SYLLABUS

Name: ***Parallel Computing (InfAAu>SI4PC19)***
Name in Polish:
Name in English: ***Parallel Computing***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau2/course/view.php?id=940

Short description:

The aim of the course is to introduce the student to the basic issues of parallel computing. The course covers the basic concepts of parallel computing, parallel computing models, designing parallel algorithms for the discussed models and their analysis. The correctness of the parallel algorithm is presented, including the deadlock and starvation problems. Classical problems of parallel computing are discussed: producer and consumer, dining philosophers, readers and writers, synchronization barrier.

Description:

ECTS: 2
Total workload: 55 hours (35 contact hours, 20 students' own work hours)
Forms of contact hours:
Lecture 30h
Other (consultations) 5h

Students' own work: reading the literature, preparation for classes, preparation for final test.

Lectures:
1. Basic definitions: concurrency and parallelism; definition of concurrent processes; physical and virtual processors; advantages and disadvantages of parallel computers.
2. Expressing concurrency.
3. Parameters of parallel algorithms: pessimistic complexity; acceleration; cost of parallel computing; efficient use of processors.
4. Amdahl's law. Gustafson and Barsis law.
5. Basic parallel algorithms: O (log n) time sort; finding the minimum in O (log n) and O (1) time; O time sort (log n).
6. Parallel computing models: classification of parallel computing models according to Flynn; PRAM models; MIMD models; SIMD models.
7. Models with distributed memory: connection networks: linear, mesh, cube (hypercube), binary tree, pyramid, perfectly shuffled; connection network evaluation criteria.
8. Designing parallel algorithms for SIMD and MIMD models.
9. Communication and synchronization of processes in the model with shared memory. Synchronization objects: mutex, semaphore, condition variable, monitor.
10. Deadlock and starvation of the process.
11. Classic problems of process synchronization: producer and consumer problem; the problem of dining philosophers; the problem of readers and writers; timing barrier.
12. Communication and synchronization of processes in the distributed memory model. Selective communication. Communication channels.
13. Designing parallel algorithms, in particular problem decomposition (functional decomposition, data decomposition, recursive, exploratory, speculative), granularity of computations, minimizing the cost of a parallel algorithm,
14. List Top500.

Bibliography:

1. Z. Czech: „Wprowadzenie do obliczeń równoległych". Wydawnictwo Naukowe PWN, Warszawa 2020.
2. Praca zbiorowa pod red. Z. Czecha, Programowanie współbieżne. Wybrane zagadnienia, skrypt Pol. Śl. nr 2191, Gliwice 1999, wyd. IV.
3. M. Ben-Ari: „Podstawy programowania współbieżnego", WNT, Warszawa 1996.
4. Z. Weiss, T. Gruźlewski: „Programowanie współbieżne i rozproszone w przykładach i zadaniach", WNT, Warszawa 1993.
5. Z. J. Czech: Introduction to parallel computing. Cambridge University Press, 2017.

Learning outcomes:

- Has general theoretical knowledge of parallel algorithms and their time complexity. (written test) K1A_W11
- Use the acquired mathematical knowledge, including elements of the calculation theory, and statistical knowledge to describe processes, create models, and designing algorithms. (written test) K1A_U08

Assessment methods and assessment criteria:

A written assesment test in the form of a test with open-ended or multiple-choice questions. To obtain the credits it is necessary to acheive a grade greater or equal to 3.0. Two repeated tests will be carried out. The final grade is the grade of the last test in which the Student took.

The syllabus is valid from academic year 2025/26 and its content cannot be changed during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	2	2020/2021-Z	