MINISTRY OF EDUCATION AND SCIENCE
Republic of Kazakhstan

SATBAYEV UNIVERSITY

«Approved by»

Seilova N.A. _____
signature of the Director of the Institute

Юнусов Р. _____
signature of the head of the Department

«27» 12 2019y.

SYLLABUS
CSE2632 Artificial Intelligence Fundamentals
Semester: spring: 2019
2019/2020 Academic Year
3 credits (2/0/1)

Almaty, 2019

SATBAYEV UNIVERSITY
Institute of Cybernetics and information technology
Department of "Software Engineering"

Developed by Professor of Software Engineering Department:

Personal Information About the Instructor	Time and place of Classes		Contact Information	
	Lessons	Office hours	Tel:	e-mail:
Ravil I. Muhamedyev **Room#XXX**	**According to the schedule**	**According to the schedule**	**87772418672**	**ravil.muhamedyev@gmail.com**

Course Duration: 3 credits, 15 weeks, 45 class hours

Course Information

Course Description:

This course is about AI, particularly what is known as Weak AI, or the methods and techniques that can help make software smarter and more useful. While early AI concentrated on building intelligent machines that mimicked human behavior (otherwise known as Strong AI), much of AI research and practice today concentrates on goals that are more practical. These include embedding AI algorithms and techniques into software to provide them with the ability to learn, optimize, and reason.

First part of the course is focused on optimization and regression. We consider some heuristic that provide us ability to solve NP complete tasks. Some knowledge of linear algebra are needed to understanding this part of discipline.

The focus of the second part is to illustrate a number of machine learning algorithms (MLA), and provide detailed explanations of their inner workings. Some of the algorithms and methods included are linear regression, logistic regression, KNN classifier, neural networks. Additionally, sample applications are provided for algorithm.

Course Objectives:

At the end of the semester, students are expected to be able to

- Understand what artificial intelligence is,
- Understand different AI techniques,
- Identify when and why a certain AI technique should be used,
- Use AI algorithms for solving simple problems,
- Use tools such as Octave, Python.

Learning outcomes

I. Produce
1. Intelligent systems that support a given application

II. Use
1. A number of AI algorithms implementations for practical problems.

III. Knowledgeably Discuss
1. The basic concepts of problem solving, vision, and language in understanding human intelligence from a computational perspective
2. The concepts of AI algorithms in purposes of development smart programs.

The basic concepts of knowledge representation, problem solving, and learning in intelligent-system engineering

Prerequisites:

- Basic knowledge of Programming, Probability, Algorithms and Data Structure, Linear Algebra & Calculus

Literature required:

1. M. Tim Jones. Artificial Intelligence: A Systems Approach. INFINITY SCIENCE PRESS LLC Hingham, Massachusetts, New Delhi, 2008. ISBN: 978-0-9778582-3-1
2. Mohri M., Rostamizadeh A., Talwalkar A. Foundations of machine learning. – MIT press, 2012.-427 p.
3. AI Application Programming by M. Tim Jones .Charles River Media © 2003. ISBN:1584502789

4. Stuart Russell and Peter Norvig. Artificial Intelligence: A modern approach. Pearson Edition, Inc., Upper Saddle River, New Jersey 07458. 2010. ISBN-10: 0136042597, ISBN-13: 9780136042594
5. Рассел Стюарт, Норвиг Питер. Искусственный интеллект:Современный подход.- М.: Издательский дом «Вильямс», 2006.- 1408 с.
6. Pedregosa F. et al. Scikit-learn: Machine learning in Python //Journal of Machine Learning Research. – 2011. – Т. 12. – №. Oct. – С. 2825-2830.
7. Джонс М. Тим. Программирование искусственного интеллекта в приложениях.-М.: ДМК Пресс, 2004.- 312 с.
8. Нейрокомпьютеры: Учеб. Пособие для вузов.- М.: Изд-во МГТУ им. Н.Э. Баумана, 2004. – 320 с.
9. LeCun Y., Bengio Y., Hinton G. Deep learning //Nature. - 2015. - V. 521. - №. 7553. - V. 436-444.
10. Muhamedyev R. Machine learning methods: An overview //CMNT. - 19(6). – 2015. - P. 14-29.
11. Internet resources focused on deep learning: tensorflow.org, caffe.berkeleyvision.org, deeplearning.net/software/theano (2017)

Week	Class work		
	Topic	Lectures	Seminars
	Part 1. Optimization and regression algorithms		
1	Introduction to Intellectual methods. Review of computer intelligence. Classification, methods and applications. (CI_L00_Intro.pptx)	1	2
2	Basic of linear algebra. Using Octave, Python&numpy as linear algebra tool (CI_L02_LinearAlgebra&SoftwareTools.pptx)	1	2
3	Clustering by ART1 (AIA_Lecture03_ART1.pptx)	1	2
4	Optimization by SA, ANT (AIA_Lecture04_SimulatedAnnealingAndAntAlgorithm.pptx)	1	2
5	Evolutionary programming and genetic algorithm (AIA_Lecture05_GA.pptx)	1	2
6	Implementation of the genetic algorithm	1	2
	Python tools for data science. ML_Ang_lab01.1_Python Basics with Numpy		
7	Intro to machine learning, linear regression (CI_L03.1_IntroToMachineLearning.pptx) (CI_L03.2_ANg_LinearRegression.pptx)	1	2
8	MT (reports, test and etc.)	1	2
	Part 2. Introduction to machine learning		
9	Python and numpy for data science, implementation of linear regression. [1]	1	2
10	Python tools for ML. Intro to SciKit Learn, pandas, matplotlib[2]. Linear regression, polinomial regression	1	2
11	Supervised learning, K-Nearest Neighbors Classification[3], logistic regression	1	2
12	Neural Networks: Short history of neural networks, Biological motivation. Single layer and muti layers artificial neural networks	1	2
13	Neural Networks, Back propagation error algorithm , Implementation, accelerated learning . MLP classifier[4].	1	2
14	Supervised Machine Learning, overfitting & underfitting, evaluation [5]	1	2
15	Unsupervised machine learning[6]*	1	2
	Optimization methods (ADAM и др)		

+ **k-means**

LABORATORY WORKS

Week	Laboratory work	Labs tutorial	Cost (in points)
	Part 1		
1	Setup Environment (Ubuntu, Octave, virtual environment) (Lab00.1)	Lab00.1-LinuxInstallation	0

[1] ML_lab00_linear regression by numpy
[2] 1-+Loading+a+dataset
[3] Module 1: A simple classification task, 3-+Supervised+Learning-Copy1
[4] MLF_MLPClassifier_py_v.1.0.doc, Module+4
[5] Module 3 (Evaluation)
[6] 4-+Unsupervised+Learning(Jeffri), Unsupervised+Learning, 7-+KMeans (Jeffri)

2	Operation of linear algebra. Basic of Octave (lab00.2)	Lab01_IntroToOctave	5
3	Clustering by ART1	Lab02 - ART1	5
4	Optimization by SA, ANT	Lab03 - SA	5
5	Evolutionary programming and genetic algorithm	Lab04_geneneticAlgorithm	5
6	Regression in practice	Lab05-linearRegression	5
7	LogisticRegression	lab06-logisticRegression	5
8			
	Part II		
9	ML_lab00_linear regression by numpy	ML_lab00_linear regression by numpy	5
10	ML_Lab01_Linear regression	ML_Lab01_Linear regression	5
11	ML_lab02_polynomial regression	ML_lab02_polynomial regression	5
12	ML_lab03_logistic regression	ML_lab03_logistic regression	5
13	ML_lab04_K Neighbors Classifier	ML_lab04_K Neighbors Classifier	5
14	ML_lab07_MLP_classifier	ML_lab07_MLP_classifier	5
15			

TASKS

for teachers supervised independent study of students (TSIS)

Week	SIS	Cost (in points)
2	Operations of Linear algebra	1
4	Simulated Annealing algorithm	1
5	Genetic programming	1
7	Ex1-LinearRegression	1
9	Polinomial regression	1
10	Logistic regression	1
11	NeuralNetworks Learning	1
13	NeuralNetworks Accelerated Learning	1
14	Supervised Learning	1
15	Unsupervised Machine Learning	1

TASKS

for student's independent study (SIS)

Week	TSIS	Cost (in points)
1	Octave/Mathlab command set	
2	Linux group operating system	
3	Machine learning algorithms	
4	Classification and clustering tasks	
5	Types of regressions	
6	Gradient descent algorithm	
7	Matrix equation of regression task	
8	Suppor vector machines	
9	Taxonomy of artificial Neural networks	
10	Back propagation error	
11	Decision trees	
12	How to measure the quality of classification	
13	Data preprocessing methods	
14	Dimentionality reduction	
15	Unsupervised learning	

COURSE ASSESSMENT PARAMETERS

Type of activity	Final scores
Attendance /participation	5%
Laboratory works	15%

SIS	12%
TSIS	8%
Midterm and endterm	20%
Final exam	40%
Total	**100%**

No	Assessment criteria	Weeks														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-17
1.	Attendance / participation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	5%
2.	Laboratory works	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	15%
3.	SIS			*					*							*	12%
4.	TSIS								*							*	8%
5.	Mid-term test								*							*	20%
6.	Final examination															*	40%
	Total																**100%**

Lectures are conducted in the form of supervising of SIS on understanding of theory of given course, that is why students supplied with handouts uploaded into the intranet. Activity on lectures is required and is one of the constituent of final score. Mandatory requirement is preparation to each lesson.

Laboratories are organized in the form of research using special equipment. The preparation to the laboratories is provided in the form of solving of typical problems according to the lectures topics, which within experiments with laboratory equipment is one of the most important tools of understanding of modeling and simulation.

Grading policy:

Intermediate attestations (on 8th and 15th week) join topics of all lectures, laboratories, SIS-I, II, TSIS and materials for reading discussed to the time of attestation. Maximum number of points within attendance, activity, SIS, TSIS and laboratories for each attestation is 40 points.

Final exam joins and generalizes all course materials, is conducted in the complex form with quiz and problem. Final exam duration is 100 min. Maximum number of points is 40. At the end of the semester you receive overall total grade (summarized index of your work during semester) according to conventional SU grade scale.

ACADEMIC POLICY

Students are required:

- to be respectful to the teacher and other students;
- to switch off mobile phones during classes;
- not to cheat. Plagiarized papers shall not be graded;
- to meet the deadlines;
- to come to classes prepared and actively participate in classroom work;
- to enter the room before the teacher starts the lesson;
- to attend all classes. No make-up tests are allowed unless there is a valid reason for missing them;

Students are encouraged to

- consult the teacher on any issues related to the course;
- make up within a week's time for the works undone for a valid reason without any grade deductions;
- make any proposals on improvement of the academic process;
- track down their continuous rating throughout the semester.

Department of Software Engineering

Lecturer *R.I.Muxamediev*

Minutes # 7 of Department of Software Engineering, «27» 12 2019y.