From Pixels to plates: assessing resnet-50 and resnet-101 models for food image classification in the food-101 dataset

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# Abstract

In this study, we investigate the performance of deep learning models, specifically ResNet-50 and ResNet-101, in classifying images from the Food-101 dataset, a comprehensive collection comprising 1000 images across 101 distinct food categories. Our aim was to determine the effectiveness of these models in recognizing various food items, with a particular focus on optimizing hyperparameters to enhance classification accuracy. Through rigorous experimentation and analysis, we achieved an average accuracy of 82.91% with the ResNet-50 model and an improved accuracy of 84.02% with the ResNet-101 model. These results underscore the potential of ResNet architectures in the domain of image classification, especially in the context of food recognition. Our findings contribute valuable insights into the optimization of deep learning models for the accurate classification of complex image datasets. This paper provides a comprehensive comparison and offers guidance for future research in the field of food image classification using deep learning approaches.

**Keywords—** Image classification, ResNet models, ResNet-50, ResNet-101, Food recognition

# 1. Introduction

At the crossroads of culinary arts and technological innovation stands a burgeoning field: the automated identification of meals through the lens of food photography. As digital solutions increasingly become integral to daily routines, the demand for advanced algorithms capable of precisely identifying and classifying a wide spectrum of food items has never been more critical. This requirement transcends mere convenience, touching on vital areas including health, education, commercial activities, and fostering community ties.

The adoption of food recognition technologies into systems for monitoring nutrition and managing dietary habits underscores its significant impact. Amidst a global surge in obesity and diet-related health issues, the simple act of logging dietary intake with a photo offers a powerful tool for individuals aiming to adopt healthier lifestyles. Additionally, with the rise of gastronomic curiosity worldwide, there’s an expanding appetite for apps capable of offering recipe ideas, dining suggestions, and meal planning assistance tailored to specific dietary needs and preferences.

The utility of automatic food identification goes beyond personal health and enjoyment, extending into practical applications like inventory management within homes and commercial establishments. This facilitates more effective resource utilization and contributes to reducing food wastage. In the educational sector, this technology acts as a gateway to learning about the rich tapestry of global cuisines and cultures, enriching the knowledge and appreciation of students of all ages.

Yet, the task of food recognition poses distinctive challenges. Food items exhibit considerable variation in appearance due to differences in preparation, presentation, and ingredients, necessitating highly adaptable and robust models. The immense diversity found in cuisines around the world further complicates this task, requiring models to be trained on extensive datasets that accurately reflect this range to ensure inclusiveness and precision.

Addressing these challenges and leveraging the extensive application potential necessitates the creation of sophisticated models. These models must not only navigate the intricate aspects of food recognition with finesse but also be accessible, efficient, and user-friendly. Their development is poised to fundamentally change our interaction with food, promising benefits that span from personal health to global food industry insights and environmental sustainability.

Confronting the inherent challenges of this domain, such as variability in food presentation and the breadth of global cuisine, our research centers on refining, testing, and enhancing models to achieve better accuracy and efficiency.

Our examination primarily involves the ResNet-50 and ResNet-101 architectures, selected for their demonstrated excellence in various image classification challenges. These models undergo rigorous testing using the Food-101 dataset, which consists of 1000 images from 101 distinct categories of food, embodying a broad spectrum of international dishes. Our goal is to evaluate the foundational accuracy of these models in identifying foods and to investigate how alterations in hyperparameters might boost their effectiveness.

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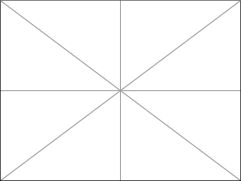
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**Fig. 1.** Example of placing a figure with experimental results.

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