CALORIE SCAN

Snap, Predict, Savor – Your Plate's Calorie Story!

Problem Statement

College students, especially those living in dormitories or relying on mess or cafeteria food, often face challenges when it comes to making informed dietary choices. They may not have access to detailed nutritional information for the food they consume, which can lead to overeating, undereating, or making unhealthy food choices.
Moreover it has been seen that students often undereat due to the perceived poor quality of the food or may opt for specific food items without achieving a balanced intake, leading to excessive consumption of fats or proteins. This lack of awareness can result in health issues, including tiredness and fatigue, which can significantly hinder their academic performance and overall well-being.

Our Solution

Step 1

Classify the food items with high accuracy

Step 2

Estimate the user's calorie and nutrients intake

Applications

- **Dietary Management and Nutritional Education:** CalorieScan aims to empower users, especially college students, by estimating meal calorie content and providing insights into the macronutrient composition.

- **Weight Control:** It can aid individuals in weight management by tracking calorie intake, suitable for those looking to lose, gain, or maintain weight.

Impact

- **Higher Metabolism:** Regularly eating enough calories can help maintain your metabolism levels, reducing fatigue. Low-calorie diets can decrease the metabolism by as much as 23%.
- **Mood and Anxiety:** Consuming a diet based on whole, unrefined foods with enough protein, healthy fat, and fiber helps to keep blood sugar stable after meals, which has been linked to improvements in mood and anxiety.
- **Better Academic performance:** Nutrition affects the brain’s short-term blood sugar and long-term nutritional help. Proper nutrition can improve memory, problem-solving, and concentration.

Literature Survey

1. FoodieCal: We found papers with detailed information about their approach to classify food images. Every paper used Convolution Neural Networks(CNN) for image classification. We gained some really great insights from one named “FoodieCal: A Convolutional Neural Network Based Food Detection and Calorie Estimation System” which had a remarkable 90 percent accuracy. For the feature extraction part of the CNN, they used the inception v3 model and fine tuned the parameters for their specific use case (Transfer learning). For class prediction, a dense layer or fully connected layer was used.

S. A. Ayon, C. Z. Mashrafi, A. B. Yousuf, F. Hossain and M. I. Hossain, "FoodieCal: A Convolutional Neural Network Based Food Detection and Calorie Estimation System," 2021 doi: 10.1109/NCCC49330.2021.9428820.

Literature Survey

2. **CalorieMeter:** The methodology in "Caloriemeter" involves: capturing front and top-view images of food, using Faster R-CNN for object detection and classification, employing Canny edge detection to outline the food, segmenting the food from the background with GrabCut, calculating food scale and size using a reference object, estimating food volume based on its classified shape (ellipsoid, pillar, or irregular), and finally, calculating calories using the estimated volume and the food's known calorie density.

P. B. Deshmukh, V. A. Metre and R. Y. Pawar, "Caloriemeter: Food Calorie Estimation using Machine Learning," 2021 , doi: 10.1109/ESCI50559.2021.9397023.

Literature Survey

3. **Food Calorie Estimation using Convolutional Neural Network:** The study's methodology leverages the ECUSTFD dataset, comprising labeled food images with volume and mass data. TensorFlow's Object Detection API is employed to identify food items within these images. A Convolutional Neural Network (CNN), developed using Keras, is trained to classify these food items, achieving a 92% accuracy rate following hyperparameter tuning. In cases where images feature multiple food items, the model counts and multiplies calories by food type, providing a total calorie estimate.

Some problems

- Similar looking food items are problematic for multiple food detector because sometimes the system detects multiple food from an image with a single food item.
- Lastly, the angle at which the image is taken was very important for their system to detect food items accurately and worked poorly for the images with top view.

Addressing Problems

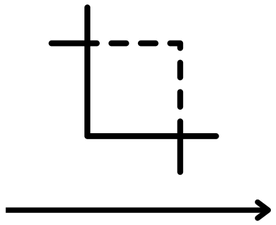
- When our model does give prediction for the food items present in the plate, we can provide the user with the options to select the food items that our model didn't give a very high probability of occurring.
- We train and test our model on images of plates from the top view only.
- We believe that we can give a much better calorie estimate as we have a general idea of the quantity that can be taken in the mess plate.
- In addition to the calorie estimation, we also give the users an idea of their nutrient intake.
- We did not just gather the data from the net but also made our own dataset.

Data Collection

Data Preprocessing

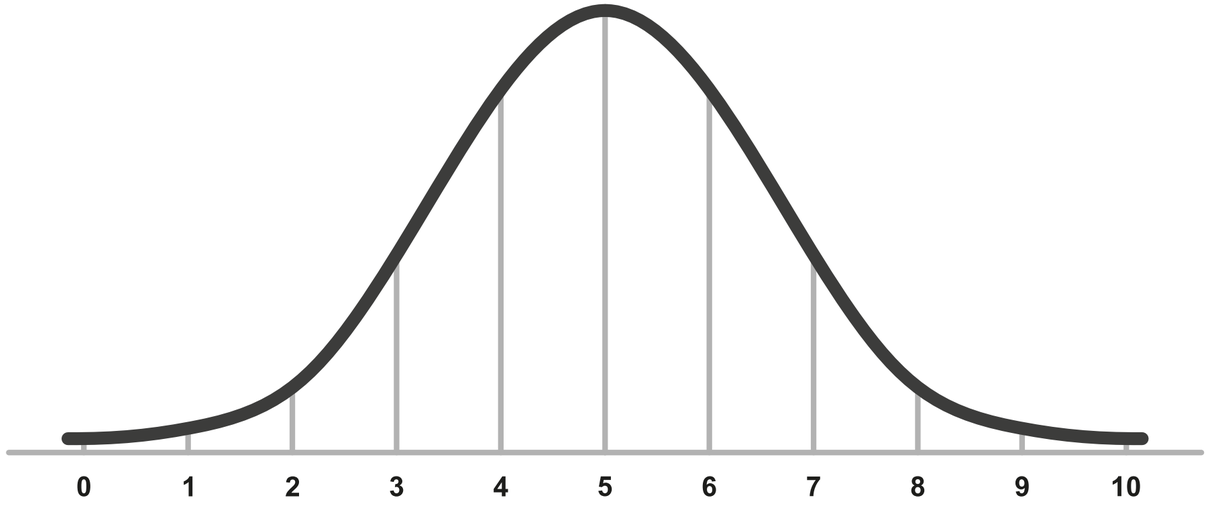
Rotating Images

Cropping Images

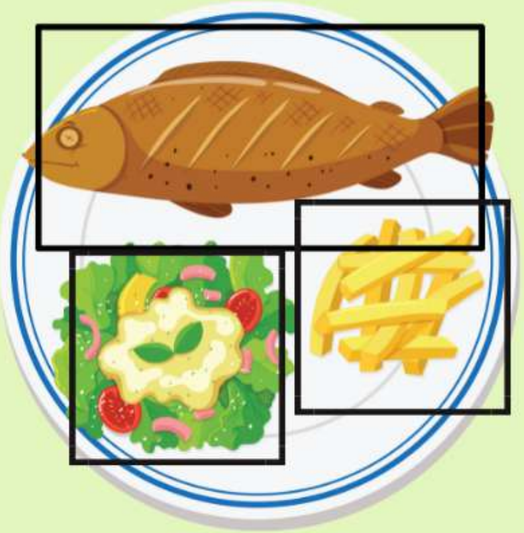


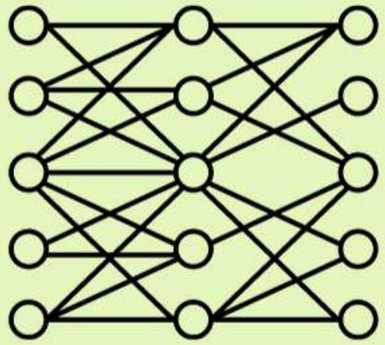
Resizing Images

Annotation and Normalisation



CALORIE SCAN





PART 1
Object Detection

To initiate the process of classifying food items on cafeteria plates, our primary challenge was to accurately identify the specific sections on the plates where the food is placed. Fortunately, the distinct design of the mess plates, featuring separate sections for different food items, significantly streamlined our task.

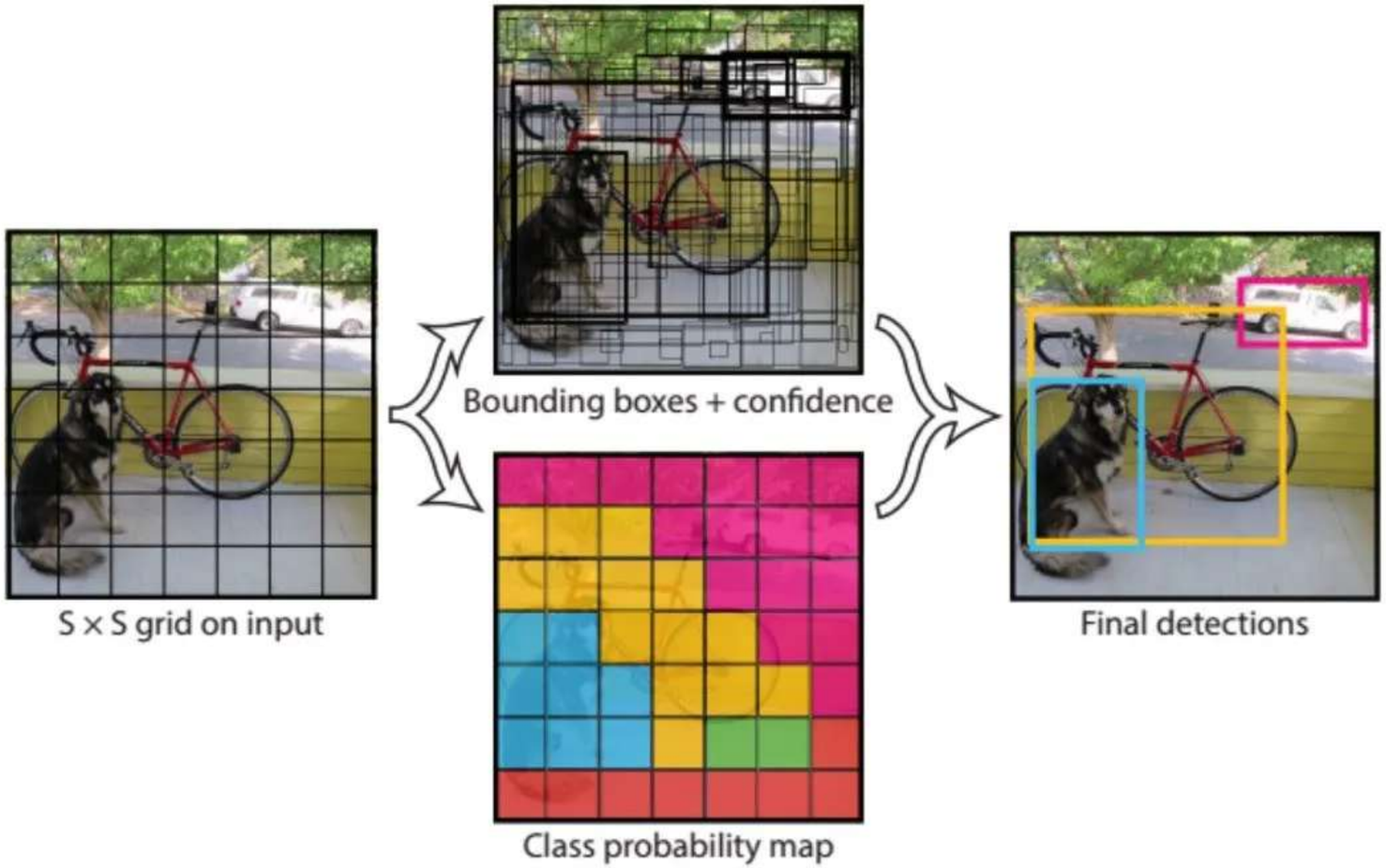
We used the YOLOv8 model for object detection to identify these sections. The training dataset included images of empty plates on top of the filled plates we had collected over the semester. The six sections of the plate were manually annotated in the image for training the model.

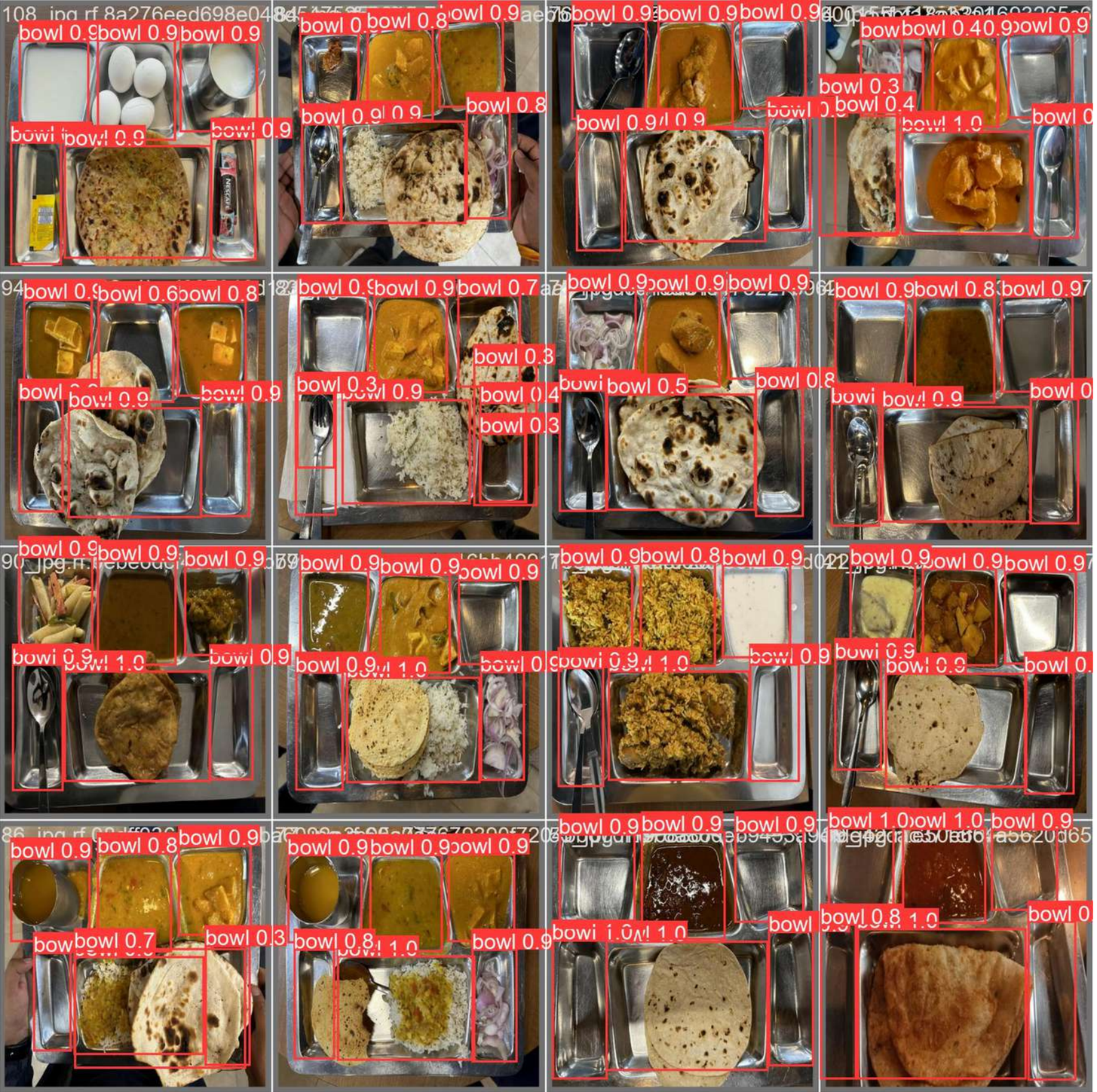
Why YOLOv8?

- YOLOv8, known for its speed and accuracy in detecting objects, efficiently handles the complex task of spatial recognition and bounding box prediction.

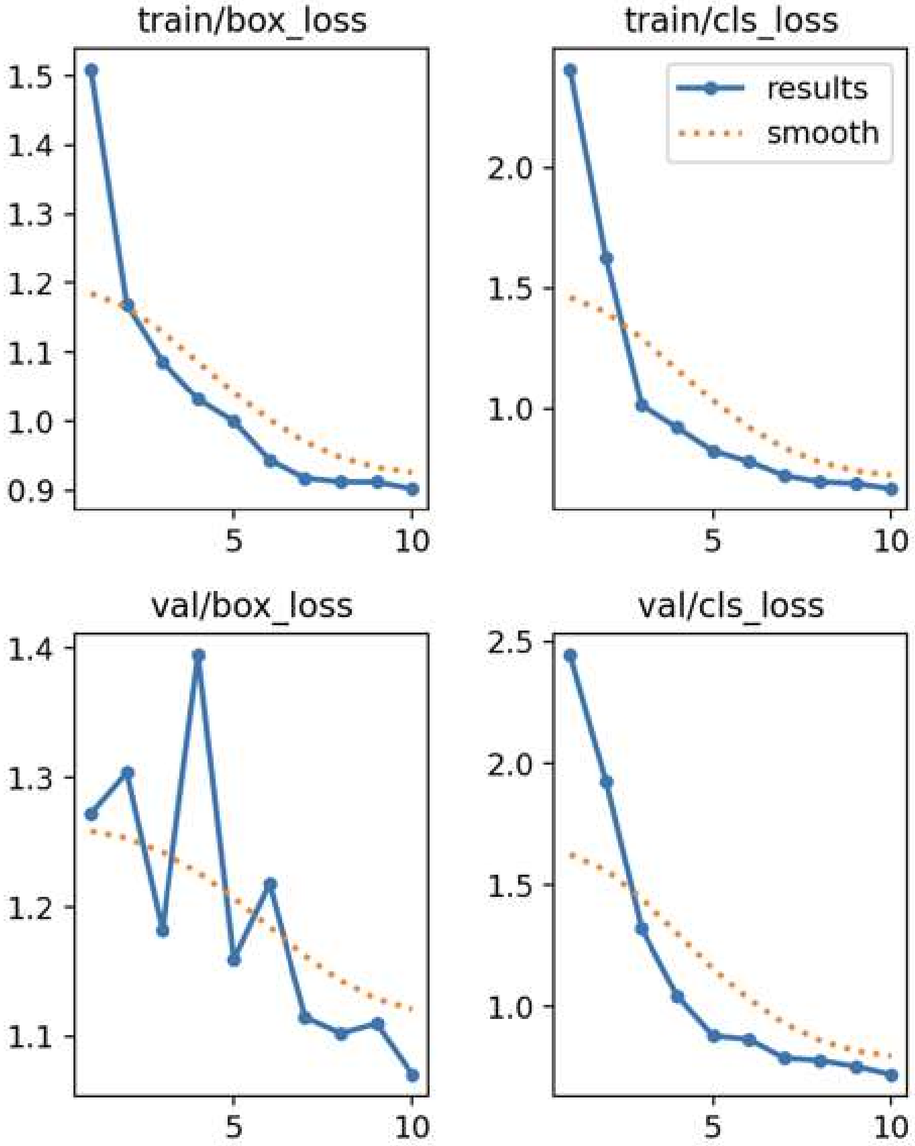
- In our approach, we utilized YOLOv8 exclusively for object detection, focusing on identifying and localizing objects within the images without determining their classes. By separating the tasks of detection and classification, we can specialize and optimize each process independently.

How YOLOv8 works?



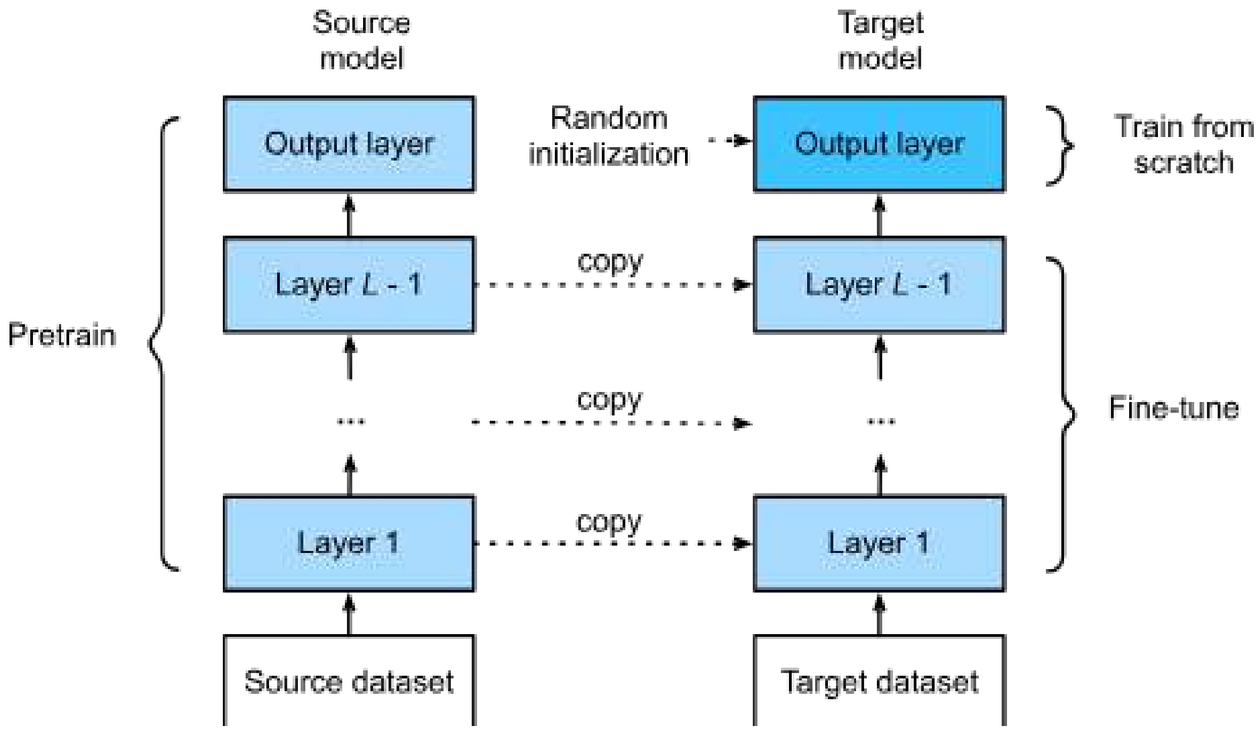


Results after YOLOv8



Results Continued

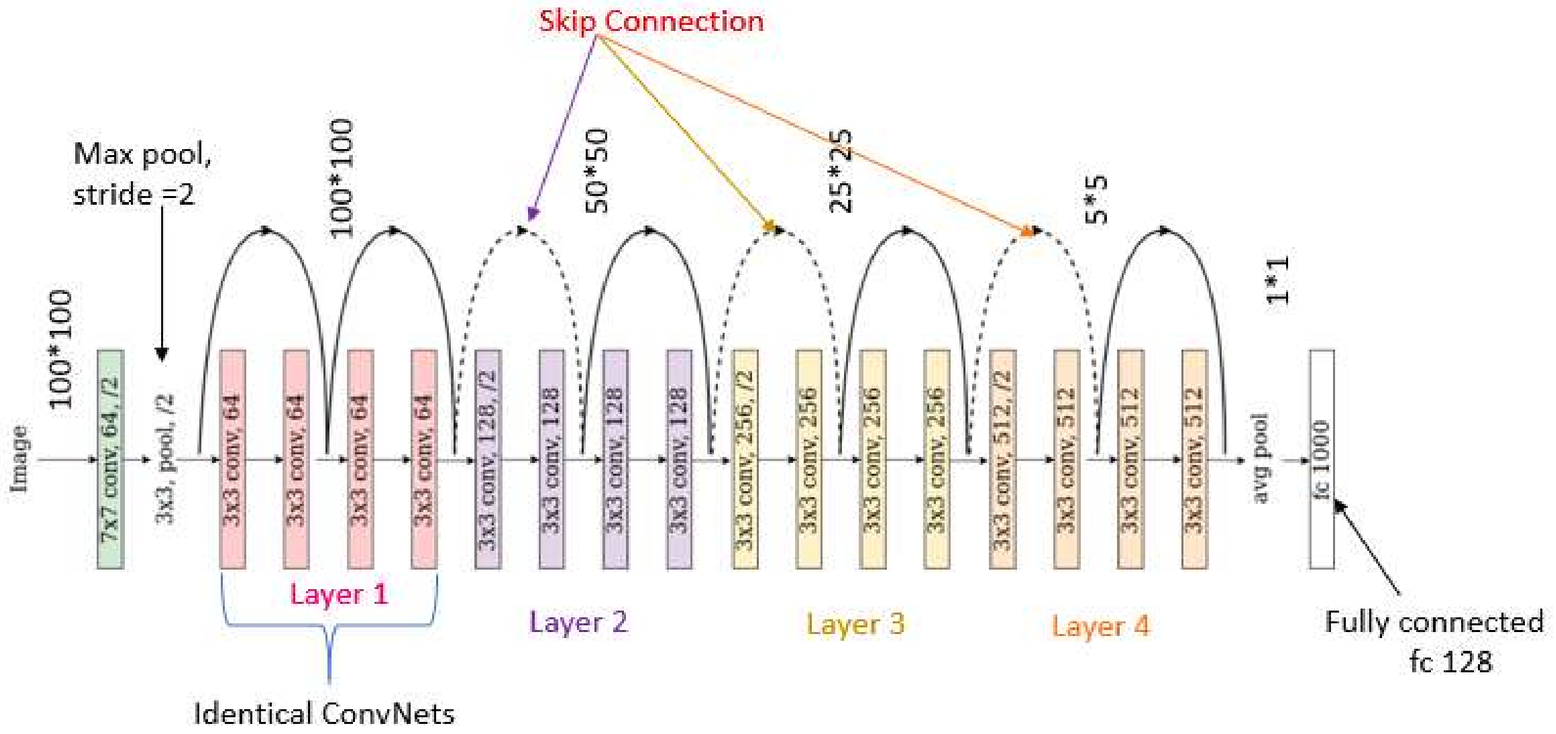
PART 2
Classification



After the initial object detection by YOLOv8, the images are segmented and then fed into RESNET18 for classification. The focus is on classifying the contents of each cropped plate section.

Fine-Tuning Approach:
The last layer of RESNET18 is modified to suit the specific requirements of the project.
Why Fine-Tune?: Fine-tuning allows the model to adapt to the specific types of objects and textures found in the dataset of plate images.

How RESNET18 works?



ResNet-18 Architecture

Fruit 360 Input Image size= 100*100 px

Why RESNET18?

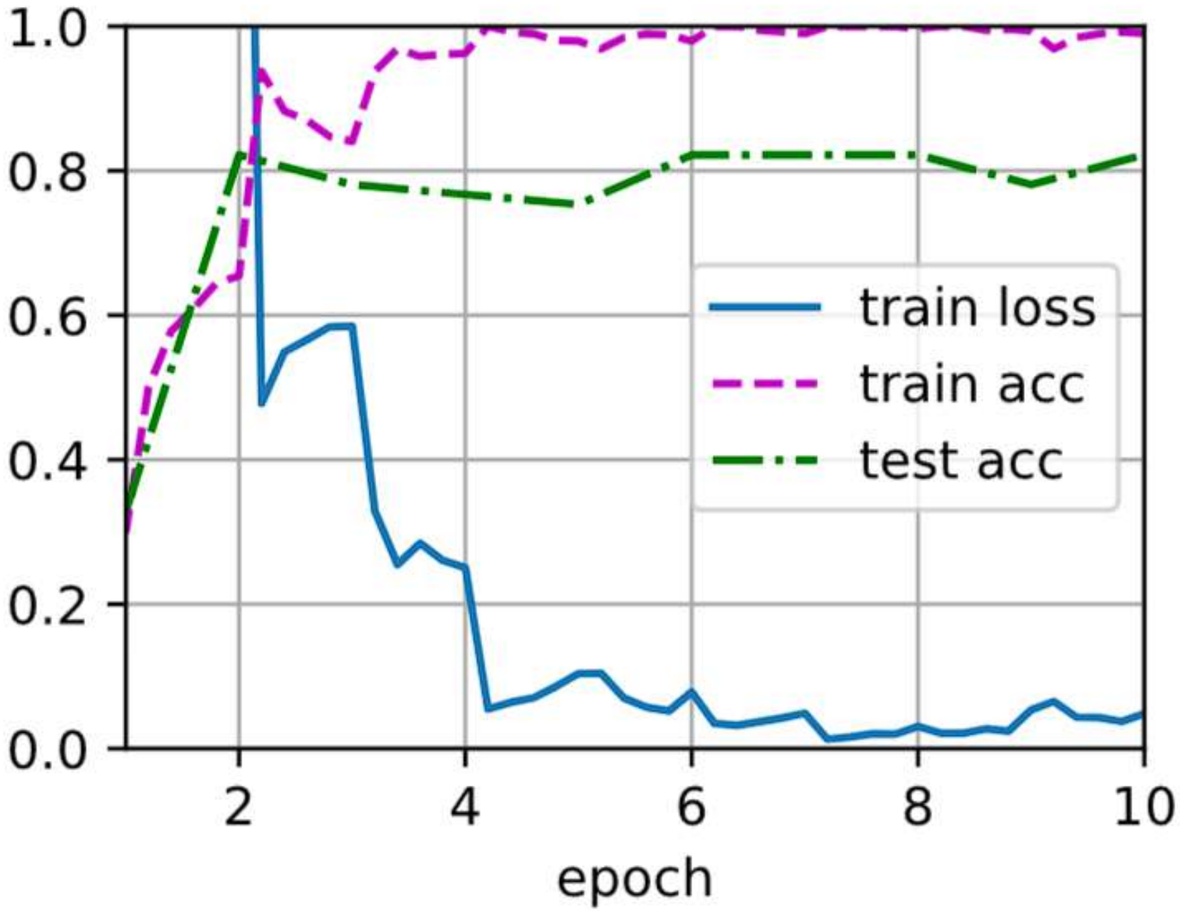
Advantages of ResNet18

- Explored various models: VGG, Inception, ResNet.
- Criteria: Efficiency, depth, dataset suitability.
- ResNet's standout feature: Skip connections.
- Solves vanishing gradient in deep networks.
- Optimal balance between performance and computational efficiency.

ResNet18 vs. ResNet50

- ResNet50's depth (50 layers) deemed excessive for our project.
- ResNet18: Lighter, efficient, ideal for our dataset.

Training Curve



The test accuracy was 82.2 percent and the train accuracy was 99 percent.

Estimating Calories

We used trusted sites like Nutrineat, to build our calorie mapping. The calories were predicted per 100g of the food item.

Accuracy Revisited

- Integrated object detection (YOLOv8) with classification (ResNet).
- Generated a unified list of all predicted food items.
- Employed set intersection to match predicted and actual food items.
- Defined accuracy metric: Correct predictions divided by total predicted items.
- Got 78.7% accuracy

Deployment

Thank You!

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