# 中正大學課程大綱(CCU Course Syllabus)
## 資訊工程研究所(Graduate Institute of Computer Science and Information Engineering)

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| 課程名稱(中文)(Course Title (Chinese))： | 電腦視覺 | 開課單位(Teaching Unit)： | 資訊工程研究所(Graduate Institute of Computer Science and Information Engineering) |
| 課程名稱(英文)(Course Title (English))： | Computer Vision | 課程代碼(Course Code)： | 4105109_01 |
| 授課教師(Lecturer)： | 江振國 | | |

| 學分數(Number of Credits)： | 3 | 必/選修 (Mandatory/Elective)： | 選修 (Elective) | 開課年級 (Year)： | 研究所，開放大三大四 |
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| 先修科目或先備能力(Prerequisites)： | Linear Algebra<br>Optimization<br>Basic Programming Skills |
| 課程概述(Course Introduction)： | Researchers in computer vision have been developing techniques for recovering the three-dimensional shape and appearance of objects in imagery. We now have reliable techniques for accurately computing a partial 3D model of an environment from thousands of partially overlapping photographs. There are two major themes in the computer vision literature: 3D geometry and recognition. The first theme is about using vision as a source of metric 3D information: given one or more images of a scene taken by a camera with known or unknown parameters, how can we go from 2D to 3D, and how much can we tell about the 3D structure of the environment pictured in those images? The second theme is all about vision as a source of semantic information: can we recognize the objects, people, or activities pictured in the images, and understand the structure and relationships of different scene components just as a human would? |
| 學習目標(Learning Goals)： | 1.The discipline of<br>2.Provide a unified perspective on the different aspects of computer vision.<br>3.Give students the ability to understand vision literature.<br>4.Give students the ability to implement components to many modern vision systems. |
| 教科書(Textbook)： | Textbook:<br>Computer Vision: Algorithms and Applications, Richard Szeliski<br>Reference Book:<br>Computer Vision: A Modern Approach, David Forsyth and Jean Ponce, Prentice Hall |

| 課程大綱(Course Syllabus) | | 分配時數(Number of Hours) | | | | 核心能力 (Core Capabilities) | 備註 (Remarks) |
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| 單元主題 (Topic) | 內容綱要 (Content) | 講授 (Lecture) | 示範 (Demonstration) | 習作 (Assignment) | 其他 (Others) | | |

| Camera Calibration | 2D and 3D feature-based alignment, pose estimation, geometric intrinsic calibration | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
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| Two-View Geometry | Epipolar geometry, sparse correspondence, dense correspondence, multi-view stereo | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
| Feature Extraction | Histogram, image gradient,corner detection, SIFT, Principal Components Analysis | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
| Image Formation | Geometric projection,optical properties, photometric properties, sensor | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
| Image Segmentation | Histogram-based segmentation, generative model, mixture of Gaussians, Expectation maximization(EM), interactive graph cuts | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
| Sparse Coding | L1-minimization, dictionary learning, sparse representation based classification, locality-constrained linear coding, spatial pyramid matching | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |

| Recognition | Random Sample Consensus, Regression Analysis, Hough Transform | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☐ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
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| Computer Vision Paper Study | Paper studying for computer vision applications, such as recognition, detection, classification problems. | 6 | | | | ☑ 1.1 ☑ 1.2 ☐ 1.3 ☑ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 | |
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### 教育目標(Education Goals)

1.G1. 具獨立從事學術研究或產品創新研發之人才

2.G2.. 具團隊合作精神及科技整合能力，並在團隊中扮演領導、規劃、管理之角色

3.G3.. 具創新研發、自我挑戰與終身學習能力之人才

4.G4.. 具有學術倫理、工程倫理、國際觀之人才

### 核心能力(Core Capabilities)

1.1. A1.具有資訊工程與科學領域之專業知識。(Competence in computer science and computer engineering.)

1.2. A2.具有創新思考、問題解決、獨立研究之能力。(Be creative and be able to solve problems and to perform independent research.)

1.3. A3.具有撰寫中英文專業論文及簡報之能力。(Demonstrate good written, oral, and communication skills, in both Chinese and English.)

1.4. A4.具有策劃及執行專題研究之能力。(Be able to plan and execute projects.)

1.5. A5.具有溝通、協調、整合及進行跨領域團隊合作之能力。(Have communication, coordination, integration skills and teamwork in multi-disciplinary settings.)

1.6. A6.具有終身學習與因應資訊科技快速變遷之能力。(Recognize the need for, and have the ability to engage in independent and life-long learning.)

1.7. A7.認識並遵循學術與工程倫理。(Understand and commit to academic and professional ethics)

1.8. A8.具有國際觀及科技前瞻視野。(Have international view and vision of future technology.)

(Please respect to the intellectual property rights, do not photocopy the textbooks which assigned by professors.)

| 教學要點概述(Course Details)： |
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| 1. 教材編選(Teaching Materials)：☑ 自編教材(Self Developed) ☑ 教科書作者提供(Provided by Textbook Authors) |
| 2. 教學方法(Teaching Method)：☑ 投影片講述(Lecture Slides) ☑ 板書講述(Blackboard Teaching) |
| 3. 評量方法(Grading Method)：☐ 上課點名(Attendance) 0%, ☐ 小考(Quiz) 0%, ☐ 作業(Assignment) 0%, ☑ 程式實作(Programming) 20%, ☐ 實習報告(Technical Report) 0%, ☐ 專案(Project) 0%, ☑ 期中考(Mid-Term Exam) 20%, ☑ 期末考(Final Exam) 20%, ☑ 期末報告(Final Report) 20%, ☑ 其它(Others) 20% |
| 4. 教學資源(Teaching Resources)：☑ 課程網站(Course Web Site) ☐ 教材電子檔供下載(Downloadable Electronic Materials) ☐ 實習網站(Lab Web Site) |
| 5. 教學相關配合事項(Other requirements)： |

| 課程目標與教育核心能力相關性(Relationship between course education goals and core capabilities) 如有未出現的核心能力，請先按『確定』送出資料 |
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| 請勾選(Please select)：☑ 1.1 ☑ 1.2 ☐ 1.3 ☑ 1.4 ☐ 1.5 ☐ 1.6 ☐ 1.7 ☐ 1.8 |

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| | **A1.具有資訊工程與科學領域之專業知識。(Competence in computer science and computer engineering.)** |
| | 為何有關：<br>Computer vision is an advanced course in the computer science field. It aims to build up the basis of knowledge and concept of this course. |
| 1.1 | 達成指標：<br>Regarding the course content, students should be able to understand the insight of the problem. |
| | 評量方法：<br>Level Three: the grade of this course is above 85; Level Two: the grade of this course is above 70; Level One: the grade of this course is below 70. |
| | **A2.具有創新思考、問題解決、獨立研究之能力。(Be creative and be able to solve problems and to perform independent research.)** |
| | 為何有關：<br>This course encourages the students to provide their own solutions to solve the problem in the projects. |
| 1.2 | 達成指標：<br>能夠運用課程所學，執行完成至少一項課程具分析與解決問題訓練之作業、試題或專題製作作品。 By applying the theories in the course to analyze the problem and finish at least one assignment or project. |
| | 評量方法：<br>等級 3：繳交程式作業四項以上 等級 2：繳交程式作業二項以上 等級 1：繳交程式作業二項以下 Level Three: finish the assignment and project above 4; Level Two: finish the assignment and project above 2; Level One: finish the assignment and project below 2. |

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| 1.4 | **A4.具有策劃及執行專題研究之能力。(Be able to plan and execute projects.)** |
| | 為何有關：<br>期末程式競賽，將結合多種電腦視覺方法，訓練學生運用所學技術執行電腦視覺領域的專題能力。 Students need to apply computer vision methods for the final project. This requires the ability to analyze the problem, choose and improve the current methods and design the system. |
| | 達成指標：<br>具有系統設計、軟體技術或演算法設計相關能力。 To have the ability to develop and improve the algorithm and implement a complete system. |
| | 評量方法：<br>Level Three: the grade of this course is above 85; Level Two: the grade of this course is above 70; Level One: the grade of this course is below 70. |