**Hashemite University**
**College of Engineering**
**Department of Computer Engineering**
**Computer Vision**
**CPE 1704081581**
**(3 Credit Hours/Dept. Elective)**

**Instructor**

| | |
|---|---|
| Dr. Khalil Yousef | |
| Email: | khalil@hu.edu.jo |
| Office: | E-3039 |
| Office hours: | Posted on the course Moodle page |

**Grading info**

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|---|---|
| Midterm Exam | 30% |
| Quizzes, Homework's and Project | 30% |
| Final | 40% |

**Class Info**

| | |
|---|---|
| Days | Sec1:Mon/Wed<br>Sec2**:** - |
| Time | Sec1: 9:30 – 11:00<br>Sec2: - |
| Location | Eng. 2030 |

**Course**

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|---|---|
| Course Number: | 1704081581 |
| Prerequisite: | 110408300 |
| Textbook: | **"Multiple View Geometry in Computer Vision"**, 2nd Edition, Richard Hartley, Andrew Zisserman, published by Cambridge University Press, 2003. |
| Course Description: | Computer vision is the "inverse" of computer graphics. In Computer Graphics, you give the computer a model, and it draws the picture. If you enjoy animation movies, you are benefiting from computer graphics. In Computer Vision, you give the computer a picture, and it computes the model. This might mean creating 3-D textured model from an image, or putting a box around a person's face. This can mean finding points that match in two images, or automatically aligning the images based on the point correspondences, or recognizing human's emotional activities.<br>This class provides a survey of modern computer vision topics and a computer vision design experience. After a brief introduction to the array representation of images and classical low-level algorithms, this course lays the foundation for modern computer vision on the foundational concepts of camera geometry, feature extraction, and machine learning (time allowed). Students will implement modern computer vision algorithms in a series of structured labs or projects whenever possible or possibly just implement such algorithms in one final project experience. This class is intended for students with a strong programming background.<br>Important to mention that the course will focus on the geometric aspects of the computer vision area, but not on the image processing part. Programming assignments using C/MATLAB will be given to enrich the understanding of the course topics. |
| Specific Outcomes of Instruction (Course Learning Outcomes) | 1. **Understand** the geometric relations between multiple views of scenes. SO(1)<br>2. **Understand** the general principles of parameter estimation. SO(1)<br>3. **Compute** scene and camera properties from real world images using state-of-the-art algorithms. SO's (1, 2)<br>4. **Understand** the value of real-world and synthetic testing for computer vision algorithms. SO(1)<br>5. **Design** and implement a computer vision algorithm. SO's (2, 3) |
| Important material | - Lecture notes<br>- References<br>- Internet resources |

**References:**


- **"Introduction to Linear Algebra"**, 4th edition, Strang, Gilbert, Wellesley, MA: Wellesley-Cambridge Press, 2009.
- **"Computer Vision: Algorithms and Applications"**, Richard Szeliski, November 24, 2010 (http://szeliski.org/Book/).

**Major Topics Covered and Schedule in Weeks:**

| Topic | # Weeks | # Contact hours* |
|---|---|---|
| Introduction to Computer Vision | 1 | 3 |
| Review: Linear Algebra | 1 | 3 |
| Review: Digital Image Processing | 1 | 3 |
| World 2D: Geometry and Transformations | 3 | 9 |
| World 3D: Geometry and Transformations | 2 | 6 |
| Camera Models | 1 | 3 |
| Camera Calibration (Zhang's Algorithm) | 1 | 3 |
| Visual Perception and Edge Detection (Sobel, LoG, Canny) | 1 | 3 |
| Epipolar Geometry and the Fundamental Matrix. | 2 | 6 |
| Extracting Interest Points and Their Descriptors (with Harris, SIFT, and SURF) in Image Pairs and Establishing Point-to-Point Correspondences Between the Images | 1 | 3 |
| Total | **14** | **42** |

**Course Policy**

- The course will follow selected subjects as listed on the course schedule. Additional lecture notes and examples will be given and discussed in class as much as time permits.
- Course Website (Moodle): http://www.mlms.hu.edu.jo/. Students are asked to check the website regularly for announcements.
- Students are responsible for the reading assignments from the text and handouts
- Students are responsible for following up the lecture materials
- Students are responsible for reading additional information and examples in order to understand the materials discussed in the lectures.
- If you miss class, there won't be a makeup test, quiz, etc. and you WILL get a zero unless you have a valid excuse.
- Cheating and plagiarism are completely prohibited.
- If you miss more than 15% of classes you will automatically fail the class.
- The following grading scale will be applied to each students accumulated course metric values:
  100% - 90% A+, 90% - 85% A, 85% - 80% A-, 80% - 75% B+, 75% - 72% B, 72% - 68% B-, 68% - 65% C+, 65% - 60% C, 60% - 55% C-, 55% - 50% D+, 50% - 45% D, 45% - 0% F

**ABET Student Outcomes (SO) Addressed by the Course:**

| # | *Outcome Description* | *Contribution* |
|---|---|---|
| ***General Engineering Student Outcomes*** | | |
| (1) | An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. *(Previously SO's (a, e, k))* | ***H*** |
| (2) | An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. *(Previously SO's (c, k))* | ***H*** |
| (3) | An ability to communicate effectively with a range of audiences. *(Previously SO (g))* | ***L*** |
| (4) | An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. *(Previously SO's (f, h, j))* | |
| (5) | An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. *(Previously SO (d))* | |
| (6) | an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. *(Previously SO's (b, k))* | |
| (7) | An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. *(Previously SO (i))* | |

**H**=High, **M**= Medium, **L**=Low

**Prepared By: Dr. Khalil Yousef** **Date: 10/10/2020**