(*faculty stamp*)

Z1-PU7	WYDANIE N1	Strona 1 z 3

COURSE DESCRIPTION

1. Course title: CONSTRAINT LOGIC PROGRAMMING	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: BSc programme	
5. Mode of studies: intramural studies	
6. Field of study: MACROCOURSE	RAU
7. Profile of studies: general	
8. Programme: Automatic Control	
9. Semester: 6	
10. Faculty teaching the course: Automatic Control, Electronics and Computer Science	
11. Course instructor: dr inż. Szymon Ogonowski	
12. Course classification: common courses	
13. Course status: elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Skills in object-oriented programming.	
16. Course objectives: The aim of this lecture is to present Constraint Logic Programming techniques for solving Constraint Satisfaction Problems and Constraint Optimisation Problems. Applications of those techniques are demonstrated by many examples taken from real-world combinatorial problems, such as scheduling, planning or job-shop problems. The theory presented in the lecture is supported by problems solving using Java language (JaCoP library).	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Knows and understands meaning of: constraint, variable domain, distribution, search method, constraints propagation.	laboratory exercise	lecture	K_W16
2.	Understands functionality of: arythemtic, reified, alldifferent, cumulative, circuit, element, count constraints and knows how to model soft constraints.	laboratory exercise	lecture	K_W19
3.	Understands functionality of search methods: depth first search, limited discrepancy search, credit search, branch-and-bound.	laboratory exercise	lecture	K_W16
4.	Can describe the given problem with constraints and choose proper search method.	laboratory exercise	laboratory	K_W16
5.	Can resolve scheduling and job-shop problems.	laboratory exercise	laboratory	K_W19,K_U24
6.	Can develop software with module structure.	laboratory exercise	laboratory	K_W05
7.	Knows the range of problems that can be solved with CLP.	laboratory exercise	laboratory	K_U20
8.	Can prioritise the tasks required to solve the given problem.	laboratory exercise	laboratory	K_U02, K_K04

18. Teaching modes and hours

Lecture: 15 h **/ Laboratory:** 15 h

19. Syllabus description:

Course

Constraint Logic Programming is a methodology having backgrounds in Operational Research and belongs to wide concept of Artificial Intelligence Methods. Its main concept is based on declarative programming – the programmer needs only to describe what computation should

be performed and not how to compute it (this part is already implemented in solver). Lecture is based on a multimedia presentation (available for the course students), supported with example code testing.The course presents concepts of:

- constraint propagation, global constraints, arc-consistency,
- different domains of variables - boolean domains, finite domains, sets and real intervals,
- global constraints such as: alldifferent, count, element, cumulative, diff2, circuit, knapsack, among, regular,
- search distributions – first-fail, most-constrained, max-regret,
- tree-based search such as - branch-and-bound, depth first search, limited discrepancy search, special search techniques,
- methods of default search algorithms modification – creating own search techniques,
- modelling and solving constraint optimisation problems and soft constraints - Weighted CSP, Fuzzy/Possibilistic CSP, Probabilistic CSP, over-constrained problems,
- scheduling/planning problems,
- incorporating local search techniques into constraint programming methodology.

Details of concepts mentioned above are presented while solving examples of simple academic and more complex, real-world combinatorial problems with usage of Java language and dedicated JaCoP (Java Constraint Programming) library. Advantages of using well known and well documented language allows the students to focus on getting to know the idea behind constraint programming. During laboratory exercises students constructs Java desktop applications and incorporates in it different modules, designed to solve different combinatorial problems.

Laboratories

All laboratory exercises are focusing on different CP problems, that are solved as a separate Java modules. Designed modules are incorporated in main Java desktop application, creating compact and scalable project.

1. Design of CLP application base
2. Simple combinatorial problems modules
3. Soft constraint problem module - reified constraint
4. Scheduling/planning problem module – building bridge example
5. Search strategy module – queens problem
6. Optimisation problem module

20. Examination: no

21. Primary sources:

Antoni Niederliński "Programowanie w logice z ograniczeniami",
Website www.jacop.eu (JaCoP API and documentation).

22. Secondary sources:

Francesca Rossi, Peter Van Beek, Toby Walsh "Handbook of constraint programming",
Peter van Hentenryck "Constraint-based Local Search".

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/5
2	Classes	0/0
3	Laboratory	15/10
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	7/20
	Total number of hours	37/35

24. Total hours:72

25. Number of ECTS credits: 3

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*