Kazakh-British Technical University

Syllabus

Introduction to Computer Vision

The academic year 2019-2020

Message from instructor

Dear student!

If I share my expression, it is a great and very convenient time for you to study and capture knowledge!

First of all, you have motivation! You are in the age, right now, with excellent potential and energy. In addition, your brain is very open to learning knowledge.

Secondly, you have full free time! Just use your time pro-actively and properly.

Those two keys are essential to get knowledge and that I have lost them today!

In my homeland, there is a proverb: “brilliant is placed on the golden ring”[1]. Comparing with other Universities in Kazakhstan, quality of teaching, quality of library facilities and learning resources, quality of IT support and equipment, quality of administration service and support and other categories of education as the basis, believe me, Kazakh-British Technical University is “golden ring”. Please, behave as brilliant!

I would like to express my gratitude to your keen interest to learn the subject “Introduction to Computer Vision”. I believe this subject will be informative, knowledgeable and interesting for you. I hope there are many new things that you will learn.

Sincerely,

Jomart Aldamuratov
Senior-Lecturer

Faculty of Information Technology
Kazakh-British Technical University

[1] Meaning only on a golden ring, not silver or other

KAZAKH-BRITISH TECHNICAL UNIVERSITY

Faculty of Information Technology

APPROVED BY
Rassim Suliyev

"____" _____ 2020

SYLLABUS
Introduction to Computer Vision

Semester Spring 2020
2019/2020 academic year

3 hours (2/1)

Lecturer's name**:** ALDAMURATOV Jomart
E-mail: z.aldamuratov@kbtu.kz

Course goals and objectives

This course aims to introduce the fundamentals of key Computer Vision concepts. The course will cover, mainly, board overview of Computer Vision and its purpose & importance.

Besides general knowledge of Computer Vision, this subject focuses on the enlargement of students' acquaintance on practices more deeply through class-works and assignments.

The main goal of this course is to strengthen students' knowledge and practice in the following topics:

Image Processing for Computer Vision
Camera Models and Views
Image Features
Lighting
Image Motion
Tracking
Classification and Recognition
Useful Methods
Human Visual System

At the end of the course, students will be able to manage real-life simple computer vision project

Prerequisites: Linear Algebra, vector calculus, Python programming with NumPy.
Course Tool: OpenCV

Course structure:

Lesson #1 **Introduction to Computer Vision**

Course overview
Course organization
Course importance
Introduction to Computer Vision

Practice:
Practice course organization

Lesson #2 **Introduction to Computer Vision**

Introduction to Computer Vision
What is Computer Vision?
Three ‘R’s of Computer Vision
Real-Life Computer Vision Applications

Practice:
Python & OpenCV installation

Lesson #3 **Image Processing for Computer Vision**

Linear image processing
Model fitting

Practice:
GUI features in OpenCV

Lesson #4 **Image Processing for Computer Vision**

Frequency domain analysis

Practice:
Core Operations in OpenCV

Lesson #5 **Camera Models and Views**

Camera models
Stereo geometry

Practice:
Image Processing in Computer Vision

Lesson #6 **Camera Models and Views**

Camera calibration
Multiple views

Practice:
Image Processing in Computer Vision

Lesson #7 **Image Features**

Feature detection
Feature descriptors
Model fitting

Practice:
Image Processing in Computer Vision

Lesson #8 **Lighting**

Photometry
Lightness
Share from shading

Practice:
Image Processing in Computer Vision

Lesson #9 **Image Motion**

Overview
Optical flow

Practice:
Feature Detection and Description

Lesson #10 **Tracking**

Introduction to tracking
Parametric models

Practice:
Feature Detection and Description

Lesson #11 **Tracking**

Non-parametric models
Tracing considerations

Practice:
Feature Detection and Description

Lesson #12 **Classification and Recognition**

Introduction to recognition
Classification: Generative models

Practice:
Video Analysis

Lesson #13 **Classification and Recognition**

Classification: Discriminative models
Action recognition

Practice:
Camera Calibration and 3D Reconstruction

Lesson #14 **Useful Methods**

Color spaces and segmentation
Binary morphology
3D perception

Practice:
Machine Learning
Computational Photography

Lesson #15 **Human Visual System**

The retina
Vision in the brain
Review course

Practice:
Face Detection using Haar Cascades
Pedestrians Detection

Final Exams

Final Exam

Literature

Recommended

1. Udacity Free Course - Introduction to Computer Vision by Georgia Tech
   https://www.udacity.com/course/introduction-to-computer-vision--ud810

2. OpenCV
   https://docs.opencv.org/4.2.0/d6/d00/tutorial_py_root.html

Additional

1. Richard Szeliski, Computer Vision: Algorithms and Applications

2. Several articles related to topics and online materials will be listed on the UNINET

Knowledge assessment forms:

Class attendance: 15 times in a semester
Assignment: 7 times in a semester
Midterm Examination: 1 time in a semester
Final Examination: 1 time in a semester, within the period of the examination session

Criteria for evaluating student's knowledge in percentage

Class attendance 30%
Assignment 22%
Mid-term Examination 8%
Final Examination 40%

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	ES	MP
Lectures	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**15**
Practices	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		**15**
Assignments		2		3		3		3		3		4		4			**22**
Midterm Exams							8										**8**
Final Exam																**40**	**40**
MP for EC	2	4	2	5	2	5	10	5	2	5	2	6	2	6	2	**40**	
																TOTAL	**100**

MP-Max. Points for the semester; MP for EC-Max. Points for each class; ES-examination session;

Evaluation System:

Grade in Letter	Grade in Number (GPA)	Grade in percentage %	Grade in traditional system
A	4	95-100	“Excellent”
A-	3.67	90-94	
B+	3.33	85-89	“Good”
B	3	80-84	
B-	2.67	75-79	
C+	2.33	70-74	“Satisfactory”
C	2	65-69	
C-	1.67	60-64	
D+	1.33	55-59	
D	1	50-54	
F	0	<50	“Fail”/ (no go grade)
I	0	0	“Incomplete Discipline”
W	0	0	“Withdraw”
AW	0	0	“Academic Withdraw”
AU	0	0	“Attend Discipline”
Pass/Not Passed	-	65-100	“Pass/No Pass”

Academic Policy

KBTU standard academic policy is used.
- Cheating, duplication, falsification of data, plagiarism, and cribbing are not permitted under any circumstances!
- Attendance is mandatory.

Attention. Missing 20% attendance to lessons, the student will be taken from a discipline with filling in F (Fail) grade.

Students must participate fully in every class. While attendance is crucial, merely being in class does not constitute “participation”. Participation means reading the assigned materials, coming to class prepared to ask questions and engage in discussion
- Students are expected to take an active role in learning.
- Written assignments (independent work) must be typewritten or written legibly and be handed in the time specified. Late papers are not accepted!
- Students must arrive to class on time.
- Students are to take responsibility for making up any work missed.
- Makeup tests in case of absence will not normally be allowed.
- Mobile phones must always be switched off in class.
- Students should always be appropriately dressed (in a formal/semi-formal style).
- Students should always show tolerance, consideration and mutual support towards other students.

When evaluation of students during semester those described below should be necessarily taken into account:

- Attendance to classes
- Actively and proactively participate in a practical study
- The study required and supplementary literature
- Performance of assignment
- Submission all work on time (deadline)

Agreement

Familiarized and agreed with requirements to “Introduction to Computer Vision” course

Author Aldamuratov Jomart
Considered in meeting at Faculty of Information Technology,
transaction №_____ in «___»_____2020 year.
Dean of Faculty of Information Technology _____ Rassim Suliyev