**BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

**THESIS MANUSCRIPT FORMAT**

1. Page Numbering

* Title Page – none
* Approval Sheet – none
* Introductory
* **ABSTRACT**
* **ACKNOWLEDGEMENT**
* **DEDICATION** Arabic
* **TABLE OF CONTENTS**
* **LIST OF FIGURES**
* Chapter pages – Arabic
* Beginning of every Chapter – no numbering
* Chapter name is bold and dropdown and Chapter number is written in Arabic (**Chapter 1**, **Chapter 2**…) (*see sample*)

The chapter heading, for example **PROJECT OVERVIEW** for Chapter 1, is written in uppercase and bold letters centered on the first line. (*see sample*)

* Spacing – 2.0

Except: Chapter name and chapter heading - spacing is 1.0 (*see sample*)

Approval Sheet (*see sample*)

Abstract of the Study (*see sample*)

* Main headings – Title Case, bold (**Background of the Study, Statement of the Problem,...)** (*see sample*)
* Font Style and Size– Times New Roman, Twelve (12) points
* Margins

Left – 1.5

Top, Bottom and Right – 1

* Text Alignment – Left
* Tables and diagrams should be properly labeled (if any) (Table 1, Table 2, etc. Figure 1, Figure 2, etc)

2. Order of Pages

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* **Scope and Delimitations**
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**Chapter 4 – SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

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**BIBLIOGRAPHY**

This includes all materials used and reviewed by the researchers arranged according to type, e.g. book, journal article, unpublished materials, and web documents. Citation with reference to APA (American Psychological Association) format shall be used. All sources included in the Bibliography section must be cited in the body of the paper (and all sources cited in the paper must be included in the Bibliography/References section).

**APPENDICES**

This contains e.g. letters and other forms of communication; instruments used; sample questionnaire; sample computations

**GUYABANO RIPENESS RECOGNITION**

A Thesis presented to the Faculty of

Computer Science Department

Pangasinan State University

Lingayen Campus

In Partial Fulfillment

of the Requirements for the Degree

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

By

STUDENT 1

STUDENT 2

STUDENT 3

STUDENT 4

December 2025

**APPROVAL SHEET**

This thesis entitled **GUYABANO RIPENESS RECOGNITION,** prepared and submitted by STUDENT 1, STUDENT 2, and STUDENT 3, in partial fulfilment of the requirement for the degree BACHELOR OF SCIENCE IN COMPUTER SCIENCE, has been examined and is hereby recommended for approval and acceptance.

**JEFFREY V. TOLENTINO, MSIT**

Adviser

PANEL OF EXAMINERS

APPROVED by the Committee on Oral Examination on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with a grade of \_\_\_\_\_\_\_\_\_.

**FERDINAND M. MATA, MIT**

Chairperson

**BADEN DARWIN C. CARRANZA, MIT** **RIZALYN A. CAPANAS, MIT**

Member Member

ACCEPTED in partial fulfilment of the requirements for the degree of BACHELOR OF SCIENCE IN COMPUTER SCIENCE.

**NORMA JEAN R. BARDIAGA, MIT CRISTETA G. TOLENTINO, DIT**

Chairman Dean

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**RENATO E. SALCEDO, Ph. D**

Campus Executive Director

**ABSTRACT OF THE STUDY**

Title of the Study : **GUYABANO RIPENESS**

**RECOGNITION**

Authors : STUDENT 1

STUDENT 2

STUDENT 3

Degree : Bachelor of Science in Computer Science

Year : 2025

Type of Document : Project Study

Type of Publication : Unpublished

Accrediting Institution : Pangasinan State University

Lingayen Campus

This thesis presents a novel approach to recognize the ripeness of guyabano fruit using the YOLOv8 object detection algorithm. The ripeness of guyabano fruit is a crucial factor affecting its quality and market value. Traditional methods of ripeness assessment are often subjective and time-consuming. In this study, the researchers developed a guyabano ripeness recognition that accurately identifies the ripeness of guyabano fruit based on visual characteristics such as color extracted from images. The researchers trained the YOLOv8 model on a dataset of annotated guyabano images, comprising various ripeness stages. The trained model demonstrates robust performance in detecting and categorizing guyabano fruit into unripe, ripe, and rotten classes. Experimental results show promising accuracy rates, with potential applications in agriculture, food processing, and quality control. This research contributes to the advancement of automated fruit ripeness recognition systems, offering a cost-effective and efficient solution for fruit growers and processors.

*Keywords: annotation, data training, image analysis, labelImg, YOLOv8*

**AKNOWLEDGEMENT**

First and foremost, we, the researchers, express our gratitude to our Almighty for His constant presence, guidance, and blessings throughout our research journey. We, the researchers, acknowledge His grace and mercy as the driving force behind our achievements, finding strength in His unwavering faith and love during challenging moments. We understand that our abilities and successes are gifts from above and we are thankful for His provision and comfort.

We, the researchers, extend our sincere appreciation to our thesis adviser, Sir Jeffrey V. Tolentino, whose guidance and support was an instrument in shaping our research's success. His mentorship has been invaluable, and we are deeply grateful for his time.

To our subject instructor, Ma’am Ma. Sheryl R. Sunga, we offer heartfelt thanks for her continuous guidance and support throughout the semester.

We, the researchers, also express our gratitude to our panel members, Sir Ferdinand M. Mata, Sir Baden Darwin C. Carranza, and Ma’am Rizalyn A. Capanas, for their valuable insights and suggestions which have contributed significantly to the refinement of our study. We appreciate their collaboration and assistance in providing essential data, recognizing their important role in the completion of our research. Our group is grateful to have them as our panelists. Their breadth of knowledge in teaching is remarkable, and we hold great respect for all of them.

Additionally, we, the researchers, wish to thank our families, friends, and loved ones for their unwavering support, empathy, and encouragement throughout this endeavor. Their belief in our capabilities and constant encouragement have been very important to our perseverance and determination.

Jacqueline B. Fernandez Harold Mart G. Entimano Jesiel C. Gutierrez Angeline C. Moneda

John Lloyd E. Eustaquio

**DEDICATION**

With profound gratitude, I dedicate this successful thesis project to You, Lord, the source of all wisdom, guidance, and strength. Your divine presence has illuminated my path and sustained me through every hurdle and triumph.

I extend my deepest appreciation to my parents, especially to my nanay, the strongest woman I know, who inspires me every day and supported me both financially and emotionally, that has made this journey possible. To my tatay, who endures the hardships of construction work, who always say, “Mansumpal ka anak ah. Anos labat, walan sansya”. This is it! This is for the both of you, my nanay and tatay! Despite their own challenges, they selflessly provided for me, ensuring I have the resources needed to pursue my goals. Their sacrifices have been my foundation, and I am forever indebted to their love and support.

To all our hardworking teachers, especially Sir Baden Carranza, Sir Ferdinand Mata, Sir Marvin Santillan, Ma’am Rizalyn Capanas, Ma’am Ma. Sheryl Sunga, and Ma’am Odessa Pacaul, I admire and respect them for their commitment in the field of teaching. I offer my sincerest thanks for their tireless dedication to education. Their passion for teaching has inspired and shaped me. Their guidance and encouragement played a significant role to me as a student and instilled in me a love for learning.

To my cherished groupmates, Harold, Jesiel, Angge, and Lloyd, mga ading ko, I express my heartfelt gratitude to all of you. Together, we have weathered countless late nights, brainstorming sessions, and revisions, united by a common goal and fueled by mutual support. Our collaboration and camaraderie have not only enriched our academic journey, but also forged bonds that will last a lifetime.

To all my BSCS D classmates, thank you! The bond we have formed has made my college journey truly memorable. Whether it was studying together, sharing laughs in class, or supporting each other through tough times, I am grateful for every moment we have shared.

Last, but certainly not least, I dedicate this to myself. I am overflowing with so much joy because, after a long time, my dream to finish college will finally come true. All the countless sleepless nights are worth it. I am so proud of myself! I made it!

And to future researchers, seize the opportunity for having access to free, quality education here at Pangasinan State University. Do not lose hope and continue to fight for your dreams! If we were able to do and finish our thesis project successfully, you could do it too!

Jacqueline B. Fernandez

To all who spent time with me, through endless hours of labor and commotion, I dedicate the thesis with a heart full of gratitude.

To our smart and compassionate instructors, guiding us while maintaining patience. Sharing your knowledge and enhancing our abilities, we aim to find in your tracks.

To my family, loving and genuine, I appreciate your love and support. You’ve supported me throughout the highs and lows and boosted my dreams with unshakable faith.

To my friends who have supported me, you’ve aided in our connection by supporting me through ambiguities and concerns. Our laughs, motivation, and mutual conflict have improved the quality of our lives all these years. We commit ourselves to the quest of knowledgeless questions, and remote realities. We assume our place in the world of college or leave no trace while seeking enlightenment.

Harold Mart G. Entimano

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**Chapter 1**

**PROJECT OVERVIEW**

**Background of the Study**

Guyabano or Soursop is a part of the Annonaceae family, also known as the custard apple family. Its flavor can best be described as a cross between a mango and pineapple. Guyabano has numerous significances in traditional pharmaceuticals, and it has been utilized to treat a wide array of health conditions and afflictions. With its strong nutrient profile, it gives a variety of health benefits.

Guyabano is high in vitamin C, an antioxidant known to boost immune health. This vitamin strengthens immune system, thus improving its ability to defend against pathogens. It also promotes the destruction of free radicals which can help to protect skin and cells from environmental oxidative damage. One whole guyabano fruit contains 215% of recommended daily allowance of vitamin C. The fruits and leaves of this plant also contain many other antioxidants, including phytosterols, tannins, and flavonoids. Antioxidants play a role in your overall health and may help to protect against a variety of health conditions. (Richards, L. 2020).

Figuring out when a guyabano fruit is ripe can be tricky and time-consuming. Artificial Intelligence and machine learning technologies streamline the complex and time-consuming process of determining fruit ripeness. These innovations are transforming agricultural methods by providing precise assessments of fruit quality, revolutionizing the industry. In recent years, there has been a growing interest in the development of automated fruit ripeness recognition systems to overcome the limitations of manual methods. These systems leverage advancements in computer vision,

image processing, and machine learning to provide objective and efficient assessments of fruit ripeness. The integration of such technologies into the agricultural supply chain promises to enhance productivity and improve the overall quality of harvested fruits. Despite the potential benefits, the design and implementation of a robust fruit ripeness recognition system poses significant challenges. Variability in fruit appearance, lighting conditions, and diverse fruit types necessitate sophisticated algorithms and models. Addressing these challenges requires a thorough understanding of existing research and technological developments in the field.

This study entitled "Guyabano Ripeness Recognition" aimed to accurately determine the ripeness of a guyabano, ultimately improving the efficiency and accuracy of fruit sorting and grading processes. The quality of fruit products relies heavily on the ripeness of the fruits used in their production. Accurate assessment of fruit ripeness is vital for both the fruit processing industry and consumers. However, current methods for determining fruit ripeness often suffer from inefficiencies and subjectivity, resulting in inconsistencies in product quality.

**Statement of the Problems**

The study aimed to develop a guyabano ripeness recognition using YOLOv8. Specifically, it seeks to answer the following questions:

1. What are the indications that a guyabano is already ripe in terms of: a. color; and b. texture?

2. What methods were used to detect and recognize the ripeness of a guyabano?

3. What is the accuracy of guyabano ripeness recognition in terms of: a. color; and b. texture?

**Objectives of the Study**

The study has the following objectives:

1. To identify the indications of a ripe guyabano in terms of: a. color; and b. texture.

2. To implement the methods used to detect and recognize the ripeness of a guyabano.

3. To identify the accuracy of guyabano ripeness recognition in terms of: a. color; and b. texture.

**Scope and Delimitation**

The research project focused on creating and applying a guyabano ripeness recognition utilizing image processing techniques and machine learning algorithms. Emphasis was placed on software development, with no exploration into specialized hardware design. YOLOv8 (You Only Look Once version 8), a neural network-based algorithm for real-time object detection, was employed. The main objective is to evaluate guyabano fruit (soursop) ripeness by analyzing visual attributes such as color and texture. The study encompassed various ripeness stages, including unripe, ripe, and rotten, aimed to accurately categorize guyabano fruits across these stages. The study period spans from December to May to capture seasonal variation in guyabano ripening.

The study did not extend to include a comprehensive variety of fruits beyond guyabano. The applicability to other fruits was excluded from the primary scope because they may exhibit different ripening patterns. The scope is limited to assessing ripeness based on visual characteristics, such as color and texture. Factors like aroma, weight, taste, and stem were excluded from this study. Just to discuss these factors, the aroma of a ripe guyabano is a reliable indicator of its ripeness. As guyabano ripens, it releases volatile compounds that contribute to its sweet and fragrant aroma. It undergoes changes in moisture content as it ripens, which can affect its weight. A ripe guyabano will be heavy for its size. The stem usually comes off easily when the fruit is at its peak of flavor. Human evaluations of guyabano ripeness were not included in this study. The focus was solely on automated ripeness recognition using image processing. It did not involve the development or design of specialized hardware components for ripeness recognition. While the study aimed to assess the effectiveness and accuracy, global applicability was not extensively explored.

**Significance of the Study**

The result of this study will benefit the following entities:

To the Farmers. They can benefit from increased efficiency in harvesting. Ripeness recognition allows them to identify optimal harvest times, reducing the risk of harvesting fruits too early or too late.

To the Producers and Distributors. They can streamline their supply chain operations by receiving fruits at the peak of ripeness. This optimization leads to better product quality and potentially lower transportation and storage costs. By delivering consistently high-quality fruits to the market, producers and distributors can enhance their competitiveness and meet consumer demand for fresh and ripe produce.

To the Consumers. Consumers benefit from receiving fruits that are at their peak ripeness, ensuring better taste, nutritional value, and overall quality.

To the Researchers and Innovators. The development and implementation of guyabano ripeness recognition contribute to the advancement of technology in

**Definition of Terms**

Agricultural supply chain. It consists of different entities like the producers, the distributors, and the consumers who are the beneficiaries of guyabano ripeness recognition.

Annotation. This refers to labeling the image of a guyabano fruit or its various parts. It involves drawing bounding boxes and assigning labels to them, enabling the training of machine learning models to recognize and classify the ripeness of a guyabano accurately.

Color. This is one of the indications to identify if guyabano is already ripe. An unripe guyabano has a vibrant green color, yellowish-green if it’s ripe, and turns brown or black if it’s rotten.

Consumer satisfaction. It refers to the degree to which consumers are happy and contented with the quality of guyabano fruits they purchased and consumed, as influenced by the accurate assessment of guyabano ripeness recognition.

Dataset. It is a collection of images, specifically guyabano fruits, that were used by the researchers for this project.

Guyabano ripeness recognition. It was developed by researchers to detect the ripeness of guyabano fruits.

Image analysis. It involves the examination of images or pictures of guyabano (soursop) to evaluate changes in color and texture as indications of ripeness.

**Chapter 2**

**METHODOLOGY**

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**Chapter 3**

**DISCUSSION OF FINDINGS**

This chapter discussed the indications of a ripe guyabano (soursop) in terms of color and texture, the methods used to detect and recognize its ripeness, and the accuracy of guyabano ripeness recognition.

1. The indications that a guyabano is already ripe in terms of: color and texture.

ccccccccccccccc dddddddd eeeeeeeeee rrrrrrrrr rrrrr eeeeeeeeee ccccccccccc kkkkkkkk aaaaaaaaaaaa ccccccccc llllll rrrrrrrrr.

Fgggggggggggggkkk hhhhhhhhhhhhhhhh ddddddddddddddd aaaaaaaaaaaaaaaaa ffffffffffff dddddddddddd dggggggg qqqqqqqqqqq wwwwwww eeee rrrrrr ttttttt yyyyy uuuuuuuuuu iiiiiiii oooooo ppppp gggggg yyyyy.

1. Methods used to detect and recognize the ripeness of a guyabano.

ccccccccccccccc dddddddd eeeeeeeeee rrrrrrrrr rrrrr eeeeeeeeee ccccccccccc kkkkkkkk aaaaaaaaaaaa ccccccccc llllll rrrrrrrrr.

Fgggggggggggggkkk hhhhhhhhhhhhhhhh ddddddddddddddd aaaaaaaaaaaaaaaaa ffffffffffff dddddddddddd dggggggg qqqqqqqqqqq wwwwwww eeee rrrrrr ttttttt yyyyy uuuuuuuuuu iiiiiiii oooooo ppppp gggggg yyyyy.

ccccccccccccccc dddddddd eeeeeeeeee rrrrrrrrr rrrrr eeeeeeeeee ccccccccccc kkkkkkkk aaaaaaaaaaaa ccccccccc llllll rrrrrrrrr.

Fgggggggggggggkkk hhhhhhhhhhhhhhhh ddddddddddddddd aaaaaaaaaaaaaaaaa ffffffffffff dddddddddddd dggggggg qqqqqqqqqqq

1. Accuracy of guyabano ripeness recognition in terms a. color and texture.

ccccccccccccccc dddddddd eeeeeeeeee rrrrrrrrr rrrrr eeeeeeeeee ccccccccccc kkkkkkkk aaaaaaaaaaaa ccccccccc llllll rrrrrrrrr.

Fgggggggggggggkkk hhhhhhhhhhhhhhhh ddddddddddddddd aaaaaaaaaaaaaaaaa ffffffffffff dddddddddddd dggggggg qqqqqqqqqqq wwwwwww eeee rrrrrr ttttttt yyyyy uuuuuuuuuu iiiiiiii oooooo ppppp gggggg yyyyy.

**Chapter 4**

**SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS**

This chapter discussed the indications of a ripe guyabano (soursop) in terms of color and texture, the methods used to detect and recognize its ripeness, and the accuracy of guyabano ripeness recognition.

**Summary**

This study aimed to develop a guyabano ripeness recognition using YOLOv8. Specifically, it answers the following questions:

1. What are the indications that a guyabano is already ripe in terms of: a. color; and b. texture?

2. What methods were used to detect and recognize the ripeness of a guyabano?

3. What is the accuracy of guyabano ripeness recognition in terms of: a. color; and b. texture?

**Summary of Findings**

Guyabano ripeness recognition efficiently and accurately identified the ripeness of guyabano fruits by analyzing visual features like color and texture. The indications that a guyabano is already ripe in terms of color is that it has a vibrant green color if it's unripe due to the presence of chlorophyll. Transition from green to yellowish-green or yellow indicates ripeness. If it's rotten, it often turns brown or black in patches. In terms of texture, ripe guyabano tends to be softer to touch compared to unripe ones. This softness indicates that the fruit’s flesh inside has reached an optimal ripeness level. Rotten guyabano is extremely soft.

The incorporation of YOLO (You Only Look Once) for this project played a key role in achieving a high level of accuracy in distinguishing between unripe, ripe, and rotten guyabano fruits. YOLOv8 (You Only Look Once version 8) is a state-of-the-art object detection algorithm that is commonly used in computer vision tasks, including object detection, localization, and classification. YOLOv8 is designed for real-time object detection, meaning it can process images quickly, making it suitable for applications where speed is crucial, such as fruit ripeness recognition.

The researchers implemented data collection, data preprocessing, data training, model testing, and lastly, implementation. In data collection, diverse dataset of images of unripe, ripe, and rotten guyabano fruits were gathered. It is important to have clear images to allow machine learning models to better distinguish the different ripeness stages that will lead to more accurate ripeness recognition results. Next is data preprocessing. The researchers cleaned the dataset by removing any irrelevant or low quality images that will affect the accuracy of the guyabano ripeness recognition. After cleaning, the data was annotated or labeled based on its ripeness stage. After being annotated, all the images were converted into the format to input it in YOLOv8. Next to data preprocessing is the data training. It involves systematically instructing the model to accurately classify the ripeness stages of guyabano fruits using labeled image data. After data training is the model testing. It involves assessing the performance of the trained model using a distinct dataset it has not encountered during training. Finally, the implementation, wherein researchers implemented mechanisms to handle input data such as guyabano fruit images.

**Conclusions**

The average accuracy of ripeness recognition for unripe guyabano fruits stands at 90%. This implies that the model correctly identifies unripe guyabano fruits in around 90% of cases, based on visual indicators like color and texture. Similarly, the average accuracy for ripe guyabano fruits' ripeness recognition is 90%, indicating the model's ability to accurately distinguish ripe guyabano fruits from unripe or rotten ones in approximately 90% of instances. Finally, the average accuracy for identifying rotten guyabano fruits also registers at 90%, indicating the model's proficiency in identifying such fruits correctly is approximately 90%.

**Recommendations**

The following are the recommendations for implementing and further developing the Guyabano Ripeness Recognition.

1. Better accuracy. Researchers recommend using clear cameras for guyabano ripeness recognition to improve the accuracy, reliability, and generalization capabilities of machine learning models. By capturing high-resolution images with detailed visual information, clear cameras contribute to more effective analysis and interpretation of ripeness cues in guyabano fruits.

2. Develop a mobile application. Developing a mobile application to identify the ripeness of guyabano can enhance accessibility for farmers and users. This application enables users to take photos of guyabano using their smartphones and determine their ripeness through classification.

3. Detect other fruit with similar features to guyabano. For future researchers aiming to develop guyabano ripeness recognition application, detecting other fruit with similar features to guyabano like jackfruit or langka could provide valuable insights and opportunities for enhancing the robustness and versatility of the recognition model. Jackfruit should be detected as “not a guyabano”.

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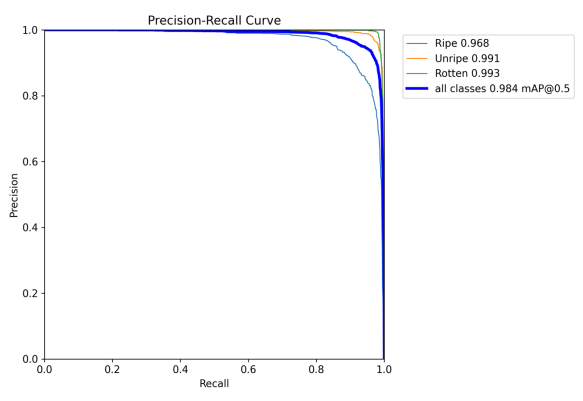
Comparative Guide. <https://www.datacamp.com/blog/the-difference-between->aiand-machine-learning

**APPENDICES**

Appendix A

Figure A.1

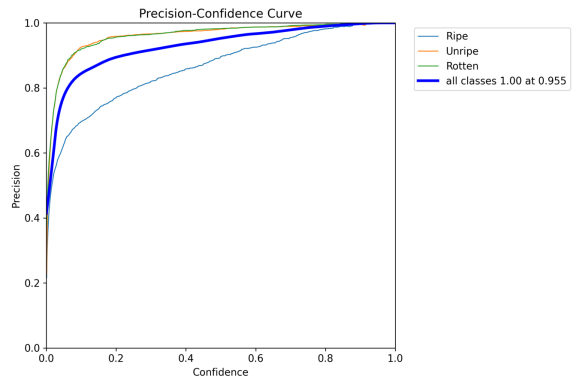
*Precision-Recall Curve*



*Note.* The graph depicts precision-recall curves, where recall assesses the model's capability to identify all pertinent instances. Concerning performance accuracy, the model demonstrates high precision and recall values across all three classes (unripe, ripe, and rotten), as evident from the precision-recall curves. With precision values near 1, indicating minimal false positives, and high recall values, signifying the model's effectiveness in capturing most relevant instances, it performs adeptly in ripeness recognition.

Figure A.2

*Precision-Confidence Curve*



*Note.* This figure shows a Precision-Confidence Curve for a guyabano ripeness recognition. Each colored line represents the precision of the system for a specific class (unripe, ripe, or rotten) as a function of confidence threshold. Precision is a measure of the accuracy of the positive predictions made by the model. It is the ratio of true positive predictions to the total number of positive predictions made by the model. Confidence refers to the level of certainty or confidence the model has in its predictions. The curve for each class shows how precision changes as the confidence threshold for classification is varied. A higher precision value indicates that the model is making fewer false positive predictions.

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