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Intelligent Analysis of Enterprise Advertisement Push Based on Cloud Computing and Markov Chain

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With the continuous improvement of communication networks, people use wireless networks more and more frequently. Whether it be in a small entertainment venue or in a large playground, wireless networks can provide people with convenient network services. People connect to wireless networks in public places to meet their Internet needs, but also receive advertisements pushed by some web pages. This is also an important way for businesses to plan and conduct advertising. In real life, there is often a process or phenomenon of mechanism conversion between multiple states. For example, an insurance company's policy will transition from the effective state to the claim termination state, from the effective state to the surrender state, or from the invalid state to the effective state. This article uses continuous-time Markov chains to build a predictive model about the probability of insurance failure or surrender, which is used to calculate the probability of being in each state at any time, and proposes a method for parameter estimation. In the actual situation, the state of the insurance policy will have an uncertain event at a specific moment, so a multi-stage Markov chain model will be used to characterize this feature. That is, at a specific moment when an uncertain event occurs, a matrix of data is used to analyze the state of the object at a certain point in time and the specific circumstances regarding its movement.

Keywords: Cloud computing; Markov chain; Corporate advertising; Intelligent analysis

1. INTRODUCTION

Due to the continuous establishment and improvement of communication networks, people are using wireless networks more and more frequently. Whether it be at a small entertainment venue or in a large playground, wireless networks can provide people with convenient network services [1]. People connect to wireless networks in public places, which enables them to meet their Internet needs, but also to receive advertisements pushed by some web pages. This is also an important way for businesses to plan and conduct advertising [2–3]. In real life, there is often a process or phenomenon of mechanism conversion between multiple states. For example, an insurance company's policy will transition from the effective state to the claim termination state, from the effective state to the surrender state, or from the invalid state to the effective state [4]. In this study, continuous-time Markov chains are used to build a predictive model about the probability of insurance failure or surrender, to calculate the probability of being in each state at any time, and to propose a method for parameter estimation. The internal network management or base station server has shortcomings in terms of cost and hardware, and its processing resources are very inferior to cloud computing technology [5]. In the designed model, the command processing module can transmit the data in the system to the terminal processing module. After the administrator enters the corresponding

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Table 1 Cloud Portal authentication related message table.

Message name	HTTP request method
AC notification of terminal redirection	302
Portal server notifies terminal redirection	302
AC requests code from portal server	200
The portal server responds to the AC with the code value	200
AC uses code to request access token from portal server	GET
The portal server responds to the AC with the code value	200
AC uses access token to request user information from the portal server	GET
Portal server sends to AC user information	POST
The AC sends the portal server user offline	POST
The portal server confirms the user logout request sent by the AC	POST
The AC returns the user online confirmation of the portal server	GET

configuration parameters, the corresponding data can be sent to the back-end guard module, through the interaction between the module and the underlying operating system Connect to establish communication links [7–9].

2. THE THEORETICAL BASIS OF CLOUD COMPUTING AND MARKOV CHAIN

2.1 Introduction to Cloud Computing OAuth2.0 Protocol

The convenience and risks associated with the use of cloud computing technology have been universally recognized in all areas of society. Hence, an important issue that must be addressed is how to improve the security of cloud computing technology itself. The study found that a more feasible means of improving safety is to use a service model with a commercial insurance system [10]. This model enables both parties to a contract to sign a corresponding risk-based contract. This allows the user to know the regulations governing the insurance body and the appropriate compensation for a particular accident. The beneficiary of the insurance compensation may be either an individual or an organization or company that uses cloud computing technology. During the entire cloud computing process, it is necessary to make full use of virtualization technology [11]. This virtualization technology has been fully integrated into computer servers, storage systems, network connection systems and management systems to improve the design and manufacturing functions of the entire system. The use of virtualization technology requires a clear distinction between the software system and the hardware system of the network. It can efficiently allocate resources, and can also save design and manufacturing costs. The extensive use of cloud services and cloud computing facilitates resource allocation so that resources can be allocated efficiently where needed [11]. Regardless of whether distributed computing or virtualization technology is being used, cloud services and cloud computing must continue to improve their operational and service capabilities. This is not just a technical research issue pertaining to cloud services [12–14].

In order to ensure the smooth operation of the cloud technology service platform, cloud computing technology needs to follow a certain network protocol, which is mainly the OAuth protocol. The agreement stipulates the authorization behavior of the client and server of the cloud computing platform, the behavior of the provider of the interval service, and the resource owner. The agreement must stipulate that the service provider will provide an authorization layer for the client. If the authorization layer provided by the service provider, the client cannot obtain the resources of the server [15].

In this work, when researching and designing the system, the relevant content of the above-mentioned network protocol was adjusted accordingly, so that the protocol was aligned with system operations. The main messages comprising network interactions are shown in Table 1 below.

2.2 Overview of Markov Chain Theory

In the calculation, assuming that E is a complete probability space, $M = \{Mt\}t > 0$ is a right continuous random process in the probability space, H is the number generated by the random process, and $Ft = Q(Ms;\ s\varepsilon(0,t), t > 0$ is the algebraic flow of a random process, it will be defined as follows:

If there is any function h, if the number of random processes approaches R and $t > 0$, then the random process M satisfies:

$$E[h(M_{t+s})|F_t] = E[h(M_{t+s})|M_t] \tag{1}$$

In this case, the random process M can be regarded as a continuous Markov chain. In the following calculations, if any s, t, u is greater than 0, then $M = \{Mt\}t > 0$ is satisfied:

$$E[h(M_{t+s})|M_t] = E[h(M_{u+s})|M_u] \tag{2}$$

Definition 2: If a random matrix is a matrix with two parameters, then the matrix can be expressed as $P(s,t)$, and the matrix is a family of matrices generated by the Markov chain when the probability measure is P. If any $0 < s < t$, then the matrix satisfies:

$$P(M_t = j|M_s = i) = p_{ij}(s,t),\ \forall i, j \in H \tag{3}$$

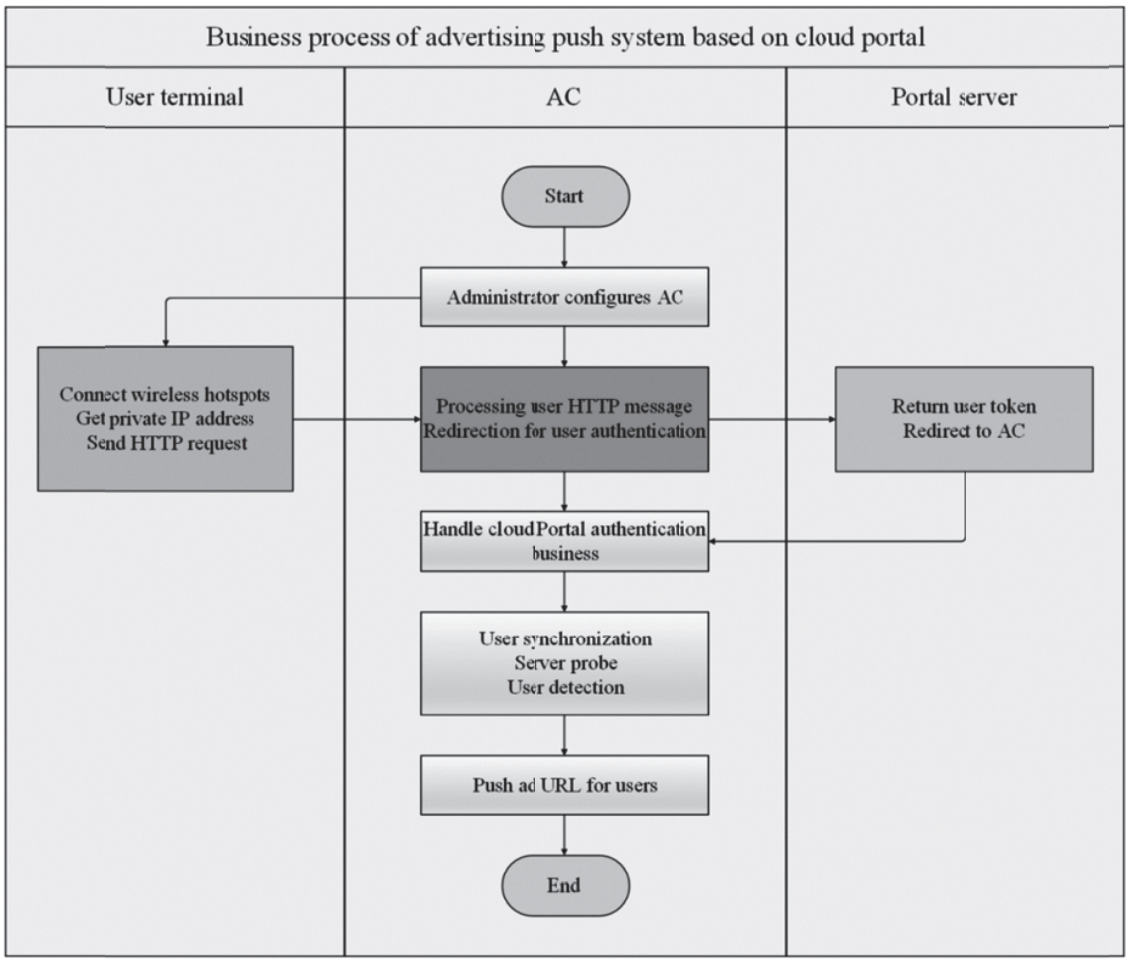

Figure 1 Business flow chart of cloud portal authentication push system.

If t is arbitrary, then the definition becomes:

$$\delta_{ij} \triangleq \begin{cases} 1, i = j, \\ 0, i \neq j. \end{cases} \tag{4}$$

According to the principle of the transition probability matrix, the elements of the transition matrix satisfy:

$$p_{ij}(s,t) \geq 0 \tag{5}$$

$$\sum_{j=1}^{H} p_{ij}(s,t) = \sum_{j=1}^{H} P(M_t = j | M_s = i) = 1, 1 \leq i \leq H. \tag{6}$$

3. DESIGN OF INTELLIGENT PUSH SYSTEM FOR ENTERPRISE ADVERTISING

3.1 System Requirement Analysis

The intelligent advertising push system designed in this study consists of two parts: the authentication of network connection and the advertising push. The specifics of the system's operation are shown in Figure 1 below.

3.2 System Function Structure

The main functions of the intelligent advertising push system designed in this study are depicted in Figure 2 below.

3.3 Design of Push Advertising Subsystem

When designing the push system, a password login authentication page needs to be set in the system. The portal server can ensure that the system provides users with normal network connection services when the system is unavailable. The system needs to set up modules for user detection and user information synchronization. The user detection module can ensure that the user's login status will be displayed automatically as offline when the user terminal is offline or dormant. The user information synchronization module can ensure that the server can obtain relevant information about the authenticated user on the AC at any time, and synchronize the user's usage data on the AC.

After the server restarts, the user can enter the normal online state again. The AC side will restart the targeted service, and the user's session interface will be saved simultaneously when the user uses the network, and the advertisement push interface will also redirect the authenticated user's usage information. The user will push certain advertisement information to the

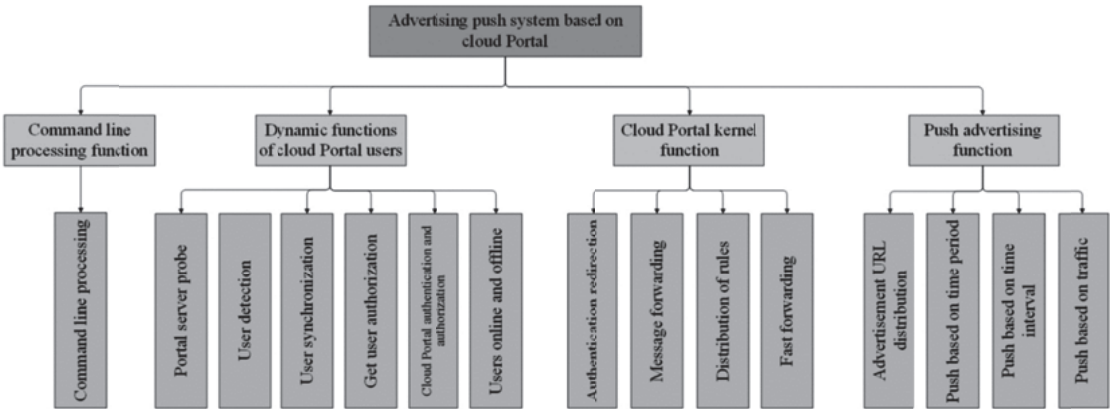

Figure 2 System function structure.

user when he reaches a certain Internet condition. When designing an advertisement push system, a certain service module can be added to the system's operating module or a password authentication interface can be created for user login at the network interface to push advertisements. When selecting an advertisement push strategy, the time and target of the advertisement push can be chosen according to the server's interface or the user's network usage. In this study, the advertising push system was designed using three strategies. The three strategies are based on the time period when the user uses the network, push according to the location where the user uses the network, and according to the amount of traffic the user uses.

When designing the system, the time for pushing advertisements is divided into different time periods according to the time when users use the network. After the user uses the network for the time period specified, the s/he can push the corresponding advertisement. The time module in the system will convey the information of pushing the advertisement to the advertisement push module. After the advertisement push module receives the push instruction, it will query the advertisement configuration at the interface. If the interface is configured with an ad group, the system will select the advertisement. The specific advertisements in the group that need to be pushed to the user are pushed, and the required pushed advertisements are delivered to the client.

In this study, as part of the system design, advertisements were pushed based on time intervals. When formulating related strategies, it is necessary to modify and adjust the control module of the server interface to ensure that the system can verify the current authenticated users. Thereafter, newly-authenticated users will push advertisements. When designing related strategies, the AC side needs to handle advertisement configuration. To determine the criteria for triggering events, it is necessary to browse the information of all authenticated users on the AC control template, manage the information of online users and the information of newly-authenticated users in a unified manner, and modify the standards for advertising push. A new push timer must be added to the system: the original user authentication standard will be modified, the advertising push rules at the interface will be adjusted, the original rules will be deleted, and new advertising push rules will be written.

Some people use Internet services in public for a long time and consume more traffic, which makes them appropriate targets for an advertising push. However, others use Internet services for a short time, so the significance of advertising push is negligible. In order to improve the effectiveness of advertising push, it is necessary to analyze the amount of traffic used by users, and design a strategy for advertising push based on this traffic. When designing the rules for advertising push, it is necessary to note the user's traffic usage, the advertisements that need to be pushed to the user, and align the corresponding advertisements with the user's usage of traffic.

4. TEST AND RESULT ANALYSIS OF ENTERPRISE ADVERTISING INTELLIGENT PUSH SYSTEM

4.1 System Test Environment Construction

In order to verify the performance of the system designed in this study, the researchers devised a test system according to the requirements of the system and the needs of users. The test system contains a 554OH model wireless controller, which is its core AC. The core AC needs to verify the redirection function, network authentication function and advertisement push function of the designed system. Specific usage. After the function of the lamp system is tested, the performance and stability of the system need to be tested thoroughly. The testing environment comprises the following:

(1) H3CWX5540H wireless controller

(2) A wireless network model H3CWA2620AGN connected to multiple devices

(3) Computers and mobile phones with wireless network cards

(4) One cloud portal server

Table 2 Comparison table of aggregation accuracy of similar web pages before and after optimization.

Feature		Travel	Renting	Stocks	Car	NBA	English training	Skin allergies
Accuracy	Before optimization	0.68	0.52	0.61	0.58	0.55	0.68	0.48
	Optimized	0.76	0.59	0.67	0.69	0.58	0.79	0.60

Table 3 Comparison of aggregation recall rates of similar web pages before and after optimization.

Feature		Travel	Renting	Stocks	Car	NBA	English training	Skin allergies
Accuracy	Before optimization	0.63	0.80	0.65	0.63	0.60	0.78	0.68
	Optimized	0.72	0.82	0.70	0.74	0.60	0.82	0.76

4.2 Experimental Evaluation Index

When evaluating the effect of the experimental test, different index values need to be calculated. The similarity page aggregation accuracy rate describes the total number of pages in each page cluster that have the same characteristics as the page cluster. The calculation formula is:

$$S_w = n/N \tag{7}$$

The results of calculation and analysis indicate that the higher the accuracy of similar web page aggregation, the better is the aggregation effect of web page clusters, and the smaller the number, the worse is the aggregation effect. Similar web page aggregation recall rate is used to show the number of web pages with the same characteristics as web pages in each web page cluster among all web pages of the same type. The calculation formula is:

$$R_w = n/N \tag{8}$$

The results of calculation and analysis indicate that the higher the number of similar web page aggregation calling rates, the better is the aggregation effect of the web page clusters, and the smaller the number, the worse is the aggregation effect. The ad-matching accuracy rate is used to indicate the extent to which the ad push situation matches the user's interest characteristics. The calculation formula is:

$$S_A = n/N \tag{9}$$

The results of calculation and analysis indicate that the higher the value of the ad matching accuracy rate, the higher is the matching degree between the ad push and the user, the better, and the smaller the number, the worse the push effect. The ad-matching recall rate indicates the extent to which the user's interest characteristics match the ads in the ad library. The calculation formula is:

$$R_A = n/N \tag{10}$$

4.3 Analysis of Results

(1) Analysis of the optimization effect of similar webpage aggregation

To determine the performance of the system, this study analyzed and processed the online log data in the system operation data, and extracted the user information, the user's online time and the user deployment resources in the online data. In order to discover a user's interests, this experiment selected a user named "13125145" for analysis, studied the user's network behavior, and summarized the characteristics of the user's network behavior. During the experiment, the system's tracking size window was set to 400, and the behavior standard was set to 3%. The user's behavior characteristics can be analyzed using the judgment method of web page aggregation. Comparing the results before and after system optimization, specific analysis can be conducted of the changes in the webpage displayed in the tracking window for two different situations. By analyzing the information users searched for on the Internet, it can be seen that travel, rental, stock investment, auto market, basketball game, English training, and skin allergies were the most searched areas, providing the main data source for web cluster analysis. The collected data is used to calculate the accuracy of similar web page aggregation and the size of the similar web page aggregation call rate to perform specific analysis and verification of the effect of web page aggregation. The results are shown in Table 2 below.

By analyzing the composition of all the experimental data, it can be seen that there are a total of 30 automobile browsing records. The automobile web page cluster can be formed by means of web page aggregation. This type of web page cluster includes a total of 34, 19 of which are web pages containing information about cars. The optimized web page aggregation method is used to form automobile web page clusters. There are a total of 36 web pages, 22 of which contain automobile information. Applying the formula, the aggregation accuracy rate of the web page aggregation method before optimization is 0.55882, and the aggregation accuracy rate after optimization is 0.73333. This indicates that the optimized polymerization method is more accurate than the optimized polymerization method.

The data presented in Table 2 above shows the aggregation and optimization of each webpage cluster. As can be seen, the optimized aggregation method can improve the aggregation accuracy of the webpage cluster.

The above analysis shows that the use of optimized web page aggregation methods can improve the accuracy and recall rate of web page aggregation and, to a certain extent, it can also improve the accuracy of web clusters indicating user interests and hobbies, thereby improving the outcomes of advertising push activities by matching them more accurately with users' hobbies and interests.

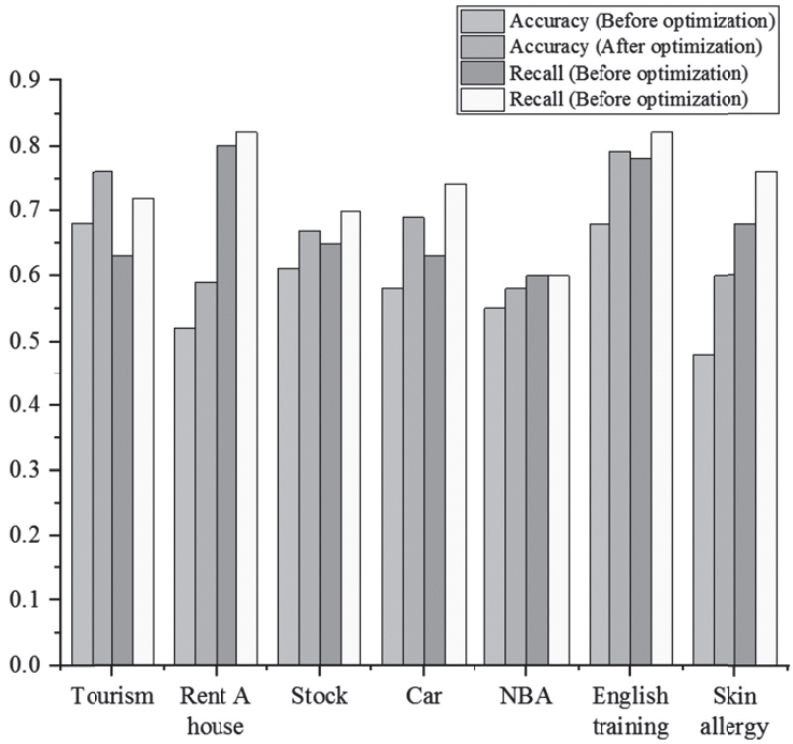

Figure 3 Comparison of similar webpage aggregation before and after optimization.

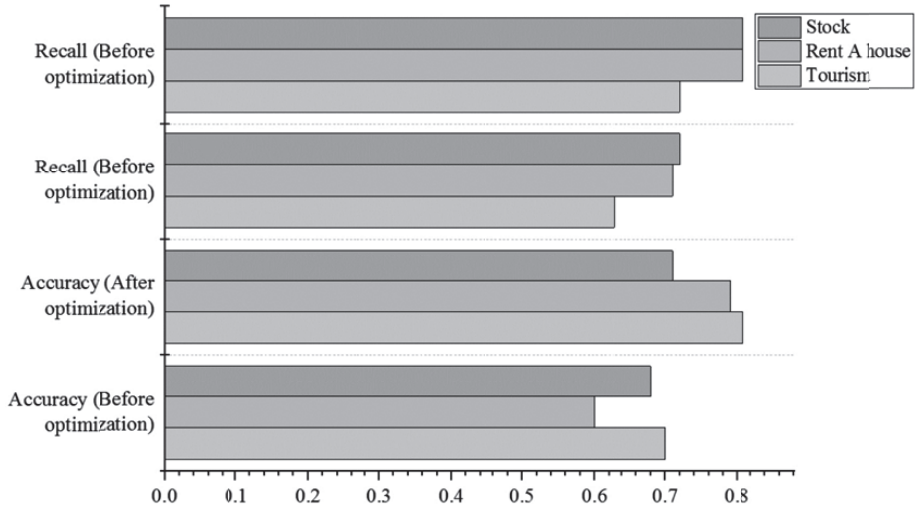

Figure 4 Comparison of advertisement matching before and after optimization.

The database management platform of the system can store the user's online records, and the user's interest characteristics can be obtained by analyzing the user's online data. Each user's interest feature can be represented by a web page collection, and each interest feature will account for a certain proportion of the web search content. In the analysis process, if only the freshness of the user's interest features is considered, and the discreteness of the features is not considered, the discrete factor can be set to zero. The results of the analysis of user behavior characteristics are shown in Table 4 below.

The data in Table 5 above shows an optimal advertising push strategy. The optimized aggregation method can improve the accuracy of advertising push and user interest matching.

5. CONCLUSION

The parameter estimation of the constant intensity matrix g of the time-Zimarkov chain is performed to obtain the predicted value of the strength matrix; the parameter estimation of the jump matrix J is performed to obtain the predicted value of the jump matrix [16]. Further, the predicted value of the probability distribution can be obtained. We applied this model to the insurance data of a domestic life insurance company [17]. The results of the study show that the predicted value obtained by this model is not much different from the true value, and the future situation can be accurately predicted. In this study, three different advertising push strategies are chosen to improve the performance of the

Table 4 Comparison table of ad-matching accuracy before and after optimization.

Feature		Travel	Renting	Stock
Accuracy	Before optimization	0.70	0.60	0.68
	Optimized	0.81	0.79	0.71

Table 5 Comparison table of ad matching recall rate before and after optimization.

Feature		Travel	Renting	Stock
Accuracy	Before optimization	0.63	0.71	0.72
	Optimized	0.72	0.81	0.81

intelligent advertising push system [18]. In future work, the design of the advertising configuration strategy needs to be further adjusted, and the advertising push of the network access layer the user's interest characteristics are matched to improve the matching degree between the advertisement push and the user's interest characteristics [19]. By adjusting the operation of the system, the functions and services of other system software can be connected, the agreement between the software and the operation of the system can be specified, and the accuracy of data mining and analysis can be improved [20].

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