Bauhaus-Universität Weimar

Photogrammetric Computer Vision

Exercise Sessions

Winter Semester 24/25

(Course materials for internal use only!)

Computer Vision in Engineering – Prof. Dr. Rodehorst
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Contact Data

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Consultation Hours: on request

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General Information

Biweekly meetings:

- Mondays starting at 11:00
- Lecture Hall C, Marienstraße 13c

Six assignments:

- to be solved in small groups
- serve as exam prerequisite

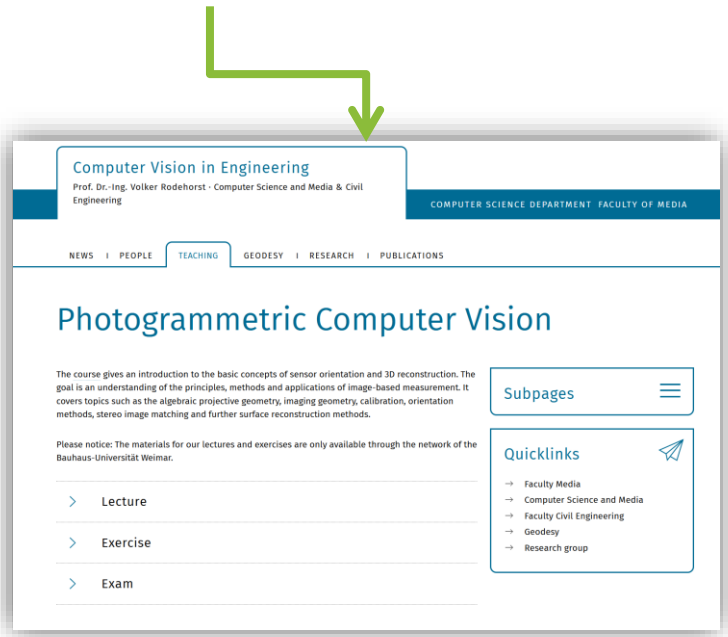
Final project:

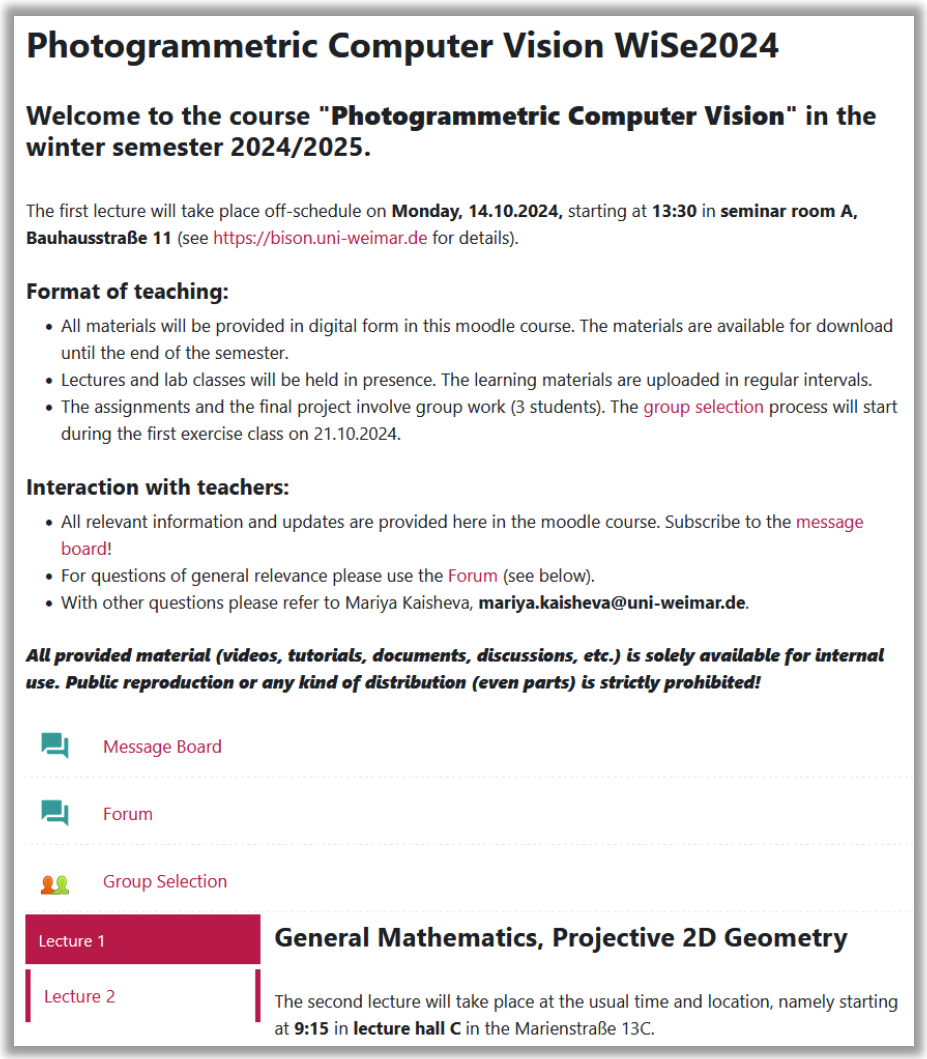
- to be solved in small groups (groups stay the same throughout the semester)
- required for the full completion of the course

General Information

Course materials:

- Moodle
- University webpage





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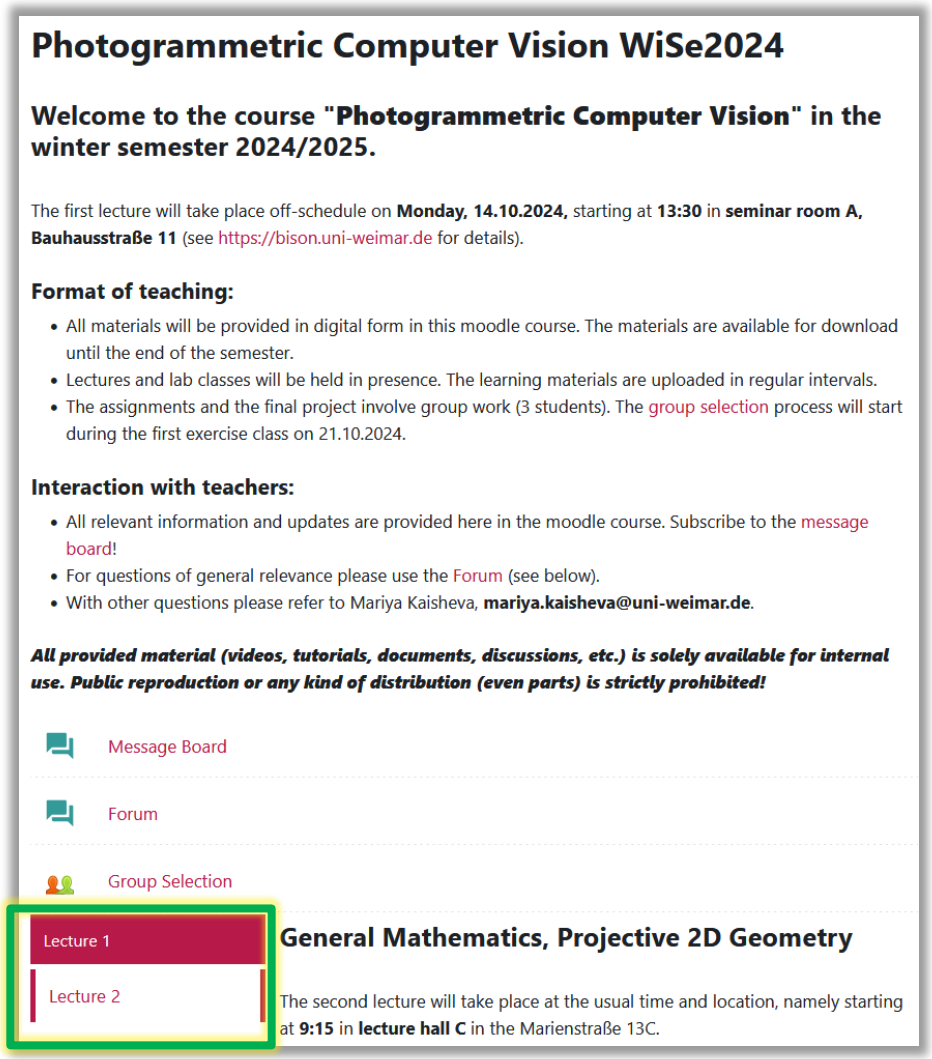
General Information

Course materials on Moodle:

- lecture slides
- exercise class materials
- assignment submissions
- exam preparation materials

learning materials will be uploaded on a regular basis



Photogrammetric Computer Vision WiSe2024

Welcome to the course "Photogrammetric Computer Vision" in the winter semester 2024/2025.

The first lecture will take place off-schedule on **Monday, 14.10.2024,** starting at **13:30** in **seminar room A, Bauhausstraße 11** (see https://bison.uni-weimar.de for details).

Format of teaching:

- All materials will be provided in digital form in this moodle course. The materials are available for download until the end of the semester.
- Lectures and lab classes will be held in presence. The learning materials are uploaded in regular intervals.
- The assignments and the final project involve group work (3 students). The group selection process will start during the first exercise class on 21.10.2024.

Interaction with teachers:

- All relevant information and updates are provided here in the moodle course. Subscribe to the message board!
- For questions of general relevance please use the Forum (see below).
- With other questions please refer to Mariya Kaisheva, **mariya.kaisheva@uni-weimar.de**.

All provided material (videos, tutorials, documents, discussions, etc.) is solely available for internal use. Public reproduction or any kind of distribution (even parts) is strictly prohibited!

Message Board

Forum

Group Selection

Lecture 1

Lecture 2

General Mathematics, Projective 2D Geometry

The second lecture will take place at the usual time and location, namely starting at **9:15** in **lecture hall C** in the Marienstraße 13C.

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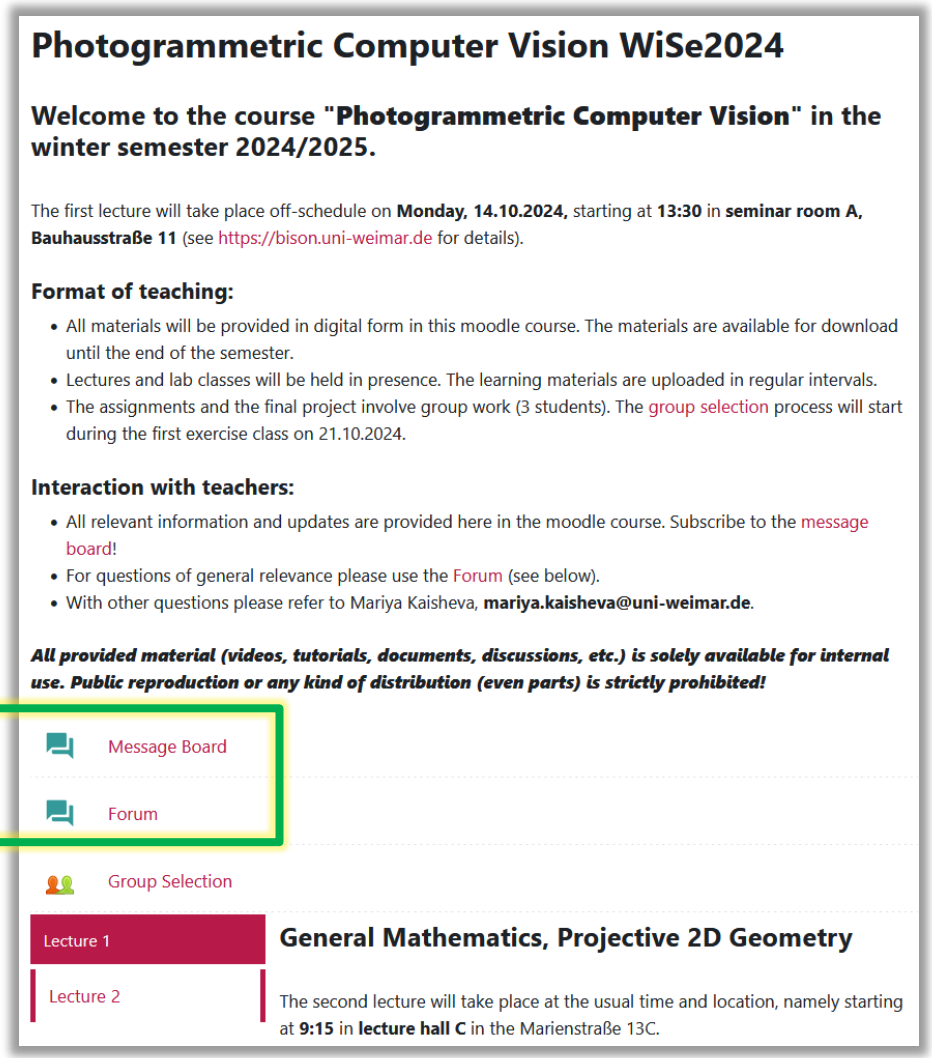
General Information

Course materials on Moodle:

- lecture slides
- exercise class materials
- assignment submissions
- exam preparation materials
- message board
- discussion forum

If you are looking for group members, **use the forum** to inform your classmates.



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Agenda

Topics:

Assignment 1.	Points and lines in the plane, first steps in MATLAB / Octave
Assignment 2.	Projective transformation (Homography)
Assignment 3.	Camera calibration using direct linear transformation (DLT)
Assignment 4.	Orientation of an image pair
Assignment 5.	Projective and direct Euclidean reconstruction
Assignment 6.	Stereo image matching
Final Project.	- will be announced later -

Agenda

Start date and submission deadlines:

Assignment 1.	21.10.24 –	03.11.24
Assignment 2.	04.11.24 –	17.11.24
Assignment 3.	18.11.24 –	01.12.24
Assignment 4.	02.12.24 –	15.12.24
Assignment 5.	16.12.24 –	12.01.25
Assignment 6.	13.01.25 –	26.01.25
Final Project.	27.01.25 –	16.03.25

Sundays by 20:00 (Central European Time)

Workflow

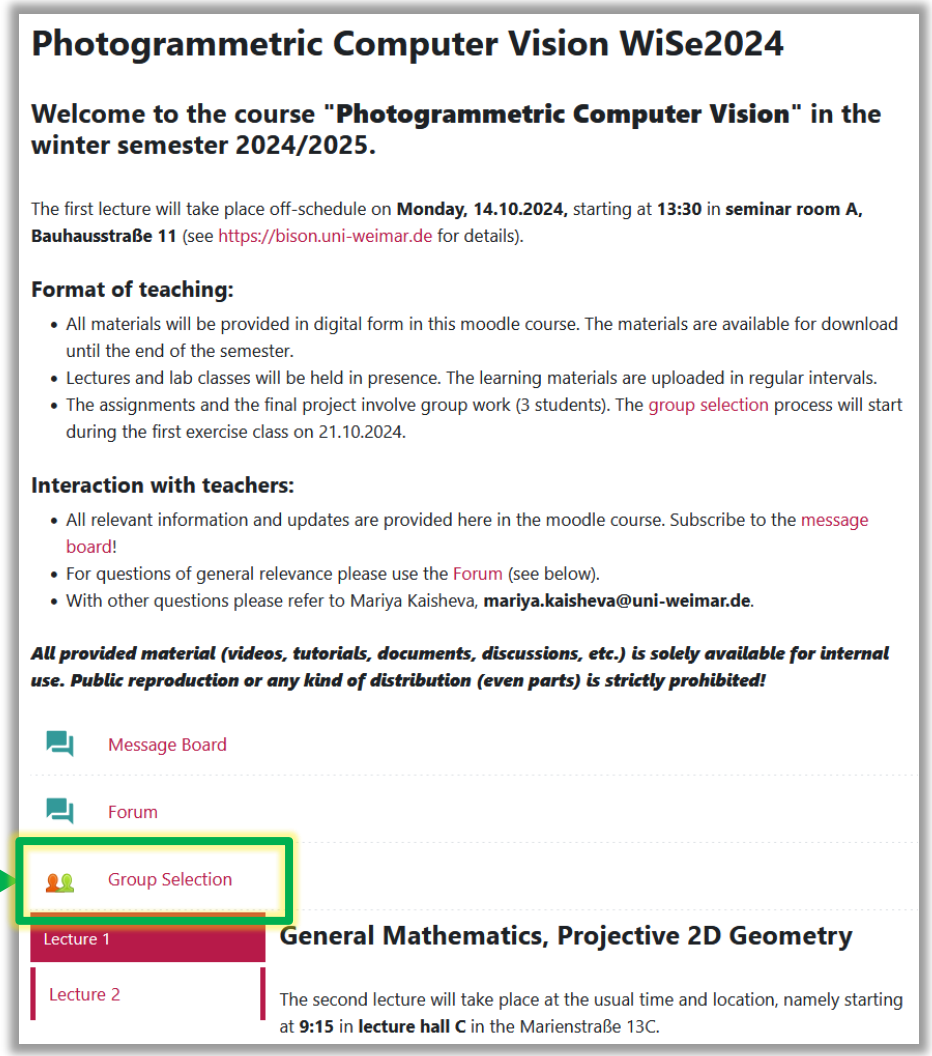
Small groups

- 3-4 members per group

- group **members stay the same** during the semester

- group selection via Moodle will be possible **until November 1st**

Disclaimer: All students who have previously completed the assignments, please contact me as soon as possible!



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Workflow

Necessary software

MATLAB

- licensed product
- installed in Pool G (room 128 in B11)
- needed for the lab classes:
  image processing toolbox

GNU Octave

- free software
- required packages:
  general, *control*, *signal*, *image*

Check the university webpage* for information on MATLAB licences

* https://www.uni-weimar.de/en/university/structure/central-university-facilities/scc-it-service/study-work-digitally/software/matlab-use-on-private-device/

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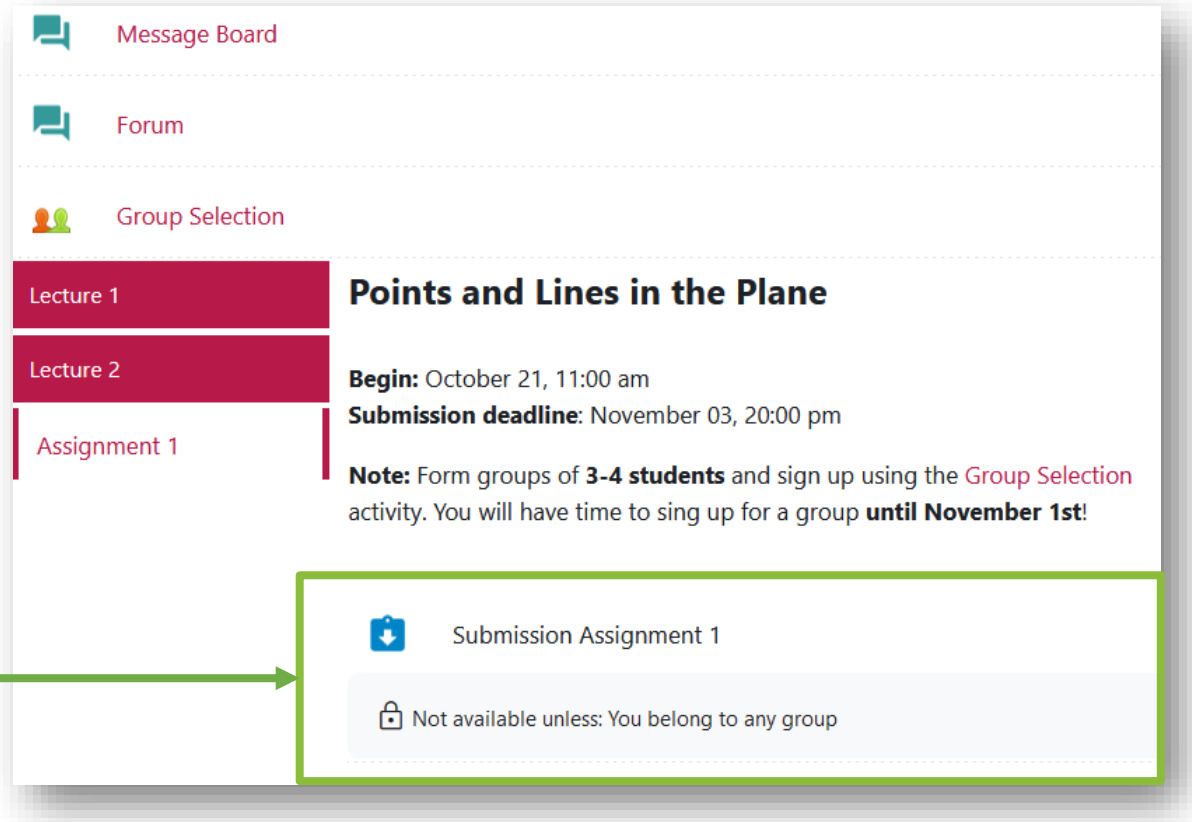
Workflow

Deliverables

- with each submission provide:
  - well commented source code (*.m files)
  - images used as input (if applicable)
  - short documentation (if applicable)
- upload using Moodle
- only one submission per group needed
- do NOT include personal data like names and student IDs in the submitted code file(s)



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Workflow

Assignment evaluation

- no direct effect on the final grade
- exam admission: at least 5 successfully completed assignments
- grading on a **pass–fail** principle
- successfully acquired exam admission may be preserved (within 5 years time period) until future exam attendance
- plagiarism will be sanctioned ➡ **work independently**

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Assignment 1

Part 1: Points and Lines in the Plane

Solve manually:

Hint for Part 1:
Use projective geometry.

1. You would like to compute the connecting line between two 2D points.
   What happens, if the two points are identical?
2. Where does the general line $x \cos \varphi + y \sin \varphi = d$ intersect the line $(0, 0, 1)^T$ given in homogeneous coordinates? How can this point be interpreted?
3. Show that the horizon is a straight line by showing that three points on the horizon are always collinear.

Part 2: First Steps in MATLAB / Octave

Hint for Part 2:
Homogeneous coordinates can be useful here as well.

Solve by implementing in Octave or MATLAB:

1. The two points $\mathbf{x} = (2, 3)^T$ and $\mathbf{y} = (-4, 5)^T$ are given.
   a. Determine the connecting line $\mathbf{l}$ between the two points.
   b. *Move* $\mathbf{x}$ and $\mathbf{y}$ in the direction $\mathbf{t} = (6, -7)^T$,
      rotate afterwards using the angle $\varphi = 15°$ and finally
      scale with factor $\lambda = 8$.
   c. Accomplish the same operations with the line $\mathbf{l}$.
2. Examine whether the transformed points $\mathbf{x}'$ and $\mathbf{y}'$ are on the transformed line $\mathbf{l}'$.

More on 2D transformations is coming in lecture 3.