**PRELIMINARY DRAFT DATED 2025-01-08**
**PLEASE SEE LATEST VERSION ON CANVAS AS THIS ONE MAY CHANGE**

**CS-256** Visual Computing Coursework (only 1 assignment, worth 20% of module)
Date set: 31/1/2025
Deadline: Monday 3rd March 2025 at 11:00
Viva booking: A booking link will be posted on Canvas closer to submission.

By submitting this coursework, electronically and/or hardcopy, you state that you fully understand and are complying with the university's policy on Academic Integrity and Academic Misconduct. The policy can be found at https://myuni.swansea.ac.uk/academic-life/academic-misconduct.

Guidance: **A lot of guidance for this assignment will be given in the lectures and support will be given in the Thursday assignment advisory classes**.

**Unfair Practice**: Do not copy code from colleagues, internet or other sources. You may discuss approaches together, but all coding must be your own. Presenting work other than your own at a viva is plagiarism and a recipe for disaster. The application which you demonstrate must be the code submitted to Canvas. To demonstrate code which is different to that submitted will count as Academic Misconduct.

**Aims**
Understand how an image is stored internally, and how to manipulate the image
Translate useful graphics algorithms into working code
Improve your programming skills through self-study and a challenging assignment
Understand that graphics can be useful to users (in this case within the medical context)
Work with a three-dimensional data set
Combine interaction with visual feedback
Practice presenting your work in a viva situation

**Individuals or pairs**
You may complete and submit the assignment as an individual or as a pair (two students working together). If done as a pair, **you must both attend the viva** at the same time and indicate that your submission is joint (so you both get the marks). Do not do it in a team of more than two people. Do not split as a team once you have decided to work together as your solutions may be duplicates. Do not work with someone who you cannot depend upon to attend the viva with you as you will lose all of your marks.

**Files**:
The supporting framework is written in Java. You may build on this framework. If you wish to carry out the coursework in a different language you may do so, but there will be no provided framework. You will be required to demonstrate your working program on 6/3/2022 or 13/3/2022 using Zoom screen share. You will require several things to start the exercise:

1. A copy of the Java template – downloaded from Canvas. This demonstrates how to display and manipulate images, with functions that will help you with the exercise.
2. A data set to operate on – CThead-256cubed.bin

[Note: *You should not redistribute this data set anywhere – you will not have permission to do that*]

**Coursework Summary**:

1. Implement a slider to go through all of the slices in each of the views [**30 marks**]
2. Implement Maximum Intensity Projection (MIP) in each of the views [**30 marks**]
3. Implement Volume Rendering in each of the views with a slider [**40 marks**]

**Coursework Details**:

1. Implement dataset slicing [30%]:

    a. Display a slider to allow the user to move through slices arbitrarily (currently a function to display slice 128 is provided). **[10 marks]**

    b. Display front and side views in addition to the top view (with independent sliders for each view). **[20 marks]**

2. Implement Maximum Intensity Projection [30%]:

    Perform maximum intensity projection for each view (10 marks each) [note the sliders will not affect this image (see guidance lectures if this does not make sense)]. **[30 marks]**

3. Implement Volume Rendering in each of the views [40%]:

    a. You should use the transfer function (TF) defined as follows:
    CT values below -300 should be completely transparent.
    CT values from -300 to 49 should be RGB=(0.82, 0.49, 0.18) and opacity = 0.12.
    CT values from 50 to 299 should be completely transparent.
    CT values above 300 should be RGB=(1.0, 1.0, 1.0) and opacity = 0.8.
    to implement volume rendering for each of the viewing directions. If you use the above transfer function, your results will look like the results in the sample coursework solution video.
    **[30 marks]**

    b. Link a slider to the opacity of the skin so you can move it between 0 (fully transparent) and 100 (fully opaque). Hint, you can use a slider of int 0..100 but get the double value and divide by 100 to get a double value between 0 and 1 for opacity. **[10 marks]**

**Submission Requirements**:
Submit your assignment through Canvas **by the deadline**. You will demonstrate your working program via Zoom screenshare to me, or a post-graduate at times you will book using a link I will send around the week of the deadline or shortly after (these will be in the Thursday slots of 6th March and 13th March). If you have several java files, place them in a ZIP – **do not include the data set. Only include .java files in your zip or submission**. E.g., just zip your src directory and submit that. **The coursework is worth 20% of this module. There is only 1 coursework.** It is called "Coursework 1" on the various university systems. **It is marked at the viva.**

**Plagiarism**:
It's so important to realise that each year a student will try to present code they don't understand – don't be that student. A simple question like "Why did you do that" or "What does that do" should not stump you.

**Marking scheme**

Note, if you cannot answer questions about your code (or have limited understanding of it), the marks will be reduced (sometimes down to zero).

I do not require extensive code comments, (all comments must be in English), nor do I require any particular approach to coding style. The code does not have to be pretty.

1. **Slicing the dataset with sliders** [30 marks]
a. Can the user operate a slider to display all the slices through the dataset along the Z axis (top view)? Is it well understood? [**10 marks**]
b. Can the user operate two additional sliders to display the slices through the X and Y axes as well? Are they well understood? [**20 marks**]
Understanding can be tested using questions like: How is this implemented, how are the other parts implemented, what does this bit of code do? Deduct appropriate marks from above if the student cannot describe their own code. **Just reading comments out is insufficient and marks should be deducted. All in code comments must be in English.**

2. **MIP** [30 marks]
MIP is implemented according to the notes. **Each** successful view (X, Y, Z directions) scores **10 marks**. Make sure the whole data set is traversed and the images look the same as the sample solution. (If you are a student reading this, you can refer to the sample solution video).
Check the code and ask some questions. Deduct appropriate marks from above if the student cannot describe their own code. **Just reading comments out is insufficient and marks should be deducted. All in code comments must be in English.**

3. **Volume Rendering** [40 marks]
a. Volume rendering should be implemented according to the notes. There should be a function that converts dataset value into a colour an opacity. This colour and opacity is accumulated using back to front, or front to back traversal. My solutions uses front to back traversal and has early ray termination which is only slightly more complex to back to front. But either approach scores full marks. **10 marks** is allocated to **each** viewing direction.
b. A slider should determine the opacity value between 0 and 1 for the skin. A demonstration of this is given in the example solution video. [**10 marks**]

**Submission Procedure**:
Submit the assignment through Canvas before the deadline. Demonstrate/viva your assignment after the deadline at times to be notified.

The college policy for late submission will be used. The timestamp from Canvas will be used. I will email students at their University account, so you must read this frequently during the term. You might not be able to demonstrate/viva if you submit late.

If you have extenuating circumstances (documentation must be provided), we will not have a problem with making alternative arrangements. Extensions: If you are granted a one week extension, you **must** do the viva on 13th March. The extension covers the time to do the assignment and not to get extra time to do the viva, unless the extenuating circumstances cover the whole period up to and including 13th March, in which case, contact me. Students who get zero in the assignment, are generally the students who do not contact me and do not respond to any emails.

**FAQ**

**I've submitted the wrong version.**

You can submit multiple times – I will mark the last version (submitted before the deadline).

**Marks? (Marks are not feedback – see the next item).**

**Marks are provided at the demonstration/viva** and very shortly **after all vivas are complete** in an email to your University number email account. Therefore, it is possible for you to get marks within a few days of the deadline if you select the earlier date.

**Feedback: How does feedback improve my performance?**

**Feedback** arises in several places within this course. Ahead of the submission you can show me and teaching assistants your solution and ask us questions about it. This feedback is especially relevant to **improving your performance** on the assignment. The feedback will directly increase your marks. Obviously, post submission, the feedback will not improve your marks on the assignment. But it may give you some ideas about areas you were stuck on which will help your future programming work on other modules including the third year project.

Other feedback (separate from the assignment) includes you carrying out the practice course examples and using the provided answers to self-evaluate. If you have difficulties, you can ask me to cover the material in lecture and particularly the revision lecture.

Therefore, when it comes to questionnaires about feedback improving your performance, please think about the feedback you can gain during the progress of the course and including self-evaluation against known answers, and not just the marks that are given once the assignment or exam is over which will obviously have limited impact at that point to improve your performance.