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| 1. | Course title | **Advanced algorithm design techniques** | | |
| 2. | Course code | BIO-I-08 | | |
| 3. | Study program | **Bioinformatics** | | |
| 4. | Unit offering the course | **FCSE** | | |
| 5. | Undergraduate/master/PhD | **Master** | | |
| 6. | Year/semester<br>1/summer/elective | 7. ECTS: **6** | | |
| 8. | Teacher(s) | associate professor Vladimir Trajkovic<br>associate professor Slobodan Kalajdziski | | |
| 9. | Course prerequisites | None | | |
| 10. | Goals (competences):<br>The student will be able to use and develop advanced algorithms applicable to solve bioinformatics problems. | | | |
| 11. | Course content:<br>With the emergence of new computational challenges of biological data, there is a need for more effective and efficient algorithms to deal with them. This course offers a study of the principles of algorithm design and an overview of existing algorithms. Focus is placed on the process of algorithm design, including problems, specifications, algorithms, efficiency: temporal and spatial complexity, big-O notation, fundamental design strategies: greedy algorithms, divide and conquer, dynamic programming. The student will master the most important existing algorithms in bioinformatics, including algorithms for exact matching of arrays, suffix trees, aligning pairs, the dynamic programming algorithms; heuristic algorithms: Blast and FastA; statistical alignment algorithms: a hidden Markov model; aligning multiple sequences: algorithms and heuristics; algorithms related to molecular structure: determination and prediction of the structure. Special emphasis will be given to the complexity of the algorithms and their usability. | | | |
| 12. | Teaching methods:<br>Lectures supported by slide presentations, interactive lectures, trainings (using lab equipment and software packages), team work, case studies, invited guests and lectures, individual practical assignments presentations, seminar paper, e-learning (forums, consultations). | | | |
| 13. | Total available time | 6 ECTS x 30 hours = 180 hours | | |
| 14. | Distribution of the available time | 120 + 0 + 60 = 180 hours | | |
| 15. | Teaching activities | 15.1. | Lectures | 120 hours |
| | | 15.2. | Training (labs, problem solving), seminar and team work | 0 hours |
| 16. | Other activities | 16.1. | Project work | 15 hours |
| | | 16.2. | Self study | 15 hours |
| | | 16.3. | Home work | 30 hours |
| 17. | Grading | | | |
| | 17.1. | Tests | | 65 points |
| | 17.2. | Seminar work/project (written or oral presentation) | | 25 points |
| | 17.3. | Active participation | | 10 points |

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| 18. | Grading criteria | to 59 points | 5 (five) (F) |
| | | from 60 to 68 points | 6 (six) (E) |
| | | from 69 to 76 points | 7 (seven) (D) |
| | | from 77 to 84 points | 8 (eight) (C) |
| | | from 85 to 92 points | 9 (nine) (B) |
| | | from 93 to 100 points | 10 (ten) (A) |
| 19. | Final exam prerequisites | Successfully completed activities 15.1 and 15.2 | |
| 20. | Course language | Macedonian and English | |
| 21. | Quality assurance methods | Internal evaluation and student questionnaires | |

22. Literature

22.1. Compulsory

| No. | Authors | Title | Publisher | Year |
|---|---|---|---|---|
| 1. | Teofilo F. Gonzalez | Handbook of Approximation Algorithms and Metaheuristics | Chapman & Hall/CRC, 1 edition | 2007 |
| 2. | Steffen Schulze-Kremer | Molecular Bioinformatics: Algorithms and Applications | Walter de Gruyter | 1995 |
| 3. | Prosenjit Bose, Pat Morin | Algorithms and Computation | Springer, 1 edition | 2002 |

22.2. Additional

| No. | Authors | Title | Publisher | Year |
|---|---|---|---|---|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |