

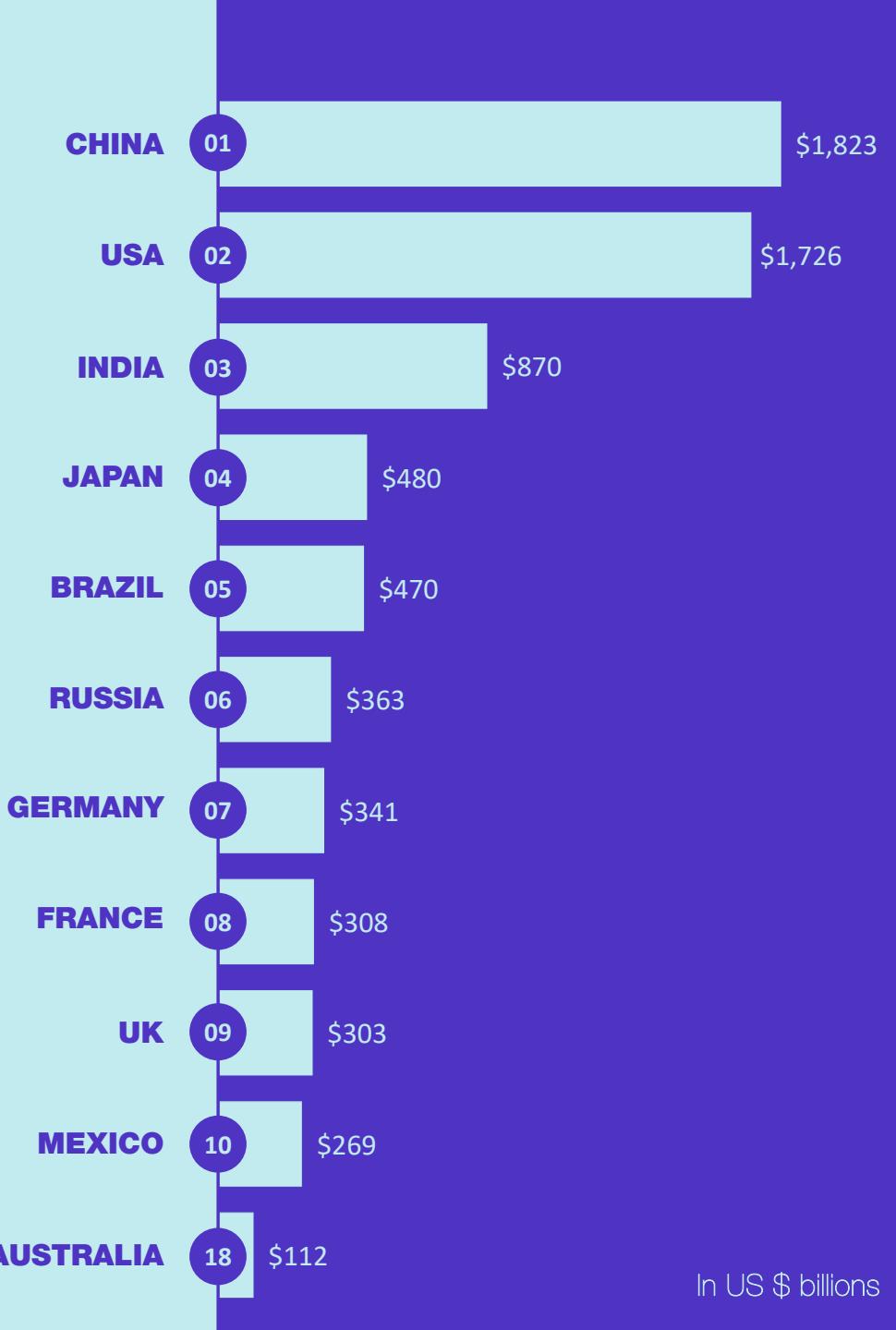


RETAIL REIMAGINED

Using Computer Vision & AI
for Product Recognition in
Supermarkets

2 | Global Grocery Market - 2023

The top 20 global grocery markets are expected to reach **\$8.5T** in 2023 from **\$6.7T** in 2018.



Top Challenges

CUSTOMER EXPECTATIONS

are reshaping demand



- personalised and seamless shopping experience
- omni-channel shopping
- best value
- conscious consumerism

INNOVATORS & DISRUPTORS

dictate new standards



- attractive to Gen Z and Millennial consumers
- new store formats and consumer experiences
- new partnerships
- strong online presence

TECHNOLOGY ACCELERATION

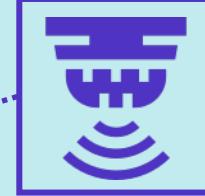
is enabling innovation and disruption at scale



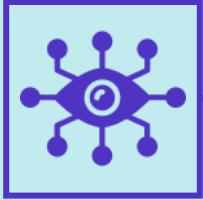
- voice commerce
- image / visual recognition
- blockchain
- machine learning & AI
- AR & VR

The Future

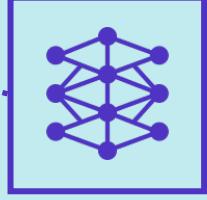
SENSOR TECHNOLOGY



ARTIFICIAL INTELLIGENCE



DEEP LEARNING



Product Recognition

Content Effectiveness

Robotic Stocking

Empty Shelf Monitoring

Zone Engagement

Anonymous Audience Measurement

Product Recognition & Recommendation

Smart Checkout

Stock Replenishment

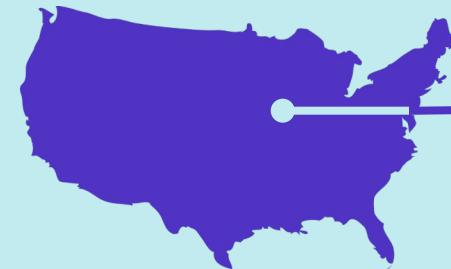
Product Engagement

Smart Trolley

Foot Traffic monitoring

Artificial Intelligence – Benefits

Retailers are accelerating their AI deployments. In 2018 **28%** retailers deployed AI as compared to **4%** in 2016.



CUSTOMER FRONT: 74%

Walmart used AI-driven image optimisation and saved **\$86Mn** with estimated savings of **\$2Bn+** over the next 5 years.



OPERATIONS FRONT: 26%

Morrisons used AI for stock replenishment to reduce shelf gap by **30%**.

Business Issue – The current state of Check-outs

SELF-CHECKOUTS



ASSISTED CHECKOUTS



33% leave the store without buying if queuing is longer than **7 mins**

LOWER SALES

50% of consumers avoid stores that have long queues

POOR CUSTOMER SATISFACTION

66% look to online alternatives to avoid time spent in brick-and-mortar stores

TARNISHED BRAND IMAGE

Business Goal – Steps to make the check-out experience seamless

Develop an CNN base-model that can be used by image recognition software to automatically recognise products leading to faster check-out experience

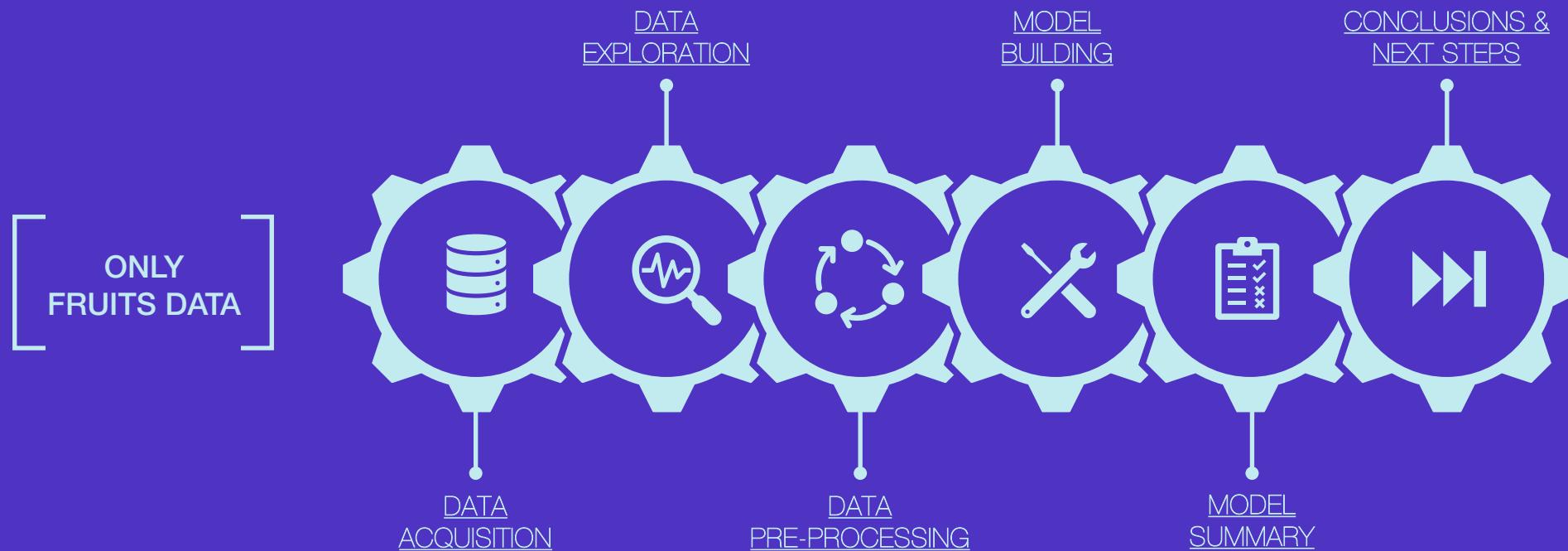


DATA SET & PIPELINE

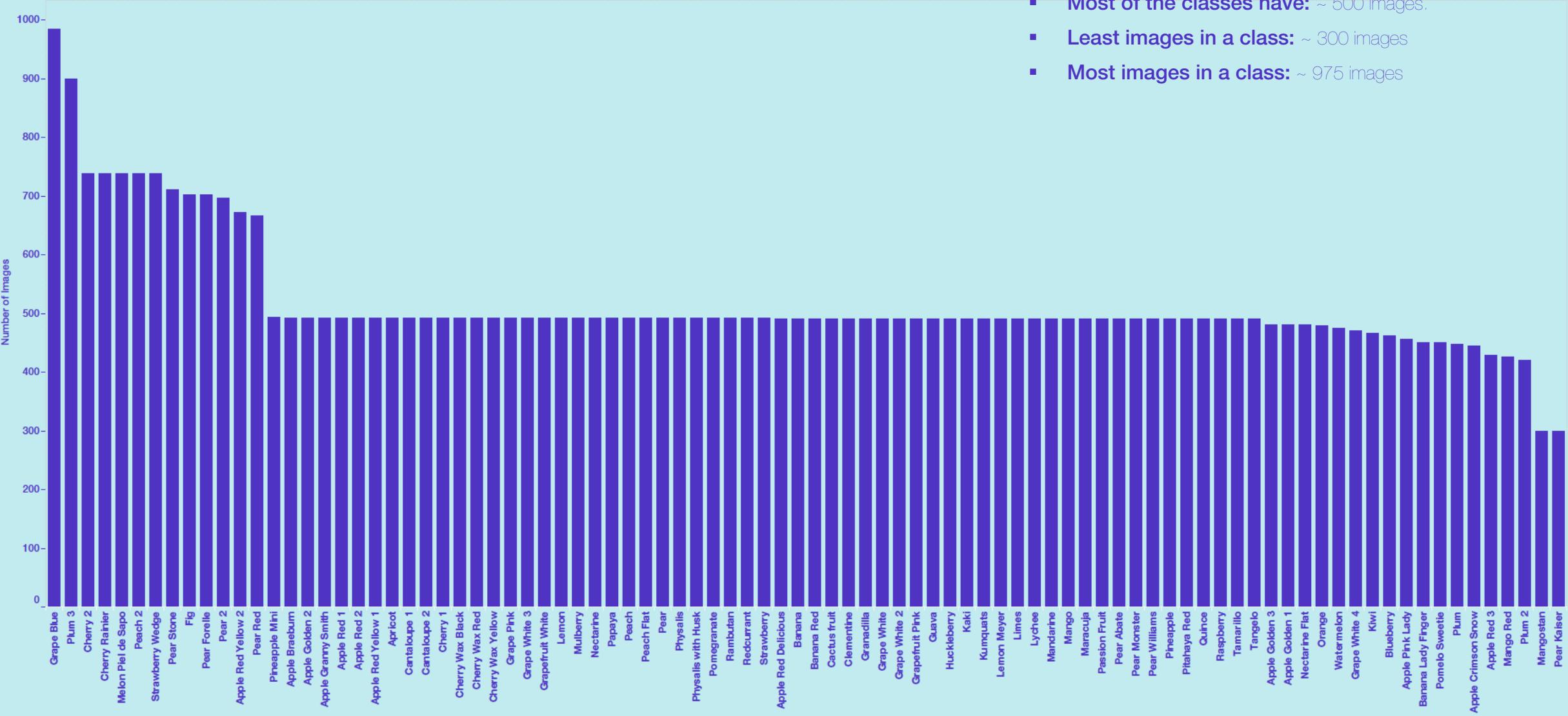
SOURCE: <https://github.com/Horea94/Fruit-Images-Dataset>

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- **Total number of images:** 90,483.
- **Training set size:** 67,692 images (one fruit or vegetable per image).
- **Test set size:** 22,688 images (one fruit or vegetable per image).
- **Multi-fruits set size:** 103 images (more than one fruit (or fruit class) per image).
- **Number of classes:** 131 (fruits and vegetables).
- **Image size:** 100x100 pixels.

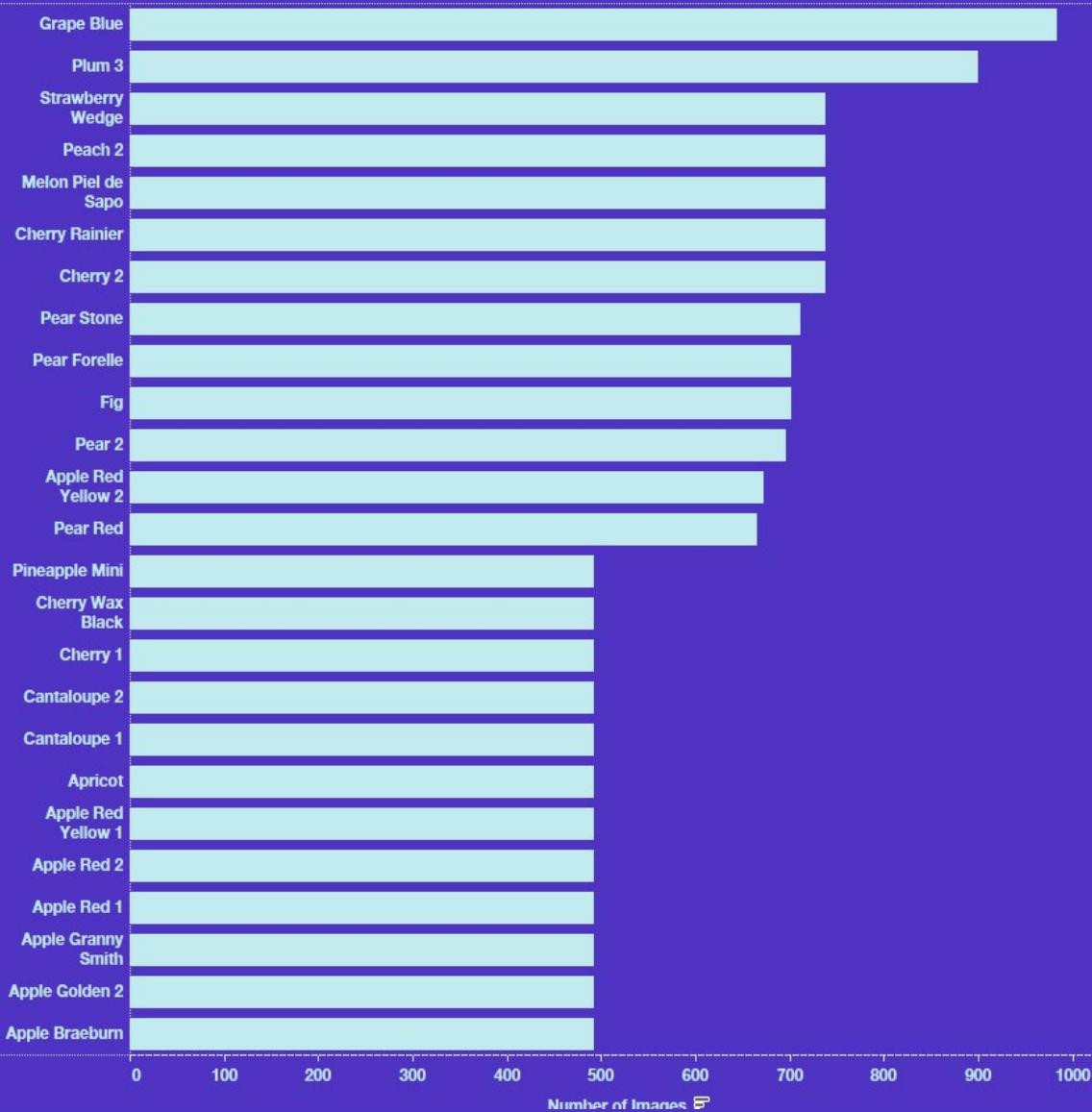


9 | Overview – Train Dataset

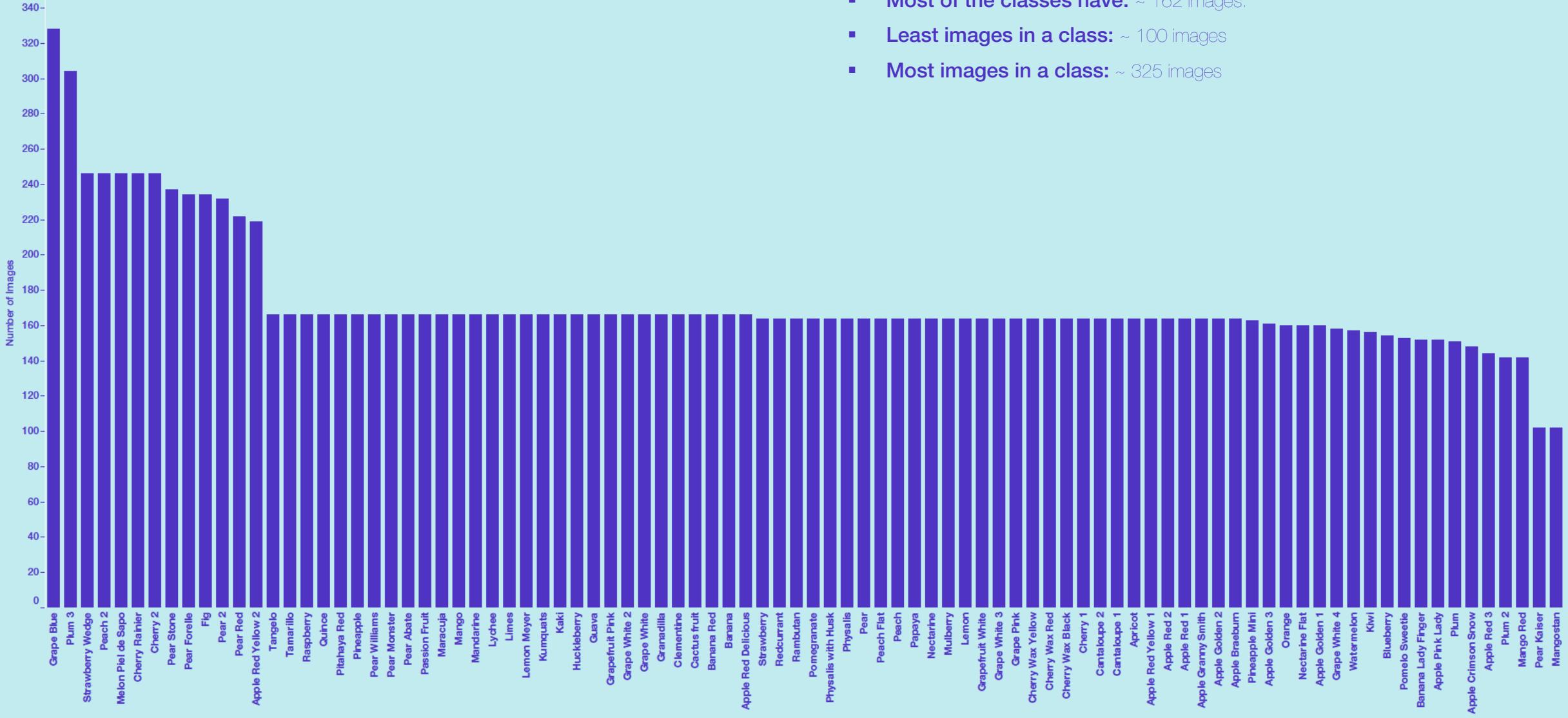


- **Total number of images:** 46,610 images (one fruit/image).
- **Number of classes:** 90 (fruits).
- **Image size:** 100x100 pixels.
- **Most of the classes have:** ~ 500 images.
- **Least images in a class:** ~ 300 images
- **Most images in a class:** ~ 975 images

Overview – Train Dataset



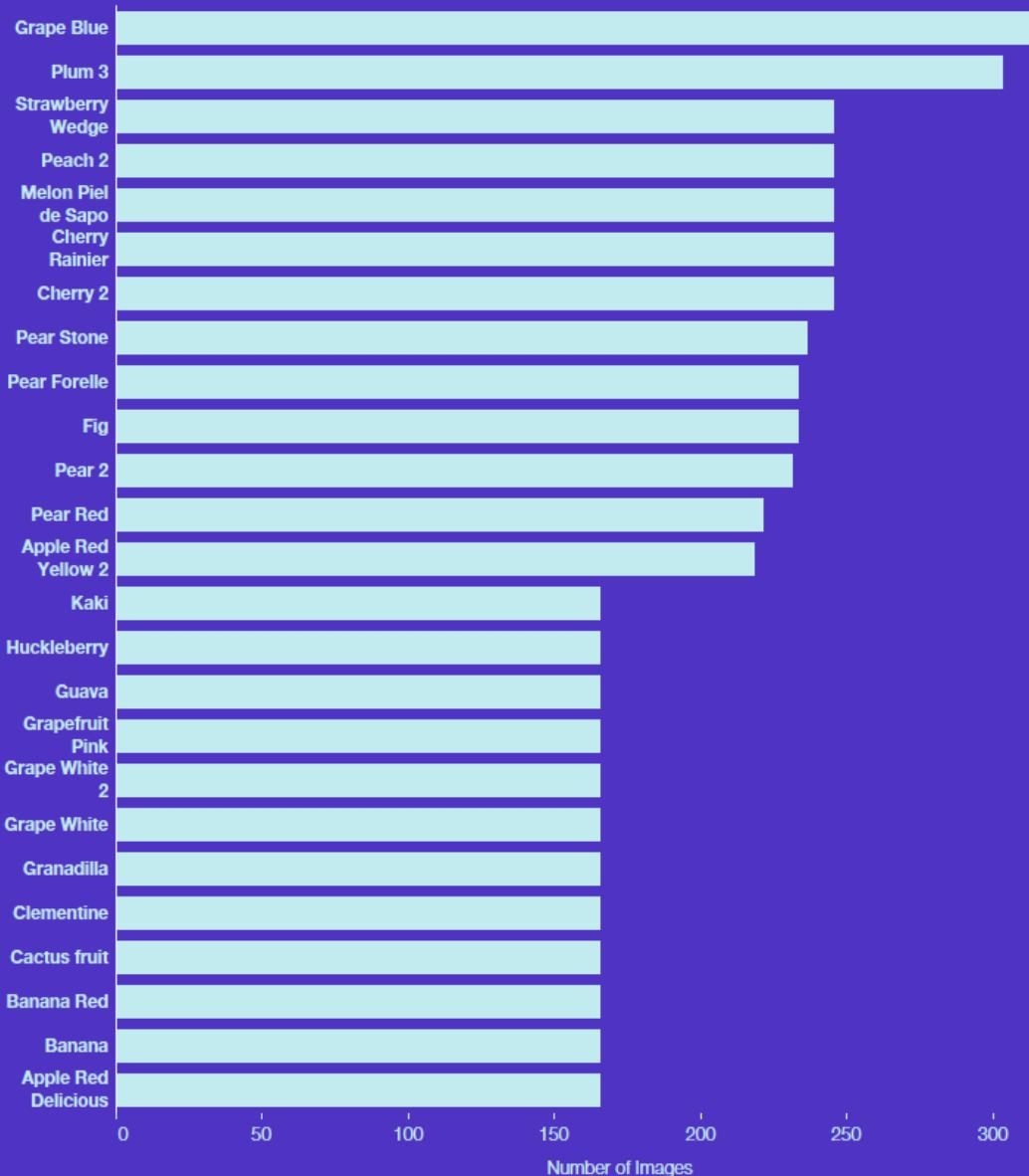
Overview – Test Dataset



- **Total number of images:** 15627 images (one fruit / image).
- **Number of classes:** 90 (fruits).
- **Image size:** 100x100 pixels.
- **Most of the classes have:** ~ 162 images.
- **Least images in a class:** ~ 100 images
- **Most images in a class:** ~ 325 images

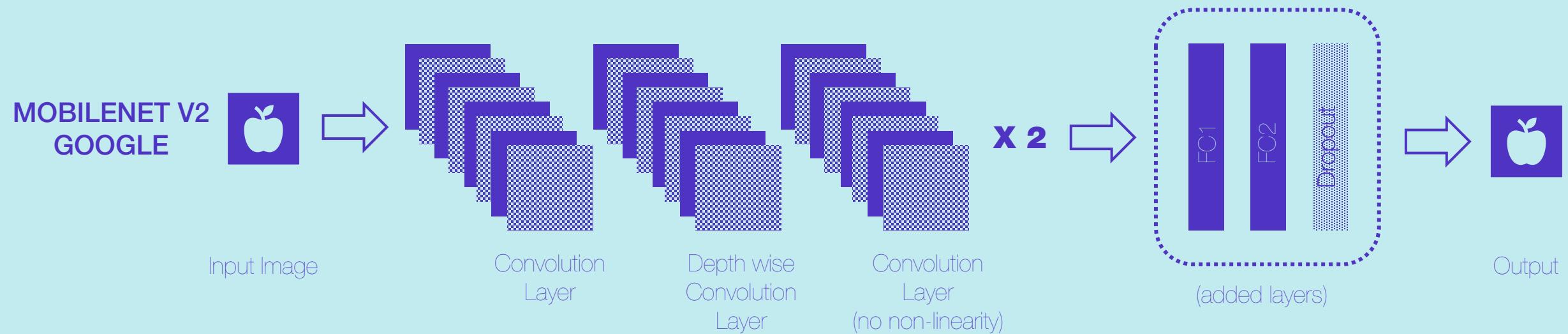
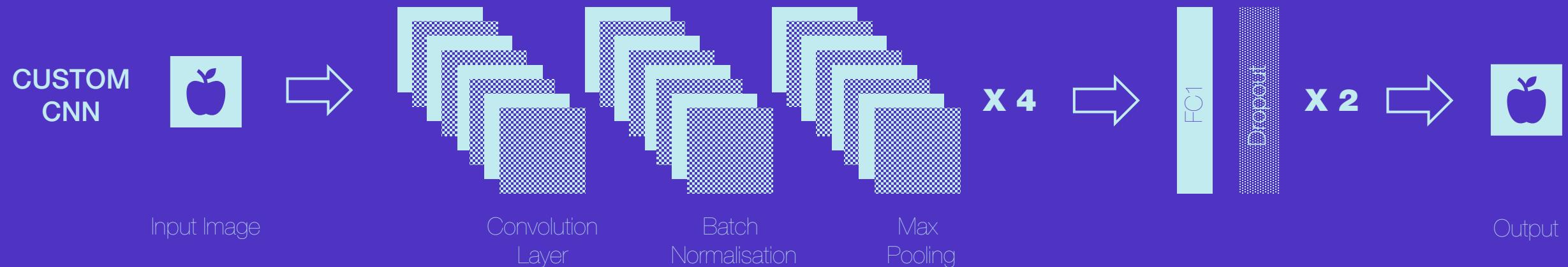
40% Validation set
60% Test set

Overview – Test Dataset



- The train and test dataset have similar distribution of fruit classes

The Models – Custom CNN & Transfer Learning with MobileNet V2

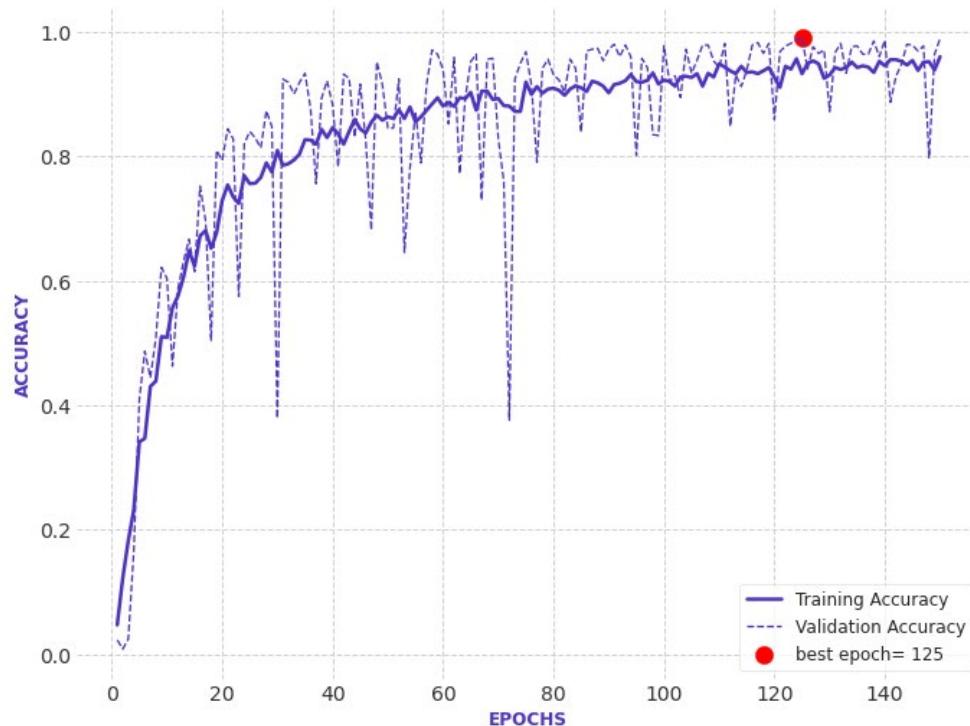


Custom CNN – Results

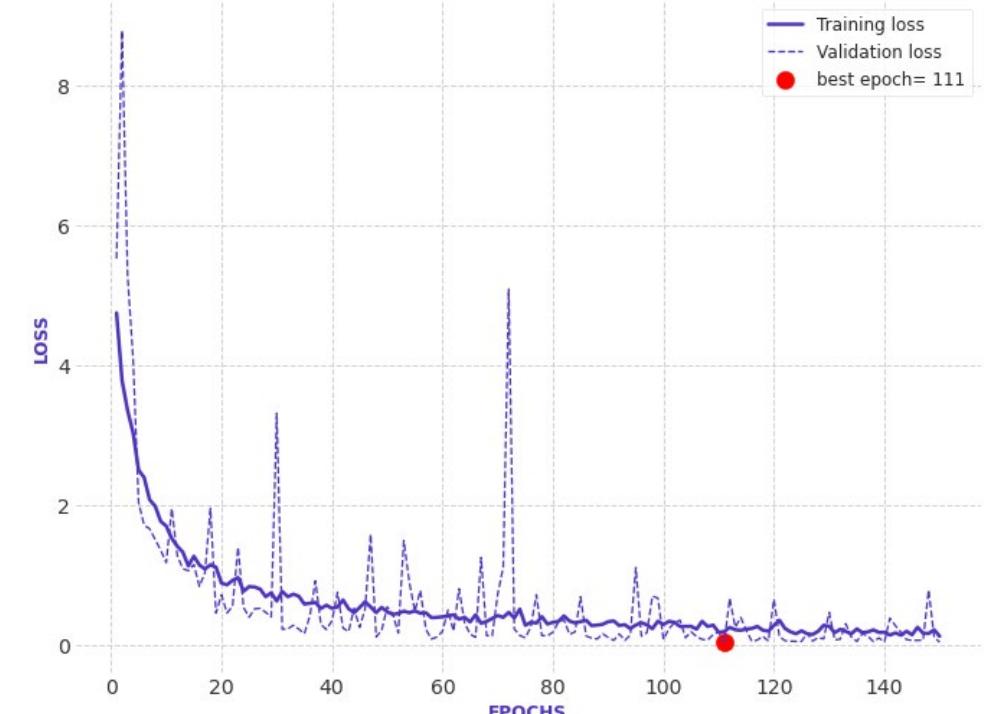
Training Accuracy: **0.95**
Validation Accuracy: **0.98**

Test Accuracy: **0.99**
Test Loss: **0.05**

Model Accuracy on Validation Dataset

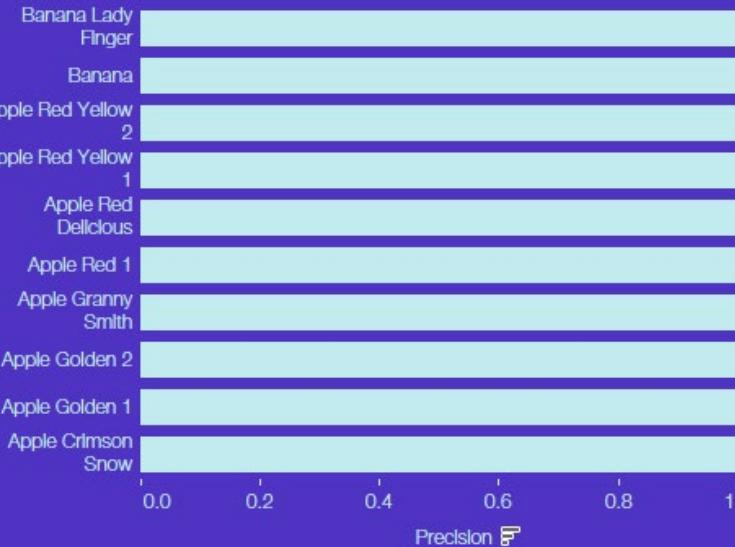


Model Loss on Validation Dataset

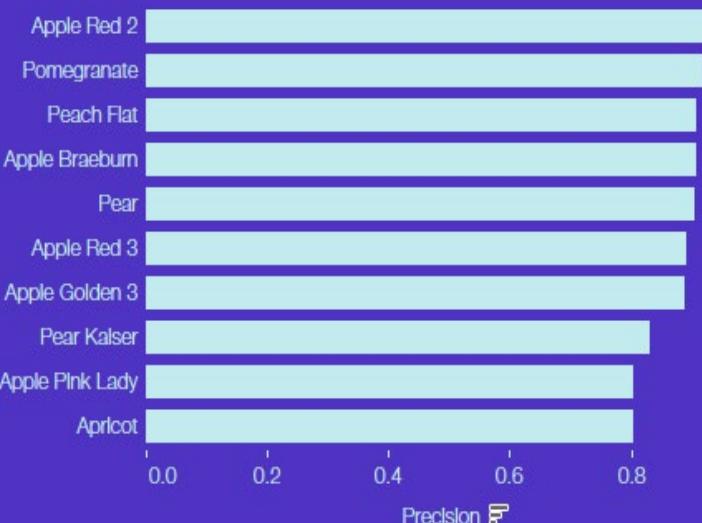


Custom CNN – Metrics

Top 10 & Bottom 10 Precisions



Precision F



Precision F

Predictions



Insert Web Page

This app allows you to insert secure web pages starting with https:// into the slide deck. Non-secure web pages are not supported for security reasons.

Please enter the URL below.

`https:// public.tableau.com/app/profile/wendy.maría.d.sa/viz/Fruits_16337154820060/Dashboard1?publish=yes`

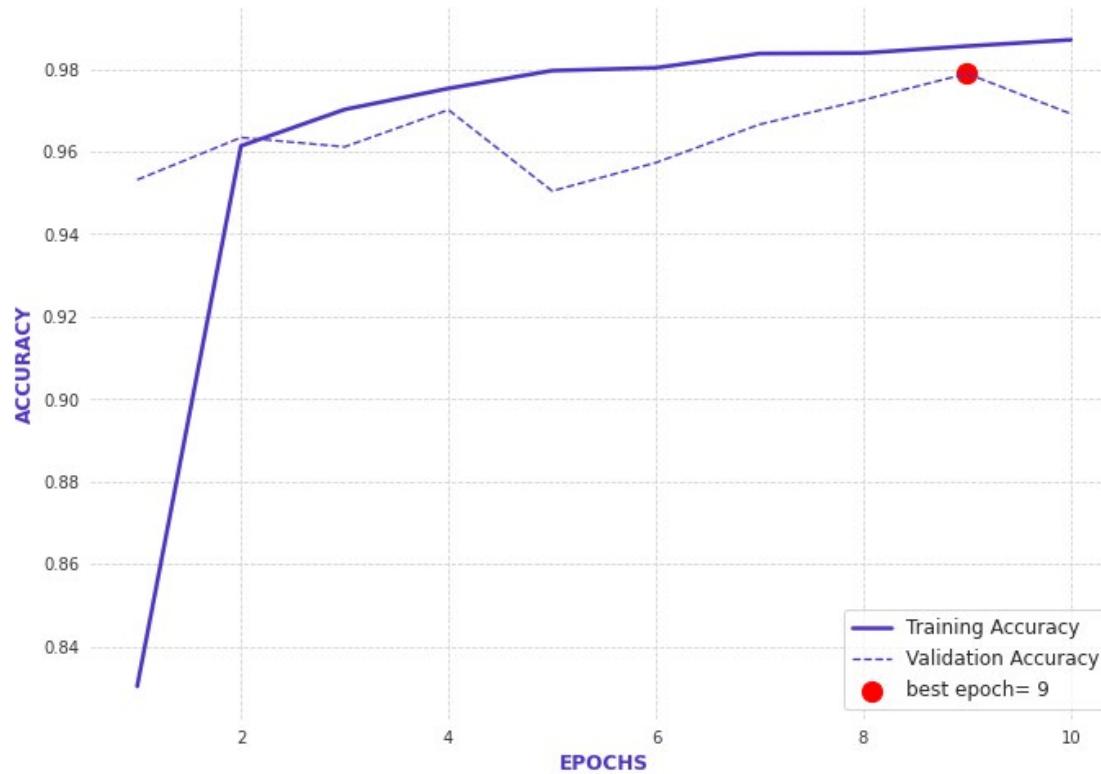
Note: Many popular websites allow secure access. Please click on the preview button to ensure the web page is accessible.

MobileNet V2 – Results

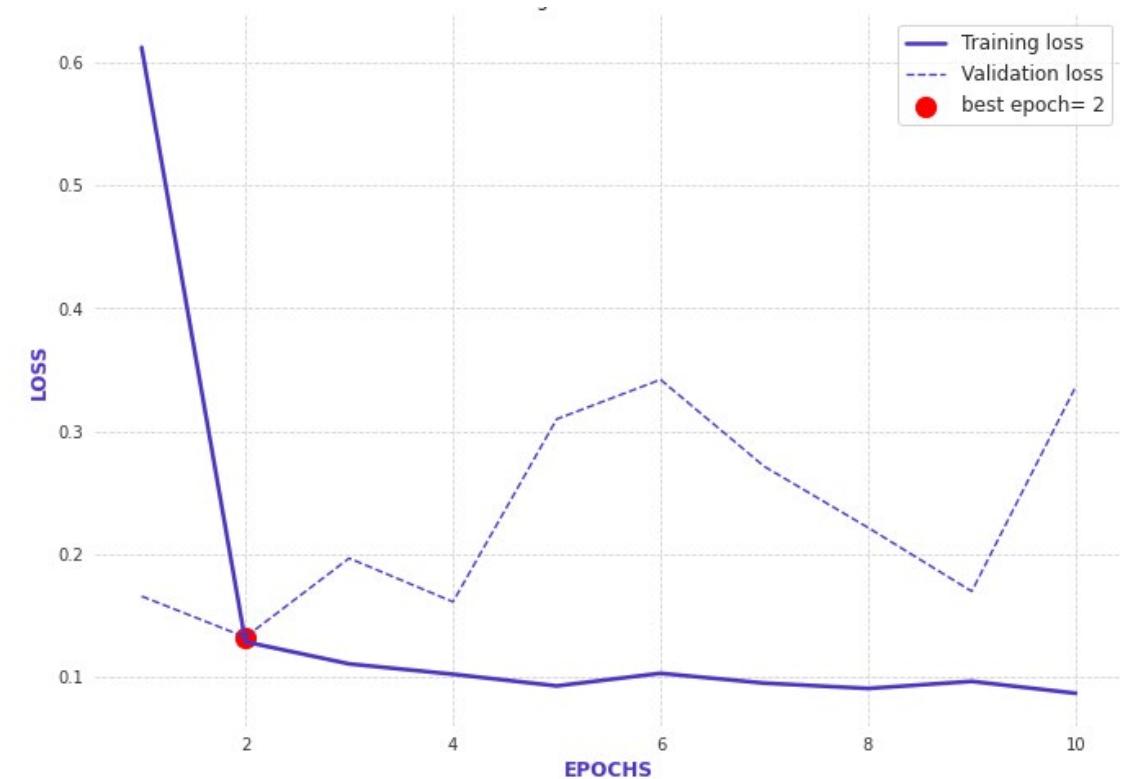
Training Accuracy: **0.99**
Validation Accuracy: **0.97**

Test Accuracy: **0.96**
Test Loss: **0.41**

Model Accuracy on Validation Dataset



Model Loss on Validation Dataset



Conclusion

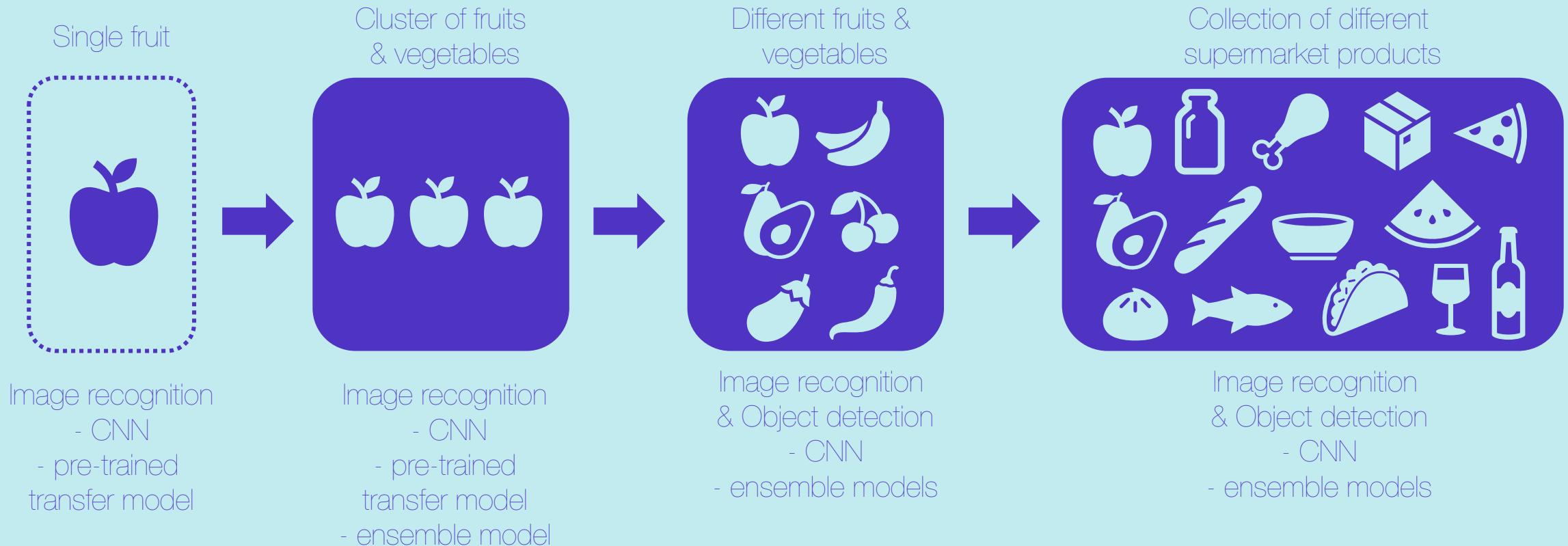
Custom CNN Model gives the best accuracy of **99%** on Test data but on high epoch values

- can be used to further train clusters of fruits and vegetables
- would be a good fit as part of an ensemble model
- time taken is highly dependent on resource allocation – varying from 30 mins to 4 hours.
- higher resource allocation would make this a good base model for further training

MobileNet V2 Model by Google comes close at **96%** accuracy on Test data and has the best epochs of the two models.

- dramatically reduces the complexity cost and model size of the network
- suitable for Mobile devices, or any devices with low computational power.
- time taken ~ 4 hrs
- a good fit for deployment in supermarket environments, especially with millions of products

Next Steps





Thank You