МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ МІСЬКОГО ГОСПОДАРСТВА імені О. М. БЕКЕТОВА

МЕТОДИЧНІ ВКАЗІВКИ

для практичних занять

з дисципліни

«ІНОЗЕМНА МОВА (ПРОФЕСІЙНОГО СПРЯМУВАННЯ)»

(для студентів 2 курсу денної форми навчання напряму 6.080101 – Геодезія, картографія та землеустрій)

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Методичні вказівки для практичних занять з дисципліни «Іноземна мова (професійного спрямування)» (для студентів 2 курсу денної форми навчання напряму 6.080101 «Геодезія, картографія та землеустрій») / Харків. нац. ун-т міськ. госп-ва ім. О. М. Бекетова; уклад.: А. М. Крохмаль, Г. Б. Сергєєва. – Харків : ХНУМГ ім. О. М. Бекетова, 2015. – 68 с.

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Методичні вказівки призначені для організації практичних занять зі студентами 2 курсу згідно із затвердженою робочою програмою навчальної дисципліни «Іноземна мова (професійного спрямування)», укладеної відповідно освітньо-кваліфікаційним вимогам до знань і вмінь студентів напряму підготовки «Геодезія, картографія та землеустрій», які в майбутньому будуть працювати у сфері будівництва.

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Introduction

The tasks are designed for students studying English for specific purposes (ESP). There are fourteen units which are expected to be covered during about 90 classroom hours. It is assumed that the students doing the tasks get detailed up-to-date information of using GIS to play a role at work and in the community. It is also expected that the students doing these tasks have the knowledge of and ability to use English up to intermediate and upper intermediate levels.

The tasks are based on the authentic texts concerning specifically the geographical information systems and technology. The units focus on the GIS's roots in cartography, maps and numbers, on getting the map into the computer and basic database management.

The presented educational materials and the choice of tasks are supposed to provide practice in using the professional lexis, in reading and comprehending the specific information, in translating from English and into English and also to give a reasonable motivation for mastering the basics of GIS in English.

Words and phrases unique to the vocabulary of GIS are italicized and defined as they are introduced.

UNIT 1

DESCRIBING ATTRIBUTES. STATISTICAL ANALYSIS

***Active words and phrases*:**

data – данные

attribute – свойство, атрибут

attribute date – атрибутивные данные

analyst – аналитик, расчетчик

statistics – статистические данные

statistical inquiry – статистическое исследование

histogram – столбчатая диаграмма

database – база данных

geographic properties – географические параметры

Exercise 1. Read and translate the text.

A GIS has at least two parts: the attribute part and the map part. The attribute data, managed by their regular database manager, are little different from any other type of statistical information when it comes to analysis. In this chapter we move away from the construction and management of data in a GIS to actual use of the information.To best understand information in the form of numbers, we must describe geographic data in methodical and quantitative ways, that is, with well-understood statistics. If this was as far as GIS went, however, there would be few advantages to GIS compared to any of the major computer statistical packages available to scientists.

What makes analysis within a GIS different is that the attribute data have established links to maps. Any statistic we can think of to describe the data then automatically has geographic properties and as a result can be placed on a map for visual processing. The situation is more fruitful than that, because we can use the geographical properties for statistical inquiry as well. This means that in addition to answering the question ‘Where?’ as far as the features is concerned, we can also ask ‘Why is it there?’ We can come up with some definitive answers to these questions and display the answers to the questions and analyses as maps. As this chapter shows, this can give the user an amazing amount of power when GIS - analysis is brought to bear on a problem.

Exercise 2. **Answer the questions using the information from the text.**

1. What two parts does a GIS have?
2. What is the attribute data?
3. What must we do to best understand information in the form of numbers?

Exercise 3. Look through the text again and find the words that correspond to the following definitions.

1. a depiction of all or part of the earth or other geographic phenomenon as a set of symbols and at a scale whose representative fraction is less that 1:1

   _____

3. the stage in science when measurements are sorted, tested, and examined visually for patterns and predictability _____
4. a characteristic of a feature that contains a measurement or value for the feature

   _____
5. a single entity that composes part of a landscape

   _____

6. a collection of data organized in a systematic way to provide access on demand

   _____

Exercise 4. Read and translate key terms and definitions.

Histogram – a graphic depiction of a sample of values for an attribute, shown as bars raised to the height of the frequency of records for each class of group of values within the attribute.

GIS – geographic information systems.

Geography – a field of study based on understanding the phenomena capable of being described and analyzed with a GIS.

Statistics – a collection of information shown in numbers.

Information – facts or details about somebody or something.

Exercise 5. Complete the sentences with the following words:

statistics analysis information histogram database

geography GIS map features

1. For this _____ we need some _____.
2. According to official _____ the disease killed over 500 people.
3. An interesting _____ of the city is the old market.
4. The book is an _____ of poverty and its causes.
5. Can you find Clack hill on the _____?
6. For further _____, write to us at this address.
7. Kim knew the _____ of New York City very well.

Exercise 6. Fill the gaps with the prepositions from the box.

to	in-2	of-2	from-2	onto

The visual description (1)_____the histogram and the number descriptions (2)_____the average and difference (3)_____the average are covered. (4)_____addition, these simple measures are described (5)_____terms of their spatial attributes when the two spatial dimensions or coordinates are used as the numbers under description. As shown, map statistical description leads (6)_____an initial ability to place (7)_____ a map what the numbers demonstrate. The average (mean) and difference (8)_____the average (variance) both have visual and geographical meaning.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. extreme – экстремальное значение
2. value – показатель, значение
3. record – запись
4. elevation – возвышенность, высота
5. descriptive question – наглядный вопрос
6. to sample – пробовать, производить выборку
7. reading – показания, (измененные) значения

A first question that might be asked about the database is ‘What are the extremes of the data?’ Data extremes are simply the highest and lowest values for all records for one attribute.

We concentrate first on the elevation attribute. A first descriptive question about the data beyond the ranges is: What are the elevations of the point that were sampled? Even though most of the readings were taken along the coast, the values for the elevation range considerably. Some of the data are clearly poor readings, outside the range we would normally expect and perhaps due to the positions of the satellites or some other factor. Quite likely, the reception problems of the GPS system had something to do with it but there is also clearly a measurement error in

terms of accuracy that far exceeds the precision of the elevation reading. How can these bad elevation values be screened out? Obviously we need to see what a good reading looks like and how it can be distinguished from the remainder of the readings.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. совместимый, непротиворечивый _____
2. исключать, удалять _____
3. нечетный _____
4. выводить среднее число _____
5. средняя линия, среднее значение _____
6. выбор, вариант _____
7. репрезентативное, характерное (значение)_____

If errors are consistent, we can correct for them. We could safely eliminate these numbers and probably correctly believe them to be wrong. We do not have this option if we have only one number or reading - we have no choice but to use it! If we have two readings only, and they disagree, we would probably average them. If we had three readings and they disagreed, we could average them, reject one reading that was obviously wrong (varies by too much), or average the two readings that most closely agree with each other.

The more numbers we have, the more we can see what the typical amount of variation is, that is, how corrupted are the readings by a random amount of error. If this is the case then we can go ahead and average the numbers, or at least give expected amounts of error. There are alternatives to averaging. For example, a simple representative value for a group of records can be selected by sorting the elevations by height, which the GIS database manager can do and then taking the value of the middle reading. This value is called the median. This works fine for an odd number of elevation readings; the centre comes out exactly. An advantage is that this is a ‘real’ typical value because it is an actual part of our data set. If the attribute in the database was, for example, state average salary for GIS professionals in dollars, we could pick the middle or median state and compare our own state to it. This is not so simple if we have an even number of records. We have to take the two centre values and average them, losing the attachment to a single data record.

UNIT 2

SPATIAL DESCRIPTION

Active words and phrases:

attribute description – характеристика атрибутов

spatial measurements – пространственные измерения

spatial data – пространственные данные

spatial description – пространственное описание

treat – рассматривать

duplication – удвоение

define – определять

bounding rectangle – ограничивающий прямоугольник

centroid – центроид

Exercise 1. Read and translate the text.

The first and most significant factor in dealing with spatial data is that there are at least two spatial measurements, an easting and a northing. We could summarize spatial description, as describing two attributes simultaneously.

In the simplest and most basic way, we can duplicate the attribute descriptions above for the locational data to give spatial descriptions. In this case, we can treat the two separate parts of the coordinates, the eastings and the northings, as if they are each a single attribute, which indeed they are. Just as we began the discussion of describing the values of a single attribute by discussing the concept of a minimum and a maximum value for an attribute and the concept of a range, when the attributes describe coordinates, a first point is described by the minimum easting and the minimum northing, and a second point describes the corresponding maxima. The two points define a rectangle, whose two side lengths are the ranges in easting and northing, respectively, and that encloses all the points.

This is called the bounding rectangle of the points. It can be found by simply sorting the records by easting, and taking the first and last record, and then repeating for the northing.

In much the same way that we calculated means and standard deviations separately for the two GPS receiver's elevations, so also were they calculated for the latitudes and longitudes. These were first translated into decimal degrees, then summed and divided to find the average latitude and longitude for the eTrex and

for the GPS48. The result of the two means is itself a point, with both a real geographic location and a special geographic name, the mean centre. This point is also sometimes called a centroid, a point chosen (in this case statistically) to represent a geographic distribution. Although the GPS data are a set of points, lines and area features can also have a centroid, selected in any one of several ways.

Exercise 2. Answer the questions using the information from the text.

1. What is the most significant factor in dealing with spatial data?
2. What two separate parts can we treat to give spatial descriptions?
3. What is called the bounding rectangle of the points?

Exercise 3. Look through the text again and find the words that correspond to the following definitions.

1. large or important enough to have an effect or to be noticed

   _____

2. the act or process of finding the size quantity or degree of something

   _____

3. happening or done at the same time as something else
   _____
4. an exact copy of something
   _____
5. to deal with or discuss something in a particular way
   _____

Exercise 4. Read and translate key terms and definitions.

Attribute – a quality or feature of somebody or something.

Concept – an idea or a principle that is connected with something.

Range – the distance over which something can be seen or heard.

Deviation – the act of moving away from what is normal or acceptable.

Latitude – the distance of a place north or south of the equator.

Longitude – the distance of a place east or west of the Greenwich Meridian in degrees.

Exercise 5. Complete the sentences with the following words:

significant attributes measurement deviation latitude

concepts simultaneous longitude duplicate range treated

1. The results of the experiment are not statistically _____.
2. His behavior was _____ from the previously accepted norms.
3. Accurate _____ is very important in science.
4. Patience is one of the most important _____ in a teacher.
5. The value plotted for each point is the difference in _____ and _____ for each point.
6. Mrs. Smith, you should _____ this document.
7. He can't grasp the basic _____ of mathematics.
8. There were several _____ attacks by the rebels.
9. The question is _____ in more detail in the next chapter.

Exercise 6. Fill in the gaps with the prepositions from the box.

of-2 in-3 between-2 at on by

Looking (1)_____this map, is it possible to see any difference between the two sets of measurements? Since the overall spread of the points exceed the differences in location (2)_____the two receivers, it is very hard to say, even (3)____the zoom of Santa Barbara harbor. Instead, we can compare the distributions statistically (4) _____examining the standard deviations (5)_____the easting and northing directions (6)_____, this case in latitude and longitude. Imagine the line between the two GPS locations for each point, with all eTrex points drawn on top (7) each other. We could look at the bearing (8)_____these lines, 'rays' stretching out between the two readings for each point. We would expect the bearings and the lengths to be random, but the average length would now give a mean with a real meaning, the expected average distance difference (9)_____the two receivers. This can also be calculated from the standard deviation (10)_____the easting and northings, calculated as the square root of the sum of the squared distances in the two directions.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. error – ошибка
2. impact – воздействие
3. statistical descriptor – статистический признак, идентификатор
4. to cause – обуславливать
5. to get rid of – избавиться от

6. to convert to – переводить в
7. square root – квадратный корень

While statistics are useful in demonstrating that an error is present, and that it has an impact on the aggregate statistical descriptors, the GIS can help us to isolate exactly which readings have caused the problem.

The value plotted for each point is the difference in latitude and longitude for each point, squared to get rid of negatives, divided by the size of the sample, and added for latitude and longitude. The values were converted to meters using the same tables as above, and the square root of the sum taken. This is then a map of the magnitude of the total spatial discrepancy between the two GPS receivers. Two points clearly stand out, point numbers 12 and 24. These two points alone account for almost all of the error in the data. Without them, the two receivers seem to be not only quite accurate, but also in agreement.

Exercise 8. Read the text. Find the English equivalents to the following terms:

1. размер _____
2. количественный _____
3. расположение _____
4. словесно _____
5. очертание _____
6. повторяющийся _____
7. стандартный _____

In this chapter we met the idea that geographic features can be classified into points, lines, and areas by their dimensions on the map. Describing each of these can lead to measuring spatial properties directly from the digital files containing the geocoded representations of the features. We started the chapter with a set of points, the GPS example, because points are the easiest type of a feature to describe. Although we have so far used quantitative measures to describe geographical features, many arrangements of features are described verbally.

For example, points are sparse, uneven, random, regular, uniform, scattered, clustered, shotgun, or dispersed. Patterns are regular, patchwork, repetitive, or swirling. Shapes are rounded, oval, oblong, drawn-out, or resemble Swiss cheese. The challenge is to find numbers that say the same thing. The bounding rectangle, the mean centre, and measures such as the standard distance can provide excellent descriptors of points, although more complex measures are obviously needed for the higher-dimension features.

UNIT 3

SPATIAL ANALYSIS

Active words and phrases:

feature – пространственный объект

predict – теоретически оценивать, вычислять

property – свойство

pattern – изображение, общая картина, вид

scale – масштаб

contiguity – смежность, близость

relation – зависимость

overlay – наложение, совмещение

merge – объединять

Exercise 1. Read and translate the text.

Numbers that describe features are useful, but the purpose of geographic inquiry is to examine the relationships between geographic features collectively and to use the relationships to describe the real-world phenomena that the map features represent. The geographic properties were size, distribution, pattern, contiguity, neighborhood, shape, scale, and orientation.

Each spatial relation begs three fundamental questions: (1) How can two maps be compared with each other?; (2) How can variations in geographic properties over a single area or GIS data set be described and analyzed?; and (3) How can we use what we have learned using the analysis to explain and therefore predict future maps of the geography in question? The third question may be as simple as selecting the best route from A to B on a map, or as complex as modeling the future growth of cities based on their size, shape, and development over time. GIS gives us the capability of doing both, and anything in between. In terms of comparing maps, a simple way is to bring multiple maps into coregistration and then merge their themes to make a composite. This is what is meant by map overlay analysis. An example of map overlay will follow a first discussion of spatial models and how GIS adds to their construction, examination, and use.

Exercise 2. Answer the questions using the information from the text.

1. What is the purpose of geographic inquiry?
2. What are the geographic properties?
3. What fundamental questions does each spatial relation beg?

Exercise 3. Look through the text again and find the words that correspond to the following definitions.

1. an excellent example to copy
   _____
2. the act of asking questions or collecting information about somebody or something
   _____
3. the way in which two or more things are connected_____
4. a quality or characteristic that something has
   _____
5. the fact of touching or being next to something
   _____

Exercise 4. Read and translate key terms and definitions.

Feature – a single entity that composes part of a landscape.

Scale – the geographic property of being reduced by a representative fraction.

Area – a two–dimensional feature represented by a line closed on itself to form a boundary.

Data – a set of measurements or other values, such as text for at least one attribute and at least one record.

Analysis – the stage in science when measurements are sorted, tested and examined visually for patterns and predictability.

Exercise 5. Complete the sentences with the following words:

contiguous features relation properties analysis

data pattern enquiry scale area

1. Both plans are drawn to the same _____.
2. This _____ was collected from 69 countries.
3. Scientific _____ is a very important process.
4. Compare the physical _____ of the two substances.

5. The software has no particular distinguishing _____.
6. This system sets the _____ for others to follow.
7. The two countries are _____.
8. There is heavy traffic in the downtown _____ tonight.
9. The book is an _____ of poverty and its causes.
10. The fee they are offering bears no _____ to the amount of work involved.

Exercise 6. Fill in the gaps with the prepositions from the box.

of-3 from to-3 in into with

One means (1)_____ map overlay is to intersect all (2)_____ the layers involved to generate a set of most common geographic units (3)_____ map algebra, the raster plays this role. The attributes are then inherited or passed down (4) _____ subsetted areas, and the attribute table gets longer and longer as more and more units are created. We have already seen the many problems (5) vector map overlay, including sliver polygons. Blind map overlay will happily assign attributes (6)_____ very small sliver polygons, and use them in further analysis. A solution (7)_____this problem is to first process each layer to reduce the number (8) _____

solution classes that will find their way (9)_____ the final map. A selective query (10) _____each layer is one simple way to do this.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. grid – координатная сетка
2. extent – диапазон, размер
3. theme – тема
4. reference – ссылка, сноска
5. datum – исходная (базовая) точка
6. granularity – степень детализации
7. aligninent – выравнивание

One of the oldest analytical methods used in GIS is map overlay. Map overlay is the set of procedures by which maps with different themes are brought into geometric and scale alignment so that their information can be cross referenced and used to create more complex themes. We have met the method already several times, and should recall that the maps to be overlain must be of the same spatial extent, on the same map projection and datum, be at comparable

granularity (that is, the spatial units, whether pixels or polygons, should be about the same average size), and if the layers are to be used with map algebra, at the same raster grid size and resolution.

The power of the GIS is in handling the geometry of the overlay process. Handling and preparing the themes is up to the GIS analyst. Under the simplest possible configuration, GIS layers are all converted to binary maps, and an overlay then sifts the map space to leave open the areas that satisfy the selection criteria in use. This is the case in the simple overlay analysis and duplicates in the GIS methods that were worked out using transparent overlay maps and blacked out areas on the transparencies. Many of these methods date back to the turn of the twentieth century.

Exercise 8. Read the text. Find the English equivalents to the following terms:

1. статистический _____
2. логическое продолжение _____
3. разброс (например, точек на графике) _____
4. прогноз, расчет _____
5. принятие, одобрение, признание _____
6. непространственные графики, изображения _____
7. график _____

Most GIS analysts use statistical and GIS tools in tandem during the analysis stage of GIS operation. The ability to produce nonspatial graphics—for example, a scatter plot or a histogram—is often far easier this way. Given the broad acceptance of statistical packages and the large number of scientists and others trained in and familiar with their use, a compromise solution seems best. GIS packages can avoid duplicating the many functions necessary for statistical analysis by making two-way data movement between GIS and statistical software easy.

In summary, one of the greatest strengths of a GIS is that it can place real-world data into an organizational framework that allows numerical and statistical description and permits logical extension into modeling, analysis, and prediction. This important step, along with examining and thinking about one’s data, is the bridge to understanding data geographically.

UNIT 4

THE PARTS OF A MAP. CHOOSING A MAP TYPE

***Active words and phrases*:**

source – источник

extract – извлекать, выбирать

realm – область, сфера

reconstruct – воспроизводить, восстанавливать

temporary – временный

permanent – постоянный

cartographer – картограф

General purpose map – универсальная карта, карта общего назначения

Thematic map – тематическая карта

Exercise 1. Read and translate the text.

A map can be defined as a graphic depiction of all or part of a geographic realm in which the real-world features have been replaced by symbols in their correct spatial location at a reduced scale. Maps are the paper storehouses of spatial information that we use as sources of data for GIS. They are also the final stage in GIS work, the means by which the information being extracted, analyzed, and reconstructed using the powers of the GIS is at last communicated to the GIS user or the decision maker who relies on the GIS for knowledge. Maps within a GIS can be temporary, designed merely for a quick informative glance, or permanent, for presentation of ideas as a substitute for a picture or a report.

Just as a map has a structure, so that structure can vary according to which media we use for map display. GISs usually use the computer monitor to display a map, rather than the traditional paper. Only now, after many years of computer mapping, are cartographers beginning to understand how map design depends on the display medium. The GIS has been a major reason why this has become an important consideration.

Over 3000 years of cartographic history, cartographers have designed numerous ways of showing data on a map. One way to divide up the methods is to look at those that show attributes by their geometric dimension, so that we can have point maps, line maps, and area maps, plus maps that show a three-dimensional view. Many maps show some or all of the types of features at the

same time. These are often called general purpose maps. Thematic maps show just one or two themes or layers of information, often coded, colored, or grouped, for convenience. In this section we take a look at the breadth of map types available.

Exercise 2. Answer the questions using the information from the text.

1. What is a map?
2. What kinds of maps within a GIS can be?
3. What is a general purpose map?
4. What is a thematic map?

Exercise 3. Look through the text again and find the words that correspond to the following definitions.

1. a map designed for use as an intermediate product in the GIS process, and not usually subject to the normal map design sequence

   _____

2. a depiction of all or part of the earth or other geographic phenomenon as a set of symbols and at a scale whose representative fraction is less than 1:1

   _____

3. a map designed primarily for reference and navigation use

   _____

4. a map designed for use as a permanent end product in the GIS process

   _____

5. a map designed primarily to show a 'theme', a single spatial distribution or pattern, using a specific map type

   _____

Exercise 4. Read and translate key terms and definitions.

Topographic map – a map type showing a limited set of features but including at the minimum information about elevations or landforms.

Flow map – a linear network map that shows, usually by proportionally varying the width of the lines in the network, the amount of traffic or flow within the network.

Dot map – a map type that uses a dot symbol to show the presence of a feature, relying on a visual scatter to show spatial pattern.

Network map – a map that shows as its theme primarily connections within a network, such as roads, subway lines, pipelines, or airport connections.

Reference map – a highly generalized map type designed to show general spatial properties of features.

Exercise 5. Complete the sentences with the following words:

temporally thematically permanent reference map

dot map topographic map map network map

1. A _____ is often used as reference information behind GIS map layers.
2. Can you find Black Hill on the _____?
3. The accident has not done any _____ damage.
4. A _____ shows the simplest properties of the map data.
5. The maps have been grouped _____.
6. More than half the staff is _____.
7. A _____ uses dots to depict the location of features and may show a distribution such as population against a base map.
8. A _____ shows a set of connected lines with similar attributes.

Exercise 6. Learn the following words and word combinations. Find them in the text given below.

1. border – граница
2. neat line – четкая линия
3. additional information – дополнительная информация
4. coordinate system – координатная система
5. copyright – авторское право
6. rectangular frame – прямоугольная рамка
7. design standpoint – точка зрения проектировщика

The border is the part of the display medium (paper, window, computer screen, or other medium) that shows beyond the neat line of the map. In special circumstances, additional information can be provided in this space, such as the map copyright, the name of the cartographer, or the date. The neat line is the visual frame for the map and is usually a bold single or double line around the map that acts as a rectangular frame. From a design standpoint, the neat line provides the basis for the page (i.e., cartographic device) coordinate system, in display units such as inches or centimeters on the page.

Exercise 7. Fill the gaps with the prepositions from the box.

to	for	of-4	in	with

A basic outline or reference map shows the simplest properties (1)_____ the map data. An example is a world outline map, with named continents and oceans. A general reference map, usually showing a suite of features including terrain, streams, boundaries, roads, and towns, is called a topographic map. Topographic maps are often used as reference information behind GIS map layers.

A dot map uses dots to depict the location (2) _____ features and may show a distribution such as population against a base map. A picture symbol map uses a symbol, such as the silhouette of a skier, to locate point features such as ski resorts. The graduated symbol map is the same, except that the symbol size is varied with the value of the feature. Typically, geometric symbols such as circles, squares, triangles, or "shaded spheres" are used.

A network map shows a set of connected lines (3)_____ similar attributes. A subway map, an airline route map, and a map (4)_____ streams and rivers are examples. The flow map is the same, but it uses the width of the line (5) show value (6)_____example, to show the air traffic volume or the amount (7)_____ water flow (8)_____, a stream system.

Exercise 8. Read the text. Find the English equivalents to the following terms:

1. a map that in two dimensions shares many of the characteristics of a map

_____

2. a map of topography involving a colour sequence filling the spaces between successive contours, usually varying from green through yellow to brown

_____

3. a map of three dimensional surface showing a set of profiles, often parallel to the ***x***, the ***y***, or the viewer's axis so that the surface appears three dimensional as a raised fishnet viewed in perspective

_____

4. an isoline map of topographic elevations

_____

5. a map in which an apparent shading effect of raised topography is produced by computer so that the land surface appears differentially illuminated, as it would in low sun angles naturally

_____

6. a map of a tree-dimensional surface showing a coloured or shaded image draped over a topographic surface and viewed in perspective

_____

Surface continuity is assumed, meaning that sharp breaks are usually smoothed. The terrain equivalent is the contour map, with its characteristic datum and ***contour interval.*** A variant is the ***hypsometric map*** in which the space between contour lines is filled with color using a sequence designed to illustrate variation. Image maps and schoolroom topographic maps use this type.

Three-dimensional views of surfaces rendered in perspective can be either a gridded ***fishnet*** where a grid is distorted to give the impression of three dimensions, or a ***realistic perspective***, when an image or shaded map is draped over the surface rather than a grid. The latter technique is often used in animations. Map views of terrain are often represented using ***simulated hill shading***, where illumination of shadowing is simulated by the computer, and a gray scale or a colored map is used to show the surface. A variant is ***illuminated contours,*** in which the shading algorithm is applied only to the contours themselves. The final map type considered here is the ***image map***, in which a value is depicted as variation in tone on a color or monochrome grid. Most raw and false-colored satellite image maps fall into this category, as does the orthophoto map.

UNIT 5

DESIGNING THE MAP

***Active words and phrases*:**

mapping process – процесс картографирования

trial and error interaction – на основе проб и ошибок

font (AE) – комплект шрифта

fount (BE) – комплект шрифта

design loop – проектный цикл

to supply – выполнять, обеспечивать

to place – размещать

macro-like command – команда, подобная макрокоманде

Exercise 1. Read and translate the text.

The last stage in the mapping process is the conversion of the GIS data into a map design. Note that for any map type we can have an almost infinite number of choices of symbols, fonts, colors, line thicknesses, and so on. Selecting the 'best' design can make an enormous difference in the effectiveness of the map. If a map has taken a large amount of work to generate, it is well worth the GIS user's effort to make doubly sure that the design is sound.

Some characteristics of the design are predetermined by the choice of the type of map. Primarily, the design stage consists of devising a balanced and effective set of cartographic elements to make the map. A trial-and-error interaction between a map design and a set of symbols or colors comes into play, called the design loop. The GIS makes this process possible in the first place by supplying the tools to create, modify, and recreate the map.

It is important to place the map elements correctly. Placement of the elements is usually in one of two ways: first, by having the GIS draw a map, then passing it to a graphic design program and interacting with the map in a design loop**;** and second, especially in a GIS, by editing a set of macro-like commands that move elements to specific places in the map space. This technique is less efficient and involves many traverses through the design loop.

Most cartography texts state that the cartographer should aim for harmony and clarity in the composition—visual balance and simplicity. This comes from experience and an aesthetic sense that can take years to perfect. For the beginner in GIS, MacEachren (1994) and Dent (1996) give fine summaries of the design experience of professional cartographers.

Exercise 2. Answer the questions using the information from the text.

1. What is the last stage in the mapping process?
2. What does the design stage consist of?
3. What is the aim of most cartography texts?

Exercise 3. **Look through the text again and find words that correspond to the following definitions.**

1. the appearance that things have that results from the way in which they reflect light

   _____

2. a consistent design for the display of the full set of English or other language characters, including special characters such as punctuation and numbers

_____

3. an abstract graphic representation of a geographic feature for representation a map

_____

4. the iterative process in which a GIS map is created, examined for design, improved, and then replotted from the modified map definition until the user is satisfied that a good design has been reached

_____

5. the set of choices relating to how a map's elements are laid out, how symbols such as colors are selected, and how the map is produced as a finished tangible product

_____

Exercise 4. Read and translate key terms and definitions.

Cartographic elements **-** the primitive component part out of which a map is assembled, such as the neat line, legend, scale, titles, figure, and so on.

Clarity **-** the property of visual representation using the absolute minimum amount of symbolism necessary for the map user to understand map content without error.

Credit - a cartographic element in which the sources, authorship, and ownership of the map and the map attributes are cited, often including a date or reference.

Ground **-** the part of the body of the map that is not featured in the figure. This area can include neighboring areas, oceans, and so on. The ground should fall lower than the figure in the visual hierarchy.

Figure **-** the part of a map that is both referenced in the map coordinate system rather than the page layout coordinates and that is the centre of the map reader's attention. The figure is contrasted against the ground, or background.

Exercise 5. Complete the sentences with the following words:

design loop *symbols* *fount* *credits* *colours*

map design *cartographic elements* *clarity* *figure*

1. For this map we need some definite _____.
2. The _____ of that map helped me to find the way.
3. This process is called the _____, because first we design a map and then set of _____ and _____.
4. A _____ is the last stage in the mapping process.
5. The _____ are not cited on this map.
6. On a map of New York State, the state is the _____, and surrounding states,

though shown and labeled, are part of the ground and may be toned down.

7. The neat line, legend, scale are the _____.

Exercise 6. Fill the gaps with the propositions from the box.

above of-3 in-4 at from

Text is an important design element. Map text should be clear, correctly and tersely worded, and the words should be positioned as the graphic elements they are. It is easy to make a map title or legend labels either too small or too big, unnecessarily grasping the map reader's attention. Map text should be edited carefully. Many a map (1)_____ final form has retained a typographical error that should have been eliminated (2)_____ first glance, or has misspelled a foreign name that should have been checked.

Facts to bear (3) _____mind to balance the map elements are that the 'weight'(4)_____ the elements can change when a symbol set (line widths, colors, text fonts, etc.) is chosen; that the elements act (5)_____ concert with each other (6) _____a visual hierarchy, that is, some of the elements naturally stand out (7) _____or 'above' others, and that using deliberately exaggerated contrast to enhance this hierarchy is usually most effective; and that the combined effect (8) all the elements is to draw the eye to the center (9)_____ gravity of the elements. Theory implies that the 'visual centre' of the map be placed 5% of the map height (10)_____ the geometric centre.

Exercise 7. Learn the following words and word combinations. Find them in the text given bellow.

1. rules of thumb – практические правила
2. map data configurations – схемы расположений данных карты
3. misuse – неправильное употребление
4. sequence – последовательность
5. monochrome – одноцветное изображение
6. dot pattern – точечное изображение
7. cartographic convention – условные обозначения

The symbolization aspect of design has been studied by cartographers in detail, and more than a few rules of thumb exist. Some symbolization methods are simply not suitable for certain types of maps and certain map data configurations. For example, a frequent misuse of color is on choropleth maps, especially when the computer gives access to thousands of possible colors. Choropleth maps usually establish value by shading, pattern, or color intensity, but rarely by color as such. Thus a sequence from light yellow to orange with a slight color change looks right, but a sequence from red to blue across the rainbow makes the map look like

a decorated Easter egg! Color changes are appropriate to distinguish between opposites on the same map, such as a surplus/deficit, above/below a statistical average, or two-party election results.

When only monochrome is to be used, the equivalent applies. Shade sequences should be even following from dark to light, with dark usually being high, and light being low. Don't forget that white or blank can be a shade tone, leaving the map looking less cluttered as a result. Another issue is pattern. Combinations of crosshatching, dot patterns, and so on can be extremely confusing to the map reader. Combining unmatched patterns can create undesirable optical illusions.

Even on general-purpose maps, color balance is essential. Computer displays use pure color, to which the eye is not usually subjected. Less saturated colors, if available, are more suitable for mapping. In addition, *cartographic convention* should be followed. Ground colors are usually white, gray, or cyan, not black or bright blue. Contours are frequently brown, water features cyan, roads red, vegetation and forest green, and so on. Failure to follow these conventions is particularly confusing to the map reader. Imagine, for example, a globe with green water and cyan land! Map colors can also look completely different on a white rather than a black background, and even on different monitors and plotters.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. положение, расположение рядом _____
2. интенсивность _____
3. одновременный контраст _____
4. насыщенность (цвета) _____
5. оттенок, тон _____
6. фон

   _____
7. десятичная величина

   _____

Color is a complex visual variable. Colors are often expressed as red, green, blue triplets (RGB) or sometimes as *hue, saturation,* and *intensity* (HSI). These values are either determined by the hardware device (e.g., 8-bit color allows a total of 256 colors from any of 256 • 256 • 256 combinations of individual values of RGB) or are decimal values of HSI between zero and one. For example, in RGB, a mid-gray would correspond to [128,128,128]. It is possible to translate directly between the RGB and HSI representations of color. Whereas RGB values are simply the degree to which the respective colored phosphors of the monitor emit light, HSI is closer to the way in which people perceive color.

Hue corresponds to the wavelength of light, going from red at the long-wave end of the visible light spectrum to blue at the other end. *Saturation* is the amount of color per unit display area, and *intensity* is the illumination effect or brightness of the color. Cartographic convention dictates that hue is assigned to categories and that saturation or intensity is assigned to numerical valve. When several hues appear in juxtaposition on a map, the colors are perceptually altered by the eye, a phenomenon known as *simultaneous contrast.* Thus maps that use several hues, even as background and line color, should be designed with caution. In addition, the eye's ability to resolve contrast varies significantly with hue, highest in red and green and lowest in yellow and blue.

UNIT 6

THE EVOLUTION OF GIS SOFTWARE

Active word and phrases:

intelligent selection	– *зд*. правильный выбор
account	– основание, причина
spectacular failure	– явная несостоятельность
background	– обоснование, объяснение
sophisticated	– усложненный
advance	– прогресс
interface	– устройство сопряжения
standardize	– нормировать
overall development	- всеобщее развитие

Exercise 1. Read and translate the text.

One of the first tasks a GIS user faces is deciding which GIS software to use. Even if a GIS has already been purchased, installed, and placed right in front of your nose, it is very natural to wonder whether some other GIS system might be better, faster, easier to use, have clearer documentation, or be better suited to the actual task you are working on. This unit gives some of the background necessary to make an intelligent GIS selection. There is quite a history to learn from, including some excellent accounts of spectacular failures, but also many examples of clear statements of how things went right. Examples from the early days of GIS are the papers by Tomlinson and Boyle (1981) and Day (1981). The philosophy

here is that the educated consumer is the best GIS user, and an effective user soon becomes an advocate and sometimes a GIS evangelist. This unit is not intended to tell you which GIS to buy or use. Rather, it is hoped that, it will help you to decide this for yourself.

As is often the case, a good education begins with a little history. The texts introduced overall GIS development in terms of the distant origins of geographic information science as a whole. This was difficult to do without mentioning specific GIS software packages. Now it is appropriate to discuss the development of software in more detail.

Exercise 2. Answer the questions using the information from the text.

1. What is the first task a GIS user faces?
2. What is Jomlinson's philosophy?
3. What are the examples of the early days of GIS?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. the circumstances or part events which help explain why something is how it is

   _____
2. connected with one particular thing only

   _____
3. a set of believes or an attitude to life that guides somebody's behaviour

   _____
4. to buy something

   _____
5. all the events that happened in the past

   _____

Exercise 4. Read and translate key terms and definitions.

Software package – a set of related programs for a particular type of task.

Congress – a large format meeting or series of meetings where representatives from different groups discuss ideas, make decisions.

Survey – the act of examining and recording the measurements, features etc. of an area of land in order to make a map or plan of it.

Sophisticated – clever and complicated in the way that it works or is presented.

Program – a set of instructions in code that control the operations or function of a computer.

Exercise 5. Complete the sentences with the following words:

congress program purchased software package history

background specific philosophy survey sophisticated

1. The system came with a database _____.
2. This international _____ was very interesting.
3. Geological techniques are becoming more _____ all the time.
4. The equipment can be _____ from your local supplier.
5. Her _____ of life is to take every opportunity that presents itself.
6. Load the _____ into the computer.
7. Many people throughout _____ have dreamt of a world without war.
8. The money was collected for a _____ purpose.
9. Can you give me more _____ on the company's financial position?
10. First of all you must do a geological_____.

Exercise 6. Fill in the gaps with the prepositions from the box.

by	of-2	in-5	on	at

GIS software did not suddenly appear as if by magic. There was a lengthy period leading up to the first real GISs during which the breed evolved rather rapidly. As we saw the intellectual ancestry included the creation (1)_____ a spatial analysis tradition (2)_____ geography, the quantitative revolution, and dramatic technological and conceptual improvements (3)_____ the discipline of cartography.

An early GIS landmark was an international survey of software conducted (4)_____ the International Geographical Congress in 1979 (Marble, 1980). This survey had three volumes, one (5)_____ which was entitled *Complete Geographic Information Systems,* although (6)_____ fact few true GIS packages were represented. This volume was influential (7)_____ deciding on the name "GIS" because many alternatives were in use at that time. Just as important were the two volumes *Cartography and Graphics* and *Data Manipulation Programs.* Together, these three volumes encapsulated the state of geographic data processing (8) the 1970s (Brassel, 1977). Most cartographic programs were single-purpose FORTRAN programs to do individual GIS operations such as digitizing, data format conversion, plotting (9)_____ a specific hardware device such as a pen plotter, map projection transformations, or statistical analysis of data. None of

these packages were integrated; a typical use would be to apply a series of one-at-a-time geographic operations to arrive (10)_____ a final result or map.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. point to grid conversion – перенос узловых точек на координатную сетку
2. line printer – устройство построчной печати.
3. mainframe computer – большая ЭВМ.
4. spreadsheet – крупноформатная таблица
5. statistical graphics – статистическая графика
6. extension – увеличение

Some of the early computer mapping systems had already devised many GIS functions by this time, however. Among these were SURFACE II by the Kansas Geological Survey, which could do point-to-grid conversions, interpolation, surface subtraction, and surface and contour mapping; CALFORM, a package that could produce thematic maps; SYMAP, a sophisticated analytical package from the Harvard Laboratory for Computer Graphics and Spatial Analysis that nevertheless ran only on mainframe computers and gave line-printer plots; and the Central Intelligence Agency's CAM, which made plots from the World Data Bank outline maps with different map projections and features.

By 1980 the first computer spreadsheet programs had arrived, led by the VisiCalc program, a very early microcomputer software ‘killer app.’ VisiCalc contained only a few of the capabilities of today’s equivalent packages, yet for the first time gave the; ability to store, manage, and manipulate numbers in a simple manner. Above all, data could be seen as active a spreadsheet rather than as a static “report” that consisted of a pile of computer printout. The links to statistical graphics, now common in packages such as SASGRAPH and Harvard Graphics, were a natural extension of this capability.

The ancestry of GIS is completed by the first advances in database management systems. Early systems for database management were based on the less sophisticated data models of the hierarchical and related data models. A landmark was the beginning of the relational database managers in the early 1970s. Relational database managers quickly became the industry standard, first in the commercial world of records management and later in the microcomputer world.

Exercise 8. Read the text. Find the English equivalents to the following terms:

1. особые требования _____

2. частые переработки и корректировки _____
3. система гражданского назначения _____
4. система производственных записей _____
5. сравнения с (географическим) геообразцом _____
6. комплексный пакет программ _____
7. пользовательский интерфейс _____

By the late 1970s all of the necessary parts of a GIS existed as isolated software programs. The largest gap to be filled was between the relational database manager and the programs that dealt with plotting maps. The specific demands of hardware devices from particular manufacturers kept this as a constantly evolving field, with frequent rewrites and updates as systems and hardware changed. Later, the device independence attributable to common operating systems such as Unix and computer graphics programming standards such as GIS, Core, and PHIGS led to a narrowing of this chasm, to the point where today it remains as barely a discernible dip in the GIS ground. The scene was set for the arrival of the first true GISs.

One of the earliest civilian systems to evolve all the capabilities of a true GIS was the CGIS (Canadian Geographical Information System), mostly because this system was the first to evolve from an inventory system toward doing analyses and then management. Essential to the emergence were the georeferencing and geocoding of the data, database management capability, a single integrated software package without separate, stand-alone elements, and a single user interface.

UNIT 7

GIS AND OPERATING SYSTEMS.

GIS FUNCTIONAL CAPABILITIES: DATA COMPUTER

***Active words and phrases*:**

workstation – автоматизированное рабочее место

multitasking – многозадачный режим

functional definition – функциональное определение

input – ввод (информации)

digitizing tablet – кодирующий планшет

node – точка пересечения

generalization – обобщение

warp – искривление

implementation – разработка, реализация (программы)

Exercise 1. Read and translate the text.

Early GIS was heavily influenced by the types of operating systems in use. Early operating systems were quite unsophisticated but were used with GIS nevertheless. Among these were IBM's mainframe operating systems, MSDOS by Microsoft, and DEC's VMS. These were rapidly replaced as the various GUI-based operating systems came into operation and as the microcomputer and workstation took over from the minicomputer and mainframe.

In the microcomputer environment, the GUI-based operating systems include Windows, Windows-NT, and Windows 95. The unified user interface, revolutionized by the Apple Macintosh's GUI and desktop metaphor, quickly took over as the dominant microcomputer operating environment, although others have remained popular also. These operating systems added two critical elements to the microcomputer's capabilities: *multitasking* (allowing many simultaneous work sessions) and *device independence,* meaning that plotters and printers could be taken out and assigned to the operating system instead of the GIS package, in somewhat the way that printing and screen fonts are handled centrally, rather than duplicated in every Windows package.

One system that had encompassed these capabilities since its inception, and that swept the workstation environment, was Unix. Unix is a very small and efficient central operating system that is highly portable across computer systems. It has been the dominant workstation environment for two reasons: first, because it has complete integrated network support, and second, because several full GUIs exist for Unix in the public domain, the most important being the X-Windows system. X-Windows implementations of most leading GUIs exist, including OpenLook and the Open Software Foundation's MOTIF interface. In many Unix systems, the user can switch the GUI to suit particular needs or applications. A full GUI programming tool kit, including such tools as Xt, Xview, and the X-Windows libraries Xlib, is part of the X-Windows release.

Exercise 2. Answer the questions using the information from the text.

1. What early operating systems do you know?
2. What two critical elements did the GIS-based operating systems add to the microcomputers capabilities?
3. Why has Unix been the dominant workstation environment?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. a computer operating system that has been made workable on virtually every possible computer and has become the operating system of choice for workstations and science and engineering applications _____
2. the ability of a computer's operating system or a GIS to handle more than one process at once; for example, editing and running a command sequence while extracting data from the database and displaying a map _____
3. the ability of software to run with little difference from a user's perspective on any computer or on any specialized device, such as a printer or plotter _____
4. the set of visual and mechanical tools through which a user interacts with a computer, usually consisting of windows, menus, icons, and pointers _____
5. the complete structure within which a user, computer or program operates _____

Exercise 4. Read and translate key terms and definitions.

Affine transformation **-** any set of translation, rotation, and scaling operations in the two spatial directions of the plane.

Clump **- t**o aggregate spatially; to join features with similar characteristics into a single feature.

Dissolve **-** eliminating a boundary formed by (the edge or boundary of a feature that becomes unnecessary after data have been captured: for example, the edges of sheet maps.)

Generalization **-** the process of moving from one map scale to a smaller (less detailed) scale, changing the form of features by simplification, and so on.

Node snap **-** instructing the GIS software to make multiple nodes or points in a single node so that the features connected to the nodes match precisely, say at a boundary.

Exercise 5. Complete the sentences with the following words.

GIS multitasking environment clump device independence Unix affine transformations dissolved generalization node snapping

1. All the original calcium had _____ away.
2. _____ is a very small and efficient central operating system that is highly portable across computer systems.
3. My computer can operate several programs at the same time _____ is its capability.
4. _____ - based operating systems include Windows, Windows NT in the microcomputer_____.
5. Galaxies lend to _____ together in clusters.
6. _____ are other functions typical of an editor.
7. Try to avoid _____.
8. These operating systems have two critical elements to the microcomputers capabilities: multitasking and _____.
9. _____ allow maps with different scales, orientations, and origins to be co registered.

Exercise 6. Fill in the gaps with the prepositions from the box.

to	of-4	for	in	on-3

As a final benefit, several versions of Unix and all (1)_____ the GUI systems run extremely efficiently (2)_____ microcomputers, including shareware Unix releases such as Linux, not only outperforming the Windows-type GUIs, but being available free or as shareware on the Internet or from inexpensive suppliers (3)_____ _____ CD-ROM. A key element here has been the Free Software Foundation's releases, including GNU (GNU is NOT UNIX) versions (4) virtually every key element of Unix.

Thus, two main avenues for GISs have evolved as far as operating systems are concerned. On the microcomputer platform a lingering set (5)_____ DOS applications is rapidly being rewritten (6)_____ the updated versions (7)_____Microsoft's Windows. (8)_____ this GIS environment, the number of systems installed, the mobility of laptop and subnotebook computing, and the low cost of software have been major strengths. (9)_____ the workstation platform, Unix and X-Windows, often with MOTIF as the GUI, reign supreme. This work environment has led (10)_____ high-end applications, large data sets, networking, depth of software, and high-quality graphics. Both are healthy and prospering workplaces for GIS.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. first critical step – первый ответственный этап
2. outline map – карта-схема

3. generic format – типичный формат
4. hand written annotation – примечание, написанное от руки
5. extensive support – широкая, экстенсивная поддержка
6. editing system – система редактирования
7. digitizing error – графическая ошибка

Getting the map into the computer is a critical first step in GIS. Geocoding must include at least the *input* of scanned or digitized maps in some appropriate format. The system should be able to absorb data in a variety of formats, not just in the native format of the particular GIS. For example, an outline map may be available as an AutoCAD DXF format file. The GIS should at a minimum be capable of absorbing the DXF file without further modification. Similarly, attributes may already be stored in standard database format (DBF) and should be absorbable either directly or through the generic ASCII format.

Before a map can be digitized, however, it needs to be prepared. Different GIS packages handle the amount of preparation required in quite different ways. If the package supports scanning, the map needs to be clean, fold-free, free of handwritten annotation and marks, and on a stable base such as Mylar. If the map is digitized by hand it may need to be cut and spliced if the package does not support *mosaicing,* and control points with known locations and coordinates need to be marked for registering the map onto the digitizing tablet. Some GIS packages have extensive support for digitizing and sophisticated *editing* systems for detecting and eliminating digitizing errors. Others have few or none.

We also saw how essential it was to edit the maps after they have been captured. This requires the software to have an editing package or module some kind. FOR a vector data set, at the minimum we should be able to delete and reenter a point or line. For a raster, we should be able to modify the grid by selecting subsets, changing the grid spacing, or changing a specific erroneous grid value.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. резкое изменение узловых точек _____
2. тождественные координаты _____
3. разлагать на составляющие _____
4. цельная, монолитная (база данных) _____
5. разрыв, отсутствие непрерывности _____
6. минимальное расхождение _____
7. допустимое отклонение _____

Other functions typical of an editor are *node snapping,* in which points that are close to each other and that should indeed be the same point, such as the endpoints of a line segment, are automatically placed into the graphic database with the identical coordinates; *dissolve,* when duplicate boundaries or unnecessary lines (e.g., the digitized edges of adjacent category-type maps) are eliminated automatically or manually; and *mosaicing* or 'zipping,' in which adjacent map sheets scanned or digitized separately are merged into a seamless database without the unnecessary discontinuities caused by the lack of edge matching of the paper maps. For example, a major road that crosses two map sheets does not need to be represented as two separated features in the final GIS database.

Another important editing function is the ability to deal with map *generalization.* Many digitizing modules of GIS systems, and certainly scanning, generate far more; points than are necessary for the use of the GIS. This extra detail can complicate data reformatting and display, slow the analysis process, and lead to memory problems on the computer. Many GIS packages allow the user to select how much detail to retain in a feature. Most will retain points that have a minimum separation and snap together all points within a fuzzy tolerance.

For point data sets, most GIS packages will eliminate or average duplicate points with the same coordinates. Some will allow *line generalization,* using any one of many algorithms that reduce the number of points in a line.

UNIT 8

GIS FUNCTIONAL CAPABILITIES: DATA STORAGE

***Active words and phrases*:**

batching commands – команды для выполнения пакетной обработки

storage – память с большой плотностью данных

high-density-storage – память (запоминающее устройство) с большой плотностью записи

resolution – разрешающая способность

user-friendliness – удобство для пользователя

data access – доступ к данным

metadata – метаданные

on-line data – оперативные данные

off-line data – данные, не установленные на устройство ввода-вывода

Exercise 1. Read and translate the text.

Data storage within a G1S has historically been an issue of both spaces—usually how much disk space the system requires—and access, or how flexible a GIS is in terms of making the data available for use. The massive reductions in the cost of disk storage, new high-density storage media such as the CD-ROM, and the integration of compression methods into common operating systems have made the former less critical and the latter more so.

Current emphasis, therefore, is upon factors that improve data access. This has been a consequence also of the rise of distributed processing, the Internet, and the World Wide Web. As a result, many GIS packages are now capable of using *metadata,* or data about data, in an integrated manner. Metadata support might include a system for managing a single project as a separate entity, to managing many projects with multiple versions, to full support for exchangeable metadata stored in common formats and searchable through online "clearinghouses". The USGS's Global Land Information System, NASA's master directory, and the Federal Geographic Data Committee's Spatial Data Clearinghouse are all examples. Participation in the common library entails both standardizing the metadata to make it searchable and agreeing to make the data available either on or offline.

Other larger issues around GIS use, most essential to the degree of user friend lines of the system, concern the mechanism for user interaction with the software's functionality. Virtually all GIS software allows user interaction via command lines and/or windows within a GUI. The GUI interface is tedious, however, without some way of *'batching*' commands so that they can be executed either at another time, as a back ground task while the user gets on with another job, or for design-loop editing to change minor aspects of the process. Most systems, therefore, also contain a 'language' for the user to communicate with the system. This allows users to add their own custom functions, automate repetitive tasks, and add features to existing modules. These languages are usually command-line programs or *macros,* but they can also be enhancements of existing programming languages such as Basic and Smalltalk.

Exercise 2. Answer the questions using the information from the text.

1. What are many GIS packages now capable of using?
2. What might metadata support include?
3. What do most systems contain for the user to communicate with the system?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. to put something together with something else so as to increase the size, number, amount etc.

   _____

2. the process of keeping information, etc. on a computer; the way it is kept

   _____

3. not very large, important or serious

   _____

4. a planned piece of work that is designed to find information about something, to produce something new, or to improve something

   _____

5. that can be exchanged

   _____

Exercise 4. Read and translate key terms and definitions.

Microcomputer – a small computer that contains a microprocessor.

Metadata - data about data. Index-type information pertaining to the entire data set rather than the objects within the data set.

Batch - submission of a set of commands to the computer from a file rather than directly from the user as an interactive exchange.

Macro - a command language interface allowing a 'program' to be written, edited, and then submitted to the GIS user interface.

Address matching - address matching means using a street address such as *123 Main Street* in conjunction with a digital map to place the street address onto the map in a known location.

Exercise 5. Complete the sentences with the following words:

storage project exchangeable added minor

metadata batching macros address matching microcomputer

1. These may be some _____ changes to the schedule.
2. You must know everything about the _____ and retrieval of in formation.
3. We use these languages which are usually command-line programs or _____.
4. My friend has a _____.
5. These tokens are _____ for CD's and cassettes only.
6. You need set up a _____ to computerize the library system.

7. The GIS interface is tedious without some way of _____commands.
8. A new wing was _____ to the building.
9. _____ a mailing list would convert the mailing of characteristics of the places on the list.
10. _____ usually includes the date, source, map projection etc. as well as data about the format and structure of the data set.

Exercise 6. Fill in the gaps with the prepositions from the box.

in-2	for	on-2	into	of-3	from

Although disk storage is less critical than (1)_____the past it can still be a constraint. GIS software (2)_____a microcomputer can occupy tens (3)_____ megabytes even without data, and (4)____ a workstation perhaps hundreds of megabytes. As data become higher resolution, as more raster layers are used, and as finer and finer detail becomes available, many GIS data sets can easily move (5)_____ the gigabyte range (6)_____ size.

This implies that not only is supporting multiple resolutions important — (7)____example, using coarse browse images as samples (8)_____ the real thing— but also that data compression should be supported. This can vary all the way (9)_____ partitioning data sets to meet constraints (such as a maximum number (10)____ polygons) to supporting compressed data formats and structures such as JPEG, run-length encoding, or quadtrees.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. data format – формат данных
2. topological structure – топологическая структура
3. three-dimensional – трехмерный
4. quadree – дерево квадрантов, 4 - дерево
5. convert – преобразовывать
6. entity – (целостный) объект
7. vector – одномерный массив, 1 – вектор

Support for data formats is important to a GIS when data are to be brought in from outside (e.g., public-domain data from the Internet). Ideally, the GIS software should be able to read common data formats for both raster (DEM, GIF, TIFF, JPEG, Encapsulated PostScript) and vector (TIGER, HPGL, DXF, PostScript,

DLG). Some GIS packages have import functions only into a single data structure, usually either an entity-by-entity structure or a topological structure.

For three-dimensional data, these systems usually support only the triangular irregular network. Others support only raster structures based on the grid, including the quadtree, and either convert all data into this structure or just ignore it. Some GIS packages continue to support only data in a proprietary format, available only at cost from the software vendor. A rather critical GIS function is the ability to convert between raster and vector data, an absolutely essential feature for the integration of multiple data sources such as GPS data and satellite images.

Of increasing interest in recent years has been the development of GIS functions that support data in standard exchange formats. At the national and international levels, several data transfer standards have now been developed, such as the Spatial Data Transfer standard and DIGEST. As these standards become mandated, and as the role of data exchange increases, led by the Internet, most GIS systems will develop support for inputting and outputting data in these standard formats. The 2000 census, with its support for the federal information processing standard for data exchange, will probably drive GIS vendors to support this necessary next step for GIS.

Exercise 8. Read the text. Find the English equivalents to the following terms:

1. система управления базой данных
   _____
2. набор программного обеспечения
   _____
3. формат плоского файла
   _____
4. ячейки памяти
   _____
5. ввод данных
   _____
6. функции поиска
   _____
7. сортировка данных
   _____

Much of the power of GIS software comes from the ability to manage not just map data but also attribute data. Every GIS is built around the software capabilities of a database management system (DBMS), a suite of software capable of storing, retrieving selectively, and reorganizing attribute information. The database manager allows us to think that all the data are available, that the data are structured in a simple flat-file format, and that they constitute a single entity.

In fact, the database manager may have partitioned the data between files and memory locations and may have structured it in any one of several formats and physical data models.

A database manager is capable of many functions. Typically, a DBMS allows data entry, and data editing, and it supports tabular and other list types of output, sometimes independent of the GIS. Retrieval functions always include the ability to select certain attributes and records based on their values. For example, we can start with a U.S. database, and select out all records for states containing cities with over one million inhabitants, forming a new database that is wholly enclosed by the original and that duplicates part of it. We can also perform functions such as sorting data by value, and retrieving a selected record by its identification, such as a name or a number.

UNIT 9

GIS FUNCTIONAL CAPABILITIES:

DATA RETRIEVAL, DATA ANALYSIS, DATA DISPLAY

***Active words and phrases*:**

retrieval – восстановление данных

single feature – отдельный пространственный объект

overlay – наложение, совмещение

polygon – многоугольник, (замкнутая) линия

cell - элемент

to multiply – умножать

to sift – тщательно рассматривать, анализировать

basin – бассейн (реки)

Exercise 1. Read and translate the text.

Another major area of GIS functionality is that of data retrieval. As we saw a GIS supports the retrieval of features by both their attributes and their spatial characteristics. All GIS systems allow users to retrieve data—they wouldn't qualify as a GIS if they did not! Nevertheless, among systems some major differences exist between the type and sophistication of GIS functionality for data retrieval.

The most basic act of data retrieval for a GIS is to show the position of a single feature. This can be by retrieving coordinates as though they were attributes, or more commonly by displaying a feature in its spatial context on a map with respect to a grid or other features. For line features, the same goes, with the exception that line features have the attribute of length, and polygon features have the attribute of area. The GIS should be able to calculate and store these important basic properties as new attributes in the database. For example, for a set of counties we may want to take a polygon attribute such as an area of forest and divide it by the county area to make a percentage density of forest cover. Another common measurement we may want is to count features. For example, with the same database we could count the number of fire stations within the same counties by doing a point-in-polygon count from a separate database of municipal utilities and then relate the forest cover to the fire-prevention capabilities.

We have seen that a GIS has the critical capability of allowing the retrieval of features from the database using the map as the query vehicle. One way, indeed the most basic way, of doing this is to support the ability to point at a feature, using a device such as a mouse or a digitizer cursor, to see a list of attributes for that feature. Again, the ability to select by pointing to a location virtually defines a GIS. If it cannot do this the system is probably a computer mapping system, not a GIS. Just as critical is the database manager select-by-attribute capability. This is normally a command to the database query language that generates a subset of the original data set. For example, we could find all houses in a real estate GIS that had been listed on the market in the last year. Similarly, we could find all houses built after 1990. All GIS systems and all database managers support this capability.

Exercise 2. Answer the questions using the information from the text.

1. What does a GIS support the retrieval of features by?
2. What is the most basic act of data retrieval for a GIS?
3. What defines a GIS?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. to face or to be directed towards a particular direction

_____

2. something important, interesting or typical of a place

_____

3. to calculate the total number of people, things, etc. in a particular group

_____

4. the act or the process of finding the size, quantity or degree of something

_____

5. a question, especially one asking for information or expressing a doubt about something

_____

Exercise 4. Read ant translate key terms and definitions.

Buffer **-** a zone around a point, line, or area feature that is assumed to be spatially related to the feature.

Map algebra **–** Tomlin's terminology for the arithmetic of map combination for coregistered layers with rasters of identical size and resolution.

Sift **-** to eliminate features that are smaller than a minimum feature size.

Desktop mapping **-** the ability to generate easily a variety of map types, symbolization methods, and displays by manipulating the cartographic elements directly.

Multiply **-** to add a number to itself a particular number of times.

Exercise 5. Complete the sentences with the following words:

queries measurement pointing counting features

map algebra sifted desktop mapping multiply

1. The project is based on _____ _____.
2. Our assistant will be happy to answer your _____.
3. GIS systems need to be able to perform _____ that is generating geographical and thematic maps so that they can be integrated with other functions.
4. The telescope was _____ in the wrong direction.
5. Accurate _____ is very important in science.
6. _____ 2 and 6 together and you get 12.
7. Dana Tomlin has classified the operations that are performed into a structure called _____.
8. He _____ the relevant data from the rest.
9. This polygon is a _____.

Exercise 6. Fill in the gaps with the prepositions from the box.

of-4 by-2 for-2 on-2

As we saw, GISs allow a set (1)____retrieval operations based (2)____using one or more map features as handles to select attributes (3)____ those features. Although some (4)_____them are very simple, these operations are also a real litmus test (5)____ establishing whether or not a software package is a GIS. A GIS should allow the user to select a feature (6)_____ its proximity to a point, a line, or an area. For a point, this means selecting all features within a certain radius. (7)_____ a line or a polygon, we have used the term *buffering.* Buffering allows the GIS users retrieve features that lie within perhaps 1 mile of an address, within 1 kilometer of a river, or within 500 meters of a lake. Similarly, weighted buffering allows us to choose a no uniform weighting of features within the buffer, favoring close-by instead of distant points, for example.

The next form (8)_____ spatial retrieval is map *overlay,* when sets of irregular, no over-lapping regions are merged to form a new set of geographic regions that the two initial sets share. In the new attribute database it is possible to search (9)____ either set of units. A GIS should be able to perform overlay as a retrieval operation since to support the many spatial analyses based (10)___ map combination and weighted layer solutions.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. option – выбор
2. pipe – труба
3. node – точка пересечения
4. Boolean operation – логическая операция
5. municipal utilities – коммунальные предприятия
6. saturated – насыщенный
7. sophisticated - сложный, усовершенствованный

Another important set of retrieval options are those that allow networks to be constructed and queried. Typical networks are subway systems, pipes, power lines, and river systems. Retrieval operations involve searching for segments or nodes, adding or deleting nodes, redirecting flows, and routing. Not all GIS systems need these functions, but if the purpose is to manage a system usually abstracted as a network, such as a highway or rail system, a power supply system, or a service delivery system, obviously the GIS should then have this feature.

Dana Tomlin (1990) has elegantly classified the operations that a raster GIS can perform into a structure called *map algebra.* In map algebra, the retrieval

operations used are Boolean, multiply, recede, and algebra. *Boolean* operations are binary combinations. For example, we can take two maps, each divided into two attribute codes ‘good’ and ‘bad’ and find a binary AND solutions layer where both layers are ‘good’. *Multiply* allows two layers to be multiplied together—for example, two sets of weights to be combined. In *recode* operations a range of computed attribute codes can be reorganized. Map *algebra* allows compute operations, such as map-to-map multiplication for a binary AND over the space of a grid.

Two truly spatial retrieval operations are the ability to *clump* or aggregate areas, and to *sift.* For example, all areas of saturated soils surrounding swamps could be added to the swamps and receded as wetlands, making a new, broader category of attribute. Sifting simply eliminates all areas that are too small, individual cells falling between two larger areas, or a tiny sliver polygon. Finally, some complex retrieval operations require the GIS to be able to compute numbers that describe shape. Common shape values are the length of the perimeter of a polygon squared, divided by its area, or the length of a “line” divided by the straight-line distance between the two endpoints.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. настольное картографирование _____
2. предметная карта _____
3. диаграмма линий уровня _____
4. диаграмма поперечного сечения _____
5. трехмерный _____
6. подходящая цветовая схема _____
7. ошибочная карта, карта с ошибками _____

Most of the display capabilities of GISs have been covered. GIS systems need to be able to perform what has become called *desktop mapping,* generating geographical and thematic maps so that they can be integrated with other functions. GISs typically can create several types of thematic mapping, including proportional symbol maps; and they can draw isoline and cross-sectional diagrams when the data are three dimensional.

Almost all GIS packages now either allow interactive modification of map elements moving and resizing titles and legends—or allow their output to be exported into a package that has these capabilities, such as Adobe Illustrator or

Corel Draw. A very limited few GIS packages include cartographic design help in their editing of graphics, defaulting to suitable color schemes, or notifying the user if an inappropriate map type is being used for the data. This would be a desirable feature for many of the GISs on today's market and could avoid many tasteless or erroneous maps before they were created.

UNIT 10

GIS SOFTWARE AND DATA STRUCTURES.

CHOOSING THE 'BEST' GIS: ArcGIS

***Active words and phrases*:**

acceptable level	– допустимый уровень
software	– программное обеспечение
favored	– предпочтительный
to imply	– подразумевать
version	– версия
geographic space	– географическое пространство
to support	– поддерживать
extensive characterization	– пространственное описание

Exercise 1. Read and translate the text.

In the preceding discussion, the focus was on what functional capabilities the typical GIS offers. It should not be forgotten that many GIS features are predetermined by the GIS's particular data structure. As we saw at the very least the underlying data structure that the GIS uses, typically raster or vector but potentially also TIN, quadtree, or another model, such as object-based, determines what the GIS can and cannot do, how operations take place, and what level of error is involved.

In general, the driving force for the choice of structure should be not only what type of system can be afforded, but more critically, what model is most suitable to a particular application, what retrieval and analysis functions will be used most, and what is the acceptable level of resolution and error.

Some examples where particular structures are favored include extensive land characterization applications such as forestry, where detailed data are not

required (favors raster); applications involving irregular polygons and boundary lines, such as political units or census tracts (favors vector); applications that require the ability to register all features accurately to ground locations (favors vector); applications making extensive use of satellite or terrain data (favors raster); or applications where image processing functions and analyses such as slope and drainage analysis are to be conducted (favors raster). In many cases, the raster to vector conversion is done outside of the GIS in specialist conversion software, so that care can be taken to avoid the most common types of error, and so that the user can be brought in to resolve cases where the software is unable to solve a rasterization problem.

Increasingly, of course, many GIS systems allow the user to input and keep data in both raster and vector form. The GIS user should realize, however, that virtually all cross-structure retrieval and analysis requires one (or both) of the layers to change structure, and that this transformation often stamps itself irretrievably on the data's form, accuracy, and suitability for further use.

Exercise 2. Answer the questions using the information from the text.

1. What is the driving force for the choice of the GIS's data structure?
2. What do many GIS systems allow the user to do?
3. What should the GIS user realize about the GIS's data structure?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. something such as an object, a fact or a situation that shows, explains or supports what you say _____
2. an act of choosing between two or more possibilities something that you can choose _____
3. a quantity that has both size and direction _____
4. an organized set of ideas or theories or a particular way of doing something _____
5. the thing or person that people are most interested in

_____

Exercise 4. Read and translate key terms and definitions.

Meaningless – without any purpose or reason and therefore not worth doing or having.

Process – a series of things that are done in order to achieve a particular result.

To automate – to use machines and computers instead of people to do a job or task.

Intuitive – obtained by using your feelings rather than by considering the facts.

Engineering – the activity of applying scientific knowledge to the design building and control of machines, roads, bridges etc.

Exercise 5. Complete the sentences with the following words:

focus choice example vectors system intuitive

meaningless process automated engineering

1. The entire manufacturing process has been _____.
2. He had an _____ sense of what the reader wanted.
3. Can you give me an _____ of what you mean?
4. The British educational _____ is very popular all over the world.
5. It was the main _____ of attention at the meeting.
6. We are in the _____ of selling our house.
7. The bridge is a triumph of modern _____.
8. We fill up our lives with _____ tasks.
9. Acceleration and velocity are both _____.
10. We are faced with a difficult _____.

Exercise 6. Fill in the gaps with the prepositions from the box.

to	with	over	of-3	for	in-2	on

The term ‘best’ is extremely subjective where GIS is concerned. Some systems have extremely loyal followings who advocate their system (1)_____ others. A “best” system implies that one solution is best for all problems, which is of course largely meaningless. The following subset (2)_____GIS systems, most available commercially, is intended to illustrate the breadth and depth (3)_____ systems (4)_____ the market today and some of the major and minor differences among these systems.

No endorsement is intended, and the list is provided (5)_____ further the GIS ‘consumer’s’ education. Research has shown that these ‘big eight" packages account (6)_____ the majority (7)_____ those used in educational, and many professional, settings (8)_____ some cases, different GIS software packages are used (9)_____ combination or along (10)_____ other software for statistical analysis, graphical editing, or database management.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. long-lived – долговечный
2. full-function – полнофункциональный
3. mainframe – большая ЭВМ
4. data conversion – преобразование данных
5. data base management systems – системы управления базой данных
6. link – связь
7. software tool – вспомогательная программа

ArcGIS, the latest version of Arc/Info, is a long-lived, full-function GIS package that has been ported to the microcomputer, the workstation, and the mainframe. Arc/Info and ArcGIS are used to automate, manipulate, analyze, and display geographic data, and the software incorporates hundreds of sophisticated tools for map; automation, data conversion, database management, map overlay and spatial analysis, interactive display and query, graphic editing, and address geocoding. The ArcInfo software includes a relational database interface for integration with commercial database management systems and a macro language called AML (ARC Macro Language) for developing customized applications. Since release 8, ArcGIS has instead used Visual Basic as its macro and programming language. ArcGIS uses a generic approach to geographic information systems that is not application specific, allowing the software to address virtually any geographic application. The software runs both on higher-end microcomputers and is available on several Unix workstations and for Windows NT.

ESRI is broadly accepted as a market leader in GIS, with many thousands of users in a variety of organizations worldwide. The software is used by federal, state, and local government organizations; and by businesses, utilities, and universities to address applications in planning, cartography, transportation, research, telecommunications, oil and gas, forestry, and many other disciplines. Release 8 of the program, in 1999, was a substantial modification of the program's user interface and functionality. Object-modeling capability and links to the Spatial Data Base Engine and other relational database management systems such as Oracle are included. With the latest versions of the software, the compatibility between ArcGIS and Arc View has been increased. The software uses the Windows COM component based software architecture, and is compatible with many other Window-based software tools.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. система типа "рабочий стол" _____
2. вывод информации на экран _____

3. метод визуального отображения _____
4. компоновка _____
5. набор инструментальных средств _____
6. визуализация данных _____
7. файл данных _____

Arc View is available for Windows, Macintosh, and a variety of Unix platforms. It is a desktop system for storing, modifying, querying, analyzing, and displaying information about geographic space. An intuitive graphical user interface includes data display and viewing tool. Support for spatial and tabular queries, “hot links” to other desktop applications and data types, business graphics functions such as charting, bar and pie charts, and map symbolization, design, and layout capabilities are supported. Geo-coding and address matching are also possible. The Spatial Analyst tool kit makes working with raster data such as terrain and DEMs possible. Other extensions permit network analysis, allow Web activation of Arc View maps, and support advanced display features such as three-dimensional data visualization. Arc View GIS since version 8 has been more compatible with ArcGIS.

ArcView is also a product of ESRI which makes ArcGIS. Compatibility exists between the two systems, with ArcView being more oriented toward map display than database management. Maps and data files are easily exchangeable between the formats used in the two systems, shape files, grid, images, and coverage’s. Outdated versions of ArcView have been placed into the public domain and are available over the Internet.

UNIT 11

CHOOSING THE ‘BEST’ GIS: GRASS, IDRISI.

SELECTING SOFTWARE

***Active words and phrases*:**

public-domain software – бесплатное программное обеспечение

image processing – обработка изображений

shell – командный процессор

source code – исходный текст, исходная программа

to integrate – объединять в единое целое

to select – отбирать

to determine – определять

to date – *зд.* на данный момент

peripheral device – внешнее, периферийное устройство

Exercise 1. Read and translate the text.

GRASS. The U.S. Army Construction Engineering Research Laboratories (CERL) developed a public-domain software called the Geographic Resources Analysis Support System (GRASS). GRASS is raster based, was the first Unix GIS software, and has been considerably enhanced by the addition of user contributions—for example, in hydrologic modeling. The Web site states that GRASS is an open source, free software GIS with raster, topological vector, image processing, and graphics production functionality that operates on various platforms through a graphical user interface and shell in X-Windows. The source code for the program is available under the GNU General Public License. The latest version, 5.0.0, the development version 5.1, and most prior versions are available free over the Internet. Many users run GRASS on PCs under the Linux version of Unix, although a Windows port is now complete. Since 1985, CERL has released upgrades and enhancements to GRASS and provided technical user support. However, CERL terminated GRASS-related work in the spring of 1996. Public domain user support has been very strong, and highly international.

IDRISI. The IDRISI GIS software has been developed, distributed, and supported on a not-for-profit basis by the Idrisi Project, Clark University Graduate School of Geography. To date, there are many thousands of registered users of IDRISI software in almost every country in the world, making it the most broadly used raster GIS in the world. IDRISI is designed to be easy to use, yet provide professional-level GIS, image processing and spatial statistics analytical capability on both DOS- and Windows-based personal computers. It is intended to be affordable to all levels of users and to run on the most basic of common computer platforms. Expensive graphics cards or peripheral devices are not required to make use of the analytical power of the system, which is designed with an open architecture so that researchers can integrate their own modules.

Exercise 2. Answer the questions using the information from the text.

1. What is GRASS?
2. What has the IDRISI GIS software been developed on?
3. When was INDISI for Windows first released?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. not difficult; done or obtained without a lot of effort or problems
   _____
2. an area of land that has or used to have its own government and laws
   _____
3. a person or thing that uses something _____
4. an institution at the highest level of education where you can study for a degree or do research
   _____
5. the process or method of building or making something, especially roads, buildings, bridges, etc. _____

Exercise 4. Read and translate key terms and definitions.

Technical – connected with the practical use of machinery, methods etc. in science and industry.

Aspect – a particular part of future of a situation, an idea, a problem etc.; a way in which it may be considered.

Fact – one of several things that cause or influence something.

Training – the process of learning the skills that you need to do a job.

Trade-off – the act of balancing two things that you need or want but which are opposed to each other.

Exercise 5. **Complete the sentences with the following words.**

user construction university easy country

technical aspect factor training trade-off

1. We offer free _____ support for those buying our software.
2. The closure of mine was the single most important _____ in the town's decline.
3. Please enter your _____ user name.
4. Few candidates had received any _____ in management.
5. He didn't make it _____ for me to leave.
6. There is a _____ between the benefits of the drug and the risk of side effects.
7. Work has been begun on the _____ of the new airport.
8. She didn't know what life in a foreign _____ would be like.
9. This was one _____ of her character he didn't see before.
10. Is there a _____ in this town?

Exercise 6. Fill in the gaps with the preposition from the box.

in-2	of-4	for	with	on-2	by	into

Selecting the best GIS (1)_____ use involves many other aspects than simply the technical capabilities (2)_____ the software package. It could be argued that very little difference actually exists between GIS packages other than their user interfaces and their data structures. Conversely, many (3)____ the issues that determine how satisfied we are (4)_____ the GIS we choose relate to how we acquire the software, how easily it installs itself (5)_____ our computer, whether or not it is flexible enough to run (6)_____ a given computer system, and how satisfied we are when the software is up and running.

Obviously, cost is an important factor. Although the cost (7)_____ basic GIS packages has fallen remarkably (8)____recent years, cost can still be significant, especially when the hidden costs are taken (9)_____ account. For example, GIS companies may charge not only a software purchase fee, but also include a maintenance fee, a fee (10)_____ upgrades, a per call support cost, and sometimes other fees.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. project deadline – предельный срок проекта
2. installation – установка
3. requirement – необходимое условие
4. manual – руководство
5. time-consuming – трудоемкий
6. implementations – реализация, разработка (программы)
7. purchase – покупка, приобретение

Training is another important factor. Few GIS packages can be used by a novice right out of the box. The user may need help from a systems expert, may have special installation requirements, and may require the user to get some formal GIS training. Of course, this book can go a long way toward helping the user to understand GIS, but there is a great deal of straightforward technical information as well. Many GIS users take technical training from one of the GIS vendors or from other sources. These vary from one- or two-day workshops to entire college semester classes. They can also be rather expensive and time-consuming. Many GIS implementations, although well thought out and organized, fail for the lack of one or two people with the right technical expertise at the right time.

Once technical training ends, the real GIS use begins. At this stage, late on a Friday evening with a project deadline looming, the usual sole self-help

mechanism is the GIS system manual. Again, these vary considerably in readability, comprehensiveness, and user-friendliness. Some are excellent, others poor. The user should ask to see documentation before making a major GIS purchase, as users will spend many hours poring over these pages.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. техническое обеспечение _____
2. электронная почта
   _____
3. строка подсказки
   _____
4. справочное руководство
   _____
5. сопровождение программного обеспечения
   _____
6. быть обновленным
   _____
7. расширенные (обновленные) версии
   _____

Regardless of the GIS's self-help capabilities, sooner or later almost all GIS users will eventually call a help line or interact in some way with the GIS vendor's technical support staff. In most cases this is done exclusively by telephone, but increasingly companies use fax. E-mail and network conference groups as help facilities. Help lines can involve being placed on hold for long periods, or worse, waiting to be called back after leaving a phone number. E-mail is far better and gets around the time-zone problem of phone lines. When contacting a help line, a concise statement of the problem and a full set of information, usually including the serial number and date of purchase of the software, will greatly speed up your call. In general, using the reference manual or user guide until there is no other means of finding information is far preferable to calling a help line. Remember, if all else fails, read the manual!

Software maintenance can be another major consideration. For example, most software is updated by complete version upgrades, which require a new installation, or by "patches" a self-contained fix for a specific problem in the software. Maintenance is more of a consideration for large and networked systems, but every user needs to be concerned about too many large files and about how critical data are to be backed up in case of emergency. A GIS should also not be seen as a static entity, but rather one that will grow and evolve. A system that is big or powerful enough for a small prototype project today will probably not be able to deal with the follow-up project. Fortunately, as time passes the hardware

becomes faster and faster, the disks get bigger and bigger, and the cost actually remains the same or falls.

UNIT 12

INTRODUCING GIS IN ACTION.

GIS LIGHTS THE GYPSY MOTH

Active words and phrases:

case study	– характерный пример, иллюстрация
to monitor	– изучать
data structure	– структура данных
grid	– координатная сетка
annual	– годовой
extreme breadth	- придельная ширина
application	– применение, использование
to spread	– распространять, расширять
broader-scale	– более широкомасштабный

Exercise 1. Read and translate the text.

As much as knowledge and understanding of the principles behind GIS are critical to getting started with GIS, the technology's true strength is and will always be in the power of its applications. In this chapter, some GIS case studies are presented. Each is unique in its own way, and the reader should pay attention to differences in data structures, software, procedures, and directions as the GIS systems we have discussed in theory now move out into the real world. What is also impressive is the extreme breadth and versatility of these applications. GIS is a tool that crosses disciplinary and professional boundaries with ease. Nevertheless, each field of expertise has an angle on GIS use and brings to the application a fresh set of approaches. The applications cover oceans, rural, suburban, deserts, and urban areas, they encompass forestry, geology and ecology, public health concerns and insects, storms and runoff, and mysterious rocks, and also how GIS assisted at the site of the tragedy in the nation's worst terrorist attack. These applications do not pretend to be comprehensive. Each has been contributed by the GIS experts in question as a summary of a broader-scale work that they have either completed or that remains in progress. Nevertheless, these

applications are a perfect starting point from which to examine GIS in action.

Exercise 2. Answer the questions using the information from the text.

1. What does each field of expertise have?
2. What do applications cover?
3. What has each application been contributed by?

Exercise 3. Look through the text again and find the words that correspond to the following definitions.

1. being the only one of its kind

   _____

2. to show or offer something for other people to look at or consider

   _____

3. the practical use of something, especially a theory discovery

   _____

4. a thing that helps you to do your job or to achieve something

   _____

5. the earth with all its countries, peoples and natural features

   _____

Exercise 4. Read and translate key terms and definitions.

Desert – a large area of land that has very little water and very few plants growing on it.

Coast – the land beside or near to the sea or ocean.

Suburb – an area where people live that is outside the centre of a city.

Population – the people who leave in a particular area city or country.

Native – connected with the place where you were born and lived for the first year of your life.

Exercise 5. Complete the sentences with the following words.

application present unique world tools

desert coast suburbs population native

1. Which is the largest city in the _____?
2. One third of the word's _____ consumes two thirds of the word's resources.
3. The new invention would have wide _____ in industry.
4. It's a long time since he has visited his _____ Poland.
5. Somalia is mostly _____.
6. They live in the _____.
7. We walked along the _____ for five miles.
8. The computer is now an invaluable _____ like questionnaires.
9. The committee will _____ its final report to Parliament in June.
10. Everyone's fingerprints are _____.

Exercise 6. Fill in the gaps with the proposition from the box.

of for-3 in-2 on by to at

The Entomology Spatial Analysis Laboratory (1)_____ the Department of Entomology (2)_____ Michigan State University is devoted (3)_____ the spatial analysis of insect pests and the assessment of risk to Michigan's forests, among other projects. The laboratory is directed (4)_____ Dr. Stuart Gage, who has conducted research (5)_____ the spatial distributions (6)_____ forest and crop pests (7)_____ _____over 25 years. Dr. Bryan Pijanowski is an ecologist, and an associate in the laboratory. He has specialized (8)_____ the use of GIS, such as Arc/Info and IDRISI, to model insect and human populations. The laboratory currently contains several Pentium computers, four Sun workstations, and a Silicon Graphics workstation (9)_____ visualization of spatial data. The staff uses Arc/Info, IDRISI, ERDAS, ER-Mapper, and Atlas, GIS (10)_____ research.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. gypsy moth – непарный шелкопряд
2. resource management – управление ресурсами
3. pest – вредитель, паразит
4. designated locations – указанные, обозначенные места
5. caterpillar – гусеница
6. multitude – множество
7. frass – экскременты насекомых

The use of GIS to study the gypsy moth in Michigan provides an excellent example of the applicability of this tool in the biological sciences and for resource management. The gypsy moth is an introduced forest pest that consumes the leaves and needles of nearly 300 woody plants. The insect was first discovered in the state 40 years ago, and outbreaks of the pest have been occurring in Michigan since the mid-1980s. Severe defoliation (i.e., loss of leaves) of oaks, aspens, and other tree species preferred by gypsy moth caterpillars has occurred throughout the northern Lower Pemnsula, and populations continue to expand into southern Michigan and into the state's Upper Peninsula. Defoliation has increased from 2800 hectares in 1984 to over 280,000 hectares in 1992.

Unlike many native forest insects, the gypsy moth is a problem in both urban areas and forests. Multitudes of large, hairy caterpillars, abundant frass (fecal material), and loss of leaves on shade and ornamental trees create much annoyance for people in wooded residential and recreational areas. Management of the gypsy moth is carried out by aerial spraying of a biological insecticide called Bacillus thuringiensis (Bt) from helicopters or planes. This biological insecticide kills only moths and butterflies that eat the Bt from tree leaves and it degrades in the environment in a few days.

Exercise 8. Read the text. Find the English equivalents to the following terms:

1. использование феромона
   _____
2. приманочная ловушка с феромоном
   _____
3. тендер-ловушка
   _____
4. число мест, участков
   _____
5. распространение организма-носителя
   _____
6. массовое поедание листьев насекомыми
   _____
7. противоположность
   _____

In 1985, a statewide gypsy moth monitoring program was implemented to characterize this pest's population dynamics. Because the male is attracted to the female through the use of a pheromone that is emitted by the female, populations of male moths have traditionally been monitored through the use of pheromone-baited traps. A small pesticide strip is placed at the bottom of these traps to kill the moths once they enter. The statewide program entails the monitoring of 3000

pheromone traps placed in a grid-like design with a 6-mile intertrapping distance. Several agencies have been involved in this monitoring effort, including the Michigan Department of Agriculture, Michigan Department of Natural Resources, the USDA-APHIS, Animal and Plant Health Inspection Service, and USDA Forest Service. Funding for the project has come from the Michigan Department of Agriculture.

Every year, these pheromone-baited traps are placed in designated locations in the spring. In the fall, trap tenders visit each location and record the number of moths contained in the trap. Trap catch data are recorded on specially designed forms and are sent to the state survey coordinator at Michigan State University for data entry and management. Trap locations are geocoded at Michigan State University's Entomology Spatial Analysis Laboratory by linking permanent site numbers to geographic coordinates. Data are then placed into a geographic information system for spatial analysis and association with other information, such as previous years' moth estimate, host distribution, and tree defoliation.

Once the data are brought into a GIS, the numbers of moths captured per year, initially represented as point data, are converted to a raster format using various interpolation methods. The most common interpolation method that is used is the inverse distance squared (IDW) method, which is available in both IDRISI and Arc/Info.

UNIT 13

GIS AT THE WORLD TRADE CENTRE AFTER SEPTEMBER 11, 2001.

THE CHANNEL ISLAND GIS

***Active words and phrases*:**

protection system	– система защиты
benefit	– преимущество
motor vehicle	– автомобиль
query	– запрос (на поиск определенных данных)
collision	– столкновение
team	– команда, группа, бригада
viewing environment	– рабочие условия для отображения
to indicate	– показывать

public-use version – общедоступный вариант

Exercise 1. Read and translate the text.

CODES stand for Crash Outcome Data Evaluation System and Connecticut is one of 20 U.S. states participating. CODES evolved from a national need to report on the benefits of regulations requiring automotive protection systems like seat belts and bicycle helmets. States are funded by the National Highway Traffic Safety Administration (NHTSA) to link motor vehicle crash data with medical outcome data to develop a better picture of the problem of motor vehicle injury and the effectiveness of protection systems. The linked database is the primary product of a CODES project, and a public-use version of the database is also required by NHTSA. In addition, CODES projects are allowed to develop state-specific products. The Connecticut CODES GIS is an example.

The purpose of the Connecticut CODES GIS is to create a viewing environment for the linked motor vehicle crash records so that users can find collisions of interest and obtain data on their attributes and locations. CODES users can easily display, query, and map data. These capabilities are especially important for the public-use version of the databases, with which the GIS works. The CT CODES GIS is a combination of Microsoft Access databases and an ESRI Arc View application modified with Avenue scripts to create a GIS specifically for the project. Users can search the CODES databases by WHAT and by WHERE. In Access, users can perform detailed queries to identify what collisions are of interest, report them, and add them as a user-defined collision data layer in the GIS to see where the collisions occurred. In the GIS, users can find where a place of interest is, and then identify and report collusion attributes to find out what kinds of collisions occurred in that place.

Exercise 2. Answer the questions using the information from the text.

1. What is the purpose of the Connecticut CODES GIS?
2. What can CODES users do?
3. What is the CI CODES GIS?

Exercise 3. Look through the text again and find words that correspond to the following definitions.

1. a thing that in used for transporting people or goods from one place to another, such as a car or lorry

   _____

2. the intention, aim or function of something

   _____

3. the act of protecting somebody/something

   _____

4. to make a physical connection between one object, machine, place, etc. and other

   _____

5. to recognize somebody/something and be able to say who or what they are

_____

Exercise 4. Read and translate key terms and definitions.

to assist – to help somebody to do something

to destroy – to damage something so badly that it no longer exists, works.

health – the conditions of a person's body or mind.

uphill – sloping upwards.

Exercise 5. Complete the sentences with the following words:

uphill destroyed protection identified

health assist purpose vehicle linked

1. The _____ of the book is to provide complete money.
2. He asked to be put under police _____.
3. Exhaust fumes are bad for your _____.
4. The building was completely _____ by fire.
5. Are you the driver of this _____?
6. The last part of the race is all _____.
7. The video cameras are _____ to a powerful computer.
8. The bodies were _____ as those of two suspected drug, dealers.
9. We'll do all we can to _____ you.

Exercise 6. Fill in the gaps with the prepositions from the box.

in-3 of-3 on by into to

September 11, 2001 saw the greatest peacetime tragedy (1)____ the recent era, the combined suicidal attack (2)_____ the twin towers of New York City's world trade center (WTQ and the Pentagon (3)___ Jour hijacked planes. At Hunter

College's CARSI (Center for the Analysis and Research (4)_____ Spatial Information) laboratory, GIS was put to immediate and effective use (5)_____ dealing with the aftermath. Fortunately, Geography Professor Sean Ahearn was ready and able to assist, having worked on the NYCMap, New York City's comprehensive GIS. The CARSI played a critical role, partly because the permanent New York City Emergency Operations Centre had been located (6) the WTC complex, and was destroyed. This case study is dedicated to all of those who helped, but also to those who died, and especially (7)____ Geographer Robert LeBlanc (8)_____ the University of New Hampshire who was on United Flight 175 on the way to a Geography conference (9)_____Santa Barbara when it was crashed (10)_____ the WTC's south tower.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. operational – действующий, работающий
2. imagery – изображения, образы
3. inaccessible – недоступный
4. outline – контур
5. to pile – нагружать
6. kernel – суть, сущность
7. rescue workers – спасатели

The call came at 4 p.m. on September 11, 2001. It was from Alan Leidner, head of New York City GIS, 'Get your staff together and start creating maps, your lab is the only operational GIS Centre in town, everything else is destroyed or inaccessible, I'll be there within the hour.' Everyone who didn't live in Manhattan had gone home except me. I called up the only two people on my staff from Manhattan, Ji Ding and Jeffery Bliss and they rushed over to the CARSI Lab at Hunter College. Leidner showed up soon after.

Maps of ground zero were needed for command and control of the operation. Rescue workers from around the country would be pouring in and they would all need detailed site maps. Fortunately New York City had recently created a 'base-map' called NYCMap, consisting of 30 cm resolution orthophotography and planimetric map data with an absolute spatial accuracy of half a meter. NYCMap has over two dozen geographic map features including building outlines, curb lines, street centerlines, parks, subway stations, rails, towers, and so on. Over the next four hours, the Hunter College team worked to create a baseline set of maps using just the planimetric data and maps showing the orthophotographs with planimetric overlays.

At about 10: 30 p.m. on September 11, Leidner and Bliss headed downtown to the Emergency Operations Centre (EOC) on 21st Street with armfuls of maps of the WTC site. The city virtually empty, the next morning at 7:00 a.m. the Hunter team piled three computers loaded with the NYCMap database into the back of a police car and sped down to the EOC. The data on these machines was to form the kernel of what would become a twenty-four hour a day, seven days a week operation involving over fifty GIS professionals and lasting for over two months. The full range of mapping science technologies would be deployed: GIS, GPS, and remote sensing. Cartographic representation of data would prove to be critical in an environment in which the consumers of maps (such as firefighters and rescue workers) had never seen the likes of the data that we would be providing, including thermal imagery and Light Detection and Ranging (LIDAR).

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. береговая система _____
2. рациональное природопользование _____
3. цифровая база данных _____
4. средства (методы) пространственного анализа _____
5. батиметрические данные (о глубине) _____
6. накапливание средств _____
7. новое понимание, представление _____

Viewing the coastal system of California as an ecosystem that includes both marine and terrestrial inputs and outputs allows managers to take account of the composition, structure, and function of the entire range of processes influencing the area's environmental health. Environmental management in the rapidly growing coastal areas of Southern California is controlled by a unique set of political and scientific challenges that can partially be met through a combination of field data collection, spatial modeling, and information technologies. In particular, digital databases, remote sensing data, and spatial analysis tools embedded in a GIS allow analysis of relations among the environmental variables. In addition to scientific challenges, coastal regions involve management by multiple agencies with distinct disciplinary and jurisdictional interests.

As a resource management tool, the CIGIS provides information on flora and fauna (for example, kelp, sea grass, harbor seals, seabird colonies, shellfish), location of sensitive archeological sites, location and dimensions of sea caves, shipping lanes, oil platforms, bathymetry, geology, vegetation cover, soils, and topography. In response to the multiple roles it serves, CIGIS is customized to meet the needs of individual users. The master database is in Arc/Info and Arc View (Unix and PC version), while users receive versions with data relevant to the mission of the agency. For example, Arc View versions now reside at a field

station and on a boat. Experience with multiple users shows that by promoting cooperation among agencies it is possible to create a database substantially more useful to the group as a whole than to have only emphasized the disciplinary or jurisdictional needs of an individual group. In addition, through pooling of resources, each agency has benefited from access to the entire database rather than only data explicitly related to their management mandate.

Success has been measured not by the size of the database, but rather by the new insight gained through spatial analysis of the environmental layers. Through analysis of a time series of Landsat remote sensing data from 1972 to the present. Dr. Mertes and her collaborators have analyzed the characteristic patterns at the surface of the coastal waters of the Santa Barbara Channel.

UNIT 14

THE FUTURE OF GIS

Active words and phrases.

distribution - распределение, распространение.

catch up (with) -*зд* .управлять, схватывать, понимать.

Immense - ограниченный

obstacle - препятствие

timely - своевременно

disaster - бедствие

glimpse - некоторое представление

Exercise 1. Read and translate the text.

The theme of this book has been an examination of the value that GIS brings to the workplace as a tool for understanding geographic distributions, and for describing and predicting what will happen to these distributions in the real world. History has shown just how powerful GIS can be as a new mechanism for managing information. From humble origins, a set of simple ideas and some rather inefficient software. GIS has grown into a sophisticated, multibillion-dollar industry in only half the length of a human career. GIS's dual role as a mainstream technology for the management of geographic information and as an effective tool for the use of resources is no longer a promise, but a reality.

So why bother to discuss the future of GIS? Quite simply, why speculate? The future always seems to catch up with the present at an alarming rate. In only 3 years, for example, GIS and GPS technologies have met and merged in a seamless way without the slightest hitch. Why not just wait and let the technology deliver our dreams and speculations if they are realistic enough to come into being? The blood of a GIS is the digital map data that runs through its' software veins and hardware body. The future holds immense promise for new types of data, more complete data, higher-resolution data, and more timely data. Once the major obstacle to GIS development, data have now become GIS's greatest opportunity. Some of the types and sources of GIS data have already been described in detail in this book. The years ahead will bring us even more new types of data, and vast revisions of the existing types. As such, this summary of future data can be only a glimpse of what is still to come.

Exercise 2. Answer the question using the information from the text.

1. What has history of GIS shown?
2. What has GIS grown from humble origins into?
3. What is the blood of a GIS?

Exercise3. Look though the text again and find the words that correspond to the following definitions.

1. extremely large or great

_____

2. a plan, thought or suggestion, especially about what to do in a particular situation

_____

3. the red liquid that flows though the bodies of humans and animals

_____

4. the act of looking at or considering something very carefully

_____

5. to say that something will happen in the future

_____

6. a single entity that composes part of a landscape

_____

Exercise 4. Read and translate key terms and definitions.

Significant - large or important enough to have an effect or to be noticed.

Theme - the subject or main idea in a talk, piece writing or work of art.

Technology - machinery or equipment designed using technology.

Revolution - a great change in conditions, ways of working, beliefs, etc. that affects large number of people.

The Internet-an international computer network connecting other networks and computers from companies, universities, etc.

Exercise 5. Complete the sentences with the following words:

examination predict theme idea Internet

technology immense revolution significant blood

1. There is still an_____)) amount of work to be done.
2. All got the information from the_____.
3. lt's impossible to _____ what will happen.
4. It might be an _____ to try again later.
5. Careful _____ of the ruins revealed an even earlier temple.
6. The naked male figure was always the central _____ of Greek art.
7. The company has invested in the latest_____ .
8. A _____ in information technology is taken place.
9. Your work has shown a _____ improvement.
10. He last a lot of _____ in the accident.

Exercise 6. Fill in the gaps with the preposition from the box.

of-4 for-2 from through to in

Hardware for GIS has gone (1)_____ at least four revolutions (2)_____ the last decade: the workstation, network, microcomputer, and mobility revolutions. Each one (3)_____ these has already had a profound impact on computer hardware and will influence the future of GIS significantly.

The first of these—the workstation revolution—has given GIS an operating platform that has all of the necessary power and storage to work with massive databases. In the space of just a few years, the capability of a $15,000 workstation has gone (4)_____ megabytes (5)_____ gigabytes of storage, while increasing the size of RAM beyond 64 megabytes and the processor speed well above and beyond the capabilities (6)_____ most mainframe computers. Examples are Sun's Sunblade, DECs DecStation, and Silicon Graphics workstations. Along with the expansion of the workstation has been the spread of Unix, the TCP/IP communications protocol, and graphical user interfaces such as Sun's OpenLook, Motif and MIT's X-Windows. The more powerful systems of the future and the falling price of workstations seem to make this the preferred GIS work environment (7)_____large-scale projects, although Windows, Macintoshes, Linux, and even DOS remain for low-end systems, small projects, and for education.

The network capabilities built into workstations have broadened include many other types (8)_____ computers, including microcomputers. Many computers are now connected to the Internet and can use network search tools such as Windows Explorer and Netscape to 'surf' the World Wide Web (WWW). Already, the Internet has become a primary means (9)_____ data exchange and information search and retrieval. Many GIS packages, including Arc/Info, GRASS, and IDR1SI, have support services on the Internet's network conference groups. The national spatial data infrastructure, a linked distributed database (10) public GIS information with common metadata, is being built upon the capabilities of the Internet and the WWW.

Exercise 7. Learn the following words and word combinations. Find them in the text given below.

1. to predominate - преобладать
2. abbreviated - сокращенный
3. system management - координация работы системы
4. flavor -особенность
5. digitizer - устройство ввода графической информации
6. track ball - шар трассировки
7. light pen - световое перо

A review of GIS software trends of recent years is in order if we are to speculate in a similar way about where GIS software is going in the future. Several themes suggest themselves.

The first major trend over the last few years has been in operating systems. In the 1970s, complex mainframe operating systems predominated, and system interaction was limited both by the inflexibility of the user interface and by the nature of the early time sharing of systems. The first minicomputer operating systems were little better, with the exception of Unix, a simple and much abbreviated set of instructions for doing file and systems management that has proven very flexible and long lived. Today, operating systems can 'multitask,' working on two problems at once, with ease. Microcomputer operating systems now also have this capability.

Early systems were somewhat poor at user interaction, yet the revolutionary Apple Macintosh system, followed by the various flavors of Windows and X-Windows, led to a significant improvement in user simplicity and comprehensiveness. Standardization was an additional unseen improvement: that is, every application could use a standard and commonly understood set of menus instead of making its own flavor. Most recently, operating systems that run on multiple platforms have flourished, including Unix. The ability to divorce standard operations such as printing and digitizer communication from the GIS led to some major improvements. Similarly, commonly accepted industry standard formats and languages, such as PostScript, led to another level of standardization, this time for hardware devices such as printers and plotters.

The computer era has seen radical changes in the very nature of both the computer and GIS user interfaces. Early systems used only the screen and the keyboard to communicate to the user. Systems now have these same functions, but also a mouse, pointing devices such as a track ball or light pen, multiple windows on the screen, sound, animation, and many other options.

Exercise 8. Read the text. Find the English equivalents to the following terms.

1. степень проникновения
   _____
2. сложные задачи предмета обсуждения
   _____
3. на уровне практики
   _____
4. все более и более распространенный
   _____
5. право на секретность (тайну)
   _____
6. крайне необходимый вопрос для обсуждения
   _____
7. научное представление
   _____

Assuming that GIS is now only a few years away from this degree of permeation into the economy, if it is not already there, it is a good idea to finish this chapter, and indeed the entire book, with a glimpse at the issues and problems we are likely to face with the future of GIS. How well we as a user community react to the challenges of the issues will play a major role in the future of GIS. As a person now introduced to the possibilities, it is you, the reader, who will have to deal with these issues at a practical level.

An issue that raises itself again and again as GIS databases become more and more widespread is that of personal privacy. We very often take our right to privacy for granted, yet all the time, by the use of telephones, credit cards, mail order, and the like, we are constantly revealing to other people what can be personal property. Facts we consider of the greatest privacy—our personal income, information about the family, our health record, and employment history—are all tucked away in somebody's database. GIS offers the integration of these data through their common geography. Although it is to the public benefit, for example, to build a link between environmental pollution and health, the more local and individual the link, the more the issue of personal privacy arises. Even the federal census, with its highly general information about groups of individuals, has strict restrictions on availability of information that can identify specific people, holding such data private for over 70 years before releasing it.

A critical issue for the future of GIS is the degree to which the systems become integrated with those new parts of computer graphics and cartography most suitable for GIS applications. The entire field of scientific visualization is an example. Scientific visualization seeks to use the processing power of the human mind, coupled with the imaging and display capabilities of sophisticated computer graphics systems, to seek out empirical patterns and relationships visible in data but beyond the powers of detection using standard statistical and descriptive methods.

Sources:David E. Davis. ***GIS for Everyone*** ESRI Press.

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Навчальне видання

МЕТОДИЧНІ ВКАЗІВКИ

для практичних занять

з дисципліни

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