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Республика Казахстан, 050026, г. Алматы,
ул. Богенбай батыра, 221
Тел./факс: +8 727 378-0517, 378-0539 (вн.125),
e-mail: bapiyeva@inti.kz, grebtsova_l@inti.kz
www.vestnik.nauka.kz

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[1]Institute of information and computational technologies, Almaty c., Kazakhstan
[2]Kazakh national women's teacher training university, Almaty c., Kazakhstan

APPLICATION OF BAYESIAN NETWORK ON THE EXAMPLE OF TRAINING MODEL «RABOTA»

Abstract. In a modern information environment, the application of artificial intelligence, including the Bayesian approach, is relevant for solving various applied problems. The Bayesian approach is used as a method of adapting existing probabilities to newly obtained experimental data. The main idea of building a Bayesian network is to decompose a complex system into simple elements. The article is devoted to the application of the Bayesian network on the example of the training model "Rabota". The advantages of Bayesian networks and a real example of use in determining the ability of an applicant to take a vacant position have been considered. The proposed research method takes into account the main factors affecting the assessment of the candidate's potential for a particular position using the Bayesian approach. The results of the study including probabilistic relationships between individual nodes of the constructed Bayesian network have been presented.
Key words: artificial intelligence, Bayesian networks, probability dependence.

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Аннотация. В современной информационной среде для решения различных прикладных задач актуально применение искусственного интеллекта, в том числе байесовского подхода. Байесовский подход используется как метод адаптации существующих вероятностей к вновь полученным экспериментальным данным. Основной идеей построения байесовской сети является разложение сложной системы на простые элементы. Статья посвящена применению байесовской сети на примере учебной модели «Rabota». Рассмотрены преимущества байесовских сетей и реальный пример использования при определении возможности претендента занять вакантную должность. Предложенный метод исследования учитывает основные факторы влияющие на оценку потенциала претендента на ту или иную должность с использованием байесовского подхода. Приведены результаты исследования, включающие вероятностные взаимосвязи между отдельными узлами построенной байесовской сети.
Ключевые слова: искусственный интеллект, байесовские сети, вероятностная зависимость.

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Түйіндеме. Заманауи ақпараттық ортада әртүрлі қолданбалы есептерді шешу үшін жасанды интеллект, оның ішінде Байес әдісін қолдану өзекті болып отыр. Байес әдісі қолданыстағы ықтималдылықтарды жаңадан алынған тәжірибелік мәліметтерге бейімдеу әдісі ретінде қолданылады. Байес желісін құрудың негізгі идеясы – күрделі жүйені қарапайым элементтерге бөлу. Мақала «Rabota» оқу үлгісі мысалында Байес желісін қолдануға арналған. Байестік желілердің артықшылықтары және өтініш берушінің бос лауазымға орналасу қабілетін анықтаудағы нақты мысал негізінде қарастырылады. Ұсынылған зерттеу әдісі Байес әдісін қолдана отырып, белгілі бір лауазымға үміткердің әлеуетін бағалауға әсер ететін негізгі факторларды ескереді. Зерттеу нәтижелері, соның ішінде салынған Байес желіде құрылған жекелеген түйіндері арасындағы ықтималдық қатынастары ұсынылады. **Түйінді сөздер**: жасанды интеллект, байесов желілері, ықтимал тәуелділік.

Introduction. Artificial intelligence is widely used in solving various problems in various fields of science, economics, social life and production. The most popular use of artificial intelligence was the use of Bayesian networks in research [1,2]. Bayesian networks are widely used in various fields: in economics, in psychology [3,4], in sociology, in governance theory, in medicine, in genetics, in the study of various complex physical processes, etc. The article [5] considers the theoretical foundations of modeling students based on Bayesian networks. The algorithms of competence model construction taking into account competence properties and Bayesian network construction for competence assessment have been described. The rule of interpreting probabilities for assessing the achievement of a learning goal has been proposed. Examples of assessing the level of competency formation on the basis of the constructed model have been considered. In [6], a student knowledge model in the form of a Bayesian trust network with a tree structure is proposed. The method of its construction and use for analysis and diagnostics in the intelligent testing system has been described. Bayesian networks provide a convenient tool for risk research, modeling, and quantification. The article [7] proposes a risk assessment model at all stages of software development. The model constructed in the form of a Bayesian trust network is dynamic, it easily adapts to the evidence obtained. This allows to enter into the system the data obtained at each stage of the project. Improved risk models in this way can be used in other similar projects.

The study [8] presents the implementation of the Bayesian model of logical inference in the development of an expert system to assess the

compliance of the graduates training level of technical areas of universities with the requirements of modern employers in the field of IT services. Effective use of the Bayesian network tool requires good computer technology and good software products to implement various tasks in the field of Bayesian networks. As a rule, there are no problems with computer technology in the modern world. A more difficult problem is the availability of good software products for working with Bayesian networks [9-12].

The problem statement is formed as follows on the example to show the use of the Bayesian network in assessing the applicant's suitability for a vacant position using the training model "Rabota".

To solve this problem, we will describe this model.

- It is required to determine the possibility of the applicant to take the vacant position.

- This requires evaluating the technical potential of the applicant and his communication skills.

- For simplicity of the model, we assume that the technical potential of the applicant depends on three factors: possession of a higher education, diligence and work experience in similar positions.

- Also, for simplicity, we assume that the applicant's sociability depends on his intelligence and social status.

- We assume that the possession of a higher education depends on the intelligence of the applicant.

We assume that the suitability of the applicant is determined by his technical training and communication skills.

Results and discussion. A Bayesian network consists of eight nodes and eight relationships (arcs) between nodes. The Bayesian network corresponding to this model is shown in Figure 1.

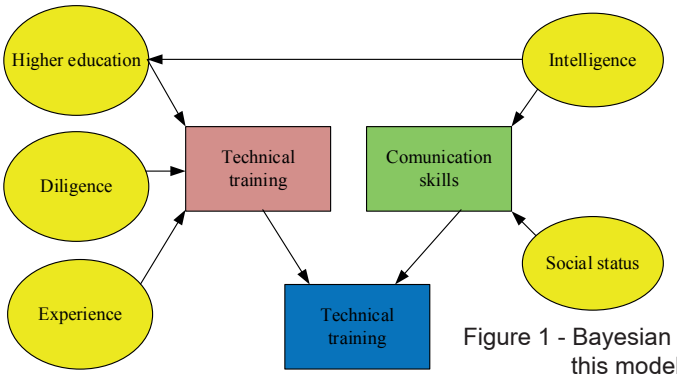

Figure 1 - Bayesian network of this model

A priori for the nodes of this network it is known:

- A priori, we believe that approximately 30% of people have low intelligence, 60% have medium intelligence, 10% have high intelligence.

- A priori, we believe that approximately 30% of people have a low social status, 50% have an medium social status, and 20% have a high social status.

- A priori, we believe that approximately 30% have a higher education.

- A priori, we believe that approximately 55.6% of people are lazy, 33.3% have average diligence, and 11.1% are hardworking.

- A priori, we believe that approximately 43% of people have low experience in this field, 43% have average work experience, and 14% have high work experience.

- Previous experience shows that 20% of applicants possess the necessary technical training.

- Previous experience shows that 20% of applicants have the necessary communication skills.

- Previous experience shows that only 10% of applicants are recognized as suitable for the vacant position.

- The probabilistic relationships between the individual nodes are described by the following tables:

- There is a probabilistic relationship between intelligence and higher education:

Table 1 - Probabilistic relationship between intelligence and higher education

Intelligence	Possession of a higher education	No higher education
Low	0.090909	0.909091
Average	0.25	0.75
High	0.75	0.25

There is a probabilistic relationship between intelligence, social status and sociability:

Table 2 - Probabilistic relationship between intelligence, social status and sociability

Intelligence	Social status	Sociability	
		Yes	No
Low	Low	0.09090909	0.90909091
Average	Low	0.33333333	0.66666667

High	Low	0.25	0.75
Low	Average	0.16666667	0.83333333
Average	Average	0.50	0.50
High	Average	0.75	0.25
Low	High	0.33333333	0.66666667
Average	High	0.75	0.25
High	High	0.83333333	0.16666667

There is a probabilistic relationship between higher education, diligence, work experience and technical training:

Table 3 - The probabilistic relationship between higher education, diligence, work experience and technical training

Higher education	Diligence	Work experience	Technical training	
			Yes	No
No	Low	Low	0.01	0.99
No	Low	Average	0.125	0.875
No	Low	High	0.25	0.75
No	Average	Low	0.01	0.99
No	Average	Average	0.167	0.833
No	Average	High	0.25	0.75
No	High	Low	0.01	0.99
No	High	Average	0.5	0.5
No	High	High	0.75	0.25
Yes	Low	Low	0.01	0.99
Yes	Low	Average	0.333	0.667
Yes	Low	High	0.5	0.5
Yes	Average	Low	0.01	0.99
Yes	Average	Average	0.50	0.50
Yes	Average	High	0.333	0.667
Yes	High	Low	0.01	0.99
Yes	High	Average	0.667	0.333
Yes	High	High	0.833	0.167

There is a probabilistic relationship between intelligence, social status, and sociability:

Table 4 - Probabilistic relationship between intelligence, social status and sociability

Technical training	Sociability	Suitable	
		Yes	No
No	No	0.091	0.909
No	Yes	0.167	0.833
Yes	No	0.667	0.333
Yes	Yes	0.909	0.091

Figure 2 shows the probability dependence of this model.

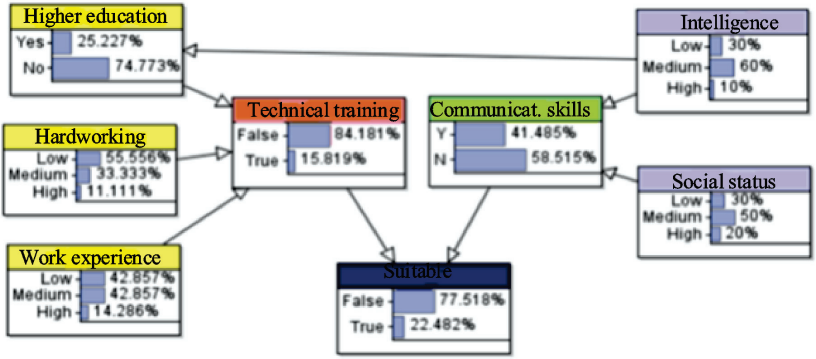

Figure 2. - Probability dependence

The data for the nodes will take the following values:

With a probability of 25.2%, the applicant has a higher education.

With a probability of 15.8%, the applicant has the necessary technical training.

With a probability of 41.5%, the applicant has communication skills.

With a probability of 22.5%, the applicant is suitable for the vacant position.

Suppose it is necessary to evaluate the applicant, who is known to have higher education and is hardworking. After entering these certificates data, we will have (Figure 3):

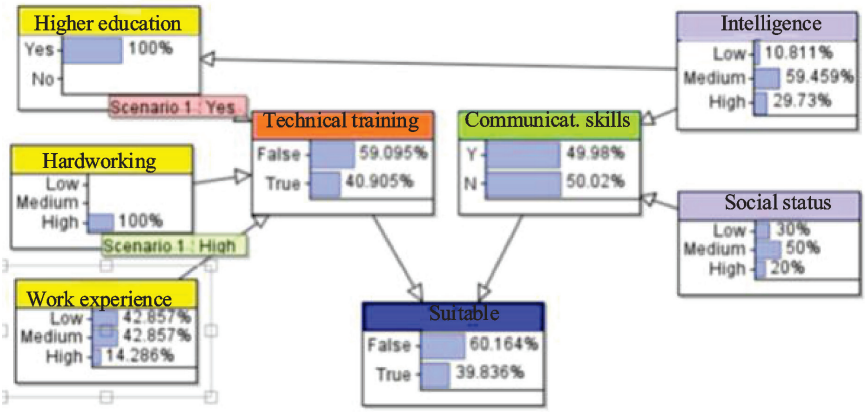

Figure 3. Probability dependence

The data for the nodes will take the following values:

With a probability of 100%, the applicant has a higher education.

With a probability of 100%, the applicant is hardworking.

With a probability of 40.9%, the applicant has the necessary technical training.

With a probability of 50% the applicant communication skills.

With a probability of 39.8%, the applicant is suitable for the vacant position.

Conclusion. Thus, this study shows some possibilities of applying the Bayesian network using the training model Rabota. The results of the study show the prospects of using Bayesian networks to solve problems with uncertainties. The model proposed in the paper reflects the initial stage of the study of this problem. In the process of studying the problem and using the results, the model can be supplemented with new personality characteristics and other indicators.

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Mamyrbayev O.Zh., PhD, e-mail: morkenj@mail.ru
Litvinenko N.G., holder of a master's degree, e-mail: n.litvinenko@inbox.ru
Shayakhmetova A.S., PhD, e-mail: asemshayakhmetova@mail.ru
Sultangazieva A.N., senior Lecturer, e-mail: anara77777@mail.ru
Turdalyuly M., junior research scientist*, e-mail: mkt_001@mail.ru*