FUNDAMENTALS OF GEOINFORMATION TECHNOLOGIES

Abdullayeva Nodira Qamaraddin qizi
Nukus State Pedagogical Institute named after Azhiniyaz

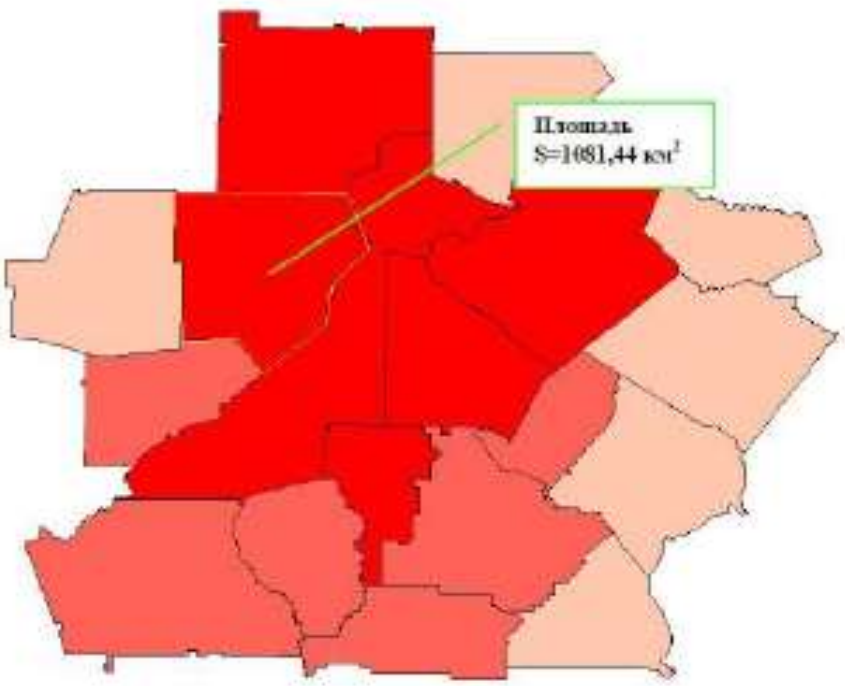
Introduction to Geoinformation Technologies**.** Geoinformation technology has been around for almost 50 years. Is this too much or too little for such a high-tech destination? Why geoinformatics and geoinformation technologies represent one of the most rapidly developing directions in information technologies? And what is it in general - a science, a technology, a method, a computer program?

A person completely unfamiliar with geographic information systems may ask the following question: "why do I need to know what geoinformatics is?". In fact, most of us do not need to refer to geographical atlases or maps every day. However, if understood, geospatial technologies represent much more than just a card inserted into a computer. At the same time, the concept of "geographical information system (geoinformation system, GAT)" is inextricably linked with the usual printed map. In essence, any geographical map is a model of the earth's surface and is considered an object of analysis by its users. A conscious look at the location of some events or objects on the card is enough for the expert to assess the laws of their occurrence and connection with other parameters, Fig. 2.

The simplest example is to determine the distance from one point to another on a map, Figure 1.3. A more complex problem is to determine the areas of irregularly shaped objects. In the most complex issues, the relationship between various thematic information of the maps, for example, the dependence of the snow leopard population on the terrain or the composition of the soil on the geology of bedrock, is determined. The list of examples can be expanded. In scientific, production and management activities, a person is always faced with the need to process large information arrays related to the spatial location of various objects that describe the changes in their characteristics and characteristics over time. Ultimately, a visual image is obtained, and the entire process of visualization is the process of creating a map.

1.2-rasm. Fotografik tasvirda o'rmon massivining kesilgan uchastkalari ko'rinib turibdi. GAT fazoviy lokallashtirilgan tabiiy ob'yektlarni tahlil qilish va o'rmon kesish ishlarini samarali boshqarish imkoniyatini beradi.

1.3-rasm. Toshkent shahri hududidan birining kartografik tasviri. Qizil chiziq ob'yektlar o'rtasidagi masofani aniqlash uchun GATda tuzilgan.



1.4-rasm. Hududiy maydonni GATda aniqlash.

Geoinformation systems, whose functions include information analysis and visualization in the form of maps and schemes, information processing used in database management systems and visualization of geographic data in automated design and machine graphics systems (CAD), automated map production was created at the junction of network systems technologies. The need to use computer power to process geographic information was recognized in the 60s and 70s of the 20th century. At that time, the implementation of the idea required huge hardware and software resources, and only large contractors, such as the Ministry of Defense, had enough capabilities for this (we will talk about it in Chapter 3). The situation has changed radically since the mid-90s, because at this time, relatively powerful PCs appear on the market, software becomes cheaper and more understandable, and users become more prepared. These factors served as a base for the rapid spread of geoinformation technologies.

Most of the problems for GAT can be solved simply without computer analysis or modeling, but the text can be printed on a typewriter, and we currently prefer to use a computer. It is very convenient, fast, efficient. Usually a person approaches GAT without realizing it. It all starts with the use of popular graphic editors such as Photoshop, CorelDraw, Illustrator. As we work, it becomes clear that we need to insert additional data from other sources into our scheme or thematic layer (such as drawing an image onto an outline map). A single coordinate space is required for such operations. This is the first step towards the use of specific coordinate systems and cartographic projections (more in Chapter 3). At the next stage, there is a need to create and make requests for attributive information. The simplest queries, for example, finding all polynomials with an area of more than 50 km2, can be done in graphic

editors. However, there is often a need for more complex queries, such as marking all high-rise office buildings built from concrete blocks, or finding the desired street on a map. As soon as you start formulating questions like these, you become a potential user of GAT.

Geoinformation technologies are a rapidly developing direction of modern information technologies. For this reason, it is currently impossible to talk about the existence of a generally accepted terminology in this field of knowledge. To understand how young this field of activity is, it is enough to mention the numerous definitions of GAT proposed by different authors.

GAT is "an internally positioned automated spatial information system created for data management, cartographic representation and analysis" (Berry J.).

I must emphasize that this definition is not very complete, since it does not consider a person as an element of the information system. A person plays an important role in any information system - he is an observer, an expert, and an analyst. In many cases, researchers in the field of geoinformatics use the phrase "man-machine complex" to emphasize the role of man in GAT.

GAT is "spatial-coordinated information collection, processing, reflection and distribution, inventorying, analysis, modeling, forecasting and management of the environment and the territorial organization of society in solving scientific and practical geographical issues related to territory It is a hardware-software man-machine complex that provides their integration for efficient use of information and knowledge about "(Koshkarev A.V.).

GAT is "a system consisting of people, as well as technical and organizational means, which collects, transmits and processes data for their further use in geographical research and for the production of information convenient for its practical application" (Konecny M).

GAT is "a complex of hardware and software tools and human activities for storing, manipulating and displaying geographic (spatially linked) data" (Abler R.).

GAT is "a dynamically organized set of data connected with a set of models implemented in EHM for computational, graphic and cartographic transformation of data into spatial information in order to meet the specific needs of certain users within the framework of clearly defined costs and technologies (dynamic database or data bank)" (Degani A.).

GAT is: "a database designed to expand the database, manipulate data, visualize them in the form of cards or tables, and ultimately make decisions about one or another option of economic activity. , a system that includes hardware, specialized mathematical support" (Lillesand T.).

GAT is: "a place of storage of the system of knowledge about the territorial aspect of the interaction of nature and society, realized with the help of automatic tools

(EHM), as well as software for modeling search, input, modeling and other functions" (Trofimov A.M., Panasyuk M.V.).

The author of this manual is the American scientist D.P. I prefer Lusch's simple yet comprehensive definition:

GAT is an integrated computer system under the management of expert-analysts, which collects, stores, manipulates, analyzes, models and displays data with defined spatial relationships (see Figure 5) .

As you can see, there are many definitions of Gat, but each of them is correct. They differ only in the breadth of coverage of the issue under consideration. In addition, the following terms are often found in the textbook, some of them are taken from www.glossary.ru:

Map - (Map, Chart, German Karte, French Carte, from Greek Chartes - a sheet, a small piece of paper) - flat, the location of natural and socio-economic phenomena of the surface of the earth, another object or cosmic space. and is a flat, mathematically defined, reduced, generalized conditional-sign representation showing connections. The map is seen as a symbolic model with high informativeness, spatial-temporal similarity to the original, metricity, high visuality and visuality, which makes it important to know it in earth sciences and socio-economic sciences. makes it a very important tool.

Map reading is mastering based on familiarization with cartographic forms, interpretation and understanding of its content. The ability to read a card depends on the level of reading ability of the card, that is, the ease and speed of mastering certain symbols, cartographic images and the entire image in general. In turn, the level of readability is determined by the clarity of conventional symbols, the quality of card decoration, the general loading level of the card, and the differentiation of image details.

Numerical map - (Numerical map, Digital map, German Numerische karte) - a digital model of the surface formed by taking into account the laws of cartographic generalization in the projection, drawing, system of coordinates and heights adopted for maps. Basically, the term "digital map" means a digital model, digital cartographic data. A digital map is created in full compliance with the norms and rules of cartography, map accuracy, generalization, conditional marking system. The digital map serves as the basis for the preparation of ordinary paper, computerized, electronic maps, it is part of the cartographic database, it is one of the most important elements of the GAT information supply, and at the same time it can be the result of the implementation of the GAT .

A computerized card is a card obtained with the help of automated mapping tools on a graphic output device (on paper, plastic, photo film and other materials in graphopostroites, printers, digitizers, etc.) or with the help of a geoinformation system.

Sometimes cards made on non-specialized equipment, for example, so-called EHM cards or ATSPU cards made on alphanumeric printing devices, are included in the category of computer cards.

GAT - technologies - the technological basis of creating geographic information systems, which allows realizing their functional capabilities.

Geoinformational analysis - analysis of the location, structure, and interconnection of objects and events using spatial analysis and geomodeling methods.

Functional capabilities of GATs - a set of functions of geographic information systems and related software tools:

• entering data into the machine environment by importing from existing collections of digital data or by digitizing sources;

• changing data, including converting data from one format to another, transforming cartographic projections, changing coordinate systems;

• storage, manipulation and management of data in internal and external databases;

• cartometric operations;

• user personalization options.

Geoinformatics - science, technology and production activities:

• on scientific justification, design, creation, operation and use of geographic information systems;

• on the development of geoinformation technologies;

• On practical aspects or applications of GATs for practical or geoscientific purposes.

Geomatics is a set of applications of information technologies, multimedia and telecommunication tools for data processing, analysis of geosystems, automated cartography; this term is also used as a synonym for geoinformatics or geoinformation cartography.

A digital overlay (layer, theme) is a family of spatial objects of the same type (of the same weight) belonging to one class of objects within a region and in a coordinate system common to a set of layers. Dotted, linear and polygonal digital overlays differ according to the type of objects.

Spatial object (graphic primitive) is a digital representation of a real object, including its location indicator and a set of properties, descriptions, attributes, and this object itself (digital model of the place). Four main types of spatial objects are distinguished: (1) points, (2) lines, (3) areas, contours and (4) surfaces.

Fields of application of GAT Today, geoinformation technologies have entered almost all spheres of life. We recognize the main ones:

• Use of ecology and tabat

• Land cadastre and land composition

• Sea, aviation and car navigation

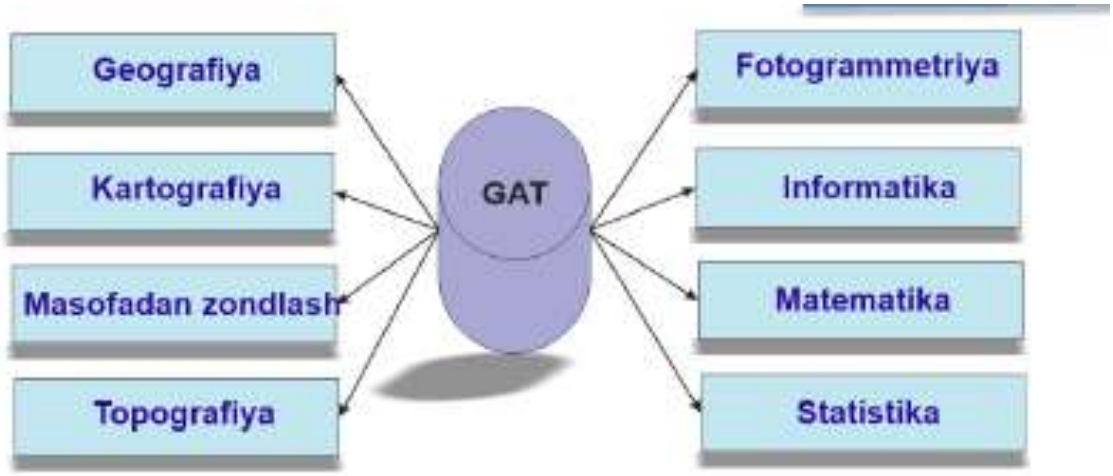
• Management of the city economy

• Territorial planning
• Marketing
• Research demographics and labor resources
• Traffic management
• Operational management and planning in emergency situations
• Sociology and political science

In addition, GAT is used to solve various problems such as:

• provision of complex and network cadastre;
• search for natural resources and their effective use;
• territory and network planning;
• control of the living conditions of the population, health care, social services, employment;
• protection of rights and ensuring the activity of structures using force;
• science and education;
• cartography.

Figure 6 shows the connection of GAT with other disciplines.



1.6-rasm. GATning ilmiy fanlar va texnologiyalar bilan bog`lanishi.

Specialists working in the field of GAT and geoinformation technologies are engaged in the following:

• collecting preliminary data;
• design of databases;
• Design of GAT;
• planning, management and administration of geo-information projects;
• Development and support of GAT;
• GAT-product and geodata marketing and their distribution;
• professional geoinformation education and study of GAT-technologies.

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