



Faculty of Engineering, Mathematics and Science

School of Computer Science & Statistics

M.Sc. Computer Science **SAMPLE EXAM**

Semester 1, 2021

Mathematics of Light and Sound

13 December 2021

"Take at Home"

14:00–19:00

Fergal Shevlin, Ph.D.

Instructions to Candidates:

- Answer **four** questions out of **six**. All questions carry **equal** marks. **25%**
- Use **three hours** as a target for how long you should take to write your answers. **180 mins**
- If you have been granted additional time for written examinations, adjust the suggested target accordingly. **45 mins**
- Email me at **fshevlin@tcd.ie** with any specific queries and I will reply if I can.

All program code should be written in the **Python** language using the **SciPy** library. Good comments and explanations are essential. Your answer to each question should be presented in a separate **Jupyter** notebook. **NB1, NB2, NB3, NB4**

- Your notebooks should be arranged within a single **private** project in your gitlab.scss.tcd.ie repository. Add me as a member with **reporter** access.

Email me a link to your repository. Your email should include as attachments either **screenshots** or PDF versions of each notebook.

- Note that **collaboration** is not permitted. You must submit a picture of the enclosed declaration signed by you.

Materials permitted for this examination:

- This is an "open book" exam. Feel free to refer to any appropriate sources of information you have available, e.g. lecture notes, textbooks, or internet.
- Non-programmable calculators—indicate make and model.

Assignment #1??

CS7GV2-1



Question 1. Write a program to plot wavefront propagation showing refraction at the interface between two media with different characteristics. Use Huygens-Fresnel construction.

[25 marks]

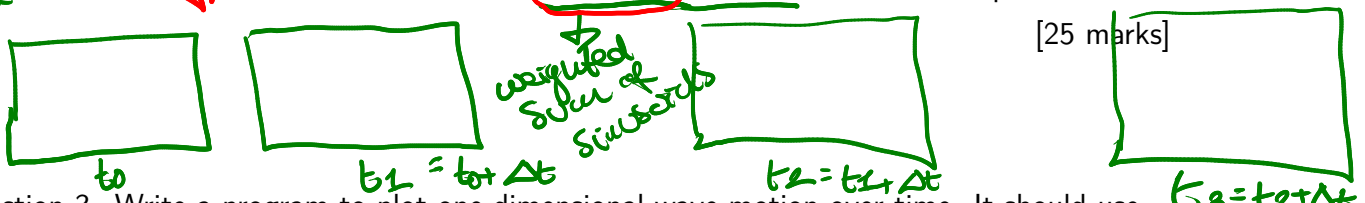


Question 2. Write a program to plot the motion over time of a set discrete particles in a transverse acoustic wave. Use a closed-form solution of the wave equation.

[25 marks]

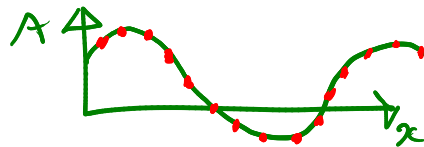
Propagation

~ static plots would be OK!



Question 3. Write a program to plot one-dimensional wave motion over time. It should use an iterative simulation algorithm for a discrete set of points. Choose appropriate initial and boundary conditions.

[25 marks]



Question 4. Write a program to plot a Normal-like distribution arising from the sum of a large number of random phasor sums.

[25 marks]



Question 5. Write a program to plot images that show the difference between the probability density of the sum of two intensities and the probability density of one intensity.

[25 marks]



Question 6. Write a program to plot the diffraction pattern of a square aperture. It should use Fraunhofer approximation and the Fourier transform.

[25 marks]

