Durham University

Computer Science

Summative Assignment

Module code and title	COMP4097 Advanced Computer Graphics and Visualisation
Academic year	2023-24
Coursework title	Visualisation
Coursework credits	5 credits
% of module's final mark	50%
Lecturer	George Koulieris
Submission date*	January 11th, 2024, 2pm
Estimated hours of work	10
Submission method	Ultra

Additional coursework files	*Earth dataset,* additional links including PyGMT tutorials and guidance.
Required submission items and formats	Please submit a compressed archive (.zip) with: (a) all your source code. Your program should run by simply calling `python3 problemX.py`, where `X` is 1 or 2. Include a readme file with instructions on how to run your program and what external resources you require if this is not obvious. (b) A .pdf report no longer than 6 pages including images (max ~2500 words). At the top of the first page of the document identify yourself using your CIS username. (c) A short video demonstrating the two visualisations and interaction (compressed to <100MB).

* This is the deadline for all submissions except where an approved extension is in place.

Late submissions received within 5 working days of the deadline will be capped at 40%.
Late submissions received later than 5 days after the deadline will receive a mark of 0.
It is your responsibility to check that your submission has uploaded successfully and obtain a submission receipt.

Your work must be done by yourself (or your group, if there is an assigned groupwork component) and comply with the university rules about plagiarism and collusion. Students suspected of plagiarism, either of published or unpublished sources, including the work of other students, or of collusion will be dealt with according to University guidelines (https://www.dur.ac.uk/learningandteaching.handbook/6/2/4/).

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COMP4097 Summative Assignment Part 2
Visualisation

Important, please read first!

- The assignment should be submitted via Blackboard; the deadline is Jan 11^{th} 2024, 2pm. All deadlines can be found in SharePoint.
- Your software will be tested and should work with Python 3.11.1. You can use additional Python libraries to achieve any additional functionality (e.g., NumPy).
- Please submit a compressed archive (.zip) with (a) all your source code. Your program should run by simply calling `python3 problemX.py`, where X is 1 or 2. Include a readme file with instructions on how to run your program and what external resources you require if this is not obvious. (b) A .pdf report no longer than 6 pages including images (max ∼2500 words). At the top of the first page of the document identify yourself using your CIS username. (c) A short video demonstrating the two visualisations and interaction (compressed to <100MB).
- The marks available for correct implementations/answers to each question are indicated. Partial credit will be given for good attempts.
- The level of achievement (good/very good/excellent/etc.) for each marking criterion is determined based on the marking and classification conventions published in the university core regulations (pp 15-16): link.
- The Visualisation sub-module contributes 50 marks, i.e., 50% of the total module mark and is only assessed by this coursework.
- A FAQ section in Blackboard will be updated with questions as they arise.

Greenpeace is a movement of people passionate about defending the natural world from destruction. One of their current campaigns is to increase awareness on the climate crisis. As part of this campaign they are building two interactive visualisations of the Earth, one targeted to scientists, and one to the general public.

As the lead Greenpeace visualisation engineer you have been tasked to create those visualisations. The first is an exploratory visualisation for scientists to gain insight on the geography of the Earth, for example its mountains and forests. The second will be used to communicate to the general public facts about the climate crisis, i.e., an easy-to-digest visualisation to help explain the causes and effects of the climate change, and the possible solutions. The visualisations will be based on real data of the Earth (source & more info.

You will be combining satellite imagery of the Earth with surface elevation data to create compelling interactive maps. All data are provided in Blackboard, in several resolutions. Low resolutions facilitate faster development, higher resolutions can be used to create stunning screenshots for your report.

To visualise the data you will be using Python and the open source library PyGMT. You can find a lot of helpful documentation in the PyGMT web pages, here and here. Your software should include a simple GUI to control certain aspects of the visualisation as required by the problem descriptions below. You can embed the visualisation in a web page and/or use JavaScript if you want.

PROBLEM 1, EXPLORATIVE VISUALISATION - 20 MARKS:

Create maps of the Earth to effectively illustrate the different surface elevation in its various areas, to help scientists identify mountains and forests.

The user should be able to zoom-in from the global view of the Earth map to smaller patches, by selecting them in the global view, and sample the heights by pointing / clicking on the map. The generated maps should compare *3D perspective displacement map* rendering to using *isolines / isocontours*. The user should be able to modify the parameters of each visualisation technique, for example, for which heights isolines are generated. A GUI should be provided to achieve this goal, enabling interactive map generation. Add any additional control / effects that you consider important to optimise the efficacy of the visualisation in understanding the Earth's surface elevation. Part of the assessment is to show a creative combination of different techniques to visualise the Earth surface. Discuss in the report the advantages and disadvantages of each method.

PROBLEM 2, VISUALISATION FOR COMMUNICATION - 15 MARKS:

The second visualisation should be appropriate for the general public. The interactive visualisation should be a *combination* of scientific visualisation, information visualisation and info-graphics to convey general facts about the causes, effects and possible solutions to the climate change.

The choices made and approaches followed should be consistent with good practices for scientific and information visualisation as discussed during the lectures. A GUI should be provided to enable interactivity as you see fit. Use the provided Earth dataset creatively. As in the previous question, part of the assessment is to show a creative combination of different techniques. Your design choices should be discussed in the report. Feel free to use additional datasets from the dataset page, for example the cloud data, or to edit the texture maps to simulate fire, destruction etc.

PROBLEM 3, REPORT & VIDEO - 15 MARKS:

Compile a report (no longer than 6 pages including images (max $\sim$2500 words)), discussing the reasoning behind your choices for the above problems. Include images that show the generated maps. For problem 1, you should discuss the advantages and disadvantages of each method (displacement maps/perspective images vs isolines). Include maps for different parts of the Earth and at different scales. For problem 2, discuss your thought process behind the creation of your visualisation for the general public.

Please attach a short video (compress to $<$100MB) demonstrating your two visualisation techniques, for a few selected parameters.