CMSC 150

Project Specifications

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Overview

This document contains the project specifications for the course CMSC150, 1st Semester AY 2019-2020. The main goal of the project is to create a software application that allows users to use different numerical and symbolic computation methods. The project specifications are described in the following sections. Other important information regarding the project are included in separate sections.

Problem Statement

The project has two main parts or features: generic solvers for two computation methods and a domain-specifc application of the simplex method. Each of these parts are described below.

Part 1: Generic Solvers

Create a program that allows users to compute using **Quadratic Spline Interpolation (QST)** and **Polynomial Regression**.

Quadratic Spline Interpolation

Given a CSV[1] file containing a list of two-dimensional data points i.e. a list of pairs of x, y values, find and display the equations of the splines for each interval. Allow also the user to input a value x and display the value of the estimate for x using the splines found.

Polynomial Regression

Given a CSV file containing a list of two-dimensional data points i.e. a list of pairs of x, y values, find and display the equation of the polynomial. Allow also the user to input a value x and display the value of the estimate for x using the polynomial found.

Note that both solvers must be able to produce outputs for any *valid* number of data points.

[1] comma-separated values

Part 2: Application for the Simplex Method

Create a program that solves the following optimization problem using simplex.

Background of the Study

One of the main products of the Fairway Woods Company is custom-made golf club. The clubs are manufactured at three plants (Denver, Colorado (P-1); Phoenix, Arizona (P-2); and Dallas, Texas (P-3)) and are then shipped by truck to five distribution warehouses in Sacramento, California (W-1); Salt Lake City, Utah (W-2); Albuquerque, New Mexico (W-3); Chicago, Illinois (W-4); and New York City, New York (W-5). Because shipping costs are a major expense, the management is investigating a way to reduce them. For the upcoming golf season, an estimate has been created as to the total output needed from each manufacturing plant and how each warehouse will require satisfying its customers. The CIO from Fairway Woods Company has created a spreadsheet of the shipping costs from each manufacturing plant to each warehouse as a baseline analysis.

The two tables below shows the two main contents of the CIO's spreadsheet. Table 1 contains the number of products to be shipped to each warehouse, from every plant. Table 2, on the other hand, contains shipping cost from a plant to a warehouse. It also includes the total number of products needed by each warehouse.

Table 1: Quantity of Products to Ship from each Plant

		Warehouse				
Plant	**Total Shipments from M-X**	W-1	W-2	W-3	W-4	W-5
P-1						
P-2						
P-3						
	Total Shipments to D-X					

Table 2: Fairway Woods Company Shipment Details

		Warehouse				
		W-1	W-2	W-3	W-4	W-5
	Total Demand of each Warehouse					
Plant	**Available Supply from Plant**	**Shipping Cost from Plant to Warehouse in USD**				
P-1						
P-2						
P-3						
Shipping Cost	*(total shipping cost here)*	*(total shipping cost to each warehouse)*				

Optimization Problem

The optimization problem involves determining the function and/or equations corresponding to:

- Goal: Minimize the total shipping cost
- Restrictions/Requirements
  - the number of shipped products from a plant must be less than or equal to the supply of that plant
  - the number of shipped products to a warehouse must be greater than or equal to the demand of that warehouse
  - the number of shipped products must be greater than or equal to zero

Summary

Given the number of products supplied by each plant; the number of product demand of each warehouse; and the costs of shipping from each plant to the warehouses (see Table 2), find the number of products to be shipped from each plant to each warehouse (see Table 1), minimizing the total shipping cost (see Table 2, last row) by solving the optimization problem described above.

Project Requirements/Constraints

- Create a single application that contains all the functionalities described in Problem Statement
- Provide a graphical user interface (GUI) that would facilitate uploading of file inputs for the generic solvers (see [Part 1])
- Provide a GUI that would facilitate insertion of inputs and/or modification of constraints and objective function for the optimization problem (see [Part 2])
- Provide a GUI that would display outputs. For the case of the simplex method, include an option to display or hide the tableau and basic solution (initial and per iteration)
- Use of any programming language (or combination) is allowed.
- Use of any built-in (or external e.g. use of library/package) functions/methods/implementations for methods discussed in CMSC150 (e.g. simplex method, Gaussian elimination, regression, etc.) is **STRICTLY NOT ALLOWED**. These must be implemented from scratch.
- Prepare a printed *User's Manual* containing information about your system, including the following:
  - how to use the application
  - about the application and the creator
  - other helpful details for the users

Grading Scheme

The project will earn you **15 points**. These points are divided as follows:

- 1 point - User's manual
- 5 points - generic solvers
  - 3 points - QSI
  - 2 points - PR
- 9 points - simplex application
  - 2 points - set up of initial tableau
  - 3 points - per iteration tableau
  - 4 points - correct final answer

Submission and Presentation

Submit a zip file named `Surname_CS150_Project.zip` to our Google Classroom a day before the presentation date. The zip file must contain the following:

- a folder named `src` which contains all the source code needed to run the project
- a file named `MANUAL.pdf`, the soft copy of your manual
- a file of any type named `RUNME.*`, which can be used to execute your program. This can be an `.exe`cutable file for compiled programs, a `.jar` file for a Java application, or a `.sh`ell file for script-based languages.
- a text file named `README`, which contains your full name, student number, section, and any other important notes you want to include.
- a text file named `INSTALL` which contains a list of requirements or dependencies needed by your application and steps to install these requirements

Questions?

Approach your instructor.