
AI guided analysis of behavioural phenotypes



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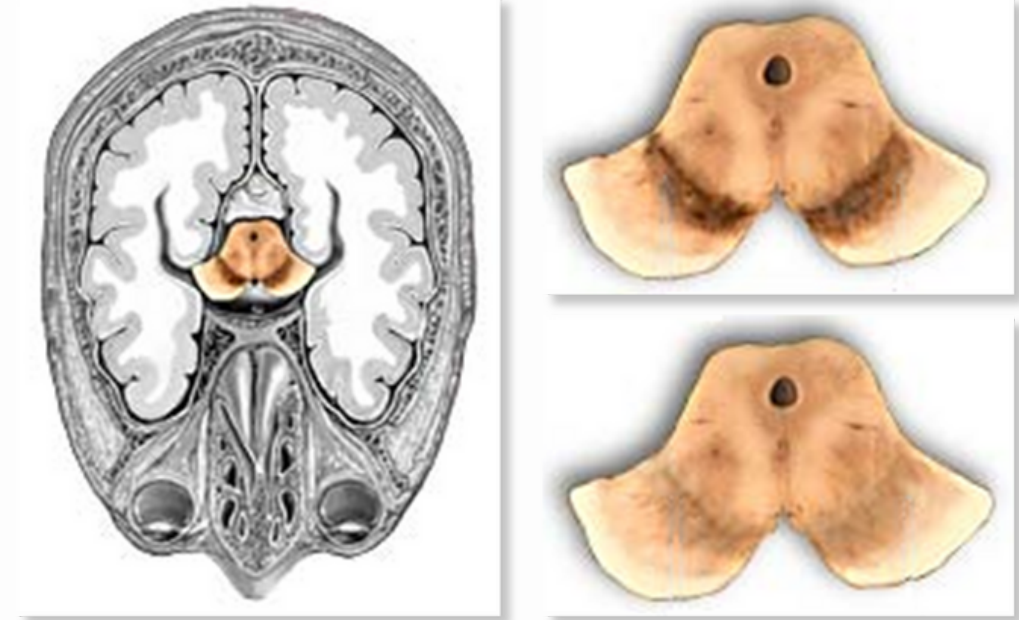


STUDENT: RUOYI ZHAO
SUPERVISOR: ANDREAS HEUER

Background - Parkinson's Disease

Symptoms

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



Catherine Montzger
13 Octobre 1869

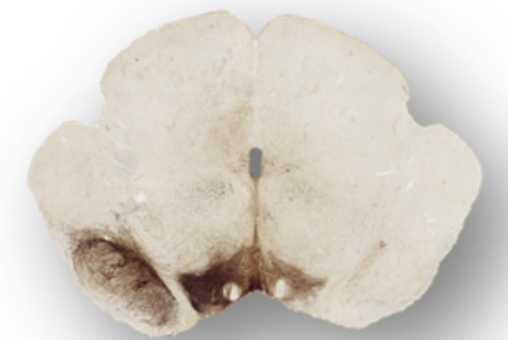
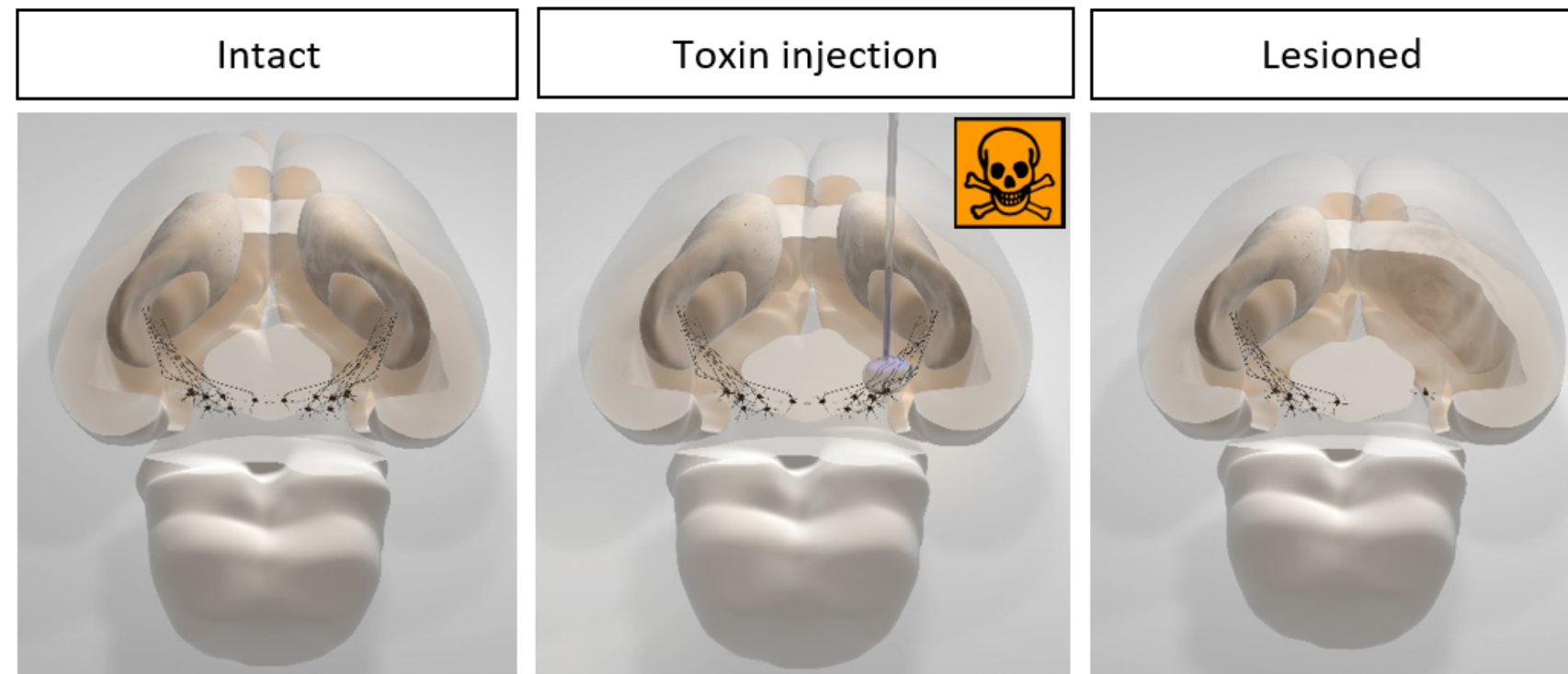
Core Pathology

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

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Brown colour = Dopamine

Core Pathology

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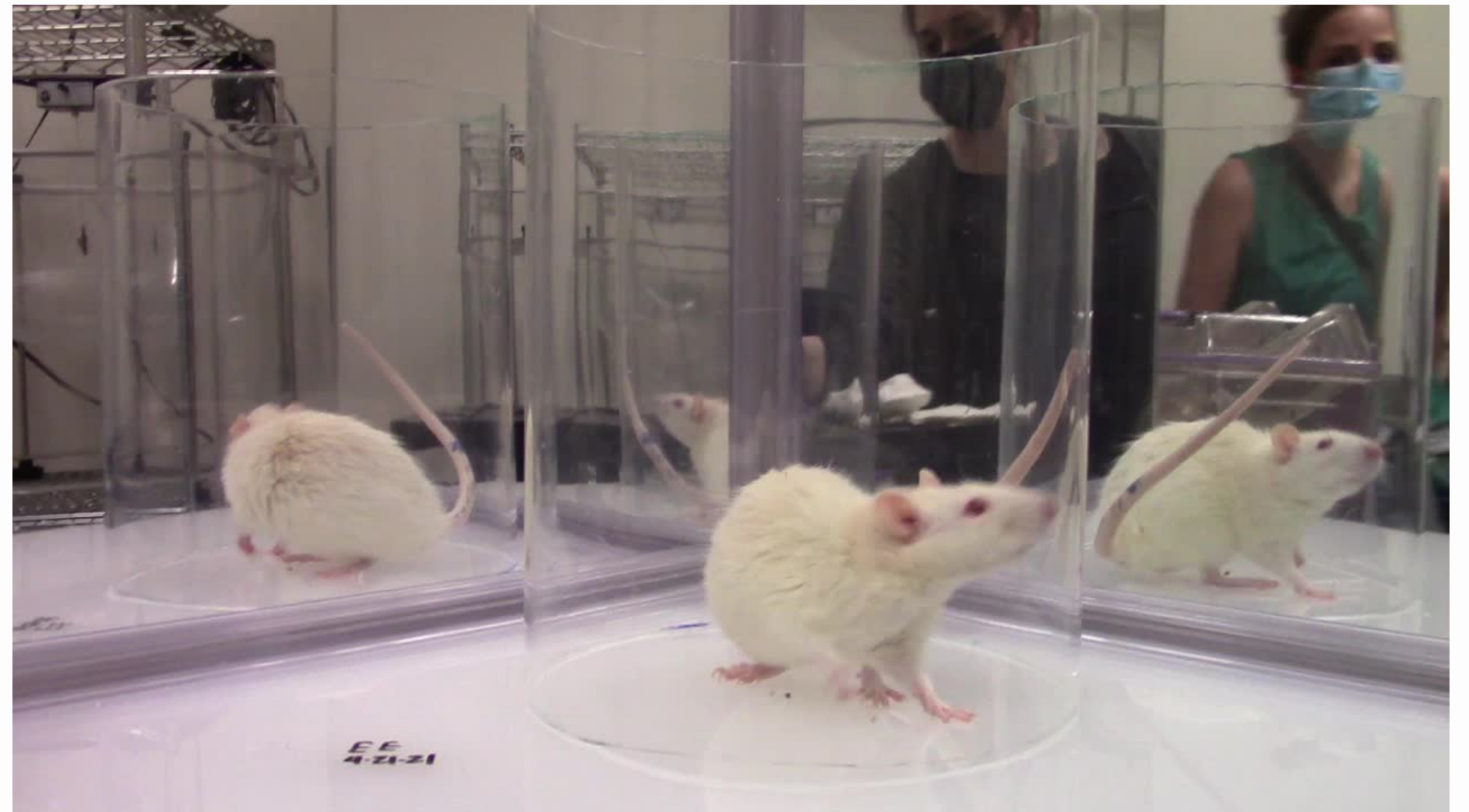
Main Purpose of AI Guided Analysis

Manual Scoring - Cons

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

AI Guided - Pros

- Fully Automatic
- Higher Accuracy
- Results Visualization

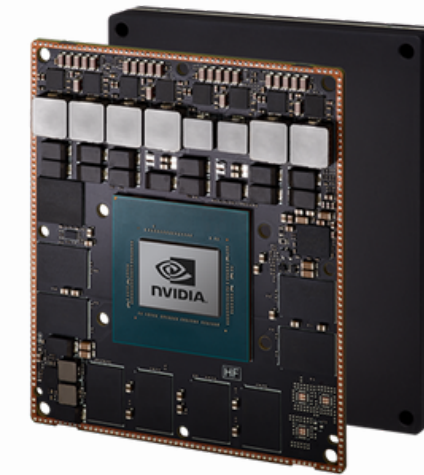


Project Overview

Core Processor & Cameras

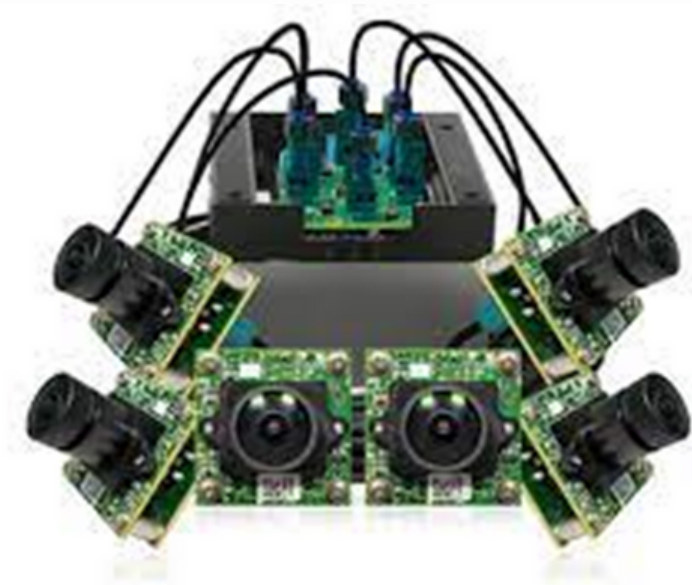
Core Processor & Cameras:

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

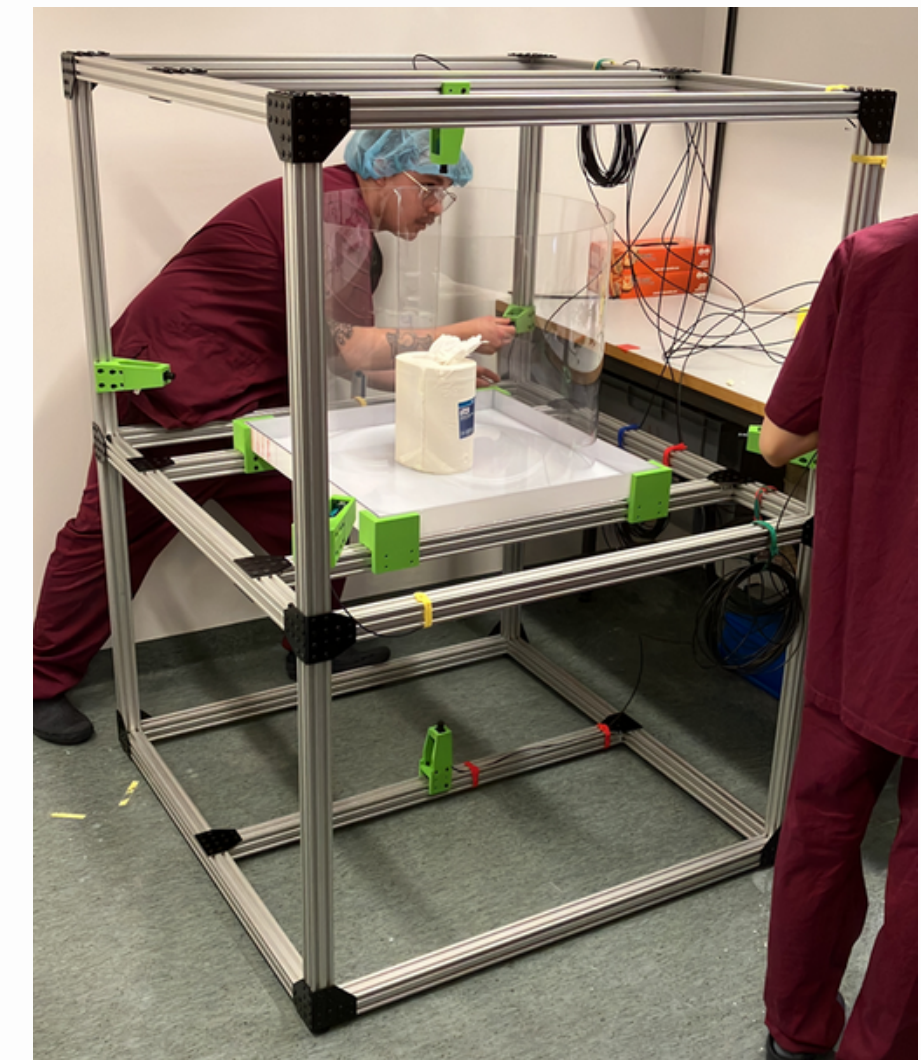


Platform:

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



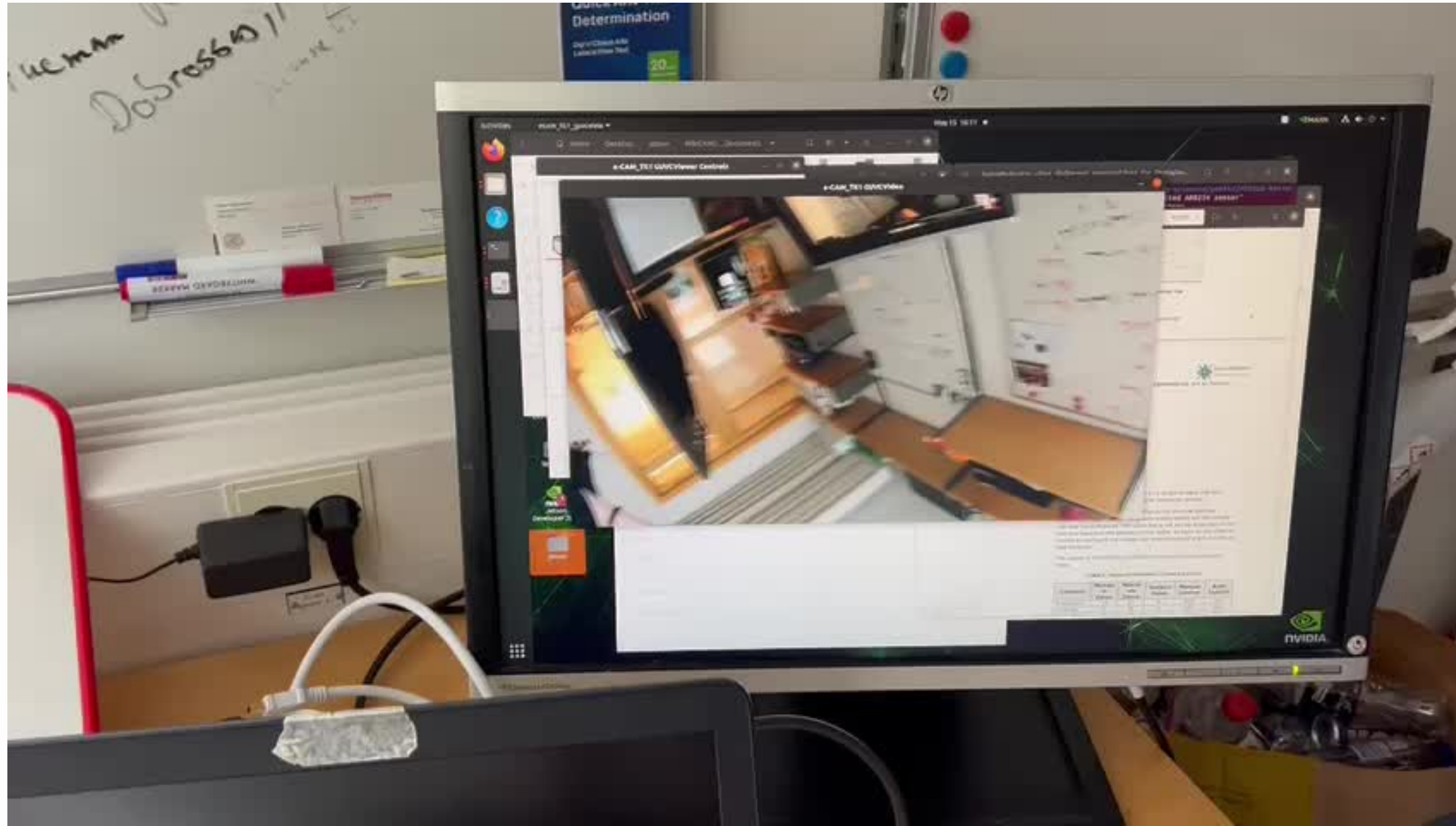
Experiment Platform





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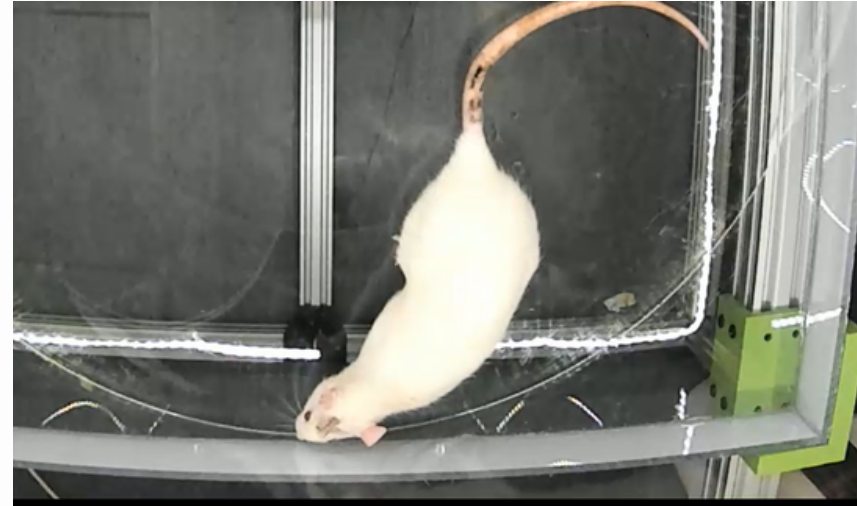
Datasets - Captured Videos from Multi-angles





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Datasets - Captured Videos from Multi-angles





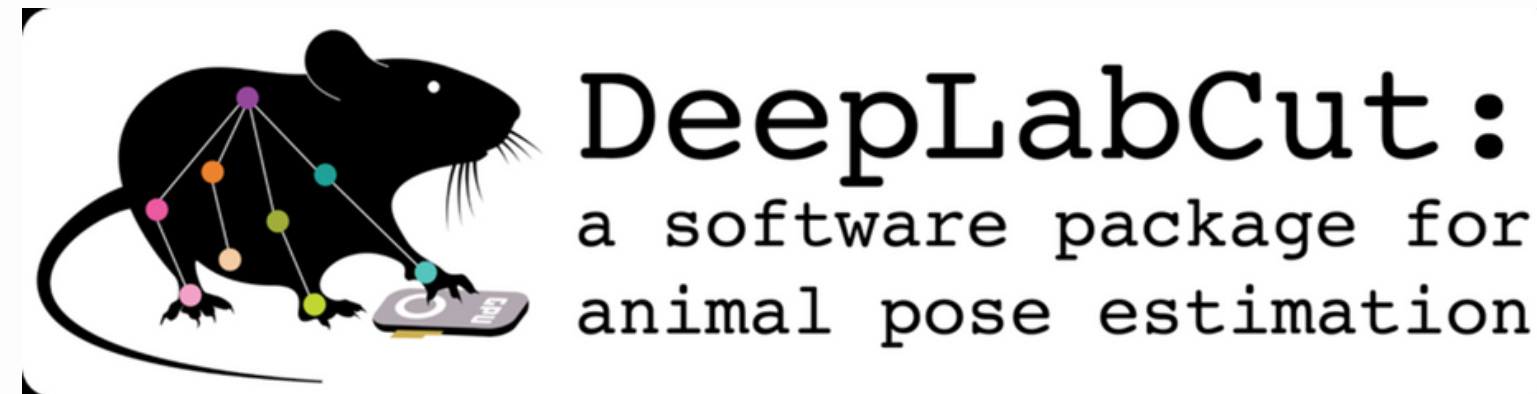
Datasets - Captured Videos from Multi-angles



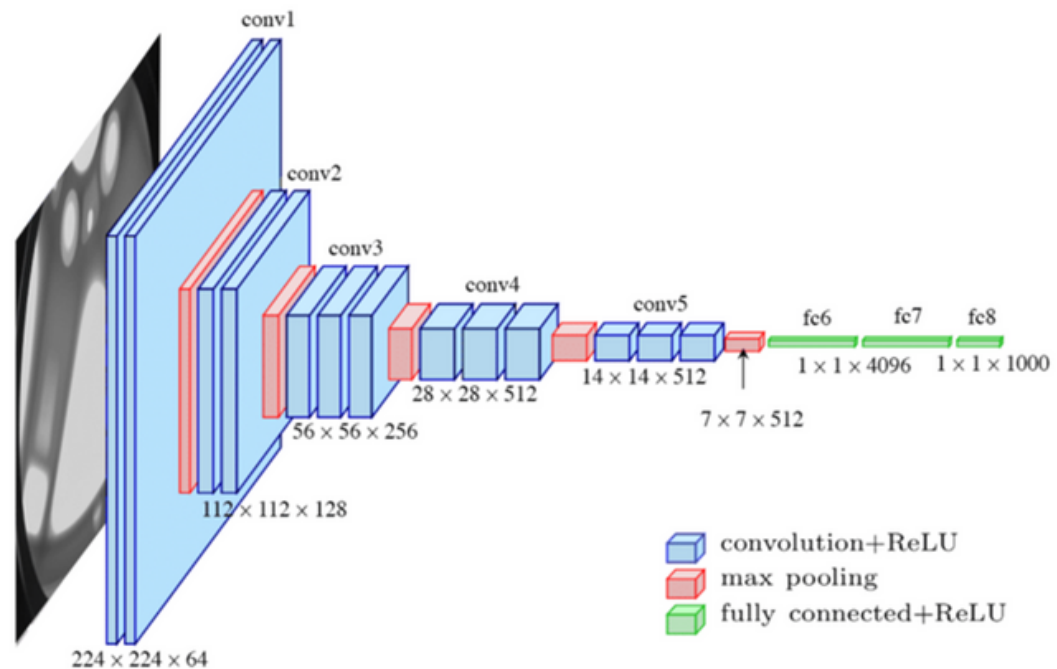
By cropping it into four individual videos as a whole dataset from one rodent models



Tools - DeepLabCut

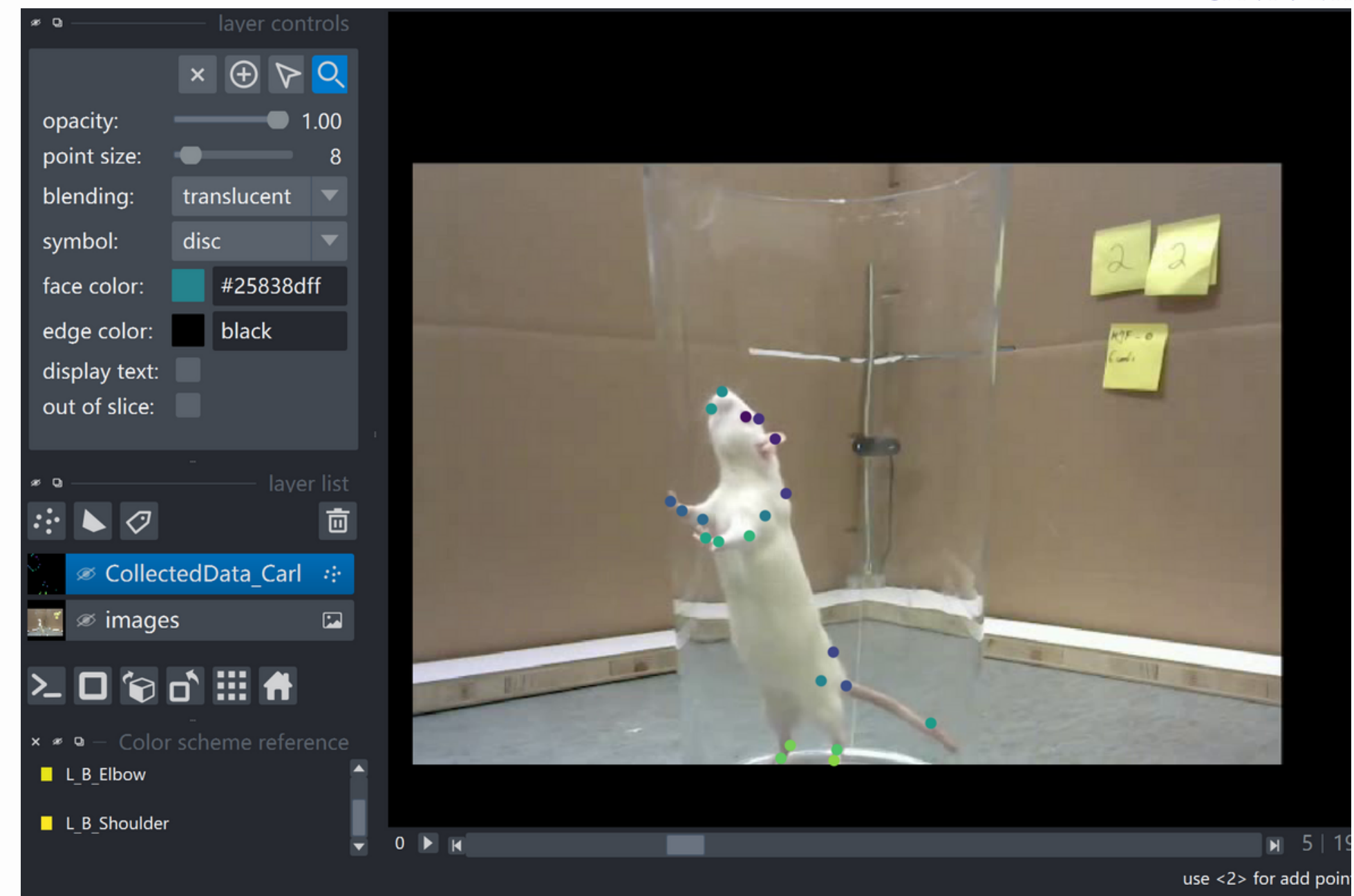


- An efficient method for 2D/3D markerless **pose estimation** based on deep neural networks
- With the **pre-trained models**, based on the **IMAGENET** dataset.
- Capable of **making predictions** for each frame



Modeling - Cylinder Test

Frame Extraction and Labeling Design



The screenshot shows a software interface with two main panels. The left panel, titled "layer controls", includes settings for opacity (1.00), point size (8), blending (translucent), symbol (disc), face color (#25838dff), edge color (black), display text, and out of slice. The right panel, titled "layer list", shows a list of layers including "CollectedData_Carl" and "images". Below the layer list is a "Color scheme reference" section with checkboxes for "L_B_Elbow" and "L_B_Shoulder". The main video window shows a white rat standing on its hind legs inside a transparent cylindrical enclosure. The rat's body is marked with colored dots corresponding to the labels in the diagram. The video player interface at the bottom shows a progress bar and a timestamp of 5 | 19.





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				
		3×3 max pool, stride 2				
conv2_x	56×56	$\begin{bmatrix} 3 \times 3, 64 \\ 3 \times 3, 64 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 64 \\ 3 \times 3, 64 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 64 \\ 3 \times 3, 64 \\ 1 \times 1, 256 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 64 \\ 3 \times 3, 64 \\ 1 \times 1, 256 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 64 \\ 3 \times 3, 64 \\ 1 \times 1, 256 \end{bmatrix} \times 3$
conv3_x	28×28	$\begin{bmatrix} 3 \times 3, 128 \\ 3 \times 3, 128 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 128 \\ 3 \times 3, 128 \end{bmatrix} \times 4$	$\begin{bmatrix} 1 \times 1, 128 \\ 3 \times 3, 128 \\ 1 \times 1, 512 \end{bmatrix} \times 4$	$\begin{bmatrix} 1 \times 1, 128 \\ 3 \times 3, 128 \\ 1 \times 1, 512 \end{bmatrix} \times 4$	$\begin{bmatrix} 1 \times 1, 128 \\ 3 \times 3, 128 \\ 1 \times 1, 512 \end{bmatrix} \times 8$
conv4_x	14×14	$\begin{bmatrix} 3 \times 3, 256 \\ 3 \times 3, 256 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 256 \\ 3 \times 3, 256 \end{bmatrix} \times 6$	$\begin{bmatrix} 1 \times 1, 256 \\ 3 \times 3, 256 \\ 1 \times 1, 1024 \end{bmatrix} \times 6$	$\begin{bmatrix} 1 \times 1, 256 \\ 3 \times 3, 256 \\ 1 \times 1, 1024 \end{bmatrix} \times 23$	$\begin{bmatrix} 1 \times 1, 256 \\ 3 \times 3, 256 \\ 1 \times 1, 1024 \end{bmatrix} \times 36$
conv5_x	7×7	$\begin{bmatrix} 3 \times 3, 512 \\ 3 \times 3, 512 \end{bmatrix} \times 2$	$\begin{bmatrix} 3 \times 3, 512 \\ 3 \times 3, 512 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 512 \\ 3 \times 3, 512 \\ 1 \times 1, 2048 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 512 \\ 3 \times 3, 512 \\ 1 \times 1, 2048 \end{bmatrix} \times 3$	$\begin{bmatrix} 1 \times 1, 512 \\ 3 \times 3, 512 \\ 1 \times 1, 2048 \end{bmatrix} \times 3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10 ⁹	3.6×10 ⁹	3.8×10 ⁹	7.6×10 ⁹	11.3×10 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



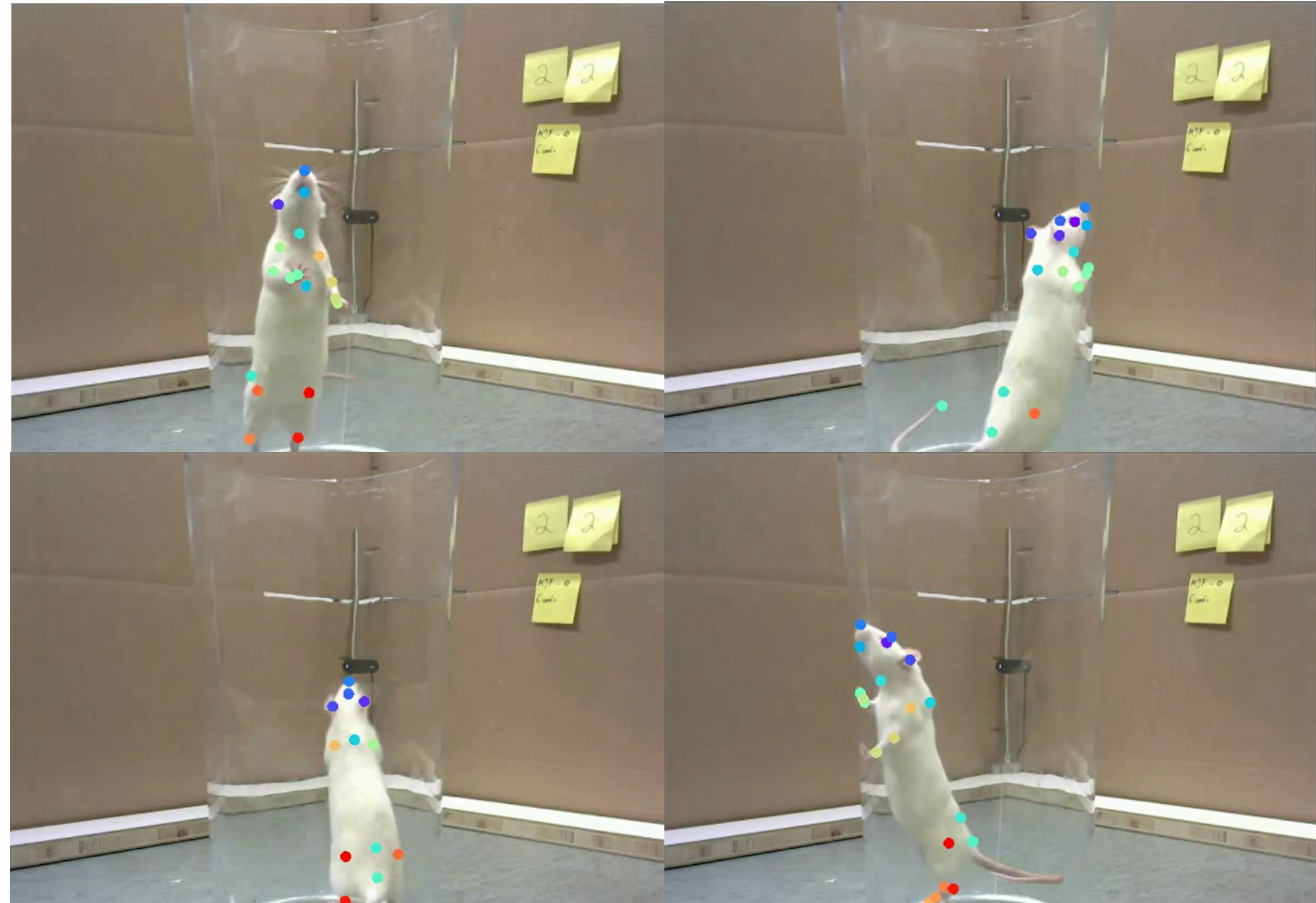
Modeling - Cylinder Test

Visualization

Keypoints tracking results

Analysis the video

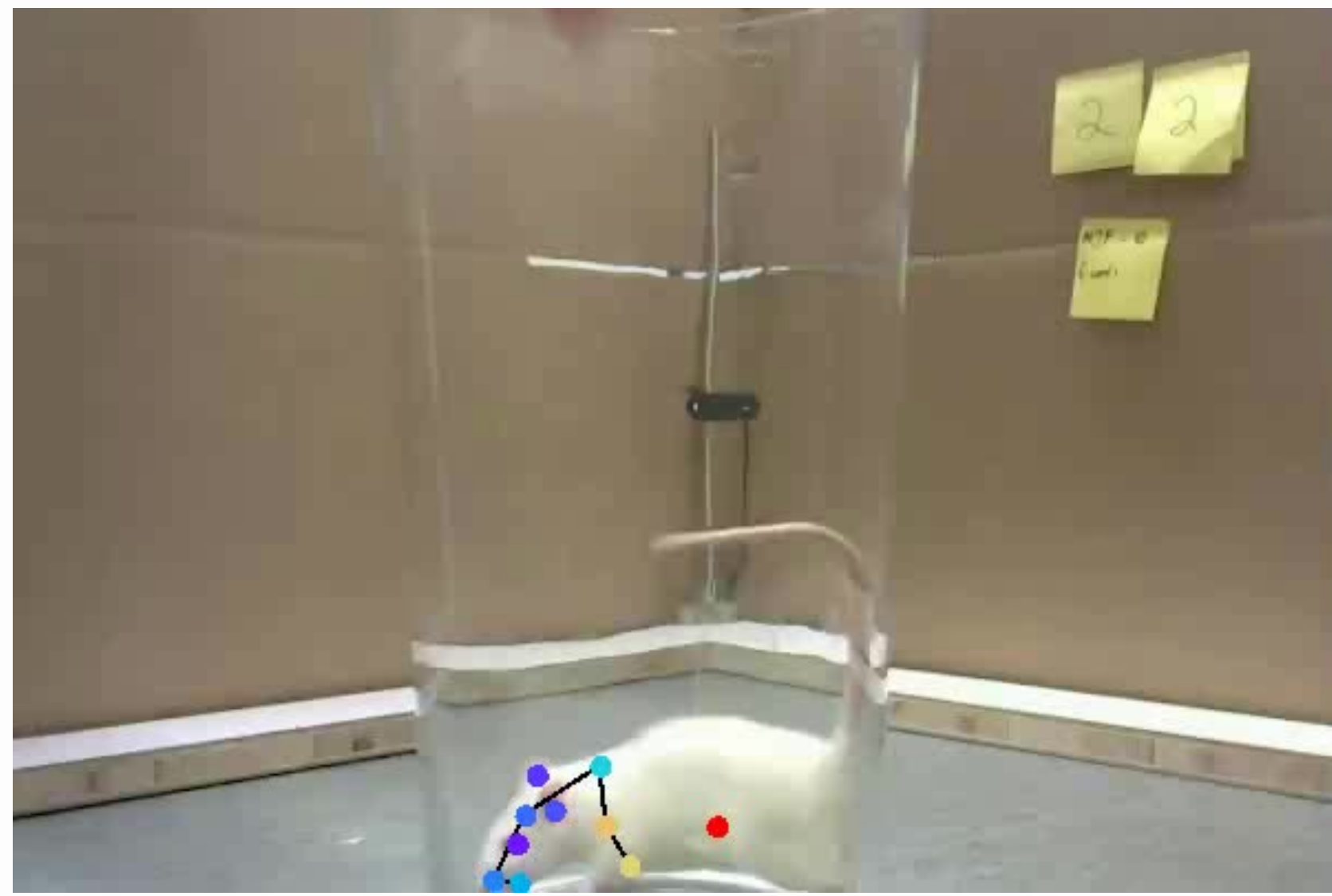
Create output videos - with skeleton





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



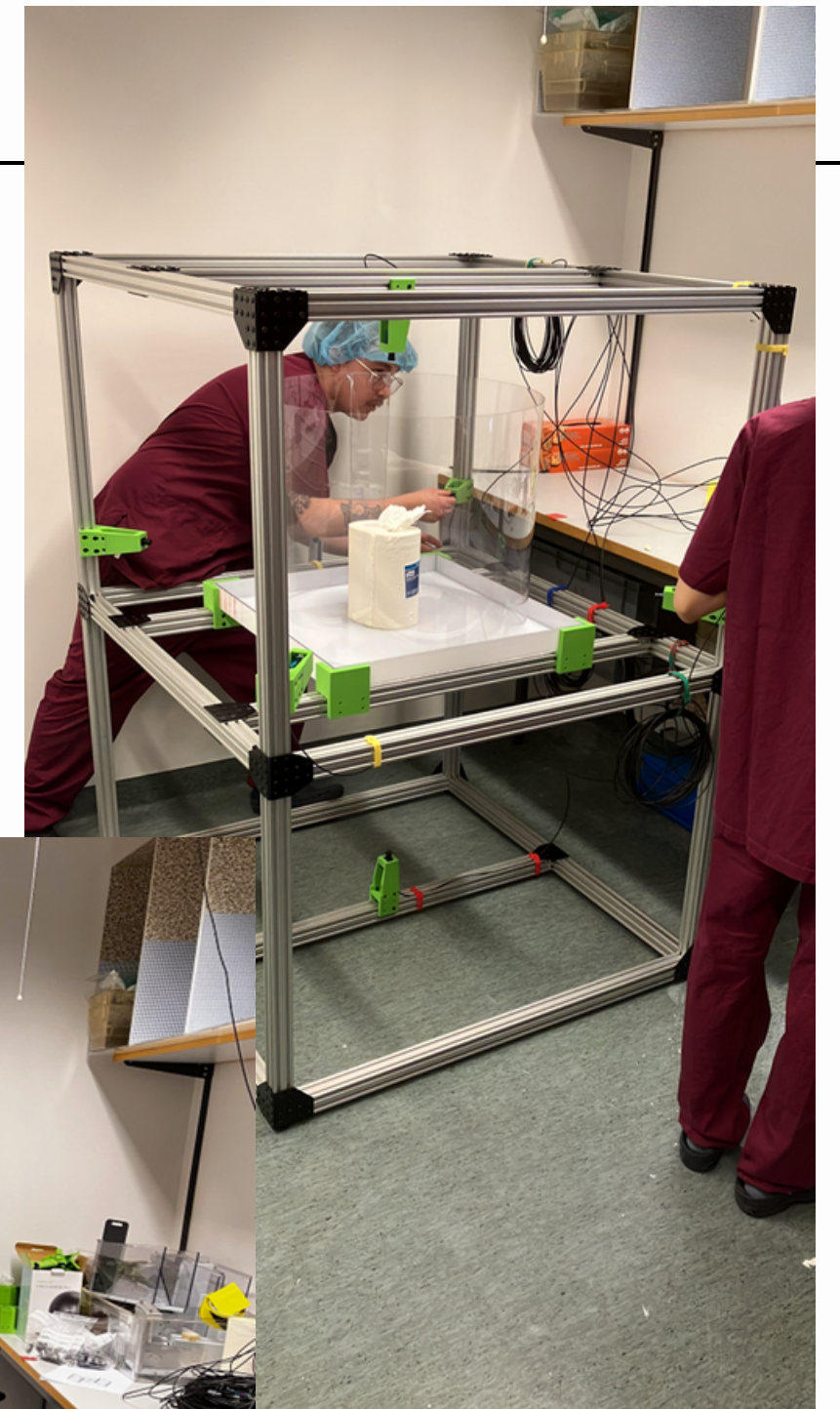
Post-Processing



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Considerations





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

Thanks!

Any Questions?



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THANKS!
