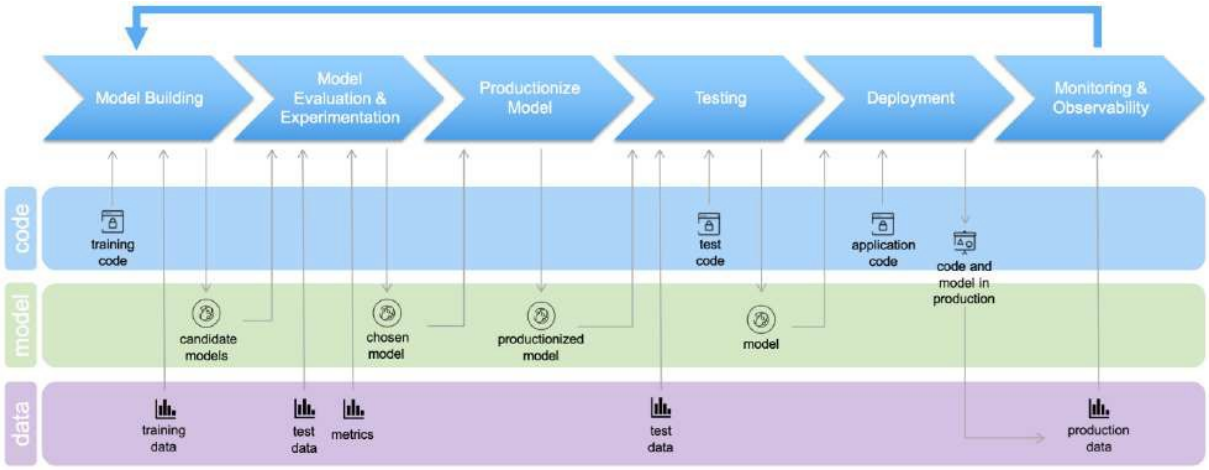

Figure 8: Methodology of machine learning model development for computer vision

in the high complexity of their maintenance and improvement, as well as their insufficiently long life cycle.

The problems of the unification of the principles for constructing various components of computer systems are solved in the OSTIS project. The OSTIS The project aims to create an open semantic technology for designing knowledge-driven systems in general and computer vision systems in particular [13].

VII. Conclusion

The methodology for developing a machine learning model for solving applied computer vision problems is presented. The article discusses the tasks of computer vision, the main components of building application systems, and the and the challenges and limitations of the existing technological level. demonstrated the need to develop areas related to the compatibility of scientific research results in the field of artificial intelligence.

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МЕТОДОЛОГИЯ РАЗРАБОТКИ МОДЕЛЕЙ МАШИННОГО ОБУЧЕНИЯ ДЛЯ РЕШЕНИЯ ПРИКЛАДНЫХ ЗАДАЧ КОМПЬЮТЕРНОГО ЗРЕНИЯ

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Представлена методология разработки моделей машинного обучения для решения прикладных задач компьютерного зрения. В статье рассматриваются задачи компьютерного зрения, основные компоненты построения прикладных систем, проблемы и ограничения существующего технологического уровня.

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Principles and Experience of Intelligent Decision Support and Recommender Systems Engineering

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***Аннотация*—In the article main principles of engineering of intelligent decision support and recommender systems are considered. Definition and concept of a generalized object are formulated. Technologies of recommender systems engineering and construction are analyzed. Classification of decision support systems is suggested. Experience of decision support and recommender systems engineering is presented.**

***Keywords*–OSTIS, intelligent system with integrated spatially referenced data, semantic model, question language, design process automation**

I. Introduction

Despite existing developments in the area of decision support systems (further — DSS) engineering, these technologies presuppose the adaptation of only individual components of the DSS and do not provide the adaptation of the subject area model. This leads to the use of irrelevant and inaccurate data in the DSS, which negatively affects the efficiency of decision-making necessary in a quickly changing environment. These problems can be solved via adapting subject known area models to the conditions of decision-making tasks and well-timed updating of the models with the data, knowledge and precedent (subject) collections necessary for this model. The concept of a generalized object became the base of different DSS with combined intellect engineering and construction. The target of this research is to generalize from theoretical and practical experience in the sphere of intelligent decision support and recommender systems construction.

The target of this research is to generalize theoretical and practical experience in the sphere of intelligent decision support and recommender systems construction.

II. Brief literature review

First theoretical research on decision support systems was made in USA at the Carnegie Institute of Technology in the late 1950s — early 1960s. The first main works on DSS were published in 1978-1980 by P.Keen, M. Scott Morton [1], [2], R. Sprague [3].

Investigations in the sphere of intellectualizing of DSS information technologies are wavy carried out in the world. Moreover, the increase in research activity in time coincides with the periods of development on computing and financial resources (the emergence of personal computers, evolution of the processors, memory capacity, the emergence of a user-friendly interface, the emergence of mobile Internet technologies, etc., with the simultaneous reducing of its prices).

Among the modern works on DSS there are books “Intelligent Decision Support System for IoTEnabling Technologies: Opportunities, Challenges and Applications” (2024) by ed. S. Sahana [4]; “Intelligent Decision Support Systems for Smart City Applications” (2022) by L. Gaur, V. Agarwal and P. Chatterjee [5]; “Intelligent Decision Support Systems” (2022) by M. Sanchez-Marr ‘ e [6]; “Understanding Semantics-Based ‘ Decision Support” (2021) by S. Jain [7]; “Intelligent Decision Support Systems: A Complete Guide — 2020 Edition” by G. Blokdyk [8].

The technology of recommender systems gained popularity only in the middle of 1990s. The concept of a recommender system was first used in 1992 in the scientific publication of Xerox, in the same year in the article “Using collaborative filtering to weave an information tapestry” the term “collaborative filtering” was introduced. Subsequently, fundamental works systematizing knowledge on recommender systems were devoted to this area. One of them is “Recommender Systems: The Textbook” [9]: in this book, description, comparison, assessment of the accuracy of basic algorithms for developing recommendations to the user were made, in addition, the field of practical use of such systems is affected. The work “Recommender Systems: The Handbook” [10] deserves special attention. In it the existing variety of methods and concepts of recommender systems was systematized. This source shows how recommender systems can help users in decision-making, planning and procurement processes, illustrates the experience of using these systems in big corporations such as Amazon, Google, Microsoft.

Nowadays the transition to the next-generation computer systems takes place. Intelligent DSS and recommender systems belong to this class of information

systems. Such systems should "independently evolve and interact effectively with each other in the collective solution of complex problems" [11]. One of the relevant problems of next-generation computer systems design and development is generalization of formal theory and methodology of their functioning.

III. Definition and the concept of objects

Usually an object O can be represented in the view O =< Data, Met, Mes >, where: Data — a set of internal information of the object (data); Met — a set of its own procedures for manipulating the data (methods); Mes — an external interface for interacting with other objects in the subject area (such as a permissible set of event messages outside and inside of the subject area).

However, the need to take into account the development of DSS requires a more general and flexible mechanism for describing and modeling them. Such a mechanism can be built on the base of further generalization of the objectoriented approach and, in particular, of the term "object" in the conceptual model of the subject area

The term "generalized object" is suggested: GO =¡ Data, Met, Model, Knowl, Mes, Link ¿, in which models, knowledge and links with the other domain objects are encapsulated in addition to data, methods and messages

Such model of a generalized subject area can be considered as a type of multi-object neural network, if add to the usual method of object interaction by messages the possibility of activating objects (transmission of excitation) through (priorities) indicating the value of the response threshold level for each object. The value of the response threshold level can with the system development stage, solved problems, accumulated statistical experience of problems solving, etc. Interaction between generalized objects can be carried messages or changes in the links structure of the generalized object system. This system is separated from their functional part. It can be and represented by a dynamic links list, by changes in the links weights (filtering) and actuation threshold values.

Each generalized object can have several states and go from one state to another depending on the incoming messages that are the result of the activities of other generalized objects. At the same time, the generalized object changes its state when its excitation value exceeds some non-zero threshold of actuation. In general, such subject area model can be considered as a hierarchy of abstractions classes of, problem and user objects. The status of the subject area actually depends on the status of each generalized object and the message queues at the input and output of these generalized objects. The latter can be considered as a database of facts about events on the base of which it is possible to determine an output machine for interpreting of existing and generating new facts in the process of simulating of modelling system functioning.

Requirements to the multi-agent DSS can be formulated by means of object-oriented classification (enumerations of the object classes involved in solving problems, their properties, relationships and behavior). The main principle of classification is the of object classes based on the set of internal properties inherent in class objects. After that, the requirements are sequentially detailed until the multi-agent DSS project is fully described in terms of the basic objects of the used tools.

IV. Recommender systems

In today's world, we can often face the problem of recommending goods and services to users of any site, information system. The modern economic formation involves intense competition in various market niches, which leads to each potential buyer among companies. In order to improve their experience of interacting with the company's services, it is beneficial to create personalized collections that will have client response. Previously, list, a set of current actions and the most popular goods was sufficient, but the current situation does not allow such low-cost methods to act. A relatively new technology of recommender systems can be used for buyers' attraction and sales increasing.

The essence of recommender systems approach presupposes the dynamic formation of recommendations personally for each specific client, which, unlike static information, significantly increases probability of coincidence with the real needs of people. Recommender systems take into account all kinds of parameters (purchase history, time and date of registration, region, purchased products, etc.), which allows prediction of the user's wishes as accurately as possible.

Recommender systems have already found their place in many areas: in addition to e-commerce, this kind of technology has been introduced for finding books, films, music, and social media contacts.

The relevance of recommender systems is growing every year. Recommender systems are the programs aimed for the prediction of the user's interest in certain objects and giving them the recommendation for purchase or using the items, which the user probably likes. Such recommendations are personalized and are formed for each user depending on their preferences. Although the technology itself appeared quite recently, its use is considered mandatory for all promising companies.

One of the first to become interested in introducing recommender systems was the largest American ecommerce platform Amazon. Already in the late 1990s, the best minds of the company developed their own algorithms for the so-called collaborative (joint) filtering, which offered recommendations to each client based on