TITLE OF THE Curricula/Module

PHOTOGRAMMETRY AND REMOTE SENSING

NKSU /Kazakhstan

2020

1. Passport of curriculum

1.1 The scope of the curriculum in credits and academic hours. Form of control.

Table 1

Total		Distribution of hours by occupation					Preparation and passing of the exam	Control form, examination form
Credits	Hours	lectures	practical	laboratory / studio	IWST	IWS		
5	150	15	30	-	15	75	15	written exam

1.2 The purpose of the curriculum and the expected learning outcomes.

The purpose of the curriculum is to study the principles of construction and functioning of modern computer vision systems, as well as methods of digital image processing and pattern recognition using machine learning systems.

Expected learning outcomes:

Know: the general composition and classification of computer vision systems; principles of operation of the elements of computer vision systems; basic algorithmic solutions for image processing; ways to implement basic logical functions of image processing; methods of pattern recognition in various systems and the tasks for which they are used; machine learning methods for pattern recognition.

Be able to: analyze the characteristics of computer vision systems by image parameters; adapt vision systems for use in specific technological processes;

Have the skills to use the necessary pattern recognition methods to solve applied problems, to implement the selected or developed algorithms.

1.3 Course policy

– strictly observe the Academic policy of the M. Kozybayev NKSU, the Ethical Code of the M. Kozybayev NKSU, the Rules of Academic Integrity of the M. Kozybaev NKSU;

– all types of academic dishonesty are prohibited;

– come to classes in business attire;

– actively participate in the educational process;

– be tolerant, open and friendly to fellow students, teachers and employees of the M. Kozybaev North Kazakhstan State University;

– promote teamwork and participate in discussions;

– be punctual and obligatory (late arrivals, absences, behavior in the classroom, late submission of work, absence from the exam);

– come to classes in business attire;

– actively participate in the educational process;

– independently and on time to do homework;

– promote teamwork and participate in discussions.

1.4 Prerequisites

1.5 Post-requisites

Writing and defending a master's thesis.

2. Classroom lessons, their content and volume in hours

Table 2

Week number	Type of educational activity	Topics and content of lessons	Number of hours	Form of training	
				Full-time	Full-time with the use of DOT
1	**Module 1: Fundamentals of Digital Imaging**				
	lecture	Theme 1. Formation of digital images. Cameras of technical vision.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 1. Model of image formation . Types of images . Digital camera. Imaging problems.	**2**	Colloquium	Platform Zoom, an e-leaning
2	**lecture**	Theme 2 . Basics of digital imaging	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 2. Digital image processing: image resizing, interpolation of Bayer patterns, image deformation, image filtering in spatial and frequency domains, quality	**2**	Colloquium	Platform Zoom, an e-leaning

		assessment, image compression.			
3	**lecture**	Theme 3. Algorithms for automatic image segmentation.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 3. Review of the main algorithms for automatic image segmentation. Comparison of different methods of image segmentation. Edge detectors.	**2**	Colloquium	Platform Zoom, an e-leaning
4	**lecture**	Theme 4. Algorithms for automatic image segmentation.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 4. Algorithms for automatic image segmentation.	**2**	Colloquium	Platform Zoom, an e-leaning
	IWS1	Theme 1.. Popular image compression algorithms .	**25**	Calculation and graphic work	
Module 2: Methods and algorithms for machine learning in computer vision problems					
5	**lecture**	Theme 5. Supervised Learning:	**1**	Multimedia lecture	Platform Zoom,

		Regression and Classification . Clustering.			an e-leaning
	practice	Theme 5. Linear regression, logistic regression. Least square method. Gradient descent method.	**2**	Colloquium	Platform Zoom, an e-leaning
6	**lecture**	Theme 6. Quality metrics in machine learning tasks	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 6. The choice of optimal quality criteria, the problem of overfitting, the size of the training sample, regularization, hyperparameters of machine learning algorithms.	**2**	Colloquium	Platform Zoom, an e-leaning
7	**lecture**	Theme 7. Metric algorithms for machine learning	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 7. K-nearest neighbors. Distance metrics	**2**	Solving problems	Platform Zoom, an e-leaning

8	**lecture**	Theme 8. Artificial neural networks	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 8. Single- layer and multi-layer neural networks. Neural network as a universal model.	**2**	Solving problems	Platform Zoom, an e-leaning
9	**lecture**	Theme 9. Multilayer neural networks	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 9. Error function, overfitting problem, network parameter optimization, gradient descent. Backpropagation method. Regularization.	**2**	Call Oquium	Platform Zoom, an e-leaning
	IWS 2	Theme 3 . Determination of the optimal number of neurons in the hidden layer of the neural network.	**25**	Calculation and graphic work	
Module 3 : Using Convolutional Artificial Neural Networks for Image Classification, Recognition, and Segmentation					

10	**lecture**	Topic 10. Convolutional artificial neural networks for image processing.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Subject 10. Basic principles of building deep convolutional neural networks. Activation functions, regularization, convolutional layers, pulling.	**2**	Colloquium	Platform Zoom, an e-leaning
eleven	**lecture**	Topic 11. Application of the keras python 3 library for constructing the DCNN.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Subject 11. Solving the problem of recognizing handwritten numbers. Preparing training datasets. Augmentation of images.	**2**	Solving problems	Platform Zoom, an e-leaning
12	**lecture**	Topic 12. Overview of DCNN models available from the keras library	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Topic 12. Analysis and application of	**2**	Colloquium	Platform Zoom,

		DCNN LeNet , VGG 16, Inception - v 3.			an e-leaning
1 3	**lecture**	Topic 1 3 . The concept of transfer learning for DCNN.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Topic 1 3 . Implementing transfer learning in keras.	**2**	Colloquium	Platform Zoom, an e-leaning
1 4	**lecture**	Theme 14. Research DCNN Mask-RCNN for image recognition, classification and segmentation.	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 14. The use of a network Mask-RCNN for recognition of objects in the image.	**2**	Solving problems	Platform Zoom, an e-leaning
fifteen	**lecture**	Theme 15. Research of the network YOLO for real-time image recognition	**1**	Multimedia lecture	Platform Zoom, an e-leaning
	practice	Theme 15. YOLO network implementation in python 3	**2**	Colloquium	Platform Zoom, an e-leaning

	IWS 3	Topic 3 . Development of a program in python 3 for real-time object recognition in an image.	**25**	Settlement and graphic work	Plat form Zoom, an e-leanin g
	Preparation and passing of the exam		**15**		
Total hours by classroo m type	**lectures**		**15**		
	practice		**15**		

2.1. Coursework (projects)

3. Independent work of a student under the guidance of a teacher

For independent work of a student under the guidance of a teacher, 15 academic hours are allocated. Within the framework of the IWST hours, consultations are held on the topics of lectures, practical exercises (laboratory exercises), SRO tasks. Consultations are carried out in accordance with the schedule of training sessions. The schedule is at the stand of the Department of Energy and Radioelectronics and on the website http://is.nkzu.edu/diary/sfmanager.asp.

4. Monitoring progress

To assess the educational achievements of students, a point-rating alphabetic system of accounting assessment is used with their transfer to the traditional rating scale.

Point-rating letter system for assessing the accounting of educational achievements of students with their transfer to the traditional scale of grades and ECTS.

Letter system score	Digital equivalent	Points (% content)	Assessment according to the traditional system
A	4	95-100	excellent
A-	3,67	90-94	
B+	3,33	85-89	well
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	
C	2,0	65-69	satisfactorily
C-	1,67	60-64	
D+	1,33	55-59	
D	1,0	50-54	
FX	0,5	25-49	unsatisfactory
F	0	0-24	

In the implementation of the current, intermediate control of students' progress, educational achievements are assessed on a 100-point scale for each completed task or answer (the answer in the current classes, on the final assessment of the module, IWS, etc.).

Monitoring of progress must be carried out by discipline modules.

The maximum assessment score for a module is 100 points.

The assessment criteria for assignments in a module are developed by the teacher independently (table 3).

The assessment of the admission rating is determined by the arithmetic mean of the total marks for the final assessment of the module received during the academic period. The final grade for the discipline is cumulative and includes assessments of the admission rating and final control.

The assessment of the admission rating is 60% of the final assessment of knowledge in the discipline, and the assessment of the exam is 40% of the final assessment of knowledge in the discipline.

5. Evaluation tools and evaluation criteria by type of control

Table 3

Control type, duration	Evaluation tool	Evaluation criteria	Max score
Control mod 1, 4 week	IWS 1	Correctness of the used mathematical apparatus (formulas)	30
		Compliance of the implemented solution with the parameters of the received task	50
		No math errors	20
	Total		**100**
Control mod 2, 9 week	IWS 2	Correctness of the used mathematical apparatus (formulas)	30
		Compliance of the implemented solution with the parameters of the received task	50
		Absence of mathematical errors	20
	Total		**100**
Control mod 3, 15 week	IWS 3	Correctness of the used mathematical apparatus (formulas)	30
		Compliance of the implemented solution with the parameters of the received task	50
		No math errors	20
	Total		**100**
	TOTAL		100

6.1. List of references

Table 5

No.	Title, year and place of publication
	Basic literature
1.	Reinhard Klette Co. Computer vision. Theory and algorithms / per. from English. A . A. Slinkin . - M .: DMK Press, 2019 .
2.	Antonio Ju lli, Sujit Pal Keras Library is a deep learning tool. Real ization of neural networks with the help of libraries Theano and T ensorFlow / per. from English. Slinkin A. A. - M .: DMK Press, 2018. - 294 p.
3.	Shapiro L. Computer vision / L. Shapiro, J. Stockman; per. from English. 2nd ed. (email). - M .: BI NOM. Laboratory of Knowledge , 2013 . - 752 p.
4	Fla x P. Machine learning. The Science and Art of Building Algorithms That Extract Knowledge from Data. from English. A. A. Slinkina. - M .: DMK Press s, 2015.-400 s .
	Additional literature
1.	Scholle F. Deep Learning in Python . - Peter , 2018. - 40 0 c.

6.2. Electronic and Internet resources

- www//nkzu.edu/e-library
- www//bookash.pro
- www//booktech.ru

6.3. Methodological support of the curriculum

Table 6

No.	Name	Location
1.	Educational-methodical complex of the curriculum " Computer vision in real time systems ". - Petropavlovsk:	Department of E&R, library 5 corps, electronic library

	NKSU im. Kozybayev M., 20, 20, city of	

6.4. The list of specialized tools

Table 7

No.	View	Location
1.	Multimedia cabinet	402/4
2.	Specialized Labora thorium	508a/4