798 | 11.943 | 9248s |

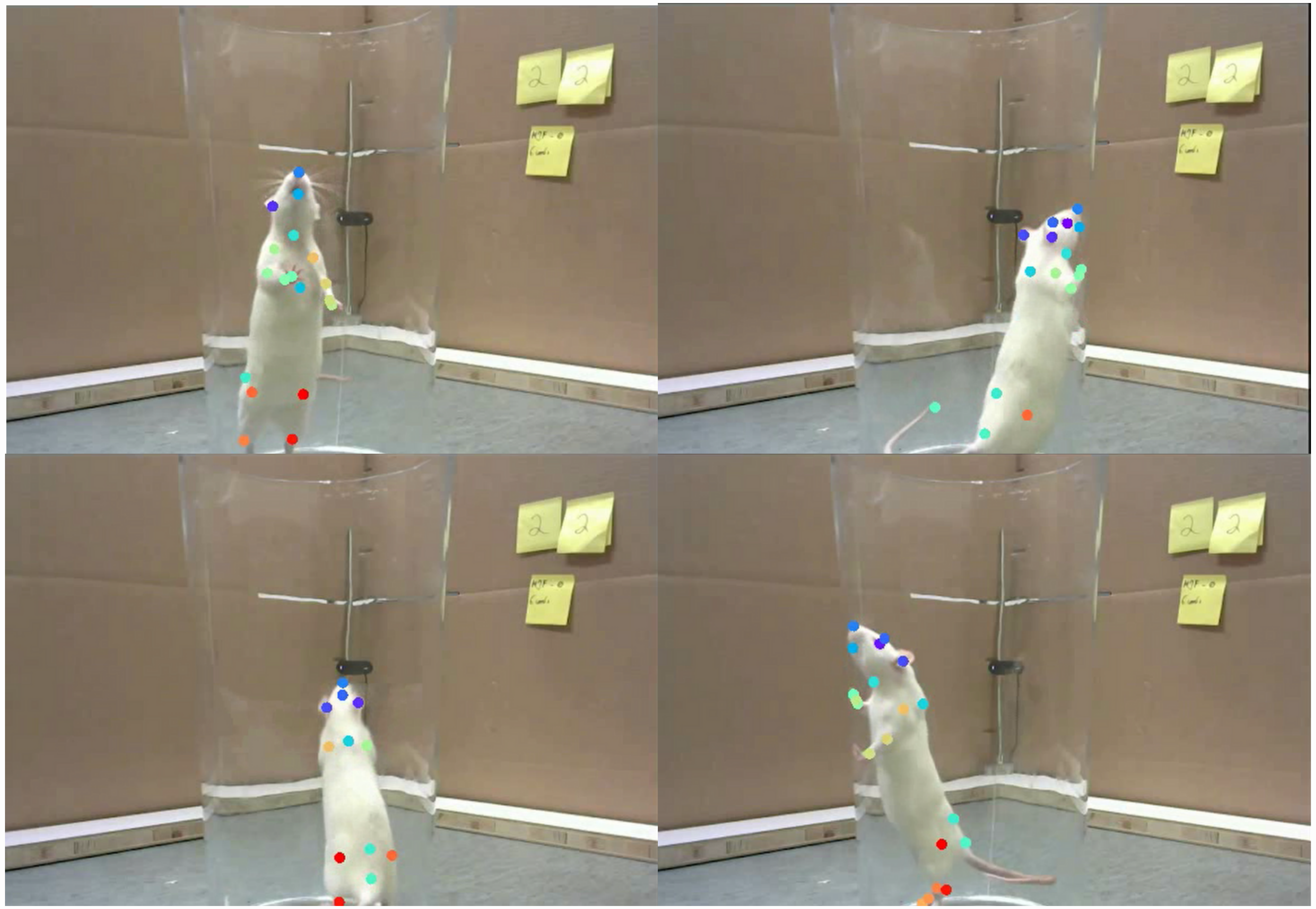
# Modeling - Cylinder Test

## Visualization

Keypoints tracking results

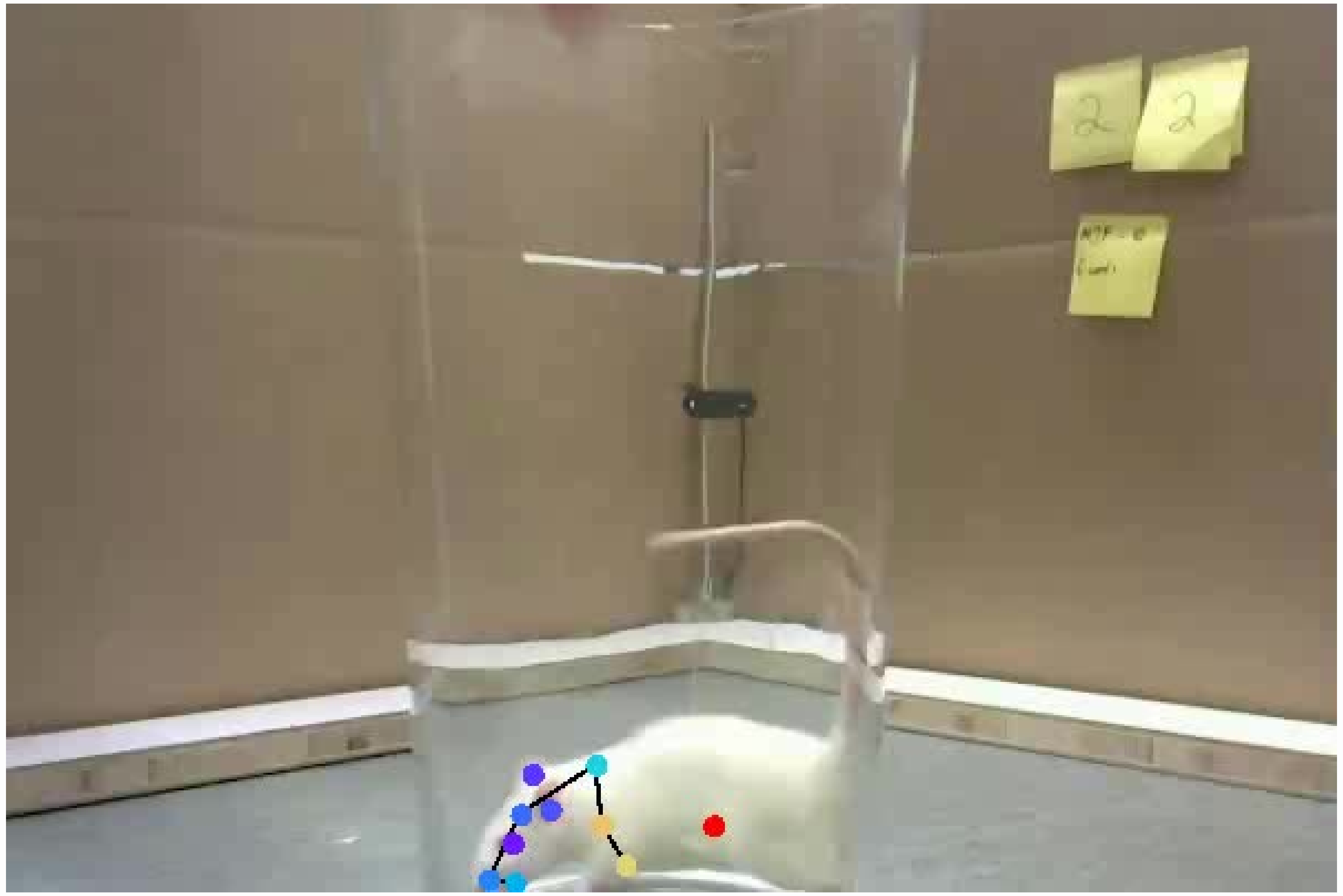
Analysis the video

Create output videos - with skeleton



# Results - Visualised Videos with Skeleton

Here is one of the four output videos we got, it is clear that there is a well performance of the key body part detections and skeleton tracking results.



# Post-Processing

- **Counts**

Determining what counts as a touch of the mouse's forelimb against the wall of a cylinder.

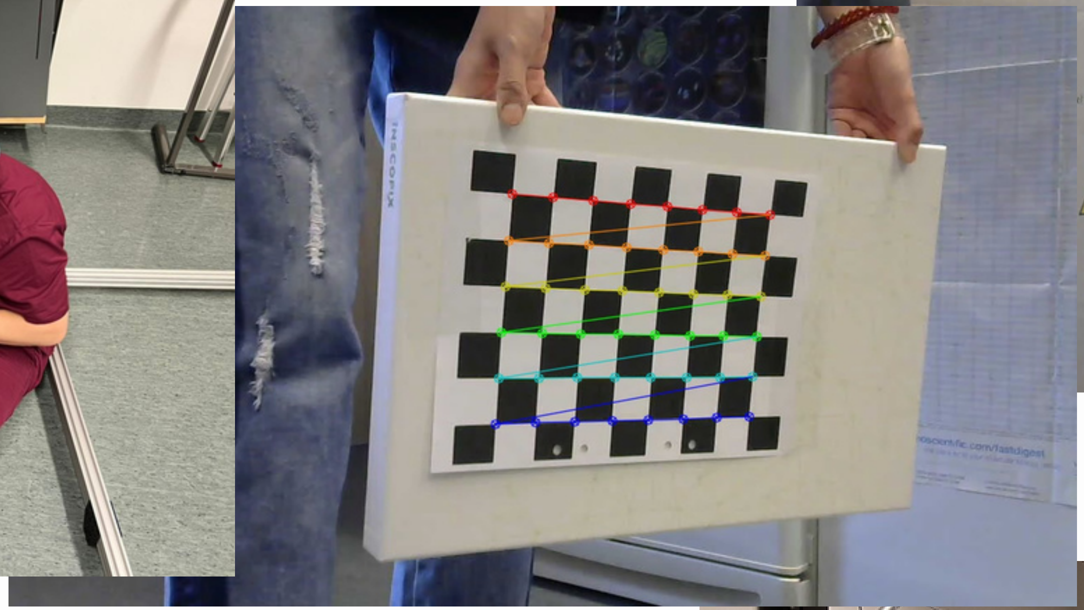
Counting how many times the rat is using its forelimbs to touched in a video over a given period of time

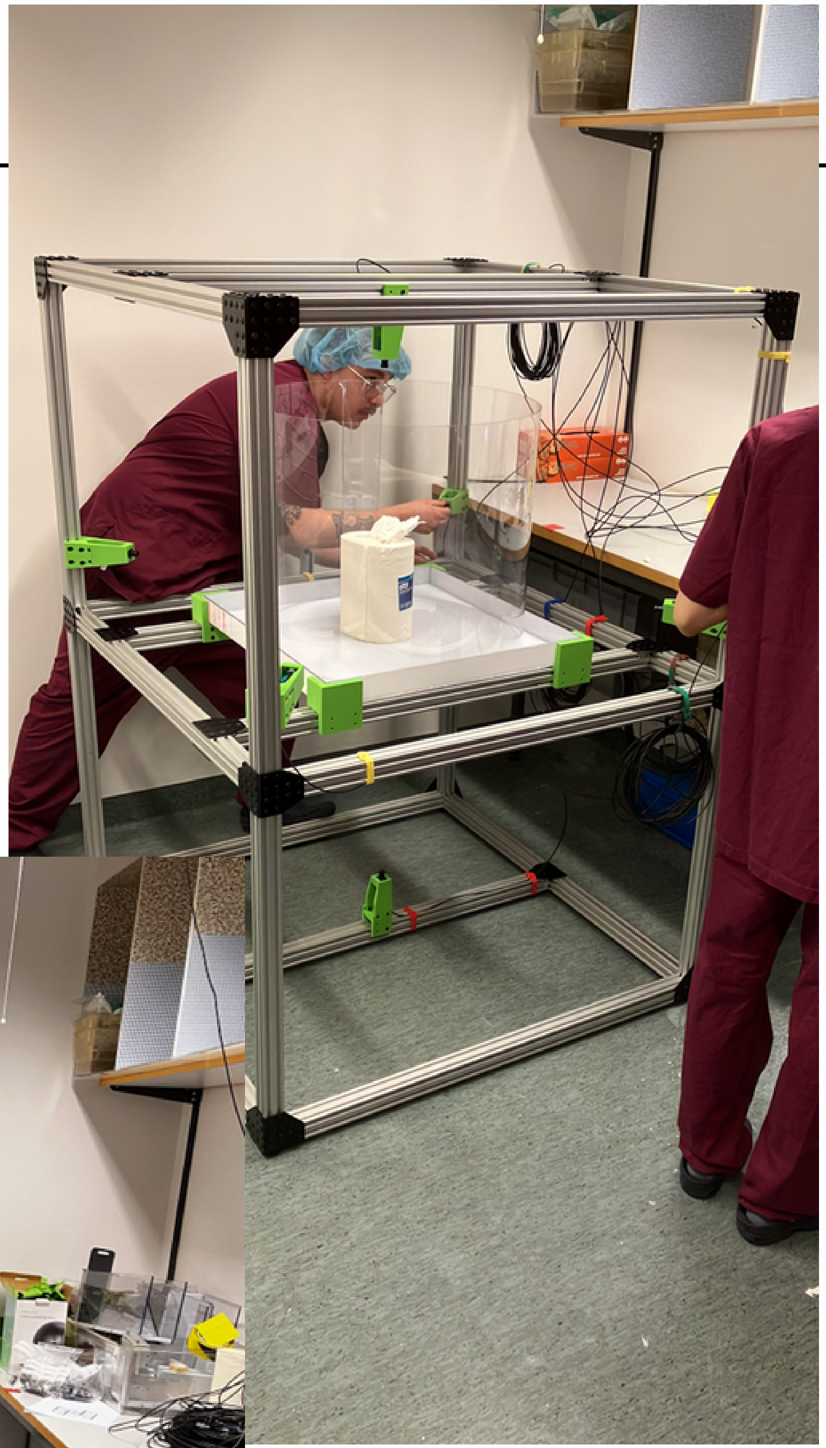
**Pixel Normalization**

**Determine distance-to-target**

# Post-Processing

Considerations






Thank you Andi! And thank you all!! ❤
It's a wonderful and unforgettable time!

# Thanks!

## Any Questions?