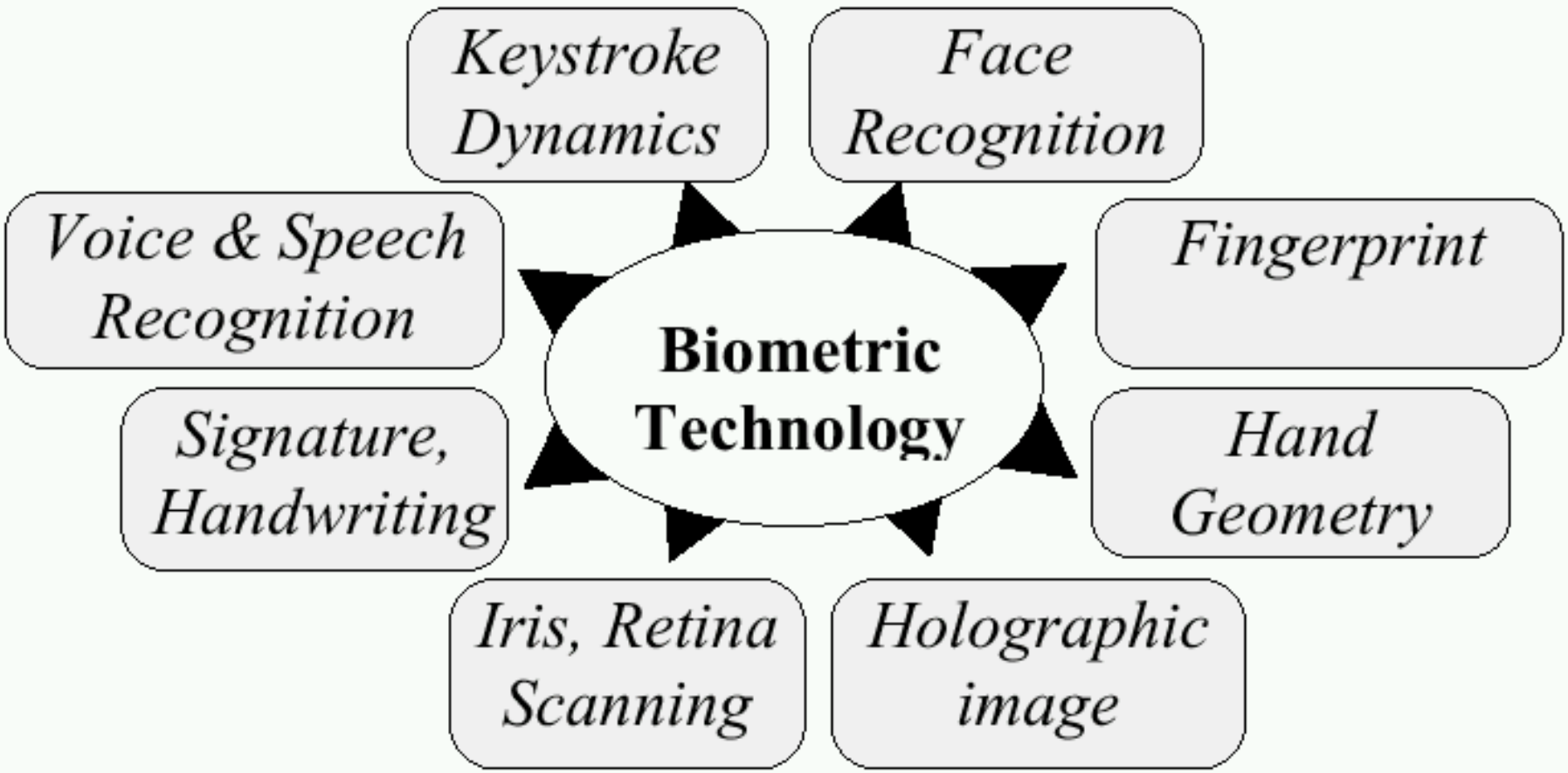
Anti-terrorist technologies

Bio-Systems and biometry

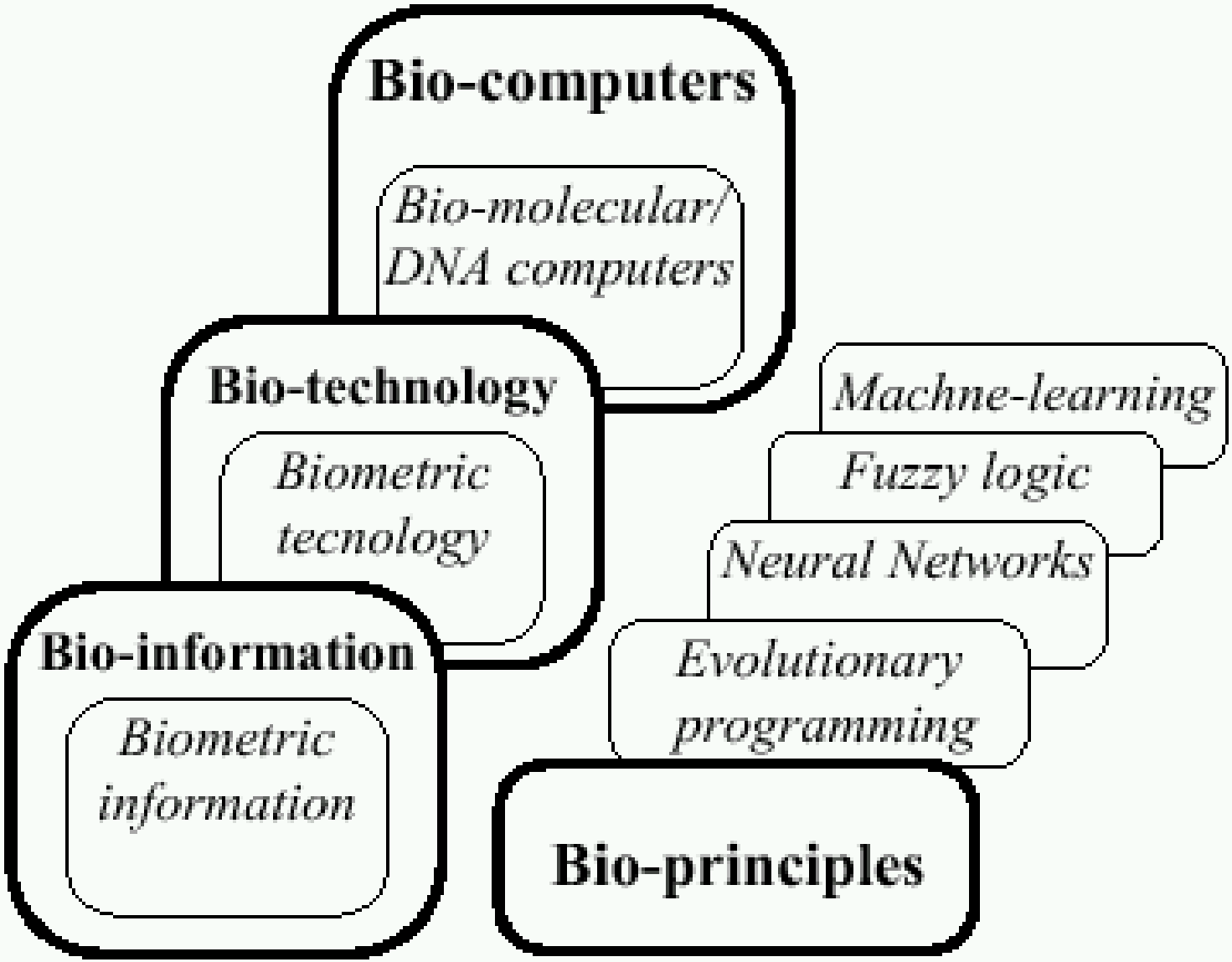
- For solutions of many tasks that cannot be solved with current computer paradigms, the researchers turn to bio-systems.
- The research area of bio-computing is based on some principles of organization of living objects.
- We analyze selected recent achievements in this domain, and we discuss mapping bio-technologies into computer science problems.
- Identification and recognition of biological objects based on feature extraction from biometric data (voice, thermal images, fingerprints et.al.).
- So far, only the simplest (i.e. statistical) forms of bio-information have found their applications (to person's identification).

Main Directions of Modern Biometric Technologies

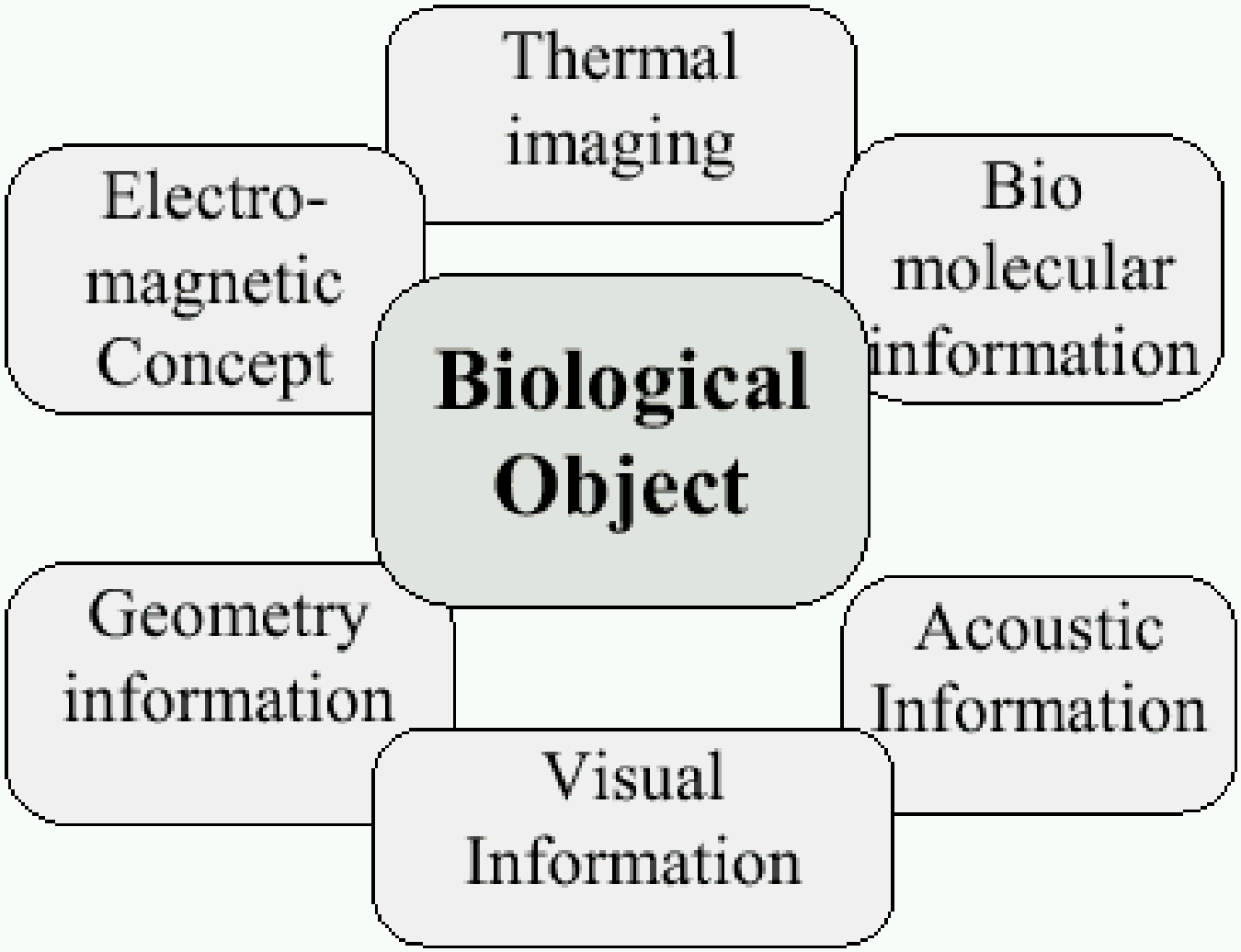


- All can be used in robotics
- Some are already used in robotics

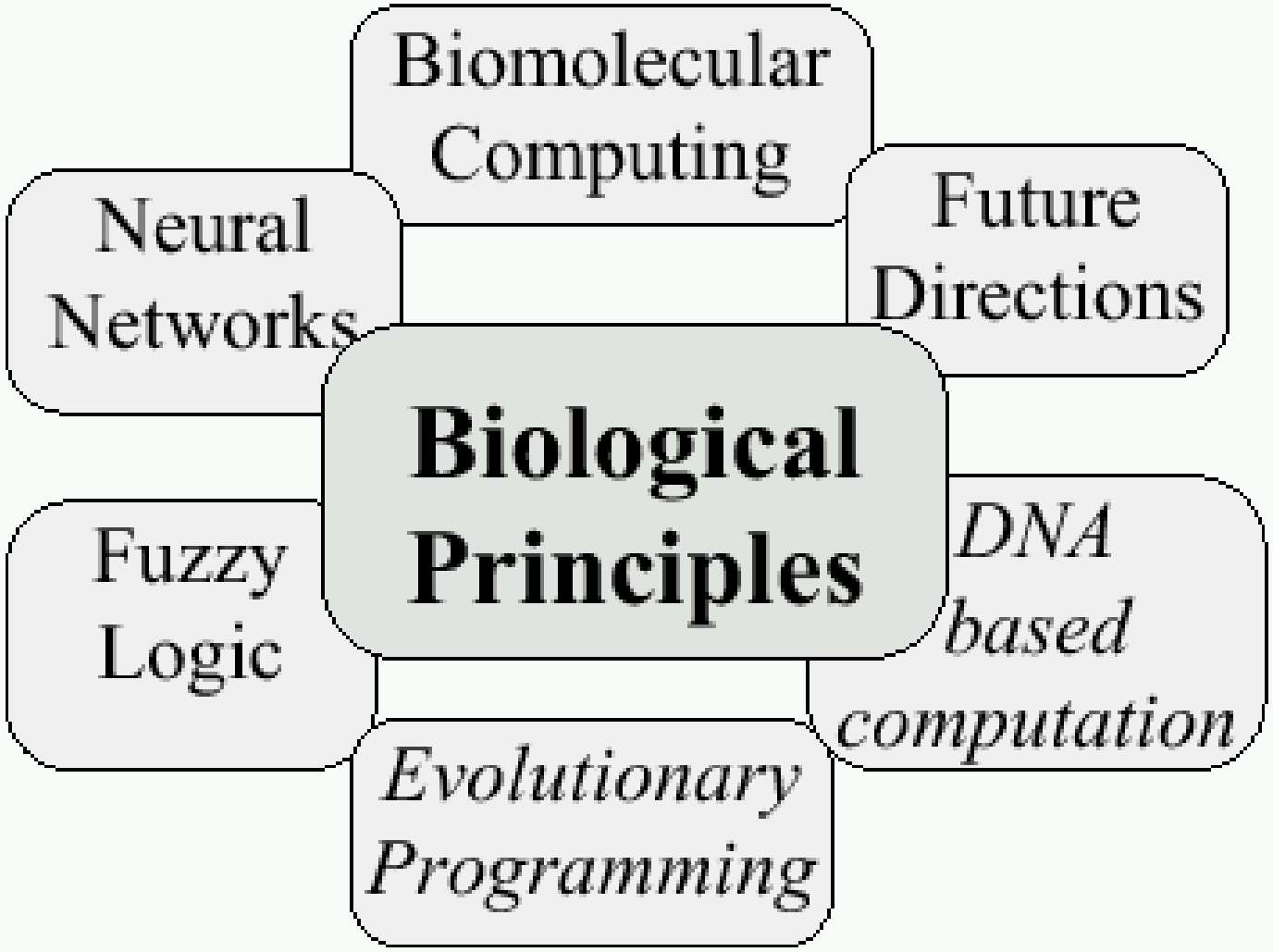
Basic Notations of Bioinformatics



BIOMETRIC INFORMATION OF A BIOLOGICAL OBJECT



PRINCIPLES OF LIVING OBJECTS IN COMPUTING SCIENCE



Fuzzy Logic in biometry

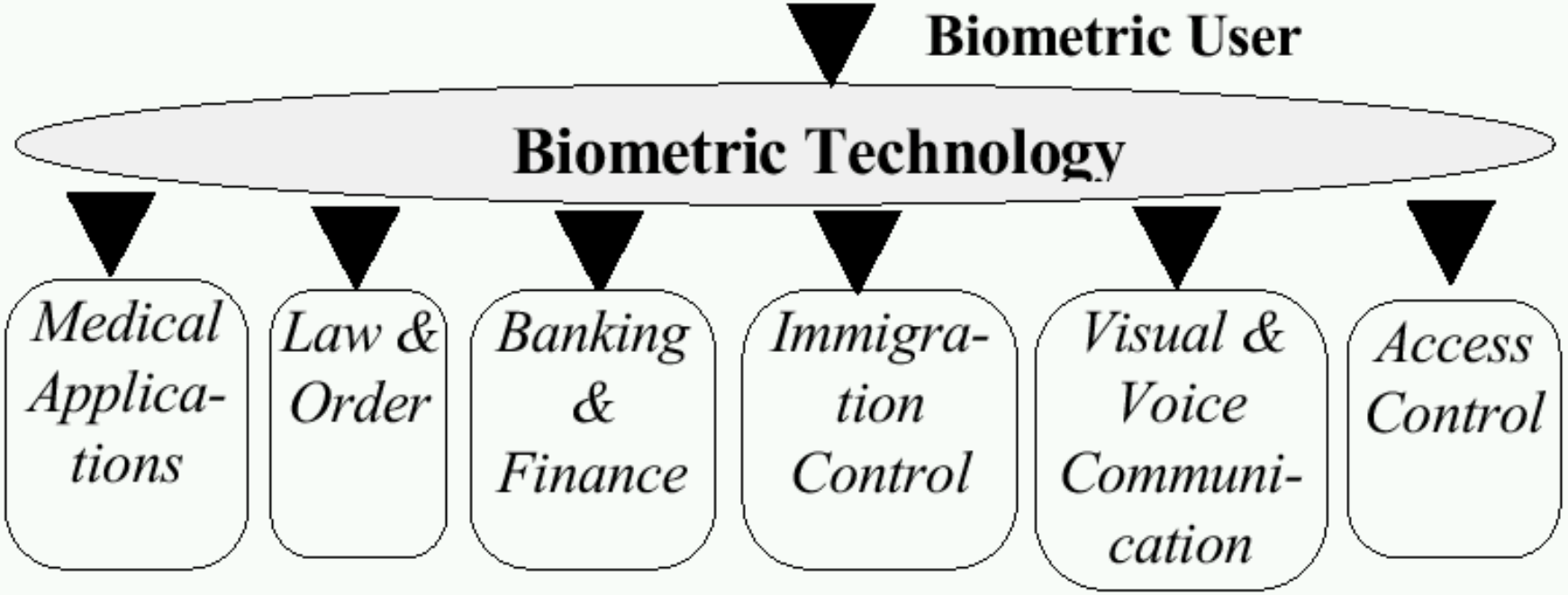
- Fuzzy logic methods are already used for many practical applications such as the automatic camera deciding which part of image should be in focus.

- Fuzzy logic is a more realistic model of thinking process in some cases.

- Also, some very advanced, machine-learning approaches, called Constructive Induction are applied to recognize patterns in complex data and to analyze problems.

- Apparatus of multiple-valued logic, fuzzy logic and abductive logic is used to extract hierarchies of new concepts from rough data such as databases, functions, images or experimental measurements.

APPLICATIONS OF BIOMETRIC TECHNOLOGIES

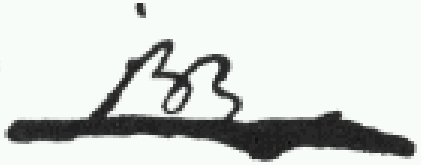


Hand Movement

- The hand movement is tightly coupled with spatial recognition (hand shape).
- Authors propose an approximate recursive partition to perform the classification.
- Two different approaches have been taken to capture the signature dynamics:
  - an active pen,
  - sensitive tablet.

Napoleon's Signature of After Some Historical Events on an During 20 Years

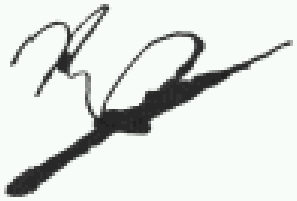
Captain Bonaparte's career start (1793)



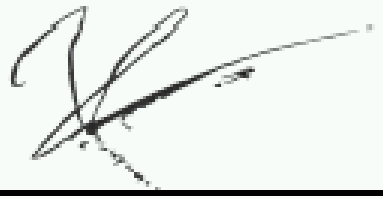
General Bonaparte's first significant successes

Napoleon the Emperor (1804)

Napoleon after the victory in Austerlits (1805)

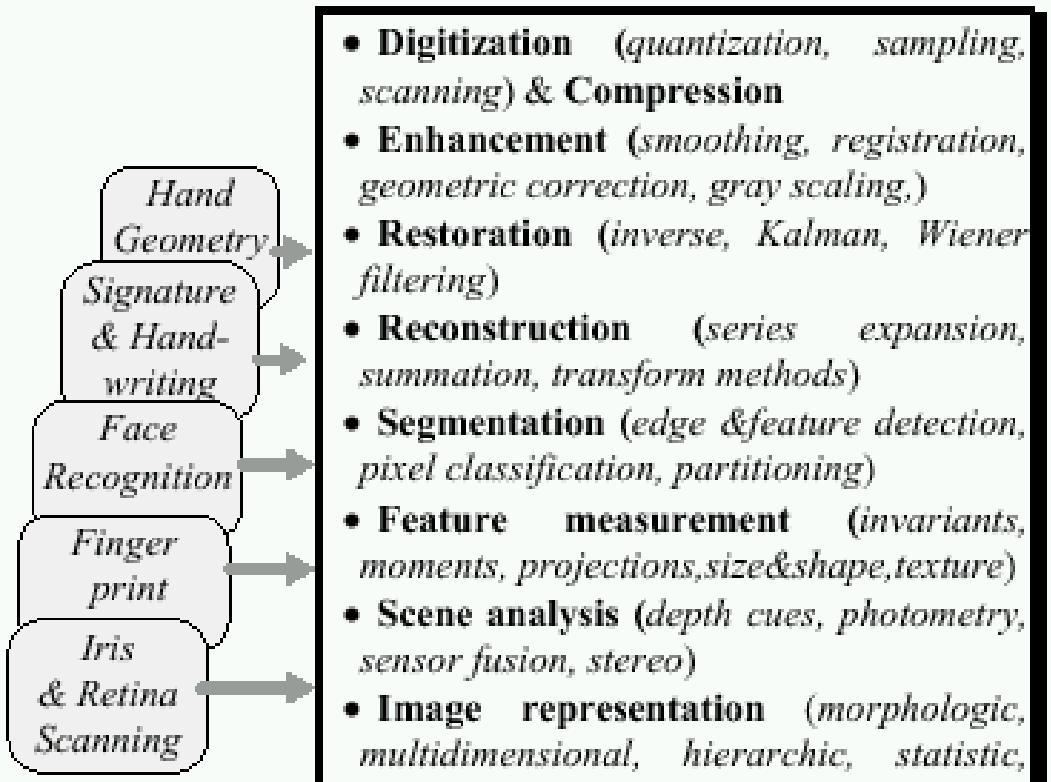


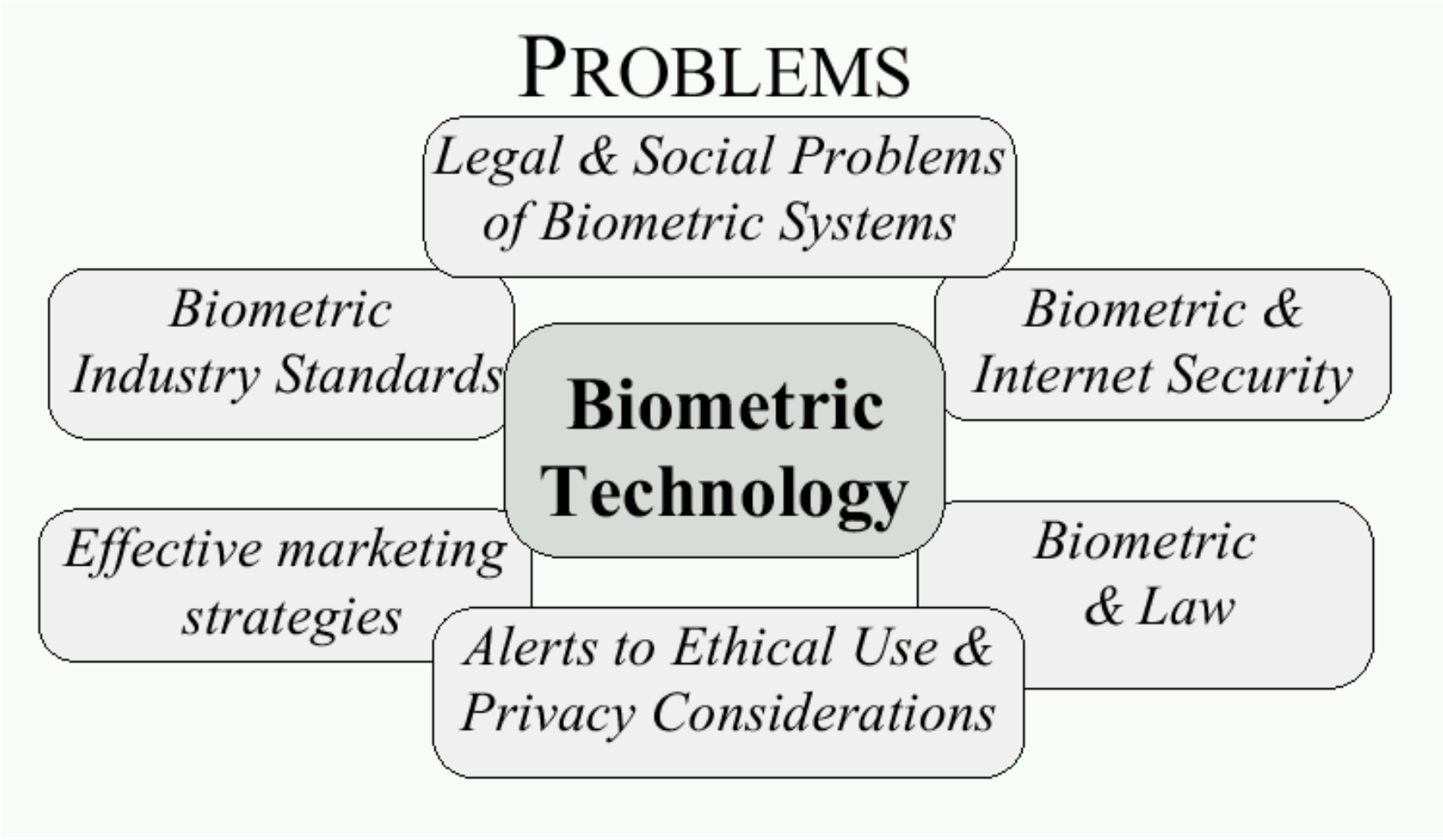
Napoleon after the battle under Moscow (1812)



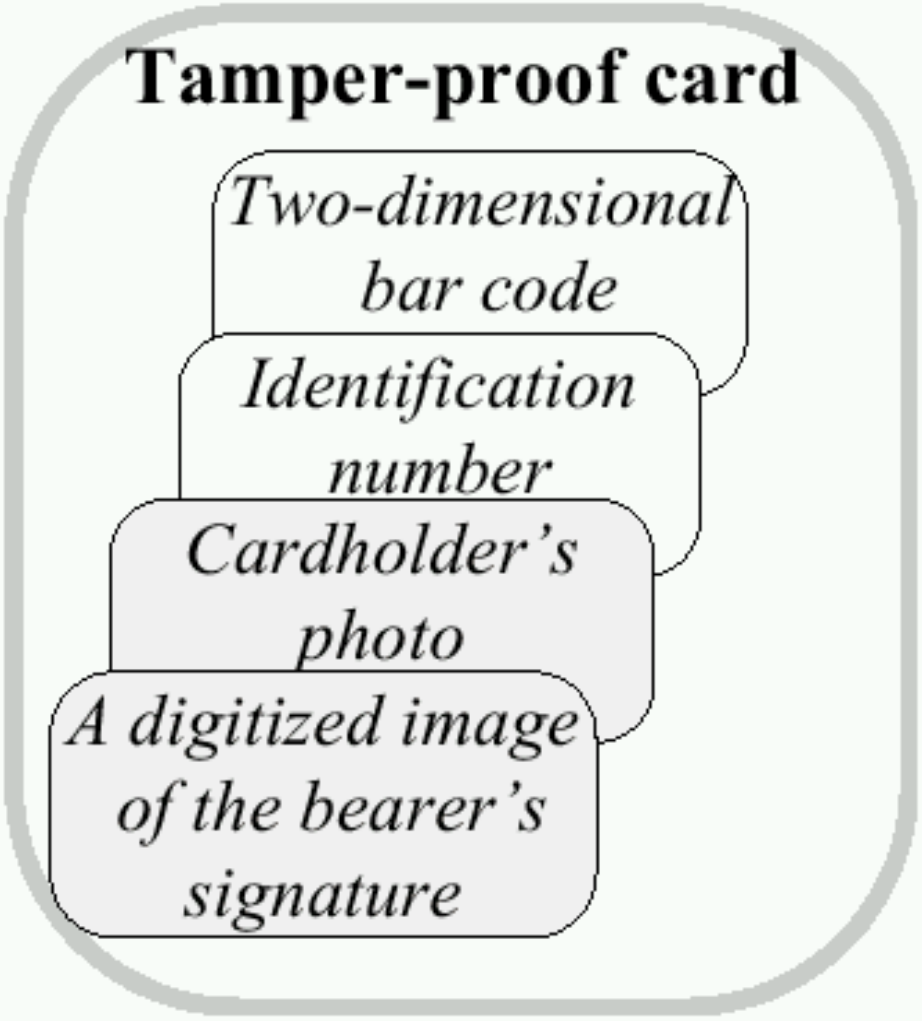
Napoleon after next shock (1813)

METHODS & ALGORITHMS OF PATTERN RECOGNITION & IMAGE ANALYSIS

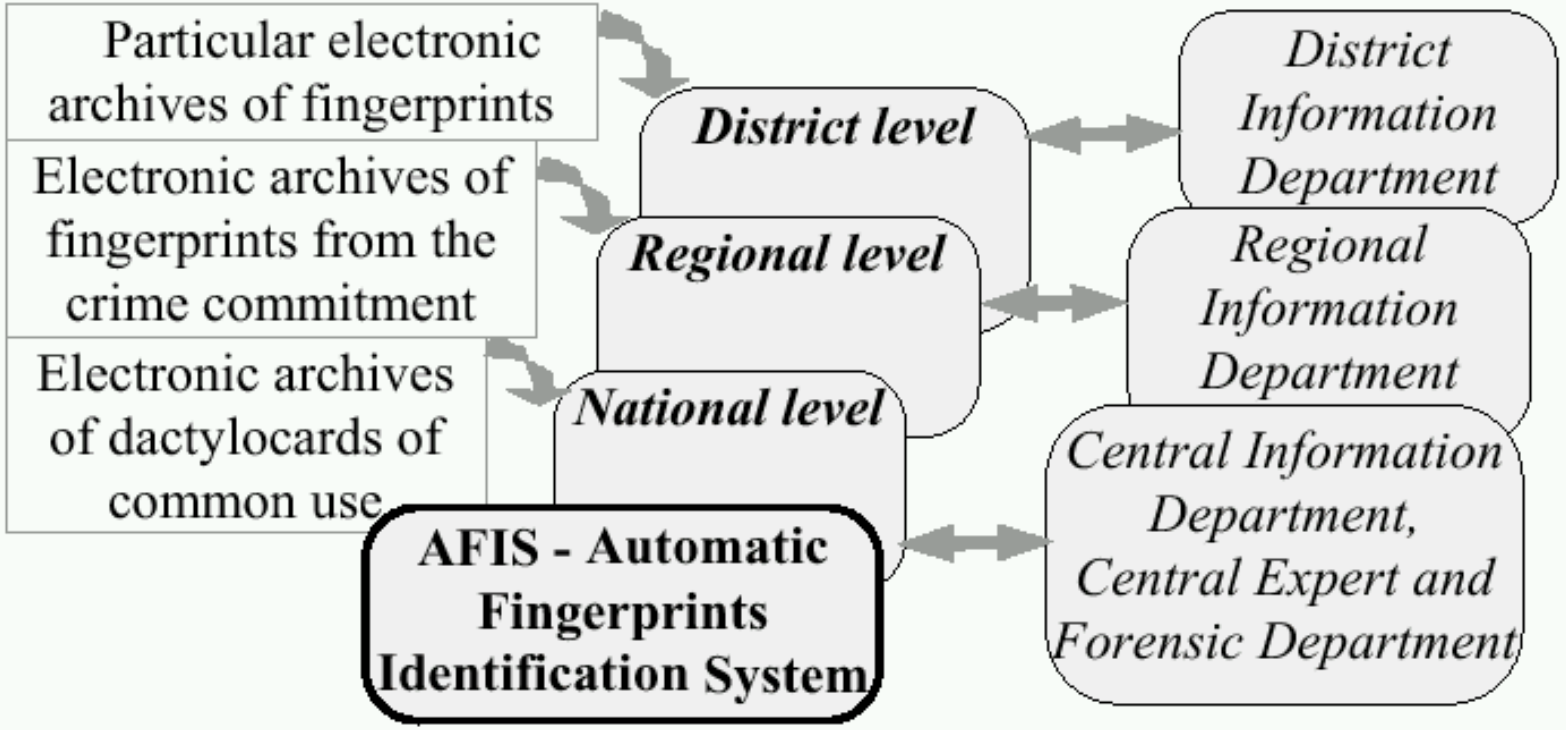



PROBLEMS
Legal & Social Problems of Biometric Systems
Biometric Industry Standards
Biometric & Internet Security
Biometric Technology
Effective marketing strategies
Biometric & Law
Alerts to Ethical Use & Privacy Considerations

BIOMETRIC TECHNOLOGIES + TRADITIONAL PERSON IDENTIFICATION METHODS



AFIS - AUTOMATIC FINGERPRINTS IDENTIFICATION SYSTEM



The Main Characteristics of Biometric Systems

- Accuracy
- Resistance to counterfeiting
- Speed, or throughput rate
- Reliability
- Storage requirement
- Social acceptability

THE BEST ACHIEVED CHARACTERISTICS FOR BIOMETRIC SYSTEMS

	Error (%)		Memory (*bite*)	*t* (*sec*)
	Type 1 (FRR)	Type 2 (FAR)		
Handwriting	0.005	0.0001	500-1000	2-4
Signature	0.05	0,01	40-500	1-2
Hand geometry	0,005	0,001	9-15	1
Hand veins geometry	-	-	9-15	1
Fingerprint	0,0001	0.000001	20-1000	1-2
Voice, speech recognition	0.001	0,0005	1000-2000	5
Iris, retina	0,001	0,0001	40-100	1-5
Face recognition	0.01	0.001	500-1000	1-5
Keystroke dynamics	0.1	0.1	-	-

Note: FRR и FAR - *False Reject* и *False Accept Rate*

New directions in biometry take ideas from biology

- Recently it has been intensively studied how to use the bio-principles to other applications, for example, in computing based on biomolecular and DNA principles.

- Bio-informatics is an interdisciplinary discipline that uses results from biology, medicine, genetic engineering, computing sciences and others.

- Two main directions of modern bio-technologies are especially attractive for many applications:
  - (i) identification of biological objects
  - (ii) technical realization of some principles of organization of biological objects.

- Biometric methods can be classified as contact and non-contact.

- The contact methods need direct or indirect contact with a biological object.

- For example, person's identification methods based on fingerprints or signatures need physical contacts with paper sheets or special devices for inputting respective data features to a computer.

Biology, DNA and FPGA

- **Very promising approach to design new generation computer systems is based on biomolecular and DNA principles.**
- **Biomolecular computer is based on a dynamism of biomolecular activities.**
- **High efficiency of this computer is related to parallel distribution of logical information represented by varieties of biological molecules.**
- **Unfortunately, biotechnological infrastructure is not yet mature enough.**
- **However, because they are based on pattern matching operations, they are well suited to be modeled in a new type of digital computers, reconfigurable computers, which are based on fast hardware reprogrammability using Field Programmable Gate Arrays.**

- It is important to understand achievements in these new directions of computer research and technology because their synergy can be used both ways;

- to create new application methods for solving biology-related questions with existing computer technologies,

- to create new computing principles based on understanding of biological phenomena.

- Researchers look for answers to the following questions:
  - Which type of knowledge about living objects is already used in computer theory and industry?
  - How the bio-principles and bio-concepts can be introduced to computer science?

- The information obtained from biological objects is called bio-information.
- The methods, algorithms and tools for bio-information processing are called bio-technologies.
- In many papers and in common use these terms are treated equivalently with terms person's identification and recognition methods and tools.
- Many types of information are being used: acoustic, visual, electromagnetic.

- Now these approaches are used mostly for person's authorization and recognition, and in medical diagnostics applications, such as pap-smear analysis, or breast cancer detection.

- But the goal of study can include also various other fields (such as electromagnetic) related to living objects, as well as how to control such fields.

- Answers to these questions will open new possibilities in communication, computation, diagnostics and therapy.

- The application which most people are familiar within this area are Automatic Fingerprint Identification Systems (AFIS) as used by police forces across the world (PRINT-PAK-ORION Systems, MORPHO Systems, NEC Systems, COGENT Systems, and others).

- Most automatic systems for fingerprint comparison are based on minutiae matching (local discontinuities in the fingerprint pattern).

- The American National Standards Institute has proposed a minutiae classification based on four classes: terminations, bifurcations, trifurcations and undetermined.

- Automatic investigations of handwritten objects such as: handwritten text, signature, short letter, notes, have been widely used.
  - to confirm the document authenticity in the financial sphere;
  - to solve the expert problems in criminology;
  - to diagnose the physical and psychic state of patients in medicine;
  - to make the psychological individual analysis in psychology,
  - And others.

Facial Recognition

- In facial recognition, the computers perform verification, and recognition.
- One of the problems is face recognition under varying poses.
- The following technology can be used:
  - (i) representation of faces with templates from multiple model views that cover different poses from the viewing sphere,
  - (ii) recognition of a novel view, the recognizer locates the eyes and nose features, uses these locations to geometrically register the input model views,
  - (iii) using the correlation on model templates to find the best match in the database of base of people.

Sources

Svetlana Yanushkevich
Vladimir Shmerko

Steve Chien

Randall Hill