Week 9: application: DeepLabCut

NRSC 7657 Workshop in Advanced Programming for Neuroscientists

course business

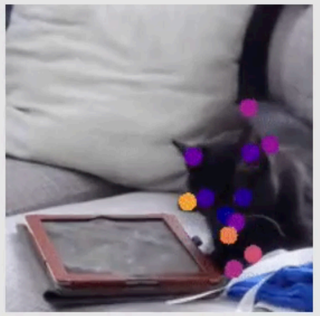
- Next week: presentations!
- Prepare a 5-10 minute presentation that describes:
    1. The goal (1-2 slides)
    2. The output (the GUI, the table of data, the figure, etc.) (1 slide)
- Make sure you `push` your final code to your repo before class
- Have your code available to demo- we will do a light code review (show it off!). This means we will look at the architecture and read some lines to see if we get it.

course business

- Ursula after class on Friday 8/13, first round on me

Deep Lab Cut
Tracking

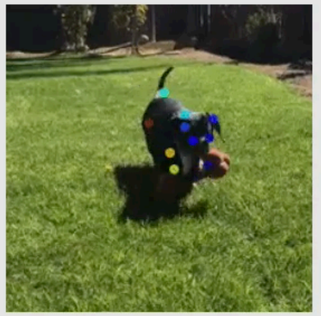
- History: reflectors or LED markers, video cameras
    - Limitations: specific angles, occluded markers, markers fall off, might want to track something you didn't mark, markers need to be small
- enter: markerless tracking and deep learning



full_cat

A pre-trained cat network! See Mathis, Biasi et al, 2021 WACV for most data details. Model trained with TF1.13 on medium sized images (~400x600) from both Animal Pose + data we internally generated (video above courtesy of Dr. Erin Diel).

CITE WACV2021



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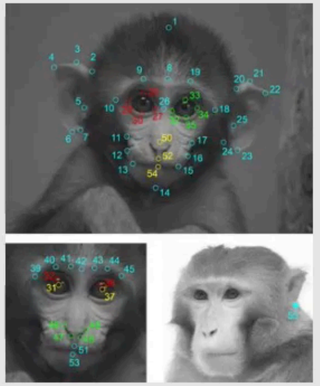
A pre-trained full 25 keypoint cheetah model. This is trained in TF1.15 with a DLC-ResNet-152 w/a pairwise model (see Joska et al. 2021 ICRA for details!). Note, the network was trained on large GoPro videos (2704x1520), so large videos are the expected input.



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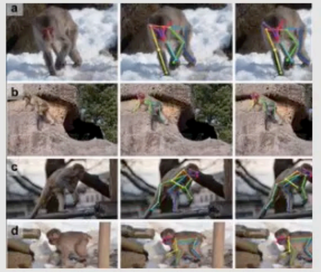
Model contributed by **Claire Witham** at Centre for Macaques, MRC Harwell, UK!

This model is trained on photos and videos of rhesus macaque faces – mostly forward facing or in profile.



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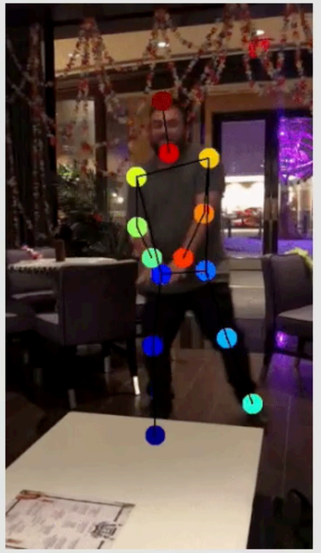
From MacaquePose!

Model contributed by **Jumpei Matsumoto**, at the Univ of Toyama.

See their paper for many details **here**! And if you use this model, please also cite their paper (see DOI below).

DOI https://doi.org/10.3389/fnbeh.2020.581154



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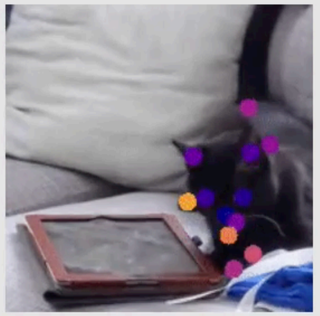

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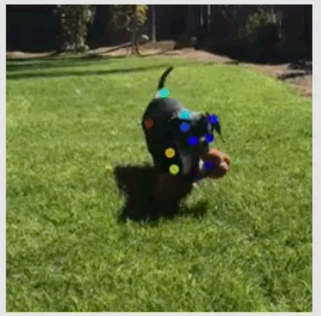

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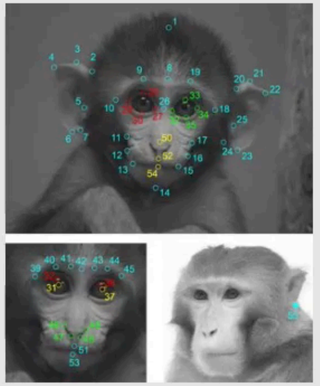

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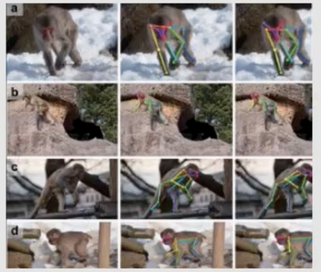

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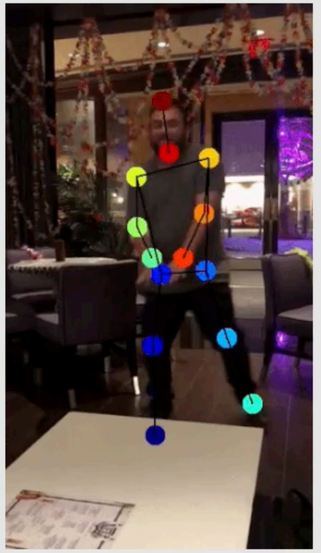

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Deep Lab Cut
Architecture

Technical Report | Published: 20 August 2018

DeepLabCut: markerless pose estimation of user-defined body parts with deep learning

Alexander Mathis, Pranav Mamidanna, Kevin M. Cury, Taiga Abe, Venkatesh N. Murthy, Mackenzie Weygandt Mathis ✉ & Matthias Bethge

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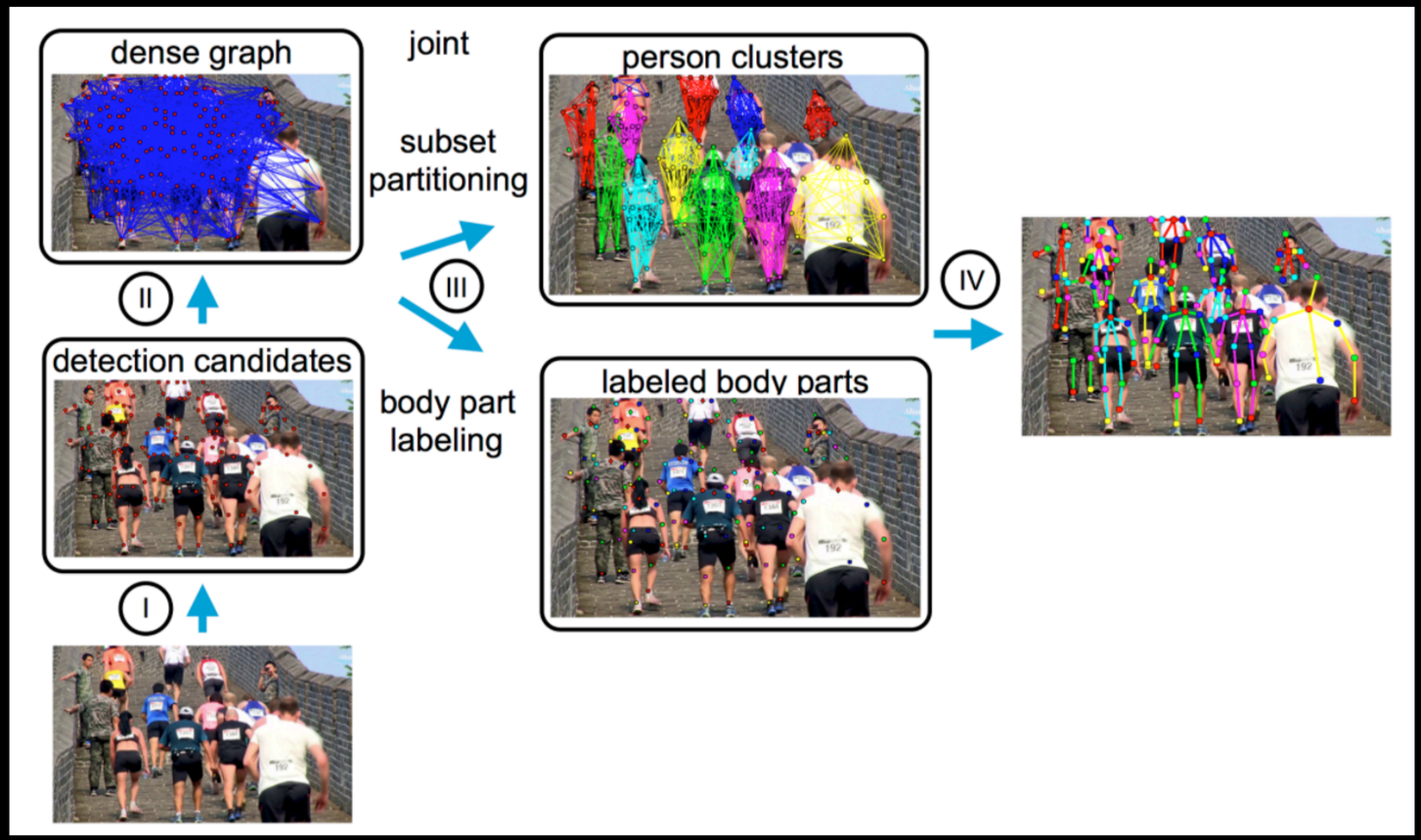
- Strategy - deep networks, transfer learning



DeeperCut
European Conference on Computer Vision (ECCV), 2016

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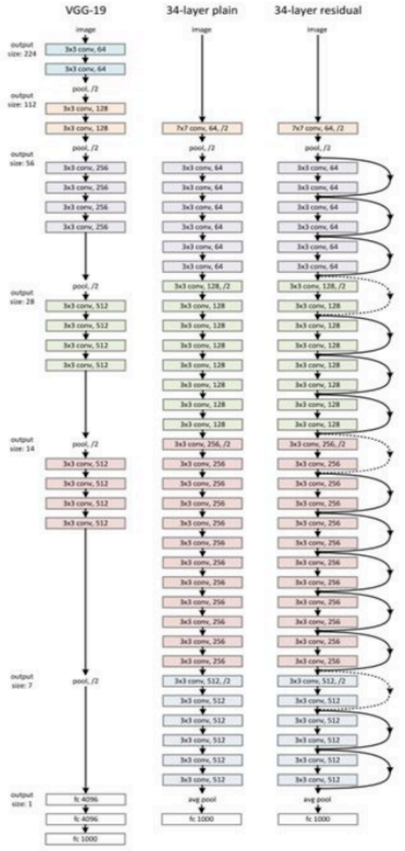
Design Deep Residual Network

- Keep it simple, just deep
- Design based on VGG style
  - All 3*3 conv (almost)
  - Batch normalization and ReLU
  - Downsampling: cov with stride of 2
  - Spatial size/2 => # filters *2
- No hidden layer, no dropout



Deep Residual Learning for Image Recognition
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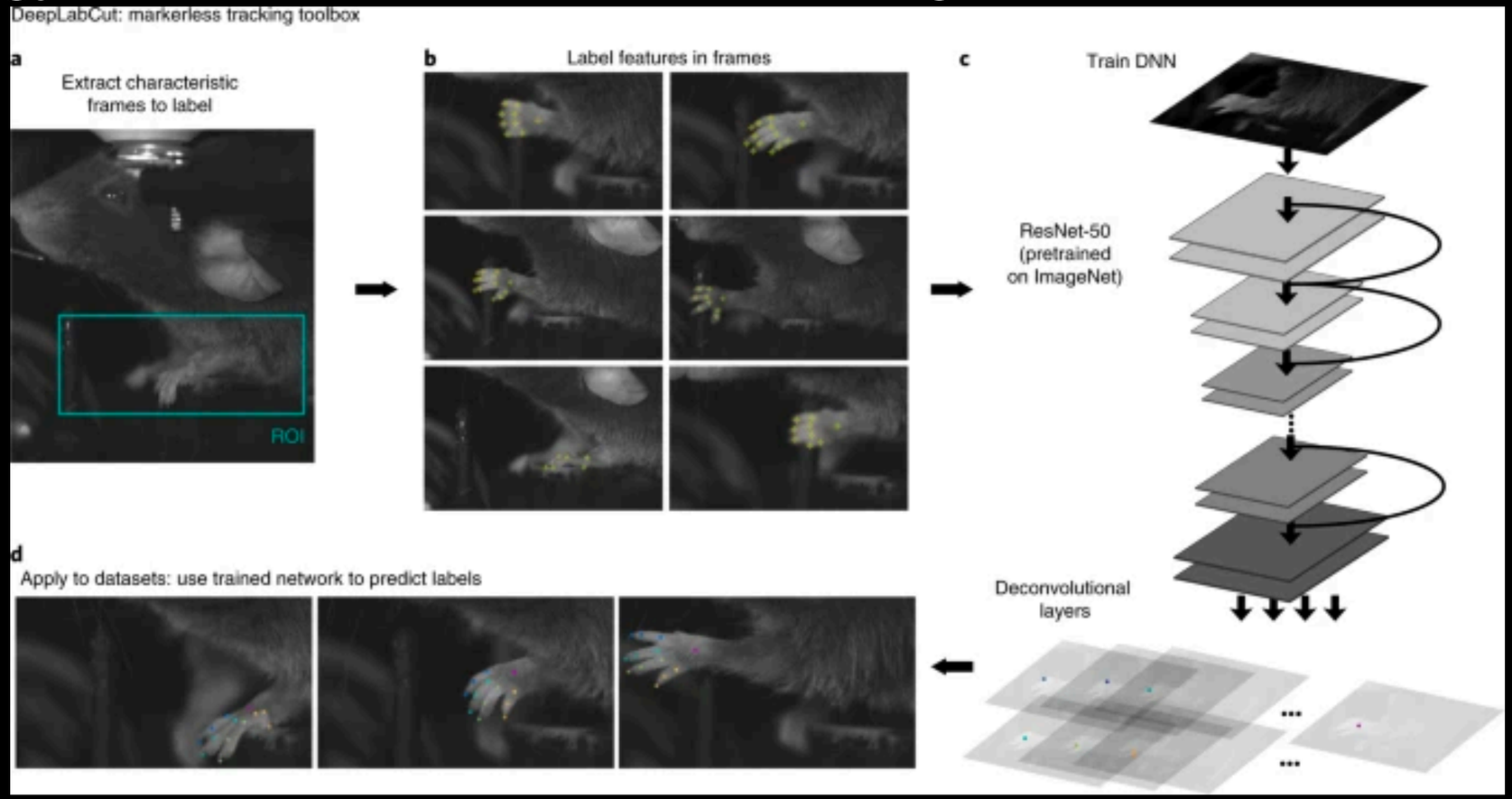

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achieves excellent performance[24]. Instead of the classification layer at the output of the ResNet, deconvolutional layers are used to up-sample the visual information and produce spatial probability densities. For each body part, its probability density represents the 'evidence' that a body part is in a particular location. To fine-tune the network for a particular task, its weights are trained on labeled data, which consist of frames and the accompanying annotated body part locations (or other objects of interest in the frame).

Deep Lab Cut

User architecture

Protocol | Published: 21 June 2019

Using DeepLabCut for 3D markerless pose estimation across species and behaviors

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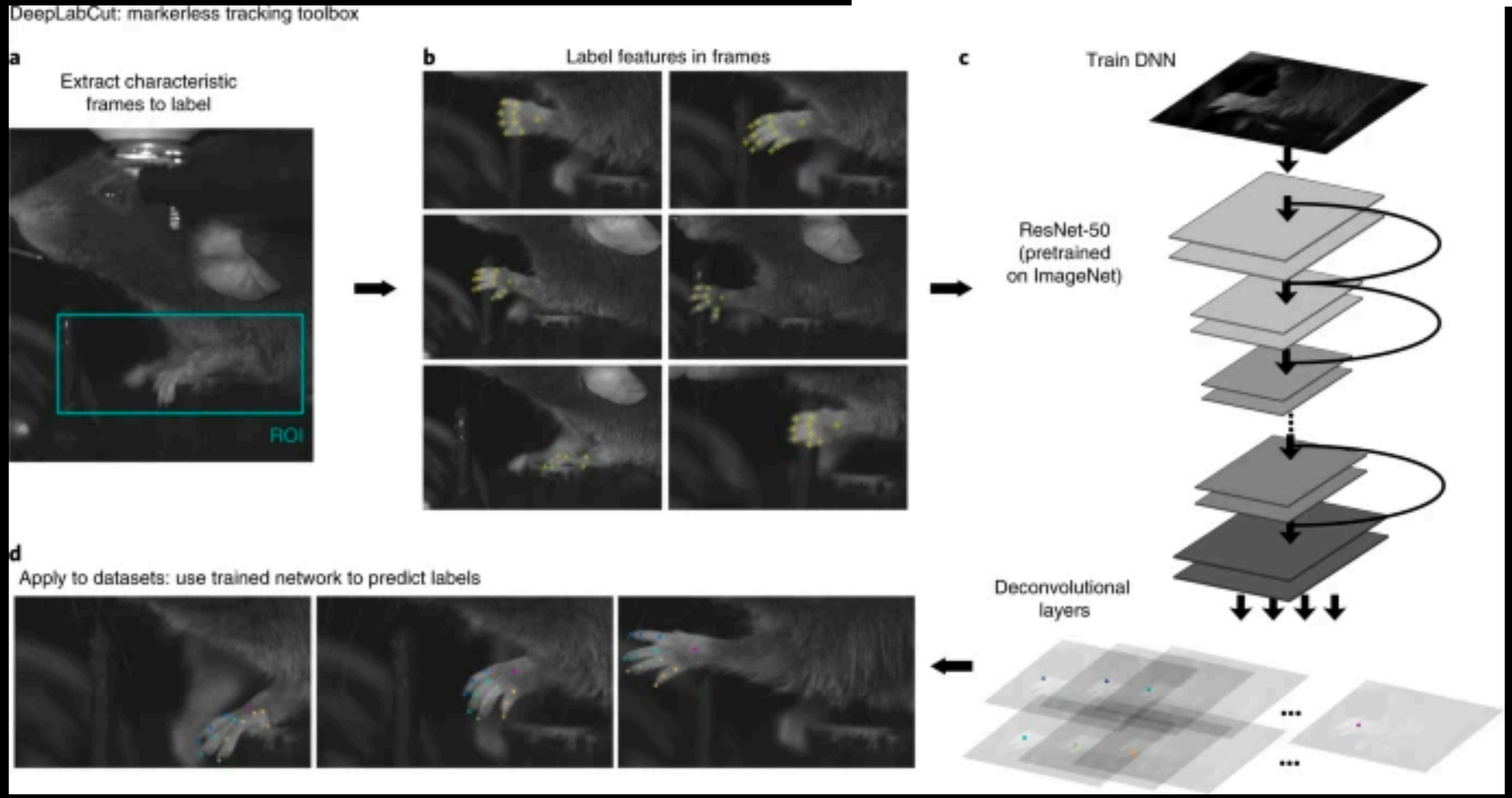

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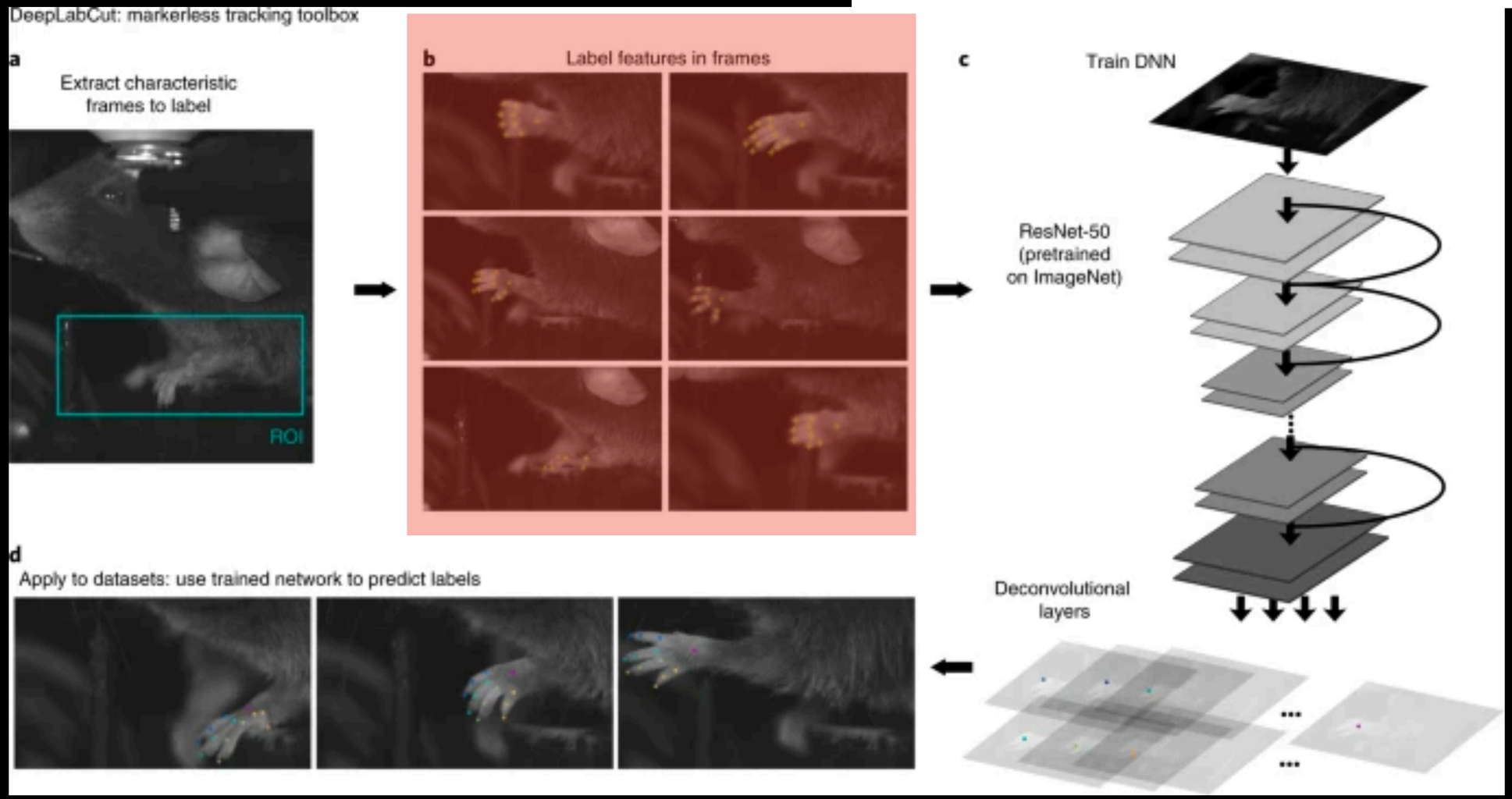
47k Accesses | **135** Citations | **106** Altmetric | Metrics



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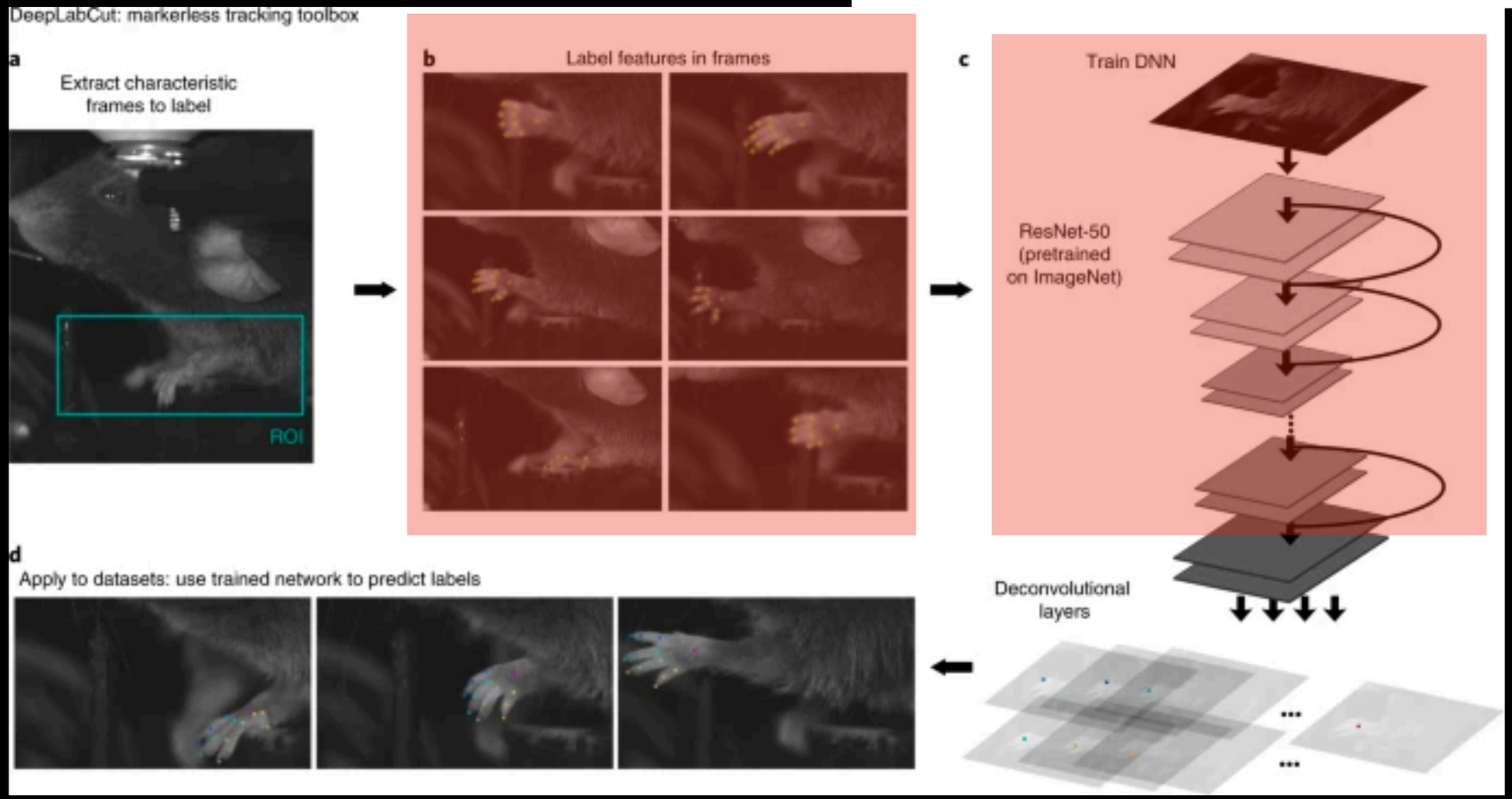

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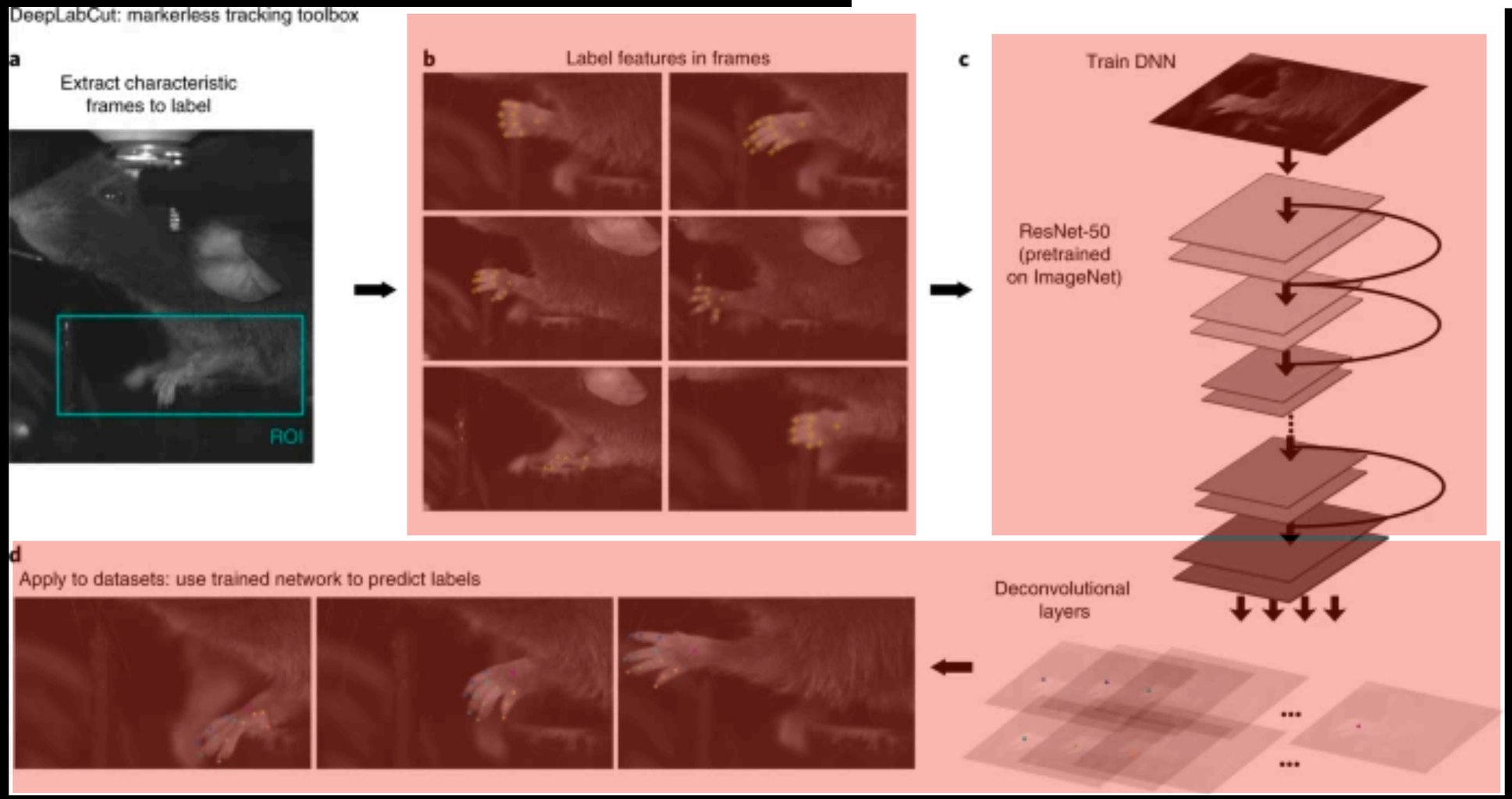

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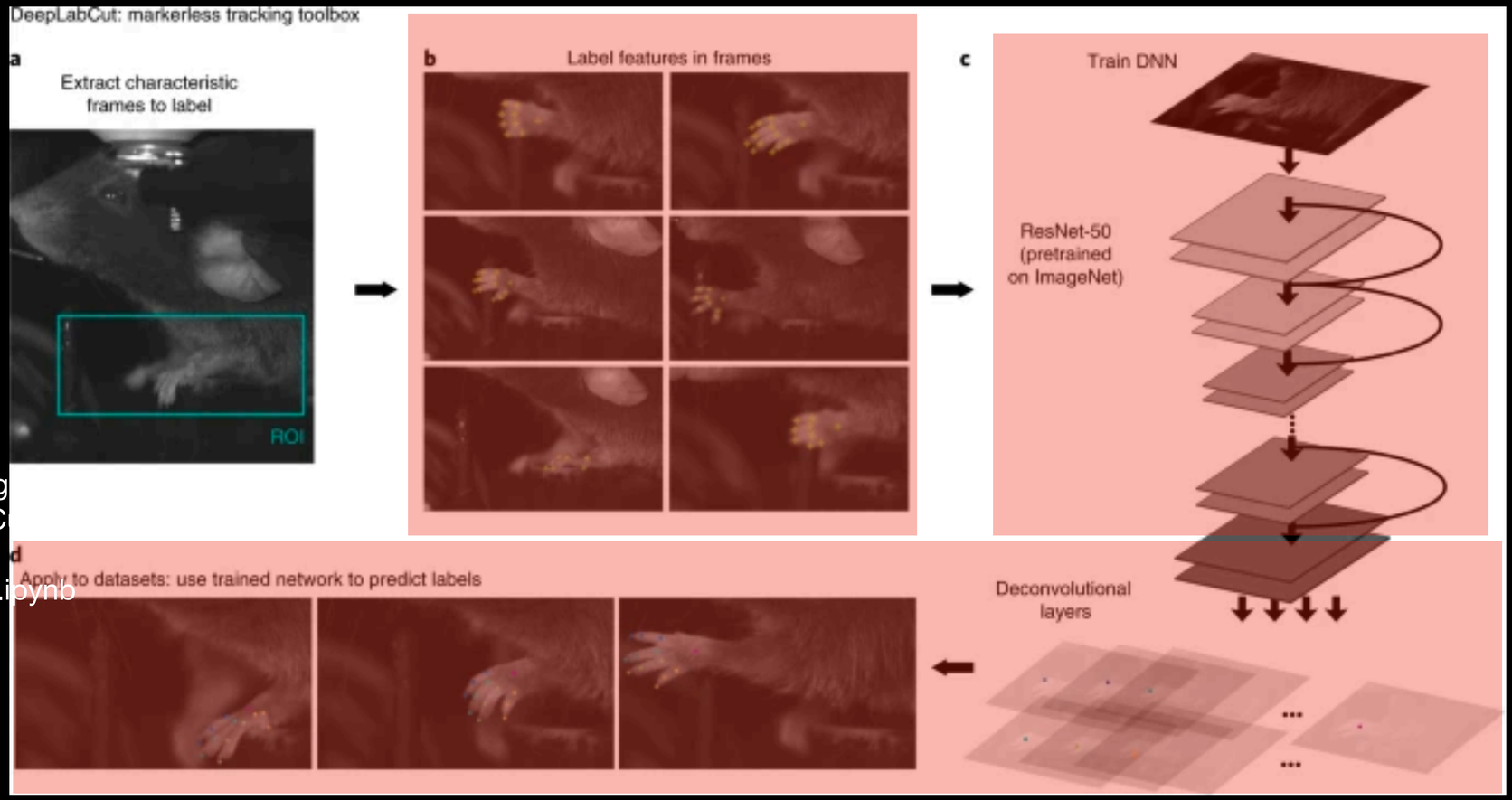

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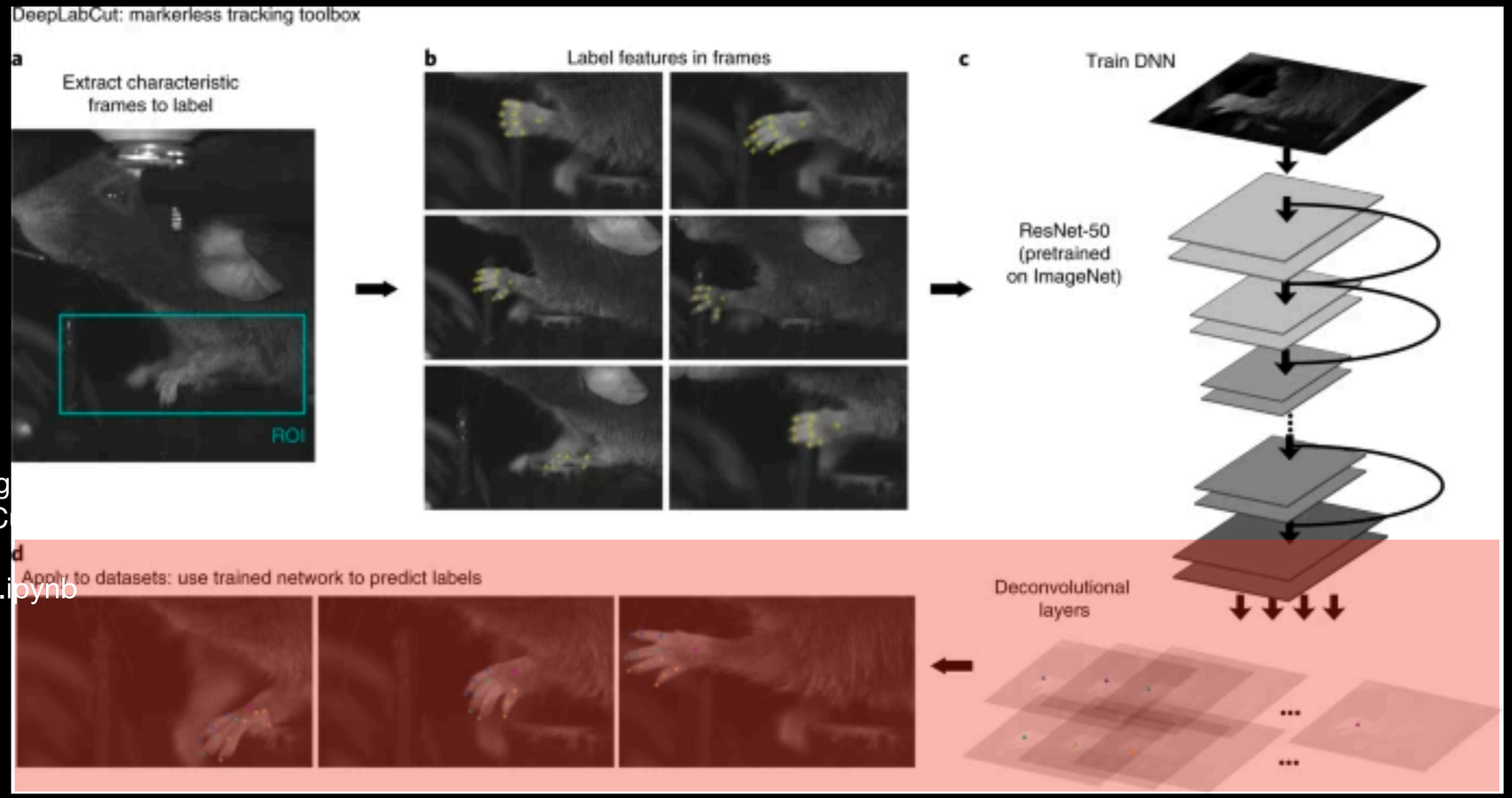

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