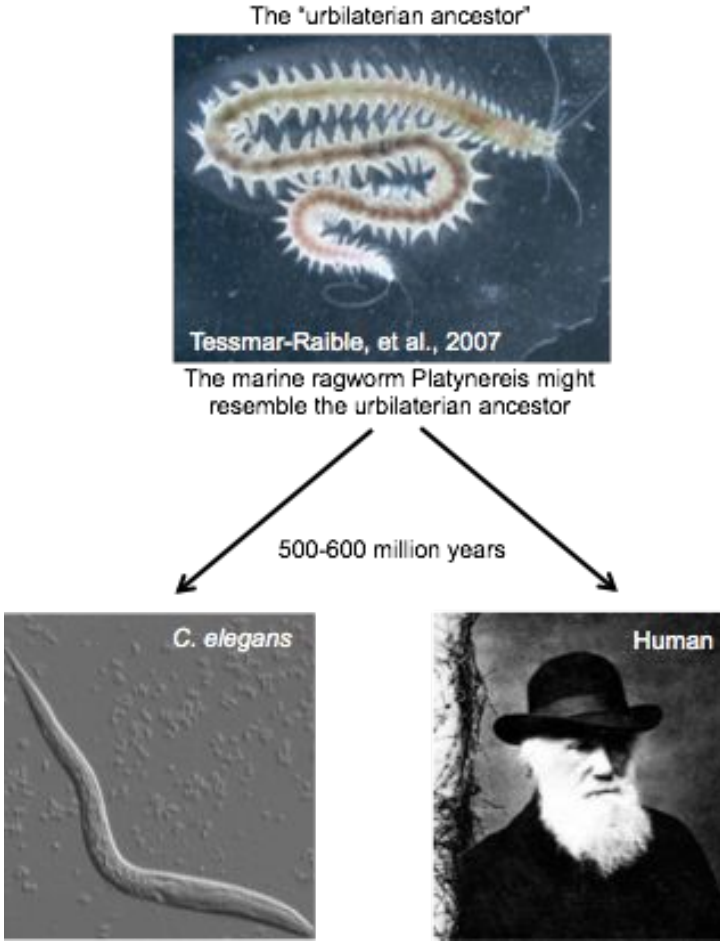
John Brugman

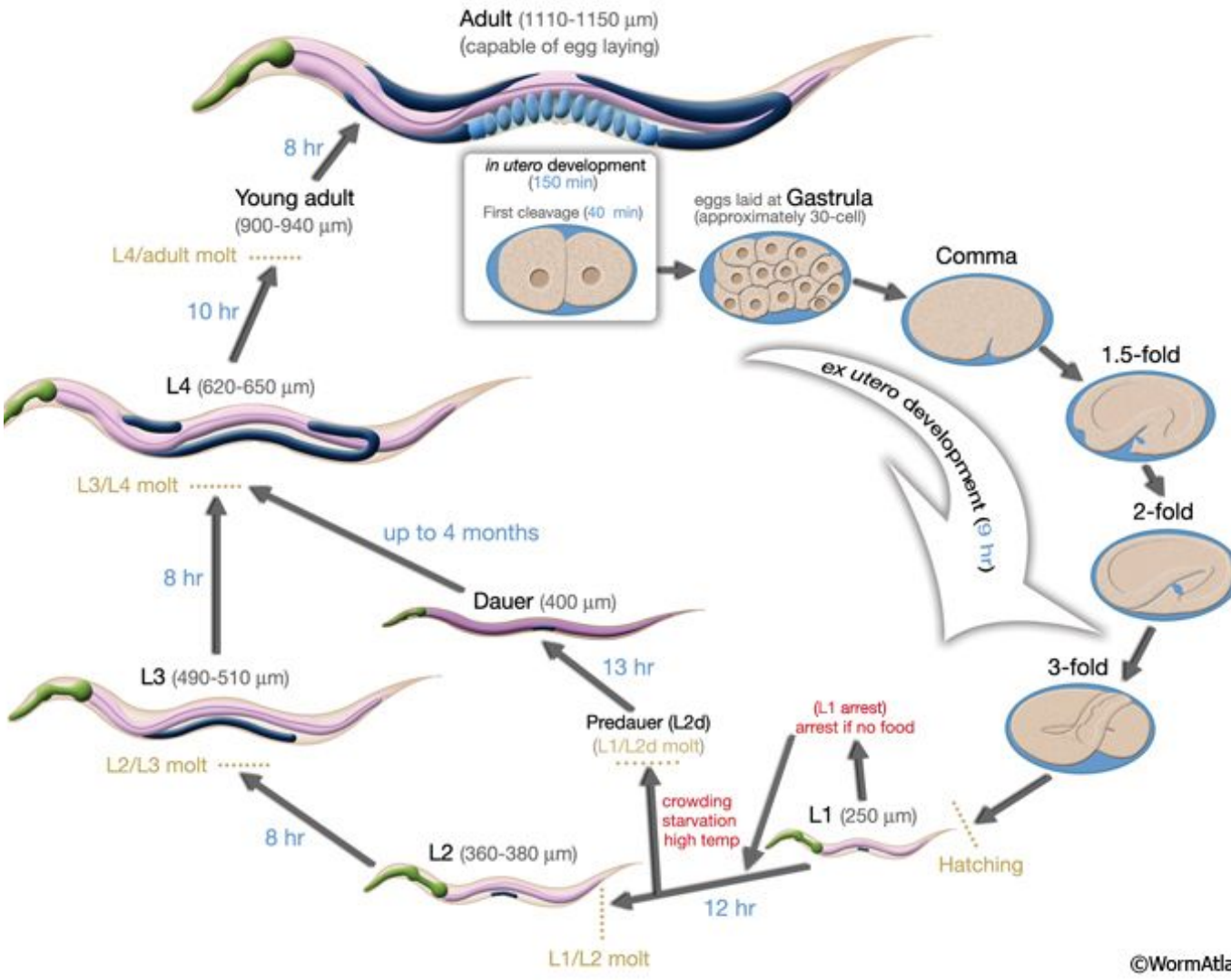
Significance

- Common Ancestor
- Neurons, gut, muscles, tissue
- Study how neurons react to diseases, and aging
- 302 Neurons
- Drug Testing



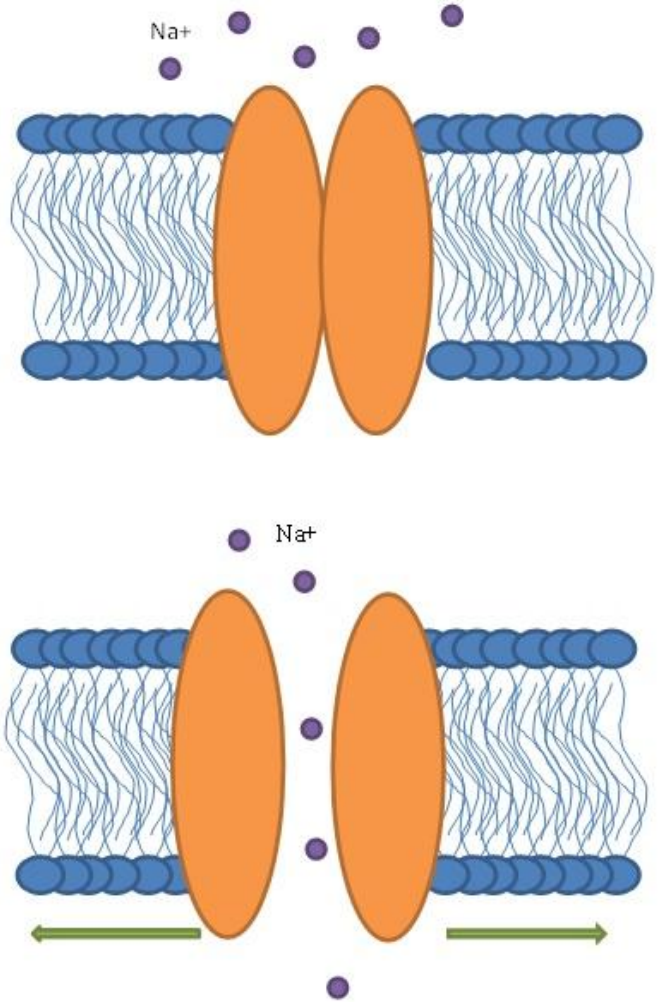
Life Cycle

- Eggs laid at 150 mins.
- Hatch at 900 mins.
- L2 Dauer Stage
- L3/L4 Reproductive Organs
- Adult Fertile 3-4 days
- Lives 10-14 more days



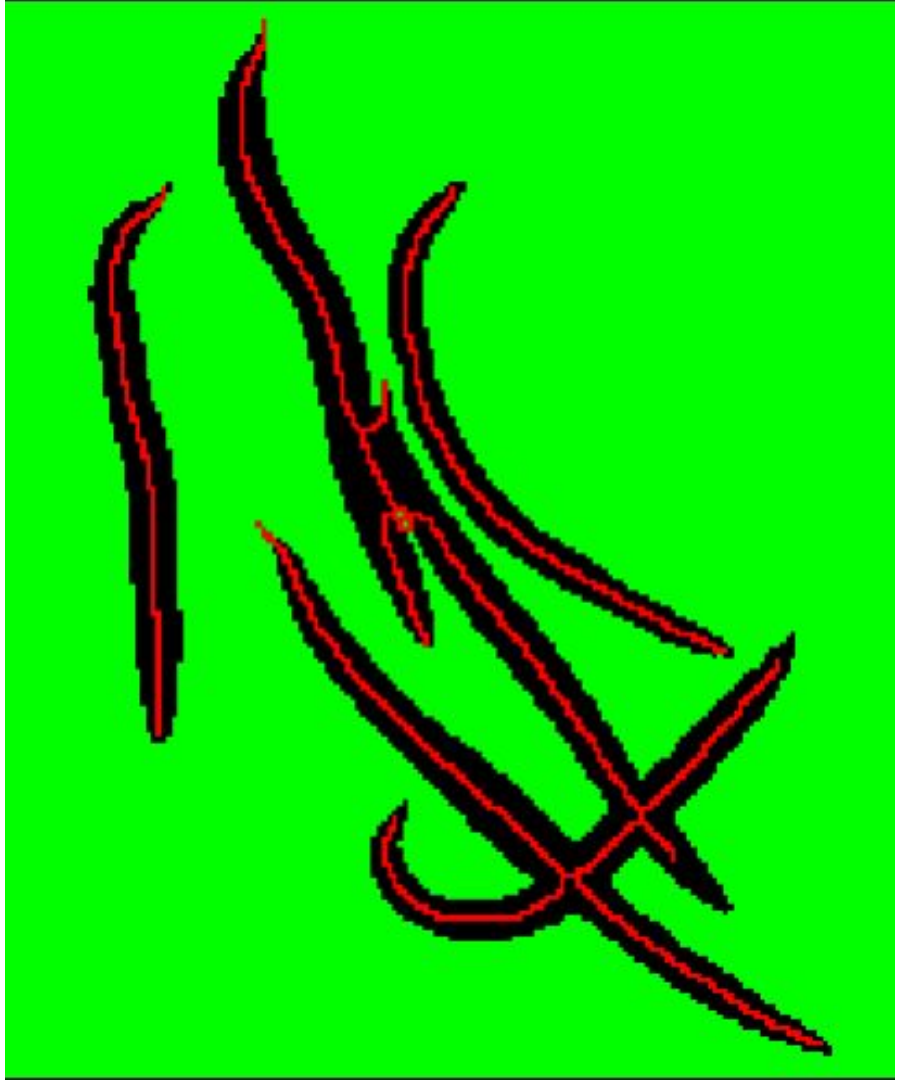
Mutations

- Mechanosensitive Ion Channels
- Action Potential
- Channels opening in response to mechanical stimuli
- PIEZO-1 (unknown)
- MEC-4 (sodium)
- TRP-4 (calcium)



Worm Data

- Max 8 worms per plate
- Agar
- E. Coli Food
- Average of 6-7 clumps
- Max 4 worms



Javier
Fernández

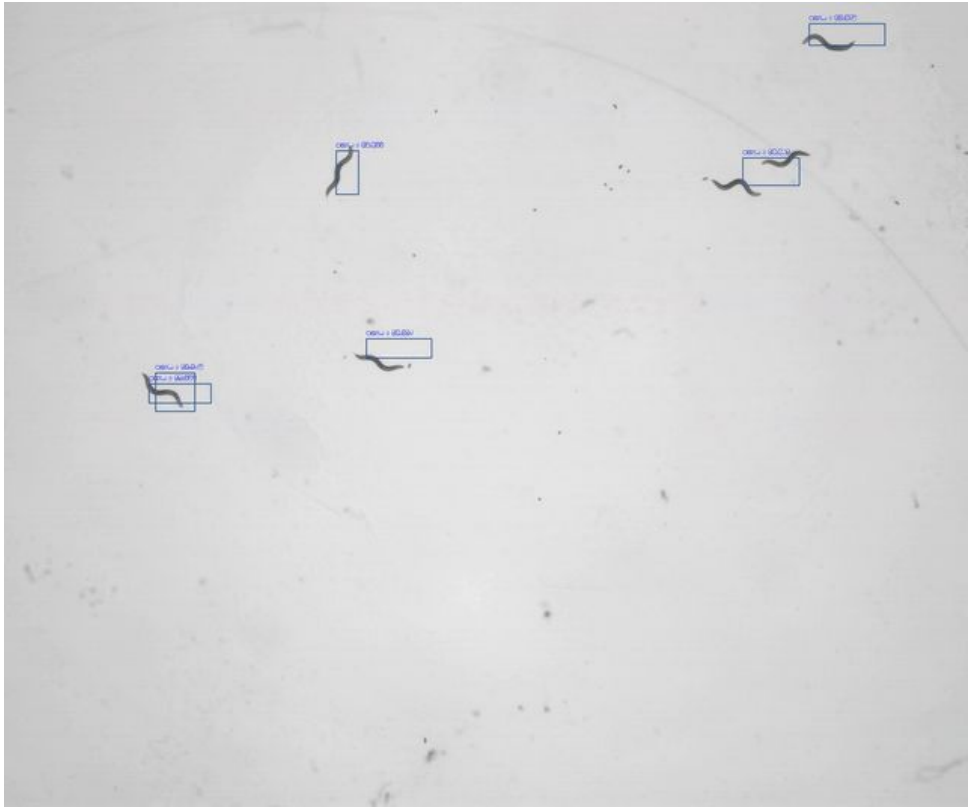
Deep Learning Tracking

- Tracking is a big issue in Computer Vision
- Tracking movement of people, or even worms

Basics of Tracking

- Assigning ID’s to the centroids of boxes
- Kalman Filter

My Models:



- YOLOv3
- Faster R-CNN
- Standard Computer Vision OpenCV

roboflow

Centroid Tracking

(765, 1634)	(849, 1644)	(1682, 1645)	(2259, 1461)	(378, 974)	(701, 966)	(735, 855)
(769, 1633)	(848, 1645)	(1683, 1650)	(2256, 1465)	(374, 972)	(698, 959)	(734, 853)

(811, 1640)	(1683, 1655)	(2253, 1469)	(370, 969)	(696, 953)	(733, 851)	
(813, 1639)	(1683, 1660)	(2250, 1473)	(367, 966)	(694, 949)	(732, 850)	
(814, 1639)	(1683, 1665)	(2247, 1476)	(364, 963)	(693, 945)	(731, 848)	

(1683, 1670)	(821, 1637)	(2244, 1479)	(361, 960)	(692, 942)	(730, 847)	
(1684, 1675)	(822, 1637)	(2241, 1482)	(359, 957)	(691, 939)	(730, 846)	
(1684, 1680)	(817, 1637)	(2238, 1485)	(357, 955)	(690, 936)	(729, 846)	

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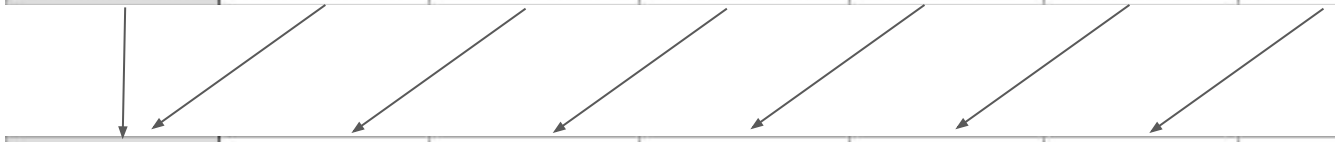

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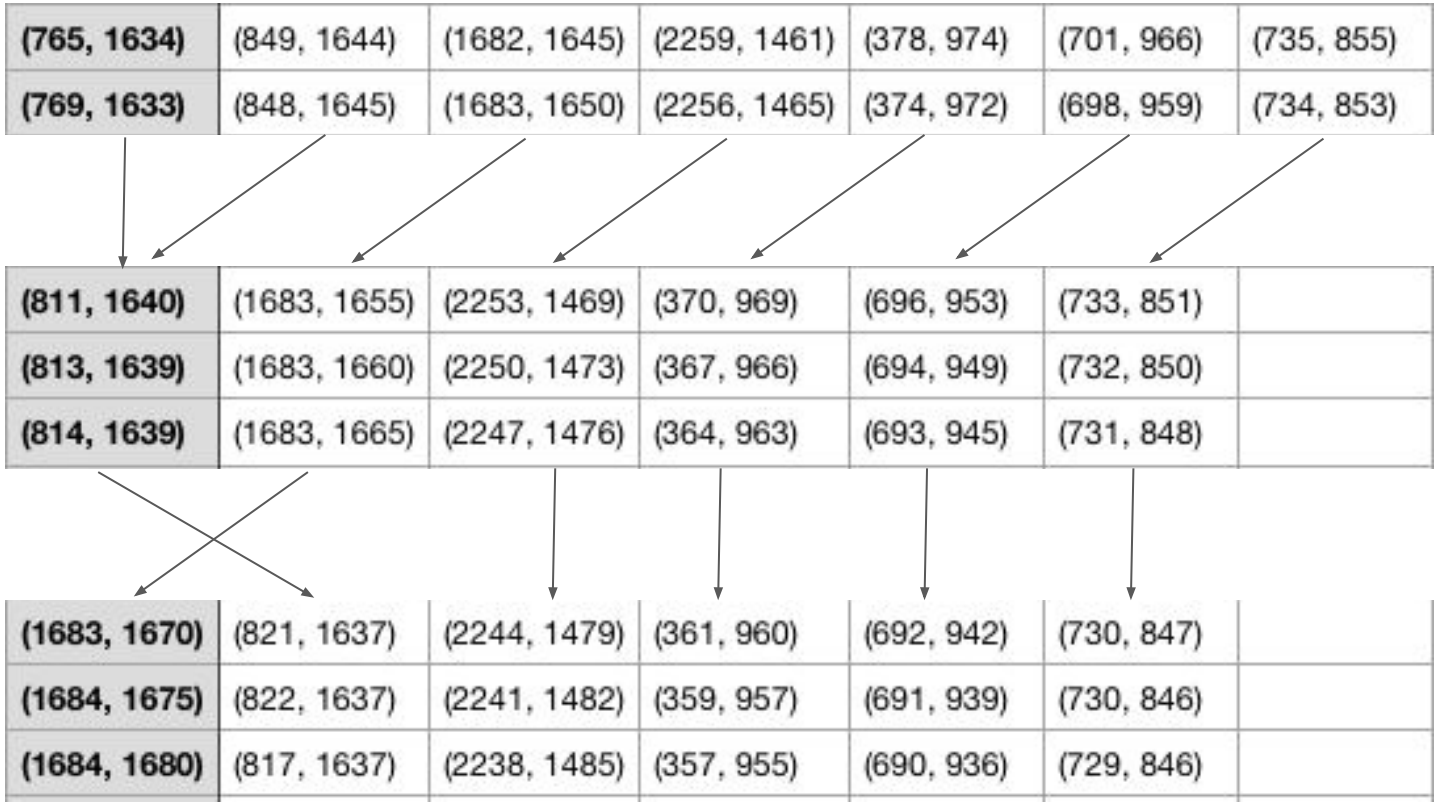
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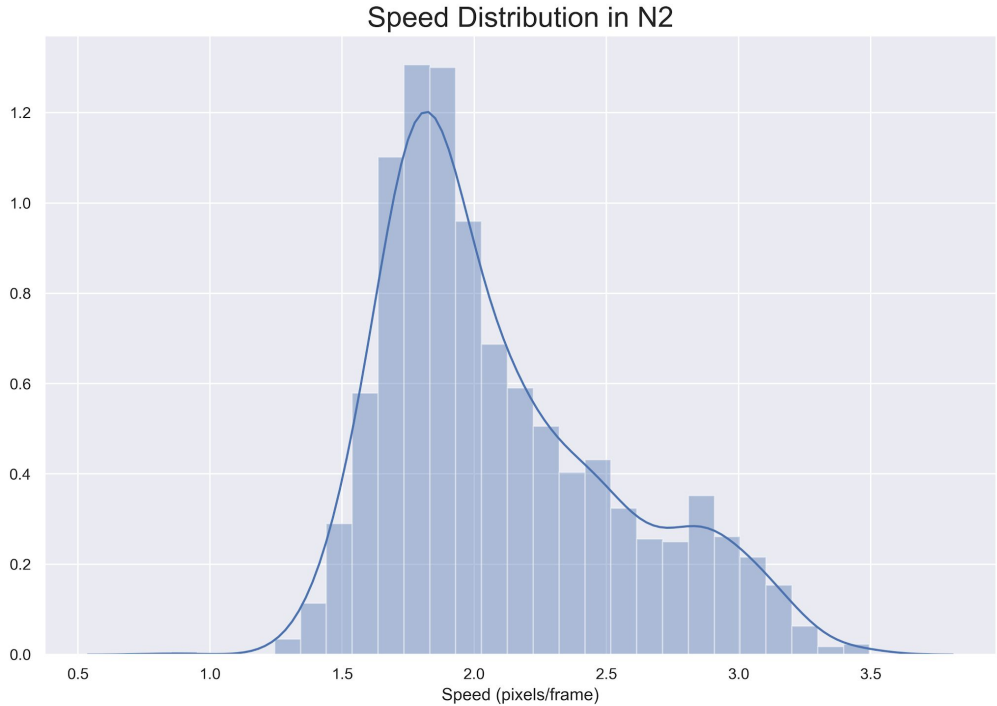
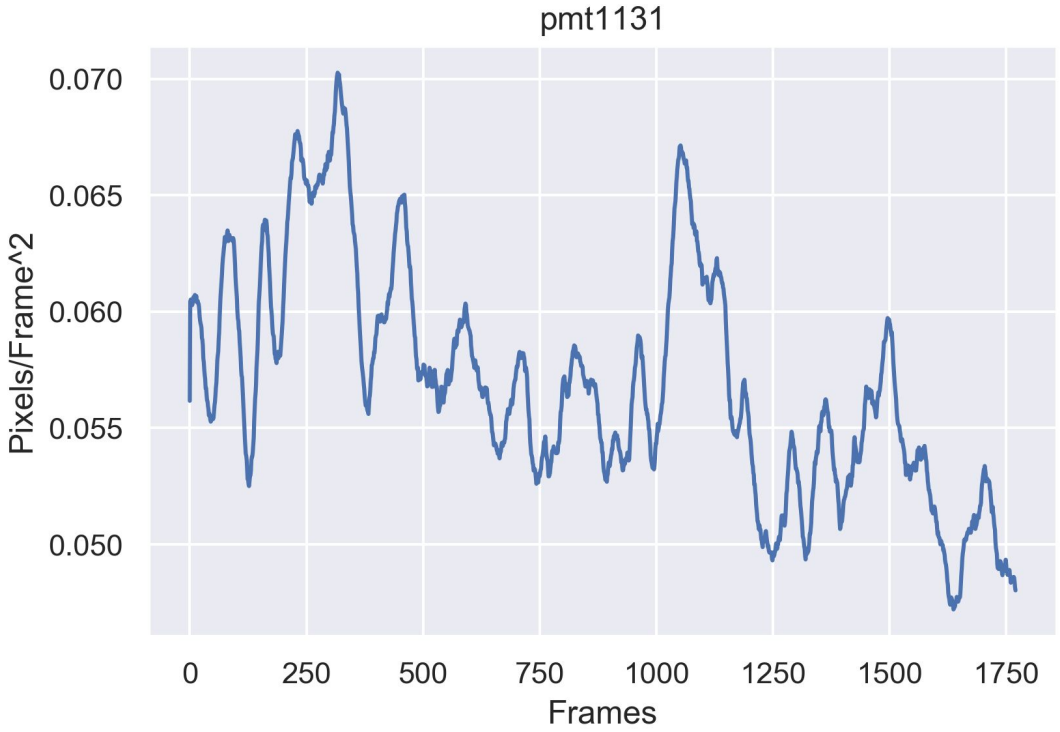
Analyzing Speed

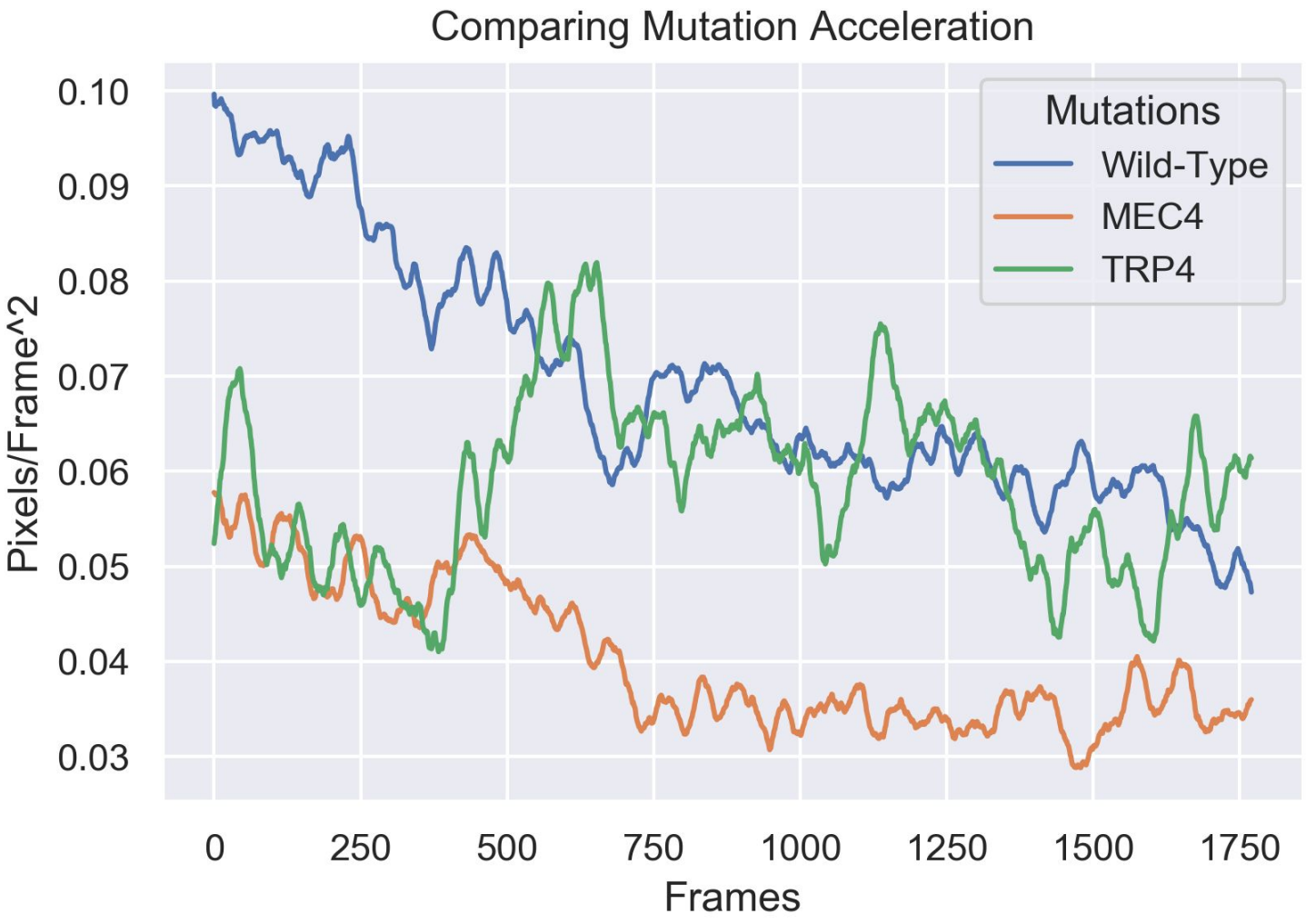
- Rolling Average over 15 frame (2 seconds)
- Average of acceleration in pixels/frame^2
- Big Difference between the accelerations
- MEC Mutation is half as active as Wild-Type
- Over ½ worm-lengths/second!



Results

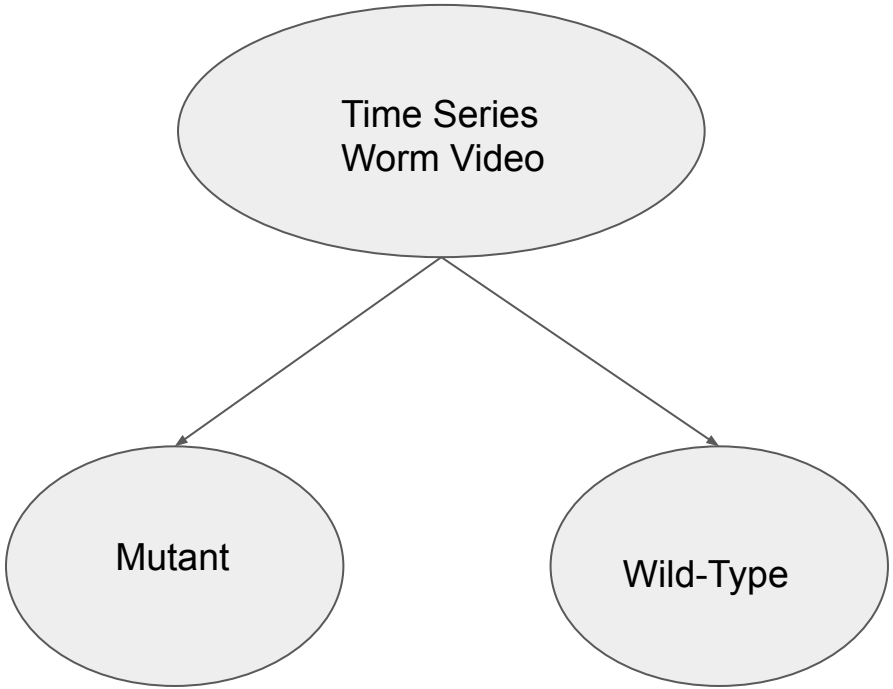
- All accelerations decreased over the course of the video
- Significance in the difference of all mutations vs. wild-type
- PIEZO-MEC4 and TRP4 were the most significant
- P-value is low with both ANOVA and T-Test




Comparing Mutation Acceleration
Mutations
Wild-Type
MEC4
TRP4
Pixels/Frame^2
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0
250
500
750
1000
1250
1500
1750
Frames

Predictive Modeling

- Tried to predict which mutation given the velocities over 15 frame average
- Predicted If a worm is mutated or not based off the rolling average
- Random Forest, SVM
- Not enough data for Random Forest.
- Some mutations were close Data Wise



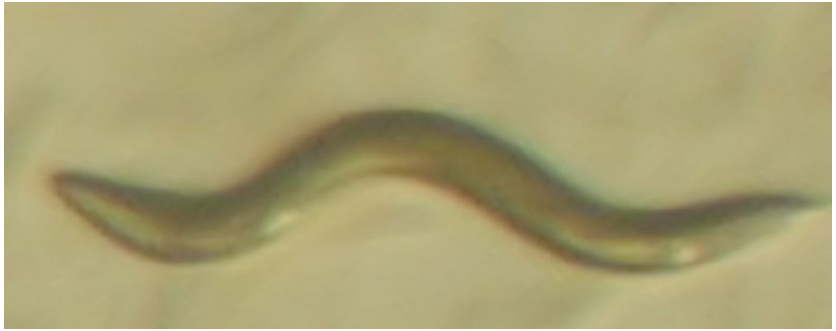
Results

Identifying Mutations:

- 54% Accuracy Score
- Only predicting N2 and PSCMEC

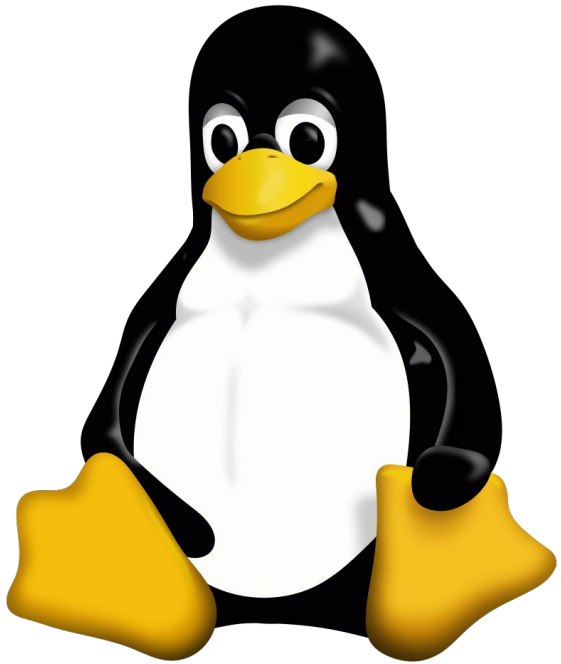
Identifying Mutants:

- 75% Accuracy Score
- Only Predicting Mutated Worms
- Bootstrapped Training Data
- More even and predicting mutant worms correctly



Challenges

- GPU Processing on Linux
- Working with video data
- Dealing with ‘merging’ worms
- Reordering Centers
- Sample Size for Worm Predictions
- Time Series Classification



Whats Next?

- Getting my GPU to work
- Better CSV Sorting Algorithm
- Working with Joseph Nelson and Roboflow
- Taking into account direction as well as distance
- Sharing my Results with Dr. Sternberg
- Analyzing Mating Videos

Caltech