STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Performance evaluation of Computer Systems	**1010512321010510514**

Field of study	Profile of study (general academic, practical)	Year /Semester
Computing	**general academic**	**1 / 2**
Elective path/specialty: **Games and Internet Technologies**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-**		No. of credits: **5**
Status of the course in the study program (Basic, major, other): **major**	(university-wide, from another field): **from field**	
Education areas and fields of science and art: **technical sciences**; **Technical sciences**		ECTS distribution (number and %): **5 100%**; **5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Learning objectives of the first cycle studies defined in the resolution of the PUT Academic Senate, that are verified in the admission process to the second cycle studies ? the learning objectives are available at the website of the faculty www.fc.put.poznan.pl A student starting this module should have basic knowledge on the architecture and organization of computer systems, operating systems, computer networks, databases, programming languages.
2	**Skills**	He/She should be able to develop simple internet applications, solve basic data analysis problems using statistical methods, as well as acquire information from the indicated sources.
3	**Social competencies**	The student should understand the necessity of expanding his/her competences and be ready to undertake cooperation in a team. As far as social competences are considered, the student must be honest, responsible, persevering, curious, creative, respectful to other people.

Assumptions and objectives of the course:

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.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. have general understanding of algorithms, complexity, computer system architecture, operating systems, network technologies, programming languages and paradigms, databases - [K2st_W2]
2. 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]
3. know the trends and main new developments in computer science and IT, as well as in related fields of science and technology - [K2st_W4]
4. knows the life cycle of hardware and software systems: Genesis and aging of benchmarks, approaches to the scalability of benchmarks - [K2st_W5]
5. 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:

1. 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]

2. designate directions of the further study, conduct a successful study - [K2st_U3]

3. 3. design and conduct experiments, including performance measurements, analyze the results, and draw conclusions from the results - [K2st_U4]

4. 4. exploit simple research and analysis methodologies to formulate and solve engineering and research tasks - [K2st_U5]

5. integrate knowledge from various branches of computer science, while formulating and solving engineering tasks - [K2st_U6]

6. formulate and test hypotheses for engineering and simple research problems related to the performance of computer systems - [K2st_U8]

7. assess practicality and applicability of new advances in computer science and IT to solve computer performance problems - [K2st_U9]

8. propose improvements in the existing technical solutions to increase performance of computer systems - [K2st_U15]

9. 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]

Social competencies:

1. realize that in computer science and IT knowledge and skills outdate quickly - [K2st_K1]

2. 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]

Assessment methods of study outcomes

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

Course description

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

Basic bibliography:

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. J.Błażewicz, W.Cellary, R.Słowiński, J.Węglarz, Badania operacyjne dla informatyków, WNT, Warszawa, 1983
4. G-P.Musumeci,M.Loukides, Optymalizacja systemów komputerowych,Wydawnictwo RM,Warszawa, 2002
5. K.Kanoun, L.Spainhower, Dependability Benchmarking for Computer Systems, J.Wiley & Sons, IEEE Computer, 2008
6. NIST/SEMATECH e-Handbook of Statistical Methods, 2003. http://www.itl.nist.gov/div898/handbook/

Additional bibliography:

1. 1. internet sources of the companies developing computer performance evaluation tools and methodologies, e.g.: www.tpc.org, www.spec.org

Result of average student's workload

Activity	Time (working hours)
1. participation in lab. exercises: 15 x 2 hours,	30
2. preparation to the lab. exercises: 14 x 0.5 hours,	7
3. finalizing the lab. exercise reports (student's work off lab hours): 14 x 0.5 hours	7
4. counseling related to the teaching process, in particular the labs and the lectures	6
5. coding, running, verifying the programs solving the lab. assignments (off the lab. exercise hours)	10
6. preparation to the tests	10
7. participation in the lectures	30
8. learning from the indicated literature, provided documents, and other indicated sources (15 pages of text =approx. 1 hours), approx.130 pages	9
9. discussion of exam results	1
10. preparation to the exam and attending the exam: 13 hours + 2 hours	15

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	73	3
Practical activities	54	2