OPTIONAL COURSES

1. Data Types - Databases - Biological Database Design

Coordinator: Prof. M. Hantzopoulos | Prof. N. Misirlis

Lecturers: Prof. M. Hantzopoulos | Prof. N. Misirlis

Optional Module

Semester: B

Syllabus:

- **Data Structures:** Introduction. The concept of Abstract Data Type (ADT). Tables, Records, Strings. Stacks, Recursion, Lists, Trees (Binary Trees, Binary Search Trees), Balanced Trees (AVL). Graphs (implementation, algorithms). Search with hashing. Implementation of ADT with an object-oriented programming language (C++ or JAVA)
- **Databases:** Conceptual database modeling. Database management system architectures, Data Models (Hierarchical, Network, Relational). Relational algebra. Relational calculus. Database Normalization. The Structured Query Language (SQL), programming advanced queries in SQL, Queries by Example (QBE), Modern trends in Databases (object-oriented, distributed, multimedia) database design.
- **Design of Biological Databases:** Applications to specific examples of designing Biological Databases.

2. Architecture of Internet Application and Bioinformatics

Coordinator: Assoc. Prof. D. Martakos

Lecturers: Assoc. Prof. D. Martakos

Optional Module

Semester: B

Syllabus:

- **Internet Application Architecture:** Client/Server architecture and its correlation with WWW, multi-tier architectures(n-tier), the WEB Server role, OSF DCE architecture, DNA architecture, WAP architecture, WAP servers, Application Servers, middleware (corba, activeX, transaction servers, message passing, message queues).
- **Designing applications:** System Design and modelling, protocols and programming (Client Side Programming: HTML, DHTML, XML, scripting languages, Server Side Programming: JSP, ASP, CGI), access to legacy systems, communications with DBMSs and multimedia systems, transaction processing (methods and environments).
- **Internet Security:** secure information access and transport, symmetrical and asymmetrical cryptography, digital signatures, secure third parties, Digital certificates, X509.3 protocol, PKI

? PKIX structures, Server and Client authentication, SSL ? TSL ? S/MIME ? PGP ? IPSPEC protocols.
- **Implementing Applications:** Development tools, Specialized applications in Bioinformatics systems.

3. Inteligent System Techniques in Bioinformatics

Coordinator: Dr. E. Tzafesta

Lecturers: Dr. E. Tzafesta

Optional Module

Semester: B

Syllabus:

- **Introduction**
- **Machine Learning Techniques:** Symbolic learning, Reinforcement learning
- **Neural Techniques:** Multi layer Perceptions, Adaptation rules (Back propagation, Hebb, competitive rules), Kohonen networks and associative memory, RBF networks, non-connectionist networks.
- **Fuzzy techniques:** Fuzzy logic, Fuzzy rules, Fuzzy networks
- **Probabilistic Graphical techniques:** Probabilistic networks, Markov Models, Bayes Models
- **Applications in Bioinformatics**

4. Complex Adaptive Systems

You can find more information for this module at the following address:
http://www.softlab.ece.ntua.gr/~brensham/CourseCAS/

Coordinator: Dr. E. Tzafesta

Lecturers: Dr. E. Tzafesta

Optional Module

Semester: B

Syllabus:

- **Introduction**
- **Behavioural models:** Models of motion, control and regulation of behaviour of real and artificial animals, Motion control, Learning Problems, Learning models (spatial, associative, etc.).
- **Population models:** Ecological models, Social insect societies, Models of groups.

- **Evolutionary models:**

    1. Techniques: Genetic and evolutionary algorithms, Genetic programming, Evolution of hierarchical structures and classifiers
    2. Problems: Evolutionary phenomena at the population level, Evolutionarily stable strategies, The problem of cooperativity, Species creation, Symbiosis and symbiogenesis.

- **Developmental models:** Morphogenesis, generative grammars and L-systems, arbitrary rule-based systems.
- **Molecular models:** Metabolic pathways and cellular regulation modeling.
- **Cellular Automata:** One-dimensional and two-dimensional cellular automata, Self-reproducted forms, Adaptative forms.
- **Dynamic Systems:** Fundamentals, Describing systems and phenomena as dynamic systems, Topics in the analysis of dynamic systems, Graphical criteria, Deterministic chaos.

5. Special Topics in Bioinformatics

For the spring semester 2003-2004 the module "Special Topics in Bioinformatics" will be covered the topic "Algebraic and Geometric Algorithms in Molecular Biology" (http://www.di.uoa.gr/~erga/AlgGewBio.html). The module will be taught simultaneously with the module under the same title, available for the students of the Postgraduate Programme of the Department of Informatics, with coordinator the Associate Professor I. Emiris.

So for the spring semester 2003-2004

5. Computational Methods in Science

Coordinator: Assoc. Prof I. Emiris

Lecturers: Assoc. Prof I. Emiris

Optional Module

Semester: B

Syllabus:

- **Three-dimensional structure of proteins, protein folding:**
    - Data: Experimental data from X-Ray Crystallography and NMR.
    - Representation: Protein modelling by distance geometry and dimensionality reduction
    - Conformational search with combinatorial and probabilistic methods, the road map approach, algorithmic complexity
    - Algebraic algorithms: linear algebra, studying and solving polynomial systems, relations between molecular conformations with robotic mechanism positions.

    - Optimization algorithms: global or local optimization, integer programming
- **Similarities and recognition of molecular structures, docking:**
    - Geometric models: alpha-shapes, spheres union, Connoly surface
    - Molecular surface representation, Delaunay triangulation and meshing
    - Data structures for Geometrical data: Geometric hashing, structure similarity metrics, data mining.
    - Recognition of Three-dimensional features, move and fit, computer vision techniques