



## Web-Based Expert System for Early Diagnosis of Skin Diseases in Cats Using the Naïve Bayes Method

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### Abstract

This journal discusses the development of a web-based expert system for early diagnosis of skin diseases in cats using the Naïve Bayes method. Skin disease in cats is a health problem that often occurs and requires fast and accurate diagnosis. This expert system is designed to assist cat owners and veterinarians in identifying potential causes of skin symptoms in cats.

The Naïve Bayes method is used in this system because of its ability to process symptom data and produce predictions based on probability. Symptom data is collected from various sources and used to train a Naïve Bayes model. Next, the system allows users to enter symptoms observed in their cat, and the system will provide an initial diagnosis based on the information provided.

The experimental results show that this expert system is able to provide an initial diagnosis of skin diseases in cats with a sufficient level of accuracy. This provides a great benefit to cat owners in taking early action and further veterinary consultation. Apart from that, this expert system can also be used as a supporting tool for veterinarians in the process of diagnosing skin diseases in cats. Thus, this research provides an important contribution to the development of expert systems in the field of animal health, especially in the early diagnosis of skin diseases in cats.

**Keywords:** *System\_Expert, Naive\_Bayes, Disease\_Cat, Disease\_Skin*

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### 1. Introduction

Skin diseases in cats can be a serious problem and can affect their health and comfort. Abnormal skin symptoms in cats often cause concern for pet owners, and can indicate a condition that requires medical attention. Skin disease can be caused by several factors in the form of viruses, bacteria, parasites, fungi and environmental conditions that are less maintained [1].

Cat owners often face difficulty in identifying the cause of skin symptoms in their pets. Correct and fast diagnosis is the key to effective management of skin diseases in cats, because delays in treatment can worsen the cat's health condition and increase medical costs.

Even though veterinarians are the main source in the process of diagnosing diseases in cats, not all cat owners can easily access veterinary consultations or have sufficient knowledge to recognize the symptoms of skin diseases. Therefore, the development of an expert system that can provide early diagnosis of skin diseases in cats quickly and accurately is relevant and important. This system can be a useful tool for cat owners to identify potential causes of skin symptoms and take appropriate early action.

In this context, the Naïve Bayes method has been known to be effective in processing symptom data and providing predictions based on probability. The use of this method in an expert system for diagnosing skin diseases in cats can help solve this complex problem by producing a more accurate and reliable diagnosis. Therefore, this study aims to develop a web-based expert system using the Naïve Bayes method for early diagnosis of skin diseases in cats to help cat owners and veterinarians in the process of diagnosing and treating skin diseases in their pets.

### 2. Theoretical Basic

#### 2.1 Definition of Expert System

Expert system knowledge is obtained from people who have knowledge in a field (experts in a particular field), the source of this knowledge is usually known as the source of expertise [2]. This knowledge is then represented or processed to simplify and organize the information so that it is easier to understand and use in a certain format.

## 2.2 Definition of Naive Bayes

According to Tofik Isa et al., [3] in his book entitled Decision Support Systems Textbook which can support Decision Support Systems courses, states that the naïve Bayes classifier works very well compared to other classifier models.

The Naïve Bayes method, which is often referred to as the Naïve Bayes Classifier or Naïve Bayes Algorithm, is a classification algorithm used in machine learning and data mining. This algorithm is based on Bayes' Theorem and is used to perform classification or prediction based on probability.

The essence of the Naïve Bayes method is to calculate the probability of classes or labels that may be given to data based on the attribute information contained in the data. This is done using Bayes' probability law. In simple terms, the Naïve Bayes method assumes that each attribute or feature in the data is conditionally independent of the class or label to be predicted. This is why it is called "Naïve" (simple) because these assumptions are often too simplistic to reflect the true relationships between attributes in the data.

Although this assumption may not always be true in real cases, the Naïve Bayes method remains a very useful and efficient algorithm for classification, especially when the number of attributes is large. It is frequently used in various applications, including text classification, email spam classification, sentiment analysis, and other data classification.

The general process carried out by the Naïve Bayes method is:

1. Calculating prior probabilities (class probabilities before looking at the data).
2. Calculating probability likelihood (probability of appearance of attribute in each class).
3. Use Bayes' theorem to calculate posterior probabilities (class probabilities after looking at the data).
4. Selecting the class with the highest posterior probability as a prediction.

Naive Bayes Calculation Process

The Naïve Bayes formula is expressed in the following equation:

$$P(Y|X) = \frac{P(Y) \prod_i^q 1^{P(X_i|Y)}}{P(X)} \dots \dots \dots (1)$$

Information :

$P(Y|X)$  = Probability of data with vector X in class Y

$P(Y)$  = Initial probability of class Y

$\prod_i^q 1^{P(X_i|Y)}$  = Independent probability of class Y of all features in vector

$P(Y)$  = Initial probability of class

## 3. Research Methods

Data collection is the activity of searching for data in the field that is used to answer research problems. This stage is intended as a support needed in the process of designing this expert system. In this study, data collection was carried out in the field by [4]:

- a. Interview (Interview); Interviews were conducted with related parties in this research, namely veterinarians, directly regarding skin diseases in cats that generally occur frequently and what symptoms generally occur in cats when they suffer from skin diseases. This interview was conducted with a veterinarian named Drh. Della Miranti.
- b. Observation; This observation observes the way the operational system runs at the Kolanyo Petshop And Clinic clinic which is located on Jl. Sure Hope No.13. Kel. Binjai. Kec. Denai. Medan City.

## 4. System Planning

The first step in designing this program is designing the work process of the system being built. The process is designed with a flow chart. Users collect data and symptoms of skin diseases in cats, input the symptoms, whether there are possible symptoms that are included in skin diseases, then calculate the comparison between the symptoms of each disease.

The flow chart of the web-based expert system program for early diagnosis of skin diseases in cats using the Naïve Bayes method will be seen in the following picture [5], [6]:

A use case diagram is a type of diagram in the UML (Unified Modeling Language) used to describe the interaction between a system (usually a software system) and various external actors or entities that interact with the system. Use case diagrams help in understanding system features, interactions between users or actors with the system, and different usage scenarios.

1. Use Case Expert

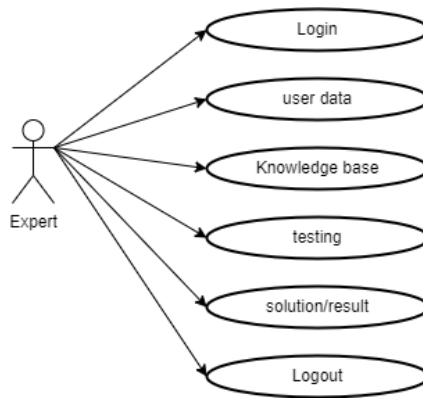


Figure 1: Use Case Expert

2. Use Case User

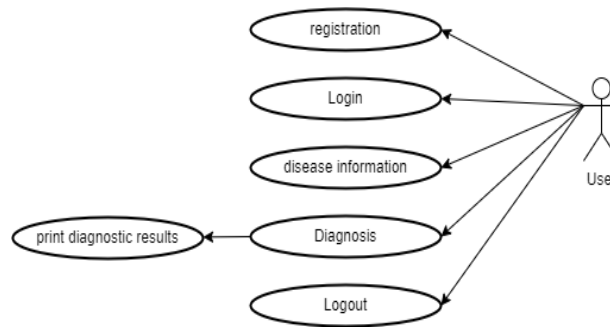


Figure2: Use Case User

The use case above explains the use case for the admin and user system where the admin starts by logging in first then inputting the training data, after finishing inputting then testing before the user can use it. So that the user can start by registering and then can log in and enter the system about disease info which then the user can input according to the symptoms that exist and according to what the cat is experiencing. Then the system will carry out a test which can finally be seen in the diagnostic results which can then be printed out the results for further examinations to the doctor.

5. Results And Discussion

By using Naïve Bayes the probability value is obtained in the following way:

Information :

1. Data was taken from 50 patients of the Kolanyo cat pet shop and clinic with 5 types of diseases experienced such as scabies, ringworm, allergicdermatitis, cat fleas, and abscesses
2. Variable P is symbolized as a disease
3. Variable G is symbolized as a symptom

The first step :

Case calculation:

- Number of data on scabies = 12
- Number of Ringworm disease data = 11
- Number of data on Allergydermatitis = 8
- Number of Cat Flea disease data = 11
- Number of Abscess disease data = 8

Total number of disease data = 50

Count :

$P(\text{Scabies}) = 12/50 = 0.24$

$P(\text{Ringworm}) = 11/50 = 0.22$

$P(\text{Allergydermatitis}) = 8/50 = 0.16$

$P(\text{Cat Flea}) = 11/50 = 0.22$

$P(\text{Abscess}) = 8/50 = 0.16$

In this knowledge base, a case study is given in which a cat named Mochi, about 6 months old and male, was attacked. Mochi experienced the following symptoms:

- Cat has itching (G02)
- Cat scratches excessively (G03)
- Rubbing his body against a rough surface (G06)
- Inflamed red skin (G08)
- There is thickening of the rough skin starting at the edge of the earlobe (G12)
- Decreased immune system (G13)

#### Second Step:

- Calculating likelihood probabilities
- Search for the probability value of a fact, symptom of a disease that influences a hypothesis.
- $P(e|h)$  = probability of fact data for symptom e, if it is assumed that hypothesis h is true.

Case calculation:

#### Scabies

Number of G02 symptoms in scabies = 6  
 Number of G03 symptoms in scabies = 4  
 Number of G06 symptoms in scabies = 3  
 Number of G08 symptoms in scabies = 6  
 Number of G12 symptoms in scabies = 5  
 Number of G13 symptoms in scabies = 3  
 $P(G02|Scabies) = 6/12 = 0.5$   
 $P(G03|Scabies) = 4/12 = 0.333$   
 $P(G06|Scabies) = 3/12 = 0.25$   
 $P(G08|Scabies) = 6/12 = 0.5$   
 $P(G12|Scabies) = 5/12 = 0.416$   
 $P(G13|Scabies) = 3/12 = 0.25$

#### Ringworms

Number of G02 symptoms in ringworm disease = 5  
 Number of G03 symptoms in ringworm disease = 3  
 Number of G06 symptoms in ringworm disease = 0  
 Number of G08 symptoms in ringworm disease = 0  
 Number of G12 symptoms in ringworm disease = 0  
 Number of G13 symptoms in ringworm disease = 4  
 $P(G02|Ringworm) = 5/11 = 0.454$   
 $P(G03|Ringworm) = 3/11 = 0.272$   
 $P(G06|Ringworm) = 0/11 = 0$   
 $P(G08|Ringworm) = 0/11 = 0$   
 $P(G12|Ringworm) = 0/11 = 0$   
 $P(G13|Ringworm) = 4/11 = 0.363$

#### Allergydermatitis

Number of G02 symptoms in allergic dermatitis = 3  
 Number of G03 symptoms in allergic dermatitis = 0  
 Number of G06 symptoms in allergic dermatitis = 0  
 Number of G08 symptoms in allergic dermatitis = 2  
 Number of G12 symptoms in allergic dermatitis = 0  
 Number of G13 symptoms in allergic dermatitis = 0  
 $P(G02|Allergydermatitis) = 3/8 = 0.375$   
 $P(G03|Allergydermatitis) = 0/8 = 0$   
 $P(G06|Allergydermatitis) = 0/8 = 0$   
 $P(G08|Allergydermatitis) = 2/8 = 0.25$   
 $P(G12|Allergydermatitis) = 0/8 = 0$   
 $P(G13|Allergydermatitis) = 0/8 = 0$

#### Cat Flea

Number of G02 symptoms in cat flea disease = 3  
 Number of G03 symptoms in cat flea disease = 5  
 Number of G06 symptoms in cat flea disease = 0  
 Number of G08 symptoms in cat flea disease = 0  
 Number of G12 symptoms in cat flea disease = 0  
 Number of G13 symptoms in cat flea disease = 0  
 $P(G02|Cat Flea) = 3/11 = 0.272$   
 $P(G03|Cat Flea) = 5/11 = 0.454$   
 $P(G06|Cat Flea) = 0/11 = 0$   
 $P(G08|Cat Flea) = 0/11 = 0$   
 $P(G12|Cat Flea) = 0/11 = 0$   
 $P(G13|Cat Flea) = 0/11 = 0$

#### Abscess

Number of G02 symptoms in abscess disease = 0  
 Number of G03 symptoms in abscess disease = 0  
 Number of G06 symptoms in abscess disease = 0

Number of G08 symptoms in abscess disease = 1  
 Number of G12 symptoms in abscess disease = 0  
 Number of G13 symptoms in abscess disease = 5  
 $P(G02|Abscess) = 0/8 = 0$   
 $P(G03|Abscess) = 0/8 = 0$   
 $P(G06|Abscess) = 0/8 = 0$   
 $P(G08|Abscess) = 1/8 = 0.125$   
 $P(G12|Abscess) = 0/8 = 0$   
 $P(G13|Abscess) = 5/8 = 0.625$

**Third step :**

- Calculating posterior probabilities
- $P(h|e)$  = probability that the hypothesis is true for the observed factual data, symptom e.
- $P(h|e) = P(h) * P(e_1 | e_2, e_3, e_4, e_5 | h)$
- $e_1 = G02$
- $e_2 = G03$
- $e_3 = G06$
- $e_4 = G08$
- $e_5 = G12$
- $e_6 = G13$

Calculation of  $P(h|e)$ :

$$P(Scabies|e) = P(Scabies) \times P(G02|Scabies) \times P(G03|Scabies) \times P(G06|Scabies) \times P(G08|Scabies) \times P(G12|Scabies) \times P(G13 |Scabies)$$

$$P(Scabies|e) = 0.24 * 0.5 * 0.333 * 0.25 * 0.5 * 0.416 * 0.25$$

$$= 0.00051948$$

$$P(Ringworm|e) = P(Ringworm) \times P(G02|Ringworm) \times P(G03|Ringworm) \times P(G06|Ringworm) \times P(G08|Ringworm) \times P(G12|Ringworm) \times P(G13|Ringworm)$$

$$P(Ringworm|e) = 0.22 * 0.454 * 0.272 * 0 * 0 * 0 * 0.363$$

$$= 0$$

$$P(Allergydermatitis|e) = P(Allergydermatitis) \times P(G02|Allergydermatitis) \times P(G03|Allergydermatitis) \times P(G06|Allergydermatitis) \times P(G08|Allergydermatitis) \times P(G12|Allergydermatitis) \times P(G13 | Allergydermatitis)$$

$$P(Allergydermatitis|e) = 0.16 * 0.375 * 0 * 0 * 0.25 * 0 * 0$$

$$= 0$$

$$P(Cat Flea|e) = P(Cat Flea) \times P(G02|Cat Flea) \times P(G03|Cat Flea) \times P(G06|Cat Flea) \times P(G08|Cat Flea) \times P(G12| Cat Flea) \times P(G13|Cat Flea)$$

$$P(Cat Flea|e) = 0.22 * 0.272 * 0.454 * 0 * 0 * 0$$

$$= 0$$

$$P(Abscess|e) = P(Abscess) \times P(G02|Abscess) \times P(G03|Abscess) \times P(G06|Abscess) \times P(G08|Abscess) \times P(G12|Abscess) \times P(G13 |abscess)$$

$$P(Abscess|e) = 0.16 * 0 * 0 * 0.125 * 0 * 0.625$$

$$= 0$$

$$\text{Total } P01+P02+P03+P04+P05 = 0.00051948$$

- Next calculates the presentation of the predicted value of each P, namely:  
 $P1 = (0.00051948/0.00051948 \times 100 = 100 \%$   
 $P2 = ( 0/0.00051948 \times 100 = 0\%$   
 $P3 = ( 0/0.00051948 \times 100 = 0\%$   
 $P4 = (0/0.00051948 \times 100 = 0\%$   
 $P5 = (0/0.00051948 \times 100 = 0\%$

Look for the probability value of symptomatic disease. The results of calculations using the Naïve Bayes method on a web-based expert system for early diagnosis of skin diseases in cats using the Naïve Bayes method are shown in the following table:

**Table 1:** The type of disease

The type of disease	P(h)	P(e1 h) G02	P(e2 h) G03	P(e3 h)G06	P(e4 h)G08	P(e5 h)G012	P(e5 h)G013	P(h e)
Scabies	0,24	0,5	0,333	0,25	0,5	0,416	0,25	0,00051948
Ringworm	0,22	0,454	0,272	0	0	0	0,363	0
Alergy dermatitis	0,16	0,375	0	0	0,25	0	0	0
Cat Flea	0,22	0,272	0,454	0	0	0	0	0
Abses	0,16	0	0	0,125	0	0,625	0	0

The results of the probability calculation table 6 will search for the largest probability value which will later become a system decision. Based on the results of calculating the greatest probability value is  $P1 = 0.00051948$  with a percentage of 100%

Where the results of the diagnosis of symptoms are that the cat experiences itching, the cat scratches its body excessively, there is a decrease in body immunity, rubbing its body on rough surfaces and thickening of the rough skin starting at the edge of the earlobe are symptoms of scabies.

## 6. Testing

In the tests that have been carried out, the display results on the web-based expert system program for early diagnosis of skin diseases in cats using the Naive Bayes method are as follows:

Figure 3: Login Page

Figure 4: Admin Page

Figure 5: User Page

TIDAK	Kode Penyakit	Nama Penyakit	Aksi
1	P01	Kudis	<span>Ubah</span> <span>Hapus</span>
2	P02	Kurap	<span>Ubah</span> <span>Hapus</span>
3	P03	Alergi dermatitis	<span>Ubah</span> <span>Hapus</span>
4	P04	Kutu Kucing	<span>Ubah</span> <span>Hapus</span>
5	P05	Abses	<span>Ubah</span> <span>Hapus</span>

Figure 6: Disease Data Page

The screenshot shows a web-based consultation form titled "SISTEM PAKAR DIAGNOSA AWAL PENYAKIT KULIT PADA KUCING". The form is divided into several sections:

- Navigation:** Home, Konsultasi (selected), Penyakit Kucing, and a user profile icon.
- Form Fields:**
  - Nama Pemilik (Owner Name)
  - Nama Kucing (Cat Name)
  - Alamat Pemilik (Owner Address)
  - Jenis Kelamin Kucing (Cat Gender) - dropdown menu with "- Pilih -"
  - No HP Pemilik (Owner Phone Number)
  - Usia Kucing (Cat Age)
- Symptom Selection Table:**

Pilih	Kode	Nama Gejala
<input type="checkbox"/>	G01	Muncul kerak kulit mati di bagian pinggir telinga berwarna putih
<input type="checkbox"/>	G02	Kucing mengalami gatal-gatal
<input type="checkbox"/>	G03	Kulitnya memanas dan kemerahan berlebihan

Figure 7: Consultation Form

## 7. Conclusion

Based on the research that has been done under the title Expert System for Early Diagnosis of Skin Diseases in Cats Web-Based Using the Naive Bayes Method, several conclusions can be drawn from the research that has been done, namely:

1. After using the Naive Bayes method, the calculations can be done automatically using an expert system that has been previously designed based on the knowledge obtained from an expert.
2. This expert system application that has been made can provide information about the initial handling of skin diseases in cats that can be done by cat owners.
3. The expert system application that has been made can make it easier for users to use this system regarding the initial handling of skin diseases in cats that can be done by cat owners.

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