Course name: **Theory of games and decisions**		
Field of study: **Computer science**	Type of study: **Full-time**	Sourse code: **CIDM2_06**
Course characteristics: **Mandatory within the additional content**	Level: **Second (M.Sc.)** **Computational Intelligence and Data Mining**	Year: **I** Semester: **II**
Type of classes: **lectures, exercises, seminars**	Hours per week: **2 lect, 2 ex, 1 sem** [E]	ECTS points amount: **5 ECTS**

COURSE GUIDE

AIMS

A1. To provide students with a foundation to normative decision theory, especially the theory of games, and equip them with basic mathematical concepts and tools that are used to analyze and solve decision problems.

A2. To present various and sometime unexpected real-world applications of this abstract mathematical theory.

A3. To equip students with knowledge which is sufficient to recognize and assess archetypal decision-making situations in complicated real-world settings.

PREREQUISITES

1. Basic probability theory, linear programming, basic linear algebra, general mathematical maturity.

LEARNING OUTCOMES

EK 1 – The student characterizes the theoretical and practical importance of the axioms, definitions and theorems occurring in the normative decision theory .

EK 2 – Student lists the most important classes of models appearing in the theory, and makes appropriate and varied interpretations. He/she recognizes archetypal decision-making situations in exemplary real-world decision problem settings.

EK 3 – Student explains different key concepts of solutions to the game problems. He/she explains the practical consequences of using particular concept of a solution. Student applies the theory to solve basic/classical problems in exemplary real-world settings.

CONTENT

Lectures		**Hours**
Lect. 1	Overview of decision theory - introduction. Behavioral vs. normative theory. Classification of decision problems.	**2**
Lect. 2	Fundamentals of (mathematical) utility theory. Axioms of the preference relation.	**2**
Lect. 3	Utility function: basic concept, theorems, importance for normative decision theory.	**2**
Lect. 4	Extensive-form games. The notion of strategy.	**2**
Lect. 5	Normal-form games. Various concepts of solutions.	**2**
Lect. 6	Matrix games. Strictly and not strictly antagonistic games	**2**
Lect. 7	Zero-sum two person game in pure strategies.	**2**
Lect. 8	Zero-sum two person game in mixed strategies. Von Neumann minimax theorem.	**2**
Lect. 9	Cooperative vs. non cooperative games. "Prisoner dilemma" problem and its various interpretations.	**2**

Lect. 10	Two-person cooperative games. Nash bargaining axioms and theorem.	**2**
Lect. 11	N-person cooperative games. Shepley theorem.	**2**
Lect. 12	Data in decision making - Statistical decision problems.	**2**
Lect. 13	Decision rules and their classification.	**2**
Lect. 14	Randomized vs. nonrandomized decision rules.	**2**
Lect. 15	Application of statistical decision theory - selected examples.	**2**
Exercises		**Hours**
Ex. 1	Classification of exemplary decision making problems.	**2**
Ex. 2	Axioms of the preferences - interpretations, verification in practice.	**2**
Ex. 3	Utility function - applications.	**2**
Ex. 4	Games in various forms - examples, interpretation.	**2**
Ex. 5	Various concepts of a solution. Examples	**2**
Ex. 6	Matrix games.	**2**
Ex. 7	Test.	**2**
Ex. 8	Zero-sum matrix games. Saddle points.	**2**
Ex. 9	Mixed strategies - the concept and the payoff.	**2**
Ex. 10	Solution of zero-sum game in mixed strategies - exemplary problems.	**2**
Ex. 11	Cooperative games - exemplary analysis.	**2**
Ex. 12	Computing arbitration pairs.	**2**
Ex. 13	Shepley value.	**2**
Ex. 14	Bayes and minimax decision rules - nonrandomized case.	**2**
Ex. 15	Test.	**2**
Seminars Topics of the seminars are generally the same as the topics of tutorials. During each seminar students present some more formal results or extraordinary examples of applications closely related to the topic.		**Hours**
Sem. 1	Classification of decision making problems.	**1**
Sem. 2	Axioms of the preferences.	**1**
Sem. 3	Utility function - applications.	**1**
Sem. 4	Games in extensive form.	**1**
Sem. 5	The concept of a strategy.	**1**
Sem. 6	Normal-form games. Various concepts of a solution.	**1**
Sem. 7	Matrix games.	**1**
Sem. 8	Zero-sum matrix games. Saddle points.	**1**
Sem. 9	Mixed strategies - the concept and the payoff.	**1**
Sem. 10	Solution of zero-sum game in mixed strategies - exemplary problems.	**1**
Sem. 11	Cooperative games - exemplary analysis.	**1**
Sem. 12	Computing arbitration pairs.	**1**
Sem. 13	Shepley value.	**1**
Sem. 14	Bayesian and minimax decision rules.	**1**
Sem. 15	Summary of the seminar presentations.	**1**

TEACHING TOOLS

1. multimedia presentations
2. electronic lecture notes
3. problem sets for students
4. traditional face-to-face, blackboard supported tutorials

LITERATURE

RECOMMENDED readings (all available at various internet book-shops and libraries):

Morris P. , Introduction to game theory, Spriger-Verlag 1994
Webb J. N., Game Theory: Decisions, Interaction and Evolution, Springer Verlag, London, 2007
Lindgren B.W., Elements of decision theory, Macmillan, London, 1971
Luce D. R., Raiffa H. , Games and decisions; introduction and critical survey, Wiley, New York, 1957.
ADDITIONAL readings:
Rasmusen E., Games And Information, An Introduction To Game Theory, Blackwell Publishers Inc., Oxford,UK,, 2007
Geçkil Il. K. Anderson, P.L , Applied game theory and strategic behavior, Taylor and Francis Group, 2010
Osborne M.J., Rubinstein A., A Course in Game Theory, MIT Press, 1994.
Hargreaves-Heap S.P. , Varoufakis Y. , Game Theory-A Critical Introduction, Taylor & Francis e-Library, London, New York 2003

TEACHERS

1. dr hab. inż. Andrzej Grzybowski, prof. PCz, andrzej.grzybowski@im.pcz.pl

2. prof. dr hab. inż. Henryk Piech, henryk.piech@icis.pcz.pl

ADDITIONAL NOTES

Links to course unit teaching materials can be found on the http://iisi.pcz.pl/CIaDM/ website for current students.