Rice Type Classification

Using ResNet50

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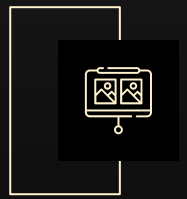
01 Background and Problem Statement

Background

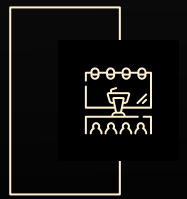
Rice is one of the most important staple foods in the world, consumed by billions of people daily. Different types of rice have distinct characteristics, flavors, and cooking properties, making accurate classification important for both consumers and producers. Traditionally, rice classification relies on manual inspection, which is time-consuming and requires expert knowledge.

With the advancement of artificial intelligence and deep learning, image-based classification has become an effective solution to automate this process. Convolutional Neural Networks, such as ResNet50, can learn complex visual patterns from rice images, providing accurate and consistent classification results. This project aims to leverage AI technology to classify five types of rice, enhancing efficiency and reducing human error.

Problem Statement



1. Manual rice classification is slow and requires expertise.
2. Similar appearance between certain rice types increases the chance of misclassification.
3. There is a need for an AI model that can reliably classify multiple rice types with minimal human intervention.



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Objective and Scope

Objective

1. Develop an AI model using ResNet50 to classify five types of rice: Arborio, Basmati, Ipsala, Jasmine, and Karacadag.
2. Achieve high classification accuracy while minimizing preprocessing requirements.
3. Provide a practical solution that can assist producers and consumers in identifying rice types efficiently.

Scope

1. Focus on image-based classification of the five selected rice types using single-grain images.
2. Use ResNet50 architecture with data augmentation to improve model generalization.
3. Evaluate the model using metrics such as accuracy, confusion matrix, precision, recall, f1 score, and macro f1 score.
4. Limit the study to digital image analysis without physical or chemical rice testing.

03 Data Understanding

Dataset

Kaggle Dataset :
https://www.kaggle.com/datasets/muratkokludataset/rice-image-dataset

- There are 5 types of rice in this dataset: Arborio, Basmati, Ipsala, Jasmine, and Karacadag.
- Each class has 15.000 image data with a total of 75.000 images.

Data Understanding

Train dataset size: 52500 (70%)

Val dataset size: 11250 (15%)

Test dataset size: 11250 (15%)

Train batches: 2188

Val batches: 469

Test batches: 469

Total Classes: 5

Arborio

Basmati

Ipsala

Jasmine

Karacadag

04 Model Development

Model Development

Model	: ResNet 50
Pretrained	: True
Epoch	: 10
Batch Size	: 24
Number of Workers	: 2
Learning Rate	: 1e-4 (Head) / 1e-5 (Backbone)
Layer Frozen	: None
Loss Function	: Cross Entropy Loss
Optimizer	: Adam
GPU	: NVIDIA RTX 3060 Mobile (6 GB VRAM)

Data Augmentation

Training Data

- Resize : 224 × 224
- Random Rotation : ±15 degrees
- Color Jitter : Brightness 0.2, Contrast 0.2
- Random Horizontal Flip : Yes
- Normalize : mean [0.485, 0.456, 0.406], std [0.229, 0.224, 0.225]

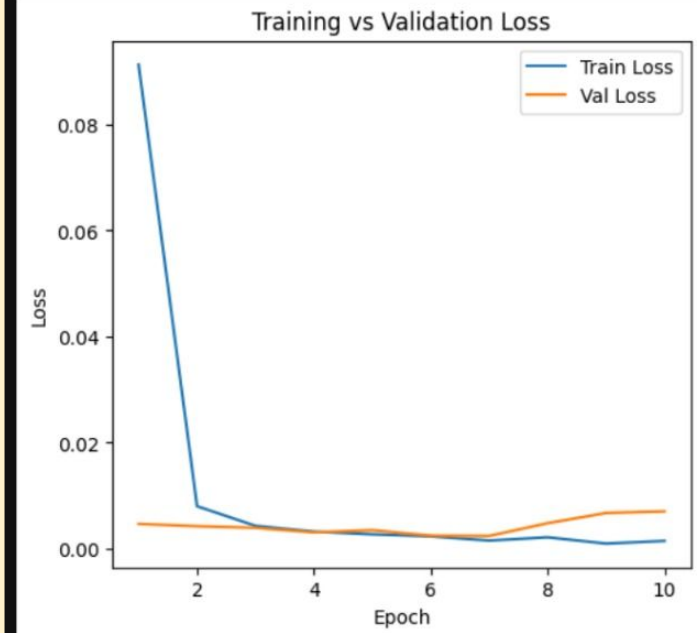
Validation/Test Data

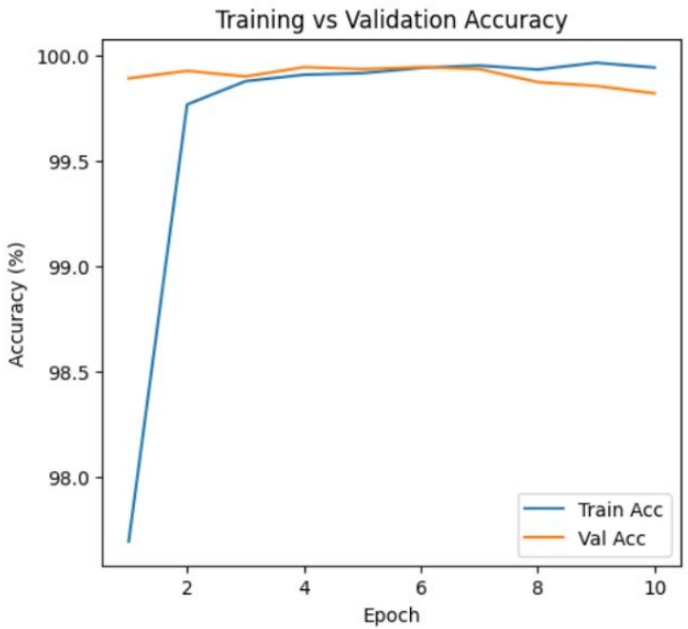
- Resize : 224 × 224
- Normalize : mean [0.485, 0.456, 0.406], std [0.229, 0.224, 0.225]

05 Evaluation

Evaluation

```
Training complete in 74m 22s
Best val Acc: 99.95%
```





Evaluation

```
Epoch 6/10
-------------------

train Loss: 0.0023 Acc: 99.94%
val   Loss: 0.0024 Acc: 99.95%

Epoch 7/10
-------------------

train Loss: 0.0015 Acc: 99.95%
val   Loss: 0.0024 Acc: 99.94%

Epoch 8/10
-------------------

train Loss: 0.0021 Acc: 99.94%
val   Loss: 0.0048 Acc: 99.88%
```

Best Epoch : 6th Epoch

Why?

For model selection, validation accuracy (or validation loss) is what matters most, not training metrics.

- Epoch 6: Val Acc = 99.95%
- Epoch 7: Val Acc = 99.94%

The best epoch is the 6th because it has the highest validation accuracy. Even though epoch 7 has a slightly lower training loss, the validation accuracy is slightly lower.

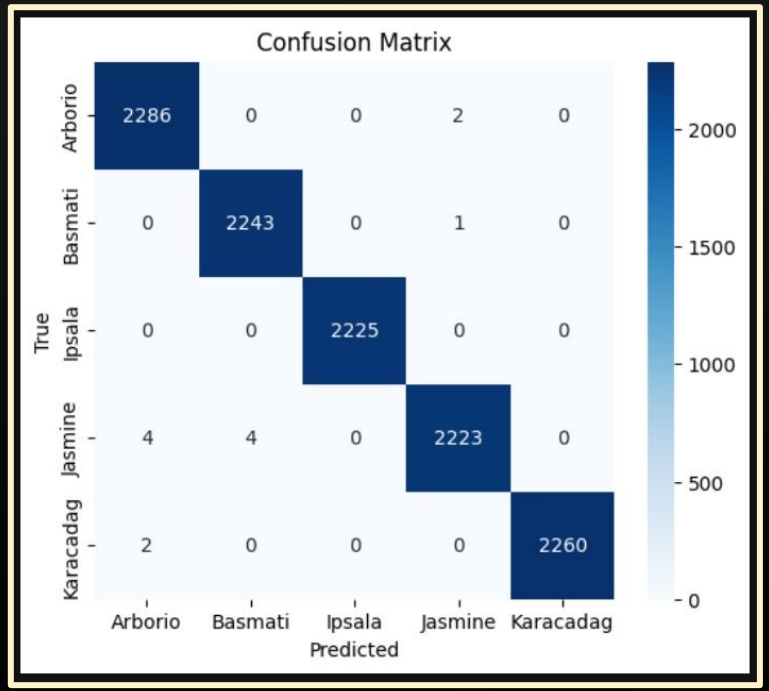
Model Weight Size : 90 MB

Evaluation

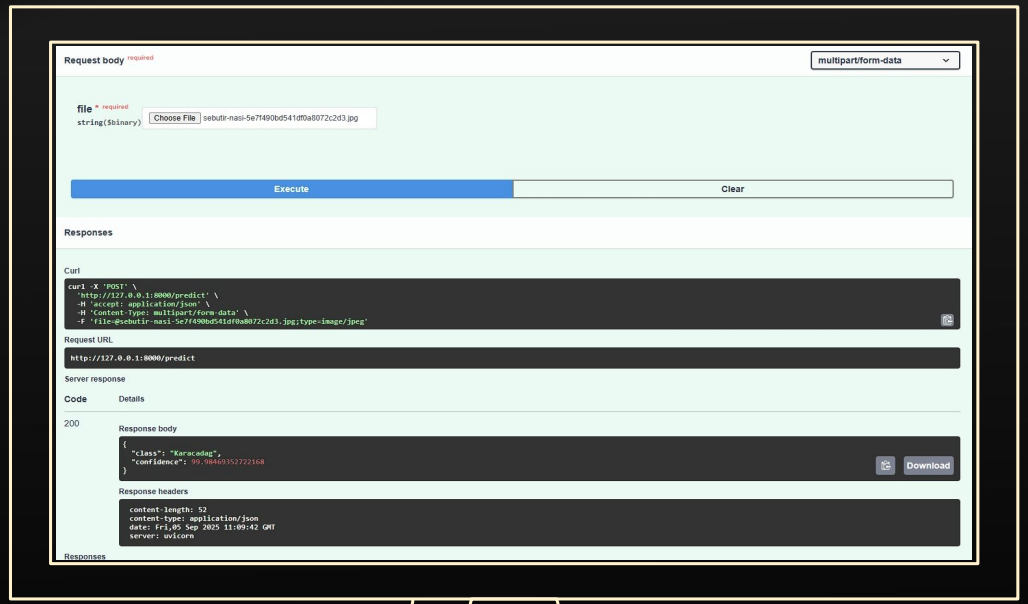
Classification Report:

	precision	recall	f1-score	support
Arborio	0.9974	0.9991	0.9983	2288
Basmati	0.9982	0.9996	0.9989	2244
Ipsala	1.0000	1.0000	1.0000	2225
Jasmine	0.9987	0.9964	0.9975	2231
Karacadag	1.0000	0.9991	0.9996	2262
accuracy			0.9988	11250
macro avg	0.9989	0.9988	0.9988	11250
weighted avg	0.9988	0.9988	0.9988	11250

Macro F1 Score: 0.9988



06 Deployment


Request body required
multipart/form-data
file * required
string($binary)
Choose File
sebutir-nasi-5e7f490bd541df0a8072c2d3.jpg
Execute
Clear
Responses
Curl
curl -X 'POST' \
'http://127.0.0.1:8000/predict' \
-H 'accept: application/json' \
-H 'Content-Type: multipart/form-data' \
-F 'file=@sebutir-nasi-5e7f490bd541df0a8072c2d3.jpg;type=image/jpeg'
Request URL
http://127.0.0.1:8000/predict
Server response
Code
Details
200
Response body
{
"class": "Karacadag",
"confidence": 99.9846935272216
}
Download
Response headers
content-length: 52
content-type: application/json
date: Fri,05 Sep 2025 11:09:42 GMT
server: uvicorn
Responses

FastAPI

07 Conclusion

Conclusion

- Successfully developed an AI model using ResNet50 to classify five rice types: Arborio, Basmati, Ipsala, Jasmine, and Karacadag.
- The model demonstrates that single-grain images can be accurately classified using deep learning techniques.
- Achieved reliable performance as shown by evaluation metrics such as accuracy, confusion matrix, precision, recall, and F1 scores.
- This project highlights the potential of AI in automating rice classification and reducing human error, providing a foundation for future expansion.

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Future Development

Possible Future Development

- Explore semantic or instance segmentation or object detection models to separate and locate individual grains in batch images.
- Expand the dataset to include images with multiple rice grains per image.
- Combine the single-grain ResNet50 model with semantic or instance segmentation and object detection to create a more complex and practical system for multi-grain classification.
- Optimize the model for speed and efficiency for potential industrial use.

Thank You!