

Bioinformatics: Definitions and Subject

Different definitions of the Bioinformatics are proposed. For example:

"The merger of biotechnology and information technology with the goal of revealing new insights and principles in biology" [1].

«Bioinformatics derives knowledge from computer analysis of biological data. These can consist of the information stored in the genetic code, but also experimental results from various sources, patient statistics, and scientific literature. Research in bioinformatics includes method development for storage, retrieval, and analysis of the data. Bioinformatics is a rapidly developing branch of biology and is highly interdisciplinary, using techniques and concepts from informatics, statistics, mathematics, chemistry, biochemistry, physics, and linguistics. It has many practical applications in different areas of biology and medicine» [2].

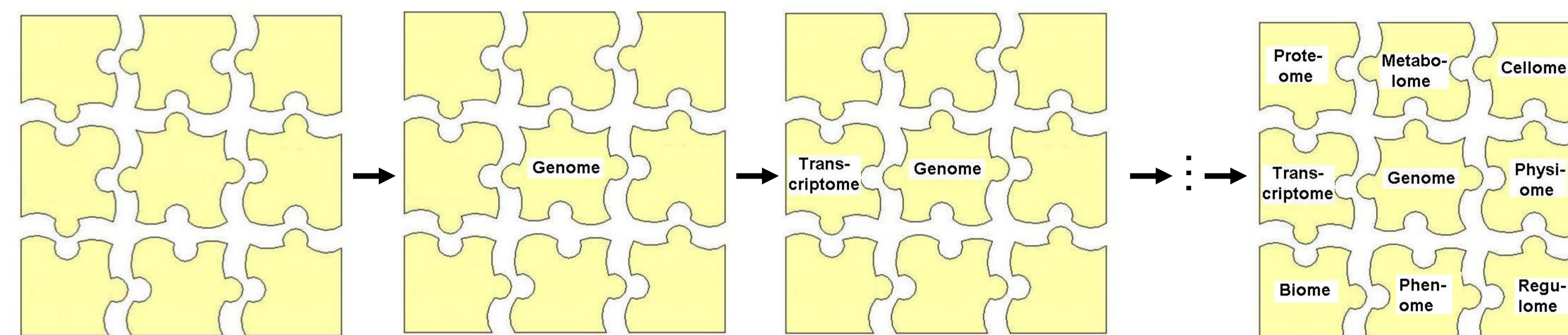
We define the **Bioinformatics** as a **multidisciplinary field of science, integrating informational-computational technologies with the achievements of biology and medicine.**

Bioinformatics' subject is the development and application of mathematical methods, computer programs and databases for storage and retrieval of information, generation of new knowledge on the basis of vast amounts of experimental data, which are obtained by highthroughput biomedical studies.

Current Fields Where Bioinformatics Methods are Needed

1. Comparative genomics and proteomics. Analysis of nucleotide and amino acid sequences of deciphered genomes. Study of molecular evolution of the organisms.
2. Functional genomics and proteomics. Determination of gene structure and regulatory signals, antigenic determinants, active sites and other functionally-essential regions in nucleic acids and proteins. Study of gene expression regulatory systems. Analysis of structure and function of non-coding regions in nucleic acids.
3. Structural genomics and proteomics. Modeling of 3D structure of proteins and nucleic acids. Determination of posttranscriptional and posttranslational modifications.
4. Analysis of proteomes of various biological samples for determination of similarity and diversity. Identification of protein-protein interactions.
5. Systems biology. Analysis of biological processes at supramolecular level using genomic, transcriptomic, proteomic and metabolomic information. Modeling of metabolic and signal regulatory pathways in a cell.
6. Analysis of SNPs and SAPs, abundance of repeats and other changes at the molecular level, in view of disease-disposing, features of their developing, and individuality of pharmacotherapeutic responses.
7. Revelation of potential markers for detection of diseases.
8. Identification of prospective molecular targets for new drugs.
9. Analysis of interaction of natural and synthetic bioregulators with molecular targets, design and optimization of lead compounds with the required properties as new pharmaceutical agents.
10. Design of immunogenic constructions for creation of new vaccines.
11. Bioengineering (design) of microorganisms and plants as producers of physiologically active substances with required properties.
12. Textomics as a method for determination of associations between the scientific results obtained in different fields of biomedical science.
13. Revelation of signals in noisy postgenomics data (mass-spectrometry, atomic force microscopy, microarrays, etc.).
14. Integration and development of means for the analysis of heterogeneous types of data in large-scale databases on biomedical information.

Bioinformatics' Mission is the Filling Gaps in the Existing Knowledge.



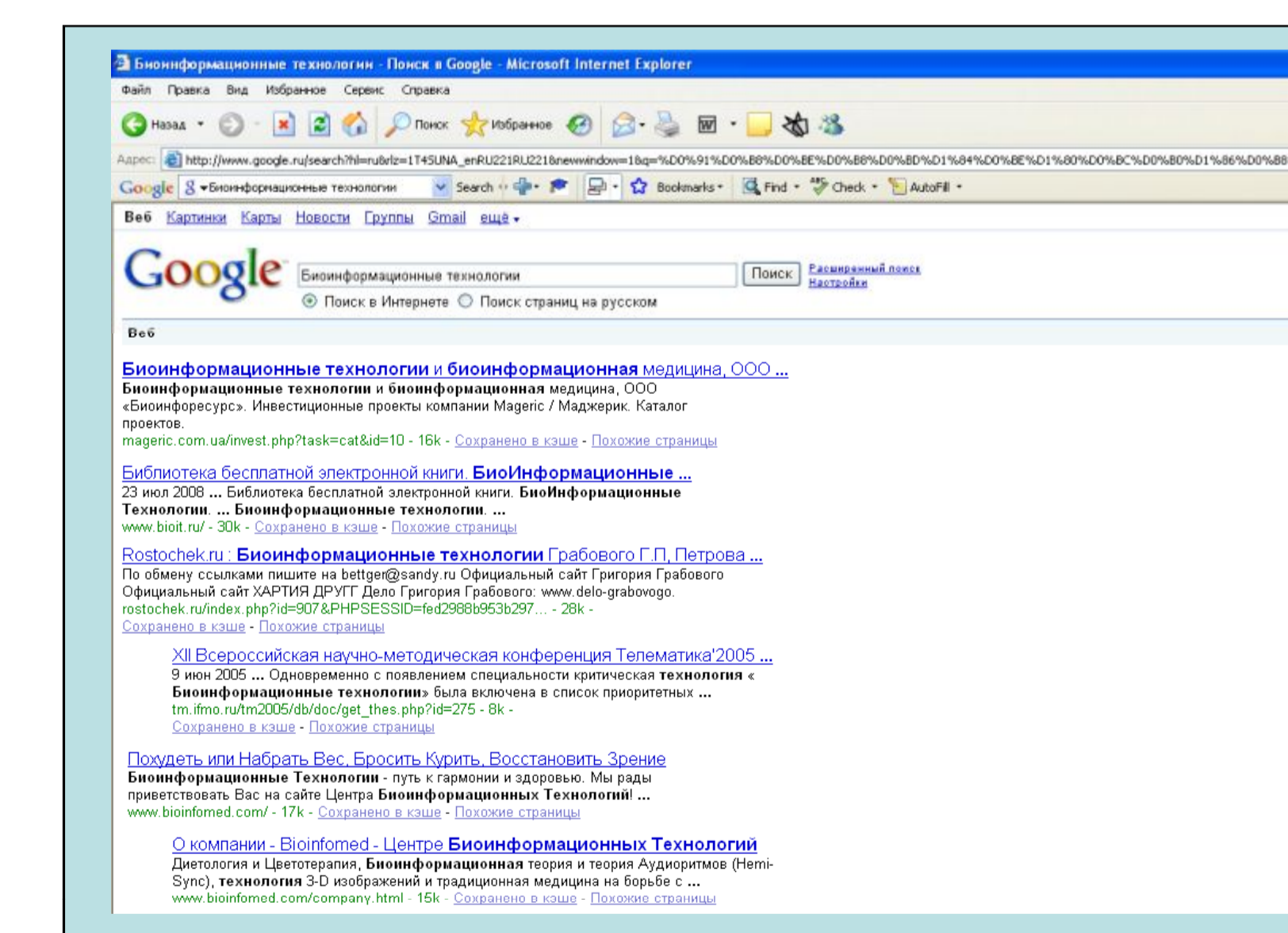
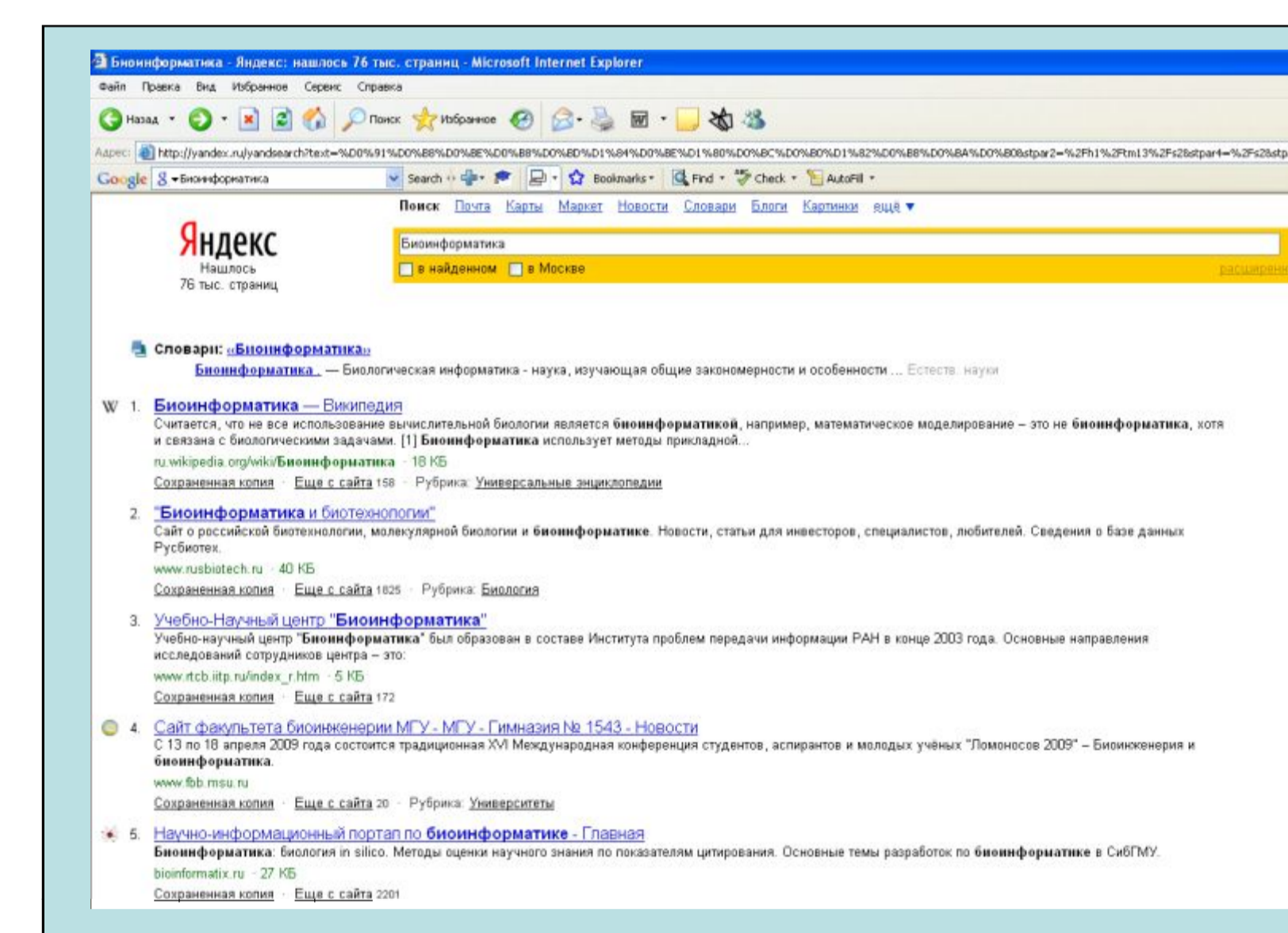
Examples of Bioinformatics Applications Filling "Gaps" in the Existing Knowledge

1. Human Genome Project: Celera Genomics (J. Graig Venter) vs. NIH (Francis Collins) [3].
2. Annotation of *Acholeplasma laidlawii* genome by Michael Gelfand's team [4].
3. Selection of the most promising macromolecular targets against *Mycobacterium Tuberculosis* [5].
4. Computer-aided prediction of new applications for the existing drugs [6].
5. Estimation of biological activity spectra for ca. 250 000 chemical compounds from Open NCI database [7].
6. Finding that the existing medicine Dimebone could be used as a cognition enhancer [8].
7. Computer-aided design of new antimicrobial peptides [9].
8. Elucidation of mechanism of action for new antiviral agent Ingavirin [10].

"Bioinformatics Technologies"

IS NOT

"Bioinformatics Technologies"



Conclusions

1. Bioinformatics is the "Critical Technology" for Life Sciences.
2. Both necessary and sufficient conditions exist for the development of Bioinformatics in Russian Federation.
3. Bioinformatics Technologies should be included into the List of Critical Technologies of Russian Federation.

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