

Machine learning based quality control for simulated production lines.

Canche Mex Mario Alejandro, Fonseca Carrillo Bryan Yahve, Herrera Tuz Alan Emmanuel, Hoil Sosa Joel Alexis
Universidad Politécnica de Yucatán
Machine Learning, Victor Ortiz
Unit 1

I. DESCRIPTION OF THE PROBLEM

For the integrity of the product and customer satisfaction in contemporary production, quality control must be maintained. Our goal is to create an automated system that can use machine learning methods to carry out quality control duties in a mock production line environment. The system will be created to recognize and classify fruits according to type and quality. This research intends to show how supervised, unsupervised, and reinforcement learning approaches can be used to accomplish this.

II. THEORICAL FRAMEWORK

A. What is machine learning?

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.

B. What is supervised learning?

Supervised learning, also known as supervised machine learning, is a subcategory of machine learning and artificial intelligence. It is defined by its use of labeled datasets to train algorithms that to classify data or predict outcomes accurately. As input data is fed into the model, it adjusts its weights until the model has been fitted appropriately, which occurs as part of the cross validation process. Supervised learning helps organizations solve for a variety of real-world problems at scale, such as classifying spam in a separate folder from your inbox.

C. What is unsupervised learning?

Unsupervised learning, also known as unsupervised machine learning, uses machine learning algorithms to analyze and cluster unlabeled datasets. These algorithms discover hidden patterns or data groupings without the need for human intervention. Its ability to discover similarities and differences in information make it the ideal solution for exploratory data analysis, cross-selling strategies, customer segmentation, and image recognition.

D. What is reinforcement learning?

Reinforcement learning (RL) is a subset of machine learning that allows an AI-driven system (sometimes referred to as an agent) to learn through trial and error using feedback from its actions. This feedback is either negative or positive, signalled as punishment or reward with, of course, the aim of maximising the reward function. RL learns from its mistakes and offers artificial intelligence that mimics natural intelligence as closely as it is currently possible.

III. OBJECTIVES.

This report's main goal is to offer a thorough study and presentation of machine learning approaches used to solve the problem of automated quality control in a fictitious production line, including supervised learning, unsupervised learning, and reinforcement learning.

A. Supervised learning objective.

Create a reliable supervised learning model that can correctly categorize fruits based on their type and quality.

B. Unsupervised learning objective.

Utilize unsupervised learning techniques to automatically group and categorize fruits based on visual features, allowing for effective quality control without the need for labeled data.

C. Reinforcement learning objective.

Use a reinforcement learning agent that can iteratively interact with the simulated environment to improve the quality control procedure.

IV. DESCRIPTION OF THE MODELS.

A. Supervised learning proposal.

The automated quality control system will train a model to categorize fruits according to type and quality using supervised learning. The model will need to be given a dataset of labeled photos, each of which is linked to a particular fruit kind and fruit quality level (poor, average, exceptional). In order to identify patterns and features in the images that correspond with these labels, the model must be trained.

The developed model can then be used to automatically classify fruits in a model of a production line, acting as an effective and precise quality control system.

B. Unsupervised learning proposal.

Unsupervised learning will be utilized in the automated quality control system to group fruits according to their visual characteristics. This means that without being specifically told which fruits go into which category, the model will group together fruits that have comparable visual qualities. To accomplish this grouping, methods like K-Means clustering or DBSCAN will be used.

The system can adapt to new fruit varieties or differences in quality by using unsupervised learning, which eliminates the need to re-label a sizable dataset.

C. Reinforcement learning proposal.

Reinforcement learning will be employed in the automated quality control system to improve the quality control procedure by interacting with a simulated environment. The agent, which may be a robotic arm, will have the ability to carry out tasks like picking a fruit, examining it, and classifying its quality. Based on how well the agent categorizes and how well its behaviors are proper, it is rewarded.

The agent will eventually develop a policy that directs its behaviors in order to quickly and properly classify fruits, thus strengthening the process of overall quality control.

V. CONCLUSION.

A potential step forward in modern manufacturing can be seen in the conceptual development of a multi-layered machine learning strategy for automated quality control. The proposed system aims to integrate supervised, unsupervised, and reinforcement learning techniques to achieve capabilities in accurate fruit classification, adaptive clustering, and dynamic optimization of quality control processes. Even though these ideas are still in the theoretical stage, they show promise for potential future applications in boosting product integrity and production line productivity. This framework offers a strong starting point for additional study and advancement in automated quality assessment.

REFERENCES

Brooks, R. (2021, diciembre 20). What is reinforcement learning? University of York. <https://online.york.ac.uk/what-is-reinforcement-learning/>

What is machine learning? (s/f). Ibm.com. Retrieved October 5, 2023, de <https://www.ibm.com/topics/machine-learning>

What is supervised learning? (s/f). Ibm.com. Retrieved October 5, 2023, de <https://www.ibm.com/topics/supervised-learning>

What is unsupervised learning? (s/f). Ibm.com. Retrieved October 5, 2023, de <https://www.ibm.com/topics/unsupervised-learning>