#### card of course

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| Subject name | Parallel and distributed processing |

1. The placement of the subject in the study system

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| 1.1. Field of study | Computer science |
| 1.2. Form and path of study | Full-time/Part-time |
| 1.3. Level of education | First-cycle studies |
| 1.4. Study profile | Practical |

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| 1. 5. Specialty | - |
| 1.6. Subject Coordinator | Dr inż. Kamil Żyła |

2. General characteristics of the subject

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| 2.1. Belonging to a subject group | Directional/Practical |
| 2.2. Number of ECTS | 2 |
| 2.3. Language of lectures | English |
| 2.4. Semesters in which the subject is taught | VI |
| 2.5.Criteria for selecting course participants | - |

1. Learning outcomes and course delivery
   1. Subject Objectives

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| No. | Subject Objectives |
|
| C1 | Introduction to parallel processing. Familiarization with concepts related to parallel processing - starvation, deadlock, critical section, control methods. |
| C2 | Acquiring knowledge about technologies that increase the computing power of modern computers, a historical outline of the development of technology. |
| C3 | Familiarization with the concepts of process, program, thread. |
| C4 | Acquiring skills in the most important concurrent and parallel processing algorithms. |
| C5 | Acquiring the ability to prepare an algorithm for a multithreaded application. |
| C6 | Acquiring the ability to prepare a simple application consistent with the idea of distributed systems. Application testing – distributed systems. |

* 1. Subject-specific learning outcomes, divided into knowledge , skills and competences , with reference to the directional learning outcomes

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Description of subject  learning outcomes | Reference to  directional effects  learning (symbols) | Method of implementation (mark "X") | | | |
| ST | | NST | |
| Classes at the University | Activities on  the platform | Classes at the University | Activities on  the platform |
| After passing the course, the student knows and understands **the knowledge** | | | | | | |
| W1 | The student knows various distributed and parallel programming techniques. | INF\_W08  INF\_W12  INF\_W18 | X |  | X |  |
| W2 | The student knows the basic laws that allow for calculating the acceleration of parallel computations, the effect of load unbalancing, and the efficiency of program operation. | X |  | X |  |
| W3 | The student knows distributed and parallel programming techniques in Java. | X |  | X |  |
| W4 | Student uses available tools to check the efficiency of a parallel application. | X |  | X |  |
| After passing the course, the student is **able** to: | | | | | | |
| U1 | The student is able to write a program that runs correctly and efficiently in a concurrent environment. | INF\_U07 INF\_U18 INF\_U19  INF\_U27 | X |  | X |  |
| U2 | The student is able to use parallel programming methods to shorten the execution time of the resulting code. | X |  | X |  |
| U3 | The student is able to evaluate different ways of implementing a concurrent program in terms of its effectiveness. | X |  | X |  |
| After completing the course, the student is ready to take part in **social competences.** | | | | | | |
| K1 | Understands the need to justify why solutions such as computing clusters and multi-core processors are used. | INF\_K05 | X |  | X |  |
| K2 | The student is ready to make decisions about software development based on concurrent and distributed solutions. | X |  | X |  |
| K3 | Is able to convey acquired knowledge in an understandable way. | X |  | X |  |

3.3. Forms of teaching and their number of hours - Full-time studies (ST), Part-time studies (NST)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Path | Lecture | Exercises | Design | Workshop | Laboratory | Seminar | Lecturer | Classes conducted using distance learning methods and techniques in the form of ………………. | Other | **ECTS points** |
| **ST** |  |  |  | 30 |  |  |  |  |  | 2 |
| **NST** |  |  |  | 15 |  |  |  |  |  | 2 |

3.4. Content of education (separately for each form of classes: (W, ĆW, PROJ, WAR, LAB, LEK, OTHER). It should be marked (X) how the given content will be implemented (classes at the university or classes on the e-learning platform conducted using distance learning methods and techniques)

TYPE OF CLASS: WORKSHOP

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Content of the course | Reference to subject-specific learning outcomes | Method of implementation (mark "X") | | | |
| ST | | NST | |
| **Classes at the University** | **Activities on  the platform** | **Classes at the University** | **Activities on  the platform** |
| 1. | Introduction to parallel processing, basic information.  The concept of process, program, threadStarvation, deadlock, critical section, control methods - definitions of concepts related to parallel processing. | W2, W4 | X |  | X |  |
| 2. | Technologies that increase the computing power of modern computers, a historical outline of the development of technology. | W1, K1, K2 | X |  | X |  |
| 3. | The most important concurrent and parallel processing algorithms  . Implementation of multithreading. | W1, W2, W3, W4, U1, U2, U3, K1 | X |  | X |  |
| 4. | Distributed systems - basic information. Examples of distributed systems. | W1, K2 | X |  | X |  |
| 5. | Preparing an algorithm for a multi-threaded application – group brainstorming. | W3, U1, U2, U3, K2, K3 | X |  | X |  |
| 6. | Summary of classes and discussion of grades. |  | X |  | X |  |

3.5. Methods of verifying learning outcomes (indication and description of methods of conducting classes and verification of achievement of learning outcomes and method of documentation)

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| --- | --- | --- | --- |
| Subject Effects | Teaching methods | Methods of verifying learning outcomes | Documentation methods |
| KNOWLEDGE | | | |
| W1-W4 | Discussing issues using multimedia, doing exercises, brainstorming | As part of the verification of learning outcomes, students perform exercises using a processor simulator and use machine code in Assembler language (parallel processing).  They configure the operation of network clusters, VPN network connection between the client and the server, and perform backups of data and operating systems (distributed processing). – 100% final grade | File with the completed exercise |
| SKILLS | | | |
| U1-U3 | Discussing issues using multimedia, doing exercises, brainstorming | As part of the verification of learning outcomes, students perform exercises using a processor simulator and use machine code in Assembler language (parallel processing).  They configure the operation of network clusters, VPN network connection between the client and the server, and perform backups of data and operating systems (distributed processing). – 100% final grade | File with the completed exercise |
| SOCIAL COMPETENCES | | | |
| K1-K3 | Discussing issues using multimedia, doing exercises, brainstorming | As part of the verification of learning outcomes, students perform exercises using a processor simulator and use machine code in Assembler language (parallel processing).  They configure the operation of network clusters, VPN network connection between the client and the server, and perform backups of data and operating systems (distributed processing). – 100% final grade | File with the completed exercise |

3.6. Assessment criteria for the achieved learning outcomes

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| --- | --- | --- | --- | --- | --- |
| Learning effect | For a grade of 3 or "pass."  the student knows and understands/is able to/is ready to | For a grade of 3.5, the student knows and understands/is able to/is ready to | For a grade of 4, the student knows and understands/is able to/is ready to | For a grade of 4.5, the student knows and understands/is able to/is ready to | For a grade of 5, the student knows and understands/is able to/is ready to |
| W | 51-60% of knowledge indicated in learning outcomes | 61-70% of knowledge indicated in learning outcomes | 71-80% of knowledge indicated in learning outcomes | 81-90% of knowledge indicated in learning outcomes | 91-100% of knowledge indicated in learning outcomes |
| U | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |
| K | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |

3.7. Literature

**Basic**

1. Scott Michael Lee; Programming language pragmatics Morgan Kaufmann Publishers; San Francisco 2015
2. Z. Weiss, T. Gruźlewski – Programowanie współbieżne i rozproszone w przykładach i zadaniach, WNT, 1993.

# Paweł Majdzik, Programowanie współbieżne, Helion, 2012

**Supplementary**

1. Sebesta Robert W; Concepts of programming languages; Pearson Education; Harlow 2016

4. Student workload - ECTS points balance

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| --- | --- | --- |
| **Types of student activity** | **Student Load** | |
| **ST** | **NST** |
| **Classes requiring direct contact between the student and the academic teacher at the university premises** | **30** | **15** |
| Classes included in the study plan | 30 | 15 |
| **Student's own work** | **20** | **35** |
| Ongoing preparation for classes, preparation of project work/presentations/etc. | 10 | 20 |
| Preparation for passing classes | 10 | 15 |
| **TOTAL STUDENT HOURLY LOAD** | **50** | **50** |
| **Number of ECTS points** | **2** | **2** |

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| Last change date | 30/09/2024 |
| The changes were introduced | INF Education Quality Team |
| The changes were approved | Arkadiusz Gwarda, M.A. |