Course Goals
An introduction to Today’s Computer Vision. After this course, students should understand the problems that face the field, know some solutions/algorithms for each of them, and acquire new skills in math and programming.

Competencies and Evaluation
During the course, students will have different activities, that are individual (I), in groups (G), in class (C), and at home (H),

- Weekly Paper Readings – PR (I,H)
- Look Ahead Study – LA (I,H)
- Participation – PA (I,CH)
- Group Activities – GA (G,C)
- 20-min questions – 20 (I,C)
- Problem Sets – PS (I/G,H)
- Class Project – CP (I/G,H)
- Licence-Plate Challenge – LC (G, C)

and will have to demonstrate proficiency in several Competence Areas:

- Mathematical Foundations (MF)
- Implementation Skills (IS)
- Participation and Commitment (PC)
- Image Fundamentals (IMG)
- Grouping (GRP)
- Localization and Recognition (REC)
- 3D Reconstruction (3DR)
- Tracking (TRK)

Some activities will bridge multiple concepts, and will count on the evaluation of several competency areas. We will use the Moodle and SuSy for submissions.

Grading
Activities are graded in a [A, G] scale (A=5, G=0). Final grade is the average of competencies, discarding the largest and the two lowest competency grades. To pass, a student need final grade A, B, or C, and at most two competencies with D or one with F. Undergrads will have different grading.

Paper Readings
Every week, there will be a paper as extra-class reading on complementary material to what has been seen. Students will write and submit a 1-2 page summary.

Problem Sets
We will have frequent 1-2 question take-home problem sets – some in groups and some individual.

Look Ahead
Small tasks to help students study ahead of a class.

Participation
Overall commitment to the course. From Q&A in class, to fulfillment of activities and attendance.

Group Activities
In-class peer-to-peer tasks to explore and learn material.

20-min Questions
Single questions to be done in 20-minutes in class.

Class Project
Groups will propose a project based on their interests – subject to the prof. approval. There will be several incremental landmarks on its development, culminating in a 15+5min presentation to the class. Projects can be implementation of known methods, evaluation and comparisons, literature reviews, etc. Each type of project will count for different areas of competency.

License Plate Challenge
Students will be paired for a competition on Brazilian license plate localization and recognition. This assignment will include dataset collection and implementations. There will be a prize for the group with the top results.

A working submission is necessary for a passing grade in IS, but the position in the final ranking will not affect the grade.

Late Work and Plagiarism
Every task will have two deadlines. After the first deadline, and before the second, there is a 30% penalty on the grade. After the second deadline there will be no submissions.

Any instance of plagiarism, cheating, or anti ethical behavior implies immediate failure (D or zero) in the class.

Contents
1. Image Fundamentals
   - Image formation and Color
   - Filtering, Edges, and Corners
   - Correspondences
     - Small and Large Baseline
     - Super Resolution
   - 2. Grouping
     - Background Sub & Segmentation
     - EM and Spectral Clustering
     - Motion, Shape, and Img Cluster
   - 3. Localization and Recognition
     - Viola & Jones and Felzenszwalb
     - Template recognition
     - Visual Dictionaries
     - Latent Dirichlet Allocation
   - 4. 3D Reconstruction
     - Camera Model and Calibration
     - Stereo, Rectification
     - Structure From Motion
     - Essential and, Fund. Matrices
     - Homography
   - 5. Tracking
     - Uncertainty Representation
     - Kalman, Particle Filters, HMM

Bibliography

Computer Vision: Alg. and Apps.
Richard Szeliski

An Invitation to 3-D Vision
Ma, Soatto, Kosecka, and Sastry
Springer, 2004

Comp. Vision: A Modern Approach
Forsyth and Ponce
Prentice Hall, 2003