

**SYLLABUS / FIȘA DISCIPLINEI**
**1. Information on the study programme / Date despre programul de studii**

|   |  |
|---|--|
| 1.1. Institution / Instituția de învățământ superior      | Universitatea de Vest din Timișoara  |
| 1.2. Faculty / Facultatea                                 | Matematică și Informatică  |
| 1.3. Department / Departamentul                           | Computer Science (Informatică)   |
| 1.4. Study program field                                  | Computer Science (Informatică)   |
| 1.5. Study cycle/ Ciclul de studii                        | Bachelor / licență   |
| 1.6. Study programme / Programul de studii / calificarea* | Computer Science / Informatică în limba engleză / Database administration / <i>Administrator baze de date - 252101; Computer network administration / Administrator de rețea de calculatoare - 252301; Analyst / Analist - 251201; Research assistant in computer science / Asistent de cercetare în informatică - 214918; Teacher in secondary schools / Profesor în învățământul gimnazial - 233002; Programmer / Programator - 251202; Software systems designers / Proiectant sisteme informatice - 251101</i> |

**2. Information on the course / Date despre disciplină**

|  |                    |                           |   |   |   |  |    |
|--|--------------------|---------------------------|---|---|---|--|----|
| 2.1. Title of the course / Denumirea disciplinei                           | Information Theory |                           |   |   |   |  |    |
| 2.2. Teacher in charge of the course / Titularul activităților de curs     | Cosmin Bonchis     |                           |   |   |   |  |    |
| 2.3. Teacher in charge of the seminar / Titularul activităților de seminar | Cosmin Bonchis     |                           |   |   |   |  |    |
| 2.4. Study year / Anul de studii   | 3                  | 2.5. Semester / Semestrul | 1 | 2.6. Examination type / Tipul de evaluare: E(xam)/C(olloquim) | C | 2.7. Course type / Regimul disciplinei: M(andatory)/ E(lective)/ F(acultative) | DO |

**3. Estimated study time (number of hours per semester) /Timpul total estimat (ore pe semestru al activităților didactice)**

|  |    |  |    |                        |                  |
|--|----|--|----|------------------------|------------------|
| 3.1. Attendance hours per week / Număr de ore pe săptămână   | 4  | out of which din care: 3.2 lecture/ curs | 2  | 3.3. seminar/laborator | 2                |
| 3.4. Attendance hours per semester / Total ore din planul de învățământ  | 56 | out of which: 3.5 lecture / curs         | 28 | 3.6. seminar/laborator | 28               |
| <b>Distribution of the allocated amount of time / Distribuția fondului de timp*</b>  |    |  |    |                        | <b>hours/ore</b> |
| Individual study /Studiu după manual, suport de curs, bibliografie și notițe   |    |  |    |                        | 30               |
| Supplementary documentation at library or using electronic repositories / Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate |    |  |    |                        | 10               |
| Preparing for laboratories, homework, reports etc. /Pregătire seminarii/laboratoare, teme, referate, portofolii și eseuri                                    |    |  |    |                        | 40               |
| Exams / Examinări  |    |  |    |                        | 20               |

|  |     |    |
|--|-----|----|
| Tutoring / Tutorat   |     | 10 |
| 3.7. Total number of hours of individual study / Total ore studiu individual | 100 |    |
| 3.8. Total number of hours per semester / Total ore pe semestru              | 156 |    |
| 3.9. Number of credits (ECTS) / Număr de credite                             | 5   |    |

#### 4. Prerequisites (if it is the case) / Precondiții (acolo unde e cazul)

|                                 |                    |
|---------------------------------|--------------------|
| 4.1. curriculum / de curriculum | Probability Theory |
| 4.2. skills / de competențe     | -                  |

#### 5. Requirements (if it is the case) / Condiții (acolo unde e cazul)

|   |  |
|---|--|
| 5.1. for the lecture / de desfășurare a cursului                              |  |
| 5.2. for the seminar, laboratory / de desfășurare a seminarului/laboratorului |  |

#### 6. Acquired skills / Competențe specifice acumulate

|   |   |
|---|---|
| Professional skills / Competențe profesionale | Abilities to compute the important formulas and to apply the data compression algorithms. Understanding several definitions of information. |
| Transversal skills / Competențe transversale  | Applying algorithms for optimal codes in data compression and data transmission.  |

#### 7. Objectives of the course / Obiectivele disciplinei (reieșind din grila competențelor specifice acumulate)

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| 7.1. General objective / Obiectivul general al disciplinei |  |
| 7.2. Specific objectives / Obiectivele specifice           |  |

#### 8. Content / Conținuturi\*

| 8.1. Lecture / Curs  | Teaching strategies / Metode de predare | Remarks, details / Observații |
|--|---|-------------------------------|
| <b>1. Fundamental quantities of information theory</b> <ul style="list-style-type: none"> <li>Entropy, Joint Entropy and Conditional Entropy</li> <li>Relative Entropy and Mutual Information</li> </ul> | Lectures, illustration, demonstration   | 2h                            |

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|--|--|-----------|
| <p><b>2. Entropy Rates of a Stochastic Process</b></p> <ul style="list-style-type: none"> <li>• Markov Chains</li> <li>• Entropy Rate</li> </ul>   | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>3. Second Law of Thermodynamics</b></p>  | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>4. Data Compression</b></p> <ul style="list-style-type: none"> <li>• Kraft Inequality, <b>Optimal Codes</b></li> <li>• Huffman Codes</li> </ul>  | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>5. Data Compression</b></p> <ul style="list-style-type: none"> <li>• Optimality of Huffman Codes</li> <li>• <b>Shannon–Fano–Elias Coding</b></li> </ul>  | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>6. Source Coding Theorem</b></p> <ul style="list-style-type: none"> <li>• Entropy and compression</li> </ul>   | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>7. Channel capacity</b></p> <ul style="list-style-type: none"> <li>• Noiseless Binary Channel</li> <li>• Noisy Channel Coding Theorem</li> </ul>   | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>8. Channel Capacity</b></p> <ul style="list-style-type: none"> <li>• Zero-Error Codes</li> <li>• <b>Hamming Codes</b></li> </ul>   | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>9. Channel Capacity</b></p> <ul style="list-style-type: none"> <li>• Source–Channel Separation Theorem</li> </ul>  | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>10. Network Information Theory</b></p> <ul style="list-style-type: none"> <li>• Broadcast and Multiple-Access Channels</li> <li>• Correlated source coding and the Slepian-Wolf Theorem</li> </ul> | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |
| <p><b>11. Kolmogorov Complexity</b></p> <ul style="list-style-type: none"> <li>• Kolmogorov Complexity: Definitions and</li> </ul>   | <p>Lectures,<br/>illustration,<br/>demonstration</p> | <p>2h</p> |

|   |   |                                      |
|---|---|--------------------------------------|
| Examples  |   |                                      |
| <ul style="list-style-type: none"> <li>Kolmogorov Complexity and Entropy</li> </ul>   |   |                                      |
| <b>12. Kolmogorov Complexity</b> <ul style="list-style-type: none"> <li>Kolmogorov Complexity of Integers</li> <li>Kolmogorov Complexity and Universal Probability</li> </ul>   | Lectures, illustration, demonstration                             | 2h                                   |
| <b>13. Rate-Distortion Theory</b> <ul style="list-style-type: none"> <li>Ultimate limits of compression, communication and signal processing</li> <li>Measure matching</li> <li>Blahut-Arimoto Algorithm</li> </ul>   | Lectures, illustration, demonstration                             | 2h                                   |
| Final examination   |   | 2h                                   |
| <b>Recommended bibliography / Bibliografie</b><br>Thomas M. Cover, Joy A. Thomas. <i>Elements of information theory</i> New York: Wiley, 1991. <a href="#">ISBN 0-471-06259-6</a><br><br>David Solomon. <a href="#">Data Compression: The Complete Reference</a> , Volumul 10 |   |                                      |
| <b>8.2. Seminar, lab / Seminar, laborator</b>   | <b>Teaching/learning strategies / Metode de predare/ învățare</b> | <b>Remarks, details / Observații</b> |
| 1. Problems with Entropy, Joint Entropy and Conditional Entropy,  | Problem solving, questioning, dialogue                            | 2h                                   |
| 2. Problems with Relative Entropy and Mutual Information  | Problem solving, questioning, dialogue                            | 2h                                   |
| 3. Markov Chains related problems. Entropy Rate computation   | Problem solving, questioning, dialogue                            | 2h                                   |
| 4. Second Law of Thermodynamics   | Problem solving, questioning, dialogue                            | 2h                                   |
| 5. <b>Kraft Inequality, Optimal Codes and Huffman Codes applications</b>  | Problem solving, questioning, dialogue                            | 2h                                   |
| 6. Optimality of Huffman Codes, Shannon–Fano–Elias  | Problem solving, questioning,                                     | 2h                                   |

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|---|--|----|
| Coding computation  | dialogue                               |    |
| 7. Entropy and compression issues   | Problem solving, questioning, dialogue | 2h |
| 8. Noiseless Binary Channel, Noisy Channel Coding Theorem examples  | Problem solving, questioning, dialogue | 2h |
| 9. Zero-Error Codes, Hamming Codes applications   | Problem solving, questioning, dialogue | 2h |
| 10. Source–Channel Separation Theorem implications, properties  | Problem solving, questioning, dialogue | 2h |
| 11. Properties of Broadcast and Multiple-Access Channels, Correlated source coding and the Slepian-Wolf Theorem   | Problem solving, questioning, dialogue | 2h |
| 12. Kolmogorov Complexity: Examples   | Problem solving, questioning, dialogue | 2h |
| 13. Kolmogorov Complexity of Integers and Universal Probability applications  | Problem solving, questioning, dialogue | 2h |
| 14. Ultimate limits of compression, communication and signal processing applications  | Problem solving, questioning, dialogue | 2h |
| <b>Recommended bibliography / Bibliografie</b><br>Thomas M. Cover, Joy A. Thomas. <i>Elements of information theory</i> New York: Wiley, 1991. <a href="https://doi.org/10.1002/9781118020114">ISBN 0-471-06259-6</a><br><br>David Solomon. <a href="#">Data Compression: The Complete Reference</a> , Volumul 10 |  |    |

**9. Correlations between the content of the course and the requirements of the IT field / Coroborarea conținuturilor disciplinei cu așteptările reprezentanților comunității epistemice, asociațiilor profesionale și angajatorilor reprezentativi din domeniul aferent programului**

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**10. Evaluation / Evaluare\***

| Activity / Tip de activitate | 10.1. Evaluation criteria / Criterii de evaluare** | 10.2. Evaluation methods / Metode de evaluare*** | 10.3. Weight in the averaged mark / Pondere din nota finală |
|------------------------------|--|--|---|
| 10.4. Lecture / Curs         | Theoretical final examination                      | answers to examination problems                  | 20%   |
|                              | Continous theoretical examination                  | answers to examination quiz problems             | 30%   |

|   |                              |   |     |
|---|------------------------------|---|-----|
| 10.5. Seminar/ lab  |                              |   |     |
|   | Final laboratory examination | final answers to practical laboratory tests | 20% |
|   | Projects                     |   | 30% |
| 10.6. Minimal knowledge for passing / Standard minim de performanță   |                              |   |     |
| Understanding the terminology from Information Theory. Computes different entropy rates. Detect the codewords of a code source. |                              |   |     |

Date/ Data completării  
 10.10.2016

Signature (lecture) /  
 Semnătura titularului de curs  
 seminar



Signature (seminar)  
 Semnătura titularului de



Signature (director of the department)  
 Semnătura directorului de departament  
 Conf.dr. Victoria Iordan