

ADVANCED MACHINE LEARNING CLASSIFIER

2.2.0

Comprehensive Handbook

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Advanced machine learning classifier 2.2.0

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Keyboard Shortcuts

Menu/Action	Shortcut Key(s)
Open Data	Ctrl+O
Save Confusion Matrix	Ctrl+M
Save Classification Report	Ctrl+R
Save Testing Results	Ctrl+T
Generate Python Script	Ctrl+G
Exit	Ctrl+Q
Resize & Preprocess	Ctrl+I
Open Settings	Ctrl+Shift+T
Edit Convolutional Layers	Ctrl+L
Classify Images	Ctrl+Enter
Display and Save Misclassified Images	Ctrl+Shift+M
Magnifier 12%	Ctrl+A
Magnifier 14%	Ctrl+B
Magnifier 16%	Ctrl+C
Magnifier 18%	Ctrl+D
Magnifier 20%	Ctrl+E
Magnifier 22%	Ctrl+F
Clear Kernel	Ctrl+K
Reset All Data	Ctrl+Shift+R

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by

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CHAPTER

1

INTRODUCTION

Welcome to Advanced Machine Learning Classifier 2.2.0! We are excited to welcome you to Advanced Machine Learning Classifier 2.2.0, an innovative and feature-rich application designed to simplify and enhance your experience with image classification tasks. With this cutting-edge tool, you can seamlessly analyze and classify images using some of the most advanced machine learning techniques available today.

This comprehensive handbook serves as your ultimate guide to understanding and leveraging the full potential of the classifier. Whether you're a beginner exploring machine learning for the first time or an experienced professional seeking an efficient classification solution, this application is equipped to cater to your needs.

The Advanced Machine Learning Classifier combines the power of state-of-the-art algorithms with an intuitive interface, making it easy to navigate even the most complex image classification processes. From feature extraction using Convolutional Neural Networks to advanced visualizations of results, we aim to deliver a robust and user-friendly experience.

If you encounter any questions along the way or require additional assistance, our dedicated support team is here to help. We are committed to ensuring you achieve the best possible results with this product.

Thank you for choosing Advanced Machine Learning Classifier 2.2.0. We are confident that it will exceed your expectations and empower you to accomplish your goals with greater efficiency and precision.

1.1. KEY FEATURES

- **Image Analysis:** Easily load and analyze images in formats such as JPG, JPEG, and PNG.
- **Customizable Image Dimensions:** Resize images to preferred dimensions, such as 150x150 or 250x250 pixels, to suit specific requirements.
- **Comprehensive Preprocessing Options:** Choose from a variety of preprocessing techniques, including Normalization, Data Augmentation, and Image Flipping options.
- **Advanced Feature Extraction:** Utilize powerful Convolutional Neural Networks (CNNs) for feature extraction. Users can build and customize their own CNN models, with the flexibility to add or remove convolutional layers based on their specific needs.
- **Diverse Algorithms:** Utilize multiple machine learning algorithms, including:
 - AdaBoost
 - Decision Trees
 - Gradient Boosting
 - Naïve Bayes

- Random Forest
- Support Vector Machines (SVM)
- **Custom SVM Kernel Options**
- **Enhanced Algorithms:** Includes bagging capabilities.
- **Flexible Train-Test-Validation Splits:** Customize the train-test-validation split for your dataset.
- **Error Identification:** Identify misclassified images along with their corresponding file names.
- **Visualization:** Explore results through dynamic confusion matrices.
- **Comprehensive Reports:** Access detailed classification reports.
- **Test Predictions Display:** View classification outcomes for test images along with predicted labels and class probabilities. For each image, detailed probability scores are provided for all possible classes.
- Option to **generate a customizable Jupyter Notebook** script based on selected inputs.
- **Visual Learner Mode:** An interactive tutorial that demonstrates how algorithms classify data. Users can:
 - Observe the classification of four species classes using multiple machine learning methods.
 - Access detailed algorithm explanations through direct links to Wikipedia.
 - Experiment in *Try It Yourself* mode by adding new data points to a two-class problem and watching decision boundaries update in real time.
 - Use the feature as both a study aid and a hands-on visualization tool to understand classification theory and practice.
- **Convenient Refresh and Reset Options**

1.2. SYSTEM REQUIREMENTS

For basic classification purposes, we recommend utilizing any Windows-based system. To ensure optimal performance, we suggest a minimum of 16 Gigabytes of RAM. Additionally, for enhanced processing capabilities, it is highly recommended to consider systems equipped with an Intel i5 or i7 processor or later model.

In scenarios involving the processing of substantial amounts of data, we advise opting for systems with a higher memory capacity, preferably a minimum of 32 or 64 Gigabytes of RAM. This will significantly enhance the efficiency and speed of data processing, ensuring a seamless experience with large datasets.

Your attention to these hardware specifications will undoubtedly contribute to a smoother and more productive computing environment.

Note: To install this software on university computers, administrative access is required. Due to its development for research purposes, it may be flagged by system firewalls as coming from an unknown source, which could block installation. However, on personal computers, the software can be installed without any issues.



CHAPTER

2

INSTALLATION

For a smooth installation process, we kindly request you to follow the provided instructions diligently. Your attention to detail during this phase will greatly contribute to the successful setup of our application.

Thank you for your cooperation, and we appreciate your commitment to ensuring a seamless installation experience.

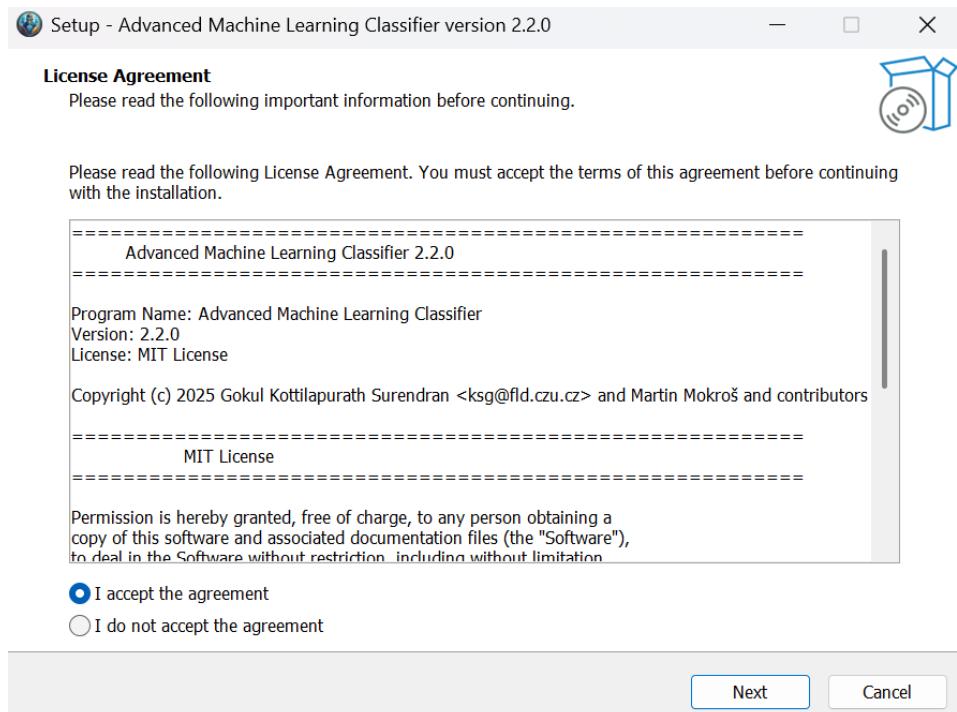
2.1. DOWNLOADING THE INSTALLER

Visit the official website or repository to download the Advanced Machine Learning Classifier installer.

<https://github.com/Gokultcr>

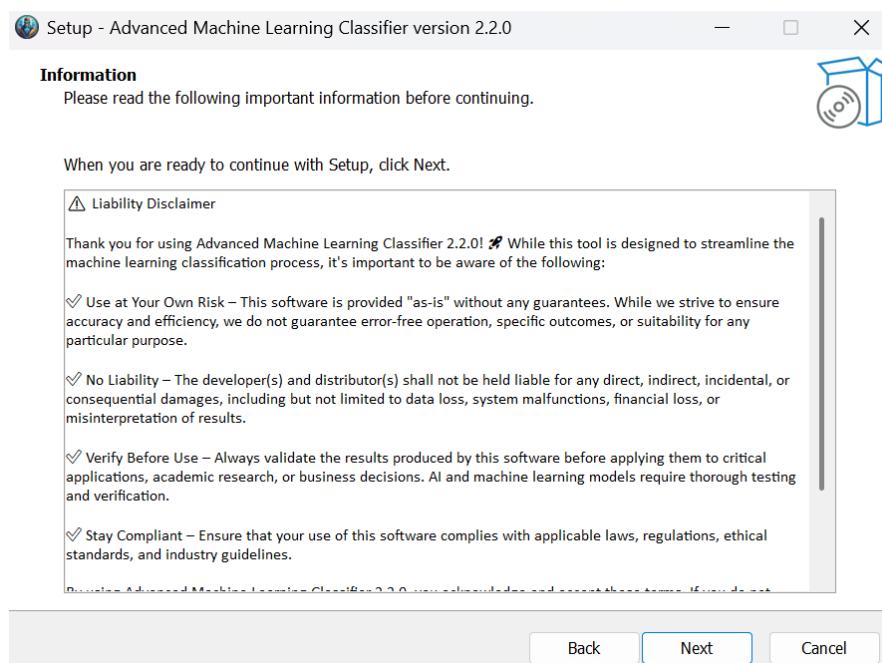
2.2. INSTALLATION PROCESS

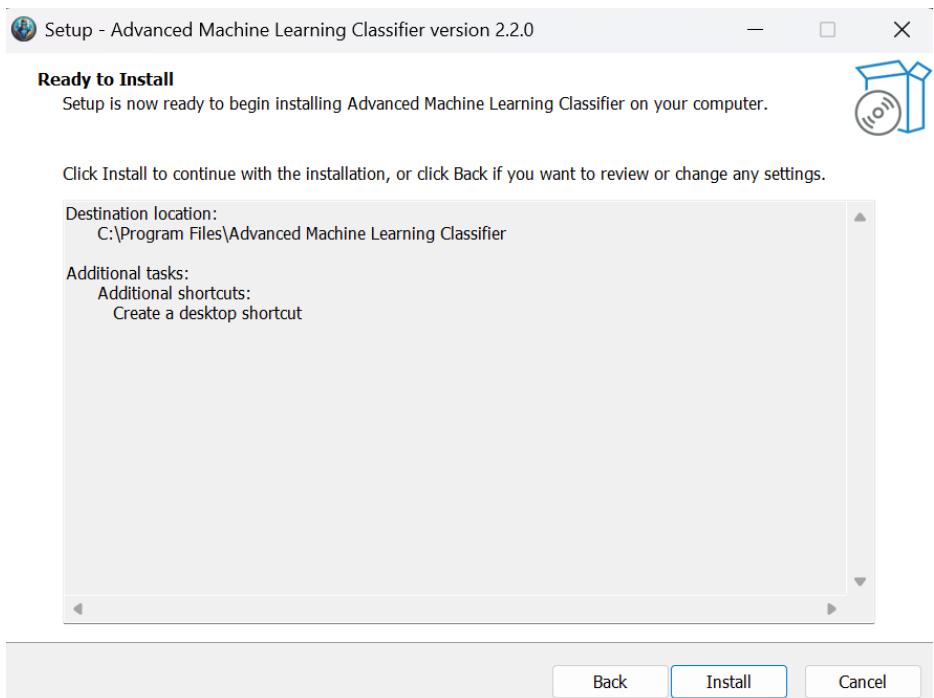
Run the installer and follow on-screen instructions for a seamless installation process.



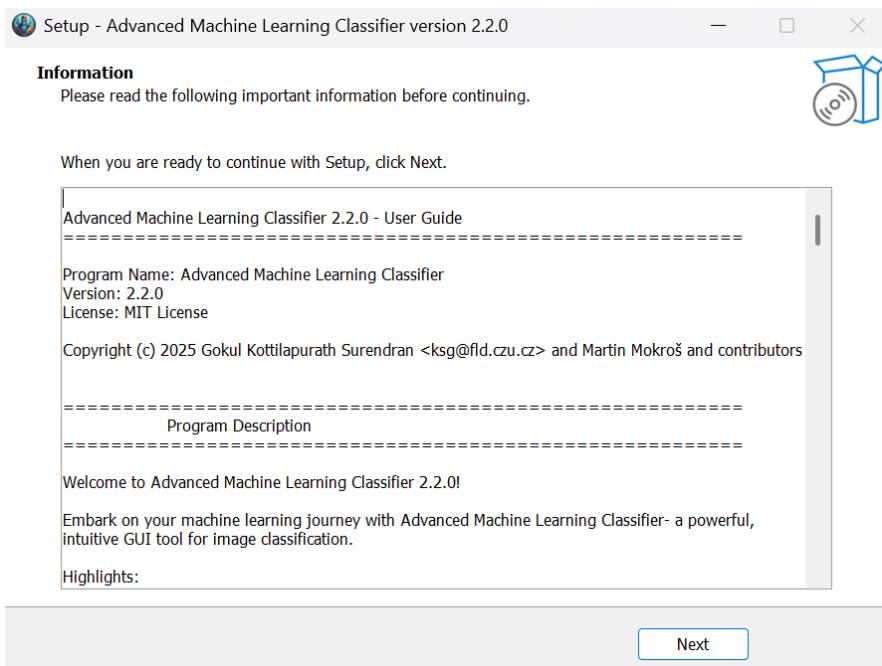
Kindly proceed by selecting the 'I accept' option and then click on the 'Next' button

Kindly ensure that you read the liability disclaimer before installing the software.





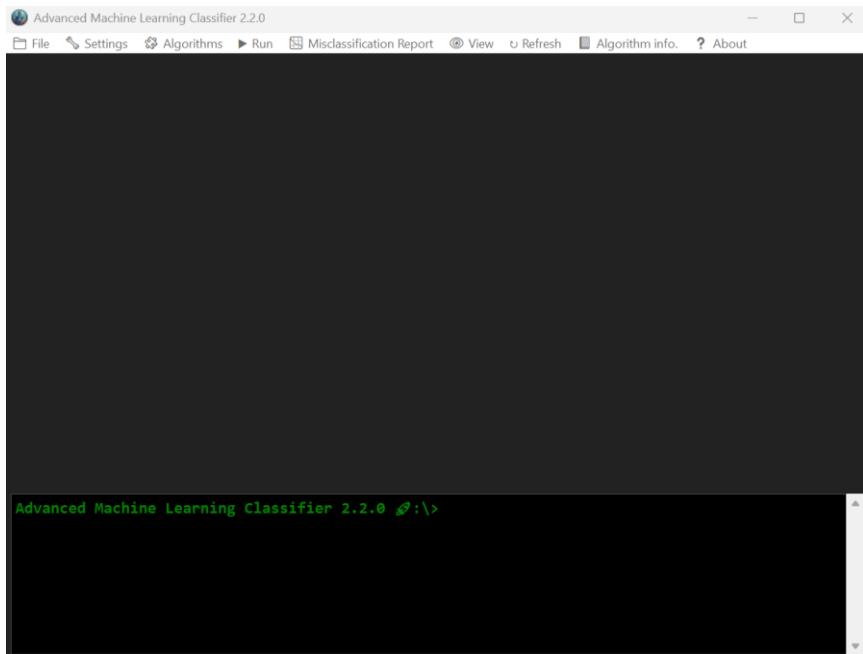
Kindly proceed by clicking on the 'Install' option to initiate the application installation.



Please take a moment to review the fundamental operational details provided. Your attention to this basic working information is greatly appreciated.

2.3. LAUNCHING THE PROGRAM

Upon successful installation, we kindly invite you to launch the program to commence your experience.



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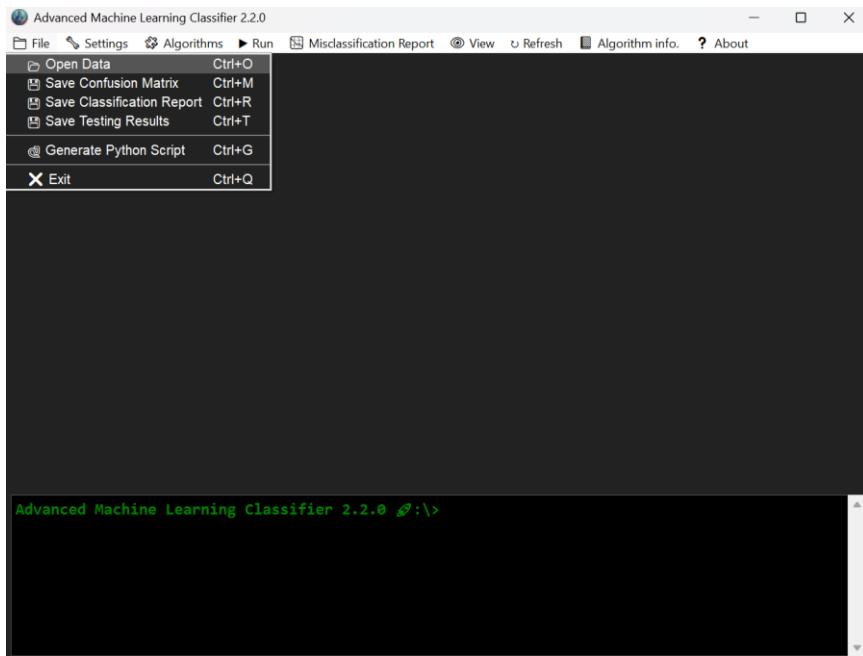
GETTING STARTED

3.1. RUNNING THE APPLICATION

While executing the application, you will notice a command prompt area at the bottom of the software. This section is designed to display warning messages, loaded data names, and a preview of results. It serves as an initial indicator of the application's functionality.

3.2. LOADING IMAGE DATA

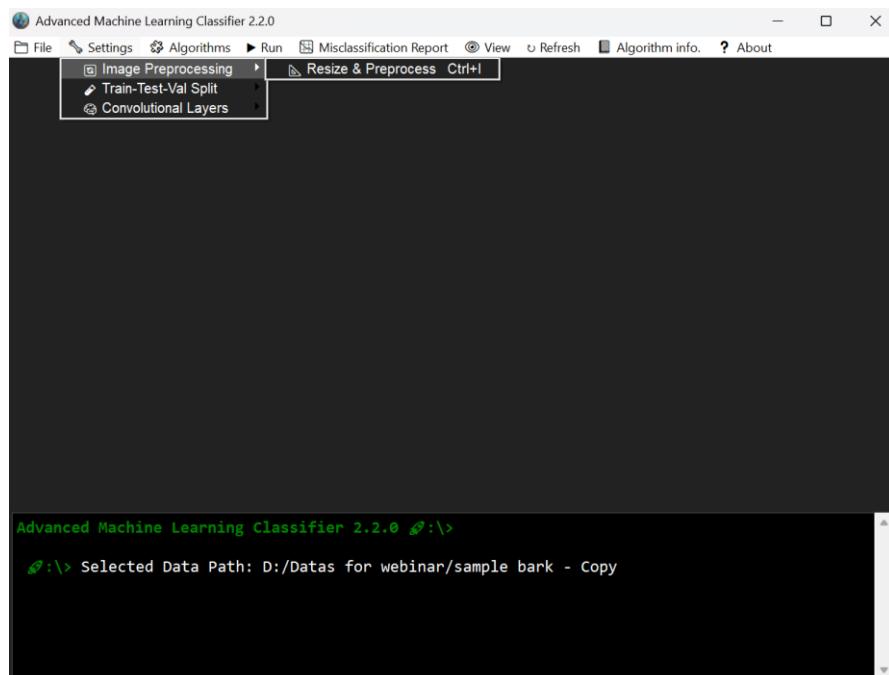
Please navigate to the ‘File’ menu and select ‘Open Data (Ctrl+O)’ to access the option for opening a folder containing image data. Please ensure that the images are organized into separate folders, with the folder names representing the class labels for the classification task. Once the data is loaded, the software will automatically recognize the folder names as the class labels.



Upon selecting the datapath, you will find it displayed in the command prompt area within the main application.

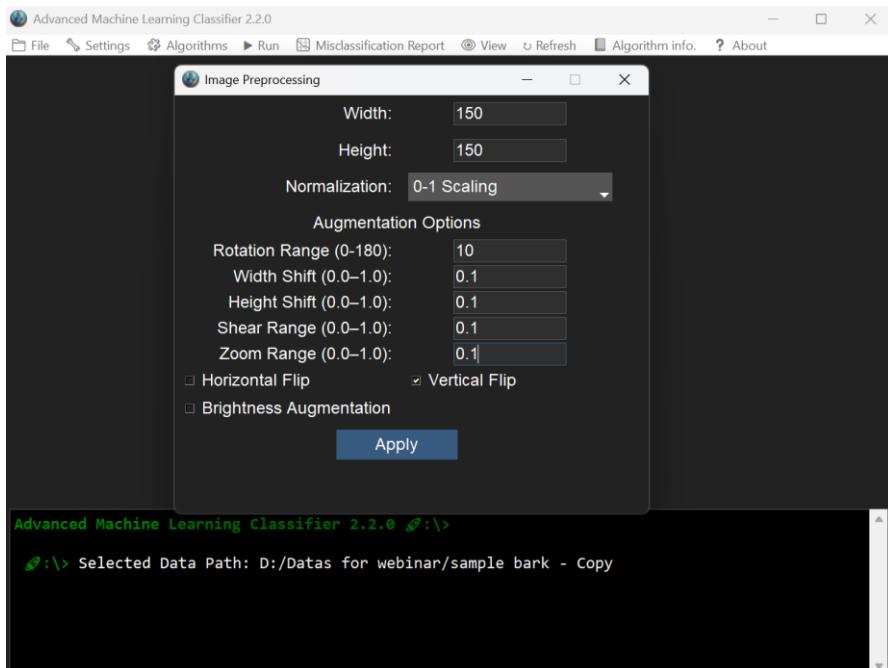
3.3. IMAGE PREPROCESSING

Kindly navigate to the ‘Image Preprocessing’ option under the ‘Settings’ menu and set the desired image size by selecting ‘Resize & Preprocess (Ctrl+I).’



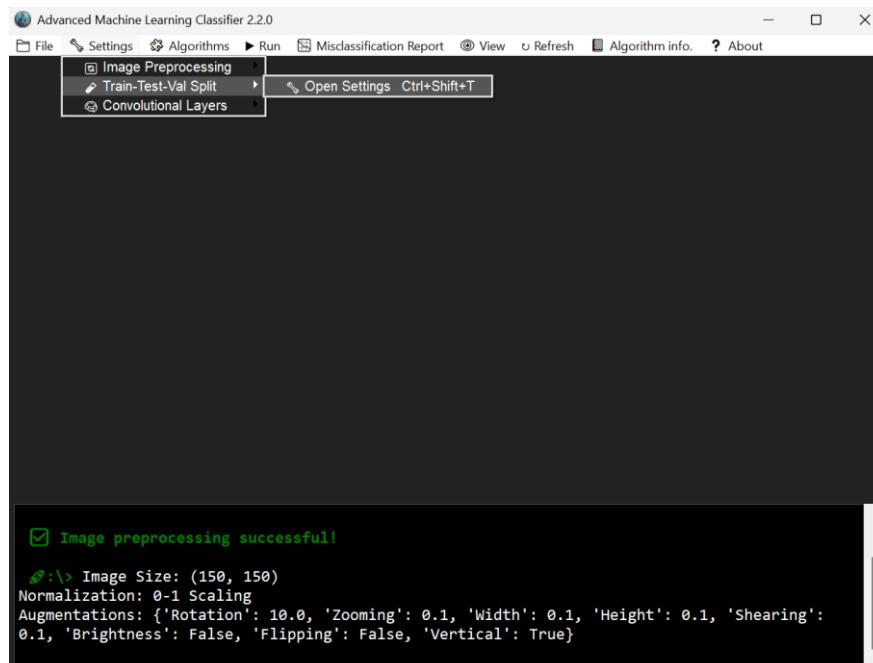
Once the Image Size window is open, set the desired image dimensions, such as 150x150, 250x250, and so on. Choose various preprocessing techniques, including:

- Normalization: None, 0-1 Scaling, -1 to 1 Scaling, Standardization
- Augmentations: Rotation Range, Width Shift, Height Shift, Shear Range, Zoom Range, Brightness Augmentation, and various Flipping options



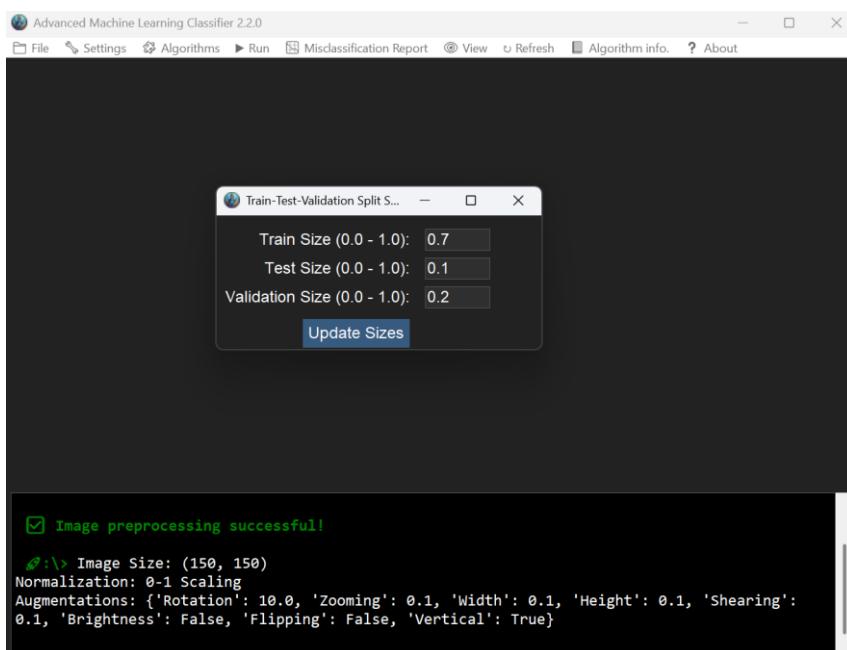
3.4. TRAIN-TEST-VALIDATION SPLIT SETTINGS

Kindly consider adjusting the training and testing size percentages by navigating to the 'Train-Test Split' option under the 'Settings' menu. Then, click on 'Open Settings (Ctrl+Shift+T)' to allocate values for train-test validation. However, it's worth noting that by default, the system is set to allocate 70% for training, 10% for testing and 20% for validation.



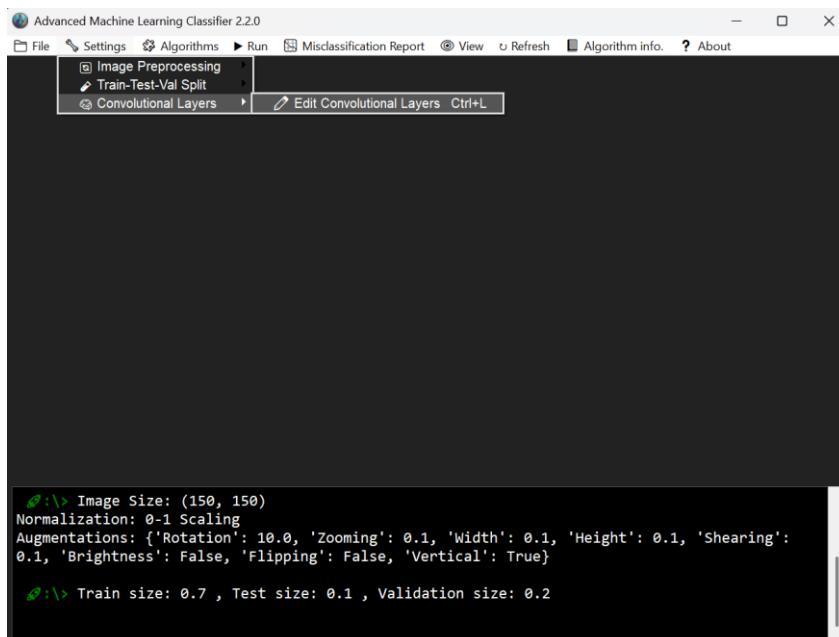
Should you opt for a 70% split, kindly input 0.7, and for a 60% split, please input 0.6. It's important to note that the total sum of training and testing sizes must equate to 100% (1.0). In the event that the total size exceeds this limit, the system will automatically clear all inputted details. Your careful consideration of these parameters is genuinely appreciated.

Enter the train, test validation sizes:

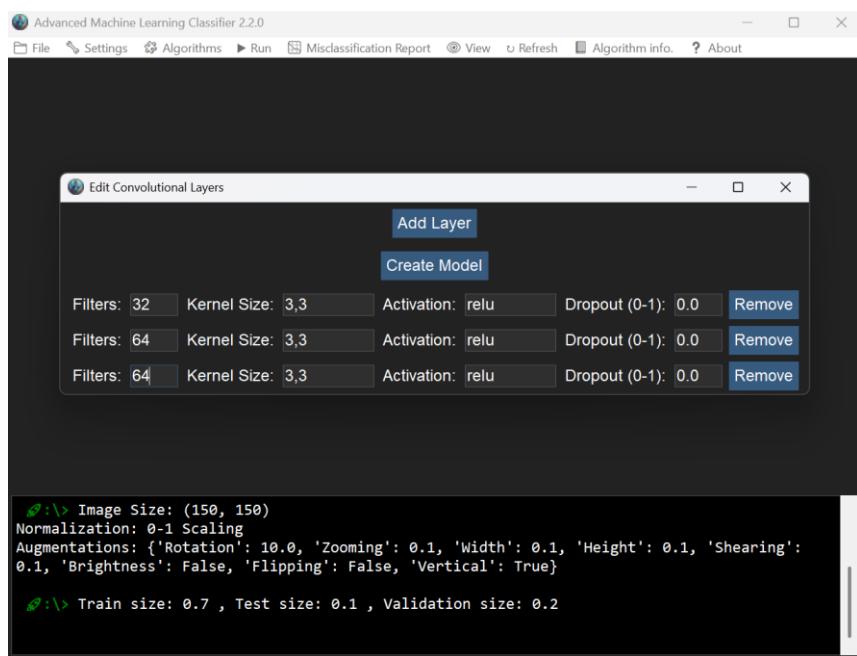


3.5. CNN FEATURE EXTRACTOR

Please click on the ‘Convolutional Layers’ option under the ‘Settings’ menu and click on ‘Edit Convolutional Layers (Ctrl+L)’ to create a CNN model for the feature extraction task.

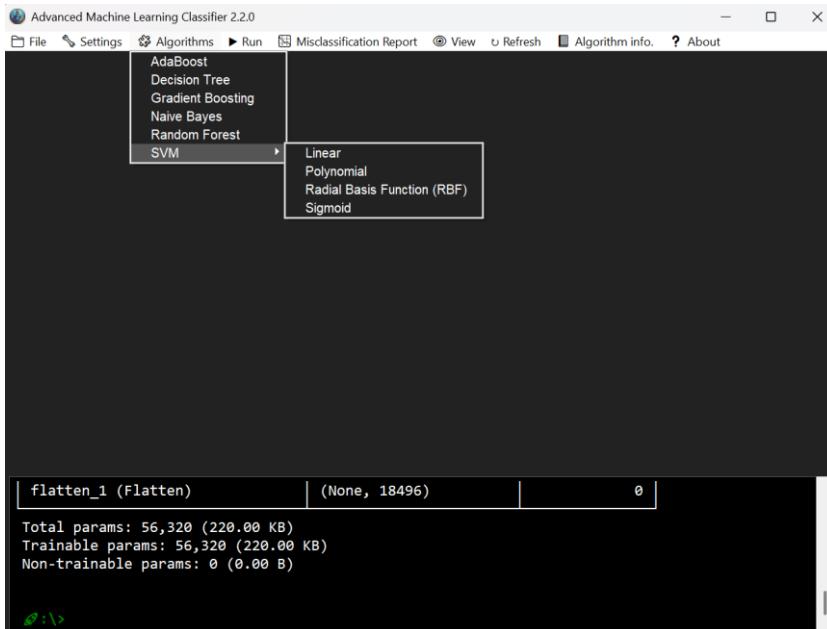


The ‘Edit Convolutional Layers’ window allows you to create a CNN model for feature extraction. Click on the ‘Add Layer’ button to add new convolutional layers with default values. You can then customize the filter values (e.g., 64, 128, 512), kernel size, and activation function for each layer as needed. Additionally, you can set the dropout rate for each layer, such as 0.1 for 10% and 0.3 for 30%. If you wish to remove any layers, click on the “Remove” button. Once you have finalized the model configuration, click on the “Create Model” button to proceed.



3.6. CHOOSING AN ALGORITHM

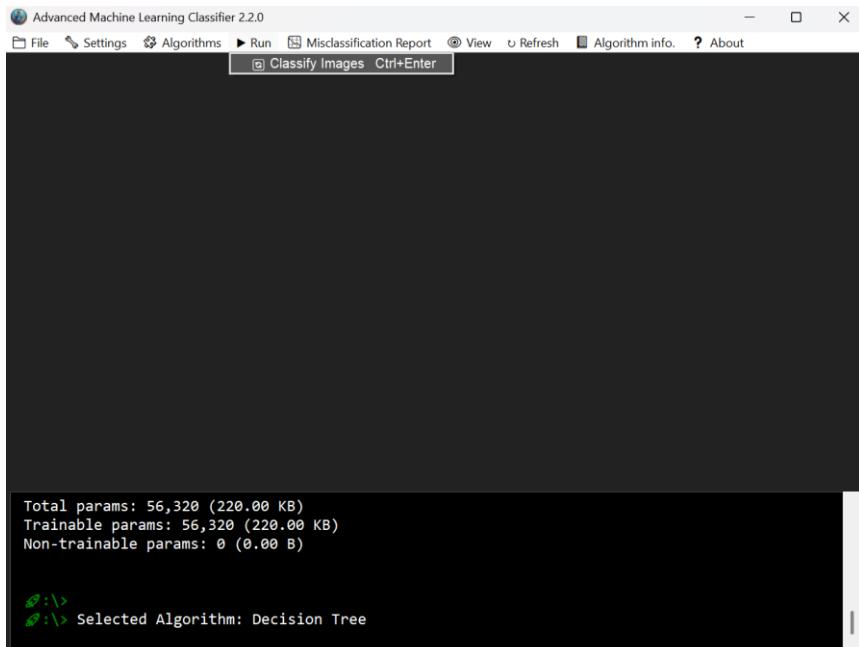
Kindly proceed by selecting an algorithm from the ‘Algorithms’ menu that aligns with your specific classification requirements.



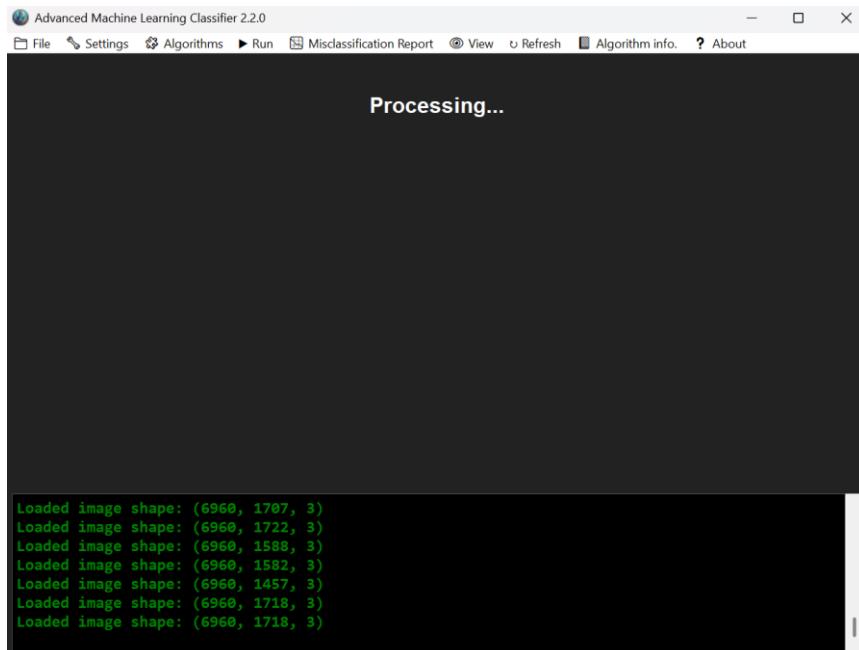
We would like to bring to your attention that for Support Vector Machine (SVM), various kernel options have been made available.

3.7. INITIATING THE CLASSIFICATION

Kindly proceed by clicking on the ‘Run’ menu, and then click on ‘Classify Images (Ctrl+Enter)’ to initiate the classification process.



Upon initiation of the processing, the system will indicate 'Processing' to signify that the operation has commenced. Your patience during this phase is greatly appreciated.

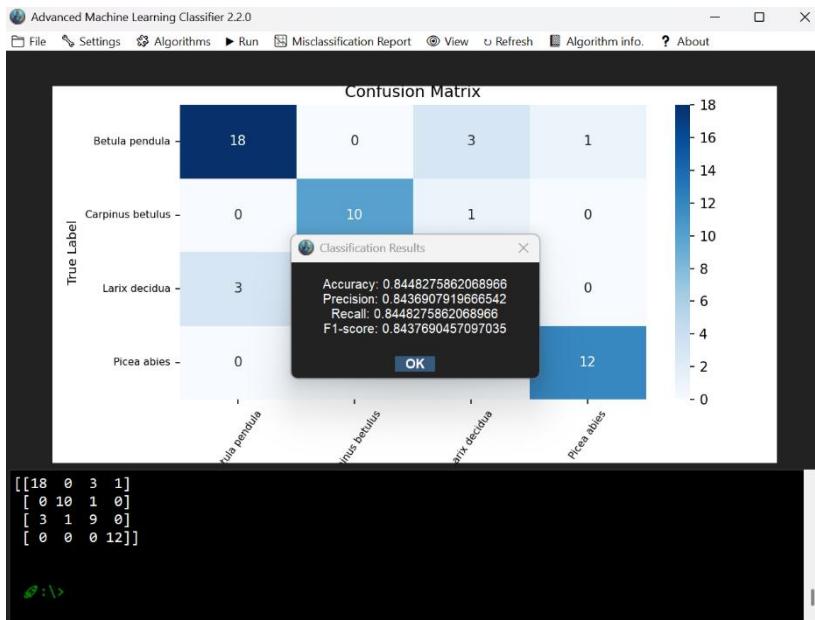


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RESULTS

After the completion of processing, a popup will display the main accuracy scores. Kindly click 'OK' to finalize the process and access the results.



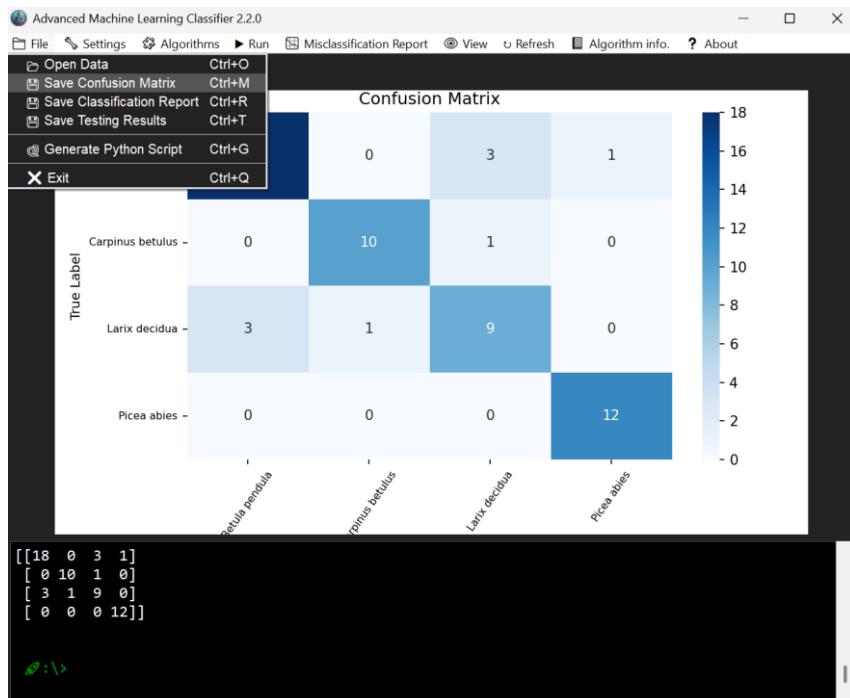
The confusion matrix will be presented in the main application window. Your attention to this crucial element is highly valued.

Additionally, the command prompt in the main application window will display essential information such as the selected data path, training-testing size, chosen algorithm, accuracy matrices, and the confusion matrix.

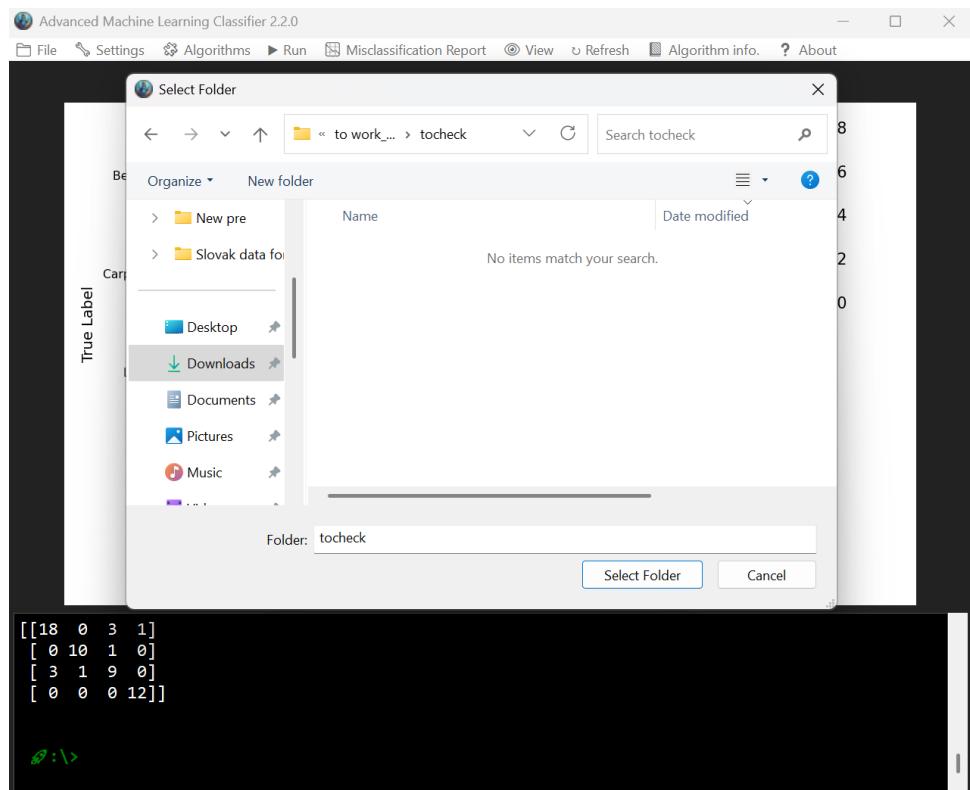


4.1. INITIATING THE CONFUSION MATRIX

To save the confusion matrix as a PNG image, kindly navigate to the 'File' menu and select the 'Save Confusion Matrix (Ctrl+M)' sub-menu. The system will prompt you to choose a folder for saving; please select the desired folder for the storage of the confusion matrix image.

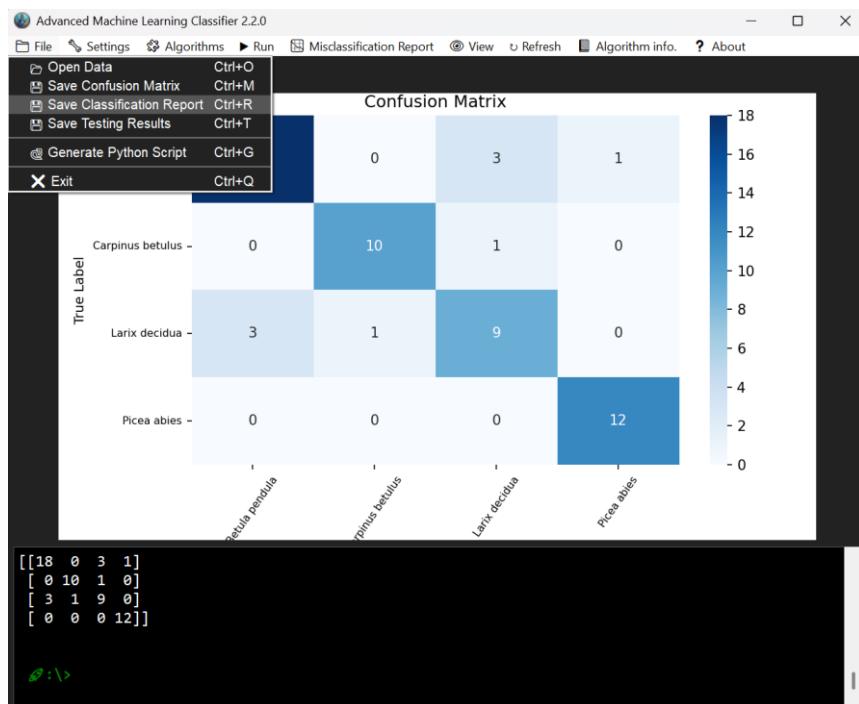


Select the folder:

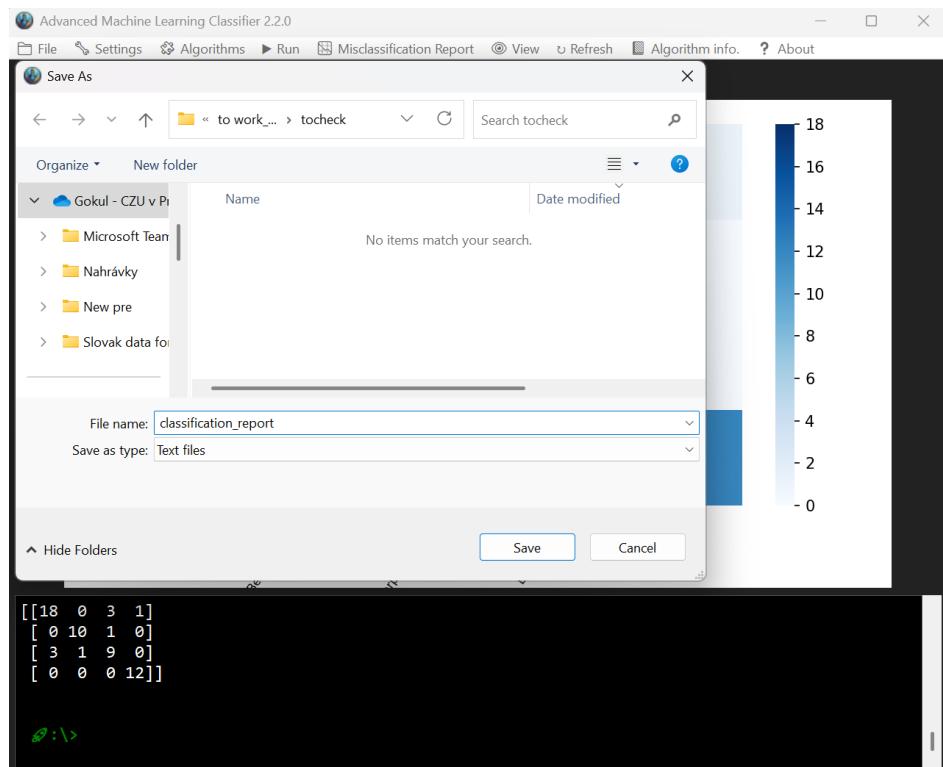


4.2. INITIATING THE CLASSIFICATION REPORT

To retain the detailed classification report as a TXT file for future reference, please navigate to the 'File' menu and select the sub-menu 'Save Classification Report (Ctrl+R).' You will be prompted to choose a location for saving, kindly select the desired folder, and provide a suitable file name.



Provide the file name for Classification report:

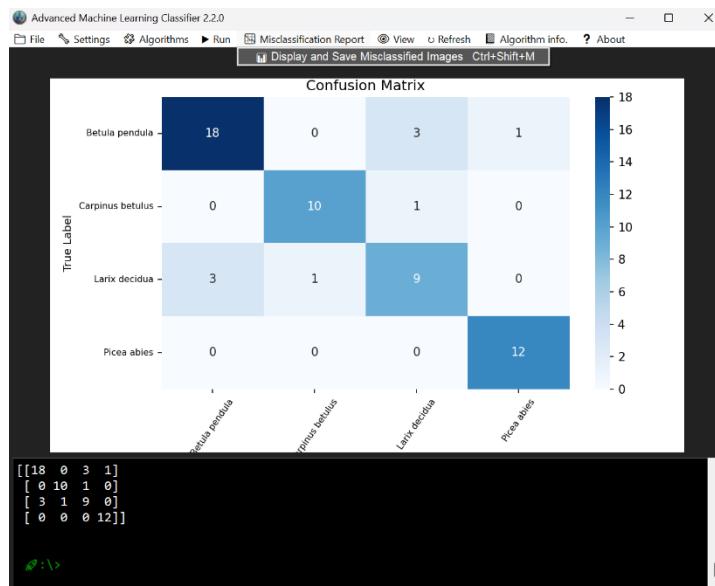


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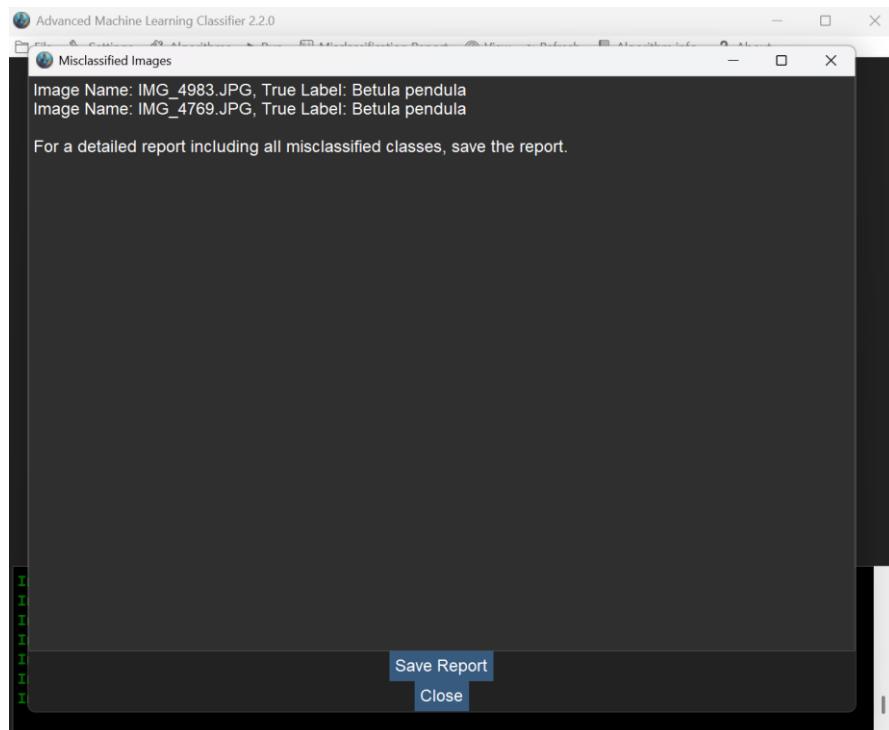
5

MISCLASSIFICATION REPORT

To access the details of misclassified images and generate a comprehensive report, which includes file names, original labels, predicted labels, and more, kindly click on the ‘Display and Save Misclassified Images (Ctrl+Shift+M)’ option in the menu. It is important to note that this feature is activated only after the completion of the initial training and testing processes.



The window will display only a limited set of details. For a more comprehensive report, please click on ‘Save Report’ to save the information as an Excel file.

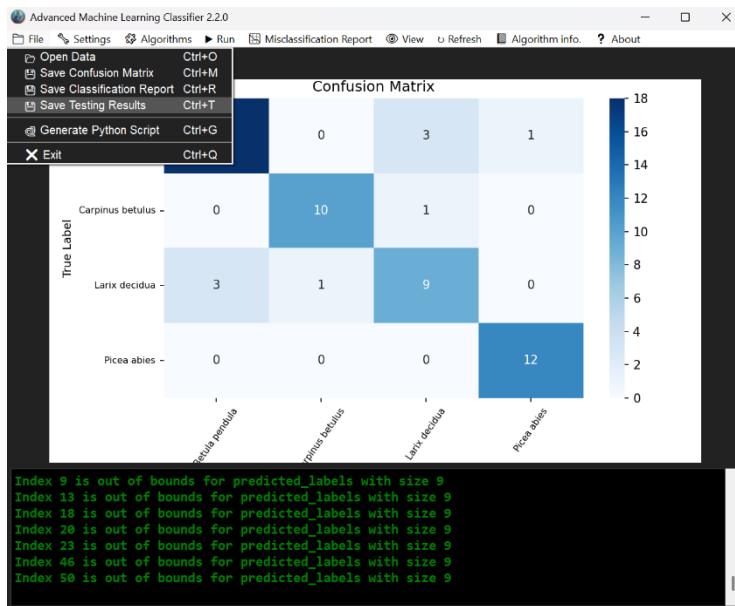


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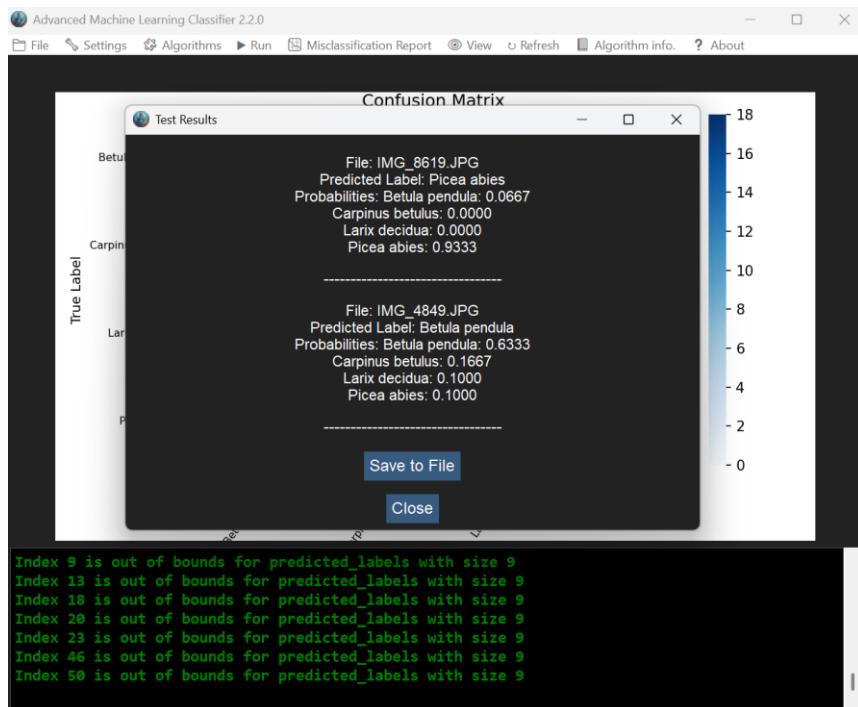
6

TESTING RESULTS

To view the testing results in more detail, please navigate to the ‘Save Testing Results (Ctrl+T)’ sub-menu under the ‘File’ menu and click on it to save the testing results



It will display the testing file name, predicted label, and the probabilities for other classes. Please save the results to obtain all testing details.

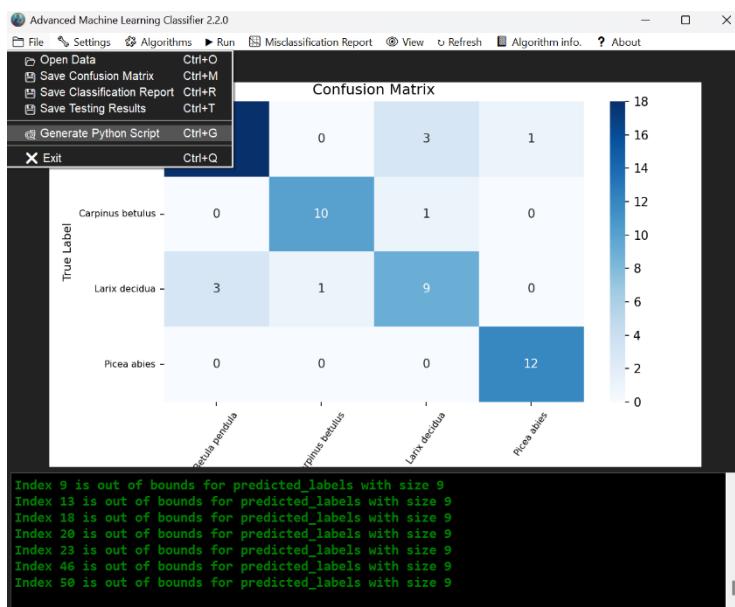


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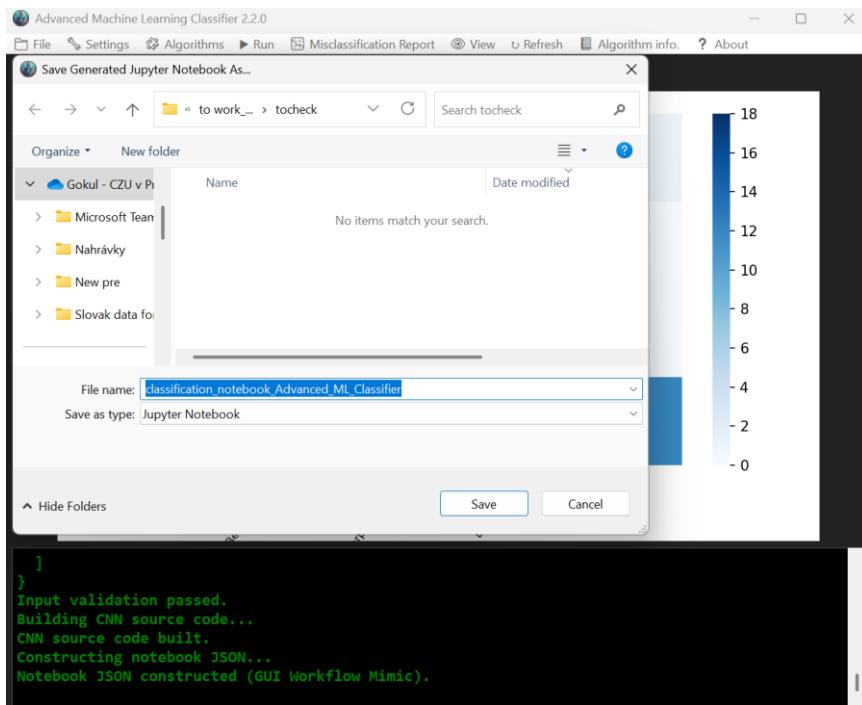
7

GENERATE PYTHON SCRIPT

To generate a python script (Jupyter Notebook) for future use, please navigate to the ‘File’ menu and select the ‘Generate Python Script (Ctrl+G)’ option from the sub-menu. A prompt will appear asking you to choose a location for saving the file, kindly select the appropriate folder.



Please select the desired location to save the generated notebook:

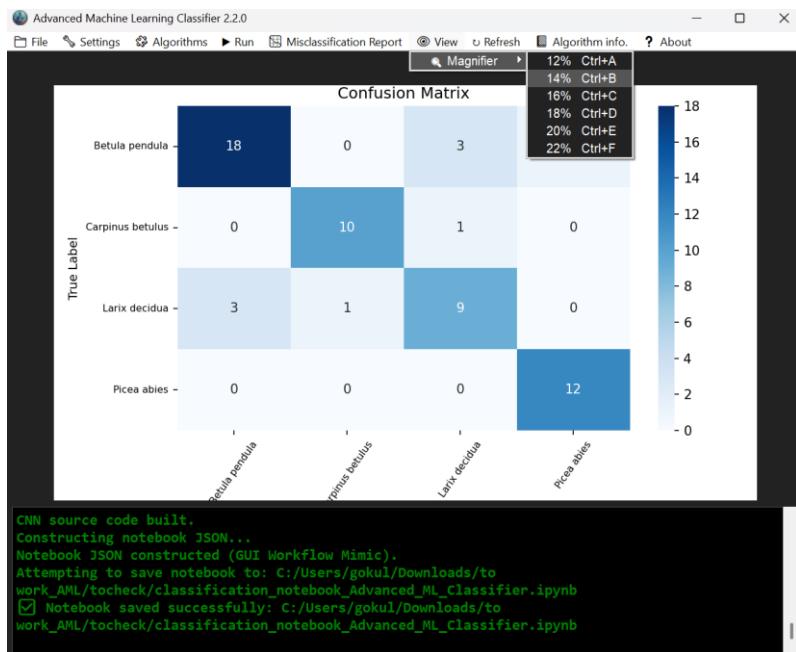


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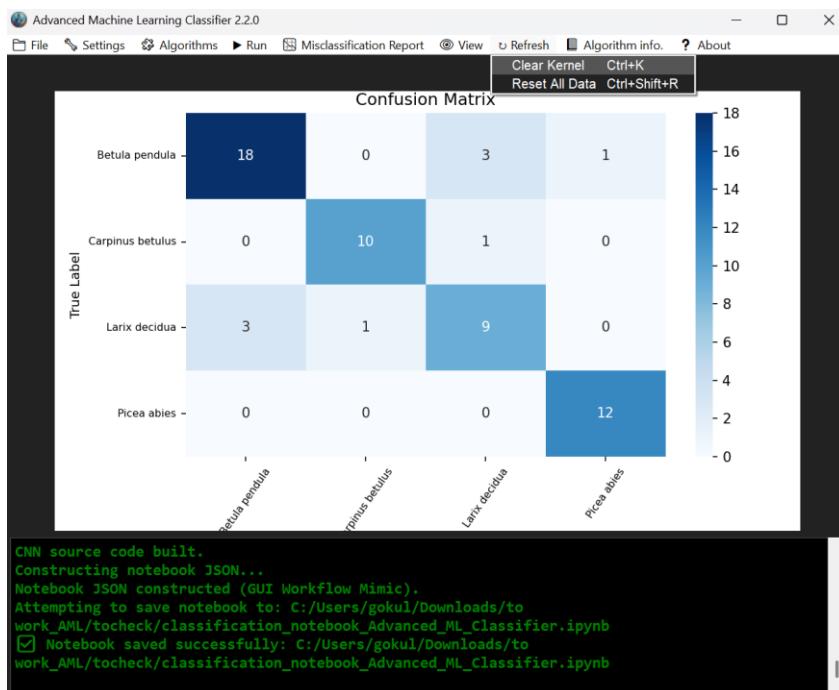
8

MAGNIFIER, REFRESH & ALGORITHM INFO.

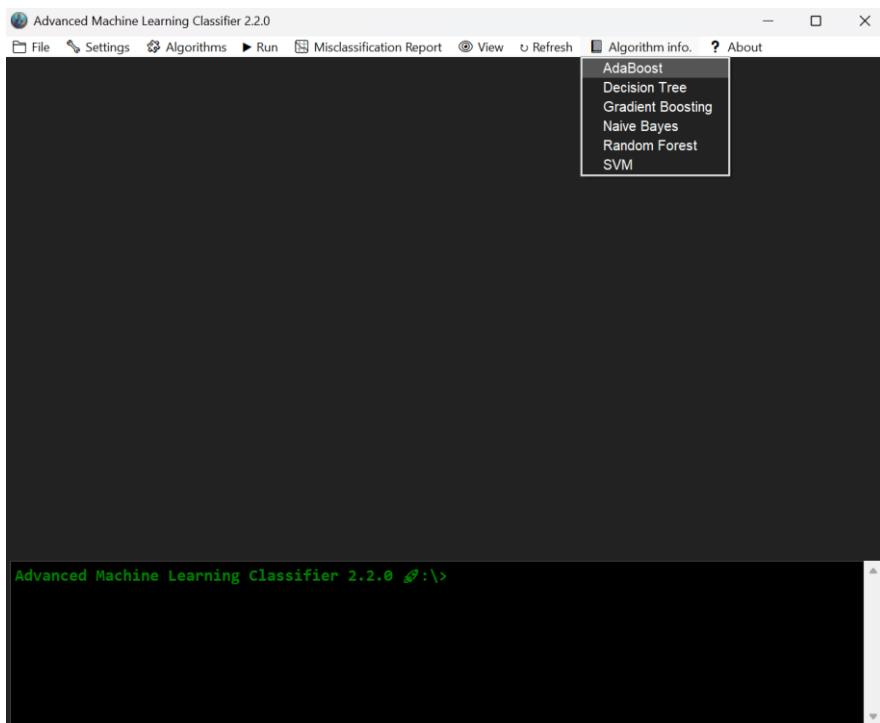
To enlarge the application command prompt area for better visibility, kindly access the ‘View’ menu and click on ‘Magnifier’ sub-menu select the desired font size.



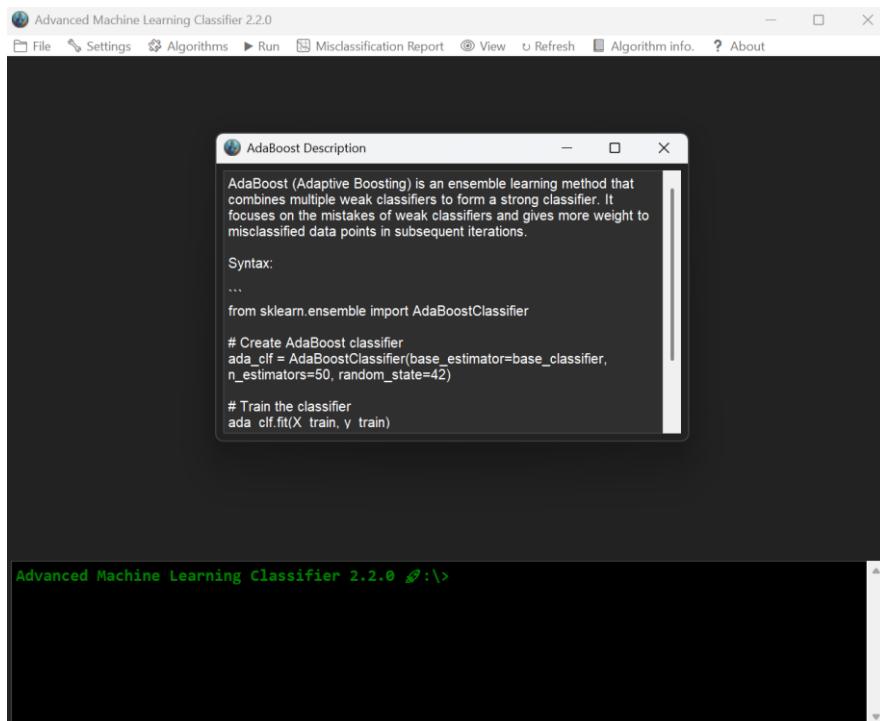
The ‘Refresh’ menu offers valuable options for managing loaded results. Clicking on the ‘Clear Kernel (Ctrl+K)’ sub-menu will effectively clear the kernel and refresh the command prompt area in the application. Alternatively, selecting the ‘Reset All Data (Ctrl+Shift+R)’ sub-menu will erase all information stored in the main arrays, including the confusion matrix and other relevant data.



The ‘Algorithm info.’ menu provides more detailed information about the algorithm’s used in this software.



ADVANCED MACHINE LEARNING CLASSIFIER 2.2.0

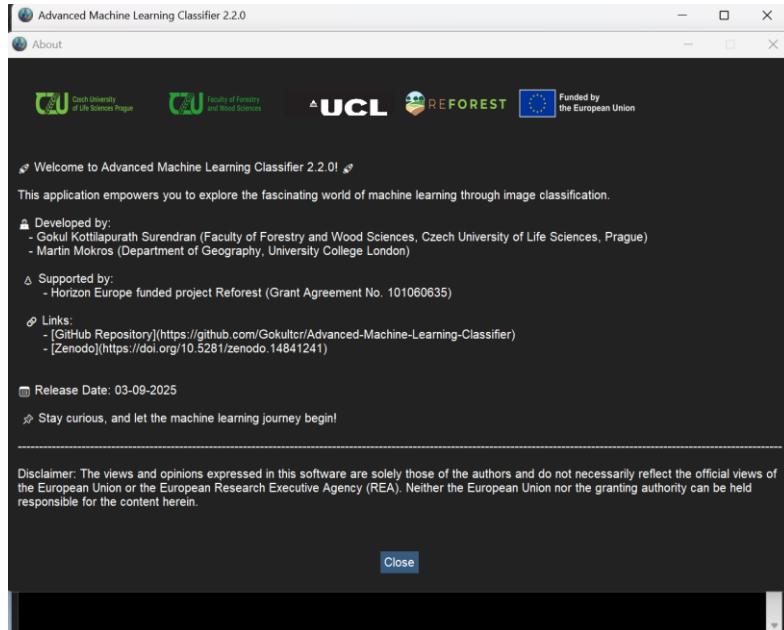


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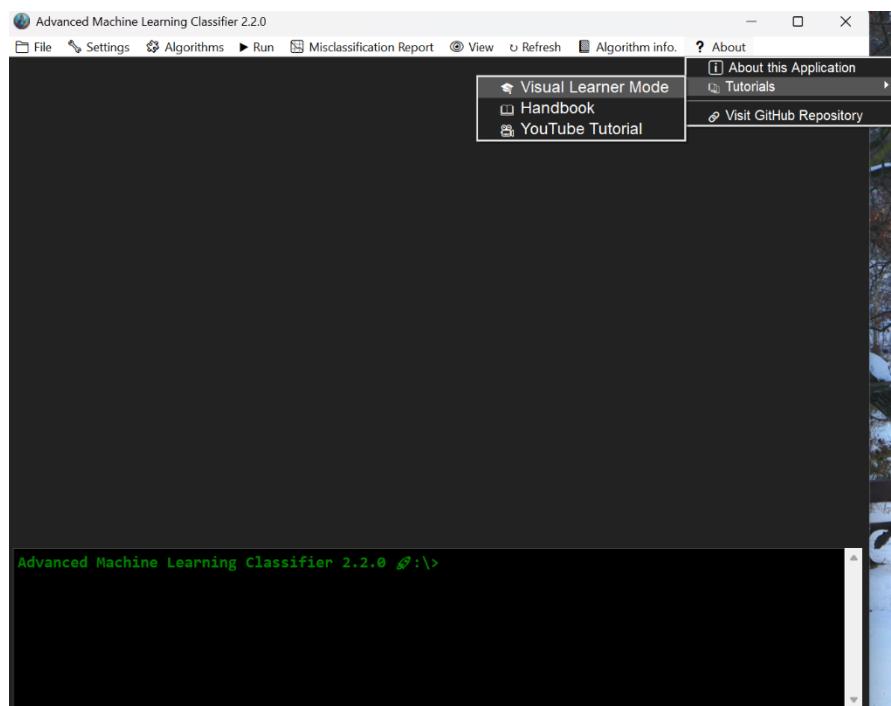
ABOUT & EXIT

The ‘About’ menu serves as a valuable resource, providing information about the application.



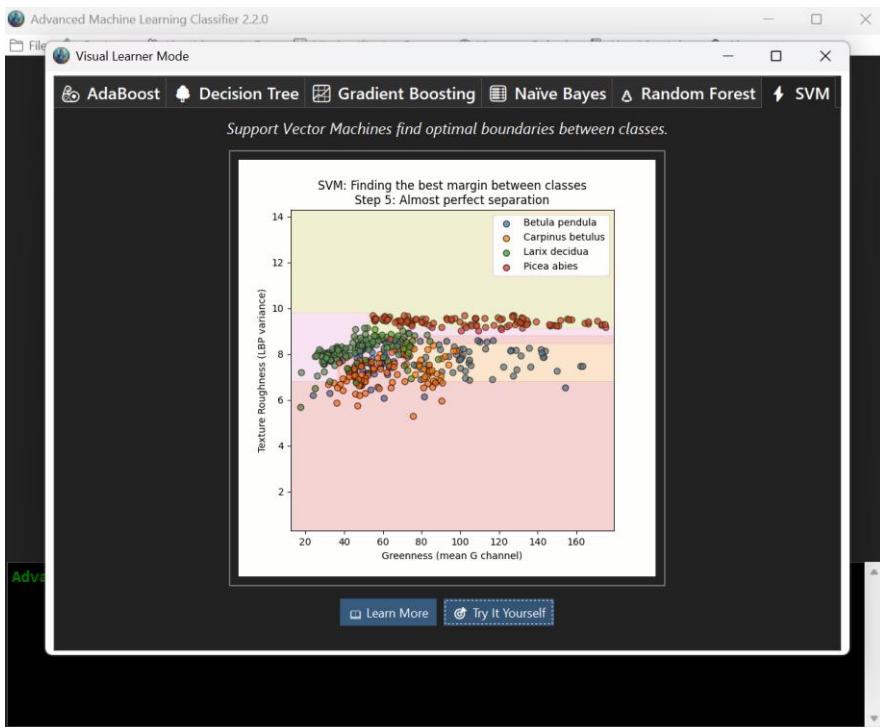
Tutorials

Under the ‘About’ menu, our software offers a dedicated ‘Tutorials’ sub-menu designed to enrich your learning experience and make the application more intuitive and approachable. The tutorials in this section not only facilitate ease of use but also deepen your understanding of how each machine learning algorithm operates within classification tasks.



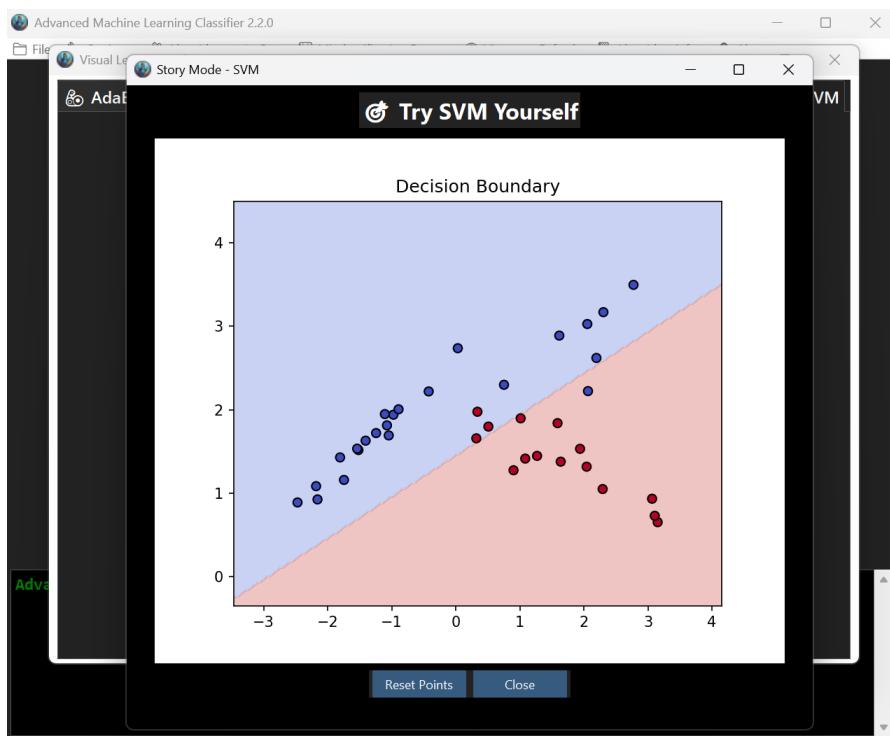
Visual Learner Mode

The first option within the Tutorials sub-menu is ‘Visual Learner Mode.’ This feature provides vivid, interactive visualizations demonstrating how the considered machine learning algorithms classify four different species classes. By observing these visual representations, users gain practical insights into how each method identifies and separates categories based on data features.



Try It Yourself

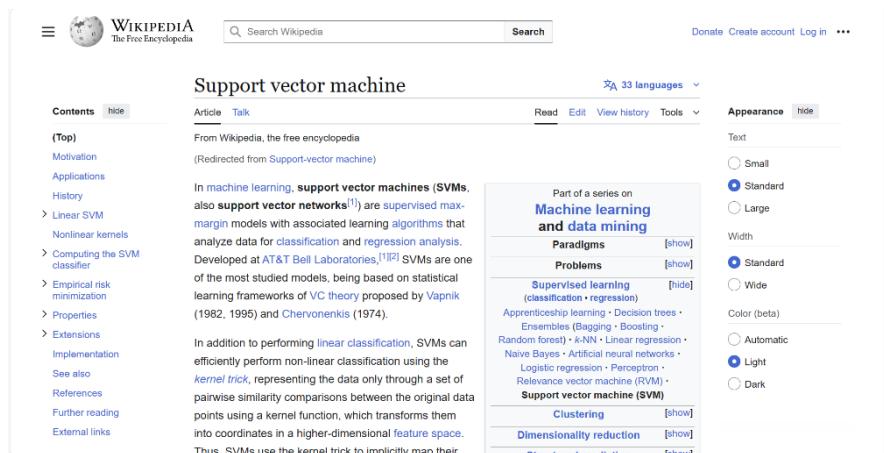
To enhance hands-on learning, we have incorporated a ‘Try It Yourself’ option within the Visual Learner Mode window. This tool lets users experiment with a 2-class classification problem by manually adding new data points. As data points are placed, the algorithm’s decision boundaries update in real time, allowing users to observe and understand how class separation evolves dynamically.



This interactive module serves as both study material and a visual tutorial, offering an engaging way for users to bridge the gap between algorithm theory and practical application.

Learn More

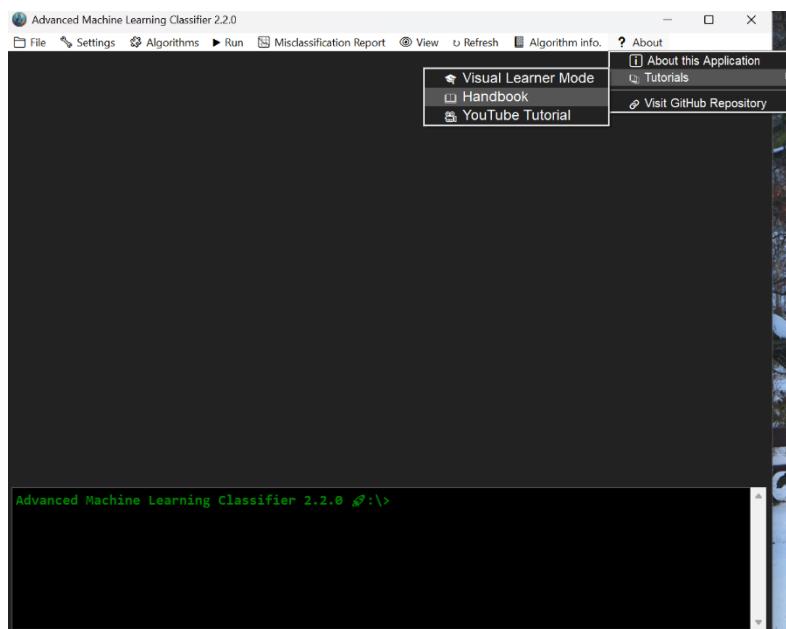
For those interested in delving deeper into the theory behind each algorithm, the ‘Learn More’ button within Visual Learner Mode provides direct access to the corresponding Wikipedia page. This ensures that users can quickly consult reliable reference material whenever needed.



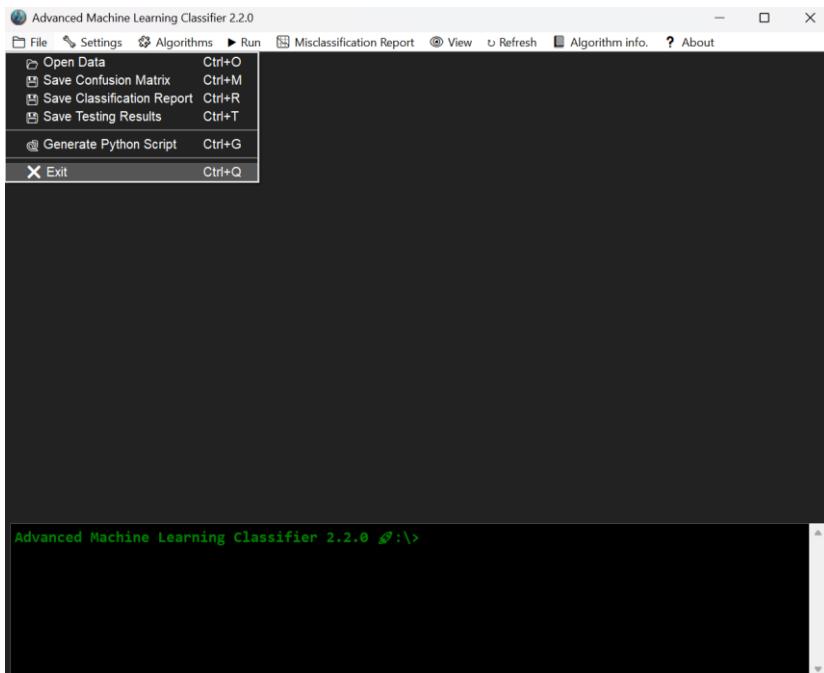
The screenshot shows the Wikipedia article for "Support vector machine". The page title is "Support vector machine". The main content area starts with a brief introduction: "From Wikipedia, the free encyclopedia (Redirected from Support-vector machine)". Below this, there is a detailed explanation of SVMs, mentioning their use in machine learning, support vector networks, and their role as supervised max-margin models. It also discusses their development at AT&T Bell Laboratories and their historical significance. The sidebar on the right is titled "Part of a series on Machine learning and data mining" and lists various related topics like paradigms, problems, supervised learning, clustering, dimensionality reduction, and structural prediction. The sidebar also includes appearance settings for the user interface.

Additional Resources

Beyond Visual Learner Mode, the Tutorials sub-menu also includes links to our application handbook ('Handbook'), as well as instructional videos ('YouTube Tutorial'). These resources offer detailed guidance, step-by-step usage instructions, and further educational materials to help users make the most of the software.



To gracefully exit the application, kindly navigate to the ‘File’ menu and select the option ‘Exit (Ctrl+Q).’ Alternatively, you can close the main application window.



Thank you 😊