



Democratic People's Republic of Algeria
University of Higher Education and Research DJILALI LIABES Sidi Bel Abbes
Faculty of Natural and Life Sciences
Department of Biology

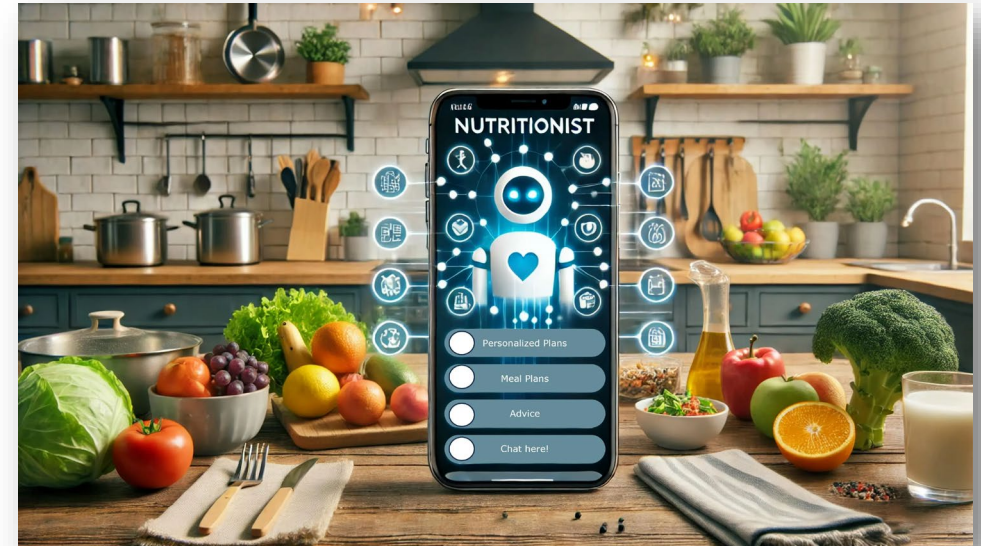


2nd year Master in Nutrition and pathology

Module: Nutritional Assessment Methodologies

Role of Ai in nutrition assessment tools

Presented by: Maroc Abir
Coordinator: Pr. Khaled Meghit



2024/2025



Introduction

Work Plan

- ❑ Traditional nutrition assessment tools;
 - ❑ Fundamentals of AI in healthcare;
 - ❑ Ai in nutrition assessment;
 - ❑ Application of AI in nutrition assessment;
 - ❑ Example of AI apps in nutrition assessment;
 - ❑ Challenges and limitations of AI;
 - ❑ Future directions;
 - ❑ Conclusion;
 - ❑ References.
-

Traditional nutrition assessment tools

- **Dietary Recall:** A method where individuals recall what they've eaten in a specific period.
- **Food Frequency Questionnaire (FFQ):** A questionnaire that collects information on the frequency of consumption of various foods.
- **24-Hour Recall:** A detailed recall of all foods and drinks consumed in the last 24 hours.



Fundamentals of Ai in healthcare

➤ *AI Definition:*

Artificial Intelligence (AI) is a branch of computer science that aims to create intelligent machines capable of simulating human-like cognitive functions, including:

Learning

Problem-solving

Decision-making

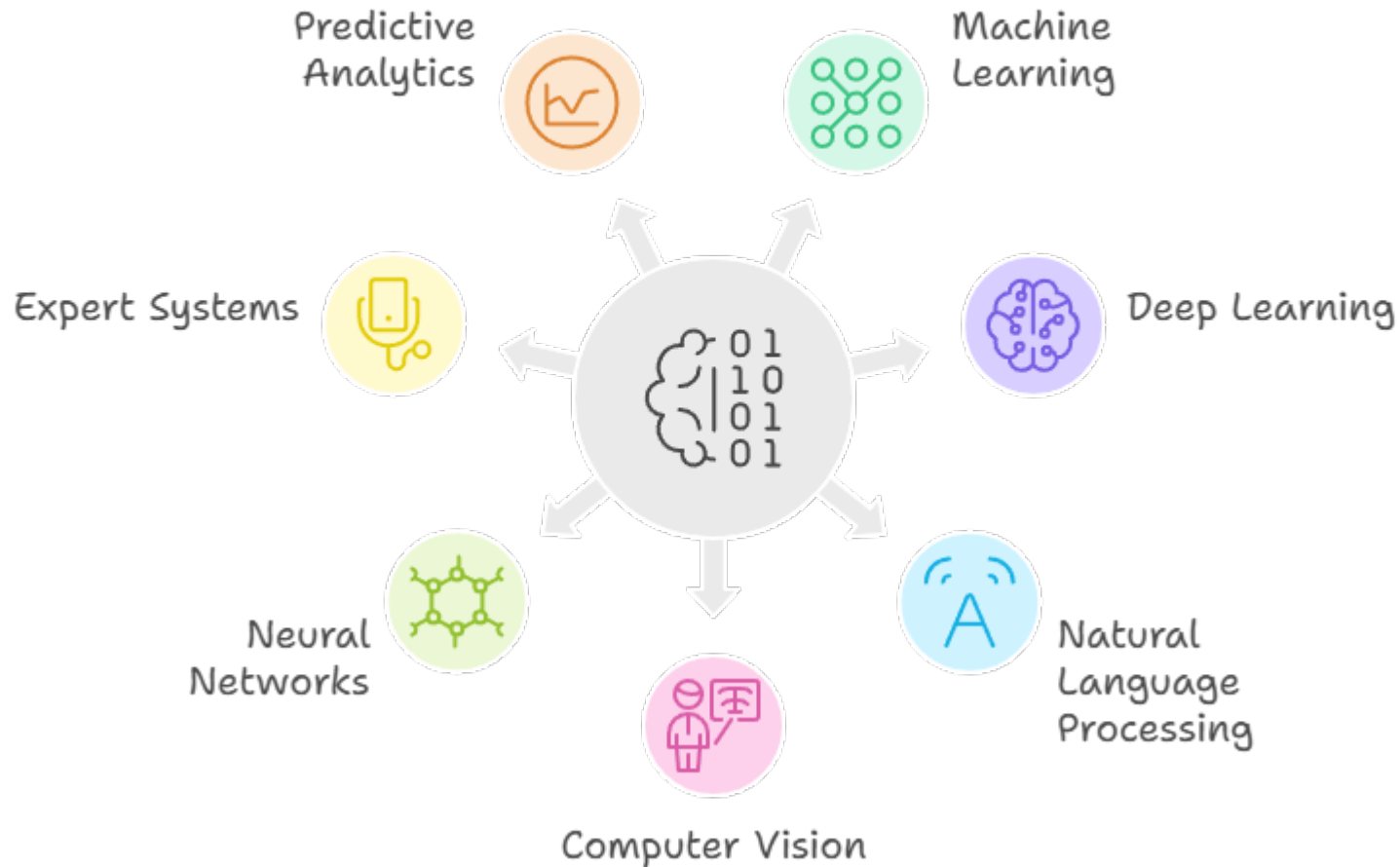
Pattern recognition



Fundamentals of Ai in healthcare

➤ *Key AI Technologies in Healthcare*

AI Technologies in Healthcare



AI in Nutrition Assessment

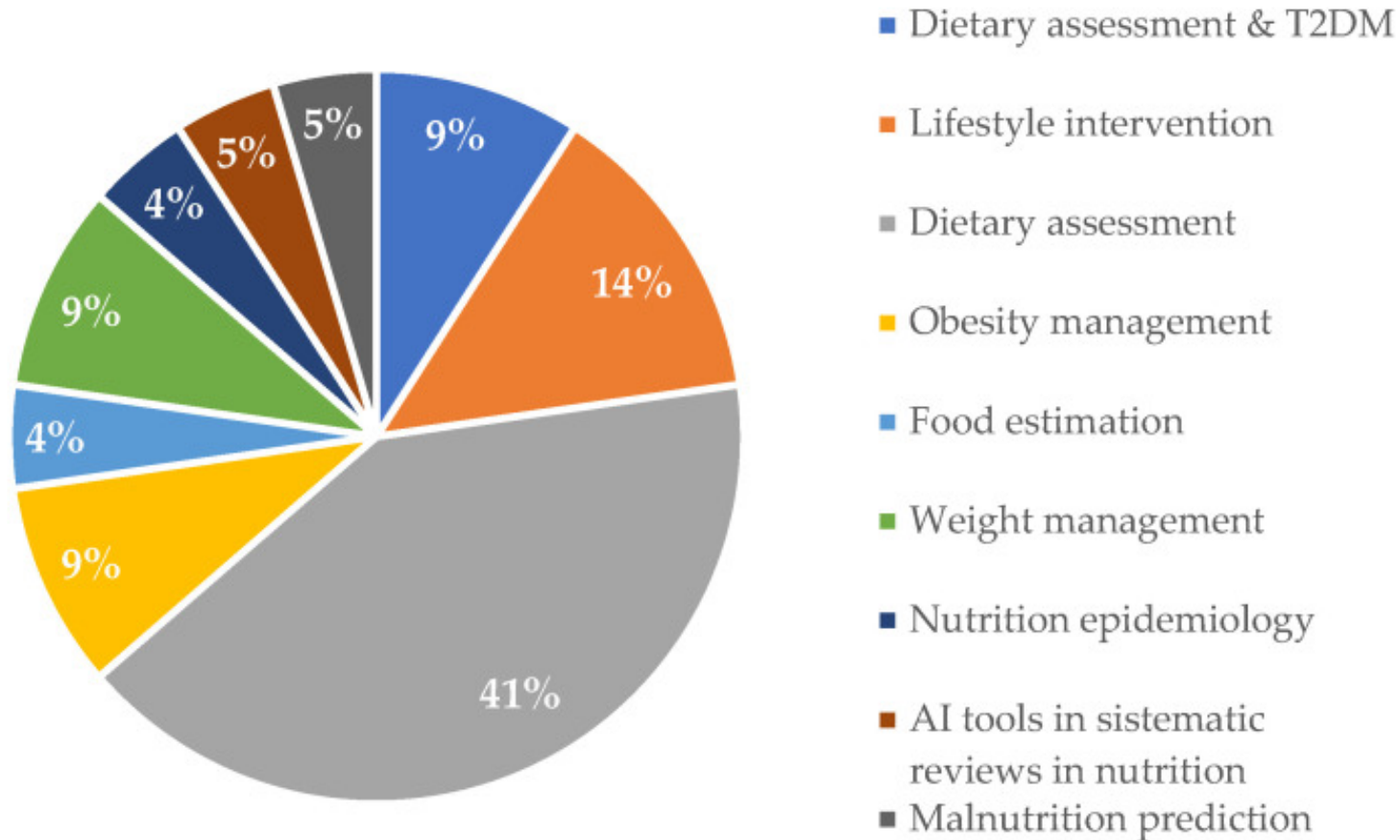


Figure: Nutrition areas in which the included articles used artificial intelligence.

AI in Nutrition Assessment

➤ *Machine Learning Algorithms*

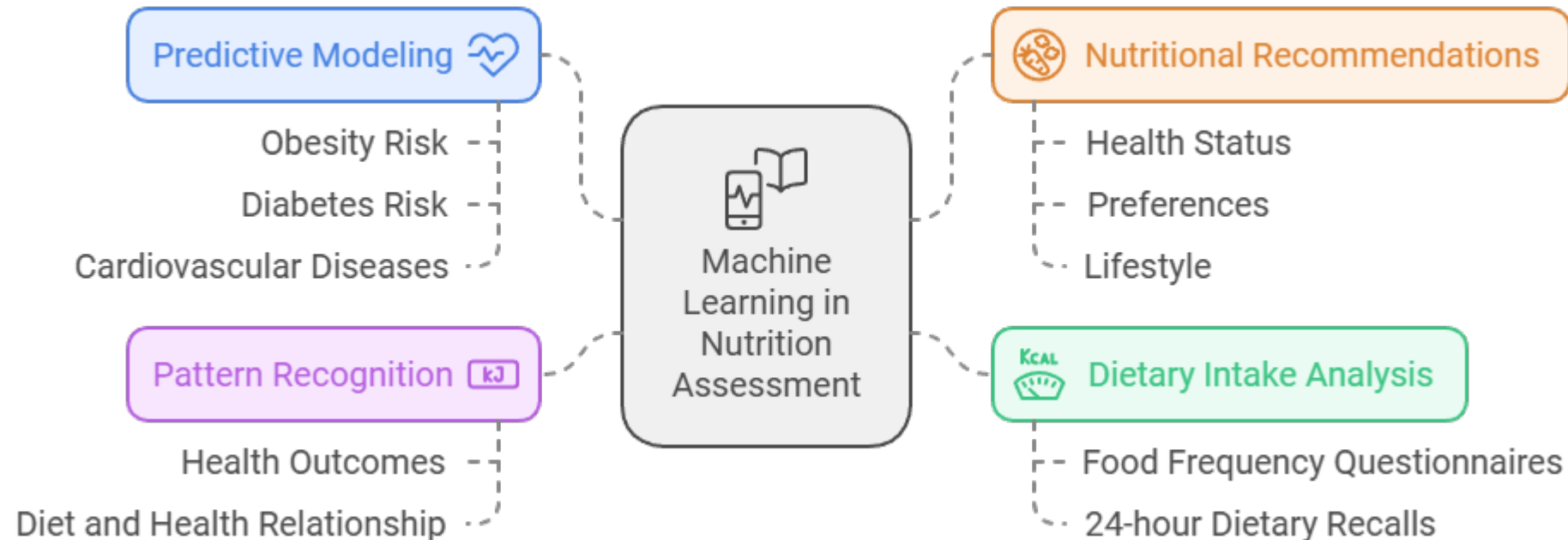
Machine learning refers to algorithms that enable computers to learn from and make predictions based on data. In nutrition, ML can analyze large datasets to identify patterns and trends related to dietary habits and health outcomes.

AI in Nutrition Assessment

➤ *Machine Learning Algorithms*

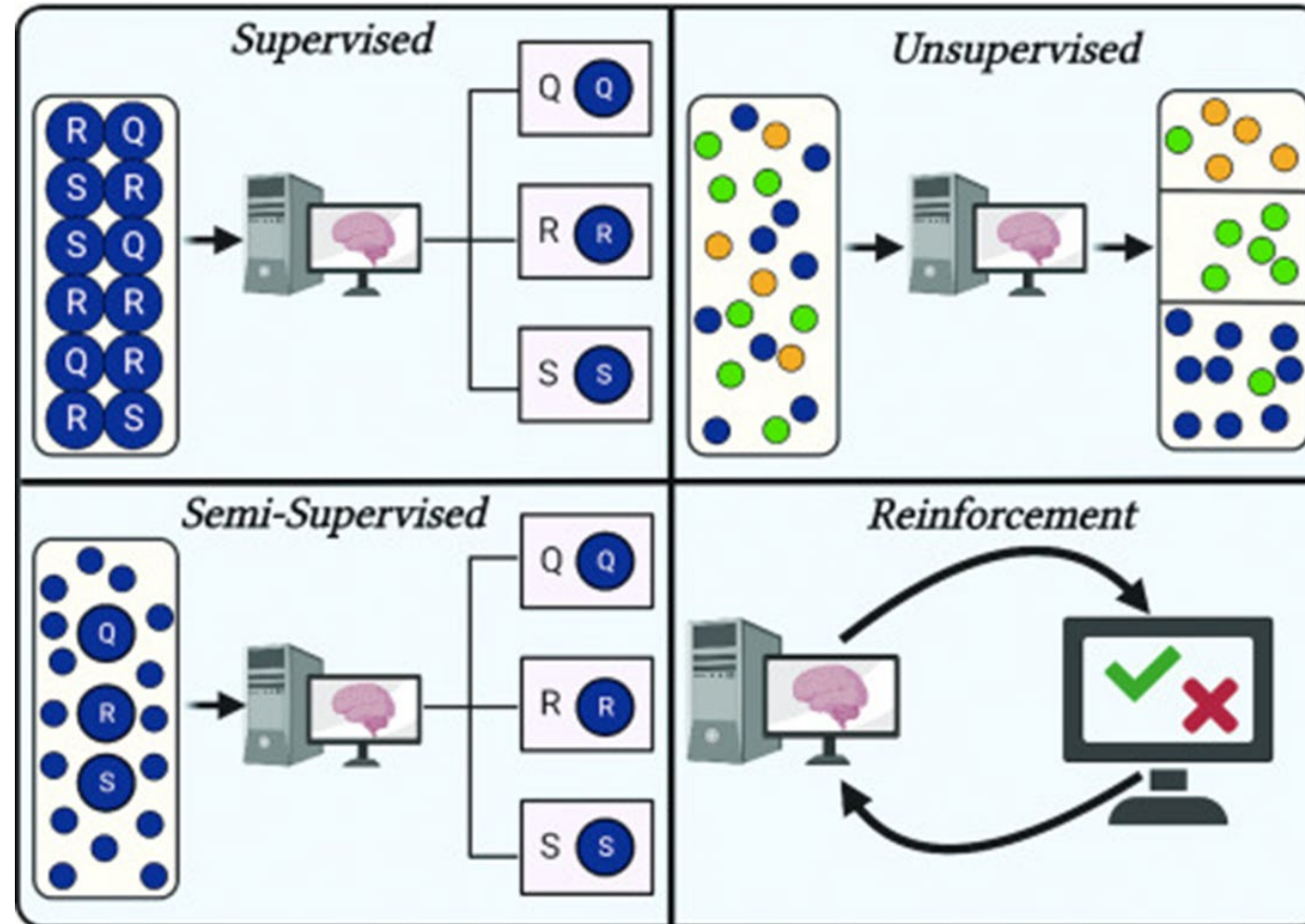
Machine learning refers to algorithms that enable computers to learn from and make predictions based on data. In nutrition, ML can analyze large datasets to identify patterns and trends related to dietary habits and health outcomes.

➤ *Applications of Machine Learning in Nutrition Assessment*



AI in Nutrition Assessment

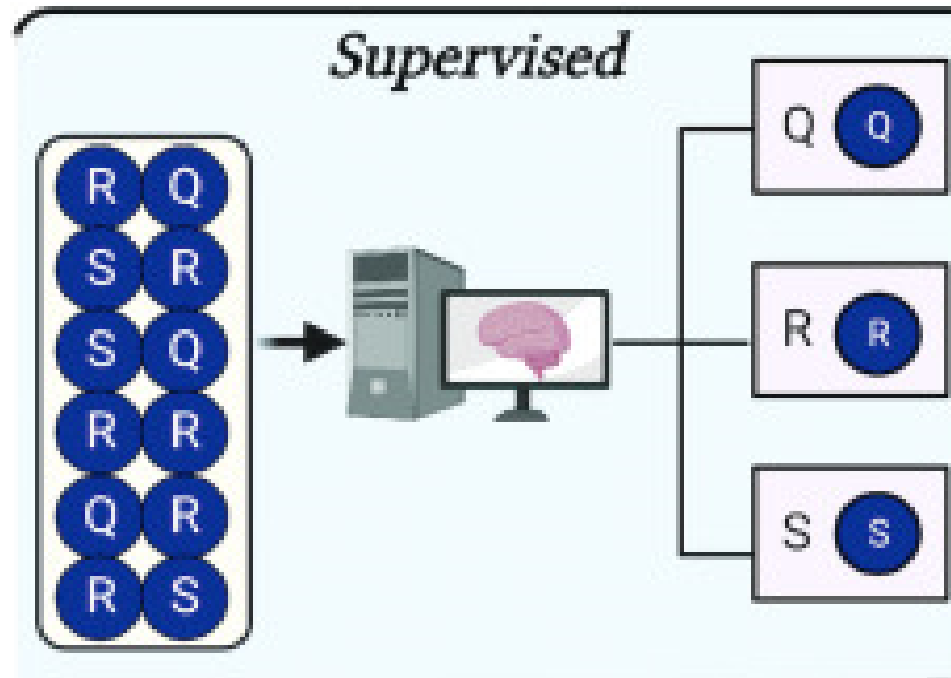
➤ *Types of Machine Learning Algorithms Utilized*



AI in Nutrition Assessment

➤ *Applications of Supervised Learning in Nutrition Assessment*

- ✓ Food Intake Analysis;
- ✓ Nutritional Risk Prediction;
- ✓ Data Sources;
- ✓ Tools and Techniques.

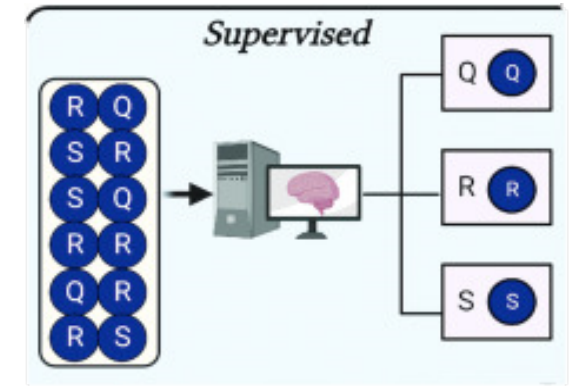


AI in Nutrition Assessment

➤ *Applications of Supervised Learning in Nutrition Assessment*

✓ Food Intake Analysis:

Supervised learning algorithms are frequently applied to analyze dietary data collected through food frequency questionnaires (FFQs).



AI in Nutrition Assessment

➤ *Applications of Supervised Learning in Nutrition Assessment*

✓ Food Intake Analysis:

Supervised learning algorithms are frequently applied to analyze dietary data collected through food frequency questionnaires (FFQs).

✓ Nutritional Risk Prediction:

Machine learning models, such as support vector machines (SVM), are utilized to predict nutritional risks based on various factors, including demographic data and clinical assessments.

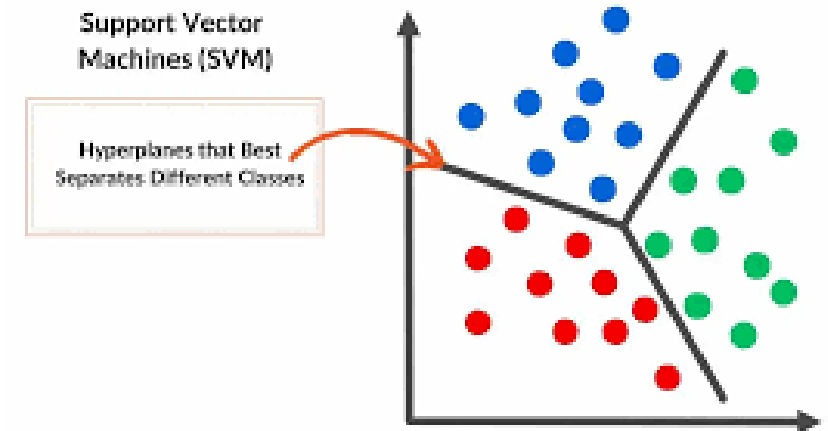
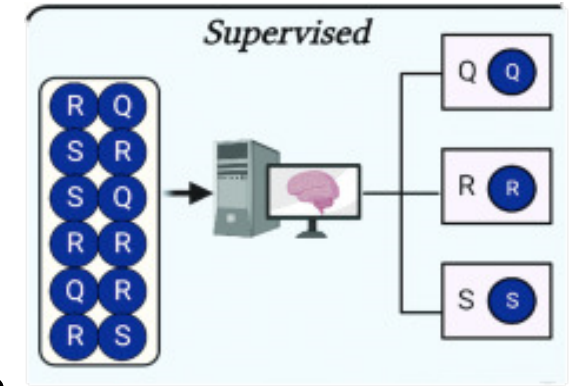


Figure: Support vector machines algorithm

AI in Nutrition Assessment

➤ *Applications of Supervised Learning in Nutrition Assessment*

✓ Food Intake Analysis:

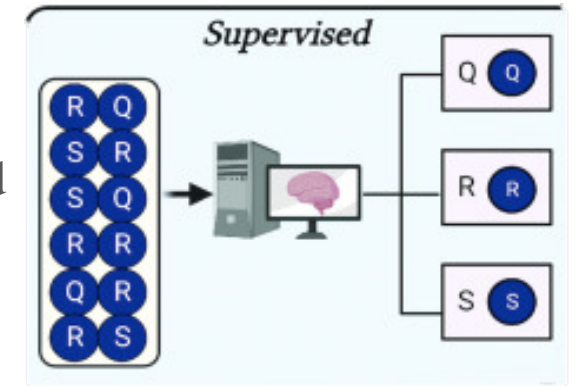
Supervised learning algorithms are frequently applied to analyze dietary data collected through food frequency questionnaires (FFQs).

✓ Nutritional Risk Prediction:

Machine learning models, such as support vector machines (SVM), are utilized to predict nutritional risks based on various factors, including demographic data and clinical assessments.

✓ Data Sources:

Large datasets from electronic health records, dietary surveys, and clinical trials are used to train supervised learning models.



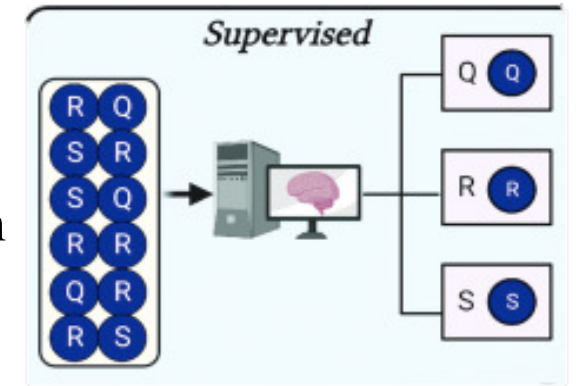
AI in Nutrition Assessment

➤ *Applications of Supervised Learning in Nutrition Assessment*

✓ Tools and Techniques:

Commonly utilized tools include programming languages like Python, along with libraries such as scikit-learn for implementing machine learning algorithms.

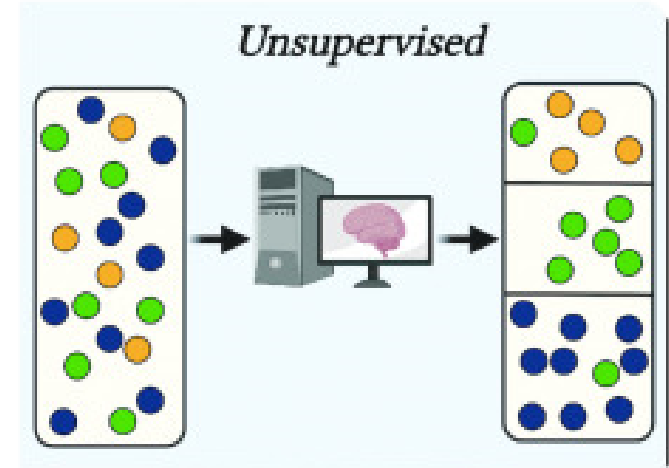
Techniques like principal component analysis (PCA) are employed for dimensionality reduction, improving model performance.



AI in Nutrition Assessment

➤ *Applications of unsupervised learning in nutrition assessment*

- ✓ Clustering Dietary Patterns;
- ✓ Nutritional Profiling;
- ✓ Dimensionality Reduction;
- ✓ Anomaly Detection;
- ✓ Market Basket Analysis.



AI in Nutrition Assessment

➤ *Applications of unsupervised learning in nutrition assessment*

✓ **Clustering Dietary Patterns**

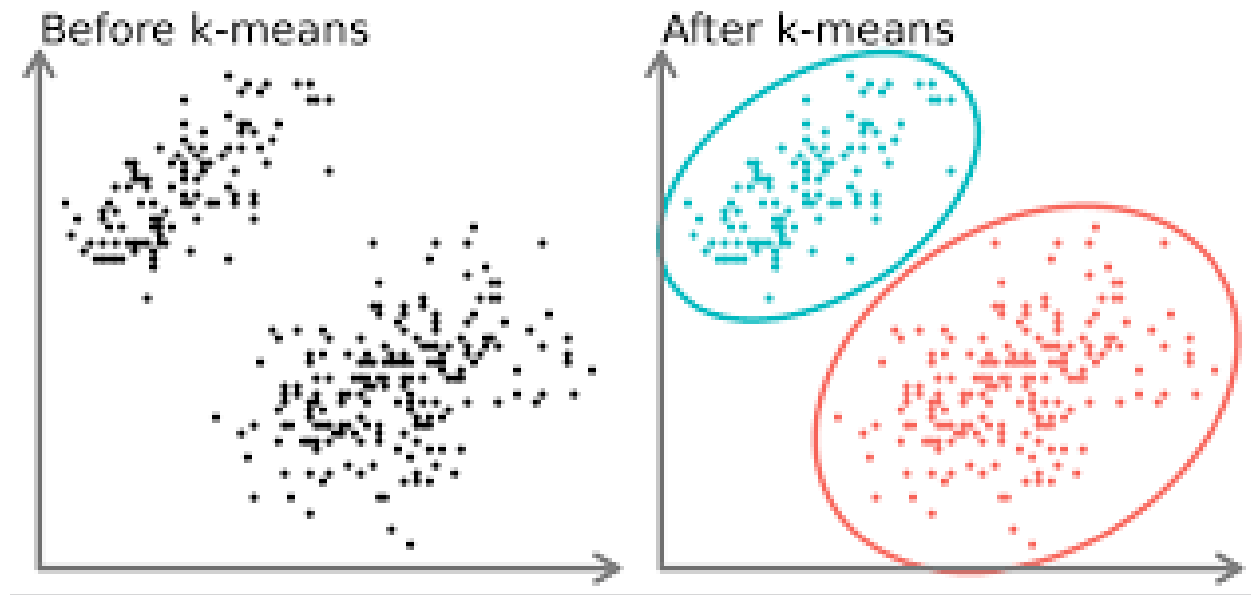


Figure: K-means Clustering Algorithm

AI in Nutrition Assessment

➤ *Applications of unsupervised learning in nutrition assessment*

✓ **Nutritional Profiling**

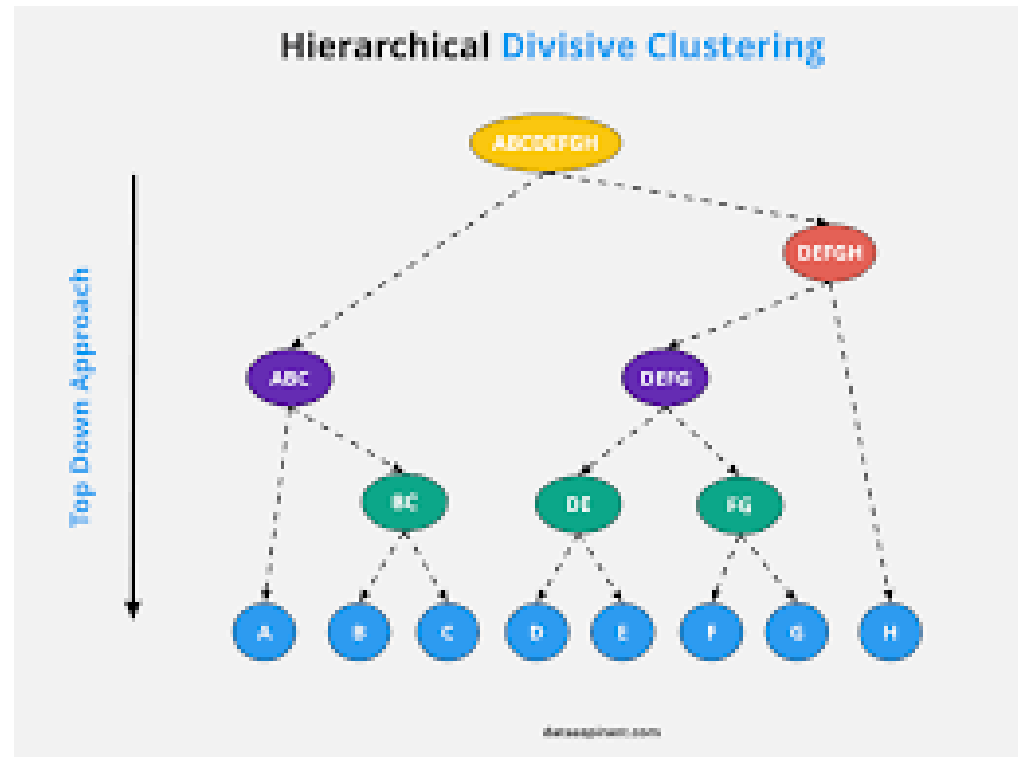


Figure: Hierarchical Clustering

AI in Nutrition Assessment

➤ *Applications of unsupervised learning in nutrition assessment*

✓ Dimensionality Reduction

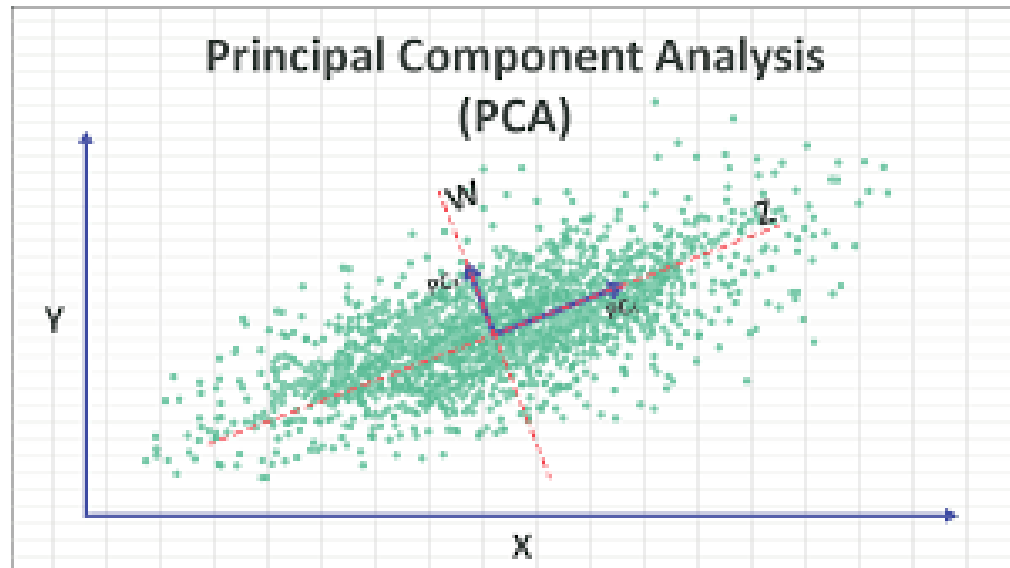


Figure: Principal component analysis

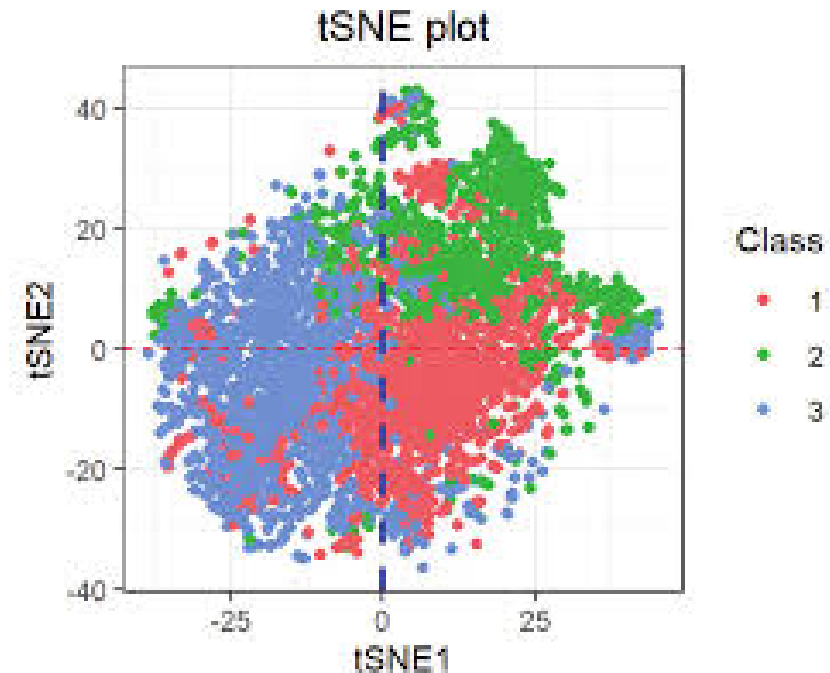


Figure: t-distributed stochastic neighbor embedding

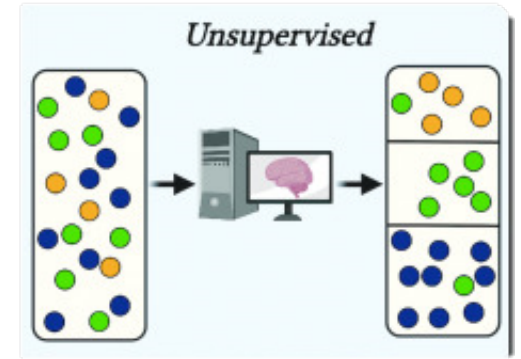
AI in Nutrition Assessment

➤ *Applications of unsupervised learning in nutrition assessment*

- ✓ Clustering Dietary Patterns;
- ✓ Nutritional Profiling;
- ✓ Dimensionality Reduction;
- ✓ **Anomaly Detection:**

Unsupervised learning can help identify outliers in dietary data, such as unusual eating patterns or extreme nutrient intakes.

- ✓ Market Basket Analysis.



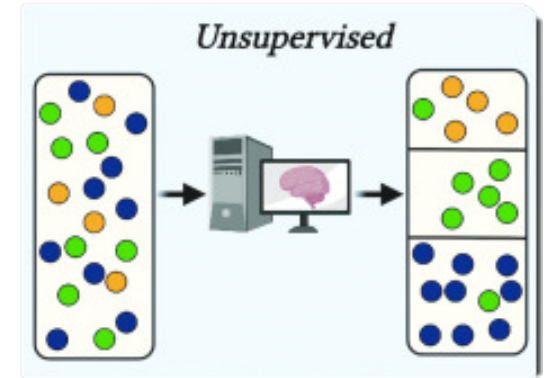
AI in Nutrition Assessment

➤ *Applications of unsupervised learning in nutrition assessment*

- ✓ Clustering Dietary Patterns;
- ✓ Nutritional Profiling;
- ✓ Dimensionality Reduction;
- ✓ Anomaly Detection;

✓ **Market Basket Analysis:**

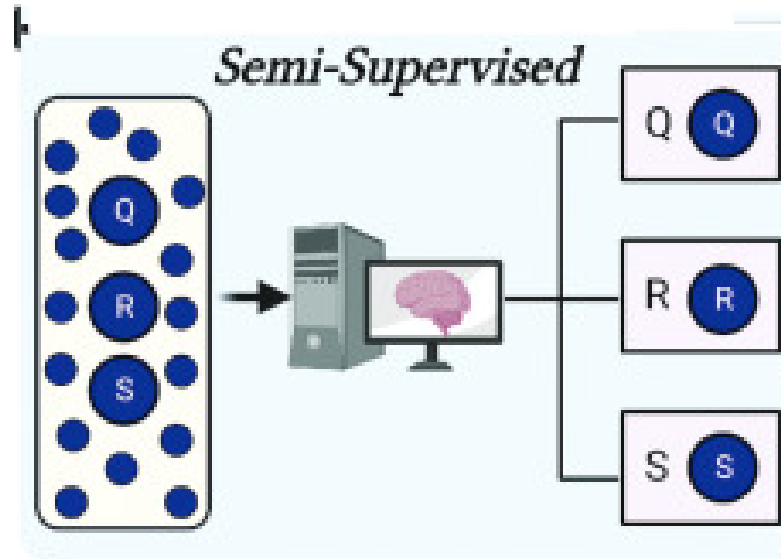
In the context of nutrition, unsupervised learning can analyze consumer purchasing behavior to identify common food combinations.



AI in Nutrition Assessment

➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

- ✓ Dietary Pattern Recognition;
- ✓ Nutritional Risk Assessment;
- ✓ Food Image Classification;
- ✓ Behavioral Pattern Analysis;
- ✓ Nutrient Intake Estimation;
- ✓ Personalized Nutrition Recommendations.

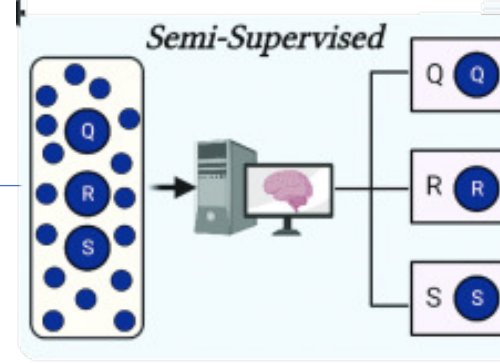


AI in Nutrition Assessment

➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

✓ Dietary Pattern Recognition:

SSL can be utilized to identify dietary patterns from food intake data, such as food frequency questionnaires (FFQs) or 24-hour dietary recalls.



AI in Nutrition Assessment

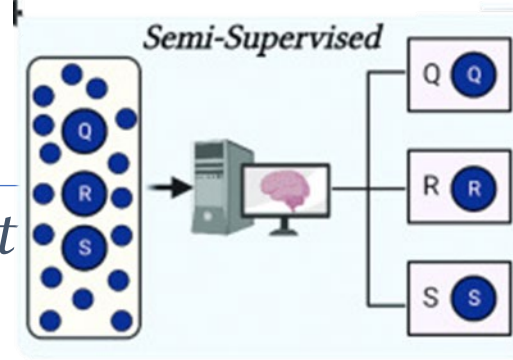
➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

✓ Dietary Pattern Recognition:

SSL can be utilized to identify dietary patterns from food intake data, such as food frequency questionnaires (FFQs) or 24-hour dietary recalls

✓ Nutritional Risk Assessment:

SSL can help in predicting nutritional risks by integrating both labeled and unlabeled data.



AI in Nutrition Assessment

➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

✓ Dietary Pattern Recognition:

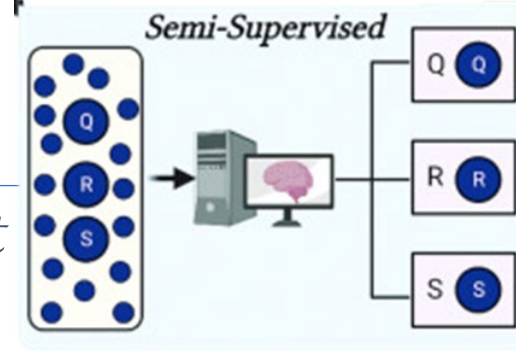
SSL can be utilized to identify dietary patterns from food intake data, such as food frequency questionnaires (FFQs) or 24-hour dietary recalls

✓ Nutritional Risk Assessment:

SSL can help in predicting nutritional risks by integrating both labeled and unlabeled data.

✓ Food Image Classification:

In studies where food images are analyzed (e.g., using smartphone apps for dietary tracking), SSL can be used to classify food items from images. A small number of labeled images (e.g., identified food items) can be combined with a large number of unlabeled images to improve classification accuracy.

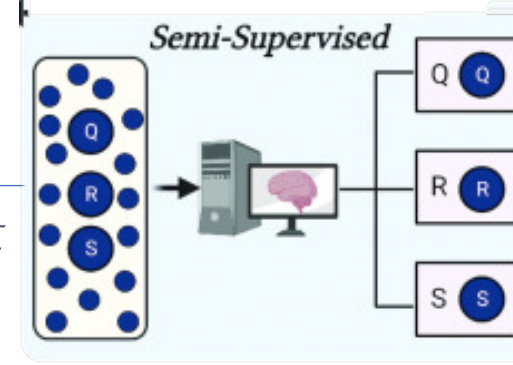


AI in Nutrition Assessment

➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

✓ Behavioral Pattern Analysis:

SSL can be applied to analyze behavioral patterns in eating habits, using a combination of labeled data (e.g., surveys indicating specific behaviors) and unlabeled data (e.g., sensor data from wearable devices).



AI in Nutrition Assessment

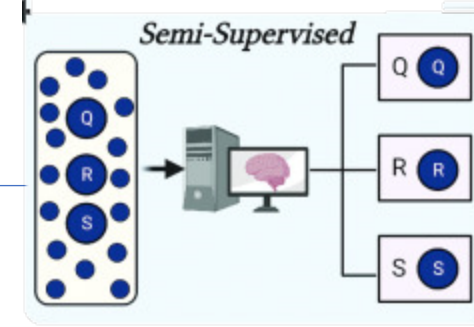
➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

✓ Behavioral Pattern Analysis:

SSL can be applied to analyze behavioral patterns in eating habits, using a combination of labeled data (e.g., surveys indicating specific behaviors) and unlabeled data (e.g., sensor data from wearable devices).

✓ Nutrient Intake Estimation:

SSL can be employed to estimate nutrient intake levels from dietary data, where only a portion of the data is labeled with specific nutrient values.



AI in Nutrition Assessment

➤ *Applications of semi-Supervised Learning in Nutrition Assessment*

✓ Behavioral Pattern Analysis:

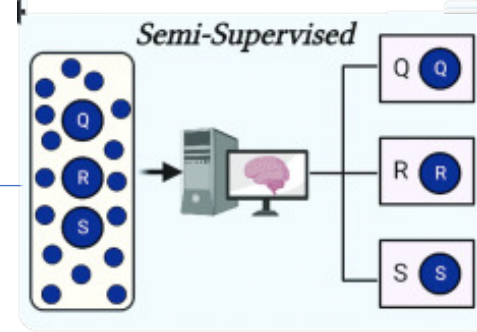
SSL can be applied to analyze behavioral patterns in eating habits, using a combination of labeled data (e.g., surveys indicating specific behaviors) and unlabeled data (e.g., sensor data from wearable devices).

✓ Nutrient Intake Estimation:

SSL can be employed to estimate nutrient intake levels from dietary data, where only a portion of the data is labeled with specific nutrient values.

✓ Personalized Nutrition Recommendations:

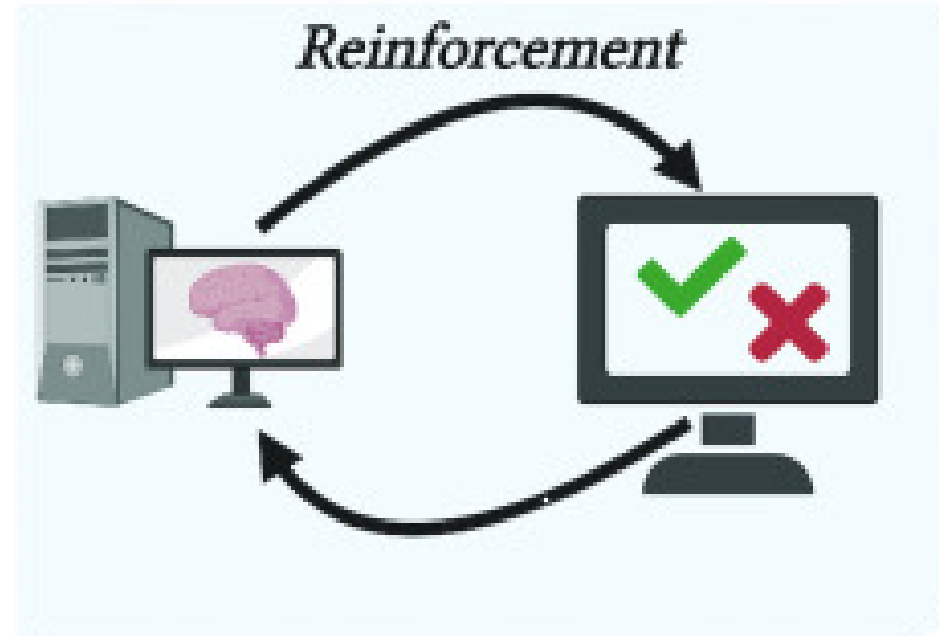
By combining labeled data from individuals with specific dietary needs (e.g., diabetic patients) and a larger pool of unlabeled data from the general population, SSL can help create personalized nutrition recommendations.



AI in Nutrition Assessment

➤ *Applications of reinforcement Learning in Nutrition Assessment*

- ✓ Personalized Meal Recommendations;
- ✓ Dynamic Dietary Interventions;
- ✓ Behavior Modification Strategies;
- ✓ Nutritional Education and Engagement;
- ✓ Food Waste Reduction;
- ✓ Monitoring and Feedback Systems.

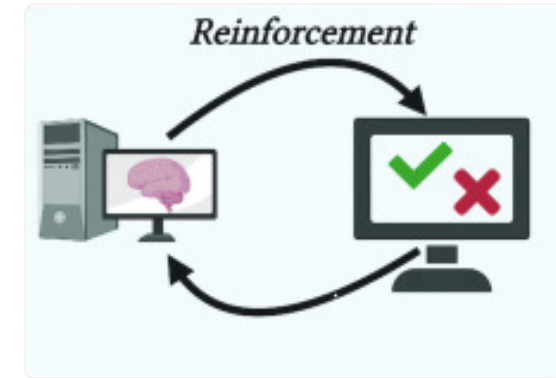


AI in Nutrition Assessment

➤ *Applications of reinforcement Learning in Nutrition Assessment*

✓ Personalized Meal Recommendations:

RL algorithms can be utilized to develop personalized meal plans based on individual dietary preferences, nutritional needs, and health goals. The agent learns from user feedback on meal satisfaction and health outcomes to optimize future recommendations.



AI in Nutrition Assessment

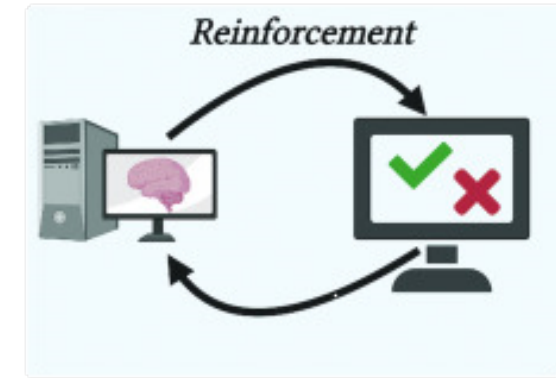
➤ *Applications of reinforcement Learning in Nutrition Assessment*

✓ Personalized Meal Recommendations:

RL algorithms can be utilized to develop personalized meal plans based on individual dietary preferences, nutritional needs, and health goals. The agent learns from user feedback on meal satisfaction and health outcomes to optimize future recommendations.

✓ Dynamic Dietary Interventions:

RL can facilitate dynamic dietary interventions by continuously adapting recommendations based on real-time data, such as changes in health status or dietary habits. The agent learns which interventions are most effective for different individuals over time.



AI in Nutrition Assessment

➤ *Applications of reinforcement Learning in Nutrition Assessment*

✓ Personalized Meal Recommendations:

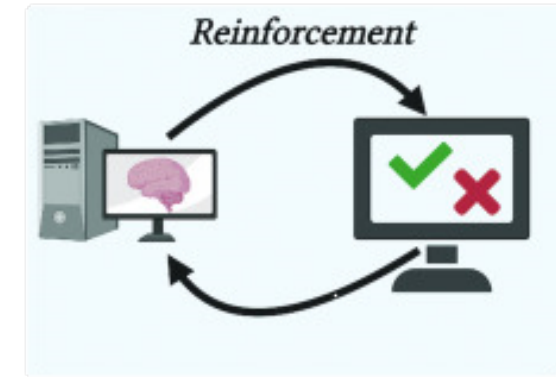
RL algorithms can be utilized to develop personalized meal plans based on individual dietary preferences, nutritional needs, and health goals. The agent learns from user feedback on meal satisfaction and health outcomes to optimize future recommendations.

✓ Dynamic Dietary Interventions:

RL can facilitate dynamic dietary interventions by continuously adapting recommendations based on real-time data, such as changes in health status or dietary habits. The agent learns which interventions are most effective for different individuals over time.

✓ Behaviors Modification Strategies:

RL can be employed to design behavior modification strategies that encourage healthier eating habits. By rewarding positive behaviors (e.g., choosing fruits over sweets), the agent can help users develop better dietary choices.

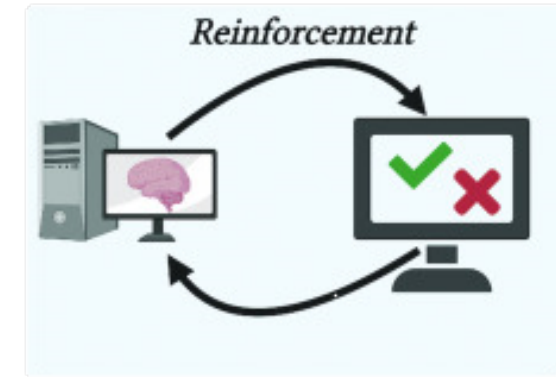


AI in Nutrition Assessment

➤ *Applications of reinforcement Learning in Nutrition Assessment*

✓ Nutritional Education and Engagement:

RL can be utilized in educational tools that engage users in learning about nutrition. The agent can adapt the content and difficulty based on user interactions, providing a personalized learning experience.



AI in Nutrition Assessment

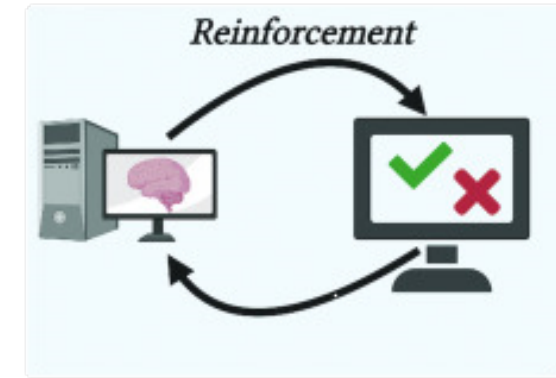
➤ *Applications of reinforcement Learning in Nutrition Assessment*

✓ Nutritional Education and Engagement:

RL can be utilized in educational tools that engage users in learning about nutrition. The agent can adapt the content and difficulty based on user interactions, providing a personalized learning experience.

✓ Food Waste Reduction:

RL can help optimize meal planning to minimize food waste by learning from past consumption patterns and preferences. The agent can suggest portion sizes and recipes that align with what users typically consume.



AI in Nutrition Assessment

➤ *Applications of reinforcement Learning in Nutrition Assessment*

✓ Nutritional Education and Engagement:

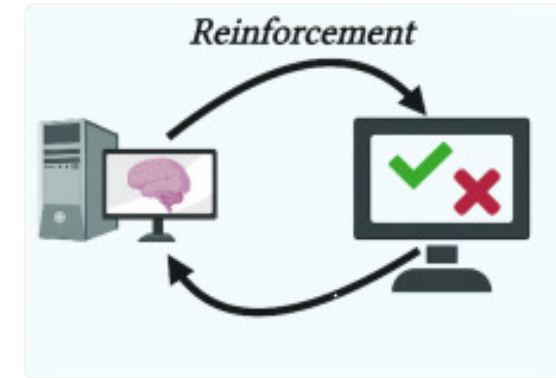
RL can be utilized in educational tools that engage users in learning about nutrition. The agent can adapt the content and difficulty based on user interactions, providing a personalized learning experience.

✓ Food Waste Reduction:

RL can help optimize meal planning to minimize food waste by learning from past consumption patterns and preferences. The agent can suggest portion sizes and recipes that align with what users typically consume.

✓ Monitoring and Feedback Systems:

RL can be integrated into monitoring systems that provide feedback on dietary intake and health metrics. The agent learns from user data to offer insights and suggestions for improvement.



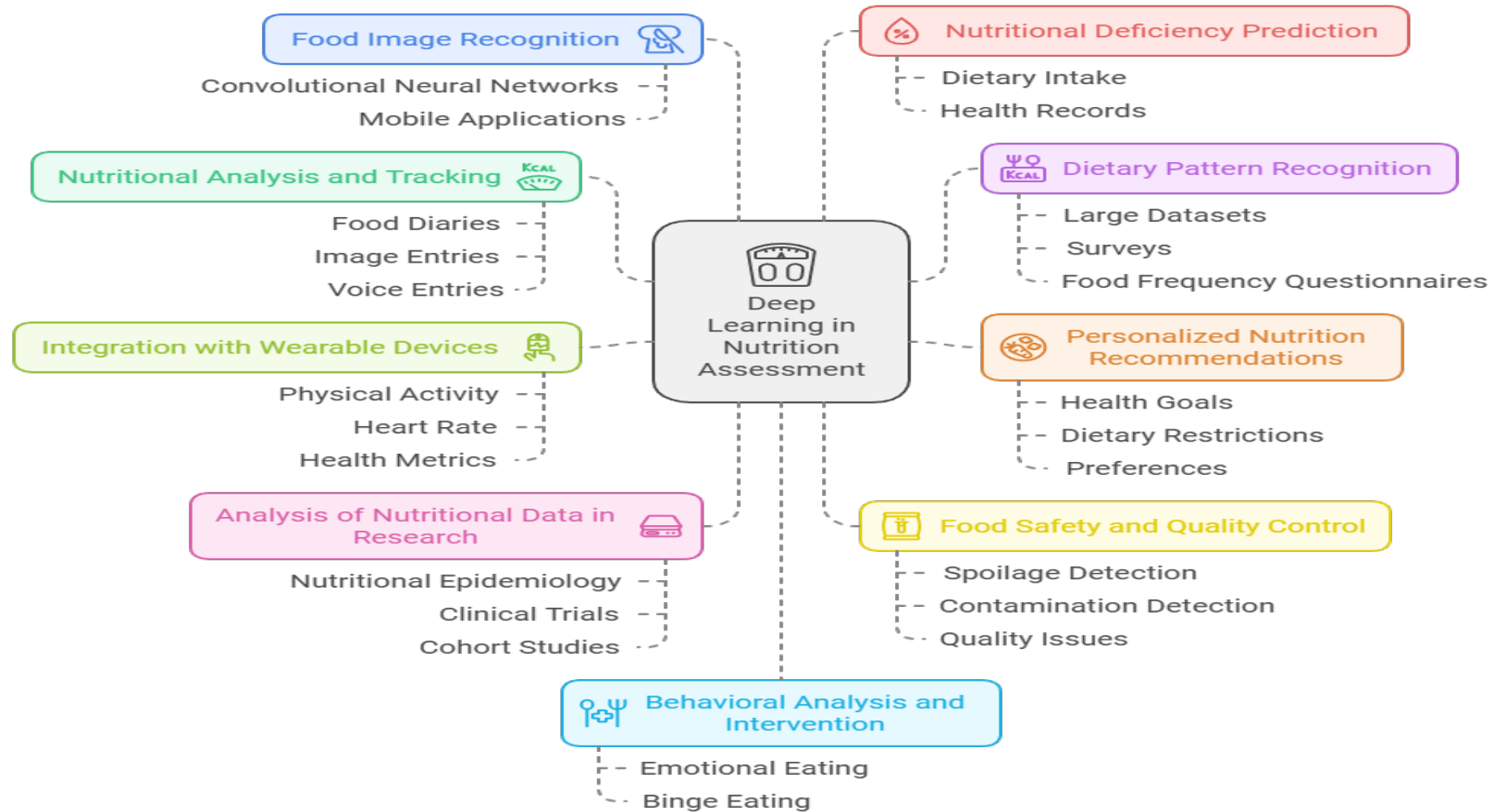
AI in Nutrition Assessment

➤ *Deep Learning*

Deep learning is a subset of machine learning that leverages artificial neural networks with multiple layers to learn complex patterns from large datasets. Inspired by the human brain's structure and function, these neural networks process information through interconnected nodes, or neurons.

➤ *Applications of Deep Learning in nutrition assessment*

AI in Nutrition Assessment



AI in Nutrition Assessment

➤ *Types of Deep Learning techniques Used*

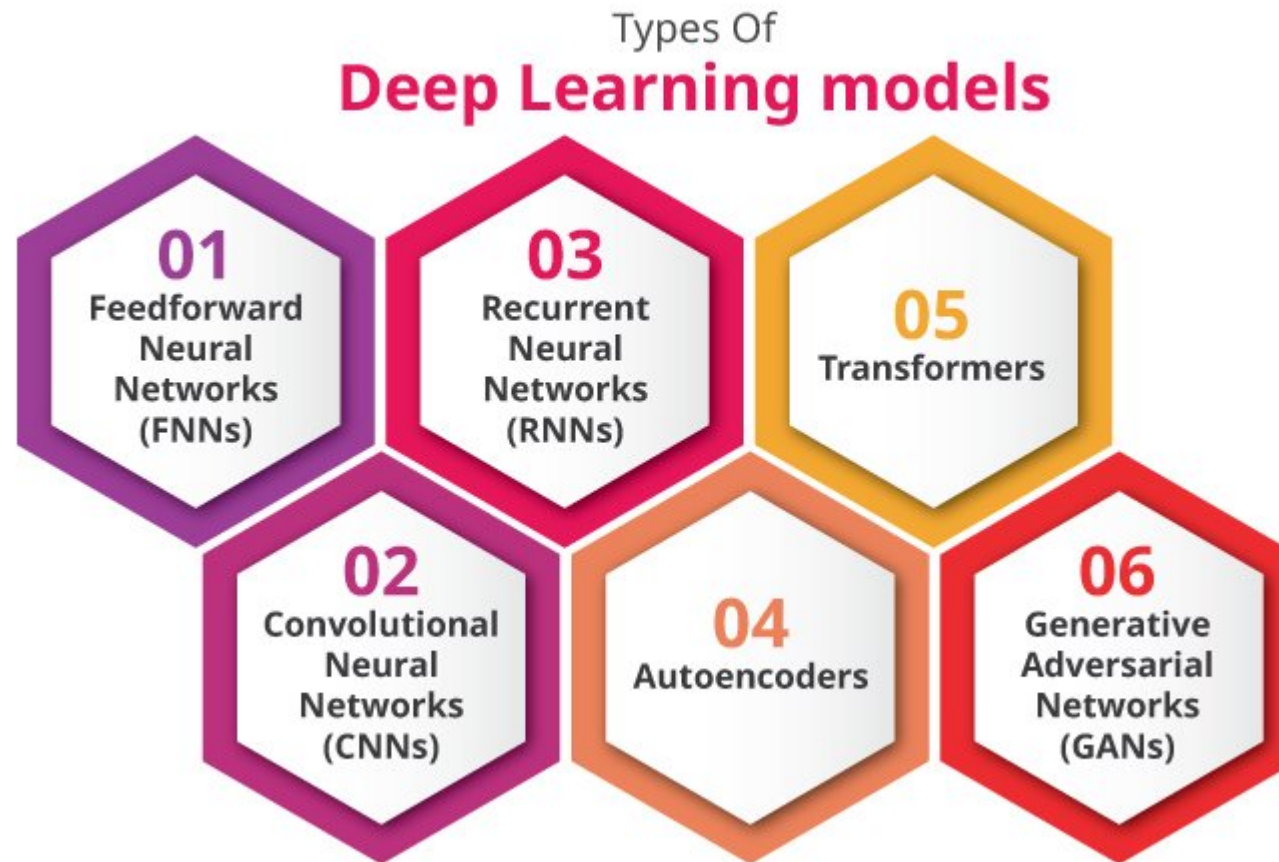


Table: Applications of Deep Learning models in nutrition assessment

Deep Learning Model	Application in Nutrition Assessment
Feedforward Neural Networks (FNN)	Utilized for estimating portion sizes from food intake data, predicting nutritional content from user input (e.g., food logs), and analyzing eating habits.
Generative Adversarial Networks (GANs)	Applied in generating synthetic food images for training food recognition systems, improving food portion estimation, and creating diverse datasets for nutrition assessment tools.
Transformers	Utilized in analyzing food consumption patterns over time, such as predicting daily nutrient intake, analyzing food logs, and tracking dietary changes.
Autoencoders	Applied in detecting anomalies or patterns in dietary intake data, reducing the dimensionality of food intake records for more efficient analysis, and identifying trends in nutrient consumption.
Recurrent Neural Networks (RNNs)	Utilized for tracking and predicting water intake patterns, analyzing eating habits, and monitoring changes in diet over time by processing time-series food intake data.
Convolutional Neural Networks (CNNs)	primarily used for food image recognition (identifying food types and estimating portion sizes from images), analyzing mastication patterns, and monitoring water intake using image-based sensors or wearable devices.

AI in Nutrition Assessment

➤ *Natural Language Processing (NLP)*

Natural Language Processing (NLP) is a subfield of artificial intelligence (AI) and computer science that focuses on the interaction between computers and humans through natural language. It enables machines to understand, interpret, and generate human language in a valuable way.

➤ *Application of NLP in Nutrition Assessment*

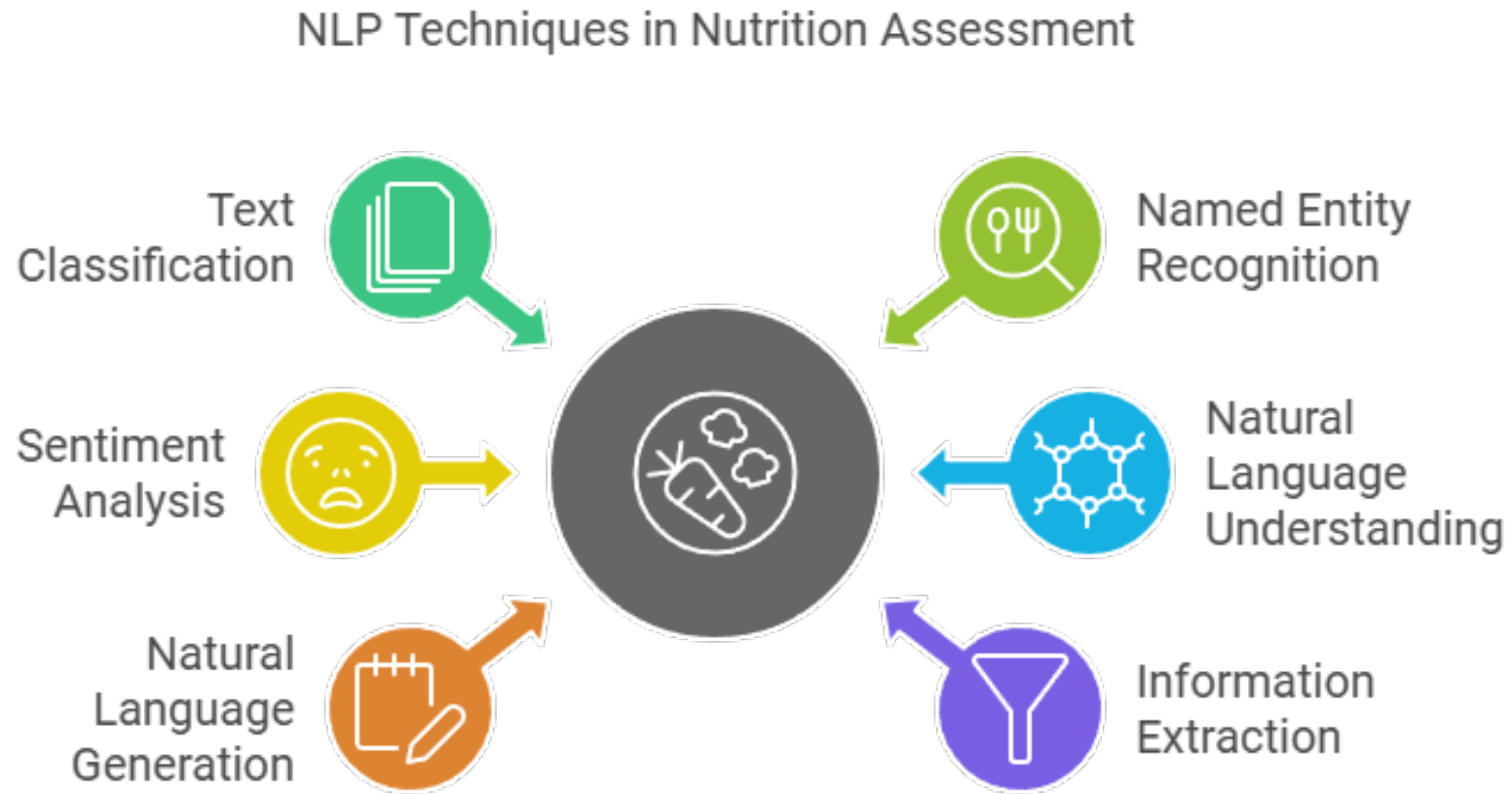


AI in Nutrition Assessment



AI in Nutrition Assessment

➤ *Types of NLP in Nutrition Assessment*



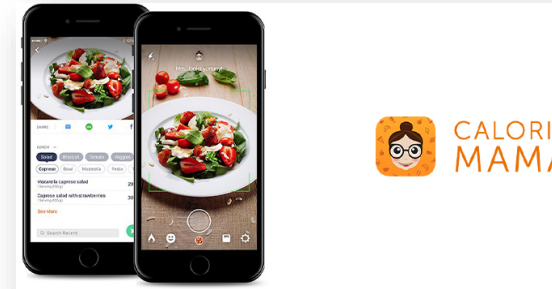
Example of Ai apps in nutrition assessment



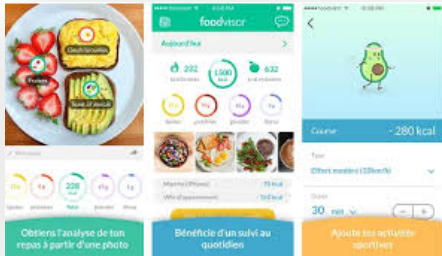
MyfitnessPal



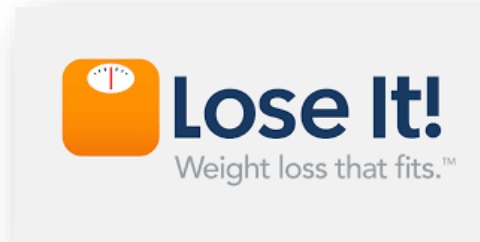
HealthifyMe



CalorieMama



Foodvisor



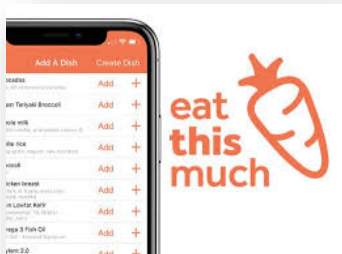
Lose it!



ate food journal



Yazio



Eat This Much

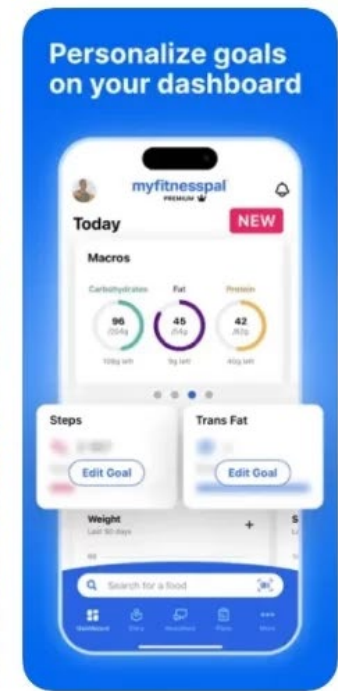
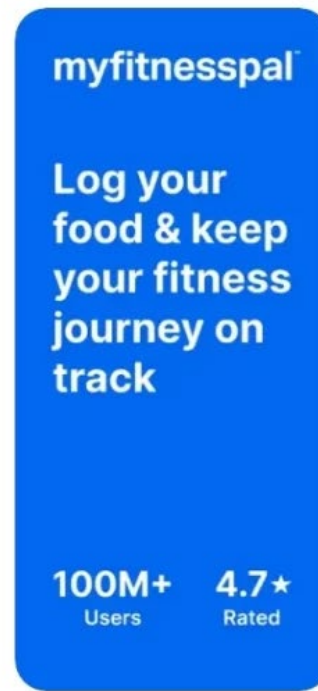


nutrition tracker cronometer

Example of Ai apps in nutrition assessment



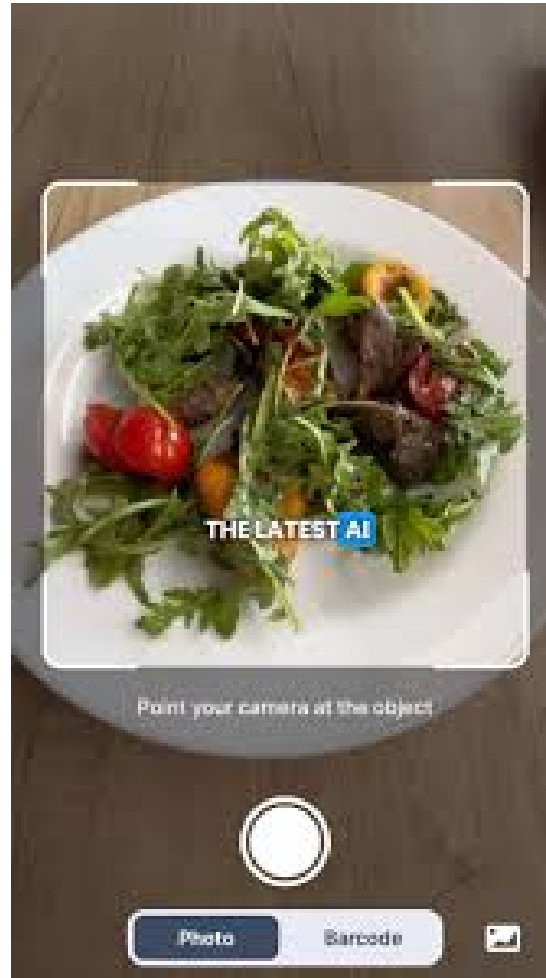
MyfitnessPal



Example of Ai apps in nutrition assessment



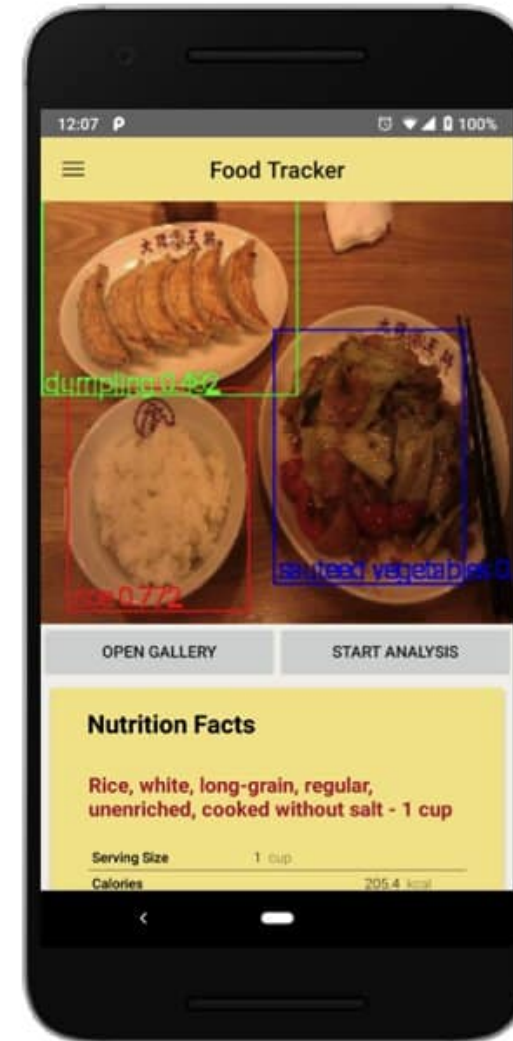
MyfitnessPal



Example of Ai apps in nutrition assessment



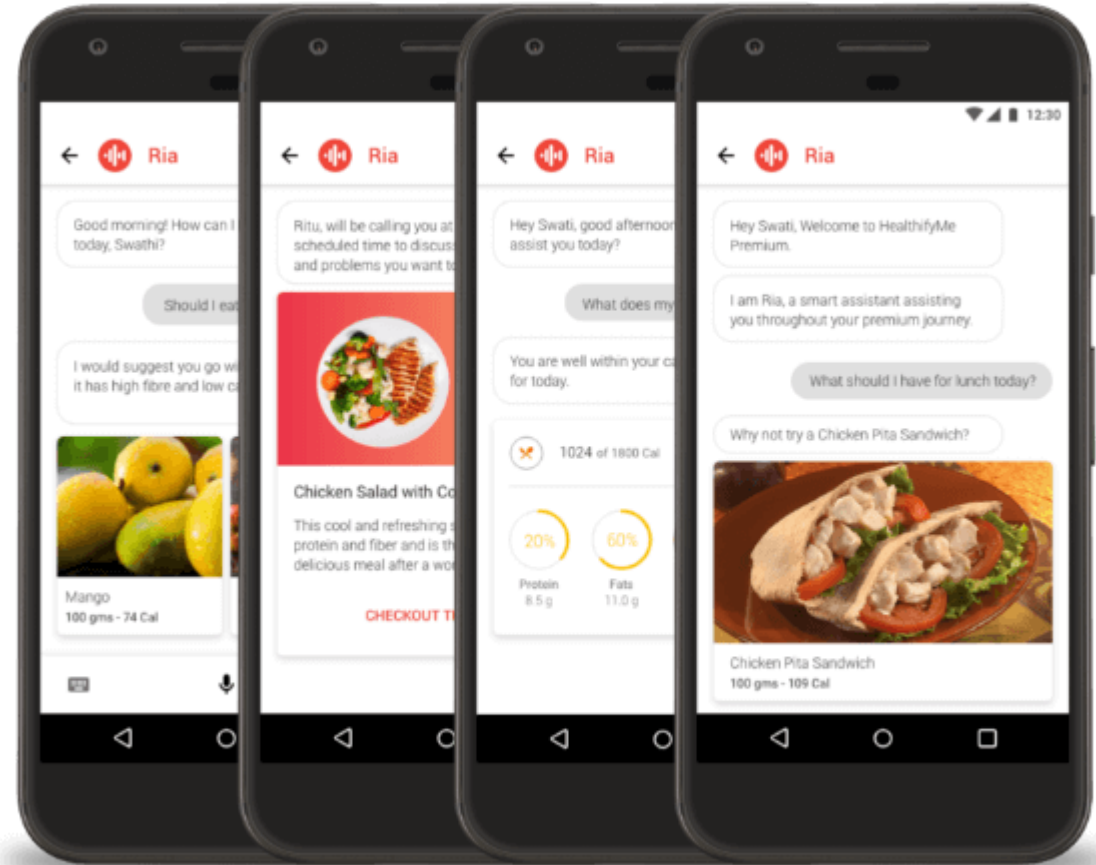
MyfitnessPal



Example of Ai apps in nutrition assessment



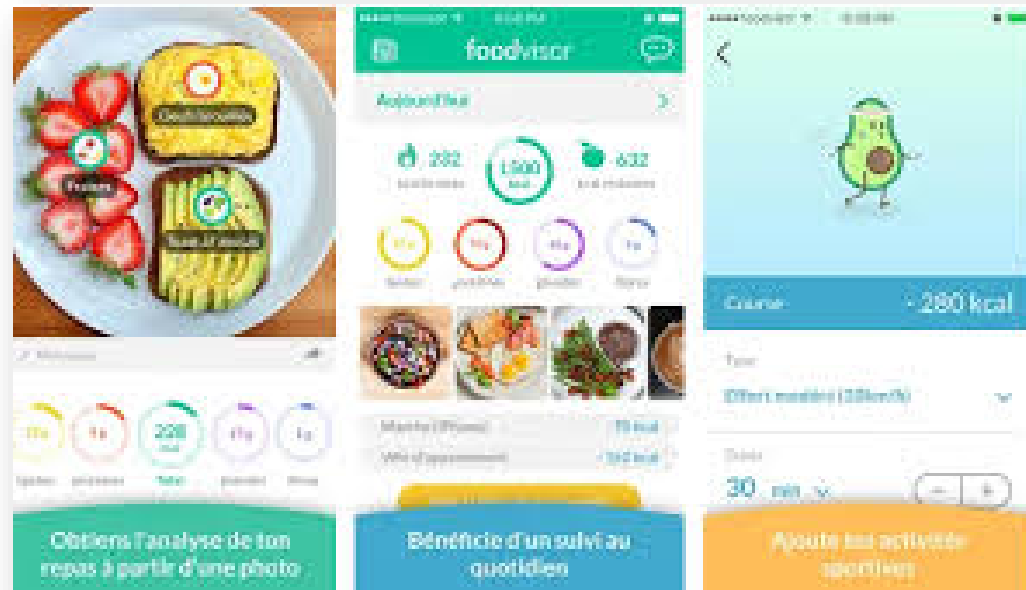
HealthifyMe



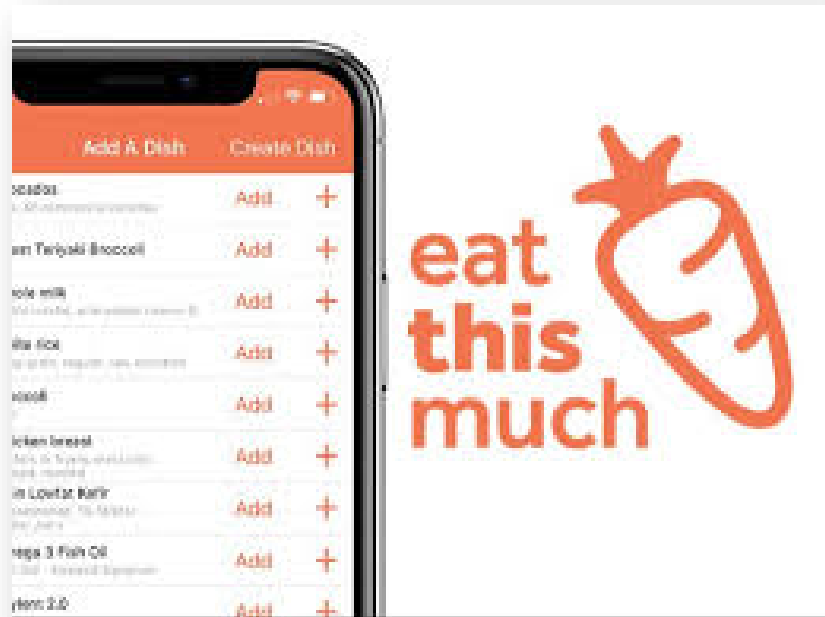
Example of Ai apps in nutrition assessment



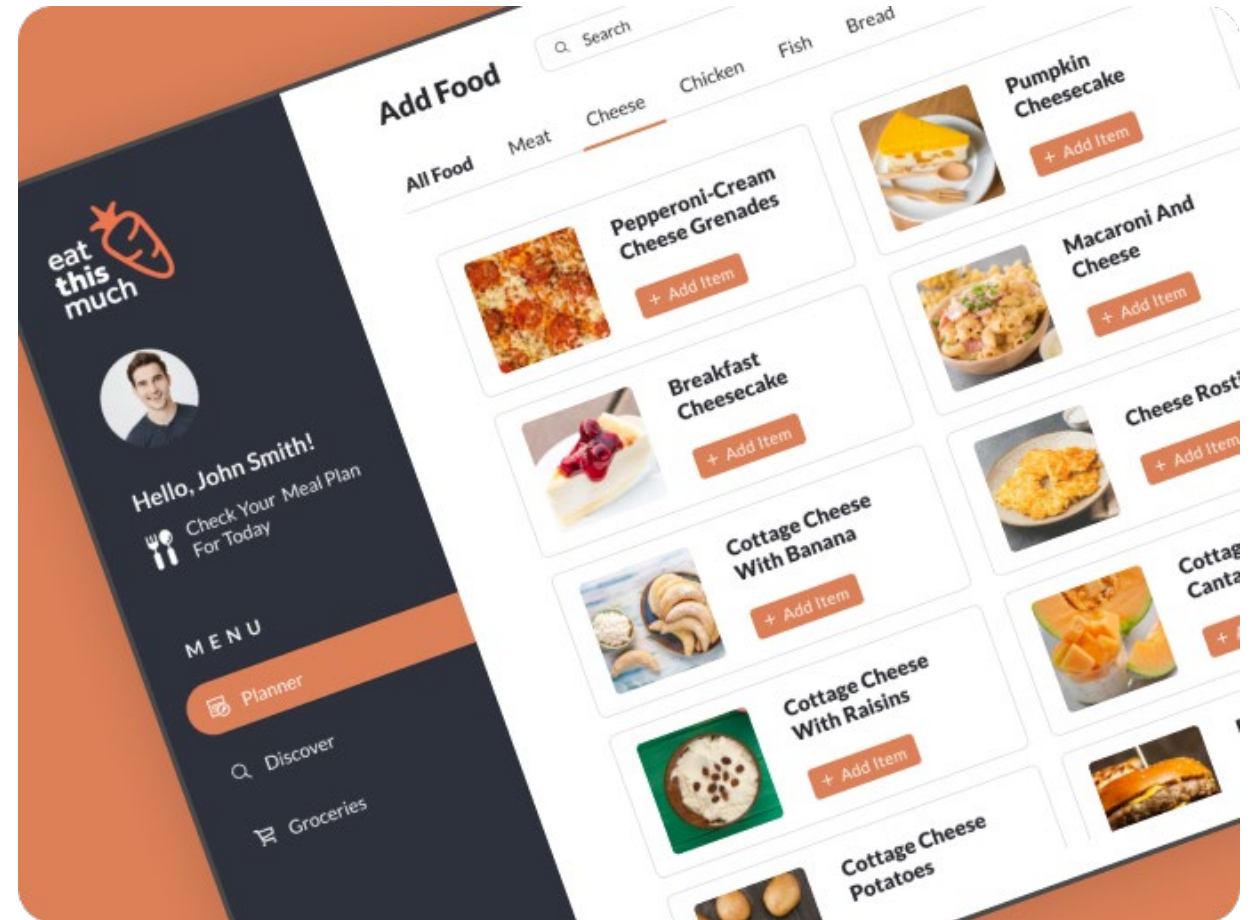
Foodvisor



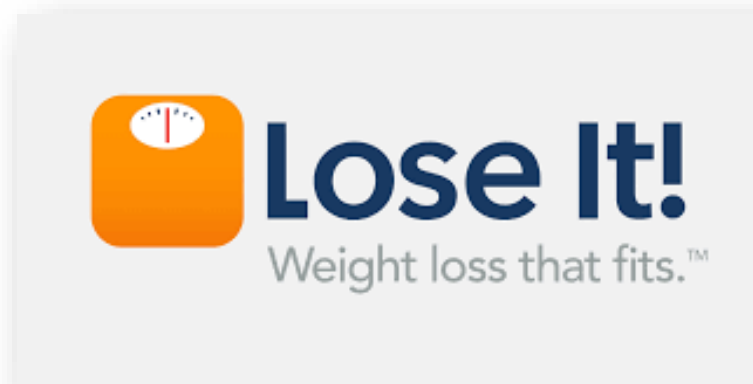
Example of Ai apps in nutrition assessment



Eat This Much



Example of Ai apps in nutrition assessment



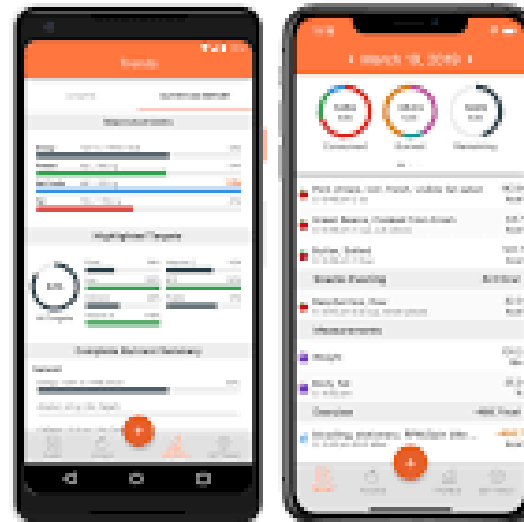
Lose it!



Example of Ai apps in nutrition assessment



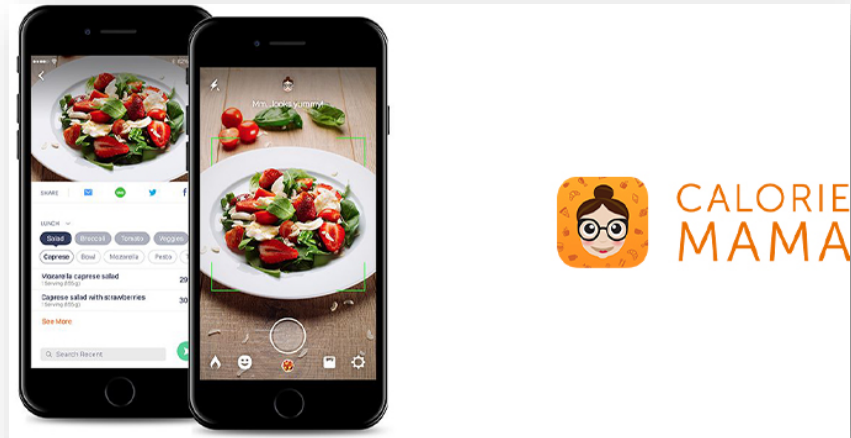
nutrition tracker cronometer



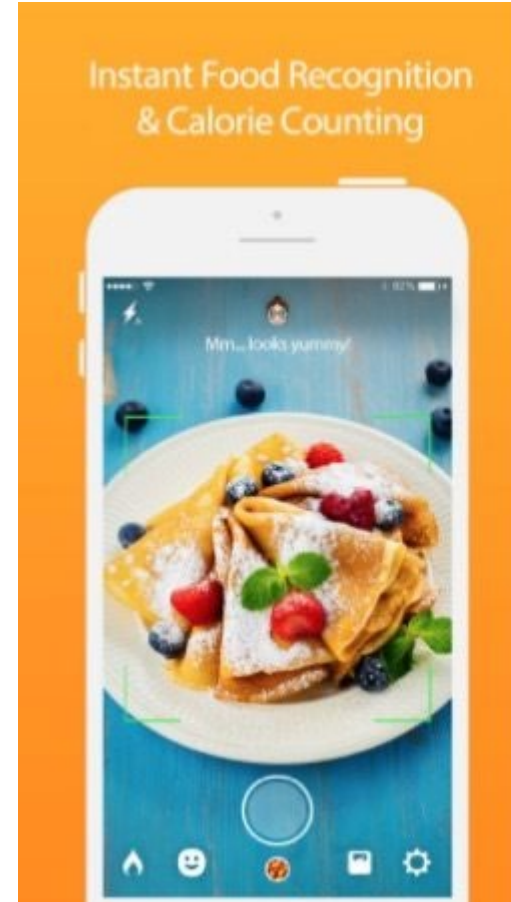
cronometer
NUTRITION TRACKER

Eat smarter.
Live better.

Example of Ai apps in nutrition assessment



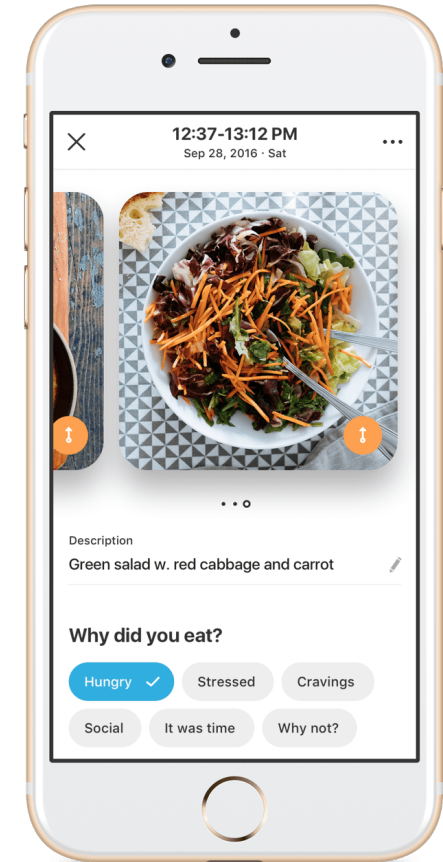
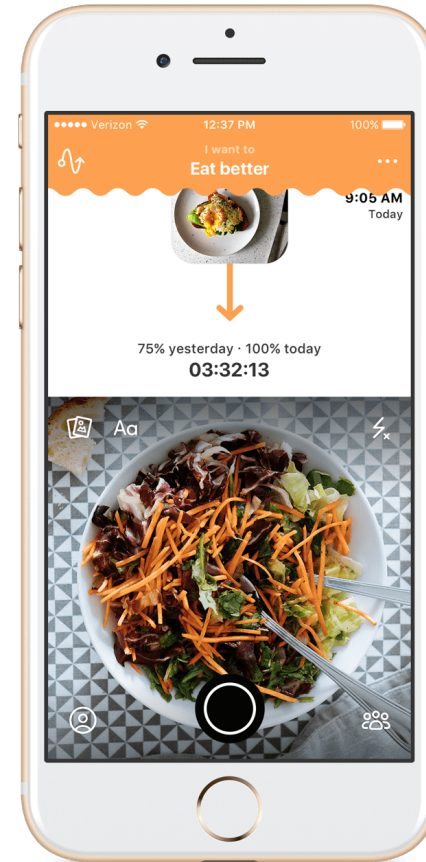
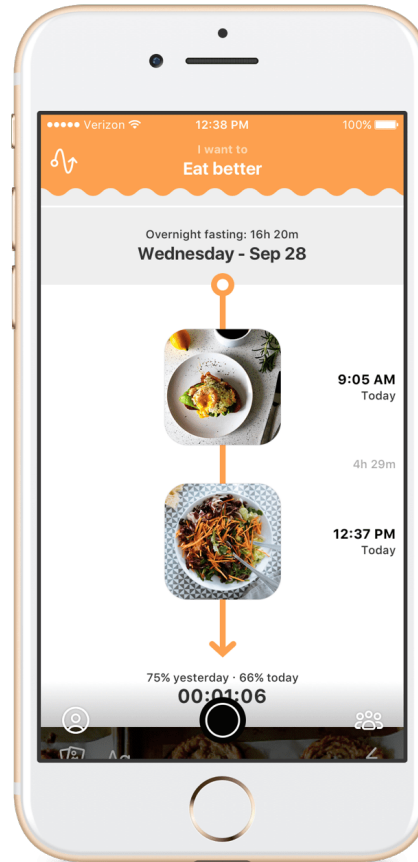
CalorieMama



Example of Ai apps in nutrition assessment



ate food journal



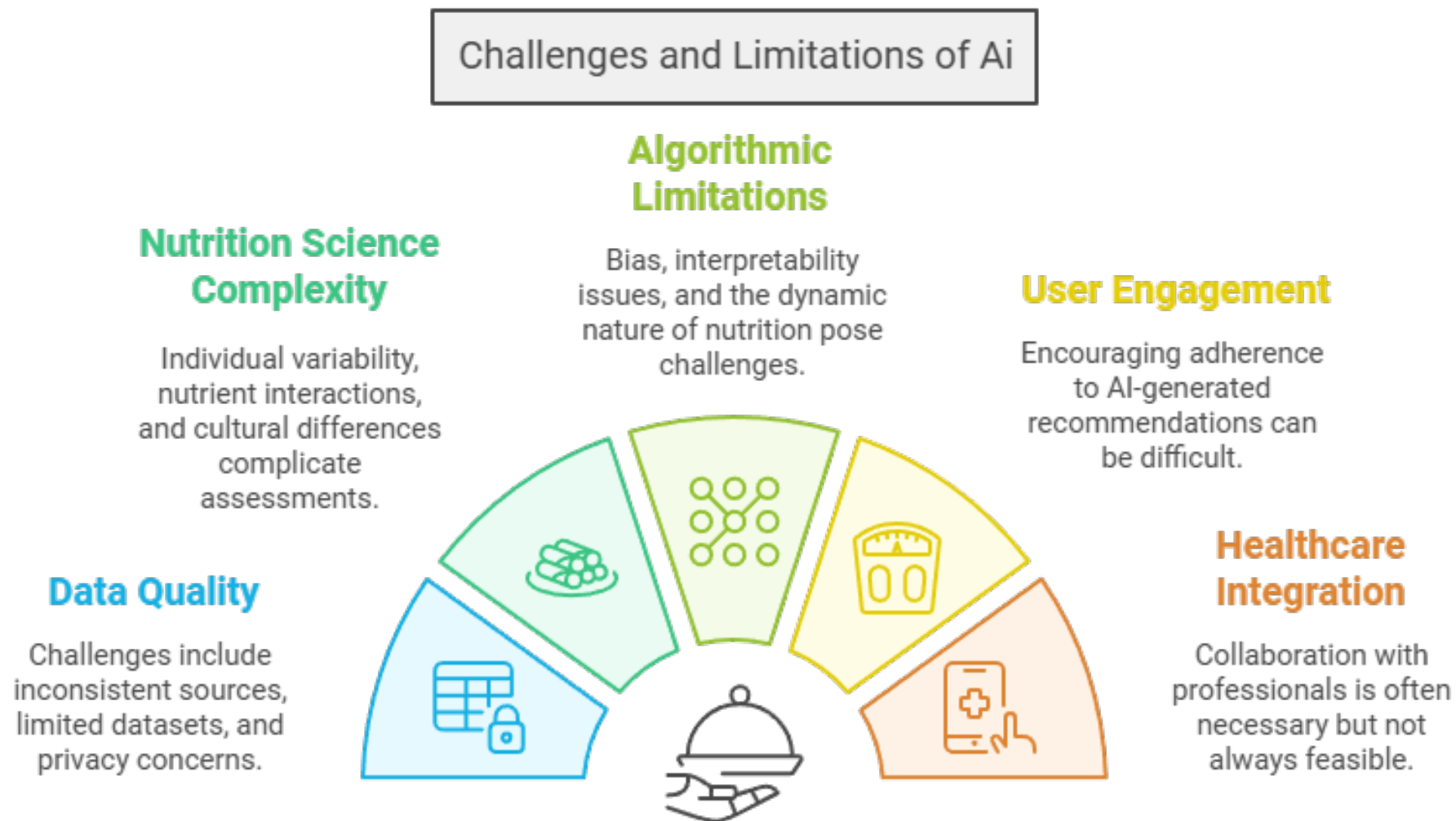
Example of Ai apps in nutrition assessment



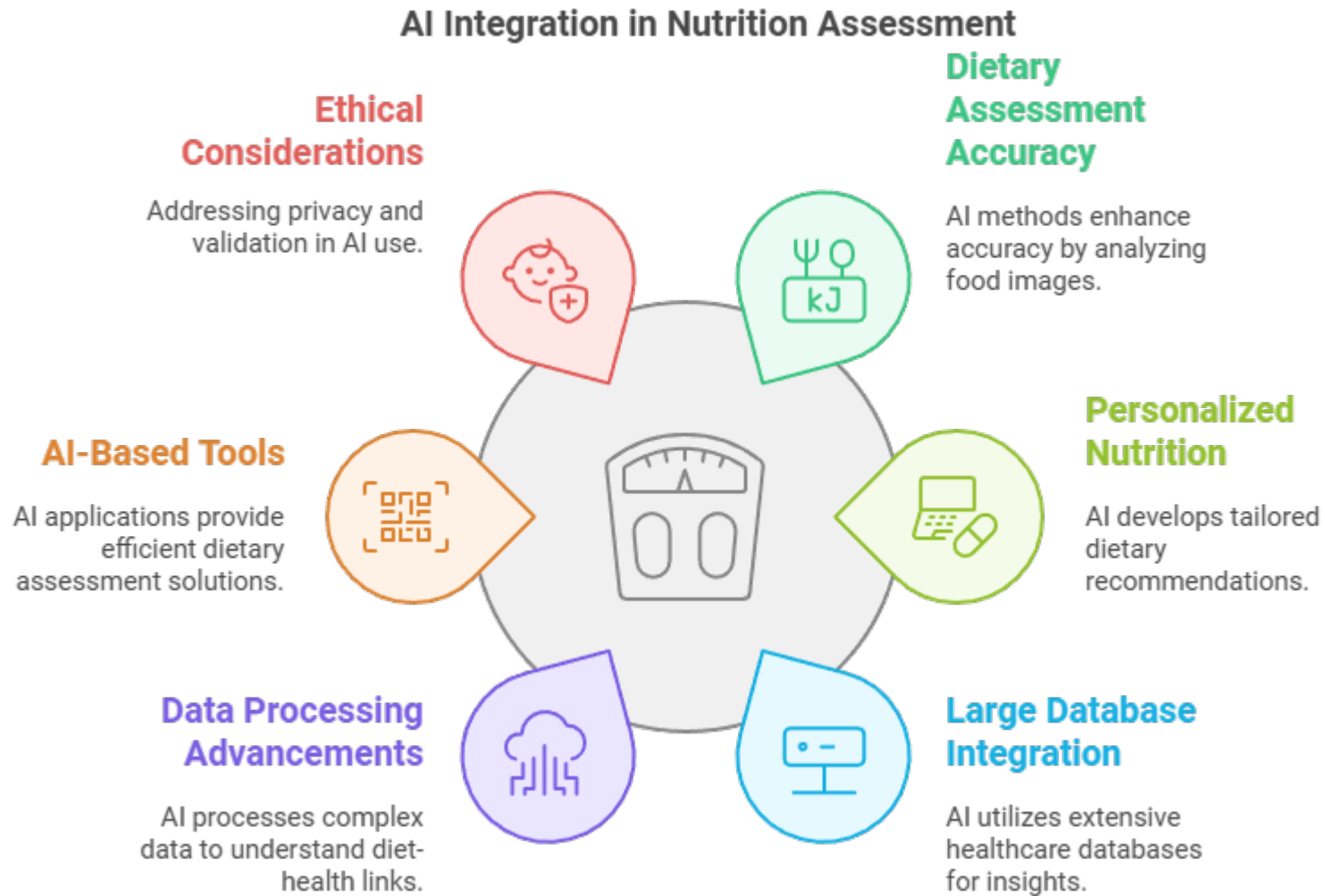
yazio



Challenges and limitations of Ai



Future directions



Conclusion

The integration of artificial intelligence into nutrition assessment offers a promising future for personalized healthcare. By harnessing the power of AI, we can achieve more precise dietary analysis, early disease detection, and tailored nutrition interventions. This technology has the potential to significantly improve public health outcomes and reduce the burden of chronic diseases. However, it is imperative to address the ethical implications and potential biases associated with AI algorithms. By ensuring transparency, accountability, and fairness in AI development, we can mitigate these challenges and maximize the benefits of this technology. As we continue to advance AI research and innovation, we must strive to create a future where AI serves as a powerful tool for promoting health and well-being.



References

1. Sosa-Holwerda et al. (2024) Sosa-Holwerda, A., Park, O.-H., Albracht-Schulte, K., Niraula, S., Thompson, L. & Oldewage-Theron, W. (2024) 'The role of artificial intelligence in nutrition research: A scoping review', *Nutrients*, 16(13), p. 2066 .<https://doi.org/10.3390/nu16132066>.
 2. Shonkoff et al. (2023) Shonkoff, E., Copeland Cara, K., Pei, X., Chung, M., Kamath, S., Panetta, K., & others (2023) 'AI-based digital image dietary assessment methods compared to humans and ground truth: A systematic review', *Annals of Medicine*, 55(2), Article 2273497.
<https://doi.org/10.1080/07853890.2023.2273497>.
 3. Salinari et al. (2023) Salinari, A., Mach, M., Amans Díaz, Y., Ciancesi, D., Qi, Z., Yang, B., Ferriero-Cornou, M.S., Villar, S.G., Dzul Lopez, L.A., Batino, M. & Giampieri, F. (2023) 'The application of digital technologies and artificial intelligence in healthcare: An overview on nutrition assessment', *Diseases*, 11(3), p. 97. <https://doi.org/10.3390/diseases11030097>.
-

Thank you for your attention