AI-Driven Food Nutrition Predictor (Predicting Food Grades via Machine Learning)

MA 707 Machine Learning, Prof. Luke Cherveny

Participants:

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The Opportunity

- Lack of accessible tools to accurately measure nutritional content.
- Growing interest in health and fitness tracking.
- **Target Audience**: Fitness enthusiasts, health-conscious individuals, dieticians.
- CVPR 2021 Paper: Google Cafeterias

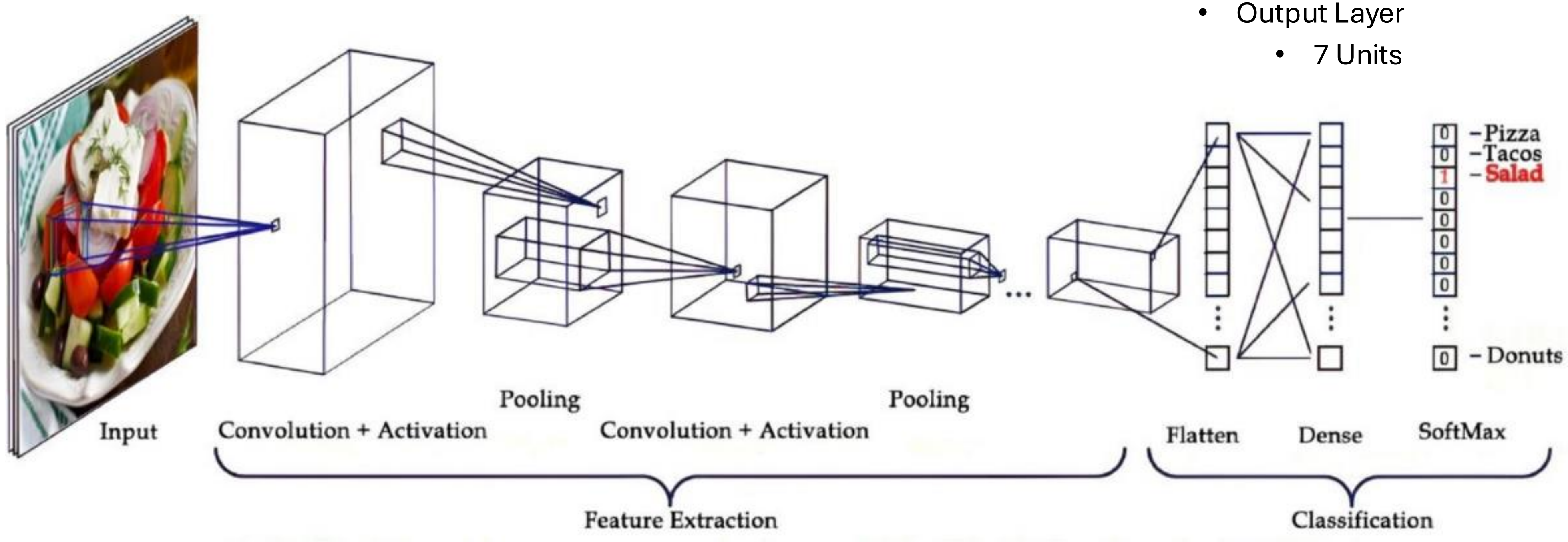
Our Solution: NutriTrack

- **Core Features:** Estimates food grade in real time.
- **Integration:** Syncs with wearables like Fitbit for holistic health tracking.
- **Impact:** Simplifies nutrition management for health-conscious individuals.

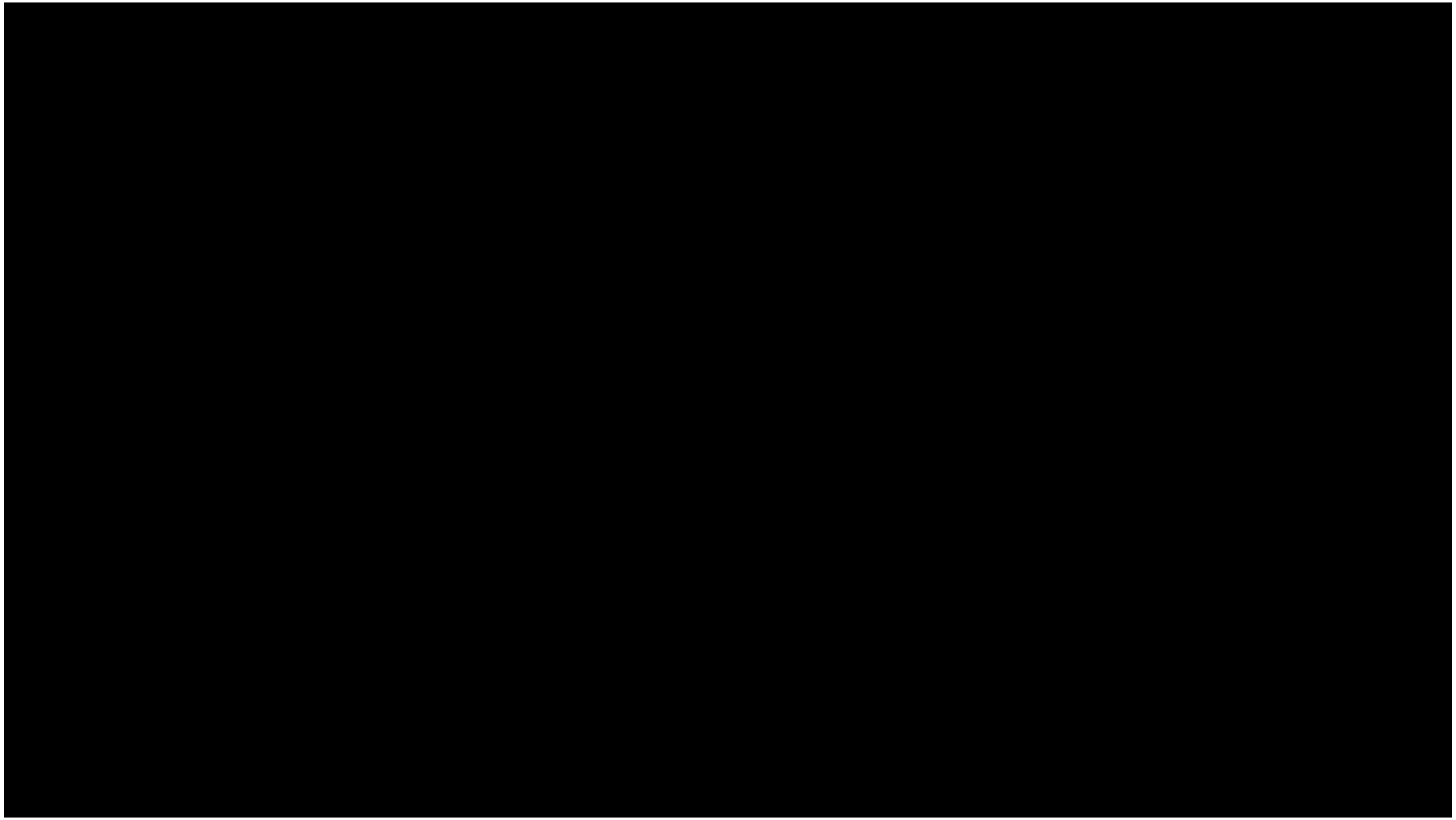
Technical Framework

- Input:
  - IMG Height
  - IMG Width
  - 3 RGB colors
- Output:
  - 7 Food Grades.

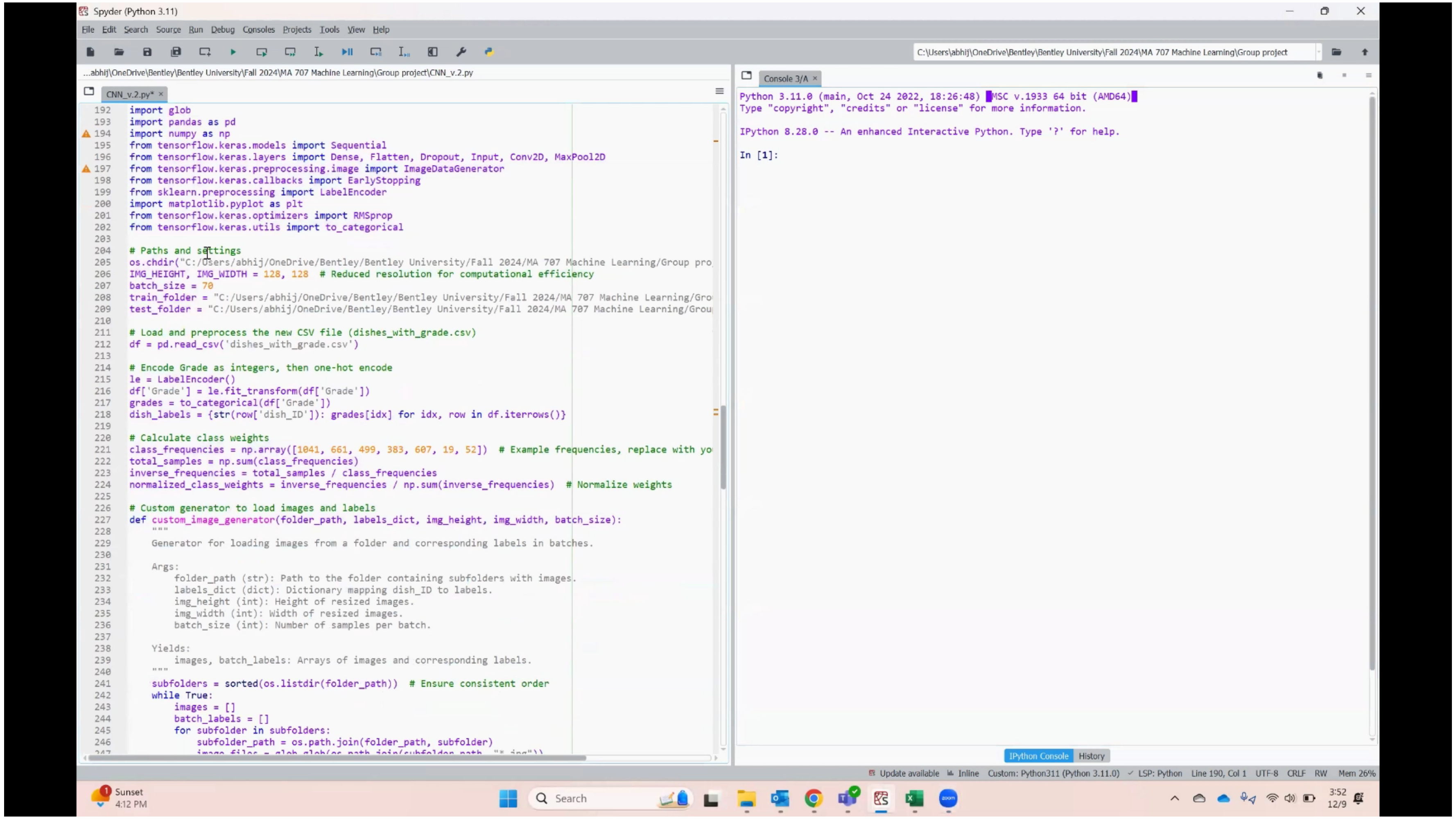
- Model:
  - 1st CNN Layer
    - 8 Filters, 4*4 Kernel, Activation: ReLU
    - Max Pool (2*2)
  - 2nd CNN Layer
    - 8 Filters, 3*3 Kernel, Activation: ReLU
    - Max Pool (2*2)
  - Flattening Layer
  - 1st Dense Layer
    - 16 Units, Activation: ReLU
  - Dropout Layer
    - 30%
  - Output Layer
    - 7 Units



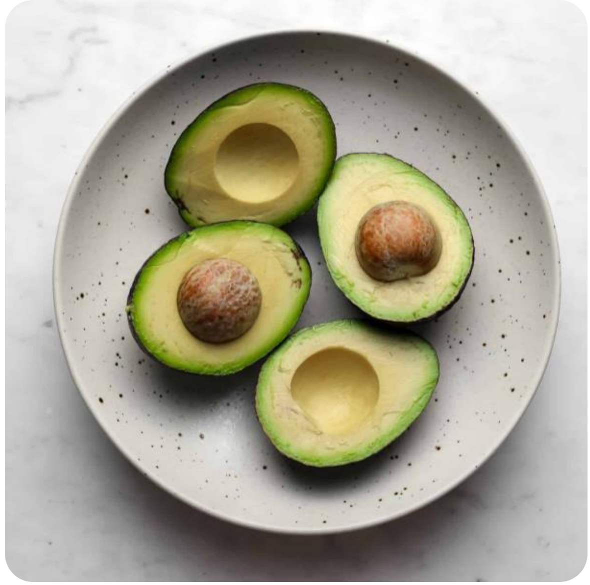
The Process



CNN Model



Spyder (Python 3.11)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\abhij\OneDrive\Bentley\Bentley University\Fall 2024\MA 707 Machine Learning\Group project
...abhij\OneDrive\Bentley\Bentley University\Fall 2024\MA 707 Machine Learning\Group project\CNN_v.2.py
CNN_v.2.py*
import glob
import pandas as pd
import numpy as np
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten, Dropout, Input, Conv2D, MaxPool2D
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.callbacks import EarlyStopping
from sklearn.preprocessing import LabelEncoder
import matplotlib.pyplot as plt
from tensorflow.keras.optimizers import RMSprop
from tensorflow.keras.utils import to_categorical
# Paths and settings
os.chdir("C:/Users/abhij/OneDrive/Bentley/Bentley University/Fall 2024/MA 707 Machine Learning/Group pro
IMG_HEIGHT, IMG_WIDTH = 128, 128 # Reduced resolution for computational efficiency
batch_size = 70
train_folder = "C:/Users/abhij/OneDrive/Bentley/Bentley University/Fall 2024/MA 707 Machine Learning/Gro
test_folder = "C:/Users/abhij/OneDrive/Bentley/Bentley University/Fall 2024/MA 707 Machine Learning/Grou
# Load and preprocess the new CSV file (dishes_with_grade.csv)
df = pd.read_csv('dishes_with_grade.csv')
# Encode Grade as integers, then one-hot encode
le = LabelEncoder()
df['Grade'] = le.fit_transform(df['Grade'])
grades = to_categorical(df['Grade'])
dish_labels = {str(row['dish_ID']): grades[idx] for idx, row in df.iterrows()}
# Calculate class weights
class_frequencies = np.array([1041, 661, 499, 383, 607, 19, 52]) # Example frequencies, replace with yo
total_samples = np.sum(class_frequencies)
inverse_frequencies = total_samples / class_frequencies
normalized_class_weights = inverse_frequencies / np.sum(inverse_frequencies) # Normalize weights
# Custom generator to load images and labels
def custom_image_generator(folder_path, labels_dict, img_height, img_width, batch_size):
"""
Generator for loading images from a folder and corresponding labels in batches.
Args:
folder_path (str): Path to the folder containing subfolders with images.
labels_dict (dict): Dictionary mapping dish_ID to labels.
img_height (int): Height of resized images.
img_width (int): Width of resized images.
batch_size (int): Number of samples per batch.
Yields:
images, batch_labels: Arrays of images and corresponding labels.
"""
subfolders = sorted(os.listdir(folder_path)) # Ensure consistent order
while True:
images = []
batch_labels = []
for subfolder in subfolders:
subfolder_path = os.path.join(folder_path, subfolder)
Console 3/A
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.
IPython 8.28.0 -- An enhanced Interactive Python. Type '?' for help.
In [1]:
IPython Console History
Update available Inline Custom: Python311 (Python 3.11.0) LSP: Python Line 190, Col 1 UTF-8 CRLF RW Mem 26%
Sunset
4:12 PM
Search
3:52
12/9




Proof of Concept

- **Food Image Analysis**: Predicts Food Grades using photos.
- **Real-Time Predictions**: Instant feedback to aid dietary choices.
- **Wearable Integration**: Syncs with Fitbit and similar devices for a complete health tracking experience.
- **Customizable Logging**: Allows users to save and track their meals over time.
- **Truly Customizable**: Unlike following a generic diet plan on the web, users would be empowered with information that is generated on wearables in conjecture with NutriTrack.

Model Dictionary & Results

Ideal Macro Ratios	
Fat to Protein	0.5 to 2
Carb to Protein	0.5 to 2

Points Based on Deviation	
Ideal	+10
Very High C/P Ratio	-5
Very High F/P Ratio	-10

Results	
Unseen Picture	**Predicted Grade**
Avocado	B
Pasta	B
Fruit Bowl	B
Unhealthy Food	C

Grade Mapping	
Food Grades	**Score**
A+	20
A	10
B	5
B+	0
C	-5
D	-1
F	-15

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
Image: Avocado.jpg - Predicted Grade: B
Image: Pasta.jpg - Predicted Grade: B
Image: Turkey-Fruit-Plate.jpg - Predicted Grade: B
Image: Unhealthy Food.jpg - Predicted Grade: C
```

Why Us?

- **Competitors**: Calorie Mama, Bite AI, Foodvisor, and Diet Camera AI
- **Differentiators**: Unlike most competitors, our focus is on integrating with wearables like Fitbit and offering a unique selling point for seamless activity and dietary monitoring.

Business Potential

- Partnership with Wearable Brands.
- **4 Potential Revenue Streams**:
  - Subscriptions, Advertisements, Partnerships, & Data Licensing
- **Fitness apps market**:
  - Expected to grow at CAGR of 21.6% from 2021 to 2028.
  - Expected to continue growing at a CAGR of 29.95%, reaching USD 56.29 billion by 2030.
- **Global wellness apps market**:
  - Size was estimated at USD 9.67 billion in 2023
  - Projected to grow at a CAGR of 15.1% from 2024 to 2030

Responsible AI

- **User Data Privacy**:
  - User Data Encryption
  - Possibility to go Incognito
  - Opt-in to Share Data
- **Proactive Ethics:**
  - Transparency about rating scales
  - Encourage consults with physicians
- **Caution:**
  - No dieting behavior nudging
  - No claims of authority or expertise

Impact

Individual: Healthier Lifestyle

- Accountability for personal goals
- Follow-through on provider advice

Society: Fitness & Wellness trends

- Community-building & dish-sharing
- Intercultural, global connections

Legal

Compliance:

Entertainment purposes

No need for FDA approval

Safety:

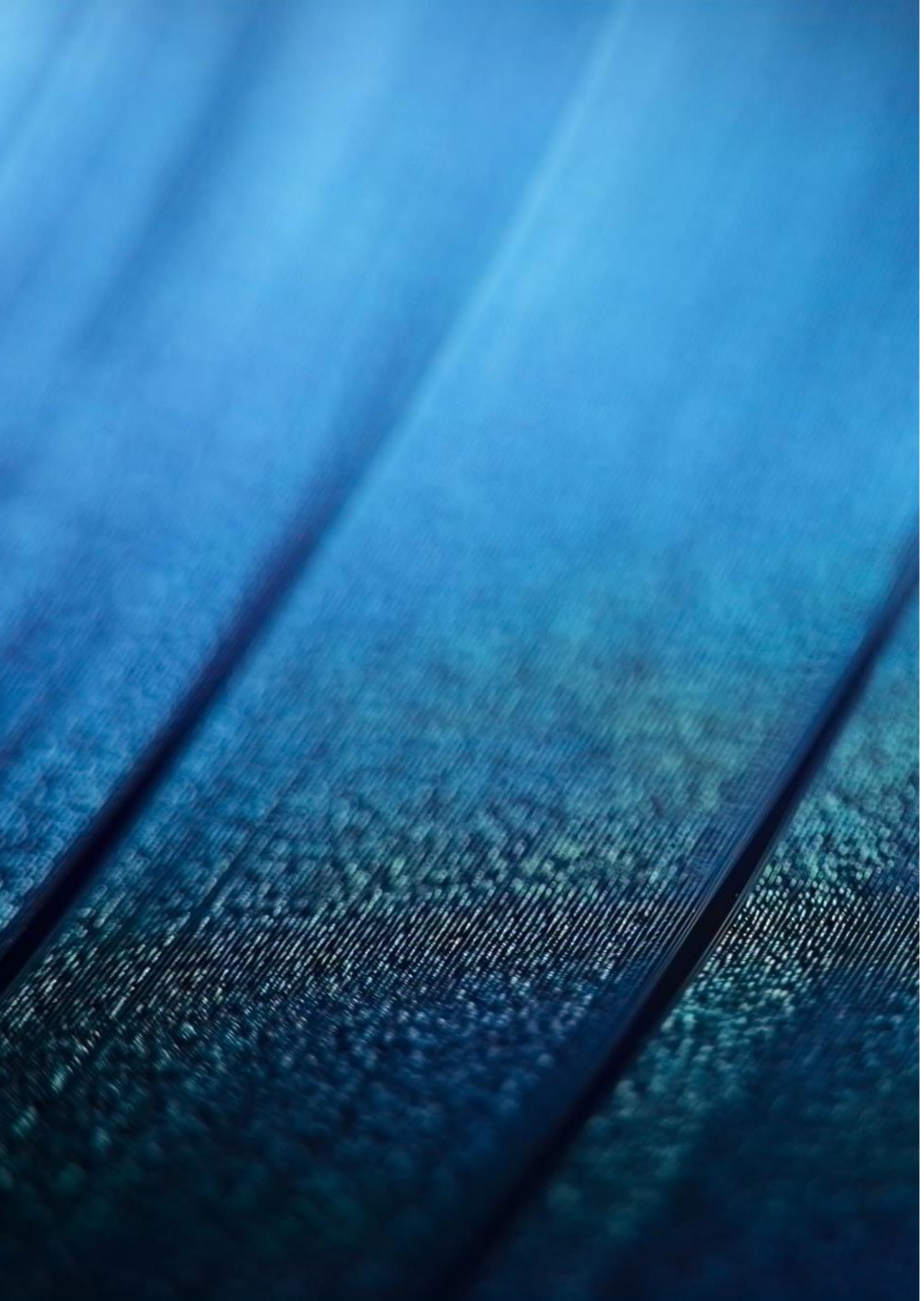
User discretion

Ingestion risks

Intellectual Property:

Trademarks

Copyrights



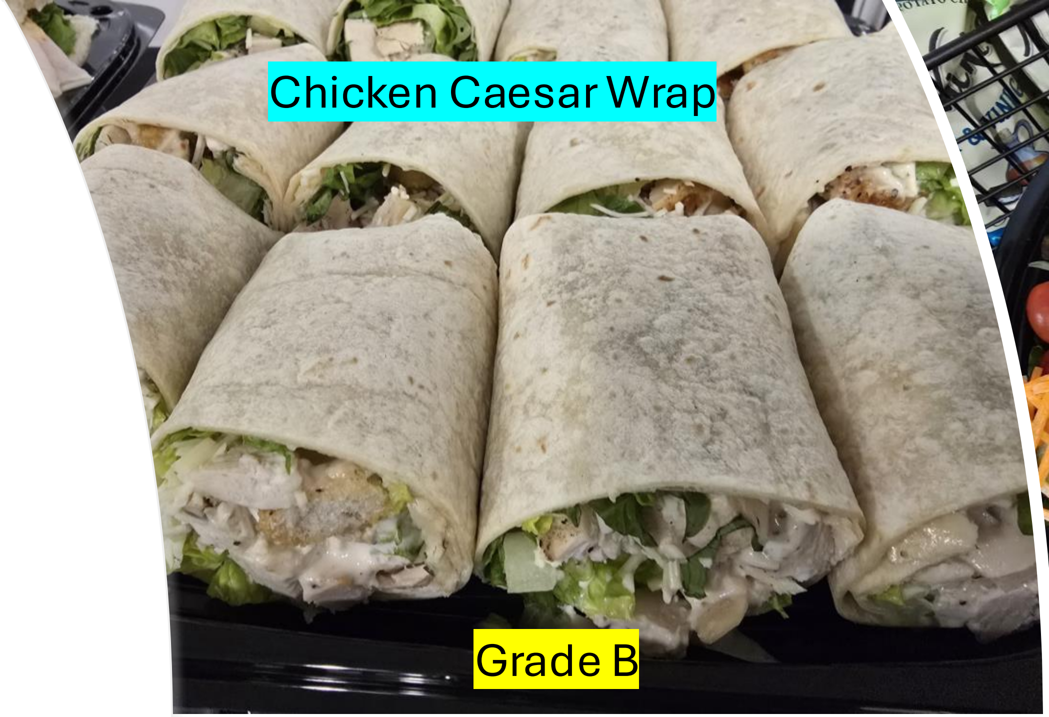
Next Steps

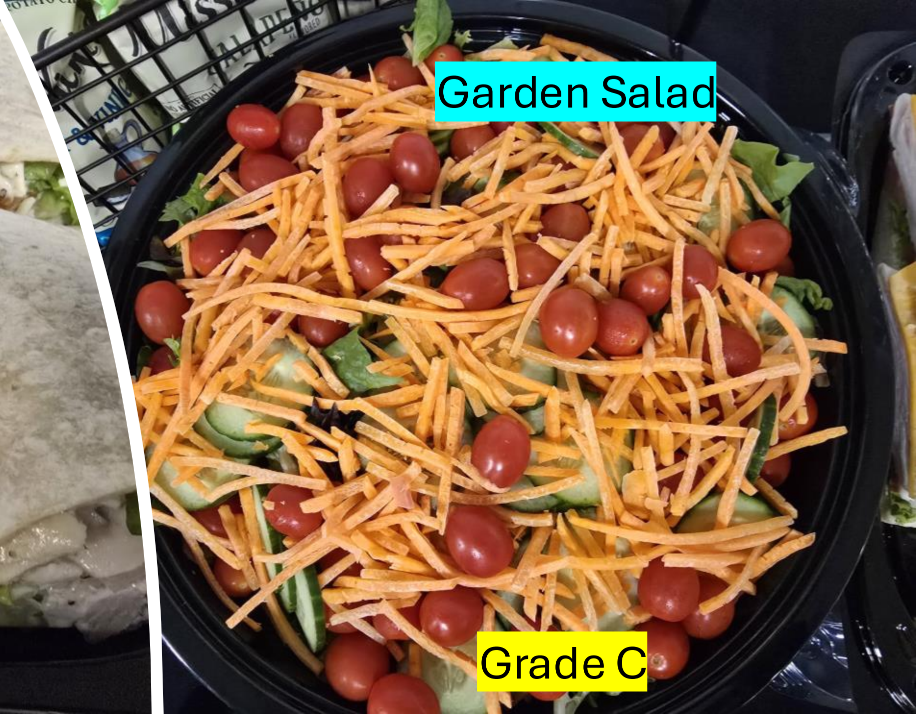
Improving Accuracy of food grade and predict macro nutrients.

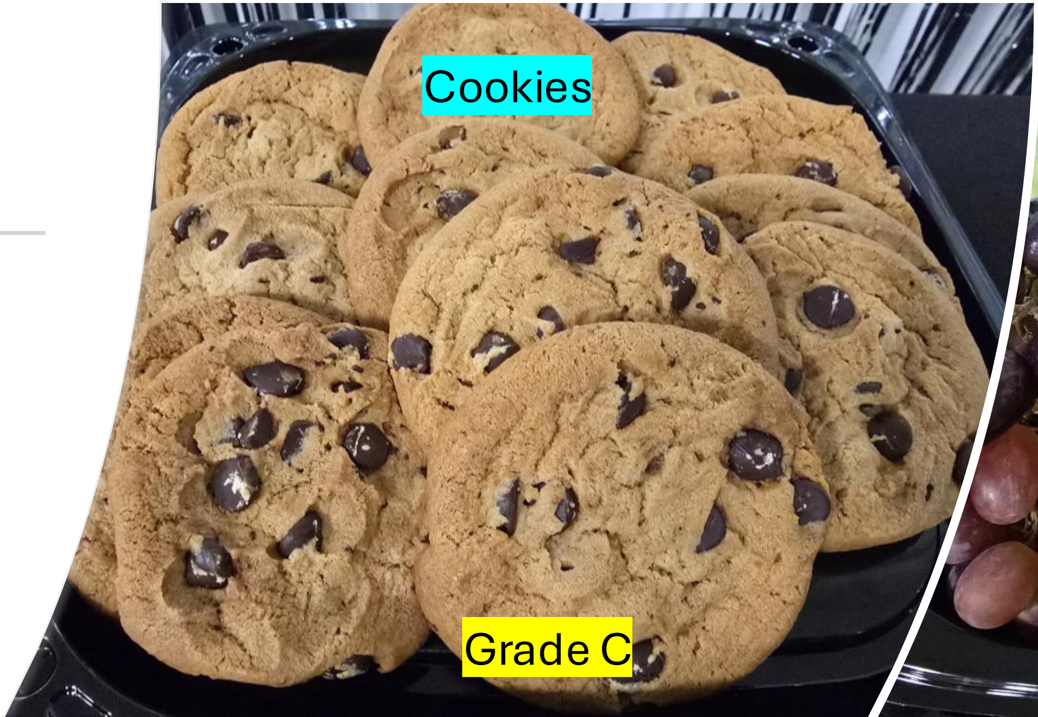
Building a User-Friendly App Interface.

Partnership Outreach with Fitbit, etc.

What is Prof. Luke Making you Eat tonight?







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