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«СИБИРСКИЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ»

А.А. Ворошилова

Учебно-методическое пособие

Современные проблемы кибернетики (на английском языке)

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Курс предназначен для студентов, область академических или профессиональных интересов которых включает информатику, программирование, системный анализ и т.д. Английский язык для специальных целей, содержащийся в учебнике, дает учащимся возможность успешно развивать свои знания профессионального английского языка, что достигается за счет соответствия национальным и международным академическим стандартам, профессиональным требованиям и личным потребностям студентов.

Проект реализуется победителем грантового конкурса для преподавателей магистратуры 2021/2022 Стипендиальной программы Владимира Потанина.

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ВВЕДЕНИЕ

Разработанное пособие является методической для обучения магистров направления 09.04.04.03 Программная инженерия и кибернетика по курсу «Современные проблемы кибернетики (на английском языке)».

Целью изучения дисциплины «Современные проблемы кибернетики (на английском языке)» является формирование навыков применения методов классической кибернетики к задачам программной инженерии.

Изучение дисциплины «Современные проблемы кибернетики (на английском языке)» позволяет сформировать у магистров компетенции, необходимые для успешного решения актуальных на сегодня задач, связанных с созданием и эксплуатацией сложных самоадаптируемых и масштабируемых программных систем.

Курс включает разделы:

1. Обзор существующих работ в области программной кибернетики, классификация ее основных задач, проблем и направлений
2. Определение и изучение структуры, магистральных направлений и текущих достижений программной кибернетики
3. Современные исследования в области кибернетики, дающие возможность контролировать сложность программной системы и наделять их адаптивными свойствами, делая тем самым более гибкими и эффективными
4. Анализ современных проектов по созданию и эксплуатации сложных самоадаптируемы х и масштабируемых программных систем
5. Кибернетика 2.0: основные тренды и перспективы развития

Проект реализуется победителем грантового конкурса для преподавателей магистратуры 2021/2022 Стипендиальной программы Владимира Потанина.

Новый онлайн курс "Современные проблемы кибернетики (на английском языке)" предназначен для магистрантов по направлению 09.04.04 - Программная инженерия, новая магистерская программа 09.04.04.03 - Программная инженерия и кибернетика, набор на которую начат в 2021 году.

Курс реализуется на платформе Е-курсы СФУ https://e.sfu-kras.ru/course/view.php?id=33133.

Курс рассчитан на 2 семестра, объемом 144 часа, включая 36 часов контактной работы с преподавателем и 108 часов самостоятельной работы. Целью курса является формирование навыков применения методов классической кибернетики к задачам программной инженерии.

Изучение дисциплины позволит сформировать у магистров компетенции, необходимые для успешного решения актуальных на сегодня задач, связанных с созданием и эксплуатацией сложных самоадаптируемых и масштабируемых программных систем.

Преподавание курса на английском языке позволит усовершенствовать навыки владения магистрантов английском языком в профессиональной сфере для общения с зарубежными коллегами, выступления на международных

научных конференциях и семинарах, публикации статей в рейтинговых журналах, индексируемых в цитатно-аналитических базах. Изучение курса предполагает чтение и анализ источников по кибернетике в оригинале, многие из которых написаны зарубежными авторами - основателями кибернетики. Самостоятельная работа студентов в разработанном курсе будет основана на интерактивных заданиях, что позволит стимулировать интерес к их прохождению.

Интерактивные лекции с вопросами на понимание материала, опросы, тестовые задания позволят студентам получать обратную связь в реальном времени, проходить курс в удобное и свободное от работы время. Элемент Wiki в курсе позволит студентам создавать групповые страницы на английском языке, подобные разработке сайтов, что особенно важно для магистрантов по программной инженерии. Живое общение через онлайн платформы для проведения вебинаров, с одной стороны, позволит совершенствовать навыки разговорного английского языка, а, с другой стороны, даст возможность подготовиться к выступлениям на английском языке онлайн, освоить современные способы онлайн общения.

Unit 1. REVIEW OF EXISTING WORKS IN THE FIELD OF SOFTWARE CYBERNETICS, CLASSIFICATION OF ITS MAIN TASKS, PROBLEMS AND DIRECTIONS

*The section is devoted to the discussion of what you already know about **cybernetics**. We will discuss what cybernetics is. We will know about Norbert Winer and Wiener's cybernetics. We will read about different types of cybernetics and basics of cybernetics. We will know about the **history of cybernetics** and about famous scientists who were founders of cybernetics.*

Task 1. What do you already know about cybernetics?

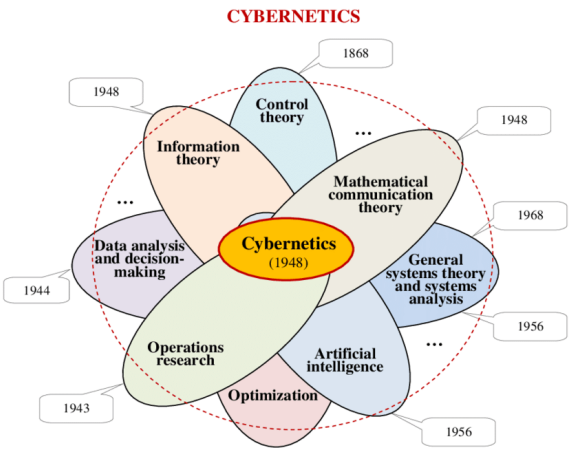
Let's discuss what you already know about cybernetics and what you think about this course. Choose two questions and write your answers to them.

1. What interesting facts can you give about cybernetics?
2. Give your definition of "cybernetics" and explain what you mean by it.
3. What do you know about the history of cybernetics?
4. Do you see any sense in studying this subject in the English language?

Task 2. What is cybernetics?

Basing on the video write a short answer of 200-250 words (not more than 250 words) answering one question from the ones given below. You can use any additional material from the Internet to help you.

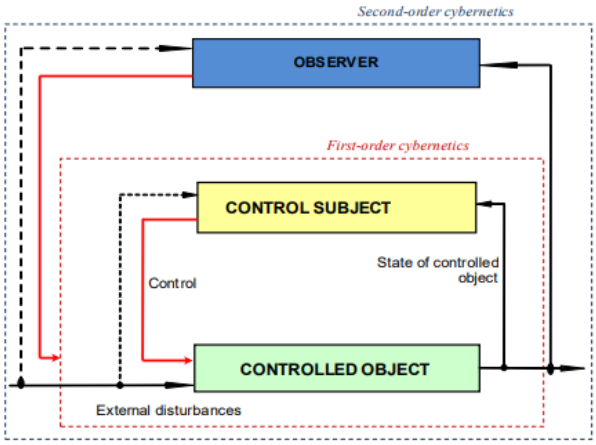
1. The origin of words "cybernetics" and "control"
2. The father of cybernetics
3. Ross Ashby and cybernetics
4. Sciences in foundation of cybernetics
5. Cybernetica is behind every aspect of the digital era
6. The heros of cybernetics
7. Cybernetics is everywhere
8. The "cyber" prefix
9. Cybernetics has changed the world in less than 70 years



Task 3. Cybernetics of Cybernetics and Other Types of Cybernetics.

Read the lecture and answer the questions.

In addition to Wiener's classical cybernetics, the last 50+ years yielded other types of cybernetics declaring their connection with the former and endeavoring to develop it further. No doubt, the most striking phenomenon was the appearance of second-order cybernetics (cybernetics of cybernetics, metacybernetics, new cybernetics; here "order" corresponds to "reflexion rank"). Cybernetics of cybernetic systems is associated with the names of M. Mead, G. Bateson and H. Foerster and puts its emphasis on the role of subject/observer performing control (see Fig. below). The central concept of second-order cybernetics is an observer as a subject refining the subject from the object (indeed, any system is a "model" generated from reality for a certain cognitive purpose and from some point of view/abstraction).



Question 1: Right or Wrong: In addition to Wiener's classical cybernetics, one of the most striking phenomena was the appearance of second-order cybernetics (cybernetics of cybernetics, metacybernetics, new cybernetics).

H. Foerster noted that "a brain is required to write a theory of a brain. From this follows that a theory of the brain, that has any aspirations for completeness, has to account for the writing of this theory. And even more fascinating, the writer of this theory has to account for her or himself. Translated into the domain of cybernetics; the cybernetician, by entering his own domain, has to account for his or her own activity. Cybernetics then becomes cybernetics of cybernetics, or second-order cybernetics."

In contrast to Wiener's cybernetics, second-order cybernetics possesses *the conceptual-philosophical character* (for a mathematician or engineer, it is demonstrative that all publications on second-order cybernetics contain no formal models, algorithms, etc.).

In fact, this type of cybernetics "transmits" the complementarity principle (with insufficient grounds) from physics to all other sciences, phenomena and processes. Moreover, a series of works postulated that any system must have positive feedback loops amplifying positive control actions. But any expert in control theory knows the potential danger of such loops for system stability!

Question 2. Which statement is wrong?

1. H. Foerster noted that "a brain is required to write a theory of a brain.

2. In contrast to Wiener's cybernetics, second-order cybernetics possesses the conceptual-philosophical character (for a mathematician or engineer, it is demonstrative that all publications on second-order cybernetics contain no formal models, algorithms, etc.).
3. In addition to Wiener's cybernetics, second-order cybernetics possesses the conceptual-philosophical character (for a mathematician or engineer, it is demonstrative that all publications on second-order cybernetics contain no formal models, algorithms, etc.).

The "biological" stage in second-order cybernetics is associated with the names of H. Maturana and F. Varela and their notion of autopoiesis (self-generation and self-development of systems). F. Varela underlined that "first-order cybernetics is the cybernetics of observed systems; second-order cybernetics is the cybernetics of observing systems." The latter focuses on feedback of a controlled system and an observer.

Therefore, the key terms of second-order cybernetics are recursiveness, self-regulation, reflexion, autopoeisis. For a good survey of this direction, we refer to P. Asaro who believed that there exist three interpretations of cybernetics (actually, we have mentioned the first two above):

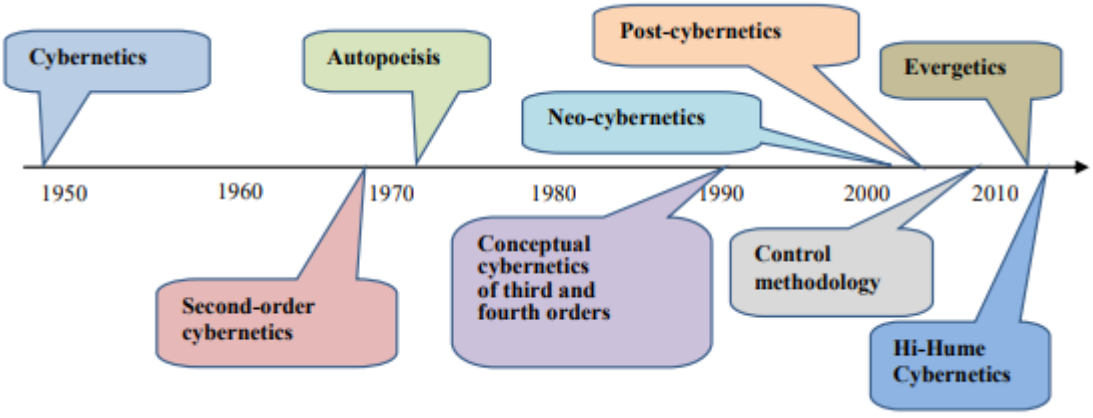
1) the narrow interpretation, i.e., a science studying feedback control;

2) the wide interpretation, i.e., "cybernetics is all the things, and we live in the Century of Cybernetics";

3) the intermediate (epistemological) interpretation, i.e., second-order cybernetics (an emphasis on feedback of a controlled system and an observer).

However, the historical picture has appeared much more colorful and diverse, not confining to the second order – see the Fig. below.

Some authors adopt the terms "third-order cybernetics" (social autopoeisis; second-order cybernetics considering autoreflexion) and "fourth-order cybernetics" (third-order cybernetics considering observer's system of values), but they are conceptual and still have no generally accepted meanings. For instance, V. Lepsky wrote: "Third-order cybernetics can be formed basing on the thesis "from observing systems to self-developing systems." In this case, control is gradually transformed into a wide spectrum of support processes for system self-development, namely,



social control, stimulation, maintenance, modeling, organization, "assembly/disassembly" of subjects and others."

Question 3. Choose the correct answer:

The "biological" stage in second-order cybernetics is associated with the names of:

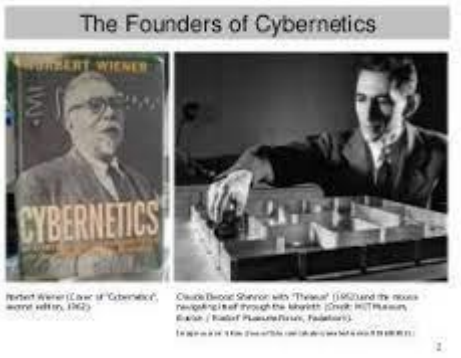
a) H. Maturana and F. Varela
b) P. Asaro and V. Lepsky

Question 4. Match three interpretations of cybernetics with their names:

1. the narrow interpretation	a) a science studying feedback control
2. the wide interpretation	b) "cybernetics is all the things, and we live in the Century of Cybernetics"
3. the intermediate (epistemological) interpretation	c) second-order cybernetics (an emphasis on feedback of a controlled system and an observer)

Task 4. The Formers of Cybernetics

Read the text and be ready to discuss it.



Cybernetics is the discipline that studies communication and control in living beings and the machines built by a man. A more philosophical definition, suggested by Louis Couffignal in 1958, considers cybernetics as "the art of assuring efficiency of action". The word cybernetics was reinvented by Norbert Wiener in 1948 from the Greek 'κυβερνητικος' (kubernetes) meaning "steersman" or "ship pilot". The word was first used by Plato in the Laws to refer to the "the art of steering" or "the art of government". Ampère used the word cybernetics to denote "the study of ways of governing". One of the very first cybernetics mechanisms to control the speed of the steam engine, invented by James Watt and Matthew Boulton in 1788, was called a governor, or a ball regulator. Cybernetics has in fact the same root as government: the art of managing and directing highly complex systems.

The first paper to bring together the central concepts of cybernetics was one written by the British psychiatrist W. Ross Ashby in 1940. There he outlines a theory of how a concrete physical mechanism can exhibit adaptive properties once thought only to be abstract properties held by living, thinking beings. His theory is based on the concept of homeostasis developed by the physiologist Walter Cannon (1932) to explain the biological mechanisms which maintain vital balances within an

organism, such as the regulation of blood pressure, blood sugar, and body temperature.

Ashby's idea is that a mechanism which can alter its internal configurations can do a random search for a configuration which achieves some desired 'goal'. The objective of an organism is to maintain a vital quantity in a stable equilibrium, like body temperature, by a complex set of mechanisms such as sweating and shivering. For a machine, the goal is to keep the values of certain "essential variables" within a desired range, and when these fall outside that range, to randomly vary the non-essential variables it can control until the values of the essential variables are restored. He called this mechanism of trial and error a "functional circuit" because it responded to its own success or failure, but later recognized it to be identical to the concept of feedback.

The theory thus offers a way to explain learning and biological adaptation, in terms of a single type of physical mechanism. In 1947, Ashby built an analogue computer to demonstrate his idea. Called the Homeostat, it consisted of four interconnected units which sought to establish a pattern of electrical currents between them such that the whole ensemble would resist various external disturbances. The model of a goal-directed search which it embodied has become central in Artificial Intelligence.

However, the birth of cybernetics is often dated back to 1943, with the publication of two foundational papers in the U.S.: Rosenblueth, Wiener and Bigelow's "Behaviour Purpose and Teleology" and Warren McCulloch and Walter Pitts' "A Logical Calculus of the Ideas Immanent in Nervous Activity".

In 1940 Wiener worked with a young engineer, Julian H. Bigelow, to develop automatic range finders for antiaircraft guns. During the course of their work Wiener and Bigelow were struck by two astonishing facts: the seemingly "intelligent" behaviour of these machines and the "diseases" that could affect them. Theirs appeared to be "intelligent" behaviour because they dealt with "experience" (the recording of past events) and predictions of the future. There was also a strange defect in performance: if one tried to reduce the friction, the system entered into a series of uncontrollable oscillations.

Impressed by this disease of the machine, Wiener asked Rosenblueth whether such behaviour was found in man. The response was affirmative: in the event of certain injuries to the cerebellum, the patient cannot lift a glass of water to his mouth; the movements are amplified until the contents of the glass spill on the ground. From this Wiener inferred that in order to control a finalized action (an action with a purpose) the circulation of information needed for control must form "a closed loop allowing the evaluation of the effects of one's actions and the adaptation of future conduct based on past performances". Thus, Wiener and Bigelow discovered the closed loop of information necessary to correct any action – the negative feedback loop – and they generalised this discovery in terms of the human organism.

During this period the multidisciplinary teams of Rosenblueth were being formed and organized. Their purpose was to approach the study of living organisms from the viewpoint of a servomechanisms engineer and to consider servomechanisms with the experience of the physiologist. An early seminar at the

Institute for Advanced Study at Princeton in 1942 brought together mathematicians, physiologists, and mechanical and electrical engineers. One man working with Rosenblueth in getting these seminars under way was the neurophysiologist Warren McCulloch, who was to play a considerable role in the new field of cybernetics. In 1948 two basic publications marked an epoch already fertile with new ideas: Norbert Wiener's Cybernetics, or Control and Communication in the Animal and the Machine, and The Mathematical Theory of Communication by Claude Shannon and Warren Weaver. The latter work founded information theory.

The ideas of Wiener, Bigelow, and Rosenblueth caught fire like a trail of powder. At the conclusion of the work of his group on the organization of the cortex of the brain, and especially after his discussions with Walter Pitts, a brilliant, twenty-two-year-old mathematician, McCulloch understood that a beginning of the comprehension of cerebral mechanisms (and their simulation by machines) could come about only through the cooperation of many disciplines. McCulloch himself moved from neurophysiology to mathematics, from mathematics to engineering.

Answer and discuss the following questions.

1. Outline the main issues of the British psychiatrist W.Ross Ashby's theory based on the concept of 'homeostasis'. What did it explain?
2. What papers were published in 1943? Why are they considered as fundamental?
3. What facts were N.Wiener and Julian H. Bigelow struck by?
4. What functions of the closed loop of information were discovered by Wiener and Bigelow?
5. What can you say about Warren McCulloch and his essential work?

Task 5. The Formers of Cybernetics.

Read the text below and find the words that mean the same as the words and phrases below.

a) the tendency toward a relatively stable equilibrium between interdependent elements, especially as maintained by physiological processes (paragraph 2);
b) information about reactions to a product, a person's performance of a task, etc., used as a basis for improvement (paragraph 3);
c) a form of computer that uses the continuously changeable aspects of physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved. (paragraph 4);
d) movement back and forth at a regular speed (paragraph 6);
e) the part of the brain which function is to coordinate and regulate muscular activity (paragraph 7);
f) an automatic device that uses error-sensing negative feedback to correct the performance of a mechanism and is defined by its function (paragraph 8);
g) the outer layer of the brain, composed of folded grey matter and playing an important role in consciousness (paragraph 9).

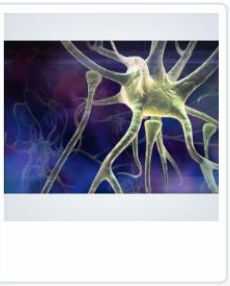
1. Cybernetics is the discipline that studies communication and control in living beings and the machines built by a man. A more philosophical definition, suggested by Louis Couffignal in 1958, considers cybernetics as "the art of assuring efficiency of action". The word cybernetics was reinvented by Norbert Wiener in 1948 from the Greek ‘κυβερνητικος’ (kubernetes) meaning "steersman" or "ship pilot". The word was first used by Plato in the Laws to refer to the "the art of steering" or "the art of government". Ampère used the word cybernetics to denote "the study of ways of governing". One of the very first cybernetics mechanisms to control the speed of the steam engine, invented by James Watt and Matthew Boulton in 1788, was called a governor, or a ball regulator. Cybernetics has in fact the same root as government: the art of managing and directing highly complex systems.
2. The first paper to bring together the central concepts of cybernetics was one written by the British psychiatrist W. Ross Ashby in 1940. There he outlines a theory of how a concrete physical mechanism can exhibit adaptive properties once thought only to be abstract properties held by living, thinking beings. His theory is based on the concept of homeostasis developed by the physiologist Walter Cannon (1932) to explain the biological mechanisms which maintain vital balances within an organism, such as the regulation of blood pressure, blood sugar, and body temperature.
3. Ashby’s idea is that a mechanism which can alter its internal configurations can do a random search for a configuration which achieves some desired ‘goal’. The objective of an organism is to maintain a vital quantity in a stable equilibrium, like body temperature, by a complex set of mechanisms such as sweating and shivering. For a machine, the goal is to keep the values of certain "essential variables" within a desired range, and when these fall outside that range, to randomly vary the non-essential variables it can control until the values of the essential variables are restored. He called this mechanism of trial and error a "functional circuit" because it responded to its own success or failure, but later recognized it to be identical to the concept of feedback.
4. The theory thus offers a way to explain learning and biological adaptation, in terms of a single type of physical mechanism. In 1947, Ashby built an analogue computer to demonstrate his idea. Called the Homeostat, it consisted of four interconnected units which sought to establish a pattern of electrical currents between them such that the whole ensemble would resist various external disturbances. The model of a goal-directed search which it embodied has become central in Artificial Intelligence.
5. However, the birth of cybernetics is often dated back to 1943, with the publication of two foundational papers in the U.S.: Rosenblueth, Wiener and Bigelow’s "Behaviour Purpose and Teleology" and Warren McCulloch and Walter Pitts’ "A Logical Calculus of the Ideas Immanent in Nervous Activity".
6. In 1940 Wiener worked with a young engineer, Julian H. Bigelow, to develop automatic range finders for antiaircraft guns. During the course of their work

Wiener and Bigelow were struck by two astonishing facts: the seemingly "intelligent" behaviour of these machines and the "diseases" that could affect them. Theirs appeared to be "intelligent" behaviour because they dealt with "experience" (the recording of past events) and predictions of the future. There was also a strange defect in performance: if one tried to reduce the friction, the system entered into a series of uncontrollable oscillations.

7. Impressed by this disease of the machine, Wiener asked Rosenblueth whether such behaviour was found in man. The response was affirmative: in the event of certain injuries to the cerebellum, the patient cannot lift a glass of water to his mouth; the movements are amplified until the contents of the glass spill on the ground. From this Wiener inferred that in order to control a finalized action (an action with a purpose) the circulation of information needed for control must form "a closed loop allowing the evaluation of the effects of one's actions and the adaptation of future conduct based on past performances". Thus, Wiener and Bigelow discovered the closed loop of information necessary to correct any action – the negative feedback loop – and they generalised this discovery in terms of the human organism.
8. During this period the multidisciplinary teams of Rosenblueth were being formed and organized. Their purpose was to approach the study of living organisms from the viewpoint of a servomechanisms engineer and to consider servomechanisms with the experience of the physiologist. An early seminar at the Institute for Advanced Study at Princeton in 1942 brought together mathematicians, physiologists, and mechanical and electrical engineers. One man working with Rosenblueth in getting these seminars under way was the neurophysiologist Warren McCulloch, who was to play a considerable role in the new field of cybernetics. In 1948 two basic publications marked an epoch already fertile with new ideas: Norbert Wiener's Cybernetics, or Control and Communication in the Animal and the Machine, and The Mathematical Theory of Communication by Claude Shannon and Warren Weaver. The latter work founded information theory.
9. The ideas of Wiener, Bigelow, and Rosenblueth caught fire like a trail of powder. At the conclusion of the work of his group on the organization of the brain cortex, and especially after his discussions with Walter Pitts, a brilliant, twenty-two-year-old mathematician, McCulloch understood that a beginning of the comprehension of cerebral mechanisms (and their simulation by machines) could come about only through the cooperation of many disciplines. McCulloch himself moved from neurophysiology to mathematics, from mathematics to engineering.

Task 6. Foundations of cybernetics.

Choose description for every picture.


A *B* *C* *D*
E

1) Self-regulated systems 2) Feedback mechanisms 3) Complex systems organization
4) Information transfer 5) Neurophysiological principals

Task 6. Pioneers of Cybernetics.

Complete the table about pioneers of cybernetics

Name	Period	Main achievements

Task 7. Norbert Wiener, the Father of Cybernetics.

Read the article. Five parts of sentences have been removed from the text. Put the correct sentence from A–F below in each space (1–5) to form a logical text. There is one extra item you don't need.

Norbert Wiener (November 26, 1894 – March 18, 1964) was an American mathematician and philosopher. He was Professor of Mathematics at MIT. (_____1) , Wiener later became an early researcher in stochastic and noise processes, contributing work relevant to electronic engineering, electronic communication, and control systems. Wiener is considered the originator of cybernetics, a formalization of the notion of feedback, with implications for engineering, systems control, computer science, biology, neuroscience, philosophy, and the organization of society.

Norbert was educated by his father at home until 7 years of age. After graduating from High School in 1906 at 11 years, Wiener entered Tufts College where he was awarded a BA in mathematics at the age of 14, whereupon he began

graduate studies of zoology at Harvard. In 1910 he transferred to Cornell to study philosophy. Harvard awarded Wiener a Ph.D. in 1912, when he was merely 17 years old, for a dissertation on mathematical logic, where he was the first to state that ordered pairs can be defined in terms of elementary set theory.

In 1914, Wiener travelled to Europe, (_____2) , and by David Hilbert and Edmund Landau at the University of Göttingen.

During 1915–16, he taught philosophy at Harvard, then was an engineer for General Electric and wrote for the Encyclopaedia Americana. He was briefly a journalist for the Boston Herald. Although Wiener eventually became a staunch pacifist, he eagerly contributed to the war effort in World War I. He tried to join the military, but the government again rejected him due to his poor eyesight. After the war Wiener became an instructor of mathematics at MIT, where he spent the remainder of his career, becoming promoted eventually to Professor. In 1926, Wiener returned to Europe as a Guggenheim scholar. He spent most of his time at Göttingen and with Hardy at Cambridge, (_____3).

Many tales were told of him at MIT, especially concerning his absent-mindedness. It was said that he returned home once to find his house empty. He inquired of a neighbourhood girl the reason, and she said that the family had moved elsewhere that day. He thanked her for the information and she replied, "That's why Istayed behind, Daddy!"

During World War II, his work on the automatic aiming and firing of anti-aircraft guns caused Wiener to investigate information theory independently of Claude Shannon and to invent the Wiener filter. His anti-aircraft work eventually led him to formulate cybernetics. After the war,
his fame helped MIT to recruit a research team in cognitive science, (_____ 4), including Warren Sturgis McCulloch and Walter Pitts.

These men later made pioneering contributions to computer science and artificial intelligence. Soon after the group was formed, Wiener suddenly ended all contact with its members, mystifying his colleagues.

Wiener later helped to develop the theories of cybernetics, robotics, computer control, and automation. He discussed the modelling of neurons with John von Neumann. After the war, Wiener became increasingly concerned with what he believed was political interference with scientific research, and the militarization of science. (_____5) to consider the ethical implications of their work. After the war, he refused to accept any government funding or to work on military projects.

A. a famous child prodigy, the first kid of the Jews of Polish and German origin

B. his article "A Scientist Rebels" for the January 1947 issue of The Atlantic Monthly urged scientists

C. working on Brownian motion, the Fourier integral, Dirichlet's problem, harmonic analysis, and the Tauberian theorems

D. to be taught by Bertrand Russell and G.H. Hardy at Cambridge University

E. was trained actively and single-mindedly as a scholar

F. composed of researchers in neuropsychology and the mathematics and biophysics of the nervous system.

Answer the following questions.

1. What are the most essential stages in N.Wiener's educational process? Characterize each of them.
2. Which professions was N.Wiener engaged in?
3. How can the World War I period of N.Wiener's research be featured?
4. What were the key issues of N.Wiener's investigation during World War II?
5. What do you think caused N.Wiener's concern of the ethical implications of his work?

Task 8. Norbert Wiener, the Father of Cybernetics.

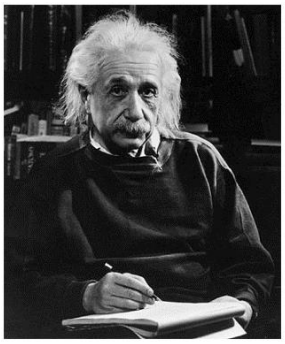
Define the most valuable facts of the birth of cybernetics. Make up a short list of some prominent cyberneticians' scientific achievements. Share your thoughts as for the following quotes and sayings:

The world of the future will be an even more demanding struggle against the limitations of our intelligence, not a comfortable hammock in which we can lie down to be waited upon by our robot slaves. – Norbert Wiener, the founder of cybernetics and artificial intelligence theory.

Control is as much an effect as a cause, and the idea that con- trol is something you exert is a real handicap to progress. – Steve Grand, A.I. researcher, developer of a robot orangutan called Lucy.

Your brain may give birth to any technology, but other brains will decide whether the technology thrives. The number of possible technologies is infinite, and only a few pass this test of affinity with human nature. – Robert Wright (one of the top 100 global thinkers) Nonzero: The Logic of Human Destiny.

It bears emphasizing: our traditional ways of thinking have ignored – and virtually made invisible – the relationship between people and technology. – Kim J. Vicente, a researcher in the field of human factors, the University of Toronto.



It would be possible to describe everything scientifically, but it would make no sense; it would be without meaning, as if you described a Beethoven symphony as a variation of wave pressure. – Albert Einstein, a theoretical physicist, the developer of the general theory of relativity.

Unit 2. DETERMINATION AND STUDY OF THE STRUCTURE, MAIN DIRECTIONS AND CURRENT ACHIEVEMENTS OF PROGRAM CYBERNETICS

This section is devoted to the structure of cybernetics, its main directions and current achievements. Control philosophy and control methodology will be studied. We will discuss main laws, regularities and principles of control.

Task 1. Cybernetics, Control Philosophy and Control Methodology

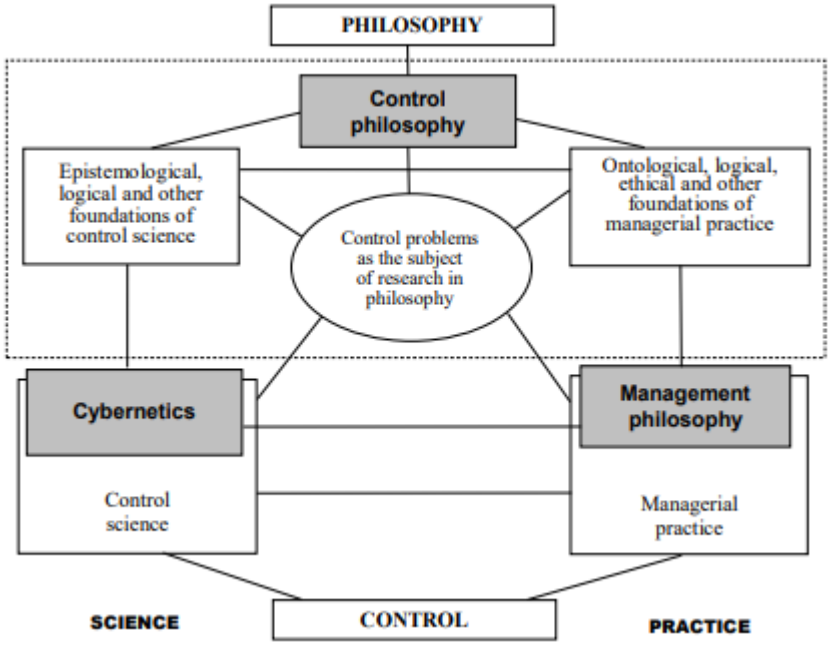
Read the text about Cybernetics, Control Philosophy and Control Methodology, then choose two of the topics in the forum and comment on the figures in them. Try to write the description of the figure using from 200 to 250 words.

Cybernetics, Control Philosophy and Control Methodology

Having reached a certain level of epistemological maturity, scientists perform "reflexion" by formulating general laws in corresponding scientific fields, i.e., create metasciences. On the other part, any "mature" science becomes the subject of philosophical research. For instance, the philosophy of physics appeared at the junction of the 19th century and the 20th century as the result of such processes. Originated in the 1850's, research in the field of control theory led to the appearance of other metasciences, i.e., cybernetics and systems analysis. Moreover, cybernetics quickly became the subject of philosophical investigations conducted by "fathers" of cybernetics and professional philosophers. The 20th century was accompanied with the rapid progress of management science as a branch of general control theory studying practical control in organizational systems. By the beginning of the 2000's, management science has engendered management philosophy. Books and papers entitled "Management Philosophy" and "Control Philosophy" appeared exactly at that time; as a rule, their authors represented professional philosophers. Generally speaking, one may acknowledge the long-felt need for more precise mutual positioning of philosophy and control, methodology and control, as well as analysis of general laws and regularities of complex systems functioning and control.

Historically (and similarly to the subjects of most modern sciences), control problems analysis was first the prerogative of philosophy. R. Descartes was used to say, "Philosophy is like a tree whose roots are metaphysics and then the trunk is physics. The branches coming out of the trunk are all the other sciences." R. Mirzoyan felt rightly that, on the basis of historical and philosophical analysis, first control/management theorists were exactly philosophers. Confucius, Lao-tzu, Socrates, Platon, Aristotle, N. Machiavelli, T. Hobbes, I. Kant, G. Hegel, K. Marx, M. Weber, A. Bogdanov–this is a short list of philosophers that laid down the foundations of modern control theory for the development and perfection of managerial practice. Consider Fig. below illustrating different connections between the categories of philosophy and control; they are treated in the maximal possible interpretation (philosophy includes ontology, epistemology, logic, axiology, ethics,

aesthetics, etc.; control is viewed as a science and a type of practical activity). We believe that the three shaded domains in Fig. below are the major ones.

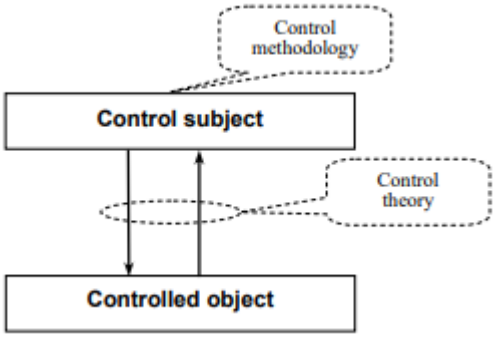


Presently, concrete control problems are no more the subject of philosophical analysis. Philosophy (as a form of social consciousness, the theory of general principles of entity and cognition, human attitude to the reality, as the science of universe laws of natural development) studies GENERAL problems and regularities separated out by experts in certain sciences. V. Diev believed that control philosophy is "a system of generalizing philosophical judgments about the subject and methods of control, the place of control among other sciences and in the system of scientific cognition, as well as about its cognitive and social role in a modern society."

One can define control philosophy as a branch of philosophy connected with comprehension and interpretation of control processes and control cognition, studying the essence and role of control. Such meaning of the term "control philosophy" has a rich internal structure and covers epistemological research of control science, the analysis of logical, ontological, ethical and other foundations (both for control science and managerial practice). Cybernetics (with capital C, as a branch of control science, studying its most general theoretical regularities). According to V. Diev, "... for many scientific disciplines, there exists a range of problems related to their foundations and traditionally referred to as the philosophy of a corresponding science. Control science follows this tradition, as well". Foundations of control science also include general regularities and principles of efficient control representing the subject of Cybernetics. In the 1970-1990's, against the background of first disillusions of cybernetics, the only bearers of canonical cybernetic traditions were philosophers (!), whereas experts in control theory lost their confidence in ample opportunities of cybernetics. Things can't carry on as they are.

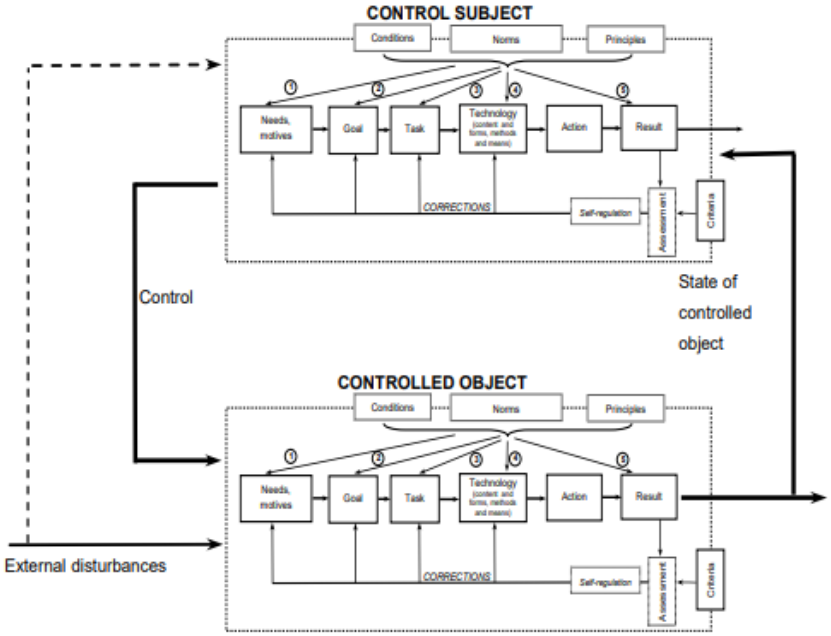
On the one hand, philosophers vitally need knowledge of the subject (actually, the generalized knowledge). In this context, V. Il'in mentioned that "philosophy represents secondrank reflexion; it provides theoretical grounds to other ways of spiritual production. The empirical base of philosophy consists in specific reflections of different types of cognition; philosophy covers not the reality itself, but the treatment of reality in figurative and category-logical forms.".

Methodology is the theory of activity organization. Accordingly, the subject of methodology is organization of an activity (an activity is a purposeful human action). Control activity represents a certain type of practical activity. Control



methodology is the theory of organization of control activity, i.e., the activity of a control subject. Whenever a control system incorporates a human being, control activity becomes activity on activity organization. Control theory puts its emphasis on the interaction of control subject and controlled object (the latter can be another subject), see Fig. below. At the same time, control methodology explores the activity of a control subject, ergo has-to-be-included in Cybernetics.

The development of control methodology formulated the structure of control activity (see Fig. below) and identified the structural components of control theory.



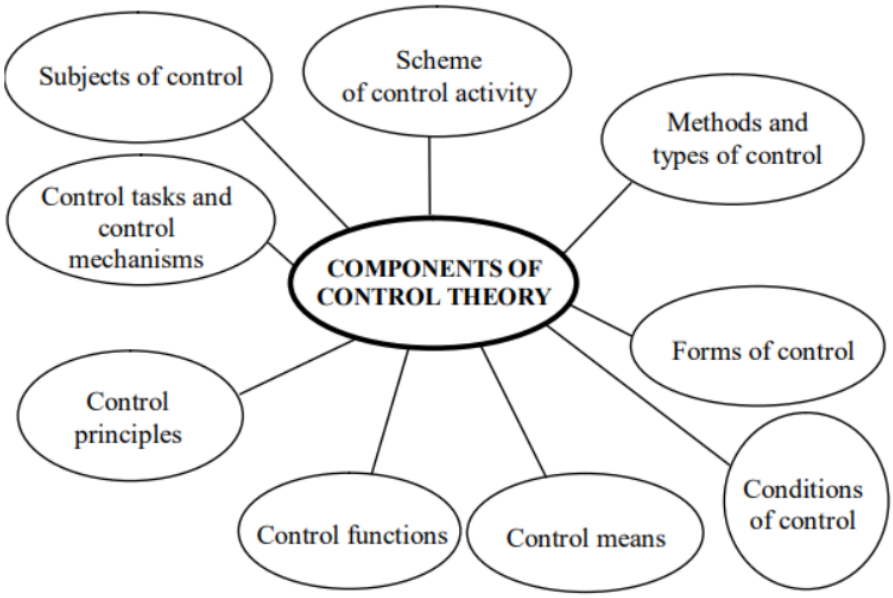
A theory is an organizational form of scientific knowledge about a certain set of objects, representing a system of interconnected assertions and proofs and containing methods of explanation and prediction of phenomena and processes in a given problem domain, i.e., of all phenomena and processes described by this theory. First, any scientific theory consists of interrelated structural elements. Second, any theory includes in its initial basis a backbone element.

The backbone element of control theory (for social systems, organizational systems and other interdisciplinary systems) is the category of organization; indeed, control is the process of organizing which leads to the property of good organization as a property in a controlled system. The structural components of control theory are:

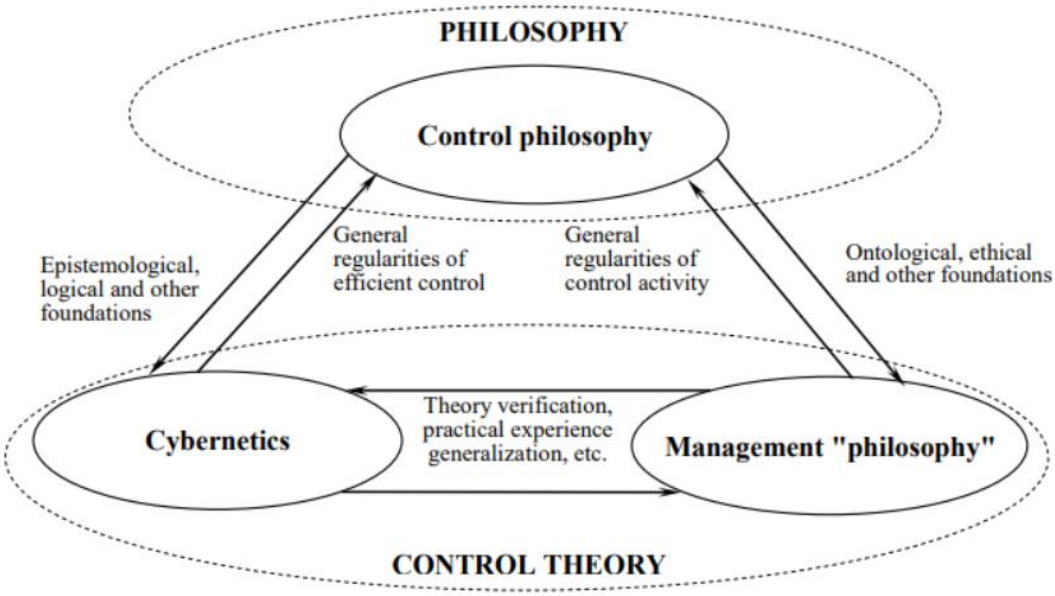
– control tasks;
– scheme of control activity;
– conditions of control;
– types of control;
– subjects of control;
– methods of control;
– forms of control;
– control means;
– control functions;
– factors having an impact on control efficiency;
– control principles;
– control mechanisms.

Tasks:

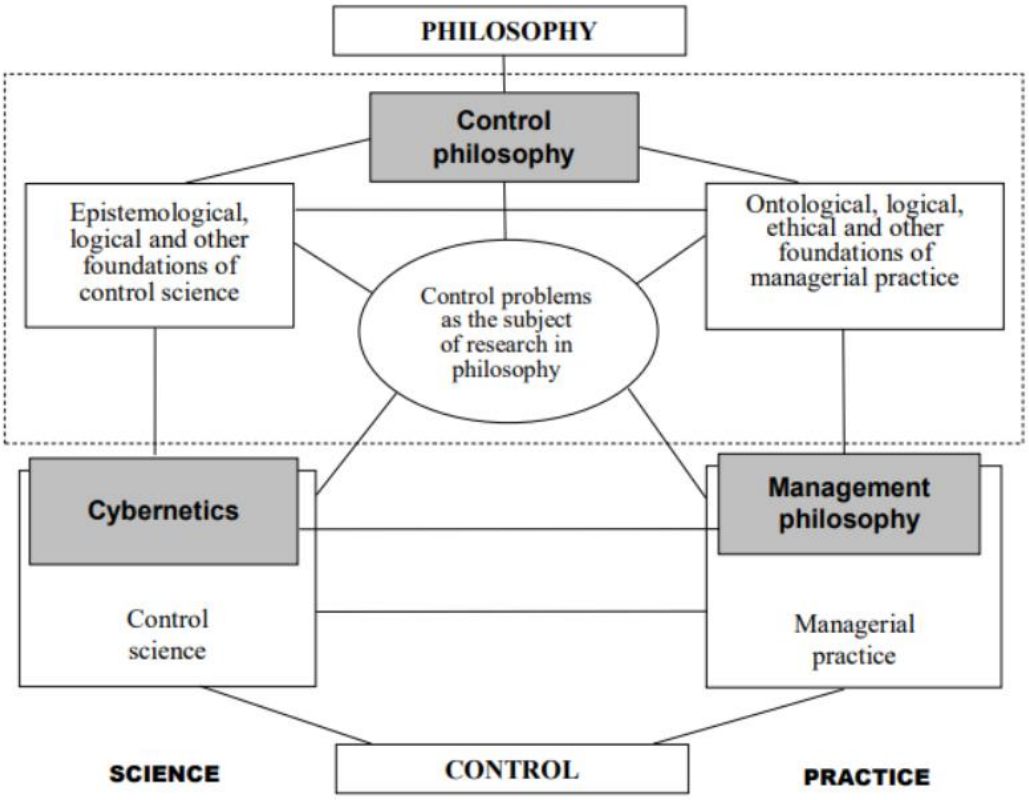
Describe the figure Components of control theory



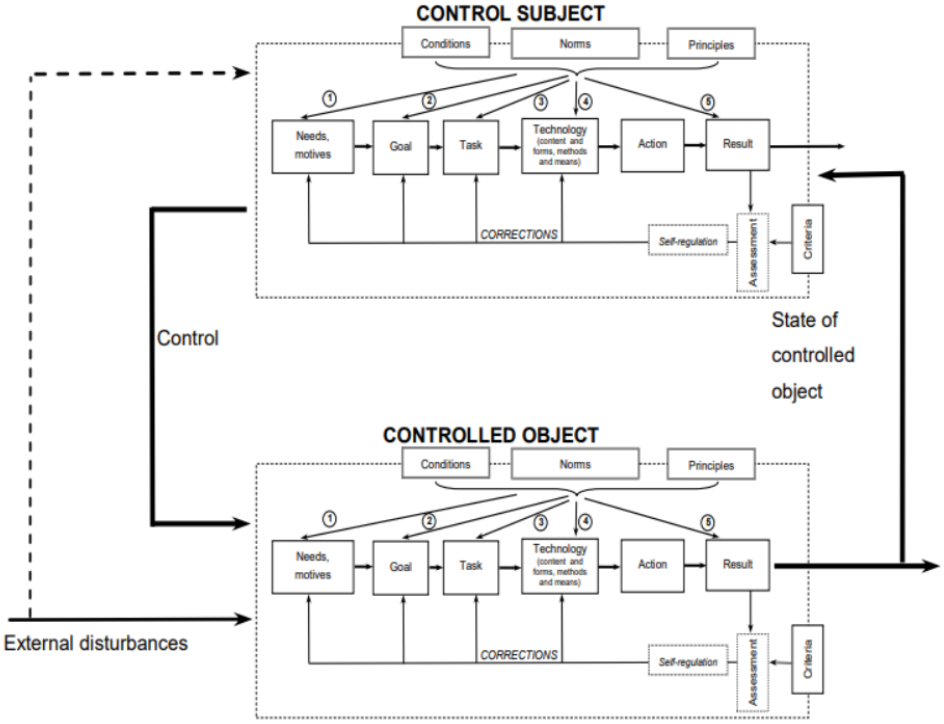
Describe the figure showing Control philosophy, Cybernetics and management "philosophy



Describe the figure Philosophy and control



Describe the figure Structural components of control activity



Task 2. Presentation

Choose of the questions given below and make a short presentation on the chosen topic. The presentation should include 3-5 slides (pages) in ppt, pptx or pdf. You can make the presentation on the chosen topic using PowerPoint, Crello, Canva or any other tool you prefer.

1. The “romantic” periods in the history of cybernetics.
2. The brief history of the evolution of cybernetics from N. Wiener to the present day.
3. Cybernetics in the 20th century.
4. The definition of cybernetics.
5. The interdisciplinary character of cybernetics.
6. Wiener’s Cybernetics.
7. Cybernetics today.
8. “Sectoral” types of cybernetics.
9. Cybernetics of Cybernetics and Other Types of Cybernetics.
10. Achievements and Disillusions of Cybernetics.
11. Cybernetics, Control Philosophy and Control Methodology.
12. The structural components of control theory.
13. Laws, Regularities and Principles of Control.
14. The hierarchy of laws, regularities and principles.
15. General control laws (regularities).
16. Principles of complex systems functioning.
17. Principles of biological systems functioning.
18. Control principles.

Useful resources in the Internet to find the information for the task

1/ Novikov D. A. Cybernetics: from Past to Future – Springe, 2016.

https://www.researchgate.net/publication/287319297_Cybernetics_from_Past_to_Future

2. Cybernetics in the USSR https://habr.com/ru/company/cloud_mts/blog/486932/
3. Популярно. Что такое кибернетика? https://youtu.be/p-frxCTiKBU
4. W. Ross Ashby. An introduction to cybernetics https://archive.org/details/introductiontocy00ashb/mode/2up
5. History of Cybernetics https://asc-cybernetics.org/foundations/timeline.htm
6. Из истории кибернетики https://computermuseum.ru/books/cibernetics_hist.pdf

Unit 3. MODERN RESEARCH IN THE FIELD OF CYBERNETICS

This section is devoted to the structure of cybernetics, its main directions and current achievements. Control philosophy and control methodology will be studied. We will discuss main laws, regularities and principles of control.

Task 1. Discussion Starters

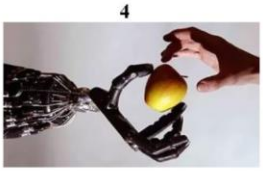
What areas of science do you think cybernetics is applied in? Have a look at the pictures below and name the fields of cybernetics' application. Describe some images which appeal to you the most.

1

2

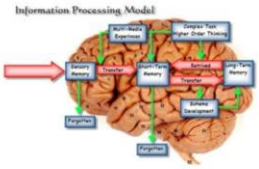
3

4



5 Unlocking your real personality

6



Task 2. Systems Theory and Systems Analysis

Read the lecture and answer the questions

Logically and historically the content of cybernetics has indissoluble connection with the category of "system" (a set of elements having mutual relations and connections, which forms a definite unity and is dedicated to goal achievement. Systems have the following basic features: integrity, relative isolation from an external environment, connections with the environment, the existence of parts and their connections (structuredness), whole system dedication to goal achievement).

Here the key role belongs to two terms – **systems approach** and **systems analysis**.

From the historical perspective, general systems analysis appeared within the framework of general systems theory founded by biologist L. Bertalanffy. In the 1930's he proposed the concept of an open system. Interestingly, the term "systems analysis" originated in RAND Corporation reports dating back to 1948). The later development of systems analysis in the USSR (Russia) and other countries was different.

First of all, systems analysis was assigned nonidentical interpretations. Our discussion begins with the traditions of the Russian scientific schools

Question 1. Right or wrong: The content of cybernetics has very tight connection with the category of "system" both logically and historically.

Question 2. The key role of the connection of cybernetics with system belongs to the following terms:

a) systems approach, systems analysis and systems operations
b) systems approach, systems analysis and systems engineering
c) systems approach, systems analysis and systems analytics
d) systems approach and systems analysis

SYSTEMS APPROACH is a direction in the methodology of scientific cognition and social practice, which studies objects as systems, i.e., an integral set of elements in the aggregate of their relations and connections.

Systems approach facilitates adequate problem formulation in concrete sciences and gives efficient strategies of their study. Systems approach is a general way of activity organization, which embraces any type of activity, reveals regularities and interconnections for their efficient usage.

SYSTEMS ANALYSIS ("a practical methodology of problem solving") is a set of methods oriented towards analysis of complex systems (technical, economic, ecological, educational and other ones). As a rule, systems studies result in a choice of a well-defined alternative (a development program of an organization or a region, design parameters, etc.). Systems approach is valuable, since consideration of systems analysis categories underlies general logical and sequential solution of control and decision-making problems. The efficiency of problem solving using systems analysis depends on the structure of problems. Being remarkable for its interdisciplinary status, systems analysis considers, e.g., an activity as a complex system aiming at elaboration, substantiation and implementation of complex problem solving including political, social, economic, technical and other problems.

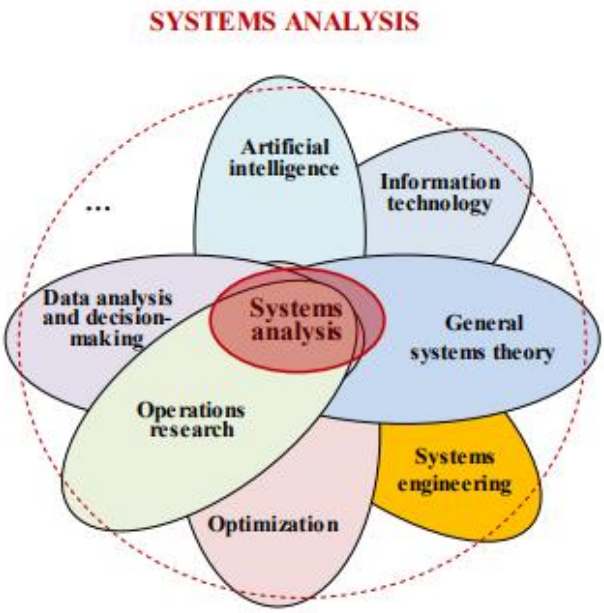
To solve well-defined problems (i.e., the ones which admit an explicit quantitative description and strong formalization), systems analysis employs optimization and operations research methods: a researcher constructs an adequate mathematical model and seeks for optimal purposeful actions (control) within the model.

To solve ill-defined problems, systems analysis operates different techniques including typical stages. Actually, systems analysis suggests universal methods of problem solving applicable to a wide range of fields: organizational control, economics, military science, engineering, and others.

Therefore, in the USSR systems analysis was considered side by side with systems theory (and later almost "absorbed" the latter) as a set of general principles of examining any systems (systems approach).

Similarly to cybernetics, systems analysis (being an integrative science) admits the "umbrella" definition as a union of different component sciences under the auspices of "systemacy":

- artificial intelligence,
- operations research,
- decision theory,
- systems engineering and others, see Fig. with the composition and structure of systems analysis below.



According to this viewpoint, systems analysis has almost no its own results.

This result has definite causes: historically, systems analysis appeared via development of operations research and systems engineering. With the course of time, operations research transformed into management science with basic applications to control of organizational and production systems. Nowadays, many Russian scientists still understand systems analysis as an aggregate of methods of optimization, operations research, decision-making, mathematical statistics and others, in addition to the concept of systemacy proper.

The second interpretation of systems analysis (by analogy with Cybernetics, Systems analysis with capital S) covers the general laws, regularities, principles, etc. of functioning and exploration of different-nature systems.

Here the main body of scientific results is the philosophical and conceptual aspects of systems analysis and general systems theory.

Among Soviet and Russian scientific schools focused on Systems analysis, we emphasize two fruitful theoretical and applied research groups, viz., the methodological school of G. Schedrovitsky and the followers of S. Nikanorov – "the school of conceptual analysis and design of organizational control systems".

The both schools operate the categories of system, control, organization and methodology, as well as seek to analyze and synthesize most general solution methods for a wide range of problems. In other words, they are inseparably linked with Cybernetics.

Systems analysis, just like cybernetics, endures the “romantic” period and the period of disillusions.

“Presently, the terms “analysis of systems” or “systems analysis” often excite the antithetical feelings of different people.

On the one part, here is faith in the omnipotence of the new approach capable of solving difficult and large-scale problems and, on the other part, charges of dalliance decorated by a fashionable terminology.” These words of O. Larichev preserve their topicality even now.

Both Cybernetics and Systems Analysis need GENERAL results including generalizations from intensively developing sciences in the “umbrella brand” of systems analysis.

Task 3. Artificial Intelligence Ideas: focus on tech, not people

Before You Read: What do you think is implied in the idea of focusing on technology, not people?
Read the essay and compare your thoughts with the author’s ones.

Artificial Intelligence (AI) has always been hyped by its enthusiasts. Companies like Google, Yahoo make headlines with technological successes that were science fiction even a decade ago: we can talk to our phones, get recommendations that are personalized to our interests, and may even ride around in cars driven by computers soon. The world has changed, and AI is a big part of why.

AI is the field within computer science that seeks to explain and to emulate, through mechanical or computational processes, some or all aspects of human intelligence. Included among these aspects of intelligence are the ability to interact with the environment through sensory means and the ability to make decisions in unforeseen circum- stances without human intervention. Typical areas of research in AI include game playing, natural language understanding and synthesis, computer vision, problem solving, learning, and robotics.

Thinking machines and artificial beings appear in Greek myths. Human likenesses believed to have intelligence were built in every major civilization. Intelligence can be thought of as a quality that is separable from all other properties of the human person. Intelligence is also seen in the functions one performs, in actions or the ability to carry out certain tasks. Finally, some researchers see intelligence as a quality that can only be acquired and demonstrated through relation- ship with other intelligent beings. Each of these understandings of intelligence has been used as the basis of an approach to developing computer programs with intelligent characteristics.

Silicon Valley sells progress, and so it’s no wonder that it has generally embraced the positive hype about AI today. Yet worries appear that AI is coming too soon, and changing human society too fast. Most of those concerns focus on the singularity, a soon-to-arrive crossover point in the affairs of a man and a machine, where machines overtake human intelligence, and we cease to be the most interesting feature of the planet.

Mostly, the machine age is a benefit, as boring or dangerous jobs are passed off to machines, and interesting work is helped along by intelligent computing assistants. Artificial Intelligence is upon us but it's basically wonderful news: for business, for our standards of living, and for the fu- ture of humanity. On the other hand, there is a firm belief that "artificial intelligence" is a misnomer – real intelligence comes from human minds – and a conviction that a fascination with computer intelligence tends to di- minish and even imperil human intelligence. Elon Musk, the founder of Tesla and SpaceX, has openly speculated that humans could be reduced to "pets" by the coming superintelligent machines. Musk has donated $10 million to the Future of Life Institute, in a bid to help stave off the development of "killer robots." At Berkeley, the Machine Intelligence Research Institute is dedicated to solve an issue of "existential threat" to humanity, eclipsing previous (and ongoing) concerns about the climate, a nuclear holocaust, and other major challenges of our modern life. Nick Bostrom's 2014 bestseller, Superintelligence: Paths, Dangers, Strategies, warns that AI could spell the end of humanity. And the former IBM Louis Del Monte, in his 2013 book, The Artificial Intelligence Revolution: Will Artificial Intelligence Serve Us or Replace Us?, agrees that AI is happening so fast that the changes could be cataclysmic. Luminaries like Stephen Hawking and Bill Gates have also commented on the scare of AI.

But technological progress always cuts both ways. Most researchers hope that their work will eventually be incorporated into a ma- chine with general intelligence (known as strong AI), combining all the skills above and exceeding human abilities at most or all of them.

Answer the following questions.

1. What made the technology of mimicking human intelligence remain far off?
2. What sectors of industry have been involved into the deployment of AI sphere?
3. How does Deep Learning technology operate?
4. What is the crucial principle of DeepMind technology?
5. Which options does the Cortana app cover?
6. What do the scientists and AI researchers warn the humanity about?

Task 4. Group Work. Vocabulary

1) *Explain the meaning of the following word combinations and use them in the sentences of your own:*

- to emulate some aspects of human intelligence,
- to interact with the environment,
- to make decisions in unforeseen circumstances,
- to be separable from other properties,
- to carry out certain tasks,

- to embrace the positive hype of smth,
- a soon-to-arrive crossover point,
- to overtake human intelligence,
- to imperil human intelligence,
- to stave off the development of "killer robots",
- to cut both ways,
- to exceed human abilities.

2) *Share with your partners the ideas as for one of Bill Gates' sayings:*

"I am one in a growing list of tech giants who have reservations when it comes to artificial intelligence".

Task 5. Missing prepositions

Fill in missing prepositions

1. Some __ the most interesting applications __ artificial intelligence came __ health care.
2. Companies __ sectors __ biotech __ computing turned __ these new techniques __ solve tough problems or develop new products.
3. Work __ deep learning often focuses __ images, which are easy __ humans __ understand but very difficult __ software __ decipher.
4. Microsoft drew __ its research __ speech recognition and language comprehension __ create its virtual assistant Cortana, which is built __ the mobile version __ Windows.
5. __ a thoughtful response __ the sci-fi movie Her, he suggested that conversational AI companions could make us better __ interacting __ other humans.
6. The most striking research results __ AI came __ the field __ deep learning, which involves using crude simulated neurons __ process data.
7. IBM began producing a prototype brain-inspired chip it says could be used __ large numbers __ build a kind __ super- computer specialized __ learning.
8. Start-ups launched products that used machine learning __ tasks __ varied __ letting you control home appliances __ your voice.

Task 6. Have we succeeded in Turing's dream?

Read the article. Fill in gaps with a suitable word form. You can use not only one word in each gap.

The holy grail of artificial intelligence – creating software that comes close to mimicking human intelligence – remains far off. But the recent years (see) ___ major strides in machine (learn) ___ software that can gain abilities from experience.

Companies in sectors from biotech to computing turned to these new techniques (solve) ___ tough problems or develop new products.

The most striking research results in AI came from the field of deep learning, which involves using crude (simulate) ___ neurons to process data.

Notable deep learning projects (allow, already) ___ computers to recognize in photos and videos the faces of humans and cats and to identify the emotions behind (write) ___ content even when they (not state) ___ explicitly.

Microsoft drew on its research into speech (recognize) ___ and language comprehension to create its virtual assistant Cortana, which (build) ___ into the mobile version of Windows. The app tries to enter a back-and-forth dialogue with people. That's intended both to make it more endearing and to help it (learn) ___ what went wrong when it makes a mistake.

Start-ups launched products that used machine learning for tasks as varied as letting you control home appliances with your voice, and making plans via text message. Some of the most interesting applications of artificial intelligence came in health care. IBM is now close to seeing a version of its Jeopardy!-winning Watson software help cancer doctors use genomic data to choose personalized (treat) ___ plans for patients. IBM (begin) ___ producing a prototype brain-inspired chip which it says could (use) ___ in large numbers to build a kind of supercomputer (specialize) ___ for learning. A more compact neuromorphic chip, (develop) ___ by General Motors and the Boeing-owned research lab HRL, (take) ___ flight in a tiny drone aircraft.

All this rapid progress in artificial intelligence led some people to ponder the possible downsides and long-term implications of the technology. One software engineer who has since joined Google cautioned that our instincts about privacy must change now that machines can decipher images.

(Look) ___ further ahead, biotech and satellite entrepreneur Martine Rothblatt predicted that our personal data could be (use) ___ to create intelligent digital doppelgangers with a kind of life of their own. And neuroscientist Christof Koch, chief scientific officer of the Allen Institute for Brain Science in Seattle, warned that although intelligent software could never be conscious, it could still harm us if (not design) ___ correctly. Meanwhile, a sounder view of the far future came from science fiction author Greg Egan. In a thoughtful response to the sci-fi movie Her, he (suggest) ___ that conversational AI companions could make us (good) ___ at interacting with other humans.

Answer the following questions:

1) What made the technology of mimicking human intelligence remain far off?
2) What sectors of industry have been involved into the deployment of AI sphere?
3) How does DeepLearning technology operate?
4) What is the crucial principle of DeepMind technology?
5) Which options does the Cortana app cover?

6) What do the scientists and AI researchers warn the humanity about?

Task 7. Have we succeeded in Turing's dream?

Introduce the topic Notable Artificial Intelligence Projects.

Choose one of the suggested AI projects and report on the issue which appeals to you the most:

- Brain-inspired.
- Cognitive architectures.
- Games.
- Knowledge and reasoning.
- Motion and manipulation.
- Music.
- Natural language processing, etc.

Task 8. Speaking Test

Dwell on the common grounds of cybernetics and communications engineering, control theory, biology, theoretical mathematics, and psychology.

Give your arguments on the essential part of the modern AI technologies.

Discuss such aspects of machine intelligence as the ability to interact with the environment through sensory means and make decisions in unforeseen circumstances without human intervention. Enrich your answer with examples.

Task 9. Writing Task

Write an argumentative essay on one of the statements given below:

- Technological progress will be accelerated by the arrival of advanced artificial intelligence.
- Superintelligence will lead to more advanced superintelligence.
- Superintelligence may be the last invention humans ever need to make.

Task 10. Checklist

Write short answers of 50-100 words to each question below:

1) Say who coined the term "AI" first and how this notion was originally defined.
2) Ponder what traits the central problems of AI include.

3) Pick out core areas throughout the technology industry AI is used for.
4) Outline the heritage of Alan Turing's work, and its ongoing effects on computing today.
5) Speak on the common hopes, fears and ethical concerns discussed by AI scientists and researchers.

Unit 4. ANALYSIS OF MODERN PROJECTS FOR THE CREATION AND OPERATION OF COMPLEX SELF-ADAPTABLE AND SCALABLE SOFTWARE SYSTEMS

The section is devoted mainly to WWW, social networking and complex software systems.

Task 1. Concepts of "net" and "information"

Comment on the given pictures. Analyse and compare the concepts of "net" and "information". Explain the notion "I-net communication".

Task 2. Concepts of "net" and "information"

Read the essay about the impact that social networking web-sites may be having on students' academic performance.

The modern era has been now extremely advanced and well- developed and the basic reason for this development is actually the launch of the internet and its applications which have provided the individuals with the easiest routine in their daily lives.

The internet is ever-present. Most people have access to it, either at home, at work, or at school. But most people do nothing more than send and receive email, and look up the weather or sports scores. But the internet has so much to offer. For instance, some museums are working on telepresence robots that you could log into across the internet and then 'drive' around the museum. Telepresence could be active 24 hours a day and make it possible to visit places no human could go, or to visit far off places, without leaving home.

The advent of social networking sites (SNSs) has created a myriad of communicative implications. Initially, these can be tremendously effective

networking tools. You can reestablish contact with friends from high school you haven't talked to in years, or build a network of contacts for business purposes. You can keep friends and family updated on what's going on in your life without having to write individual messages.

However, there are dangers lurking in the shadows. The realm of stalking has now expanded to the Internet, and social networking sites can help facilitate those insidious intentions. Moreover, as many recent college graduates have come to find, one must be very careful of the information they put out and the way they present themselves on these sites, as potential employers may see the pages.

SNSs have been growing in popularity at an astonishing rate and have revolutionized the way we communicate with friends, colleagues, classmates, and even family members. It is now possible to interact and maintain a relationship with someone without ever meeting in person.

There are many positive aspects of these new types of interactions. Some proponents claim that students can join online groups in which everyone shares the same interest, and they can learn how to communicate effectively in this digital age. It has been further argued that, when online, students will discuss current events and issues that they are less likely to discuss in "real life" interactions. In an ideal world, this could indeed be a beneficial way to promote interaction with people from different cultures and backgrounds. However, the excessive use of such websites has created a distraction for some users. It is estimated that at least 85 percent of students in the United States spend hours a day "networking" instead of focusing on their studies and preparing for their future careers. Opponents argue that students are growing dependent on such networks.

SNSs present a new way to find, organize, and share information. These visually stimulating, highly interactive websites attract many college students. However, their addictive nature can potentially disrupt student life to the degree that colleges and universities have to take action and ban access to social networking sites in some areas on campuses. The thing is that some studies report a link between time on SNSs and students' grades. In addition, lecturers are increasingly concerned about social networking use in class. They complain that students are messaging friends or posting status updates from their laptops instead of paying attention to lectures. Based on these concerns, establishing clear policies for use of these websites on campus is likely to help students focus on their studies. They would spend more time studying, and their grades should improve as a result.

Write answer the following questions.

1) What is believed to be the major reason of rapid improvement of the contemporary society life?
2) What kinds of technologies have been created to enhance the internet possibilities?
3) Does the writer think of social networking sites as having a positive or negative impact on students? Why?
4) Why does the author want to limit or ban social networking sites on campuses?

5) Do you agree or disagree with the writer's point of view? Why?

Task 3. Miracles of the World Wide Web in Education

Read the article below.

Education these days has been the top priority for any family or in- dividual person, and no doubt the internet comes first in promoting and maintaining the education standards among the latest technologies. A clear majority of people in the emerging and developing countries see the internet as a positive influence on education. They believe that the net is not only an access to websites, these days there is knowledge and communication on every aspect of the educational world. The resources provided on various web pages are indeed very informative and useful for professionals and students related to every field of work. The only pre-requisite is the research over the internet for a specific educational topic, and then this information just needs to be filtered to gain the basic knowledge of what you are looking for.

Arguably, it is believed that visual data has a higher impact on learning and memorizing than a plain text. Therefore, images, graphics, animation, pictures, slides, documentaries, etc., have a greater appeal than a plain textbook because they can stimulate more than one sense at a time, and in doing so, may be more attention-getting and attention-holding. In educational settings, sing multimedia products and online services provides an opportunity for learners to gain knowledge about a particular subject in depth.

Another positive effect of the internet in education is the onset of distance education or online education (internet-based training (IBT) or web-based training (WBT)). With this facility, you can take up short-term courses with the material available online, attend virtual classes, learn, and appear for exams. Today, both able students as well as less-able ones can be benefited to the sea of knowledge through the internet.

The most amazing thing about studying in the net is that the international education is no more a chance for only the wealthy and high profile family students. Now via internet no matter if one can afford to study in top most universities, people can easily benefit from the international quality education and gain a respectable university degree sitting at home through the online educational courses provided by the world universities. Relatively low-cost access has become one of the major benefits of internet to people and students all over the world.

Online courses provide an opportunity for people of all age groups to take up education of their choice, according to their liking and wish. Be it a student, a housewife, or a professional, they can just start up their computers, connect to the internet, and take virtual classes. There

fore, people can now gain knowledge according to their need and time available. They are free to balance their time according to their own needs, as there is no fixed moment to attend the lectures. Moreover, you are, now, never too old or too busy to learn something new.

Although such programs as e-learning, mooc and opencourse-ware broaden access to traditional training, there are a number of concerns regarding the implementation of open education systems, specifically for use in developing countries. These include: a potential lack of administrative oversight and quality assurance systems for educators / materials in some programs; infrastructure limitations in developing countries; a lack of equal access to technologies required for students' full participation in online education initiatives; and questions regarding the use of copyrighted materials.

Nowadays education is open to new approaches and challenges of the world progress. Close attention is paid to the technological innovations of young teams that start their projects on international markets. One of the latest breakthroughs within the use of the internet is 'The Cave', an immersive virtual reality environment where projectors are directed to three, four, five or six of the walls of a room-sized cube. This technology was firstly developed at University of Illinois at Chicago. This foam lined area, roughly egg-shaped filled with video monitors, speakers and microphones, reproduces excellent sound and has become the third major physical form of immersive Virtual Reality (after Goggles 'n' gloves and vehicle simulators). Today, on college campuses all over the world, musicians use Caves to create intercontinental jam sessions. In the future, you may take a class from inside a Cave, or take in a concert or play.

If you're researching something for school, try using the internet to access your library card catalogue. When you have made your list of books, place them on reserve and the librarians will collect them up and hold them for you to pick up. If you find out about books, journal articles, and other resources which are not available in your libraries, explore 'Inter-Library Loan' – you can check books out of libraries that are not anywhere near you. That's a real boon for students.

With these points, the importance of internet in education cannot be denied, and hence, every student should be given access to the internet for deeper understanding of a subject. However, loads of information can be termed as both, advantages and disadvantages of the Internet as students can also have an access to

unwanted or un- ethical information and sites. Therefore, it is only wise for parents to make children understand what is good and what is not for them, or keep watch on their surfing. Lastly, although the Internet cannot replace books or classroom education because the aesthetic quality of sheets of a downloaded text leaves much to be desired, it is still one of the best substitute for those who wish to gain deeper knowl- edge on literally every subject under the sun.

Put the sentences (1–11) in order to form a summary of the article. There is one extra idea you do not need to use.

1) The development of the internet has led to a revolution in the sphere of studying.
2) Sometimes, encyclopaedia sources may not always be available to students and they may have difficulty in gaining access to the books in the library.
3) One of the benefits of e-learning programs is that people from any part of the world can gain knowledge on different subjects, complete courses, etc.
4) There are no age limitations for education any more.
5) Information is currently one of the two basic uses within the Internet.
6) The Internet is in no way can compare with the warm, personal experience of reading a good book.
7) A great number of online school services and virtual options have not been facilitated by the internet.
8) Students can now see the actual photographs of rare bird species or animated graphics of a volcanic eruption to understand the concept in detail.
9) While it is a fact that online schooling has loads of advantages, it is also a fact that there are a few drawbacks too.
10) Emerging technologies and furthering innovation prospects find overall support on educational arena.
11) University courses and learning is now easy for people belonging to all strata of the society with the help of online programmes.

Task 4. Complex systems

Arrange the paragraphs in the logic order.

a) The term complex systems often refers to the study of complex systems, which is an approach to science that investigates how relationships between a system's parts give rise to its collective behaviors and how the system interacts and forms relationships with its environment.[1] The study of complex systems regards collective, or system-wide, behaviors as the fundamental object of study; for this reason, complex systems can be understood as an alternative paradigm to reductionism, which attempts to explain systems in terms of their constituent parts and the individual interactions between them.

b) As an interdisciplinary domain, complex systems draws contributions from many different fields, such as the study of self-organization and critical phenomena from physics, that of spontaneous order from the social sciences, chaos from mathematics, adaptation from biology, and many others. Complex systems is therefore often used as a broad term encompassing a research approach to problems in many diverse disciplines, including statistical physics, information theory, nonlinear dynamics, anthropology, computer science, meteorology, sociology, economics, psychology, and biology.

c) A complex system is a system composed of many components which may interact with each other. Examples of complex systems are Earth's global climate, organisms, the human brain, infrastructure such as power grid, transportation or communication systems, complex software and electronic systems, social and economic organizations (like cities), an ecosystem, a living cell, and ultimately the entire universe.

d) Complex systems are systems whose behavior is intrinsically difficult to model due to the dependencies, competitions, relationships, or other types of interactions between their parts or between a given system and its environment. Systems that are "complex" have distinct properties that arise from these relationships, such as nonlinearity, emergence, spontaneous order, adaptation, and feedback loops, among others. Because such systems appear in a wide variety of fields, the commonalities among them have become the topic of their independent area of research. In many cases, it is useful to represent such a system as a network where the nodes represent the components and links to their interactions.

Task 5. The Nine Billion Names of God by Arthur C. Clarke

Read the story.

“This is a slightly unusual request,” said Dr. Wagner, with what he hoped was commendable restraint. “As far as I know, it’s the first time anyone’s been asked to supply a Tibetan monastery with an Automatic Sequence Computer. I don’t wish to be inquisitive, but I should hardly have thought that your — ah — establishment had much use for such a machine. Could you explain just what you intend to do with it?”

“Gladly,” replied the lama, readjusting his silk robes and carefully putting away the slide rule he had been using for currency conversions. “Your Mark V Computer can carry out any routine mathematical operation involving up to ten digits. However, for our work we are interested in letters, not numbers. As we wish you to modify the output circuits, the machine will be printing words, not columns of figures.”

“I don’t quite understand....”

“This is a project on which we have been working for the last three centuries — since the lamasery was founded, in fact. It is somewhat alien to your way of thought, so I hope you will listen with an open mind while I explain it.”

Retrieved from: https://urbigenous.net/library/nine_billion_names_of_god.html

“Naturally.”

“It is really quite simple. We have been compiling a list which shall contain all the possible names of God.”

“I beg your pardon?”

“We have reason to believe,” continued the lama imperturbably, “that all such names can be written with not more than nine letters in an alphabet we have devised.”

“And you have been doing this for three centuries?”

“Yes: we expected it would take us about fifteen thousand years to complete the task.”

“Oh,” Dr. Wagner looked a little dazed. “Now I see why you wanted to hire one of our machines. But exactly what is the purpose of this project?”

The lama hesitated for a fraction of a second, and Wagner wondered if he had offended him. If so, there was no trace of annoyance in the reply.

“Call it ritual, if you like, but it’s a fundamental part of our belief. All the many names of the Supreme Being — God, Jehovah, Allah, and so on — they are only man-made labels. There is a philosophical problem of some difficulty here, which I do not propose to discuss, but somewhere among all the possible combinations of letters that can occur are what one may call the real names of God. By systematic permutation of letters, we have been trying to list them all.”

“I see. You’ve been starting at AAAAAAA... and working up to ZZZZZZZZ....”

“Exactly — though we use a special alphabet of our own. Modifying the electromatic typewriters to deal with this is, of course, trivial. A rather more interesting problem is that of devising suitable circuits to eliminate ridiculous combinations. For example, no letter must occur more than three times in succession.”

“Three? Surely you mean two.”

“Three is correct: I am afraid it would take too long to explain why, even if you understood our language.”

“I’m sure it would,” said Wagner hastily. “Go on.”

“Luckily, it will be a simple matter to adapt your Automatic Sequence Computer for this work, since once it has been programmed properly it will permute each letter in turn and print the result. What would have taken us fifteen thousand years it will be able to do in a hundred days.”

Dr. Wagner was scarcely conscious of the faint sounds from the Manhattan streets far below. He was in a different world, a world of natural, not man-made, mountains. High up in their remote aeries these monks had been patiently at work, generation after generation, compiling their lists of meaningless words. Was there

any limit to the follies of mankind? Still, he must give no hint of his inner thoughts. The customer was always right....

"There's no doubt," replied the doctor, "that we can modify the Mark V to print lists of this nature. I'm much more worried about the problem of installation and maintenance. Getting out to Tibet, in these days, is not going to be easy."

"We can arrange that. The components are small enough to travel by air — that is one reason why we chose your machine. If you can get them to India, we will provide transport from there."

"And you want to hire two of our engineers?"

"Yes, for the three months that the project should occupy."

"I've no doubt that Personnel can manage that." Dr. Wagner scribbled a note on his desk pad. "There are just two other points —"

Before he could finish the sentence the lama had produced a small slip of paper.

"This is my certified credit balance at the Asiatic Bank."

"Thank you. It appears to be — ah — adequate. The second matter is so trivial that I hesitate to mention it — but it's surprising how often the obvious gets overlooked. What source of electrical energy have you?"

"A diesel generator providing fifty kilowatts at a hundred and ten volts. It was installed about five years ago and is quite reliable. It's made life at the lamasery much more comfortable, but of course it was really installed to provide power for the motors driving the prayer wheels."

"Of course," echoed Dr. Wagner. "I should have thought of that."

The view from the parapet was vertiginous, but in time one gets used to anything. After three months, George Hanley was not impressed by the two-thousand-foot swoop into the abyss or the remote checkerboard of fields in the valley below. He was leaning against the wind-smoothed stones and staring morosely at the distant mountains whose names he had never bothered to discover.

This, thought George, was the craziest thing that had ever happened to him. "Project Shangri-La," some wit back at the labs had christened it. For weeks now the Mark V had been churning out acres of sheets covered with gibberish. Patiently, inexorably, the computer had been rearranging letters in all their possible combinations, exhausting each class before going on to the next. As the sheets had emerged from the electromatic typewriters, the monks had carefully cut them up and pasted them into enormous books.

In another week, heaven be praised, they would have finished. Just what obscure calculations had convinced the monks that they needn't bother to go on to words of ten, twenty, or a hundred letters, George didn't know. One of his recurring nightmares was that there would be some change of plan, and that the high lama (whom they'd naturally called Sam Jaffe, though he didn't look a bit like him) would suddenly announce that the project would be extended to approximately A.D. 2060. They were quite capable of it.

George heard the heavy wooden door slam in the wind as Chuck came out onto the parapet beside him. As usual, Chuck was smoking one of the cigars that

made him so popular with the monks — who, it seemed, were quite willing to embrace all the minor and most of the major pleasures of life. That was one thing in their favor: they might be crazy, but they weren't bluenoses. Those frequent trips they took down to the village, for instance...

"Listen, George," said Chuck urgently. "I've learned something that means trouble."

"What's wrong? Isn't the machine behaving?" That was the worst contingency George could imagine. It might delay his return, and nothing could be more horrible. The way he felt now, even the sight of a TV commercial would seem like manna from heaven. At least it would be some link with home.

"No — it's nothing like that." Chuck settled himself on the parapet, which was unusual because normally he was scared of the drop. "I've just found what all this is about."

What d'ya mean? I thought we knew."

"Sure — we know what the monks are trying to do. But we didn't know why. It's the craziest thing—"

"Tell me something new," growled George.

"— but old Sam's just come clean with me. You know the way he drops in every afternoon to watch the sheets roll out. Well, this time he seemed rather excited, or at least as near as he'll ever get to it. When I told him that we were on the last cycle he asked me, in that cute English accent of his, if I'd ever wondered what they were trying to do. I said, 'Sure' — and he told me."

"Go on: I'll buy it."

"Well, they believe that when they have listed all His names — and they reckon that there are about nine billion of them — God's purpose will be achieved. The human race will have finished what it was created to do, and there won't be any point in carrying on. Indeed, the very idea is something like blasphemy."

"Then what do they expect us to do? Commit suicide?"

"There's no need for that. When the list's completed, God steps in and simply winds things up... bingo!"

"Oh, I get it. When we finish our job, it will be the end of the world."

Chuck gave a nervous little laugh.

"That's just what I said to Sam. And do you know what happened? He looked at me in a very queer way, like I'd been stupid in class, and said, 'It's nothing as trivial as that.' "

George thought this over a moment.

"That's what I call taking the Wide View," he said presently. "But what d'you suppose we should do about it? I don't see that it makes the slightest difference to us. After all, we already knew that they were crazy."

"Yes — but don't you see what may happen? When the list's complete and the Last Trump doesn't blow — or whatever it is they expect — we may get the blame. It's our machine they've been using. I don't like the situation one little bit."

"I see," said George slowly. "You've got a point there. But this sort of thing's happened before, you know. When I was a kid down in Louisiana we had a crackpot preacher who once said the world was going to end next Sunday. Hundreds of people

believed him — even sold their homes. Yet when nothing happened, they didn't turn nasty, as you'd expect. They just decided that he'd made a mistake in his calculations and went right on believing. I guess some of them still do."

"Well, this isn't Louisiana, in case you hadn't noticed. There are just two of us and hundreds of these monks. I like them, and I'll be sorry for old Sam when his lifework backfires on him. But all the same, I wish I was somewhere else."

"I've been wishing that for weeks. But there's nothing we can do until the contract's finished and the transport arrives to fly us out.

"Of course," said Chuck thoughtfully, "we could always try a bit of sabotage."

"Like hell we could! That would make things worse."

"Not the way I meant. Look at it like this. The machine will finish its run four days from now, on the present twenty-hours-a-day basis. The transport calls in a week. O.K. — then all we need to do is to find something that needs replacing during one of the overhaul periods — something that will hold up the works for a couple of days. We'll fix it, of course, but not too quickly. If we time matters properly, we can be down at the airfield when the last name pops out of the register. They won't be able to catch us then."

"I don't like it," said George. "It will be the first time I ever walked out on a job. Besides, it 'would make them suspicious. No, I'll sit tight and take what comes."

"I still don't like it," he said, seven days later, as the tough little mountain ponies carried them down the winding road. "And don't you think I'm running away because I'm afraid. I'm just sorry for those poor old guys up there, and I don't want to be around when they find what suckers they've been. Wonder how Sam will take it?" "It's funny," replied Chuck, "but when I said good-by I got the idea he knew we were walking out on him — and that he didn't care because he knew the machine was running smoothly and that the job would soon be finished. After that — well, of course, for him there just isn't any After That...."

George turned in his saddle and stared back up the mountain road. This was the last place from which one could get a clear view of the lamasery. The squat, angular buildings were silhouetted against the afterglow of the sunset: here and there, lights gleamed like portholes in the side of an ocean liner. Electric lights, of course, sharing the same circuit as the Mark V. How much longer would they share it? wondered George. Would the monks smash up the computer in their rage and disappointment? Or would they just sit down quietly and begin their calculations all over again?"

He knew exactly what was happening up on the mountain at this very moment. The high lama and his assistants would be sitting in their silk robes, inspecting the sheets as the junior monks carried them away from the typewriters and pasted them into the great volumes. No one would be saying anything. The only sound would be the incessant patter, the never-ending rainstorm of the keys hitting the paper, for the Mark V itself was utterly silent as it flashed through its thousands of calculations a second. Three months of this, thought George, was enough to start anyone climbing up the wall.

"There she is!" called Chuck, pointing down into the valley. "Ain't she beautiful!"

She certainly was, thought George. The battered old DC3 lay at the end of the runway like a tiny silver cross. In two hours she would be bearing them away to freedom and sanity. It was a thought worth savoring like a fine liqueur. George let it roll round his mind as the pony trudged patiently down the slope.

The swift night of the high Himalayas was now almost upon them. Fortunately, the road was very good, as roads went in that region, and they were both carrying torches. There was not the slightest danger, only a certain discomfort from the bitter cold. The sky overhead was perfectly clear, and ablaze with the familiar, friendly stars. At least there would be no risk, thought George, of the pilot being unable to take off because of weather conditions. That had been his only remaining worry.

He began to sing, but gave it up after a while. This vast arena of mountains, gleaming like whitely hooded ghosts on every side, did not encourage such ebullience. Presently George glanced at his watch.

"Should be there in an hour," he called back over his shoulder to Chuck. Then he added, in an afterthought: "Wonder if the computer's finished its run. It was due about now."

Chuck didn't reply, so George swung round in his saddle. He could just see Chuck's face, a white oval turned toward the sky.

"Look," whispered Chuck, and George lifted his eyes to heaven. (There is always a last time for everything.)

Overhead, without any fuss, the stars were going out.

Task 5. Essay

Please describe the novel "The Nine Billion Names of God" by Arthur C. Clarke with at least 1000 characters and up to 1500 characters.

Unit 5. CYBERNETICS 2.0: MAIN TRENDS AND DEVELOPMENT PROSPECTS

This section is devoted to Cybernetics 2.0 and main trends in the development of this science. We will discuss such topics as future technologies and quantum computing.

Task 1. Speak up

Choose one topic and record your answer. Not more than 1.5 minute.

1/ Do you consider yourself as a 'digital citizen' of modern era? Speak on your favourable career prospects.

2/ Feature the phenomenon 'Internet addiction'. Do you consider it to be the norm or a kind of some disorders? Substantiate your ideas.

3/ Explore emerging I-net technologies and discuss how they alter and create new information environments.

Task 2. Top-5 Facts about the Internet

Here are Top-5 Facts about the Internet. Find additional information on most of the topics that are listed.

- The fastest growing means of communication ever.
- Devices connected to the web outnumber humans.
- China does not have the most Internet users.
- The first webcam was used to watch the coffee.
- There is far more to the web than you see.

Task 3. Cybernetics 2.0

Insert the words into proper places.

constructive-optimistic | cybernetics | the general picture of a wide subject domain (and a common language of its description), the positioning of their results and promotion in new theoretical and applied fields | challenges | laws

confidence in the uniform positions of researchers; more efficient solution of control problems for different objects based on new fundamental results and associated applied results | subject-oriented | umbrella | philosophical | CONTROL

negativistic | COMMUNICATION | global challenges | promising | technologies | organization | control, organization and system

The history of ___1 and its state-of-the-art, as well as the development trends and prospects of several components of cybernetics (mainly, control theory) have been already discussed in previous lessons. What are the prospects of cybernetics? To answer this question, let us address the primary source – the initial definition of cybernetics as the science of 2 ___ and 3___.

We have defined cybernetics 2.0 as the science of systems 4 ____ and their

control.

A close connection between cybernetics and general systems theory and systems analysis, as
well as the growing role of technologies leads to a worthy hypothesis. Cybernetics 2.0 includes cybernetics (Wiener's cybernetics and higher-order cybernetics), Cybernetics, and general systems theory and systems analysis with results in the following forms:
– general 5 _____, regularities and principles studied within metasciences
– Cybernetics and Systems 6 ____analysis;
– a set of results obtained by sciences - components ("umbrella brands"– cybernetics and systems
studies uniting appropriate sciences);
– design principles of corresponding 7 _____.

Keywords for cybernetics 2.0 are 8 _____.

Further development of cybernetics has several alternative scenarios as follows:
– the 9_____ scenario (the prevailing opinion is that "cybernetics does not exist" and it gradually falls into oblivion);
– the 10 _____ scenario (owing to past endeavors, cybernetics is considered as a "mechanistic"
(non-emergent) union, and its further development is forecasted using the aggregate of trends displayed by the basic and complementary sciences under the "umbrella brand" of cybernetics);
– the 11 _____ scenario (the framework of new results in cybernetics 2.0 includes conceptual
considerations only–the development of conceptual level);
- the 12 _____ (sectoral) scenario (the basic results of cybernetics are obtained at the junction of sectoral applications);
– the 13 _____ (desired) scenario (the balanced development of the basic, complementary and "conceptual" sciences is the case, accompanied by the convergence and interdisciplinary translation of their common results, with subsequent generation of conceptual level generalizations (realization of Wiener's dream "to understand the region as a whole").

The development of cybernetics 2.0 in the conditions of intensified sciences differentiation provides the following:
- for scientists specialized in cybernetics proper and the representatives of adjacent sciences:
14 _____;
- for potential users of applied results (authorities, business structures): 15 _____.

Main 16 _____ are control in social and living systems. Several classes of control problems seem topical, namely:

- network-centric systems (including military applications, networked and cloud production);
- informational control and cybersafety;
- life cycle control of complex organization-technical systems;
- activity systems engineering.

Among 17 _____ application domains, we mention living systems, social systems, microsystems, energetics and transport.

There exists a series of 18 _____ to cybernetics 2.0 (i.e., observed phenomena going beyond cybernetics 1.0):
1) the scientific Tower of Babel (interdisciplinarity, differentiation of sciences; in the first place, in the context of cybernetics–sciences of control and adjacent sciences);
2) centralization collapse (decentralization and networkism, including systems of systems, distributed optimization, emergent intelligence, multi-agent systems, and so on);
3) strategic behavior (in all manifestations, including interests inconsistency, goal-setting, reflexion and so on);
4) complexity damnation (including all aspects of complexity and nonlinearity (Figuratively, in
this sense cybernetics 2.0 has to include nonlinear automatic control theory studying nonlinear decentralized objects with nonlinear observers, etc.) of modern systems, as well as dimensionality damnation–big data and big control).

Thus, the main tasks of cybernetics 2.0 are developing the basic and complementary sciences, responding to the stated global challenges, as well as advancing in appropriate application domains.

Task 4. The Most Unusual Use of the Internet from My Point of View

Research the theme "The Most Unusual Use of the Internet from My Point of View".

Make speech in class revealing the main issues of the topic with a couple of specific examples.

Task 5. Presentation

Choose of the questions given below (in the enclosed file) and make a short pesentation on the chosen topic. The presentation should include 3-5 slides (pages) in ppt, pptx or pdf. You can make the presentation on the chosen topic using PowerPoint, Crello, Canva or any other tool you prefer.

1. The history of artificial intelligence

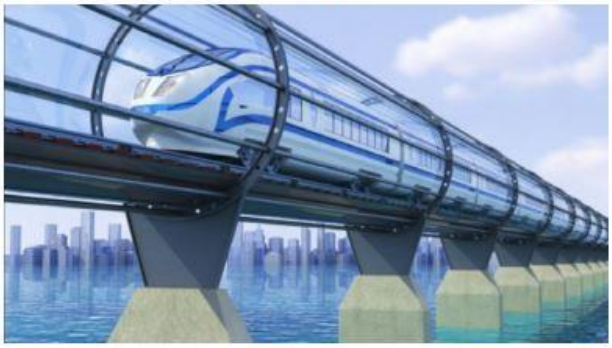
2. The history of operations research
3. The history of systems science and systems engineering

Task 6. Future Technologies

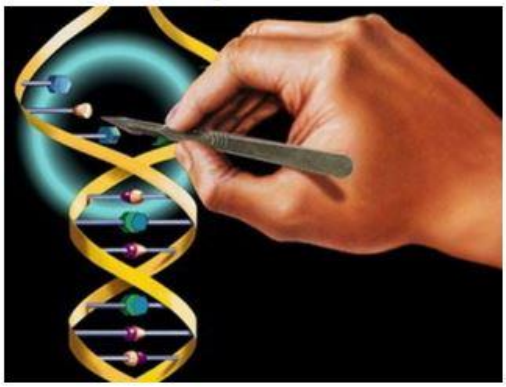
Dwell on core features of the technologies depicted below and ponder upon their would-be merits and risks. Write not more than 250 words.

A

B



C



D

Task 7. Your comments

Comment on one of the following sayings given by Isaac Asimov and Thomas Frey, the great futurists of the past and present. Do you agree or disagree with them? Explain why. Write not more than 250 words.

1. "The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom."
2. "Humanity will change more in the next 20 years than in all of human history".
3. "What once was believed to be science fiction will simply be known as science".
4. "The farther we move into the future, the less accurate our predictions become".
5. "Our greatest motivations in life come from NOT knowing the future".

Task 8. Quantum computing

You are requested to write an analysis essay for the student magazine. Write from 500 to 1500 characters.

Give your consideration as for significance of quantum computing for future development of science and technologies. Explain why quantum theory may be a potential solution to time travel.

Использованная литература и полезные источники

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2. Novikov, Dmitry. (2016). Cybernetics: from Past to Future. https://www.researchgate.net/profile/Dmitry-Novikov-4/publication/287319297_Cybernetics_from_Past_to_Future/links/56754f8208ae125516e6fff3/Cybernetics-from-Past-to-Future.pdf
3. Кибернетика в СССР: от лженауки до панацеи https://habr.com/ru/companies/cloud_mts/articles/486932/
4. Популярно. Что такое кибернетика? https://e.sfu-kras.ru/mod/url/view.php?id=1304013
5. W. Ross Ashby. An introduction to cybernetics https://e.sfu-kras.ru/mod/url/view.php?id=1304015
6. History of Cybernetics https://asc-cybernetics.org/foundations/timeline.htm
7. A bibliographical genealogy of cybernetics https://e.sfu-kras.ru/mod/url/view.php?id=1304024
8. Cybernetics (Video resources) https://e.sfu-kras.ru/mod/page/view.php?id=1304030