COURSE DESCRIPTION CARD - SYLLABUS

Course name
Performance evaluation of Computer Systems [S2Inf1-GiTI>OESK]

Course

Field of study
Computing

Year/Semester
1/2

Area of study (specialization)
Games and Internet Technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Educational outcomes from first-cycle studies defined in the Resolution of the PUT Senate, verified in the recruitment process for second-cycle studies. In particular, a student starting this subject should have basic knowledge of computer hardware, organization of computer systems, operating systems, computer networks, databases, programming languages, and understand how typical modern information technologies work. He should have the ability to create simple Internet applications, solve basic problems in the field of statistical data analysis and the ability to obtain information from indicated sources. He should also understand the need to expand his competences / be ready to cooperate within the team. Moreover, in terms of social competences, the student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. Introducing basic knowledge on methodology of computer system performance evaluation in typical applications of electronic commerce, and web applications 2. Developing ability of discovering, analyzing and solving computer performance problems.

Course-related learning outcomes

Knowledge:
have general understanding of algorithms, complexity, computer system architecture, operating systems, network technologies, programming languages and paradigms, databases (k2st_w2)
knows the life cycle of hardware and software systems: genesis and aging of benchmarks, approaches to the scalability of benchmarks (k2st_w5)
know the trends and main new developments in computer science and it, as well as in related fields of science and technology (k2st_w4)
have extended understanding of selected issues of computer science, such as performance metrics, infrastructure for performance evaluation tests, methods of performance evaluation used in the past (k2st_w3)
know basic methods, techniques and tools applicable in solving complex engineering tasks in the field of performance evaluation, detecting and removing performance problems. (k2st_w6)

Skills:
3. design and conduct experiments, including performance measurements, analyze the results, and draw conclusions from the results (k2st_u4)
4. exploit simple research and analysis methodologies to formulate and solve engineering and research tasks (k2st_u5)
integrate knowledge from various branches of computer science, while formulating and solving engineering tasks (k2st_u6)
designate directions of the further study, conduct a successful study (k2st_u3)
1. acquire knowledge from literature, databases and other sources (in polish and english), integrate and critically interpret it, on basis of that draw conclusions, formulate justified opinions (k2st_u1)
formulate and test hypotheses for engineering and simple research problems related to the performance of computer systems (k2st_u8)
asses utility of methods and tools applied to solve an engineering task consisting in constructing and evaluation of an information system or its components, as well as recognize limitations of such methods and tools. (k2st_u16)
propose improvements in the existing technical solutions to increase performance of computer systems (k2st_u15)
assess practicality and applicability of new advances in computer science and it to solve computer performance problems (k2st_u9)

Social competences:
realize that in computer science and it knowledge and skills outdate quickly (k2st_k1)
know examples of, and understand reasons why, faulty performance of computer systems caused financial and social damages or even severe health or life loss (k2st_k2)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learningoutcomes presented above are verified as follows:
Formative assessment:
a) lectures:
• answers to short questions related to the content of the lecture,
• 2-3 short tests related to the subjects of the lecture,
b) labs:
• on the basis of progresses in doing the current assignments
Total assessment:
a) lectures:
• evaluation of the knowledge and skills by a written exam. The exam has 5 to 8 questions related to theoretical issues and quantitative performance estimation methods presented in the lectures. To pass the exam at least 50% of possible points must be scored.
• discussion of exam results
b) labs:
• assessment of readiness and skills necessary to conduct the lab exercises,
• continuous assessment on all labs by questions and answers, rewarding progresses of skills in applying the taught methods
• assessment of the reports prepared partially during the labs and finished afterwards; the assessment includes contribution to the team work,

Additional elements cover:
• accurate comments to and explanations of the considered issues of computer performance evaluation
• essays on the current state and trends in computer performance evaluation,
• accurate indication of information technologies performance limitations and ways of bypassing such limitations,
• ability to cooperate in a team to solve the assignment from the lab exercises
• indicating possible improvements in the teaching process and materials

Programme content

This subject covers the following topics:
1 Introduction to performance evaluation
2 Typical performance measures
3 Techniques measurement
4 Planning of experiments
5 Elements of data analysis
6 Simple efficiency models
7 Experimental assessment of hardware and software systems, factors determining performance and performance optimization.

Course topics

The lecture covers the following topics: Place and goals of performance evaluation studies. Relationships between the components in the infrastructure of performance evaluation. Three classic techniques of performance evaluation: analytic methods, simulation, experiments, criteria of choosing evaluation techniques. Methodologies of performance evaluation. Classification of performance metrics. Examples of typical performance metrics related to speed, resources, reliability, cost, fairness. Tools and techniques of performance evaluation: types of workloads, selection, specification, generation of workloads. Performance monitors. Past and the current benchmarks to illustrate methods of performance evaluation methodologies, aging of benchmarks, scaling of benchmarks to prevent the aging. Benchmarks of CPU, memory, I/O, application benchmarks for DBMS, autonomic computing and reliability benchmarks, energy efficiency benchmarks. Computer system capacity planning: instrumentation, simple techniques of time series analysis. Experimental designs: simple experimental design, 2^k factorial design, 1- and 2- factor experiments. Problems with the graphical presentation of data. Queuing systems. Performance simulation.
The labs consist of 15 2-hour exercises starting with a 2-hour introductory instruction session. The exercises are conducted in 2-people teams. The lab exercises cover experimental measurement of computer hardware and software performance, performance determinants, and performance optimization in e-commerce class applications. Students prepare at least two experimental designs to measure speed of communication links, programs written in binary-compiled vs. interpreted computer languages, CPU performance, memory subsystem performance, file system performance, DBMS performance. During the demo sessions the issues of performance measurement, data presentation, testing WWW servers, popular WWW servers log analysis, web-page load time as a metric of performance and optimizing it, optimizing the Apache server, web-page traffic as a measure of performance, electric energy consumption as a measure of performance, are discussed.
Teaching methods:
1. Lectures: multimedia presentation, presentation illustrated with examples presented on black board, solving tasks, discussions on performance limitations of selected computer technologies, discussion on the current and future trends in IT determining computer performance
2. Labs: solving tasks, practical experimentation, discussion, multimedia presentation, teamwork, case studies, demos

Teaching methods

Lecture: multimedia presentation, illustrated with examples given on the board.
Laboratory exercises: a multimedia presentation, a presentation illustrated with examples given on the board and tasks given by the lecturer, practical exercises.

Bibliography

Basic

1. R.Jain, The Art of Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling, Wiely, 1991
2. R.Hockney, The Science of Computer Benchmarking, SIAM Press, Philadelphia, 1996
3. G-P.Musumeci,M.Loukides, Optymalizacja systemów komputerowych,Wydawnictwo RM,Warszawa, 2002
4. B.Gregg, Wydajne systemy komputerowe. Przewodnik dla administratorów systemów lokalnych i w chmurze, Helion, Gliwice, 2014
5. K.Kanoun, L.Spainhower, Dependability Benchmarking for Computer Systems, J.Wiley and Sons, IEEE Computer, 2008
6. J.Błażewicz, W.Cellary, R.Słowiński, J.Węglarz, Badania operacyjne dla informatyków, WNT, Warszawa, 1983
7. NIST/SEMATECH e-Handbook of Statistical Methods, 2003. http://www.itl.nist.gov/div898/handbook/
Additional
1. internet sources of companies dealing with computer system performance studies, eg: www.tpc.org, www.spec.org

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50