

Cloud technologies for basics of artificial intelligence study in school

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Abstract. Changes in society related to the development of science, technology, computing power, cloud services, artificial intelligence, increasing general access to huge amounts of open data, lead to increased global investment in technology and services. Appropriate training is required by specialists to create a workforce to work with artificial intelligence. On the one hand, it puts forward new requirements for the training of young people, and educational content, on the other hand, provides opportunities for the use of cloud technologies during the educational process. Widespread use of AI in various fields and everyday life poses the task of understanding the basic terms related to Artificial intelligence (AI), such as Machine learning (ML), Neural network (NN), Artificial neural networks (ANN), Deep Learning, Data Science, Big Data, mastering the basic skills of using and understanding the AI principles, which is possible during the study in the school course of computer science. Cloud technologies allow you to use the power of a remote server (open information systems, digital resources, software, etc.) regardless of the location of the consumer and provide ample opportunities for the study of artificial intelligence. In this article we reveal the possibilities of cloud technologies as a means of studying artificial intelligence at school, consider the need for three stages of training and provide development of tasks and own experience of using cloud technologies to study artificial intelligence on the example of DALL-E, Google QuickDraw, cloud technologies Makeblock, PictoBlox, Teachable Machine at different stages of AI study.

Keywords: artificial intelligence, cloud technologies, school, education, education applications, informational computer technologies

1. Problem statement

The Stanford Institute for Human-Centered Artificial Intelligence (HAI) published its Artificial Intelligence Index (AI) in 2021 [27]. According to their findings, the demand for labor with artificial intelligence has increased significantly. During the pandemic, which has been going on for two years, global investments in the development of the artificial intelligence industry

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have increased by 40%. The world leaders are the United States and China, whose investments are more than 80% of investments in AI and blockchain development [20]. This attention is due to the automation of processes, the use of artificial intelligence in business can increase its efficiency, save time and human resources. Over the past 10 years, the number of AI-related research has increased from 14.2% to about 23% as of 2019. Among the research, there are publications with keywords about the ethics of artificial intelligence.

Such growth is facilitated by: powerful computing solutions, the development of cloud services and access to a huge amount of open data. Despite fears, frustrations, misunderstandings and “winter” in AI research, the level of acceptance of artificial intelligence is increasing rapidly. Canada published the world’s first national AI strategy in 2017. More than 30 other countries and regions have published similar documents as of December 2020. At the same time, humanity has come to understand the risks posed by the AI introduction. Therefore, countries are beginning to introduce regulatory documents that will help limit its use. For example, China and Shat California have introduced a law to punish people for misleading people with Deep Fake technology: any videos or photos that carry manipulation or misinformation must be labeled accordingly. In mid-April 2021, the European Commission published a Regulation draft governing the use of artificial intelligence [16]. The Regulation applies a risk-based approach, distinguishing between the AI use which creates:

- *Unacceptable risk* – includes all those AI systems that have significant potential for manipulating people through subconscious techniques beyond their consciousness, or exploiting the vulnerabilities of certain vulnerable groups, such as children or people with disabilities, in order to significantly distort their behavior in such a way that may cause them or other psychological or physical harm to the person. It also includes AI-based scores for general purposes, real-time biometric identification systems in public places, etc.
- *High risk* – systems that pose a high potential risk to the health and safety or fundamental rights of individuals. In particular, these are technologies used in medicine, justice, employment.
- *Low or minimal risk* – about tools such as chat bots, spam filters, music recommendations, etc.

The main issue is users’ understanding they are interacting with the machine, not the person.

It is not entirely clear to what extent this will affect the scope of AI. It will allow to form the rules on which AI further development will be based. It will also help to adequately assess not only the benefits but the risks of such systems using.

Ukraine is moving in this direction. The Association for the Development of Artificial Intelligence has developed and submitted to the government for approval the concept of the development of artificial intelligence in Ukraine until 2030. In December 2020, the government approved the concept [5]. The main directions of the Concept include:

- improvement of secondary, higher education and advanced training in order to train qualified professionals in the artificial intelligence;
- stimulating research in the field, in particular through grants;

- stimulation of entrepreneurship in the AI, as well as the development of personnel retraining method who may lose their jobs due to automation in 5–10 years;
- work to increase the cyber security level, improve legislation in the cyber security;
- application of artificial intelligence technologies in the defense and public administration;
- solving problems of state registers;
- use of AI in justice, in particular to prevent dangerous phenomena through analysis of available data.

It is also about developing of a legal framework for the AI use in accordance with international standards. The concept covers nine areas of artificial intelligence application, one of which is education.

Digital literacy, improvement of educational and methodical base and preparation of qualified personnel for work with AI are the main tasks facing education. Digital literacy primarily refers to the use of digital tools for solving applied problems, searching for information on the Internet, protection of personal data, media literacy, etc.

2. Research questions

People use artificial intelligence without even realizing it. Every industry already has tools that use artificial intelligence technology. Examples include Google Intelligent Search, contextual advertising, mobile applications such as Reface, smart assistants (such as Siri and Alexa), disease prediction tools, drone production, optimized, personalized treatment recommendations, talk bots for marketing and service of customers, stock trading advisors, e-mail spam filters, social media monitoring tools for dangerous content or false news, song or TV show recommendations from Spotify and Netflix, and more.

Therefore, there is a need to consciously use this tool and expand its scope. One way is to learn the basics of AI in the curricula of schools, universities for future teachers, as well as in informal education. It raises the question of using available tools to learn the AI basics. Most of the current developments are in the form of cloud resources. Therefore, the purpose of this article is to review of existing AI basics training programs and identify available cloud tools for studying AI performance.

3. Related work

Such areas as data science, artificial intelligence, machine learning, deep learning, distributed and quantum computing have been considered only as hobbies by some interested educators, or as a specific area of research of algorithms, mathematical statements. However, most countries are already preparing to introduce the study of such topics in school education. In 2019, the Association for the Promotion of Artificial Intelligence (AAAI) and the Association of Computer Science Teachers (CSTA) created recommendations for study of artificial intelligence in schools [25]. It emphasizes the reasons underlying the introduction of artificial intelligence study in schools. Among them: the growing role of intellectual assistants and autonomous mechanisms in society. AI technologies are supported by government strategies. AI causes a

decrease in demand in some professions and increase in others, the need for skilled workers knowledgeable in artificial intelligence. The document defines what students should know and do studying artificial intelligence throughout their education from primary school to senior age. Researchers have also developed an online catalog of resources that teachers can use. The authors identify five problematic issues that may underlie the study of artificial intelligence: perception (speech recognition, computer vision), presentation and reasoning (path planning, web search, and strategy in games), machine learning (recognition, preferences, and translation), natural interaction with intellectual agents (Alexa and Siri assistants, adaptive education), social impact of AI (positive and negative impact, value of compromises, ethical issues). For each of the topics, examples of tasks are given and the knowledge and skills that students of a certain age should master are described.

At one of the AAAI conferences, the development of curricula for study of AI at school was presented. In particular, in 2020, Personal Robots Group at the MIT Media Lab, MIT STEP Lab, and Boston College presented the DAILY Workshop [6]. The program also included pilot partners, STEAM Ahead and BC College Bound. The course consists of four sections: AI Introduction, Supervised Machine Learning, GANs, AI and My Future. Each section contains explanations of basic concepts and exercises to better understand the work of artificial intelligence, neural networks and more.

Lin and Van Brummelen [11] describe the experience of conducting seminars in which teachers and researchers created lesson plans and AI concepts were embedded in various core subjects. They identified entry points in various subjects (not computer science) for AI teaching.

The first step of curricula development to study the basics of artificial intelligence by students in Ukraine was the course “10-11 grade. Computer Science. Artificial Intelligence”, developed within the UNICEF program by Oksana Pasichnyk, Oleksiy Molchanovsky, Vyacheslav Osaulenko, Veronica Tamayo Flores [1]. It contains the adapted versions of the AI course and test materials.

The analysis of scientific publications on education in the artificial intelligence showed there is the majority of curricula are presented by universities in Ukraine in the form of textbooks and articles. In part, these curricula are presented in schools and lyceums that actively cooperate with universities or their teachers [10, 13, 21–23, 26]. It should be noted, in Ukraine study of artificial intelligence as an object was based on the use of expert systems as teaching aids. However, the current level of knowledge allows us to consider the tasks of direct training of artificial intelligence and expert systems: teaching, management, planning, monitoring, diagnostics, data interpretation, forecasting, designing [12].

Mokin [14] presents examples of solving real problems by machine learning methods for forecasting water quality in the Southern Bug River, forecasting the number of COVID-19 diseases, etc. These models are designed to be studied by graduate students and scientists involved in mathematical modeling and computational methods. In particular, master’s students of specialty 126 – Information Systems and Technologies of Vinnytsia National Technical University are working on it. In the author’s works there are many solutions to real problems by machine learning and artificial intelligence based on Kaggle’s own public laptops [15]. Also, these developments are successfully used by the author to teach high school students (10–11 grades of specialized schools).

4. Results

Widespread use of AI in various fields and everyday life poses the task of mastering the basic skills of its use and understanding the principles of work in the school study. Therefore, the question of defining basic terms is relevant. Transferring the simplest task into terms and analogies available to a particular age group is a separate task. Usually using the terms “artificial intelligence”, “machine learning”, “deep learning”, “neural networks” is often a substitution of concepts. Let’s define these concepts.

Artificial intelligence (AI) is a technological and scientific solution that helps to develop programs similar to the human mind that can think, recognize and self-learn. Machine learning (ML) are methods in the artificial intelligence, algorithms used to teach classification and clustering. It is due to the processing of large data sets and finding patterns in them. Neural networks (NN), Artificial neural networks (ANN) and deep learning works with complex data and fuzzy logic. Deep learning is one of the methods of machine learning. Data science are methods of data analysis for their further processing, sorting, sampling and search. It sets the correlation between data. Big Data – technologies of working with large data sets.

To begin the introduction of the study of artificial intelligence basics, it is necessary to meet the following conditions:

- setting tasks in terms and analogies that will be clear to a certain age group;
- selection of tools. It will ensure the task performance and the appropriate level of skills;
- development of learning course, content and determination of expected learning outcomes.

Among the tasks that can be set and solved with the help of AI is the development of smart systems that will help not only in business or office, but also at home. Smart systems can perform many tasks, from setting the alarm to turning the light on/off. Another task for AI is to collect data from different portals. With machine learning, you can apply different algorithms to the data to get it in the right shape. The task of obtaining recommendations based on what customers view or buy in the online store is also performed on the basis of AI machine learning. It will also help to make more profit for the business. When it comes to buying a product or service, visiting a website and using a helpline through an online chat or chat window is the norm in today’s online stores. This 24/7 help is only possible thanks to AI (Chat bot). Modern electronic dictionaries and search engines also use AI to translate text or issue search queries based on text or images. Some of these tasks can be considered in lessons in the form of simplified tasks. Examples:

1. Image recognizer. Using the platform, images of any object, such as a toy, are added to the database, and then, by expanding the detection of the human body and objects. It is raised to the camera, and the program detects the toy and names it.
2. Language recognizer. Design own intelligent chat bot with artificial intelligence. It is possible to create a chat bot that recognizes the language and converts it into text using the language recognition extension, and then accordingly this chat bot answers the questions.
3. Recognizer of the face or body parts. For example, developing of a visitation system based on face recognition. It can be, for example, a system of automatic door unlocking using face recognition.

4. Home automation based on artificial intelligence. Control devices with voice commands using artificial intelligence speech recognition technology.

To fulfill the first condition, we have established three stages of studying artificial intelligence in the school:

1. *Familiarity with the AI capabilities.* It is designed to create an idea of the AI functions, its importance in human life and in life or professional processes. The purpose is to get acquainted with the tasks that AI can solve, which it cannot, to establish the causes and consequences of errors in the work of AI. It will also be appropriate to consider the ethical issues that arise when using AI, such as data security and privacy.
2. *Construction of own machine learning programs in designers.* The aim is to get acquainted with the stages of building a recognition program, and the AI basic concepts: neural network, set date, data sampling, sample size, etc. At the same time, students acquire skills of creating a dataset, training the network, using the network.
3. *The transition to programming.* This stage involves the study of the mathematical foundations of neural networks and programming. In the previous stages, this mechanism was “hidden” from students by the functions of services. At this stage there is a detailed study of the neural network, the principles of its training, data set and their markup.

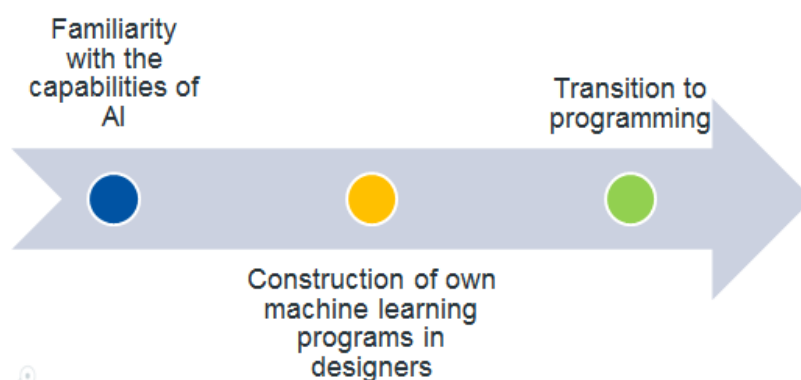


Figure 1: Stages of AI learning.

At the first stage there is an acquaintance with AI technology on examples of its use and basic terms mastering on this subject. There are a number of cloud services that help build the necessary knowledge and build interdisciplinary and integrated research. Such services are:

- DALL-E – a neural network called DALL-E that creates images from text captions for a wide range of concepts expressible in natural language [19]. It allows combining a variety of things that combine real and imaginary things. Students can be asked to choose text captions and discuss: Is this possible? How can this be created? How do others perceive it? What does it take to put this into practice, etc. (figure 2)
- Recognition of emotions is a separate topic of AI training. Scientists have launched a game to show how artificial intelligence recognizes emotions. They want to draw attention to



Figure 2: DALL-E combines the shape of the chair with the lotus root.

the problem of tracking a person [3, 8]. The game is available in the cloud and involves various tasks related to the recognition of emotions by artificial intelligence through a computer webcam. It has two stages. In the first you need to guess – in the picture a person squints at the rays of light or winks. In the second, you need to capture on camera each of the six emotions (Happiness, Sadness, Fear, Surprise, Disgust, Anger) so that the AI recognizes it. The first game shows how difficult it is for a person to determine the condition of another person by a static photo. The second is to train children's acting skills, whether AI will be able to determine your emotions. In class, it will be appropriate to discuss the ability to understand emotions. Even recognizing their own is not so easy. And to teach artificial intelligence to recognize our emotions is a task of the highest level (figure 3).

- The topic of images recognition can be considered on the example of Google QuickDraw [7, 18]. The software gives task to draw a particular object, and AI must guess what the user drew. It will be useful for learning to discuss the stages of creating and solving pictures. The system accompanies each stage of image construction by a voice. It is possible to track the dynamics of the AI approach to the correct answer. It is interesting to gradually analyze the image elements, which are clearly defined by the system for its identification. How many traits did it take to identify? How fast did the image system recognize? What and how many features are needed to recognize a cat, a dog, a person? Will the image be recognized from a non-standard point of view (top view, side view)? Why are there problems with the identification of people, animals, objects by intelligent



Figure 3: Software Emojifying.

systems, how to prevent it? What are the good/bad consequences of identification? (figure 4)

When the AI functionality is studied, it is possible to move on to the second stage – building your own machine learning programs in designers. You can use the following cloud technologies:

- Makeblock has five AI tools: mental services, machine learning, text-to-speech conversion, and translation (figure 5).
- PictoBlox [2] has tools for Computer Vision, Face Recognition, Optical Character Recognition, Language Recognition, Machine Learning, Ethics in AI, Internet of Things (figure 6).
- Teachable Machine – a service from Google [24]. It can recognize images, voice commands, human movements (figure 7).

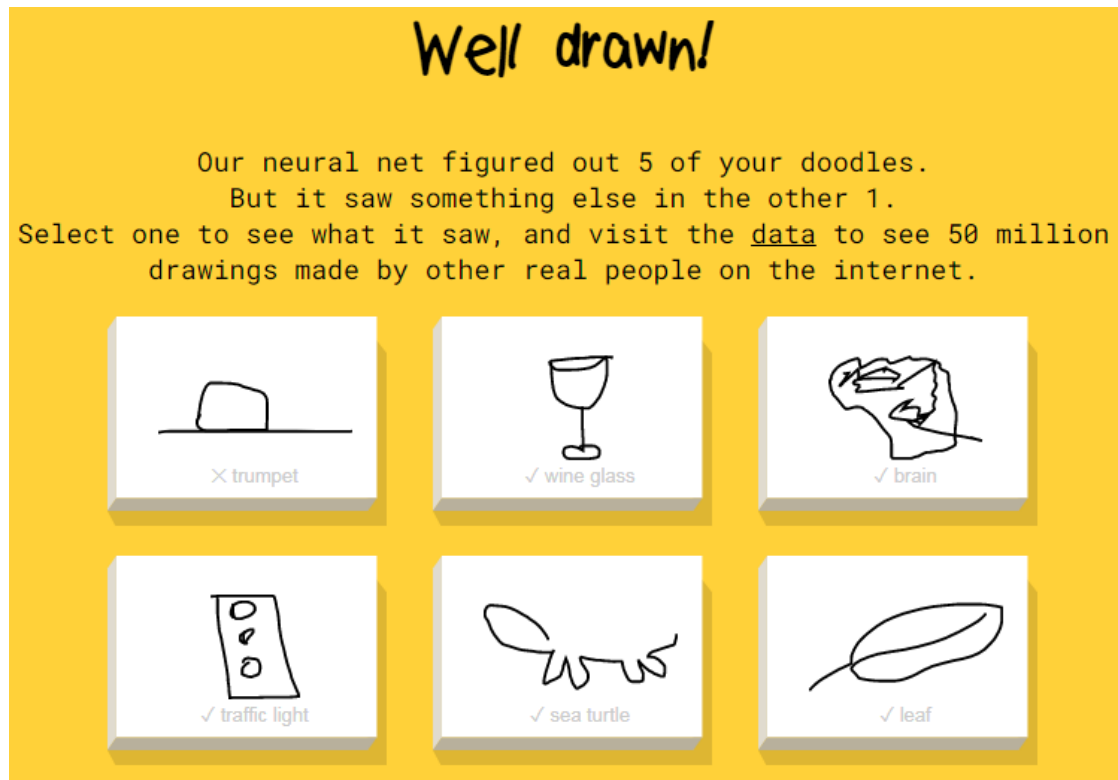


Figure 4: Results of QuickDraw.

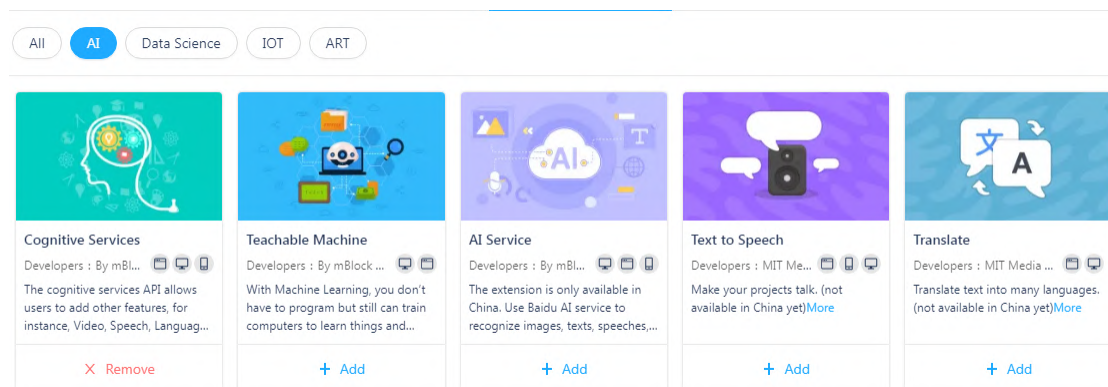


Figure 5: AI tools.

All these services are free and can be used during the lesson. The only requirement is sufficient power of the device to stream video. Also, these resources work in the same way: first you need to collect a dataset of images, then teach, then use for recognition (figure 8).

These services are suitable for the second stage of training. They allow creating a full-featured program without a deep knowledge of the mathematical foundations of AI and programming.



Figure 6: PictoBlox screens.

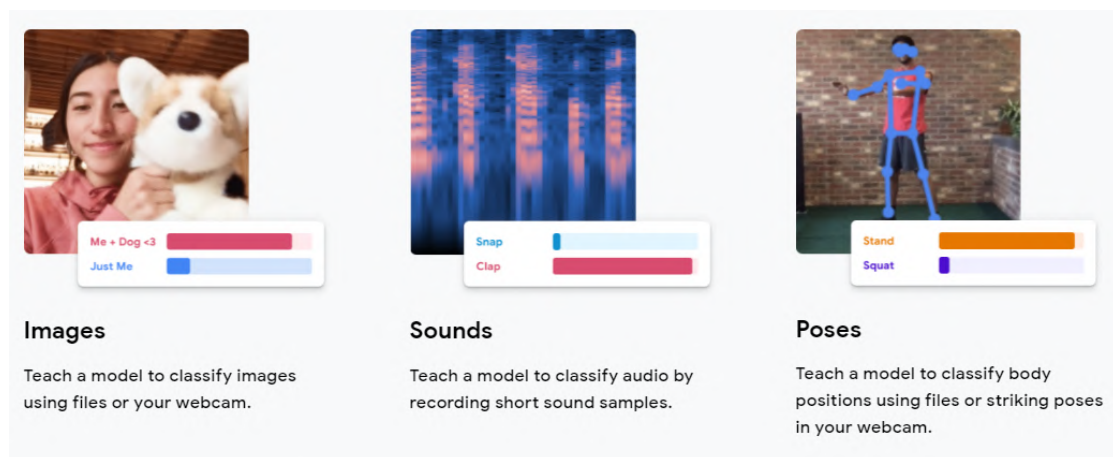


Figure 7: Teachable Machine capabilities.

At this stage, students gain an understanding of the network training process, understand the importance of the dataset and the size of the data sample.

The third training stage is the transition to programming. It is aimed at mastering the fundamentals of algorithmization and programming [10, 22]. Kaggle is a platform for analytics and predictive modeling competitions [4, 9, 17] can be used to support this stage (figure 9). On the platform you can create your own laptops with algorithms and participate in competitions on big data.

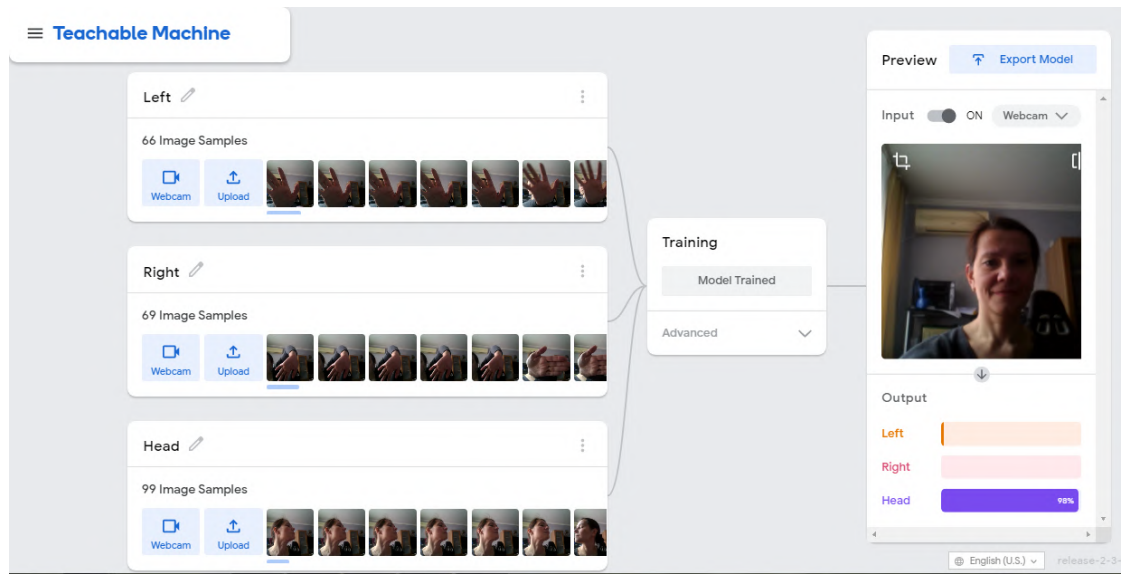


Figure 8: The example of the image recognition system learning.

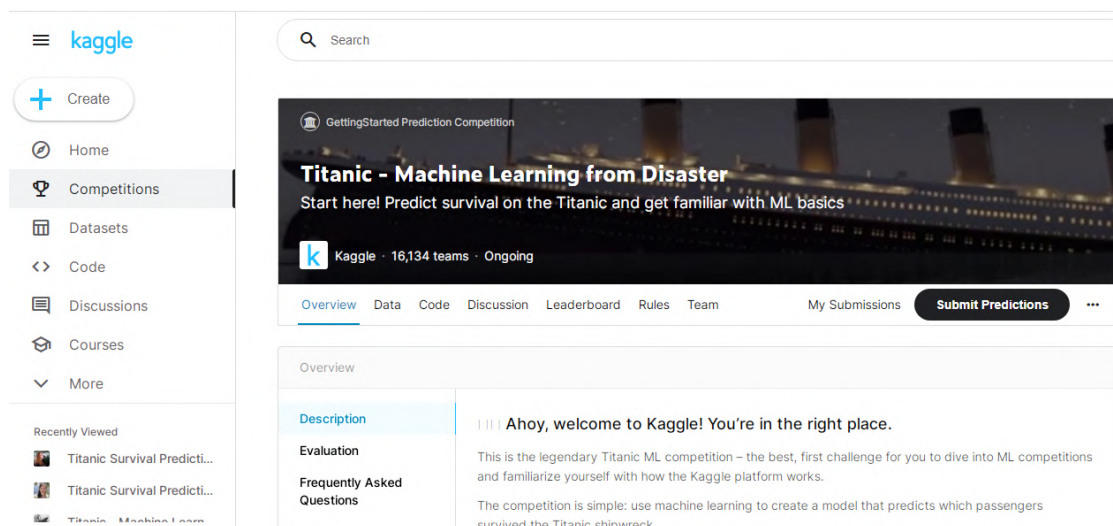


Figure 9: The start page of the competition “Titanic - Machine Learning from Disaster”.

5. Conclusions and prospects for further research

Technologies are changing and countries are trying to anticipate their development and regulate them by standards. It also forces the economy to move in the extensional direction of development and to look for workers who are knowledgeable in technology and technologically literate. It does not mean the ability to “program”. It means understanding the principles of operation and using technology as effectively as possible. In examples of daily activities, we see

manifestations of chatbots, neural networks, machine learning. So far, these technologies are in a disparate state. But in the future we expect their integration and interaction – the development of so-called “strong intelligence” [1]. Being able to recognize their work, know the principles of their operation, predict the consequences of use, consciously use – this is a non-exhaustive list of what should be able to a person familiar with the technologies of artificial intelligence. Our task was to consider the available cloud resources that allow classes for students of different ages and for different classes, not only computer science. We also found that some of these tools are fairly easy to use and can be used as a means of generating tasks in classes in art, ethics, literature and other school subjects that are not related to the natural sciences. So, cloud technologies allow to form technological literacy in children of an early school age. The knowledge formation in fundamental subjects requires a more formalized approach and performance of tasks on large data sets. There are resources allowed to consider the construction and operation of artificial intelligence algorithms. Their analysis and development of a course for the study of artificial intelligence for adolescents, the purpose of our next research.

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