Disclaimer

This project description is a proposal. You are welcome to propose a different project altogether, provided it covers a similar level of complexity and similar learning outcomes. You are also allowed to present a project that you have completed in your work placement, with the same restrictions. Before submitting a different proposal you must obtain approval from the course instructor.

The project below is expected to build from topics you have likely practiced in MATH 1516. You are welcome to use the information created there as a starting point.

Description

In this project you will create a program in Python that generates an image corresponding to a roller coaster, based on a sequence of formulas that describe its shape in a cartesian plane. The program will read, from the terminal (standard input), two file names:

- An input file name corresponding to a CSV file with the formulas to be used for the roller coaster;
- An output file name corresponding to an SVG file to be created, containing the final drawing of the roller coaster.

The CSV file passed as input will include multiple rows, each one corresponding to a segment of the roller coaster. The file will contain at least these three columns. The columns may be in any order, but will require an appropriate header name in the first row. In particular, the following columns are required:

- `formula`: a string representation of the formula to be used for a particular segment, using x as the variable (e.g., `x**2+1`);
- `start_x`: The starting value of x for the segment, either as a number (e.g., `3.5`) or as an expression (e.g., `2*pi`);
- `end_x`: The ending value of x for the segment, either as a number or as an expression.

Additional columns are allowed but ignored. Your program will then read the CSV file and evaluate if the CSV file is valid. In particular, it will check if:

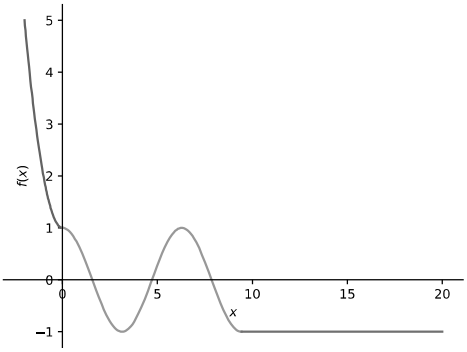
- The formula is a valid Math formula using x as its only variable (or using no variable at all);
- The ending value of x in each row is larger than the start value of x for the row;
- The starting value of x in each row (other than the first one) matches the ending value of x in the previous row;
- For each x between rows, the corresponding formulas (e.g., $f(x)$ and $g(x)$) meet at the same location (i.e., $f(x) = g(x)$) and provide a smooth transition (i.e., $f'(x) = g'(x)$) for the roller coaster.

If any of the restrictions above is not met, an appropriate error message is shown, and the program ends with a failed state (see `sys.exit()` for information on how to cause the program to exit with a failure).

If all the restrictions are met, your program will then generate an image file containing a graph that includes listed formulas with their corresponding bounds. For example, if the CSV has the following content (see sample.csv):

formula	start_x	end_x
x**2+1	-2	0
cos(x)	0	3*pi
-1	pi*3	15

Your program will generate the following image:



You are strongly encouraged to use existing libraries to provide some of the functionality needed in this project. In particular, the following libraries will likely be of value:

- sympy: to convert string representations of formulas into symbolic math objects;
- pandas: to handle structured data manipulation, including handling CSV files.
- matplotlib and numpy may also be useful, though most of their functionality is embedded in the libraries above.

Your program must be broken down into suitable functions with well-defined behaviour (e.g., you may create a function that checks if two functions are tangent to each other). You must also provide appropriate test functions to evaluate the specific functionality of these helper functions. You do not need to provide testing functions for the plot output, though.

Drop files here or click to upload.
Only the files listed below will be accepted—others will be ignored.
The combined size limit of all uploaded files is 5MB.

Files

○ roller_coaster.py
not uploaded

○ roller_coaster_test.py
not uploaded

Save

Project

Assessment overview

Total points:	0/100
Score:	0%

Question

Submission status: unanswered

History:

Total points: — /100

Manually-graded question

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Staff information

Staff user:

Dev User dev@illinois.edu

Question:

QID: Project/RollerCoaster
Title: Project: Roller Coaster Graph
Started at: 2024-02-13 14:40:07 (EST)
Duration: 0

Show/Hide answer

Assessment Instance:

AID: Project
Started at: 2024-02-13 14:40:05 (EST)
Duration: 00:00:00
View log

Manual Grading:

Status: Graded
Grade

This box is not visible to students.