FIZ 272E Take-Home Midterm Exam - Spring 2023

Please read the following instructions very carefully before proceeding to the questions.

- There are **two** questions in this assignment.
- You **must** upload your project **as a single PDF** to Ninova **before** the deadline.
- Uploading the **correct** file to Ninova **before** the deadline is **your** responsibility.
- If you fail to upload your project because of a Ninova malfunction, send me an e-mail (birkandant@itu.edu.tr) with your file from your İTÜ account **before the deadline**.

- Do **not** write additional features or functions to the programs, just follow the questions.
- The first line of a program should be a **comment** line including your student number and full name. (e.g. % 090909090 Tolga Birkandan)
- You will use your initials in the codes. If you have three names use all initials. (e.g. for "**T**olga **B**irkandan", "f" will be "fTB", for "**H**üseyin **Ş**evki **T**opuz", "f" will be "fHST"). Use the English alphabet.
- You must use proper references for the first part of the second question. Give your **reference list** at the end of your answer, including the internet resources (Wikipedia or artificial intelligence chatbot outputs **cannot** be used as references). Adding a reference list is a **must**.
- You can use **screenshots** for adding your codes and their outputs. The theory, analysis, comparison, etc. parts **cannot** be in the code or in the outputs.
- If you think that a question is **inaccurate**, you are **free** to make minor improvements. In this case, **describe** your amendments in your report. You are also **free** to nominate extra parameters/numerical values if they are needed. They should also be **addressed** in your report.

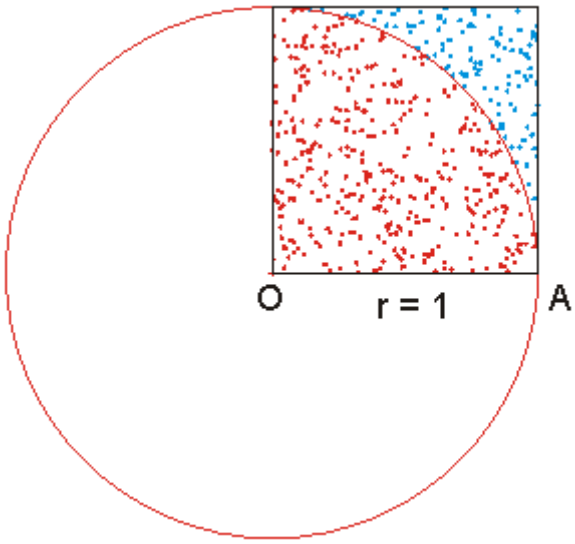
You can use your notes and any online/offline documents as references but you are not allowed to communicate with another human being online / offline / directly / indirectly.

Please **double-check** your report to make sure that you followed **all** the instructions before uploading it to Ninova. If something is **not** forbidden clearly by the above instructions or in the questions, then you are **allowed** to do it.

QUESTIONS

(There are two questions in this assignment.)

1)



We have calculated the number pi (π) approximately using a Monte Carlo scheme with a quarter circle and random numbers. You will do the same exercise with an ellipse (full or quarter, as you like it) instead of a circle.

- **a)** Draw your setting similar to the plot given above (you can draw by hand), and explain your method in your own words.
- **b)** Write your code by explaining **each line** by comment lines and **put your initials at the end of each variable** (as **T**olga **B**irkandan, I would use numberTB, vector1TB, piTB, etc.).
- **c)** Ask an artificial intelligence chatbot (ChatGPT, etc.) to write the code (no need for comment lines and initials). Compare this code with yours. (You can use ChatGPT freely via https://cocalc.com/.)
- **d)** Use your code to calculate pi for $N=10^k$ (k=1, 2, 3, 4, 5, 6) as the total number of sample points. Give your results as a table (k vs. pi values). You can add more k (7, 8, etc.) if your computer allows.
- **e)** Use your code to plot your table (k as the x-axis and pi values as the y-axis).
- **f)** For $N=10^6$ (or the highest N value that you used), measure the calculation time (you can use tic-toc for MATLAB/GNU Octave, etc.) for the circle (the code you wrote in class) and ellipse cases (your code and artificial intelligence code). Compare your results (calculation time and the difference of your approximate pi result from the actual pi value) and comment on the pros&cons of each method if there are any. Programming languages know the actual value of pi ("pi" in MATLAB/GNU Octave, "numpy.pi" in Python, etc.).

2)

a) What is the chi-square (χ^2) test? How is it performed mathematically? (Give your **reference list** at the end of your answer.)

b) Using the code for the cricket chirps-temperature exercise that we did in class (using the datafile "sleeplessnights.txt"), modify your code to perform the chi-square test and explain your result. Write your code by explaining **each line** by comment lines and **put your initials at the end of each variable** as you did in the first question. **Do not use special commands like "chi2gof", "chisquare", etc. Code the chi-square test yourself.**

c) Do the same exercise using an artificial intelligence chatbot for the code. Compare your code and results.