POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Parallel Programming [S2Teleinf2-SWxR>PR]

Course

Field of study	Year/Semester
Teleinformatics	2/3
Area of study (specialization)	Profile of study
xR virtual systems	general academic
Level of study	Course offered in
second-cycle	Polish
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other
14	24	14
Tutorials	Projects/seminars	
0	0	

Number of credit points

4,00

Coordinators	Lecturers
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Prerequisites

Knowledge: - Knows the basic data structures and algorithms used in programming languages. - Has a working knowledge of programming methodologies and techniques in high-level languages. - Has a basic knowledge of digital signal processing methods in data communications. Skills: - Can obtain information from literature and databases and other sources in Polish or English. - Can use programming mechanisms and programming environments of object-oriented languages and available library software. Social competencies: - Knows the limitations of his/her own knowledge and understands the need to update it. - Understands the influence of his own work on the team's results and the necessity of submitting to the rules of teamwork and taking responsibility for jointly implemented tasks.)

Course objective

To learn the basic features of parallel processing. Getting acquainted with existing technical solutions on methods of designing algorithms of parallel processing. Preparing own implementations of selected algorithms. Shaping and developing the ability to acquire knowledge of the current solutions in the field of parallel processing systems.

Course-related learning outcomes

Knowledge:
K2_W02 Has advanced knowledge in the area of parallel programming, including:
Design and implementation of parallel computing algorithms
Optimising the performance of parallel tasks
Using modern parallel programming techniques for complex systems
K2_W04 Understands the methodology of designing complex ICT; familiar with hardware description languages and computer-aided design and simulation tools for systems, is familiar with modern programming languages and software engineering principlesK2_W05 Zna i rozumie algorytmy wykorzystywane w systemach teleinformatycznych z obszaru specjalizacji
K2_W07 Has an in-depth knowledge of the latest developments and key innovations in the field of ICT, including:
Awareness of current trends and new developments in the field of information technology
Understanding of dynamic changes and innovative solutions in the field of digital communications
Orientation in the latest technological developments in telecommunications and information technology

Skills:
K2_U01 Demonstrates the ability to obtain information effectively from a variety of sources, including specialist literature, databases and other resources, and to:
Integrate and analyse collected data to formulate comprehensive conclusions
Critically evaluate information and form reasoned and accurate opinions
Interpret data and conclusions in order to draw accurate and balanced conclusions
K2_U09 Has the ability to propose innovative improvements or alternative solutions to existing projects and information and communication systems, taking into account:
Creativity in developing innovative concepts for system improvements
Ability to identify opportunities for optimising IT projects
Ability to formulate alternative strategies for the development of ICT systems
K2_U10 Demonstrates the ability to analyse and evaluate the application of new technologies and design methods in the development of innovative ICT systems and systems, considering:
Ability to critically evaluate the usefulness of new technological developments in practice
The ability to identify potential applications of new technological developments in ICT projects
Sensitivity to innovative approaches to the creation of modern information and communication systems

Social competences:
K2_K01 Demonstrates a willingness to appreciate the role of knowledge in solving both theoretical and practical problems, and to:
Critically analyse and evaluate information and content received from a variety of sources
Appreciate the importance of theoretical and practical knowledge in decision-making
Use knowledge to make sound and balanced decisions in a variety of fields

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Lecture
Written and/or oral exam. The exam consists of several - several questions (depending on the adopted nature of the questions) and concerns the content presented during the lectures. The exact nature of the exam questions will be presented to the students during one of the last lectures. Threshold for passing the exam: 50% of the points.
Grading scale: <50% - 2.0 (ndst); 50% to 59% - 3.0 (dst); 60% to 69% - 3.5 (dst+) ; 70% to 79% - 4.0 (db); 80% to 89% - 4.5 (db+); 90% to 100% - 5.0 (bdb).
2 Laboratories
Reports on thematically uniform blocks of laboratory exercises. Ongoing assessment of the degree of mastery of the material, progress of the tasks and activity in class. Passing threshold: 50% of the points.
Grading scale: <50% - 2.0 (ndst); 50% to 59% - 3.0 (dst); 60% to 69% - 3.5 (dst+) ; 70% to 79% - 4.0 (db); 80% to 89% - 4.5 (db+); 90% to 100% - 5.0 (bdb).

Programme content

Parallel processing:
- division into tasks that do not require synchronization,
- division into tasks that require synchronization,

- barriers, fences,
- synchronization points,
- collisions in data access,

Multithreaded programming:
An overview of bibiots for developing parallel processing software:
- CPU: C++ threads, pthreads, MPI, OpenMP.
- GPU: OpenCL, Cuda, Vulcan.

Laboratory classes will consist in the preparation by students of programs implementing selected algorithms of parallel processing, including on GPUs, together with experimental verification of their correctness.

Course topics

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Teaching methods

1 Lecture
Classes with distinct elements of traditional lecture, problem lecture (discussion with students of a specific problem) and conversation lecture (mobilizing students to discuss a specific topic), depending on the content of the material presented. Selected content of the lecture is presented on a multimedia projector or blackboard. The discussion of issues is accompanied by information on their practical application.
2 Laboratories
Computer classes with the use of software for parallelized programming Solving problems given by the instructor and/or defined in the laboratory manual. Interpretation of the obtained solution and formulation of conclusions. Discussion of the possibility of practical application of the issues covered in the laboratory.

Bibliography

Basic:
- Foster I., “Designing and Building Parallel Programs”, książka dostępna w internecie http://wwwunix.mcs.anl.gov/dbpp
- M. Herlihy, N. Shavit „The Art of Multiprocessor Programming” Elsevier, 2008 (wydanie polskie „Sztuka programowania wieloprocesorowego”, PWN 2010)
- Z. Czech, "Wprowadzenie do obliczeń równoległych", PWN, Warszawa 2013

Additional:
- Grama A. et al., „Introduction to Parallel Computing” (wyd. 2), Addison-Wesley, 2003
- Internet websites: www.openmp.org, www.mpi-forum.org

Breakdown of average student's workload

	Hours	ECTS
Total workload	103	4,00
Classes requiring direct contact with the teacher	38	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50