COURSE SPECIFICATION FORM,
approved by the Academic Council 17.06.2015 (#39)

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SECTION A: DEFINITIVE

Items in this section may be reviewed and developed within Schools as part of the Annual Program Monitoring Process and in line with the Guidelines to Modifications to Programs and Courses.

1.	**General course information**		
1.1	School: School of Science and Technology	1.6	Credits (ECTS): 6
1.2	Course Title: Statistical Methods and Machine Learning	1.7	Course Code: ROBT407
1.3	Pre-requisites: MATH 273 Linear Algebra with Applications, MATH 321 Probability, (must be completed with a grade of "C-" or better);	1.8	Effective from: *2016*
1.4	Co-requisites:		
1.5	Programs: Bachelor of Science (B.Sc.) in Robotics and Mechatronics ☐ Core ☒ Elective *(in which the course is offered)*		

2. Course description (max.150 words)

ROBT 407 introduces the students to the state-of-the-art analytical tools and methods used for machine learning. The 6-credit course consists of two 75 minute lectures. Topics include (semi) supervised and unsupervised learning, neural networks, deep learning, support vector machines, the design of machine learning experiments, decision trees, linear discrimination and kernel-based learning methods. The course also contains integrated term projects. Python-based machine learning packages (e.g., scikitLearn, Pytorch, Numpy, Scipy, Pandas, Matplotlib) and online databases will be used extensively.

3.	**Summative assessment methods** (tick if applicable)**:**				
3.1	Examination	☒	3.5	Presentation	☒
3.2	Term paper	☐	3.6	Peer-assessment	☐
3.3	Project	☒	3.7	Essay	☐
3.4	Laboratory Practicum	☐	3.8	Other *(specify) Reading assignment*	

4. Course aims

1) Establish fundamental theoretical knowledge in statistical learning field.
2) Acquire core knowledge and practical skills on basic techniques of machine learning, including linear/nonlinear methods.
3) Be competent with theoretical analysis and formulation of statistical learning techniques for solving real-world data mining problems.

4) Be familiar with the wide class of methods for supervised/unsupervised data analysis, classification, regression, including linear/logistic regression, kernel methods, neural networks, and other methods.

5.	**Course learning outcomes (CLOs)**
5.1	At the completion of this course, students will know the following areas: 1) Demonstrate an understanding of different types of learning algorithms used in engineering fields 2) Design and implement machine learning algorithms for feature extraction, classification, and clustering. 3) Demonstrate hands-on experience with practical data mining using machine learning algorithms and implement those algorithms in different programming languages. 4) Use advanced machine learning tools for data analysis.
5.2	

CLO ref #	**Program Learning Outcome(s) to which CLO is linked**	**Graduate Attribute(s) to which CLO is linked**
1	1	
2	2,3	
3	2,3,4,7	
4	6	

SECTION B: NON-DEFINITIVE

Course Syllabus Template

Details of teaching, learning, and assessment

Items in this Section should be considered annually (or each time a course is delivered) and amended as appropriate, in conjunction with the Annual Program Monitoring Process. The template can be adapted by Schools to meet the necessary accreditation requirements.

6.	**Detailed course information**		
6.1	Academic Year: 2018	6.3	Schedule (class days, time): Tues/Thurs, 10:30-11:45:
6.2	Semester: Fall	6.4	Location (building, room): 7.322

7.	**Course leader and teaching staff**			
Position	**Name**	**Office #**	**Contact information**	**Office hours/or by appointment**

Course Instructor	**Berdakh Abibullaev**	**7e.318**	berdakh.abibullaev@nu.edu.kz	**Mon/Wed/Fri, 13:00-14:00**
Teaching Assistant(s)				**By appointment**

8. Course Outline

Session	Date	Topics and Assignments	Course Aims	CLOs
1	Week #1	○ **The Learning Problem** ○ **Binary Classification – learning to answer Yes and No**	1	1,2
2	Week #2	○ **Types of Machine Learning** ○ **The Feasibility of Learning**	1	1
3	Week #3	○ **Training versus Testing** ○ **Theory of Generalization**	1,2	1,2
4	Week #4	○ **The VC dimension** ○ **Noise and Error**	1,2	1,2
5	Week #5	○ **Linear and Logistic Regression**	1-3	1
6	Week #6	○ **Linear models for supervised learning** ○ **Kernel Methods**	4	1
7	Week #7	○ **Hands on experiments with ScikitLearn. Pytroch, TensorFlow** ○ **Midterm exam**	3,4	1,4
8	Week #8	○ **Hazard of overfitting** ○ **Regularization Theory**	1-3	1,2
9	Week #9	○ **Cross-Validation Techniques** ○ **Three learning principles**	1-4	1,4
10	Week #10	○ **Multilayer Neural Networks** ○ **Radial Basis Function Neural Networks**	4	2-4
11	Week #11	○ **Deep Learning Methods (1)**	4	2-4
12	Week #12	○ **Deep Learning Methods (2)**	4	2-4
13	Week #13	○ **Deep Learning Methods (3)**	4	2-4
14	Week #14	○ **Deep Learning Methods (4)**	4	2-4

9.	**Learning and Teaching Methods** (briefly describe the approaches to teaching and learning to be employed in the course)
1	Class discussion conducted by teacher
2	Lecture-demonstration by the teacher; Class projects; In-class problem-solving.
3	Formal face-to-face lectures and office hours.

10.	**Summative Assessments**			
#	**Activity**	**Date** (tentative)	**Weighting (%)**	**CLOs**
	Homework		15%	1,2
	Midterm Project		20%	3,4
	Reading Assignment		5%	1
	Quizzes		15%	1,2
	Attendance		5%	1-4
	Midterm Exam		20%	1
	Final Project		20%	2-4

11.	**Grading**	
Letter Grade	**Percent range**	**Grade description** (where applicable)
A-	**95-100**	
A-	**90-94.9**	
B+	**85-89.9**	
B	**80-84.9**	
B-	**75-79.9**	
C+	**70-74.9**	
C	**65-69.9**	
C-	**60-64.9**	
D+	**55-59.9**	
D	**50-54.9**	
F	**0-49.9**	

12.	**Learning resources** (use a full citation and where the texts/materials can be accessed)
E-resources, including, but not limited to: databases, animations, simulations, professional blogs, websites, other e-reference materials (e.g., video, audio, digests)	moodle.nu.edu.kz ; a mailing list; scikit-learn.org; archive.ics.uci.edu/ml. pytorch.org github.org
E-textbooks	
Laboratory physical resources	Laboratory PCs, Workstations;
Special software programs	Matlab, Open source software (e.g., Python 2.7).
Journals (inc. e-journals)	
Textbooks	***Learning From Data,*** Abu-Mostafa, Magdon-Ismail, Lin. Publication date and edition - 1st ed., March 27, 2012 ISBN Number - 1600490069 Reference book: ● *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, 2nd ed. Springer Series in Statistics, 2009, ISBN Number - 0387848576

13. Course expectations

- Students are expected to work independently on their homework assignments. However, discussion amongst students is encouraged, but when in doubt, direct your questions to the instructor
- Offering and accepting solutions from others are an act of plagiarism, which is a severe offense and all involved parties will be penalized according to the Nazarbayev University Policy.
- Homework and Lab assignments are due on the date specified in the course schedule, and they should be submitted via the University Moodle System. Handwritten homework should be scanned and converted to PDF for submission.
- For late submissions, there is a reduction of 10% of the total credit for each day it is late.
- Attendance is expected and will be taken each class and lab session. Students are not allowed to miss any class during the semester unless he/she is sick. Any further absences will result in point and grade deductions.
- Students are responsible for all missed work, regardless of the reason for the absence. It is also the absentee's responsibility to get all missing notes or materials.
- Absence during the midterm or final term exams will fail of the course. However, students will be able to re-take exams if an absence is due to a medical condition or treatment.
- Students are expected to regularly check Nazarbayev University email for updates and announcements about the course, and are also required to use Moodle as determined by the instructor.

14.	**Academic Integrity Statement**

- Students may only get help on graded assignments from designated people, and are always welcome to get help on an assignment from the course instructor, teaching assistants. They may help at the computer, on paper, or any way they believe will be useful.

- Do not give direct help to, nor receive direct help from, your classmates on a graded assignment. Never show your work to your classmates or seek to see their work. Homework should be completed individually. In cases where inappropriate sharing occurs, all students involved are at fault, regardless of whether they are the source or recipient of shared work.

- If something has your name on it, you are claiming it as your own work and academic integrity rules apply. The assignments in this class are exercises designed to help you absorb and comprehend the covered topics. Doing the work is much more important than getting the right answer.

- The severity of sanctions imposed for an academic integrity violation will depend on the transgression and ascertain the intent of the student. Penalties for a first offense may range from failing the assignment to failing the course and referral to an academic review board. Students can find more information about the consequences of academic integrity violations from Student Affairs.

15.	**E-Learning**

If the content of the course and instruction will be delivered (or partially delivered) via digital and online media, consult with the Head of Instructional Technology to complete this section and provide a separate document complementary to this Template.

16.	**Approval and review**

Date of Approval:	**Minutes #:**	**Committee:**
Date(s) of Approved Change:	**Minutes #:**	**Committee:**