COMP 0137 Machine Vision: Homework #2
Due 5th January 2024 at 4:00 pm on Moodle
Worth 10% of your overall grade
(Grading scheme: 50% is a basic pass, 70% is a low 'A')

For this homework, we'll revisit two practicals: Homographies and Particle Filters. Though some of this will feel repetitive, it is meant to solidify what we learned in the practicals. There are multiple parts, so please read the instructions carefully. Everything you turn in must be YOUR OWN WORK, except obviously the helper-code and data given to you on Moodle. See below for more details. As always, list names/references for anything you're submitting that is not your own work.

Late Policy: We must follow the official UCL late-policy, and this gets applied *after* your coursework is marked on Moodle, based on the Moodle timestamps. The instructor/TA's have no control over this – at all:
https://www.ucl.ac.uk/academic-manual/chapters/chapter-4-assessment-framework-taught-programmes/section-3-module-assessment

What to turn in (all inside one YourParticipantNumber.zip file):
- Four jupyter notebooks containing your code and explanations for the Homographies lab. Like Homework #1, you should complete all the TO DO's. For every figure or plot that is generated by the code (for videos, a few frames are enough), put a copy in your notebook, and write 1-3 sentences (maximum) explaining what the figure shows or pros/cons of what is happening.
- Two jupyter notebooks for the Condensation lab, with your explanations – as above.
- Two jupyter notebooks for the additional tasks in parts G and H, for which we created templates for you to fill in your code. Include explanations – as above.
- Limit file-upload size to 250Mb, which is the Moodle maximum. Hopefully, that will make it easier for you to submit all the notebooks with all the outputs saved. If the zip'd file still doesn't fit for you, then save the rendered output for the tracking of Upper right corner "ur", and not the other three.
- To reiterate: just annotated Python code is not a valid report!
- One folder containing all your code. Do not use subfolders.
- Please write your Participant Number in the first line of EACH notebook. Please name your zip-folder YourParticipantNumber.zip. And check that your zip file isn't corrupted.
- Please do not write your explanations as comments, but as markdowns.
- Please save your notebooks with ALL outputs. For repetitive tasks, show the output for each example in your notebook. Make sure you do not accidentally overwrite outputs.
- Keep in mind: Clearly structured code and explanations are easier to read and make your graders happy! (Read the `Special Notes` below; they contain advice/tips)

Homographies Part I (25%)

A) 06_Practical_Homographies\practical1A.ipynb

Besides completing the TO DO's, make sure to describe and illustrate the first two TO DO's in the list of three: scale ambiguity and exact mapping of pairs of four points.

B) 06_Practical_Homographies\practical1B.ipynb

Complete TO DOs and document in your notebook. You may use PracticalDataSm.mat instead of PracticalData.mat to go faster.

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Homographies Part II (25%)

C) 06_Practical_Homographies\practical2A.ipynb

Complete TO DOs and document in your notebook.

D) 06_Practical_Homographies\practical2B.ipynb

Complete TO DOs and document in your notebook.

Condensation (25%)

(**Special Note:** Be aware that there are some small differences between the code given in the lab practical #7, and the code used in G) below.)

E) 07_PracticalCondensation\labA.ipynb

Complete TO DOs and document in your notebook.

F) 07_PracticalCondensation\labB.ipynb

Complete TO DOs and document in your notebook. **Special Note**: You do NOT need to document the three TO DOs from the bottom of the intro (i.e. varying # of particles, modeling velocity in **w**, and visualizing the top-scoring particles). Though feel free to experiment with these.

Combining Tracking and Homographies (25%)

G) **HW2\HW2_Practical7c. ipynb**

Complete TO DOs and document in your notebook. **Special Note**: This task is mainly a repeat of F), so you can apply what you did for the TO DOs in 07_PracticalCondensation\labB.ipynb, but note the differences.

- This function will be performed four times in the next part. But for now, you can run it by passing in 'll' as the lower-left *corner* argument.
- Also, the image sequence is now converted to grayscale when computing the likelihood.
- Some other tips & advice have been provided as comments.

H) **HW2\HW2_TrackingAndHomographies.ipynb**

Complete TO DOs and document in your notebook. Special Note: This task is mostly a repeat of D), so you can apply what you did for the TO DOs in 06_Practical_Homographies\practical2B.ipynb, but note the differences.

- Most importantly, consider this simplistic example, and mention at least two actions or changes we could make to improve the results (excluding actions from the Not-for-Credit Extensions).
- Other tips and advice have been provided as comments.

Not-for-Credit Extensions

- Reduce the search space where particles can land by using an edge-detector.
- Choose (or film!) a different video and/or 3D mesh, and augment the video as we did here.
- Each particle filter's state space **w** here was just the 2D image location of an interest point. Each interest point was tracked independently. Consider making a particle filter whose **w** represents the state of an affine transformation of the whole pattern (black square on white paper). This will require modifying how new measurements are incorporated.