UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU

Logic and Computation

Educational subject description sheet

Basic information

Study programme Matematyka	**Didactic cycle** 2023/24
Speciality -	**Subject code** 06MATS.24K.11717.23
Organizational unit Faculty of Mathematics and Computer Sciences	**Lecture languages** English
Study level Second-cycle programme	**Course type** Elective
Study form Full-time	**Block** Major subjects
Education profile General academic	

Subject coordinator	Wojciech Buszkowski
Lecturer	Wojciech Buszkowski

Period	**Activities and hours**	**Number of ECTS points**
Semester 3	• Lecture: 30, Exam • Classes: 30, Graded credit	6

Goals

Code	Goal
C1	Students learn logical systems and methods connected with applications of logic in computer science.
C2	Students train formal proofs in different systems of computational logic, e.g. proofs in sequent systems, resolution proofs, tableau proofs, linear resolution with unification.
C3	Student learn basic notions of the theory of computability.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge – Student:			
W1	Students understand basic notions and results of the theory of computablity and their applications in showing the undecidability of different problems.	MAT_K2_W01, MAT_K2_W03, MAT_K2_W04	Written colloquium
W2	Students know different systems of automated theorem proving: sequent systems, tableau systems, proving by resolution, linear resolution and the foundations of logic programming.	MAT_K2_W01, MAT_K2_W02, MAT_K2_W03, MAT_K2_W04	Written exam, Written colloquium
W3	Students know different constructions of models of formal systems.	MAT_K2_W01, MAT_K2_W03, MAT_K2_W04	Written exam
Skills – Student:			
U1	Students are able to write formal proofs in different systems.	MAT_K2_U02, MAT_K2_U08, MAT_K2_U09, MAT_K2_U10	Written exam, Written colloquium
U2	Students are able to apply algorithms of proof search for different systems of automated theorem proving.	MAT_K2_U02, MAT_K2_U06, MAT_K2_U08, MAT_K2_U09	Written exam, Written colloquium
U3	Students are able to run different versions of the algorithm of unification.	MAT_K2_U06, MAT_K2_U08, MAT_K2_U09	Written exam, Written colloquium
U4	Students can build simple programs in Prolog.	MAT_K2_U02, MAT_K2_U06, MAT_K2_U08, MAT_K2_U09	Written colloquium
Social competences – Student:			
K1	Students see some applications of logic programming in computational linguistics and knowledge representation.	MAT_K2_K03, MAT_K2_K04, MAT_K2_K06, MAT_K2_K07	Written colloquium

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Recursive functions and relations.	W1	Lecture, Classes
2.	Register machine and encoding of programs.	W1	Lecture, Classes
3.	The Church thesis and unsolvable problems.	W1, W3	Lecture, Classes
4.	The parameter theorem, the Rice theorem and the recursion theorem.	W1, W3	Lecture, Classes
5.	Recursively enumerable relations.	W1, W3	Lecture, Classes
6.	Classical propositional logic and a Hilbert-style system.	U1	Lecture, Classes

No.	Course content	Subject learning outcomes	Activities
7.	Classical propositional logic: sequent systems, tableau systems and resolution proofs.	W2, U1, U2	Lecture, Classes
8.	First order logic: models and a Hilbert-style system.	U1, K1	Lecture, Classes
9.	First-order logic: the Herbrand theorem and its applications in automated theorem proving.	W2, W3, U1, U2, K1	Lecture, Classes
10.	Unification.	W2, U3	Lecture, Classes
11.	Definite programs: declarative semantics, linear resolution, the completeness theorem.	W2, W3, U2, U4, K1	Lecture, Classes
12.	The computational completeness of definite programs.	W1, W2, U2, U4, K1	Lecture, Classes

Additional information

Activities	Teaching and learning methods and activities
Lecture	Lecture with a multimedia presentation of selected issues
Classes	Problem-based lecture

Activities	Credit conditions
Lecture	The condition for taking the exam (written form) is to obtain passing grades in exercises. Grading scale with applied percentage distribution: excellent (5.0): achievement of the student's expected learning outcomes at a minimum of 90.0%. very good (4.5): achievement by the student of the desired learning outcomes ranging from 80.0% - 89.9%. good (4.0): achievement of student learning outcomes 70.0% - 79.9%. average (3.5): achievement of student learning outcomes 60.0% - 69.9%. satisfactory (3.0): attainment of the student learning outcomes within 50.0% - 59.9%. unsatisfactory (2.0): failure of the student to achieve the expected learning outcomes below 50.0%.
Classes	Written colloguium, Grading scale with applied percentage distribution: excellent (5.0): achievement of the student's expected learning outcomes at a minimum of 90.0%. very good (4.5): achievement by the student of the desired learning outcomes ranging from 80.0% - 89.9%. good (4.0): achievement of student learning outcomes 70.0% - 79.9%. average (3.5): achievement of student learning outcomes 60.0% - 69.9%. satisfactory (3.0): attainment of the student learning outcomes within 50.0% - 59.9%. unsatisfactory (2.0): failure of the student to achieve the expected learning outcomes below 50.0%.

Literature

Obligatory

1. A. Nerode and R.A. Shore, Logic for Applications, Springer, 1993.

Optional

1. N. Cutland, Computability. An introduction to recursive function theory, Cambridge University Press, 1992.
2. J.R. Shoenfield, Recursion theory, Springer, 1991.

Calculation of ECTS points

Activities	**Activity hours***
Lecture	30
Classes	30
Reading the indicated literature	60
Paper preparation	60
Student workload	**Hours** 180
Number of ECTS points	**ECTS** 6

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
MAT_K2_K03	The graduate is ready to samodzielnego wyszukiwania informacji w literaturze i bazach danych, także w językach obcych
MAT_K2_K04	The graduate is ready to zrozumienia i docenienia znaczenia uczciwości intelektualnej w działaniach własnych i innych osób
MAT_K2_K06	The graduate is ready to wyrażania zdania i jego logicznego uzasadnienia w zagadnieniach, które używają matematyki jako języka opisu
MAT_K2_K07	The graduate is ready to zrozumienia społecznych aspektów praktycznego stosowania zdobytej wiedzy i umiejętności matematycznych oraz związanej z tym odpowiedzialności
MAT_K2_U02	The graduate can przeprowadzać rozumowania matematyczne, dowodzenie twierdzeń, jak i weryfikację hipotez drogą doboru odpowiednich przykładów
MAT_K2_U06	The graduate can odnosić pojęcia matematyczne do niematematycznych kontekstów, w analizowanych problemach potrafi dostrzec i wykorzystać struktury formalne opisywane w wybranych działach matematyki
MAT_K2_U08	The graduate can rozpoznawać podstawowe struktury algebraiczne i ich własności oraz potrafi wykorzystać działania i przekształcenia algebraiczne w innych działach matematyki
MAT_K2_U09	The graduate can posługiwać się zaawansowanymi metodami i narzędziami przynajmniej z jednej dziedziny matematyki
MAT_K2_U10	The graduate can komunikować się w co najmniej jednym języku obcym na poziomie średniozaawansowanym B2+ z uwzględnieniem języka specjalistycznego z zakresu matematyki
MAT_K2_W01	The graduate knows and understands klasyczne pojęcia z zakresu matematyki i jej zastosowań oraz najważniejsze metody i twierdzenia z głównych jej działów
MAT_K2_W02	The graduate knows and understands rolę, znaczenie i zasady poprawnego prowadzenia rozumowań matematycznych oraz zna różne techniki dowodzenia
MAT_K2_W03	The graduate knows and understands podstawy konstruowania modeli matematycznych przydatnych w zastosowaniach matematyki w różnych dziedzinach wiedzy
MAT_K2_W04	The graduate knows and understands specjalistyczne zagadnienia z wybranej dziedziny matematyki