

# KIWI RECON





# About Kiwi-Recon

- Estimating the size of kiwi fruits on collection bins is crucial to compare production between orchards or sections.
- This approach addresses a crucial gap in the current fruit measurement methods.
- Industrial measurements involve machines that, while efficient, cannot be practically employed in orchards. Manual measurements on fields are time-consuming and resource-intensive.



# OBJECTIVE



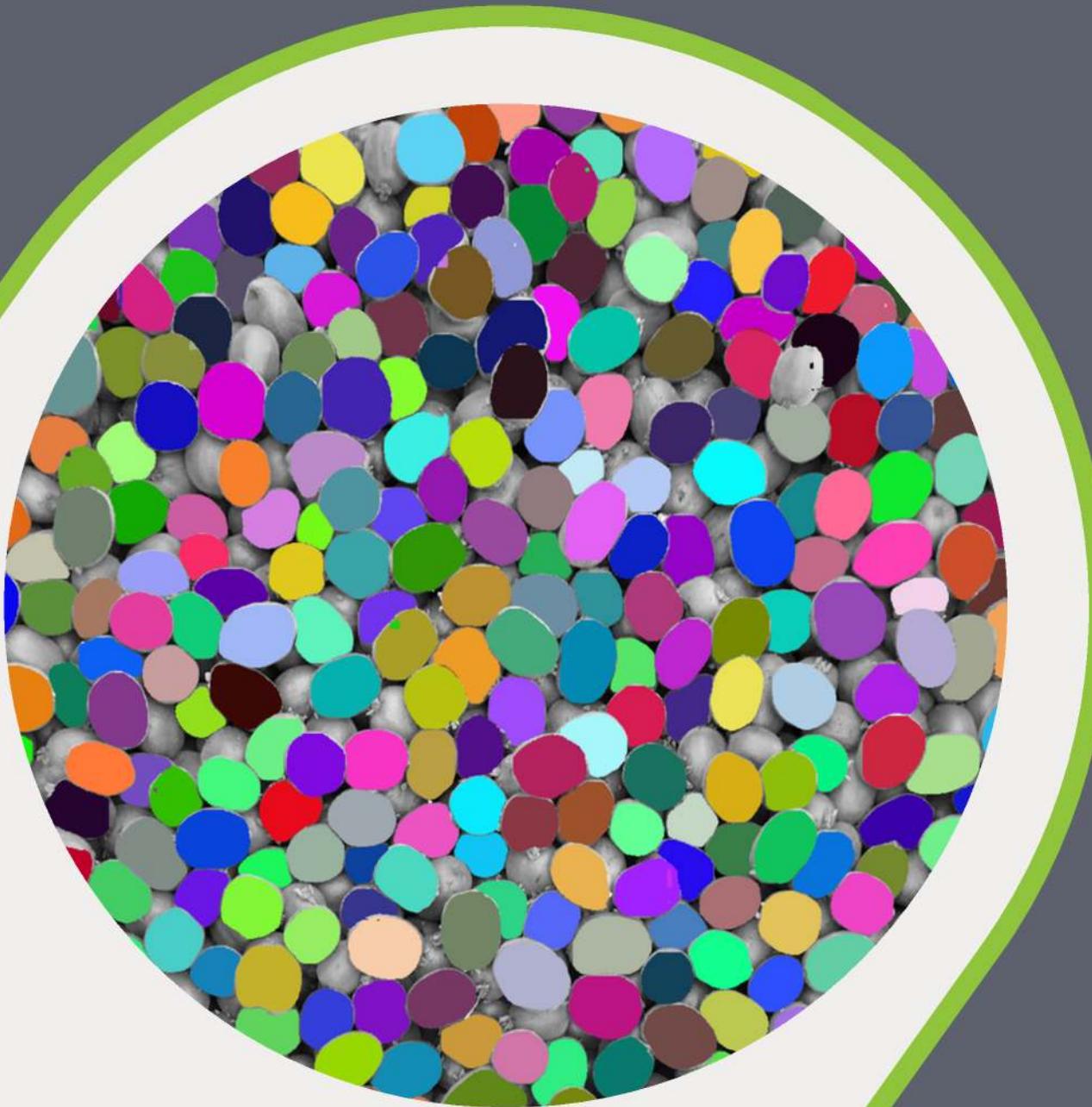
Assess the quality distribution of kiwi fruits within orchards, using 2D images



Use as little Machine Learning as possible



Assume kiwi mass can be estimated from its geometric dimensions



# KIWI FRUIT

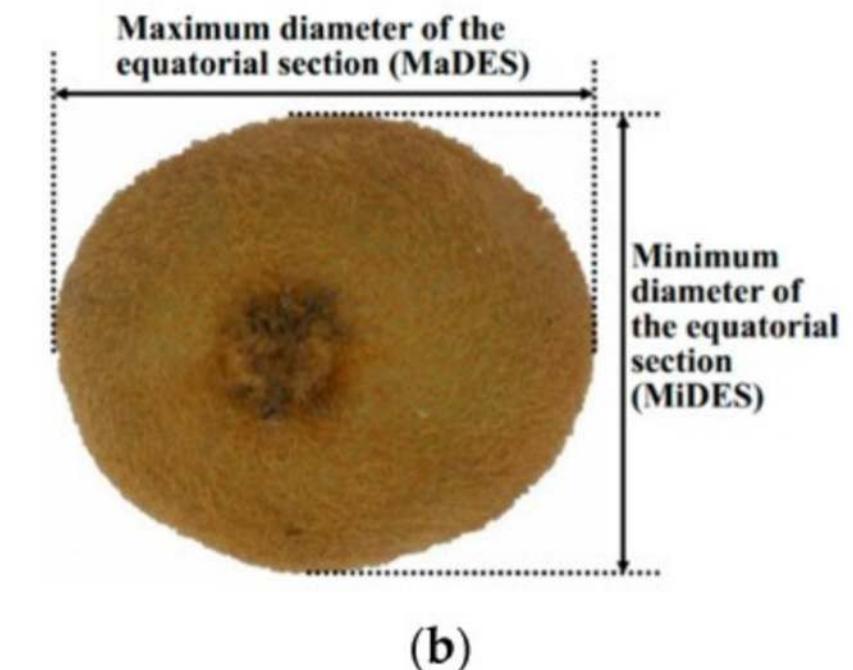
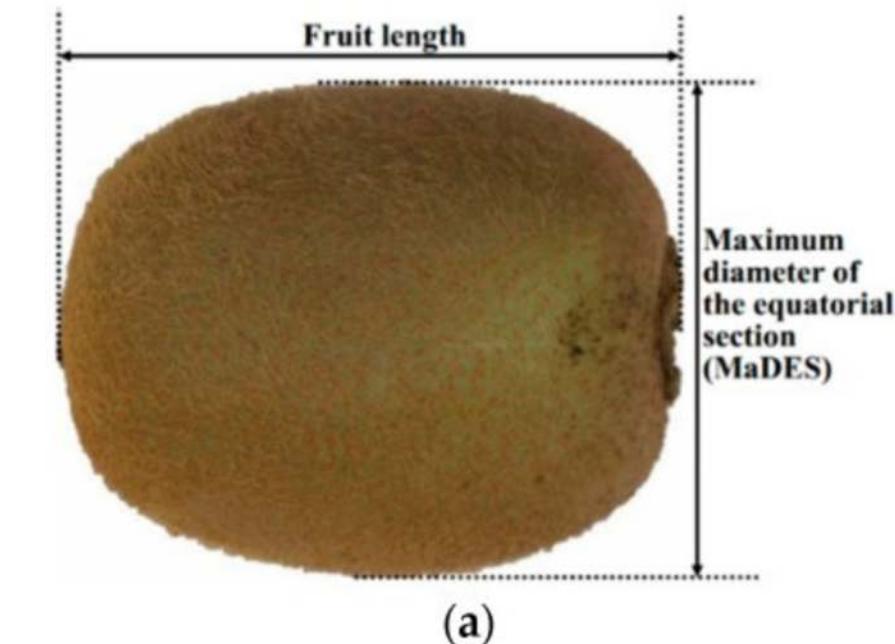
Some physical properties and classification system of ‘Hayward’

Typically exhibits an oval or elliptical shape, characterized by two different equatorial sections

Sizes approx 5-8cm in length, 4.5-5.5cm at the equator

Bulk density  $k = [544.73; 572.14]$  kg/m<sup>3</sup>

I Cat.	II Cat.	Industry
No defects	Small defects	Big defects
Weight > 60g	eq.ratio > 0.8	Abnormal shapes
eq. ratio > 0.9		

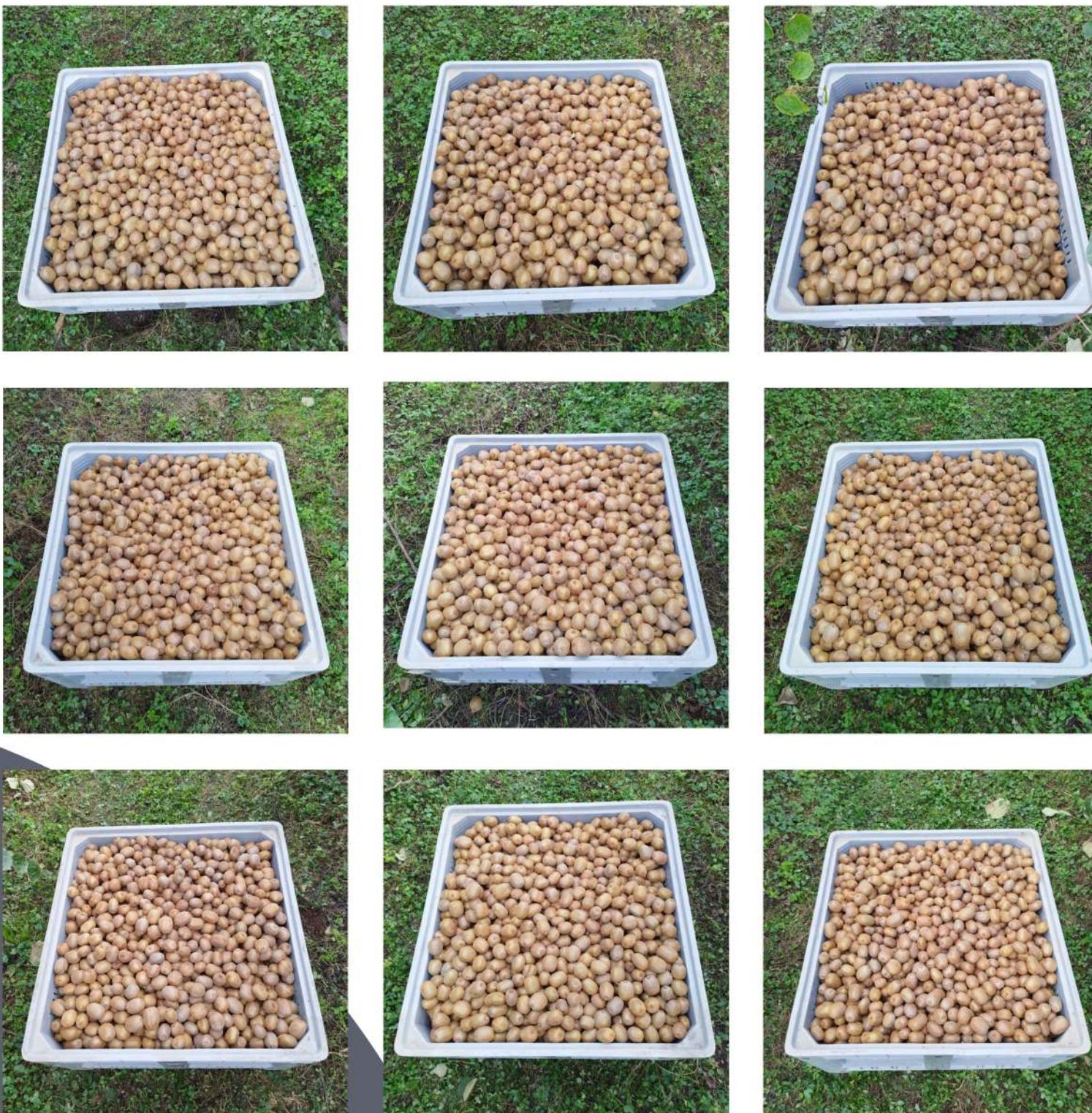




# FRUIT IMAGE DATASET

- Two different fruits
- Images 100x100 px
- Images rotated by 360 degrees on x,y axis
- 600 images

# ORCHARD-CAPTURED IMAGES



- Top-down perspective to minimize side view
- 43 pictures
- Side of the bin used as a scale
- Manually taken images on the orchard

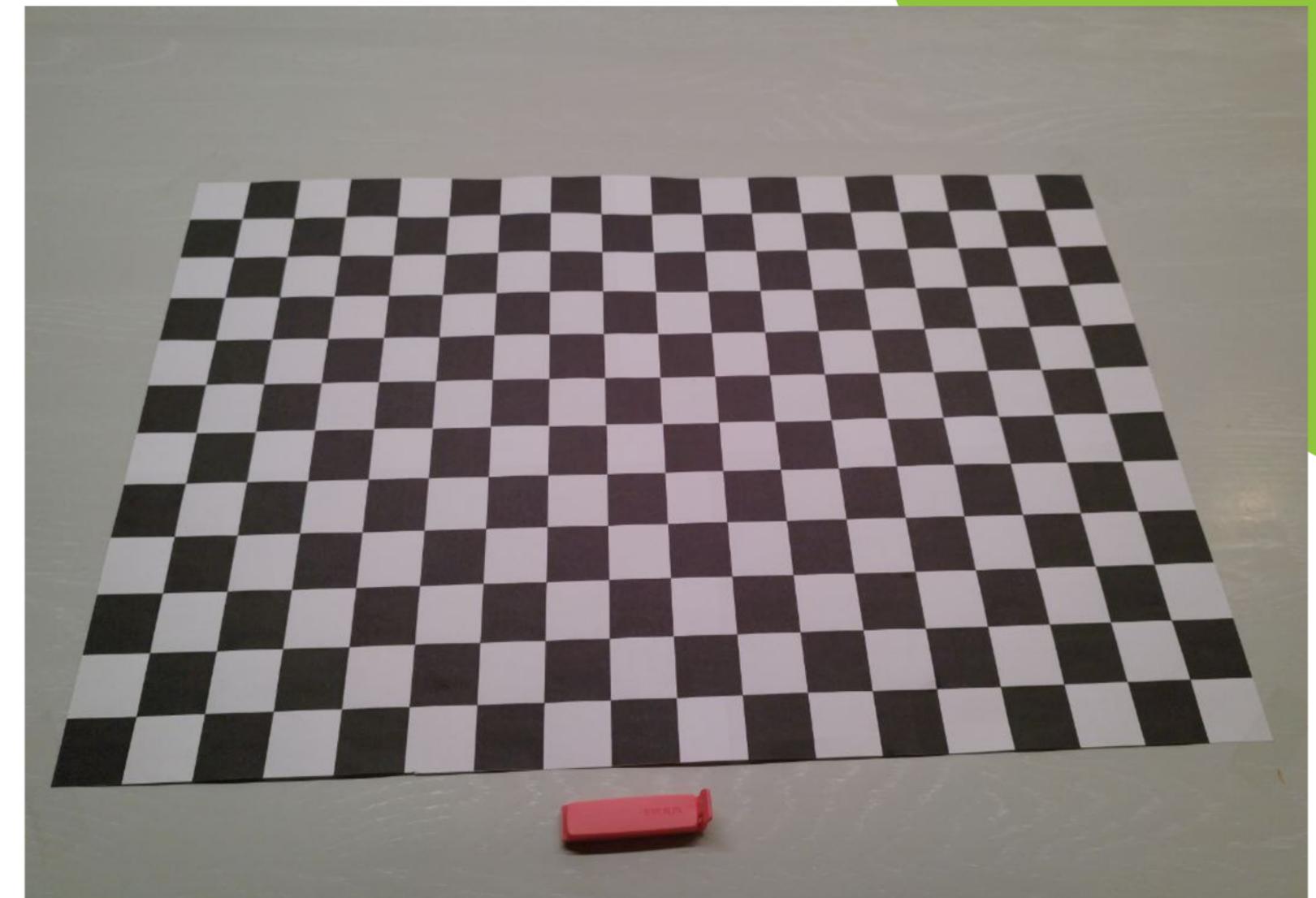
# REFERENCE DATA

I Cat.		II Cat.		Industry	
Grade	Percentage	Grade	Percentage	Grade	Percentage
150+	3.35%	120+	1.99%	Industry	6.74%
125/150	13.78%	100/120	1.44%		
115/125	10.39%	80/100	1.17%		
105/115	11.99%	70/80	0.34%		
95/105	13.27%				
85/95	12.96%				
75/85	11.64%				
70/75	4.72%				
65/70	3.17%				
60/65	3.05%				

Dataset comprises measurements and weights recorded by the co-operative during the fruit assessment process. Notably, the dataset's errors and approximations remain unknown.

# Metodology

- 1 Camera Calibration
- 2 Bin Detection and Perspective Transform
- 3 Instance Segmentation
- 4 Instances Selection
- 5 Stem Detection
- 6 Estimated Distribution



Calibration grid example

# Metodology

1 Camera Calibration

2 Bin Detection and Perspective Transform

3 Instance Segmentation

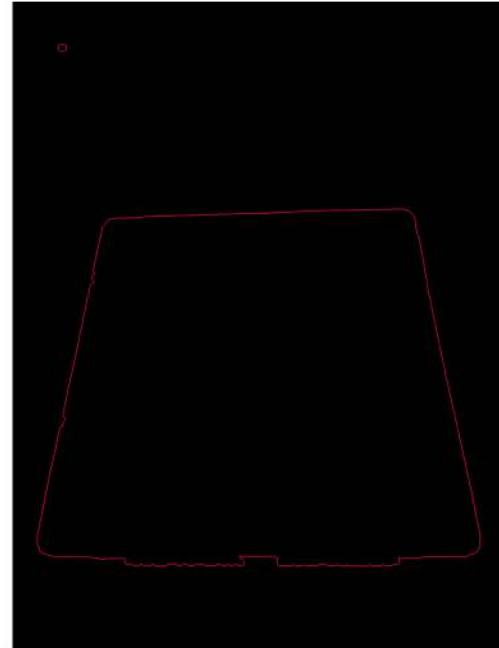
4 Instances Selection

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Sample collection bin of kiwi



Edge detection after filtering



Bin detection



Crop and Perspective Transform

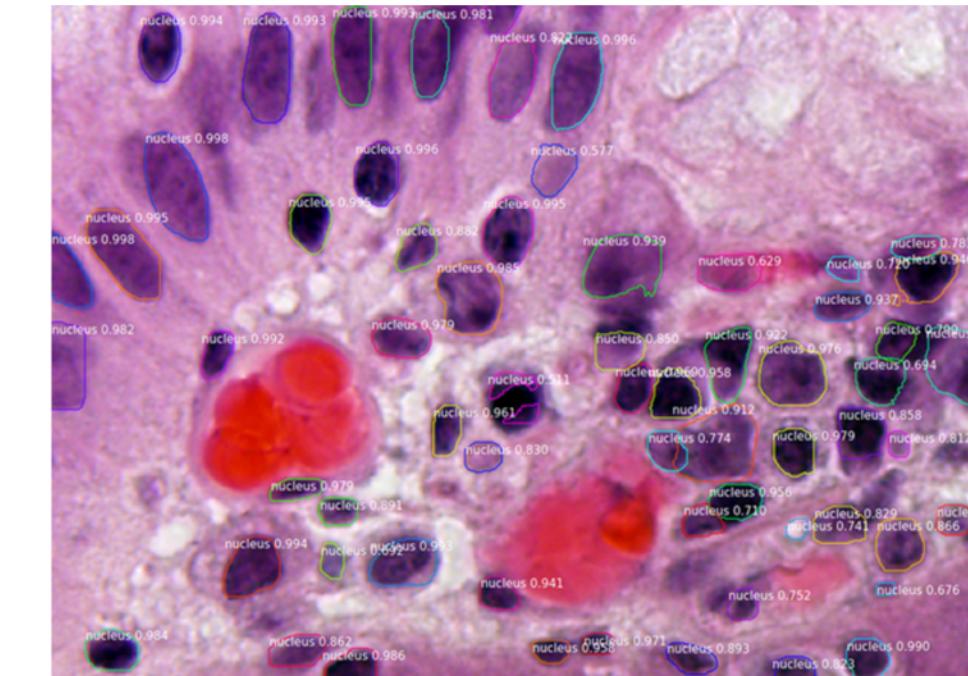
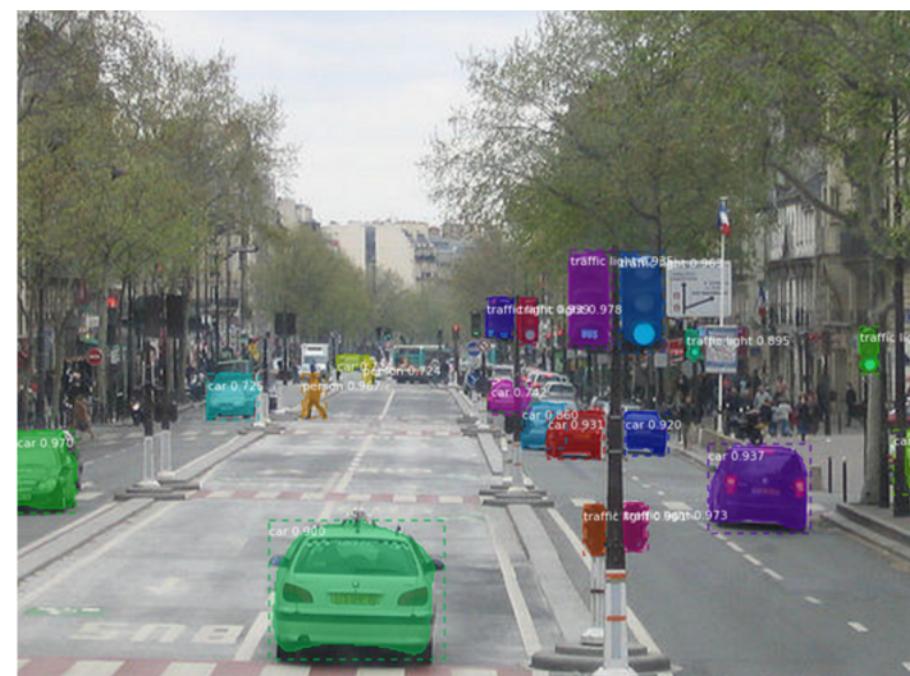
# Digression: Mask-RCNN

Typical Mask-RCNN usage

State of the art instance segmentation framework

Fast and reliable

Fine tuned on Fruit-Image-Dataset



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Sample Mask-RCNN output



Sample Mask-RCNN output  
confetti for better visualization



Score

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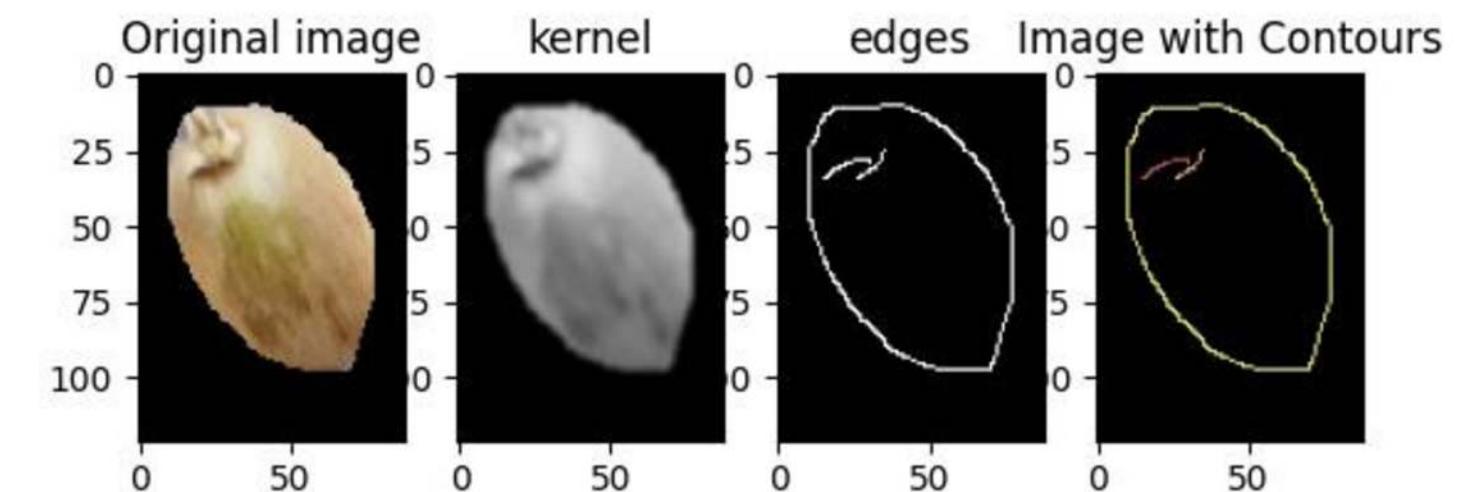
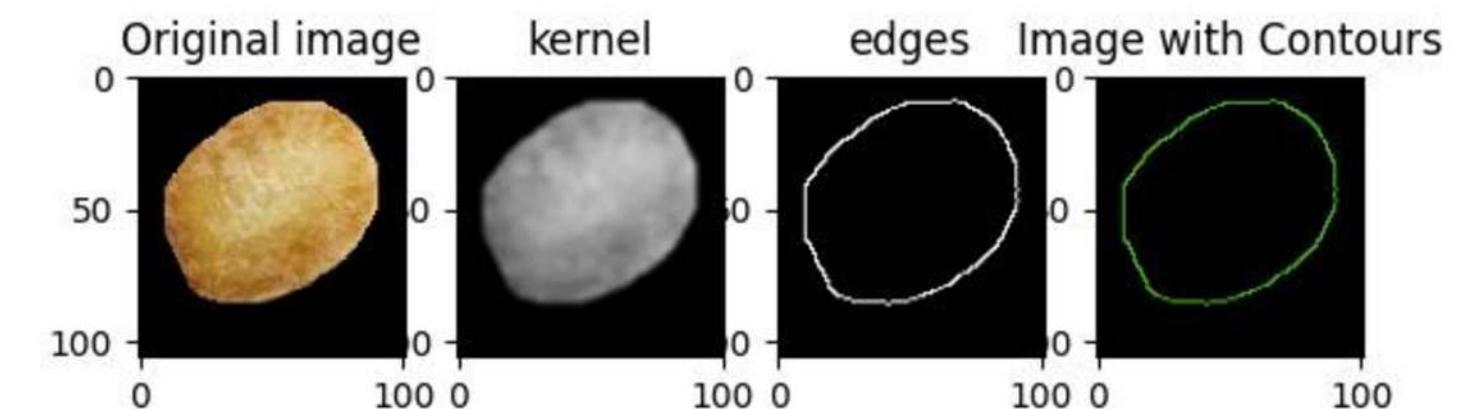
Area

Polygons overlap

Occlusion

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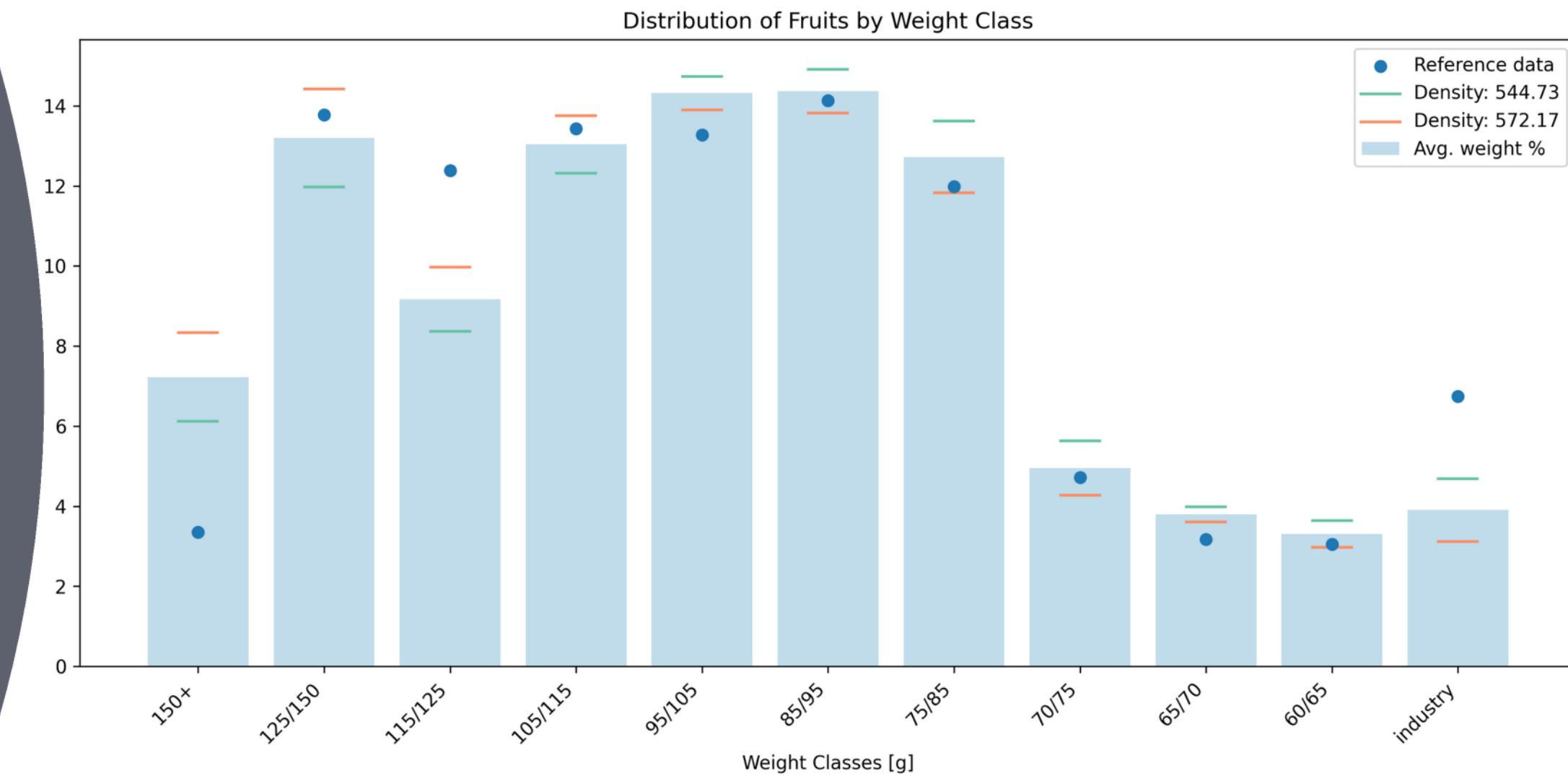
Stem detection



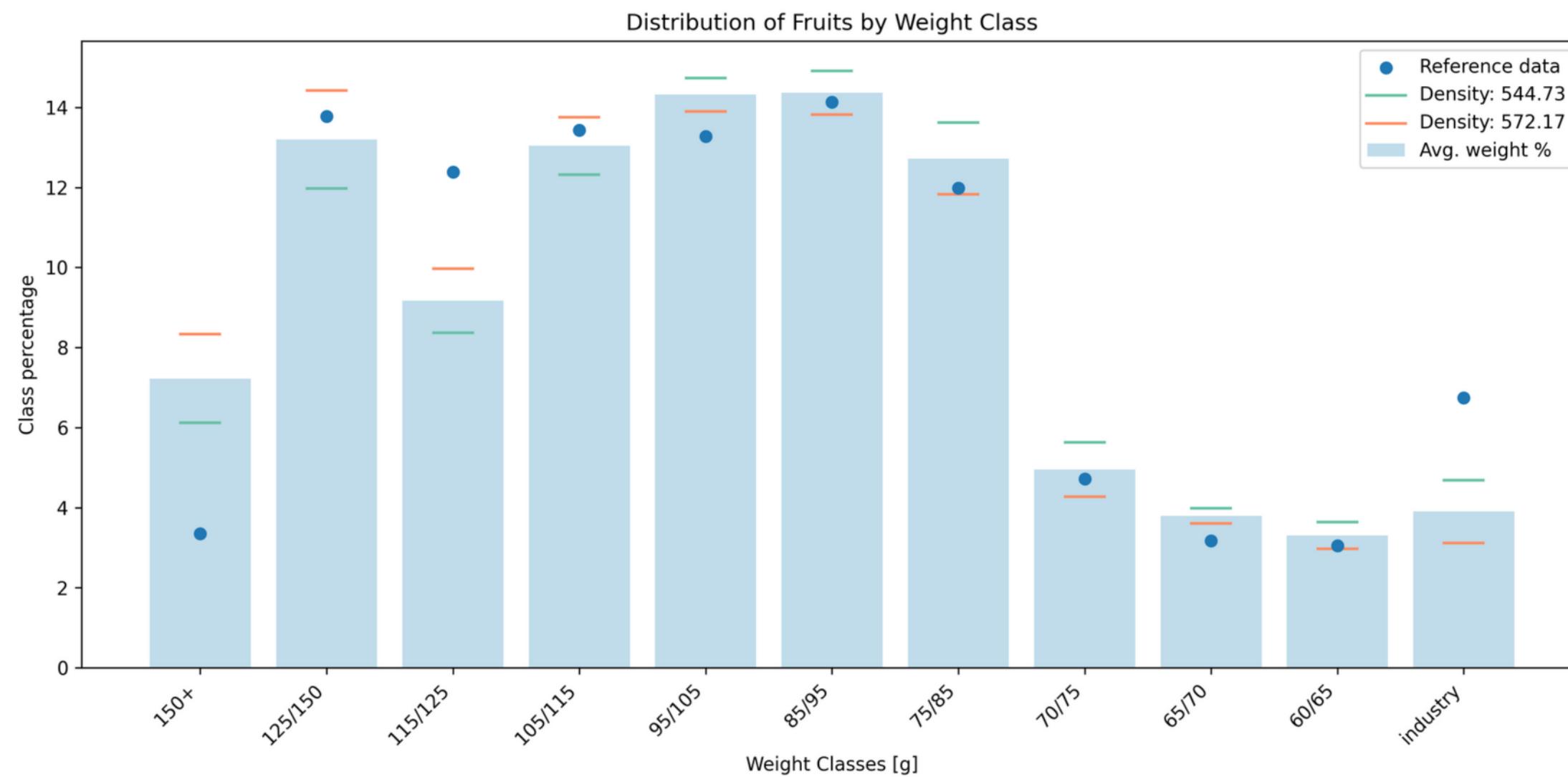
Final result

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# Results



Promising predictions



Difference between I cat. 150+ and industry



Measurements not conducted kiwi-by-kiwi,  
but estimated through sampling the entire  
population





# Future Works



Expand the datasets



Record short videos instead of still images to obtain better data



Run on mobile devices enhancing usability in the real world



Use ML to enhance accuracy



Pursue zero false positives



# KIWI RECON



THANKS FOR THE ATTENTION

