Toxic Mushroom Detection Application

SK Lawn Care Service

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Table of Contents

[Prompt A 4](#_Toc145551192)

[Letter of Transmittal 4](#_Toc145551193)

[Project Recommendation 6](#_Toc145551194)

[Problem Summary 6](#_Toc145551195)

[Application Benefits 6](#_Toc145551196)

[Application Description 6](#_Toc145551197)

[Data Description 6](#_Toc145551198)

[Objective and Hypothesis 7](#_Toc145551199)

[Methodology 7](#_Toc145551200)

[Funding Requirements 8](#_Toc145551201)

[Stakeholders Impact 8](#_Toc145551202)

[Data Precautions 8](#_Toc145551203)

[Developer Expertise 8](#_Toc145551204)

[Prompt B 10](#_Toc145551205)

[Project Proposal 10](#_Toc145551206)

[PROBLEM STATEMENT 10](#_Toc145551207)

[CUSTOMER SUMMARY 10](#_Toc145551208)

[EXISTING SYSTEM ANALYSIS 11](#_Toc145551209)

[DATA 11](#_Toc145551210)

[PROJECT METHODOLOGY 11](#_Toc145551211)

[PROJECT OUTCOMES 11](#_Toc145551212)

[IMPLEMENTATION PLAN 12](#_Toc145551213)

[EVALUATION PLAN 16](#_Toc145551214)

[RESOURCES AND COSTS 17](#_Toc145551215)

[TIMELINE AND MILESTONES 17](#_Toc145551216)

[Prompt C 18](#_Toc145551217)

[Application Files 18](#_Toc145551218)

[Prompt D 22](#_Toc145551219)

[Post-implementation Report 22](#_Toc145551220)

[Project purpose 22](#_Toc145551221)

[Datasets 22](#_Toc145551222)

[Data product code 23](#_Toc145551223)

[Hypothesis verification 23](#_Toc145551224)

[Effective visualizations and reporting 24](#_Toc145551225)

[Accuracy analysis 29](#_Toc145551226)

[Application testing 30](#_Toc145551228)

[Appendices 30](#_Toc145551229)

[Installation Guide 30](#_Toc145551230)

[User Guide 31](#_Toc145551231)

[Summation of Learning Experience 31](#_Toc145551232)

[References 32](#_Toc145551233)

# Prompt A

## Letter of Transmittal

Dear Mr. Smith,

I am pleased to submit the proposal for a Lawn Care Service for your review and consideration. At Care Company we understand the importance of creating a secure and healthy outdoor environment for your furry family members. Our proposal outlines the key features of our innovative Lawn Care Service, which includes the proactive detection and removal of poisonous mushrooms from your lawn.

This unique offering is designed to address a common yet often overlooked danger to pets, ensuring their safety while enjoying the great outdoors. My proposal includes a full suite of lawn care services. My team is trained in pet-friendly lawn care practices to ensure all treatments are safe for your animals and poisonous mushroom detection and regular Inspections to proactively identify and address any potential issues that may arise. I believe that our Lawn Care Service will protect your pets from potentially harmful mushrooms.

Please take the time to review the enclosed proposal in detail. If you have any questions or would like to discuss the proposal further, please do not hesitate to reach out to me. I am excited about the opportunity to partner with you in creating a safe and beautiful environment for your pets to enjoy. Thank you for considering this document. I am looking forward to your feedback.

Sincerely,

Sunita Karki

## Project Recommendation

### Problem Summary

Many pet owners face the challenge of ensuring a safe and healthy outdoor environment for their beloved furry family members. Pets, including dogs and cats, are known to be curious and may ingest or interact with mushrooms in the yard, some of which can be toxic and pose serious health risks. The danger of poisonous mushrooms is often overlooked by pet owners, leaving their animals vulnerable to accidental ingestion. The proposed Lawn Care Service aims to provide a solution that enhances the safety and well-being of furry family members.

### Application Benefits

The benefit of this application is that it leverages advanced applications that can give businesses a competitive edge in their industry and the automation and validation features in applications minimize human errors, leading to more accurate results in detecting toxic mushrooms.

### Application Description

This application is designed to help users distinguish between toxic and non-toxic mushrooms by allowing them to choose specific characteristics through a set of radio buttons. Once the user makes their selections, the application will provide them with a corresponding result based on their choices.

### Data Description

Source: Kaggle website

Contents: Several thousand mushroom species are classified as edible or poisonous

Features: Twenty-two characteristics of mushrooms

Benefits of Using the Dataset:

Large Dataset: The dataset's size with several thousand mushroom species provides a substantial amount of data for analysis. This can lead to robust and reliable insights.

Rich Feature Set: The inclusion of twenty-two characteristics for each mushroom species offers a diverse set of data points. This richness allows for in-depth analysis and the potential to identify patterns or relationships between mushroom characteristics and their classification.

Classification: The clear classification of mushrooms as either edible or poisonous is valuable for creating predictive models or decision support systems in your application.

### Objective and Hypothesis

The primary objective of this application is to enhance the safety and well-being of pets by providing accurate and localized information about wild mushroom species found in the customer’s yard. We hypothesize that by incorporating local mushroom data, developing a reliable classification model, and providing user-friendly tools and safety information, we can significantly reduce the risk of pets encountering and ingesting toxic mushrooms.

### Methodology

I will adapt the Agile methodology for the development of my mushroom safety application. This methodology is a suitable choice for the mushroom safety application because it provides the flexibility, adaptability, user-centricity, and collaboration required to create a reliable and continuously improving tool.

### Funding Requirements

The initial funding requirement for the prototype is $1,000. The total cost for the finalized version will amount to $15,000. This will cover the cost of development coding, machine learning model development, user interface, software testing, application deployment, marketing and awareness, and data security.

### Stakeholders Impact

This application holds the promise of delivering substantial advantages to both SK Lawn Care employees and their valued customers. Employees can look forward to an increased workload, offering them more job opportunities. Meanwhile, customers can enjoy peace of mind, knowing that their lawns are safe for their beloved pets to frolic in, free from the threat of toxic mushrooms. This sense of security will alleviate concerns, allowing employees to focus on other projects and offering customers a worry-free environment.

### Data Precautions

The dataset used for the prototype is non-sensitive and has not been subject to any protective measures. SK Lawn Service has the option to maintain data privacy to prevent unauthorized replication of the application.

### Developer Expertise

I possess experience in developing front-end and back-end applications that incorporate machine learning, and these applications have been proven to deliver effective solutions and show ongoing improvement. Furthermore, I have a solid track record of deploying websites using the same technology and tools that SK Lawn Service uses. This helps me to efficiently address the current challenge and solve issues.

# Prompt B

## Project Proposal

### PROBLEM STATEMENT

The problem at hand is that numerous pet owners encounter the dilemma of guaranteeing a secure and wholesome outdoor space for their cherished furry companions, such as dogs and cats. These pets, renowned for their curiosity, may ingest or meet yard mushrooms, certain of which can be harmful and lead to severe health hazards. Unfortunately, the peril associated with toxic mushrooms often goes unnoticed by pet owners, thereby leaving their animals susceptible to inadvertent consumption. Considering this challenge, the proposed SK Lawn Care Service aspires to offer a solution geared toward elevating the safety and overall welfare of these furry family members.

### CUSTOMER SUMMARY

Many pet owners face the challenge of providing a safe outdoor environment for their beloved dogs and cats. These curious animals can encounter and even ingest yard mushrooms, some of which are toxic and pose serious health risks. The danger of poisonous mushrooms often goes unnoticed, putting pets at risk. Our Lawn Care Service is designed to address this issue and enhance the safety and well-being of your furry family members.

### EXISTING SYSTEM ANALYSIS

The company website uses Python-based frameworks such as Flask and NumPy along with other libraries. Flask is a lightweight and microweb framework for Python. It is designed to be simple and easy to use, making it a popular choice for building web applications, especially small to medium-sized projects.

### DATA

The dataset employed in this application prototype consists of a mushroom CSV file containing meticulously curated data downloaded from Kaggle. It comprises more than eight thousand mushroom species sourced from the UCI machine learning data archive. This dataset categorizes mushrooms as either non-toxic or toxic and encompasses twenty-two distinctive attributes.

### PROJECT METHODOLOGY

The development of this application will adhere to the Agile methodology, which is characterized by an iterative and incremental approach. It places a strong emphasis on flexibility and adaptability throughout the development process.

### PROJECT OUTCOMES

The application aims to significantly improve mushroom safety for pets, particularly dogs and cats, and their owners by providing accurate mushroom identification and safety. The application will feature an intuitive and user-friendly interface that makes it easy for users to identify mushrooms, access safety information, and take appropriate actions. Ultimately, the success of the application will be measured by its positive impact on pet safety, reducing the risks associated with toxic mushrooms in outdoor environments.

### IMPLEMENTATION PLAN

Project Objectives: Develop a web-based application for mushroom identification. Assist users in identifying mushrooms based on their characteristics. Provide information about the edibility or toxicity of identified mushrooms.

Project Deliverables: A fully functional web application accessible to users. Visualizations and images of mushrooms for reference. An instructional manual with example attribute combinations.

In-Scope Features and Requirements: User interface with a styled HTML form for inputting mushroom characteristics. Machine learning model for mushroom classification based on user input. Display of identified mushrooms and their images. A brief instructional manual to guide users.

Out-of-Scope Items: In-depth scientific analysis or research on mushroom toxicity. Mobile application development (if not part of the project scope). Extensive database maintenance beyond the initial dataset.

Constraints: Use of the PythonAnywhere hosting service. Free hosting service available for three months following deployment.

|  |  |
| --- | --- |
| Requirements | The application's requirements encompass precise prediction of the toxicity of mushroom specimens based on a combination of attributes. |
| Analysis | Data analysis will be conducted within a Jupyter Notebook to facilitate easy data visualization. The exploration process will involve inputting various combinations of characteristics into the random forest classifier. |
| Design | After identifying the essential characteristics, the design phase commences. The user interface will be crafted in a visually appealing form that uses HTML, CSS, and a radio button for the form submission. It will determine the mushroom class that aligns with the selected traits and display the result on whether it is non-toxic or toxic. |
| Implementation | The initial stage of implementation involves writing the application's code while adhering to established coding practices and standards. Subsequently, we will proceed to implement core functionalities such as mushroom identification, safety recommendations, and user authentication. Following this, we will configure the development environment, utilizing essential tools, libraries, and frameworks, including Flask, NumPy, and others. The integration of machine learning models for mushroom classification will be the subsequent step. Then, we will focus on constructing the user interface (UI) components, aligning them with the design specifications. Finally, comprehensive testing will be conducted to ensure functionality, followed by the deployment of the application to production environments, which may include web servers or cloud platforms. |
| Testing | Following the execution of these procedures, the application will proceed to undergo regression testing. This process involves systematically submitting a wide array of characteristic combinations. The primary objective of this testing phase is to confirm the precision of results and evaluate the application's robustness, diligently inspecting for any possible software crashes. Any identified bugs will be promptly addressed and resolved. |
| Deployment | Upon successful validation of the application's functionality, the deployment phase will commence. This deployment will be facilitated through PythonAnywhere which provides a Python development and hosting environment accessible through a web browser. It is designed to simplify the process of developing, running, and hosting Python applications, particularly web applications. |
| Maintenance | To ensure continued online availability, the author is required to log in to PythonAnywhere every three months to extend the hosting duration at no extra charge. Failing to do so will result in the website no longer being hosted. Additional maintenance is not necessary. |
| Validating and Verifying | Creating comprehensive test cases and scenarios that encompass a broad spectrum of user interactions and potential use cases is essential for the thorough validation and verification of the application's functionality. |

### EVALUATION PLAN

The objective of the evaluation plan is to assess the performance, usability, and impact of the mushroom safety application. It measures the application's accuracy in correctly identifying mushroom species.

### RESOURCES AND COSTS

PyCharm, a code editor, using Python 3.11, and an integrated development environment (IDE), is available for free. PythonAnywhere, a cloud-based environment, also offers a free plan. The initial funding needed for the prototype is $1,000, while the overall cost for the finalized version is projected at $15,000. This budget encompasses development coding, machine learning model creation, user interface design, comprehensive software testing, application deployment, marketing and awareness initiatives, and robust data security measures.

### TIMELINE AND MILESTONES

Project Kick-off (Week 1-2): Define project objectives, scope, and requirements.

Data Collection and Enrichment (Week 3-6): Collaborate with the mycologist to update the mushroom dataset with local species.

Application Development (Week 7-16): Follow Agile sprints for iterative development. Implement machine learning models for mushroom classification.

User Testing and Feedback (Week 17-20): Conduct user testing with park visitors to gather feedback.

Deployment (Week 25-26): Deploy the application to production servers or cloud platforms.

Launch (Week 27): Announce the official launch of the mushroom safety application.

# Prompt C

## Application Files

A screenshot of a computer program

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One Descriptive Method and One Non-Descriptive Method

Descriptive visualizations like pie charts, bar plots, and heatmaps provide insights into the dataset's characteristics and relationships. The machine learning model implementation, specifically the Random Forest Classifier, is a non-descriptive method.

Available Datasets

The dataset originates from Kaggle, a versatile platform that offers a diverse collection of datasets spanning a multitude of subjects, including the dataset related to mushrooms.

Decision-Support Functionality

Upon mushroom characteristic selection, the application will promptly recognize the species and offer comprehensive details regarding its suitability for consumption. The primary objective of the decision-support features is to bolster user safety and instill confidence, especially in outdoor settings where wild mushrooms abound.

Ability to support Featuring, Parsing, Cleaning, and Wrangling Datasets

Yes, this application possesses the capability to support various data-related tasks, including featuring which can assist in identifying and extracting relevant features or characteristics from datasets, which is important for analysis and modeling. Parsing, in which the application can parse data, involves breaking it down into structured formats for easier processing and analysis. Cleaning is equipped to perform data cleaning, which involves removing or correcting errors, inconsistencies, or outliers in the dataset to ensure data quality. Wrangling, the application can also handle data wrangling tasks, such as reshaping and transforming data to make it suitable for specific analytical or modeling purposes.

Methods and Algorithms Supporting Data Exploration and Preparation

The application uses methods and algorithms that support data exploration and preparation. It includes descriptive statistics and analysis of data attributes, such as cap color and cap shape, which are part of data exploration. The application employs a machine learning algorithm (Random Forest Classifier) for classification, which is part of data preparation for predictive modeling.

Data Visualization Functionalities

The application contains data visualization functionalities. It creates a pie chart to visualize the distribution of toxic and non-toxic mushrooms, providing an overview of class balance. A heatmap is generated to display the correlation between different attributes in the dataset, helping to identify relationships and patterns. The code includes horizontal bar charts to illustrate the counts of mushrooms for specific attributes, such as cap color and cap shape. A violin plot is used to visualize the distribution of data attributes, such as cap color, by class (toxic or non-toxic). A bar graph is created to display the count of non-toxic and toxic mushrooms, offering a clear comparison. Horizontal bar plots are utilized to represent categorical data, such as cap color and cap shape, by class (non-toxic and toxic).

Implementation of Interactive Queries

Yes, the Mushroom web application includes the implementation of interactive queries. Users can interact with the application by inputting values for various mushroom characteristics, such as cap color, cap shape, cap surface, bruises, and habitat.

Machine-Learning Methods and Algorithms

Yes, the application includes the implementation of machine learning methods and algorithms. Specifically, it uses the scikit-learn library to create a machine-learning model for classifying mushrooms as toxic or non-toxic based on various characteristics.

Functionalities to Evaluate the Accuracy of the Data Product

The mushroom application includes functionalities to evaluate the accuracy of the data product. Specifically, it calculates and displays the accuracy of the machine learning model's predictions for the given input mushroom characteristics. The accuracy score measures the proportion of correctly predicted instances out of the total number of instances in the testing dataset.

Industry-Appropriate Security Features

The application does not explicitly include industry-appropriate security features; however, we will keep all dependencies and libraries updated to patch security vulnerabilities with regular updates.

Tools to Monitor and Maintain the Product

The product will include proper documentation and knowledge base tools to assist in maintaining documentation related to the application's architecture, codebase, configurations, and procedures, making it easier for developers and administrators to manage and troubleshoot. The application includes at least three types of data visualizations. This includes pie chart, heat map, and bar graph.

# Prompt D

## Post-implementation Report

### Project purpose

The purpose of the mushroom application is to assist users in identifying mushrooms based on their characteristics and providing information about whether the identified mushrooms are safe to eat or potentially toxic. It is also used to enhance safety and provide decision-support functionality for users, particularly those who are interested in foraging or dealing with mushrooms in outdoor environments. The mushroom application serves as a valuable tool for users to safely interact with mushrooms and make informed decisions about their edibility, thereby reducing the risks associated with toxic mushrooms.

### Datasets

The dataset used for the mushroom application is a public collection of mushroom species data that includes information about various characteristics of mushrooms. The dataset is obtained from Kaggle, a platform that hosts a wide range of datasets on various topics, including mushrooms. The data needed to be modified to make it compatible with predictive algorithms. To achieve this, I employed the Scikit-Learn LabelEncoder function to transform the data into numerical format.

A screenshot of a computer

Description automatically generated

### Data product code

The data needed to be divided into two sets for the algorithm to function effectively – one set included all attributes except for the class, while the other solely consisted of the class. Subsequently, both sets were further divided in half to generate separate training and testing subsets. The code utilized for data analysis and the creation of a descriptive, predictive, or prescriptive data product is depicted in the image below.



### Hypothesis verification

The primary objective of this application is to enhance the safety and well-being of pets by providing accurate and localized information about wild mushroom species found in the customer’s yard. We hypothesize that by incorporating local mushroom data, developing a reliable classification model, and providing user-friendly tools and safety information, we can significantly reduce the risk of pets encountering and ingesting toxic mushrooms. The application will accurately predict the edibility of mushrooms based on their characteristics and provide valuable safety recommendations.

### Effective visualizations and reporting

The pie chart displays the distribution of toxic and non-toxic mushrooms, giving an initial overview of the dataset's balance.

A pie chart with text

Description automatically generated

The heatmap visualizes the correlation between different mushroom characteristics, helping identify potential relationships between features.

A diagram of a number of numbers

Description automatically generated with medium confidence

The bar chart shows the count of toxic and non-toxic mushrooms, providing a simple comparison of the two classes.

A graph of a number of different colored squares

Description automatically generated

The violin plot presents the distribution of mushroom characteristics, allowing for deeper insights into their variations.

A graph with different colored lines

Description automatically generated with medium confidence

The confusion matrix evaluates the performance of the classification model, providing information on true positives, true negatives, false positives, and false negatives.

A chart of a number of different colored squares

Description automatically generated with medium confidence

The bar chart ranks the importance of different mushroom characteristics in making classification decisions, helping to identify key factors.

A bar graph with blue and white text

Description automatically generated

These plots illustrate the distribution of mushroom characteristics by their impact on toxicity.

A graph of a number of blue and purple squares

Description automatically generated

A graph with blue and purple squares

Description automatically generated

A graph with blue and purple rectangles

Description automatically generated

The application utilizes the Flask framework and features an HTML template with CSS for styling. Its primary functionality centers on a form, enabling users to choose five mushroom characteristics through radio buttons. Additionally, a red button initiates the classification process and promptly presents the result to the user.

A screenshot of a computer

Description automatically generated

### Accuracy analysis

The confusion matrix code below describes part of the accuracy analysis. It provides information about true positives, true negatives, false positives, and false negatives, allowing you to see where the model might be making errors.

### A screen shot of a computer program Description automatically generated

### Application testing

The following testing will be performed to ensure that the application is working as expected.

Unit Testing: Test individual components, functions, and methods of the application in isolation. Verify that each unit of code behaves correctly.

Functional Testing: Verify that the application's features and functionalities work as expected.

# Appendices

## Installation Guide

Before you begin, make sure your system meets the following requirements:

Operating System: Windows or macOS

Internet Connection: Required for initial setup and data retrieval.

No installation is necessary to use the application. Just visit <http://sunitakarki60.pythonanywhere.com/> and access it directly.

## User Guide

To utilize the application, please go to <http://sunitakarki60.pythonanywhere.com/>. Choose all five attributes, then click the red button to retrieve the result.

## Summation of Learning Experience

Through this experience, I learned the importance of data preprocessing, model training, and accuracy analysis in machine learning projects. I also improved my programming skills in Python and gained hands-on experience with libraries such as scikit-learn, Flask, and seaborn.

Additionally, I discovered the significance of user-centered design when creating a user-friendly interface. The user guide and installation instructions taught me how to communicate complex technical concepts in a clear and accessible manner.

Throughout the project, I encountered challenges and obstacles, but I also developed problem-solving abilities and resilience. Collaboration with the course instructor and seeking help when needed became vital aspects of my learning process.

In conclusion, this learning experience has not only equipped me with technical skills but has also deepened my understanding of the importance of effective communication, continuous learning, and the satisfaction of turning an idea into a functional product.

## References

Learning, U. M. (2016, December 1). *Mushroom classification*. Kaggle. https://www.kaggle.com/datasets/uciml/mushroom-classification