# Modeling the processes of a mentorship assistance information system based on linguistic features of requests

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**Abstract**

The aim of this paper is to model the processes of an information system for mentorship assistance to users based on the linguistic features of requests. This makes it possible to provide timely mentorship assistance to users, taking into account their professional interests. Today, a significant part of the communication processes between the Client and the Mentor takes place in the virtual space using web platforms and resources. But each request for relevant information depends on the user's need. The specific need forms the motivational intent, which is an integral part of the request in the form of keywords. Participants' communications contain parts that indicate certain motivational intentions. That is why a computer-linguistic analysis of motivated users' requests to an information system for a mentorship assistance with template key phrases is considered in this article. The article also contains a list of functional requirements for an information system for providing mentorship assistance and modeling the processes of this system. The modeling of the specified information system includes the display of the static structure of the system model using a class diagram; the relationship between actors and precedents in the system is represented by a use case diagram; the process of processing the application by the Mentor and providing the results to the User is represented by a statechart diagram. The results of the study are the basis for developing an appropriate information system and improving existing resources for effective and timely mentorship assistance to users.

**Keywords**

information system, mentorship assistance, request, motivational intention, CASE technologies

## 1. Introduction

The modern world offers many opportunities for self-development, career advancement, and changing the field of activity according to one's interests. Therefore, the issue of timely mentorship assistance is important and relevant today.

A detailed analysis of search terms on the Internet revealed that the most popular search terms over the past year were “Mentorship”, “Career coaching”, “Tutoring” and “Counseling”. In particular, the term “Career coaching” gained its popularity on the Internet in January 2024,

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and the term “Mentorship” was marked by a decline in search rates in this period. As for the terms “Tutoring” and “Counseling”, these terms have shown significant interest since the beginning of 2024 and remain among the top search terms for Internet users according to the analytical resource https://trends.google.com.ua/(see Figure 1).

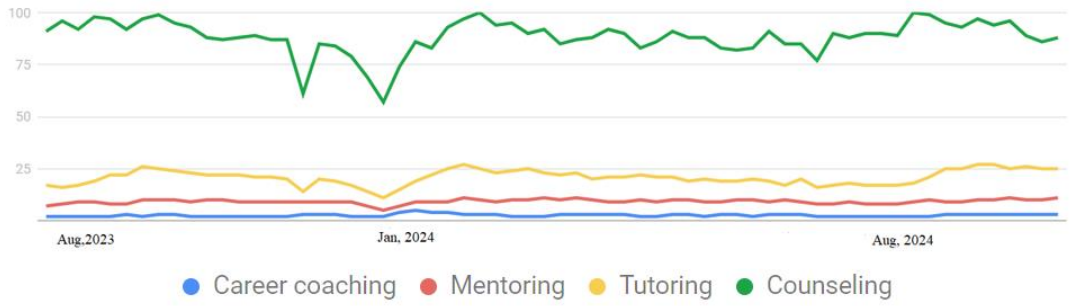


**Figure 1:** The rate of interest over time for the search terms “Mentorship”, “Career coaching”, “Tutoring” and “Counseling” *(*https://trends.google.com.ua/ in 2023-2024*)*

With the development of technology and the growing demand for personalized services, special attention has been paid to mentorship assistance systems that adapt to the needs of each user. In this context, an important task is to model the processes of information systems that provide a mentorship assistance, taking into account the linguistic features of user requests.

Mentorship has always been an important tool for developing professional skills and career growth, but traditional approaches do not always take into account the individual characteristics of each user. The introduction of linguistic analysis methods allows systems to more accurately determine the needs of users by analyzing their natural language queries and, based on this, offer more relevant recommendations and advice. Also linguistic aspects in the mentoring system can significantly improve the interaction between mentors and clients through better understanding, analysis, and adaptation to the personal needs of each user. In particular, studies [[1]; [2]] demonstrate the successful use of linguistic aspects of requests to systems for the decision-making process. This opens up new opportunities for creating more adaptive and intuitive information systems that can meet the needs of users with different levels of training and expectations.

Linguistic aspects in the mentoring system can significantly improve the interaction between mentors and clients through better understanding, analysis, and adaptation to the personal needs of each user.

## 2. Related works

Modeling the processes of a mentorship assistance information system for users based on the linguistic features of requests relates to various areas of research. Namely, the factors of career success and the issue of employment using the latest technologies are considered in studies [[3]; [4]]. In particular, studying the impact of various factors on users' readiness for change and transition, with an emphasis on their career readiness, is the goal of the study [5]. Studies [[6];

[7]; [8]; [9]]examine the use of the latest technologies for careers, in particular, using artificial intelligence technologies.

Study [10] discusses the processes of managing and using information systems. The development of recommendation systems for career choice is the goal of research [[11]; [12]]. An overview of the Unified Modeling Language (UML) and its capabilities for modeling information systems processes is presented in [[13]; [14]; [15]]. The practical application of CASE technologies for the development of information systems is the subject of research [[16]; [17]].

Generalization and characterization from the methodological and technical point of view of the research, in which machine learning and NLP methods were used, is the purpose of the study [18]. In particular, the application of NLP methods to dialog systems is considered in [19]. Study [20] presents a framework for the systematic analysis of NLP use cases, taking into account the characteristics of NLP techniques applicable to almost all industries.

The search for career opportunities using social networks is analyzed in studies [[21];[22] The linguistic analysis of users' motivational intentions and the development of information motivational systems are the aim of research [[23][23]; [24]]. The method of extracting the necessary phrases from the text is the subject of research [25].

However, none of the studies considers the possibility of modeling the processes of the mentorship assistance information system for users based on the linguistic analysis of their requests. This confirms the relevance of this study.

## 3. A formal model of requests to an information system for the mentorship assistance to users based on linguistic analysis

The request of a particular user of an information system depends on his or her motivational intentions. Using the lexical, syntactic and stylistic characteristics of the request, we can determine the main motivation of its author, which will allow us to quickly and efficiently assist him/here and formulate a response to his query that will fully reflect the necessary information. To describe the author's motivation, we will use the linguistic method of analyzing the content of the request using markers. Linguistic markers in the request text are linguistic units that help to reflect the structure, logic, emotional coloring, and other features of the text. Since a motivation marker is a phrase, word, or part of a sentence that somehow characterizes the author's motivation for creating an information system request [23], it can be represented as follows:

$$MarkerMotivation = \{Marker_i\}_{j=1}^{N(Marker)}, \quad (1)$$

where $N(Marker)$ is the number of markers in the request text.

The types of motivation markers in user requests vary depending on the initial needs of using the information system, as well as on the information already provided from previous requests. A request text is an appeal formulated by a user to obtain information, a response, or perform a certain action. Several motivation markers can be identified in a request (e.g., “what courses”, “what qualifications”, etc.)

The analysis of user requests shows that their wording depends on the purpose of communication and the lexical composition of the request itself. That is why the formal request model can be represented as follows:

$$Request_i = \langle RequestAim_i, LexicalComposition_i \rangle, \quad (2)$$

where $RequestAim_i$is the purpose of the request, such as obtaining information, clarifying details, asking for help, etc., $LexicalComposition_i$ is the lexical composition of the request, which contains relevant terms, keywords, and professional terms most often used in requests. For example, for mentoring, these can be words such as “mentoring”, “career development”, “consultation”.

The purpose of the request depends directly on the user's needs. That is why it can be represented as a tuple:

$$RequestAim_i = \langle CareerDevelopment_i, \quad Consultation_i, \quad EducationalTerms_i \rangle, \quad (3)$$

where $CareerDevelopment_i$ is the need for career development of the user, $Consultation_i$is the need for consultation of the user, $EducationalTerms_i$ is the need for an educational component.

The need for career development of the user is to fully inform him/her about career opportunities, professional development, as well as about the necessary skills and abilities to achieve the goal.

The need for career development is the following tuple:

$$CareerDevelopment_i = \langle CareerGrowth_i, ProfessionalDevelopment_i, Skills_i \rangle, \quad (4)$$

where $CareerGrowth_i = \{CareerGrowth_i\}_{i=1}^{N(CareerGrowth)}$are markers of motivation for career growth (e.g., “improve training”, “additional qualifications”, etc.), $ProfessionalDevelopment_i \subset MarkerMotivation$ are markers of motivation for professional development (e.g., “professional development programs”, “new technologies in the field”, etc.), $Skills_i \subset MarkerMotivation$ are markers of motivation for additional skills (e.g., “development of new skills”, “required skills”).

The need for counseling is to provide timely assistance and clarification of certain issues related to achieving the goal.

The need for counseling is a tuple:

$$Consultation_i = \langle Info_i, Meeting_i, Recommendation_i \rangle, \quad (5)$$

where $Info_i = \{Info_i\}_{i=1}^{N(Info)} \subset MarkerMotivation$ are markers of motivation for obtaining thematic information (e.g., “information”, “question”, ect.), $Meeting_i \subset MarkerMotivation$ are markers of motivation for a consultation meeting (e.g., “meeting”, “consultation”, ect.), $Recommendation_i \subset MarkerMotivation$ are markers of motivation for recommendations and advice (e.g., “recommendation”, “advice”, ect.).

The need to receive information about education and training includes information about the educational component of the user's professional development to achieve the goal.

The need for the educational component is a tuple:

$$EducationalTerms_i = \langle Training_i, Seminar_i, Workshop_i \rangle, \quad (6)$$

where $Training_i = \{Training_i\}_{i=1}^{N(Training)} \subset MarkerMotivation$ are markers of motivation for training (e.g., "training courses", "education", ect.), $Seminar_i = \{Seminar_i\}_{i=1}^{N(Seminar)} \subset MarkerMotivation$ are markers of motivation for participation in the seminar (e.g., "seminar", "knowledge", ect.), $Workshop_i = \{Workshop_i\}_{i=1}^{N(Workshop)} \subset MarkerMotivation$ are markers of motivation to participate in workshops (e.g., "workshop", "practical skills", ect.).

The lexical composition of a request depends on the user's ability to formulate their needs. That is why it can be represented as a tuple:

$$LexicalComposition_i = \langle Keywords_i SemanticElements_i, Token_i, EticalElements_i \rangle, \quad (7)$$

where $Keywords_i$ are words that define specific professions and skills, $SemanticElements_i$ are the words that add semantic meaning to the user's request or clarify it. They can indicate the direction of the request or its specifics (e.g., the words "for," "on," "in" can indicate specific details of the request, $Token_i$ are words that express the actions or intentions of the user in the request (e.g., "find", "get", "ask"), $EticalStandards_i$ are words that indicate compliance with ethical norms in the text of the request (e.g., "could you", "please"). The formal definitions of the indicators of the other sets are as follows (8).

Here are the types of motivation markers in a user's request:

a set of motivation markers for career growth that characterize the user's motivation to get a higher-level position (career, promotion, professional development, progress, etc). For each type of markers from (6), the indicator for a set of these markers is defined as follows:

$$CareearIndicator(CareerDevelopment_i) == \{\langle Marker(CareerDevelopment_i)_j, \omega(CareerDevelopment_i)_j \rangle\}_{j=1}^{N(CareerDevelopment)}, \quad (8)$$

where $\omega(CareerDevelopment_i)_j \in [0,1]$ is the degree of correspondence of the j-th marker to the motivational intention of the i-th user.

a set of markers of motivation for consultation that characterize the stage of targeted informatization of a particular user (e.g., "consultation", "consult", "recommendations", "expert opinion", etc.).

a set of motivation markers for the educational component includes information about available trainings, educational courses, seminars, workshops (e.g., "training", "educational course", "language learning", etc.)

## 4. Modeling the processes of the information system for the mentorship assistance to users based on linguistic analysis

Modeling the processes of an information system includes the construction of appropriate diagrams to best highlight the capabilities of the system and the processes it provides, taking into account the motivational intentions of its users. That is why the modeling of the information system for providing professional assistance was developed using case technology tools and is represented by a use case diagram, a class diagram, and a statechart diagram.

### 4.1. Requirements for the functionality of the information system

The main functional requirements for the development of an effective information system for the mentorship assistance to users based on the linguistic features of their requests are:

1. **Efficient and fast processing of user requests**. The main task of the aforementioned information system is to process requests from users to provide them with effective assistance and advice from the appropriate mentor. That is why this system should recognize and analyze the texts of user requests using natural language processing methods. This will help to identify keywords, user intent, and formulate the content of the query. The solution to this problem is to analyze the context of the user's request based on the topic and the chain of previous requests to determine its semantic meaning. It should also recognize between synonyms, antonyms, polysemous words, and grammatical constructions to ensure the accuracy and relevance of the answer.
2. **Thematic classification of requests and redirecting them to the appropriate mentor**. The quality of the answer clearly depends on the mentor's relationship to a particular industry. That is why the system should automatically classify user requests by identifying different categories (e.g., technical questions, career development, training) based on linguistic analysis. This will allow the user to get qualified advice and assistance from the right mentor based on their specialization, experience, and the subject of the request. And the mentor will be allowed to work only with professional requests that come into the system, which affects his or her effectiveness.
3. **Personalization of responses to user requests**. The quality of the advice received is also determined by the level of knowledge and skills of the users who made the request. The level of knowledge, skills, and abilities of the user also affects their intentions and needs for receiving appropriate mentoring assistance. The level of personalization of the response should take into account these features and adapt responses to requests individually for each user. The system should also store the history of previous requests and responses. This will increase the efficiency of interaction with the system, as this history will be taken into account when generating new responses. It will also ensure the continuity and consistency of consultations.
4. **Feedback**. This information system requirement includes assessing the quality of responses received by users to a particular request and analyzing the feedback process itself. To accomplish this task, the system should allow users to evaluate the quality of the responses they receive on their own, taking into account their experience, level of knowledge and intentions. The system should also analyze feedback from users. This will allow for continuous improvement of algorithms and functionality, based on improving the accuracy of query classification and the quality of recommendations.
5. **Confidentiality and security of user data**. Ensuring the confidentiality and security of user data includes requirements for the protection of personal data and access control. The system must protect users' personal data and information about them by using encryption of this data for its transmission. The system must also have access control mechanisms. This will allow only authorized users and mentors to provide access to specific information or functions of the information system.

These basic functional requirements are a guideline for the development of an effective information system for the mentorship assistance that will take into account the linguistic features of requests, which will provide users with timely, high-quality support and good results for their further development.

### 4.2. Modeling of information system processes

The relationship between the main actors of the system and the precedents is represented by a class diagram (see Figure 2).

The main users of the system are the Client, the Mentor, and the System User Support Service. For the Client, the following options are defined: “Submit a request”, which includes “Description of motivational intentions”, and “Evaluation of the Mentor's work”. For the Mentor, the following options are available: “Apply for a Mentor”, “Process a request”, which includes the ability to “update information on the status of the request” and “Evaluate the user's profile according to the request”. The result of the interaction between the Client and the Mentor is the Processed Request Result, which contains a list of possible vacancies. Another actor for this system is the Support Service, which has the ability to “Process requests from Clients and Mentors” and “Verify the request” in case of misunderstandings and complaints.

A static representation of the structure of the information system model is built using a class diagram.

The class diagram contains the following components:

- User is a class that defines the initial set of data for all users of the system during registration.
- Client is a class that contains the Client profile. It contains such attributes as Name, User_status, Password.
- Mentor is a class that contains the Mentor profile. It contains such attributes as Mentor_description, Rating, Field, Proficiency, Mentor_status, Remunetation.
- Proficiency is a class that contains information about the professional level of the Mentor and includes such attributes as Junior, Middle, Senior.
- MentorStatus is a class that contains information about the Mentor's ability to process the application immediately and includes such attributes as Online, Available, Busy.
- FieldList is a class that contains a list of professional areas and qualifications.

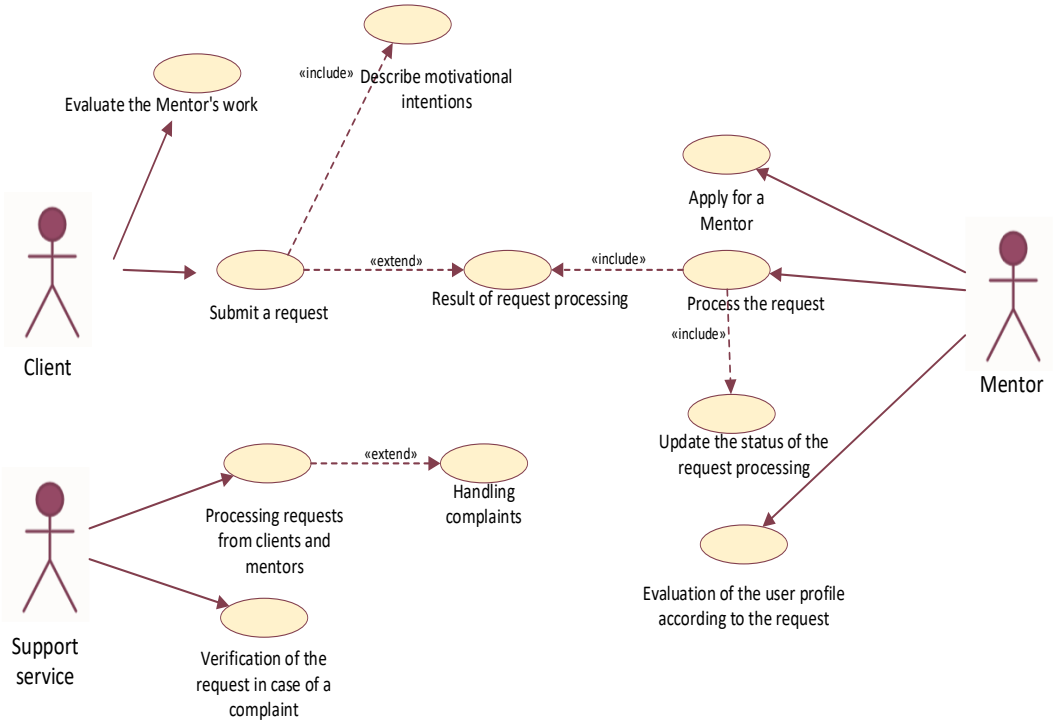


**Figure 2:** Use case diagram of the information system for the mentorship assistance to users based on the linguistic features of their requests

The class diagram of the information system of the mentorship assistance for users based on the linguistic features of their requests is shown in Figure 3.

The statechart diagram for the information system describes the process of processing the application by the mentor and providing the results to the user (see Figure 4).

The Mentor receives a request from the User that contains motivational intentions and begins to process it. The system records the degree of processing of the application in the In progress and On hold states. The summary of the processed request is displayed at the Ready for results stage. If the results meet the User's expectations, the process is considered complete. If the results do not meet the User's expectations, they are returned to the Mentor for revision. In case of a misunderstanding between the Mentor and the User, it is possible to file a Complaint.

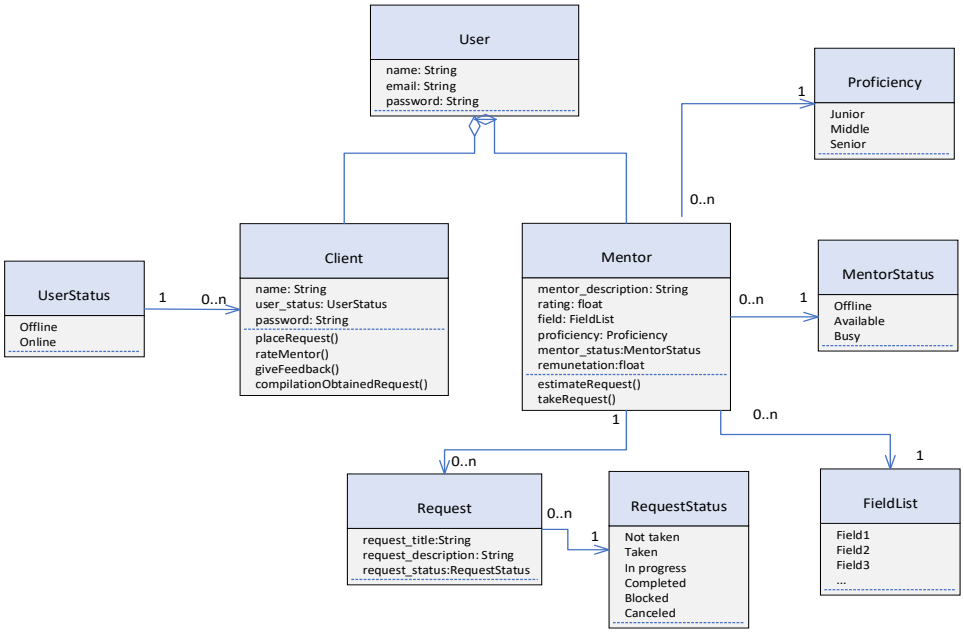


**Figure 3**: Class diagram of the information system for the mentorship assistance to users based on the linguistic features of their requests

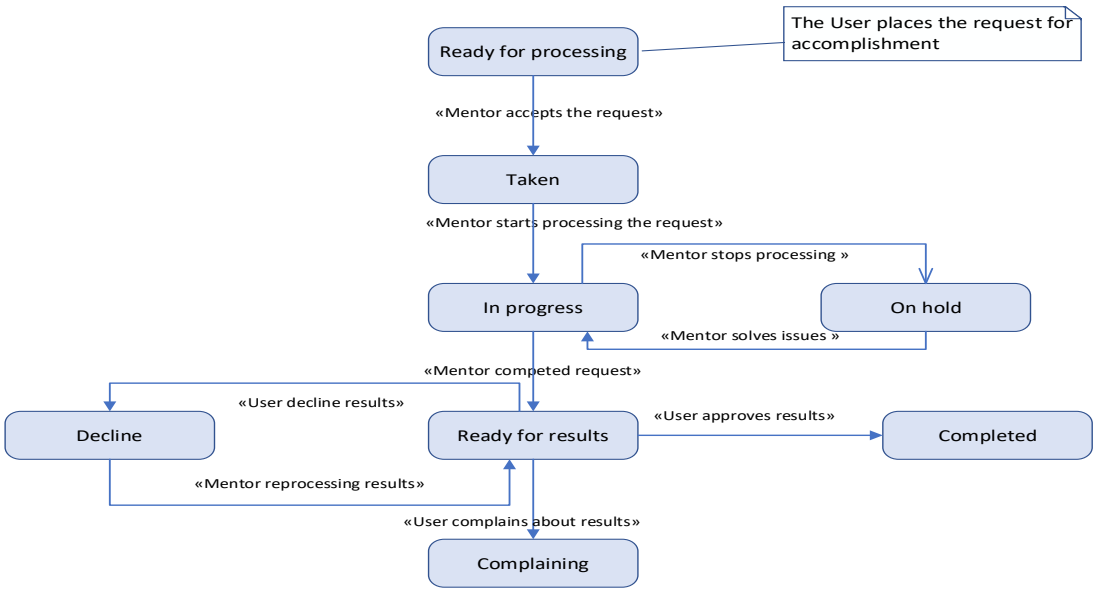


**Figure 4**: Statechar diagram of the information system for the mentorship assistance to users based on the linguistic features of their requests

## 5. Results

Analysis of the experience of users who used different platforms aimed at providing mentoring assistance, in particular in the field of information technology, was conducted. In particular, these resources include StackOverflow (https://stackoverflow.com), ChatGPT

(https://chatgpt.com), Freelancer.com (https://www.freelancer.com), and the proposed information system of mentoring based on linguistic features of requests. The data for analysis were anonymous and took into account only the experience of using the mentioned platforms. The data contained the following questions about the use of platforms for mentoring in professional activities, as well as information about the use of the proposed platforms. Its also included a task to evaluate the proposed platforms on a scale from "1" to "10", where "1" means completely dissatisfied, and "10" means completely satisfied. The specific findings of the survey are presented in the form of a competitiveness polygon, which includes such criteria as Effective communication and efficiency, Client satisfaction, Experience, Service quality, Price policy, Expertise (see Figure 5).


**Figure 5:** Competitiveness polygon of information platforms aimed at providing mentorship assistance to users based on the data analysis results

The results of the study show the competitiveness of the proposed system in comparison with existing systems and resources that are able to provide mentoring assistance in job search and inform about career opportunities.

The proposed model of the information system of the mentorship assistance to users, which takes into account the linguistic features of requests, is the basis for the development of the corresponding information system. It provides an opportunity for a broader study of the process of interaction between users of relevant resources and will optimize employment processes with high-quality selection of candidates and career opportunities.

## 6. Conclusions

Thus, this paper proposes modeling the activities of an information system for the mentorship assistance to users, which takes into account the linguistic features of their requests. The modeling process included the construction of a formal model with template key phrases, the definition of requirements for the information system and the modeling of the relevant information system using case technologies.

In particular, based on linguistic analysis, a formal model of requests ($Request_i$) was defined and user needs based on motivational intentions ($RequestAim_i$) and lexical composition ($LexicalComposition_i$) were described. It's became the basis for further defining the functional requirements for the system and modeling the corresponding processes of the system.

The model of the system's processes is presented using CASE technologies. In particular, a class diagram representing the static structure of the model; a use case diagram to display the relationship between actors and precedents in the system; a state diagram to describe the process of processing the note by the mentor and providing the results to the user. The proposed models are the basis for developing the architecture of an appropriate information system or improving existing resources for providing mentoring assistance to users. The study also contains an analysis and comparison of the competitiveness of the proposed system in accordance with existing platforms, such as StackOverflow, ChatGPT, Freelancer.com, тbased on a survey of bachelor's and master's students majoring in System Analysis at Lviv Polytechnic National University.

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The results of the study are based on a survey of bachelor's and master's students majoring in Systems Analysis at Lviv Polytechnic National University. A total of 80 students took part in the survey, including 32 master's students and 48 bachelor's students.

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