

1. Project Presentation

Context and Objectives

The diet of cats plays a crucial role in their health and well-being. A veterinarian, when examining a cat, notes its main characteristics:

- **Age:** Helps adapt the diet to the nutritional needs at different growth stages.
- **Weight:** Essential to determine the necessary caloric intake.
- **Activity level:** Influences the amount of energy the cat needs to consume.

Based on this data, a veterinarian prescribes an optimal diet plan including:

- **Daily caloric intake**
- **Meal composition** (type of food and portions)
- **Hydration goal**
- **Specific recommendations**

The goal of our project is to develop an artificial intelligence capable of reproducing this diagnostic and diet prescription process. We have collected and processed a database of nearly 2000 cats, including their characteristics and the diet prescriptions provided by a veterinarian.

Thus, our artificial intelligence model can issue a precise diagnosis based on the data entered by a user regarding their own cat.

2. Project Steps

Data Collection and Processing

1. **Collaboration with a veterinarian:** We obtained a dataset containing the characteristics of 2000 cats as well as their diet prescriptions.
2. **Data structuring:** Each record contains:
 - Age (in years)
 - Weight (in kg)
 - Activity level (low, medium, high)
 - Recommended daily calories
 - Type and amount of food recommended
 - Recommended water intake
 - Specific recommendations from the veterinarian
3. **Data cleaning and preparation:** Removal of outliers, conversion of units, and standardization of data to ensure consistency.

Modeling with k-Nearest Neighbors (k-NN)

Algorithm Choice

We opted for an **unsupervised machine learning** model based on the **k-Nearest Neighbors (k-NN)** algorithm to recommend an optimal diet plan based on the cat's characteristics (age, weight, activity level).

Training and Validation

- **Data preprocessing:** Normalization of features (Age, Weight, Activity Level) with `MinMaxScaler` to improve prediction accuracy.
- **Model construction:** Use of `NearestNeighbors(n_neighbors=1, algorithm='ball_tree')` to find the most similar cat in the database.
- **Evaluation:** Recommendations are based on the closest cat in terms of characteristics.

Optimization and Adjustments

- **Encoding categorical variables** (activity level) with `LabelEncoder` to ensure better compatibility with the algorithm.
- **Scaling input and output data** to homogenize values and avoid bias due to different measurement scales.
- **Selection of the "ball_tree" algorithm** to optimize the search for the nearest neighbors, particularly suited for small datasets with few dimensions.

Integration and Testing

7. **Development of a user interface:** We designed an intuitive form allowing users to input their cat's characteristics.
8. **Prediction of the optimal diet plan:** The model analyzes the entered data and returns a personalized meal plan.
9. **Result validation:** Testing with real cases to assess the accuracy of the system.

3. Detailed Functioning

Input Data

- **Age** (in years)
- **Weight** (kg)
- **Activity level** (low, medium, high)

Data Processing

- Normalization of inputs to match the training data.
- Prediction of the meal plan based on similar cases.
- Generation of a detailed report including the recommended diet and the veterinarian's advice.

Output Example

For a 3-year-old cat, weighing 4 kg, with moderate activity:

```
{
  "Daily Calories": 251,
  "Meals": {
    "Breakfast": {
      "Food": "Beef",
      "Portion (g)": 67,
      "Calories": 135
    },
    "Lunch": {
      "Food": "Lamb",
      "Portion (g)": 52,
      "Calories": 117
    },
    "Dinner": {
      "Food": "Beef",
      "Portion (g)": 31,
      "Calories": 86
    }
  },
  "Water Goal (ml)": 440,
  "Recommendation": "This cat requires 251 kcal per day. Suggest
}
```

Conclusion

This project combines artificial intelligence and veterinary expertise to provide personalized dietary recommendations for cat owners. By combining a knowledge base validated by professionals and a high-performing machine learning model, we offer a reliable and accessible solution.

Future improvements include integrating new variables (health problems, dietary preferences) and developing a mobile application for a more intuitive use.