155GISE = Geographic Information Systems

Geoinformatics - Fields of informatics

Theoretical computer science - examines the use of mathematical models and methods for creating algorithms and computer construction-

> *theory of automata, complexity, formal languages*

Practical informatics - = development of methods for creating and executing computer programs -

> *creation of translators, compilers, operating systems, simulation, artificial intelligence*

Technical informatics - - architecture of computers and additional devices

> *computer operation, process management*

Applied Informatics - application of theoretical, practical and technical informatics methods to other sciences

> *business informatics, medical informatics and* **geoinformatics** *(Streit , 1997)*

Geoinformatics = geoinformation science = geomatics

deals with the development and application of methods for solving problems in geosciences /geographical sciences with an emphasis on the geographical location of objects

socio-economic, demographic and other phenomena that take place in the geographical area are also addressed

Streit , U.: Geoinformatics . - *University of Muenster , 2000*

Geoinformatics - Geoinformatics

- collection of digital geo data = geodata in terrain
- global positioning and navigation systems
- evaluation of remote sensing data
- geographic information systems
- integration of knowledge systems and GIS
- development and application geostatistical methods
- numerical simulation models and prognostic models for spatial processes
- decision support systems - decision making
- application of multimedia methods
- digital cartographic methods
- three-dimensional visualization , virtual reality

So finally, what is GIS?

◉ It can be understood as

- **technology** = HW and SW

- **application tool** = information system (= a system for storing, retrieving, combining and evaluating information) of an organizational unit

- **scientific field** = integration of a number of disciplines, the main idea of which is interdisciplinarity and integration , i.e. (interconnection of different fields)

So finally, what is GIS?
GIS as a scientific field

scientific field =

▶ computer-assisted data collection ,

▶ modeling dynamic spatial processes by numerical and statistical methods,

▶ digital cartography and visualization ,

▶ digital image processing (remote sensing data) ,

▶ knowledge approaches as the basis of spatial systems for decision support

Finally,
the different definitions of GIS

- Any set of manual or computer procedures used to store and manipulate geographically defined data (Aronoff , ´89)

- Information technology that stores, analyzes and displays spatial and non-spatial data (Parker , 1989)

- A database system in which most of the data is spatially defined and can be processed by query procedures on spatial entities in the database (Smith, 1987)

- A decision support system that allows the integration of spatially defined data in a problem-solving environment (Cowen , 1988)

Properties GIS

GIS is a computer-based information system on

1. capturing
2. management,
3. analysis,
4. modeling and
5. visualization of geoinformation.

They describe the geodata they use

1. geometry,
2. topology *- will be explained later*
3. subject matter (attributes) a
4. dynamics *of changes in objects over time* (Streit , 1997)

. GIS preliminary summary, what it is

GIS must therefore have the ability to:

- ▶ to capture
- ▶ manipulation = to manipulate
- ▶ storage and retrieval = to store and retrieve
- ▶ analyzes = to analyze,
- ▶ display = to display,

geographical data**.**

Geographical means arbitrarily chosen scales

Application areas of GIS

Who uses GIS ?

- public organizations and
- companies responsible for infrastructure

- from business and international companies to large farms.

- government,

You can use it yourself for your room, house, … !!!!!!!!

Application areas of GIS

The category of different users needs BY TOPICS :

▶ demographic analysis ;

▶ environment = environmental management;

▶ equipment of buildings = AM/FM Automated Mapping / Facility Management Systems (network manager)

▶ BIM = Building Information Management (or Modeling)

▶ territory administration = land management,

   ▶ LIS – territory information system (land information system)

   ▶ MIS - urban information system (Urban information system)

   ▶ natural resources

   network analysis = network analysis ;
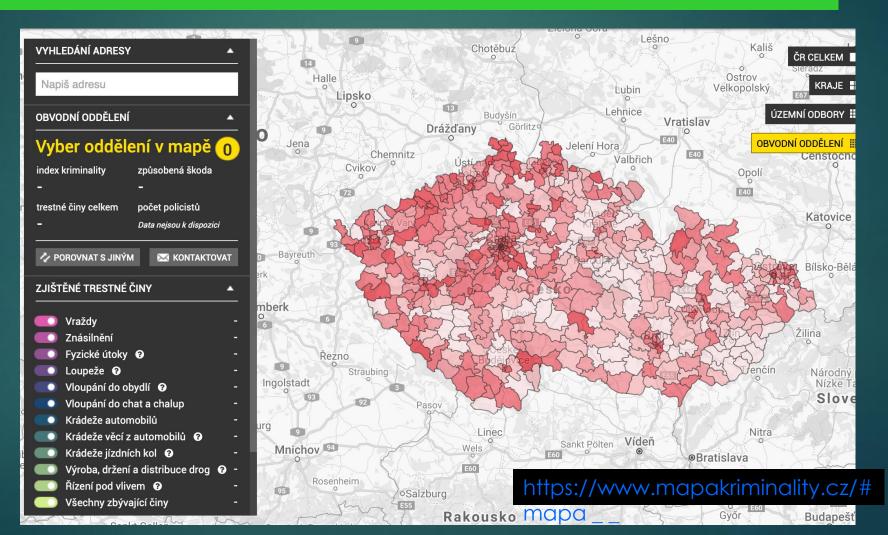
Application areas of GIS

1) **Demographics**

- population studies ,
- planning ....

Data used:

- statistical data = census;
- boundaries of postal districts ;
- financial/social data , e.g. identity documents, bank details ;
- infrastructure , e.g. road network ,
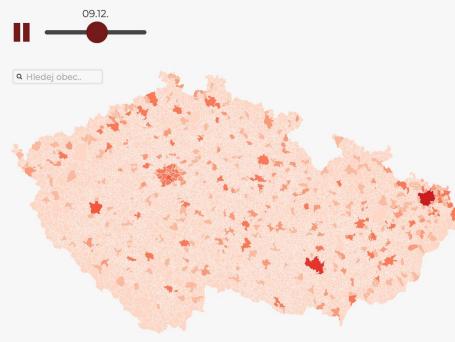- Often for business purposes – selection of supermarket locations .
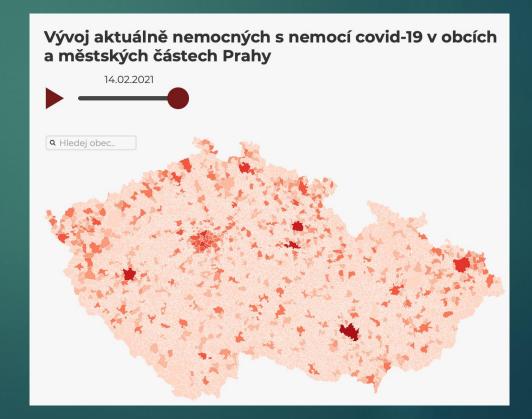
Application areas of GIS - demography

https://www.mapakriminality.cz/#mapa _ _

Application areas of GIS

1) Demographics - characteristics and behavior of the population depending on the territory - data from 2021

Application areas of GIS

2) Environment

- a large number of applications, e.g.:

▶ Pollution monitoring = pollution monitoring,
▶ Precision agriculture = high precision farming ,
▶ = wild-life habitat assessment .

Data used:
▶ geophysical ;
▶ remote sensing of the Earth
▶ infrastructure;
▶ land surface/land use = land cover / land use,

Most of these projects not commercial - an exception is e.g. projects for insurance companies , ...

Application areas of GIS

2) Environment - RS data - monitoring of changes

year 2003   year 2015

Application areas of GIS

3) Maintenance and planning of effective infrastructure networks

These are :
- gas, water and oil pipelines, electrical lines ;
- optical wires, telephone network, sewage networks .

Data used :
- own internal infrastructure data ;
- overall infrastructure of the area ;
- statistical data ,
- territory coverage (land cover)

All, for example, with regard to the dynamic development in the development of the consumption of electrical networks .

Application areas of GIS – passport = records

Passport

there are GIS documents from various areas of larger amenities . municipalities - =

= simplified documentation (records) of property, its condition, etc.

the format of the passport is determined by the requirement and the subject of the record

The most common types of passports:

- ▶ passport of communications,
- ▶ passport of vertical road markings,
- ▶ passport green
- ▶ public lighting passport
- ▶ etc.

Application areas of GIS
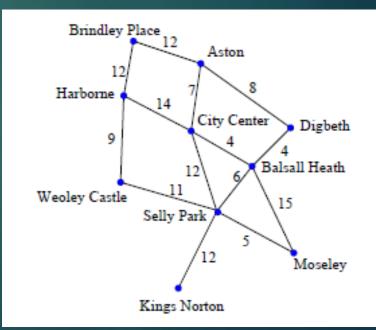
4) Network analysis = network analysis

It is an optimization task for navigation and planning procedures

▶ Efficient complex analysis often using special software
▶ Often used by transport companies for transport routes

Data used :
▶ Infrastructure of communications, networks, .. ;
▶ statistical data = census.
▶ Other data can also be used :
▶ meteorological data,
▶ immediate traffic status, etc.

In the first GIS, GIS is only used for data storage

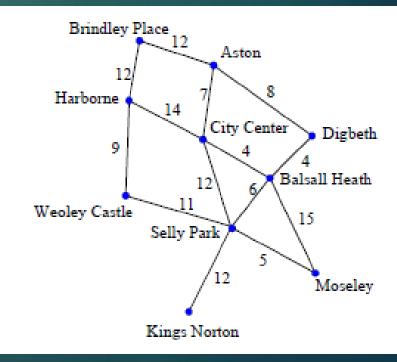# Application areas of GIS

4) Network analysis

Solve the quest in locations: Aston, ...

Connections of localities/municipalities are numerically **evaluated** (distance, fuel consumption, travel time, etc.)

The goal is: find optimal:
- connection of 2 or more locations
- passing through all locations
with regard to the evaluation of the connections between the nodes

Application areas of GIS

4) Network analysis

Network analysis is **also a tool** for project analysis and management.

A project is a set of interrelated activities that make up a certain process.

These activities can take place **in parallel** or **consecutively** from the beginning of the project to its completion.

Optimization will determine how to proceed and not jeopardize the progress of work leading to the end of the project

Application areas of GIS

5) Spatial planning and development

Individual types of development in the given area, used to analyze:
- how to expand construction,
- which parts to rebuild ,
- where to build schools, …
- colors according to building heights, their use, etc.

Application areas of GIS

5) Spatial planning and development

Different requirements for GIS for spatial planning

▶ systems require a temporal view of data.

▶ they contain a large number of legal documents , which are gradually being digitized
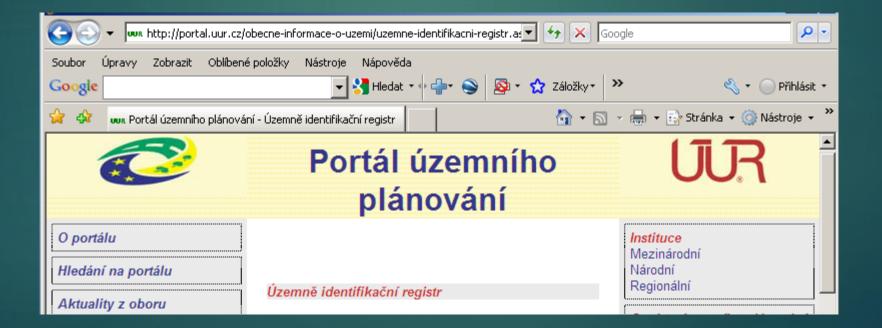
Data used:

▶ internal ;

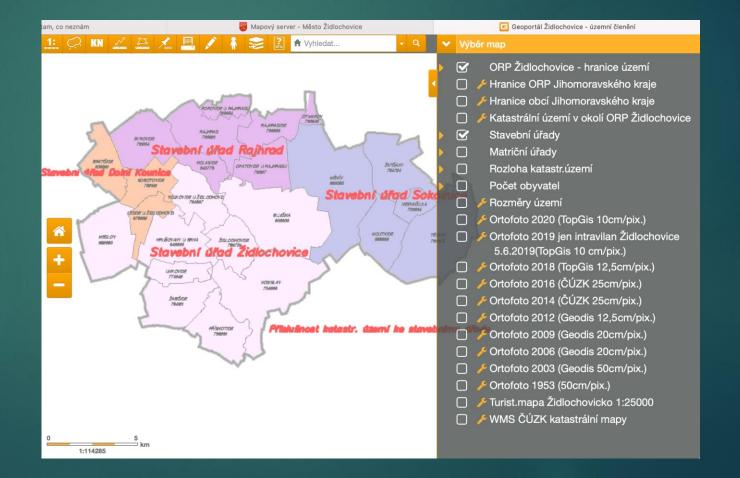▶ Village infrastructure ;

▶ statistical data = census.

Application areas of GIS

5) Spatial planning and development

Examples from the Internet

Application areas of GIS

5) Territorial planning a development

Application areas of GIS

5) Spatial plan of Prague https://www.iprpraha.cz/platnyplan
https://www.iprpraha.cz/platnyplan

Application areas of GIS

- **The spatial plan** defines, among other things, public buildings, deals with transport or technical infrastructure and, above all, defines how which area can be used.

- The valid spatial plan sets the conditions for:

- Areas with different ways of using individual categories of land (e.g .: residential land, production and service land , sports and recreation land, public facilities, transport, etc.)

- Spatial regulation - especially building capacity (separately for stabilized, development and transformation areas)

- Share of housing in the central part of the city , Greenery and ÚSES , Flooded areas , Large development areas , Conditionality of buildings , Public benefit buildings , Transport infrastructure , Technical infrastructure and others.

- The territorial plan is **generally binding** , in certain cases it is possible to make changes to it