

CS 116 PROJECT

Spring 2014

Grade: Up to 8 points.

Rules:

- To be worked on individually.
- Must be presented to the instructor in person in order to be graded.
- Similar projects will both receive a grade of zero regardless as to who did the actual work. Therefore giving your files to someone else will cost you the grade also.

Due Date: 4/28 and 4/30 depending on your presentation date:

- Presentation in person in class or in my office on either Monday 4/29 or Wednesday 5/1 as per schedule to be published. When the schedule is posted, you will need to choose a time slot and notify me via an email. Time slots are awarded on first come first served basis. Your presentation will last on the average about 10-15 minutes. If 4/30 date is filled you will have to choose the earlier date of 4/28.

You can get partial credit based on your design and your code even if your classes are not compiled or the project is not producing the correct result (in this case your presentation could last slightly longer). You should be able to explain your work. **No project presentations the week of the final exams.**

- Upload all files on Blackboard two hours minimum before your presentation session starts. You can not make any changes after the submission.
- You must work this project by yourself. No groups are allowed. Ask for help early enough. You can work with me the TAs and/or ARC.
- There will be lectures devoted to the project over the next few weeks.

HOW TO PRESENT THE PROJECT:

- When ready, I will sit next to you. You should have the files ready so that the program can be run. I will ask you to run the program using my own data file. Your program should respond according to the data file's input data and provide the correct output. I will bounce

the results against the expected results. You will not know which tests my data file has until your presentation time.

- Be ready to show me your design next. Explain the structure of your files. Present to me the document that has the design explanations (see project description).
- Provide me with a HARD (paper) copy of your source code files at the time I sit next to you to go over your project. It should have your name at the top of each class!!
- If your program does not work you will receive partial grade based on your design document that you discussed with me and your source code hard copies. If you don't have either one then it will be difficult to expect a partial credit.

WHAT TO PRESENT AND SUBMIT

- A word file that has a diagram that shows your classes and their relationships, similar to the diagram in lab 5.
- The source code files.
- The compiled files (unless your program does not compile).
- A bat file to start the DOS window (if you don't remember what a bat file is ask a TA or myself)
- For the presentation only: hard copies of the code (not for submission).

PROJECT DESCRIPTION.

This project is based on a Physics concept. It is the concept of Electric Field calculated at a point in a two dimensional space, based on point charges in that space. You will be given the concept explanation below plus examples (hand outs in class plus discussion).

Your job is to design a program that calculates the Electric Field at points in a two dimensional space based on the position of point charges in that space. The input data to your program will be provided via a text file.

The text file needs to be produced by you. You are given examples of the format below. You will need to generate multiple files like than to test your program.

Your program reads the text file, does the required calculations provides the display on the DOS window, and also writes certain data in a binary coded file of objects (writes serializable objects). Your program also should be able to read that file when the user requests so.

PHYSICS THEORY

From basic Electrodynamics the concept of the Electric Field at some point in space due to a charge is defined as follows:

A Point charge is a charge that is located somewhere in space and it has no dimensions (thus called point). It carries an electric charge that can be positive or negative. The point charge generates a field of force that can affect other charges. The field is called the Electric Field. The Electric Field's strength varies in space depending how far away from the charge you want to calculate it. It is also a vector quantity meaning that besides a value (magnitude) it also has direction at that point.

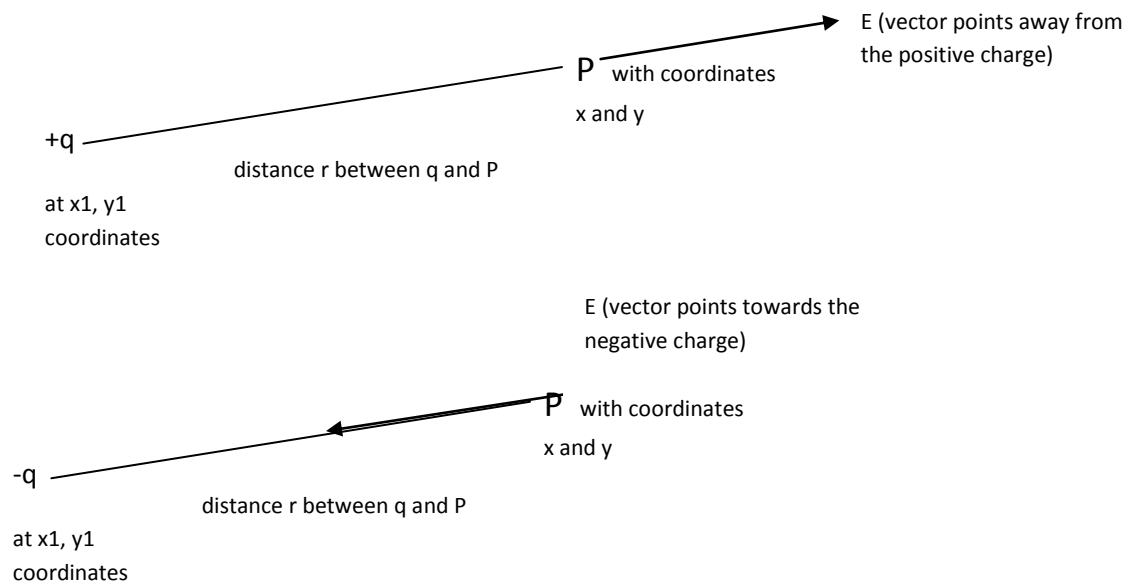
The value of the Electric field due to a point charge with charge of **q** Coulombs (Coulomb is the unit of measurement for electrical charges) at a point P in space which is a distance **r** meters away from the point charge is given by the formula:

$$E = k * q / r^2$$

Where k is a constant whose value is given as $k=8.99*10^9$

(the unit is: Newtons*meters squared/ coulombs squared). Thus the unit of measurement for E is N/C (Newtons/ Coulombs). I am listing the units but we will not be using them in our program. Only the numbers. The above formula calculates the magnitude of the electric field vector only.

If we have more than one point charge in space, each charge contributes its own Electric Field at a point P in space. The vector sum of all contributions from all charges is the total Electric Field at that point. A positive charge contributes an Electric Field vector at point P in space (r distance away from the charge) in a direction away from the charge. A negative charge will cause an Electric Field vector at point P pointing in the direction of the charge.



If we had a collection in space of point charges, the total field at point P can be the resultant vector of all vector E at P .

GOAL OF PROJECT

Design and implement a program that calculates the electric field.

Input:

A text file that has information about point charges, their location on the x-y plane. It also provides information about point in space where the electric field caused by the charges should be calculated.

Output

- A DOS display that matches the sample output provided further down in this document.
- A binary coded data file of objects (.ser extension file) that represent electric fields calculated at various points.
- A message to ask user if the binary coded file should be read. The display of the data written in the file on the DOS window.

PROGRAMMING PROCEDURE

Consider the examples distributed in class (if you are absent on March 31st it is your responsibility to ask for the examples. The first example outlines the manual procedure for calculating the electric field.

You can use it to develop the required algorithms.

Your program should work for any distribution of point charges and points to where the electric field should be calculated.

REQUIREMENTS

The design is up to you. No specific guidelines will be provided as to what classes to use or what attributes to create. It should be up to you how to design. Keep in mind that because it is up to you any similarities between submissions will be scrutinized.

You must, however, adhere to the following guidelines in your design.

1. You must have at least an abstract super class.
2. You must have a class that extends serializable in order to produce serializable objects to be written in a binary coded file. Your choice of which class based on your design.
3. You must have at least one interface in your designs with a minimum of 3 abstract methods.
4. You must have at least two sub classes in your design.

5. You must have at least one exception class of your choosing. The throwing of the exception must make a logical sense with respect to the problem.
6. You must have a class that represents points in x y plane.
7. You must have a class that represents electric fields.
8. You must have a class with the main method of course.
9. Your program must read the text file with the input data using the proper streams and not by using the scanner.
10. Serializable Objects must be saved (written) in the binary coded file. One line of data written is one object.
11. When the file is read back the objects are type casted back to their original data type and their encapsulated content is displayed.

SAMPLE DATA

INPUT TEXT FILE :

Q:2,-1,-0.00000003

Q:2,-3,+0.00000003

P:P1,0,-2

Explanation of written data in text file :

Notice that Q identifies a point charge. The colon separates the identification character from the data. The data is separated by coma. First number is the x coordinate value, second number is the y coordinate value and the third number is the amount of charge.

The identification character P identifies points in space where the electric field produced by the charge should be calculated. After the colon the identification P1 gives the name of the point. The next number is the x coordinate and the number after that is the y coordinate of the point in space.

Data on DOS display pertaining to above input file:

```
C:\CS116\SPRING2014\Project\ProjectSolution>java CalculationsOfFields
```

The magnitude of electric field at point: P1 due to charge point #: 1 is: -53.94

The charge is: -3.0E-8

cosine of the angle= -0.8944271909999159

The value of the x component of the Electric field at point: P1 due to point charge #: 1 is : 48.25

sine of the angle= 0.4472135954999579

The value of the y component of the Electric field at point: P1 due to charge point #: 1 is: 24.12

The magnitude of electric field at point: P1 due to point charge #: 2 is : 53.94

The charge is: 3.0E-8

cosine of the angle= -0.8944271909999159

The value of the x component of the Electric field at point: P1 due to charge point #: 2 is : -48.25

sine of the angle= 0.4472135954999579

The value of the y component of the Electric field at point: P1 due to charge point #: 2 is: 24.12

The magnitude of the resultant field is: 48.24 for point: P1

Do you want to have the .ser binary coded file read?

No

Program is terminating

SAMPLE DATA

INPUT TEXT FILE :

Q:2,-1,-0.00000003

Q:2,-3,+0.00000003

P:P1,0,-2

P:P2,2,-2

P:P3,-2,-2

Data on DOS display pertaining to above input file:

C:\CS116\SPRING2014\Project\ProjectSolution>java CalculationsOfFields

The magnitude of electric field at point: P1 due to charge point #: 1 is -53.94

The charge is: -3.0E-8

cosine of the angle= -0.8944271909999159

The value of the x component of the Electric field at point: P1 due to charge point #: 1 is 48.25

sine of the angle= 0.4472135954999579

The value of the y component of the Electric field at point: P1 due to charge point #: 1 is 24.12

The magnitude of electric field at point: P1 due to charge point #: 2 is 53.94

The charge is: 3.0E-8

cosine of the angle= -0.8944271909999159

The value of the x component of the Electric field at point: P1 due to charge point #: 2 is -48.25

sine of the angle= 0.4472135954999579

The value of the y component of the Electric field at point: P1 due to charge point #: 2 is 24.12
The magnitude of the resultant field is: 48.24 for point: P1

The magnitude of electric field at point: P2 due to charge point #: 1 is -269.7
The charge is: $-3.0\text{E-}8$
cosine of the angle= 0.0
The value of the x component of the Electric field at point: P2 due to charge point #: 1 is -0.0
sine of the angle= 1.0
The value of the y component of the Electric field at point: P2 due to charge point #: 1 is 269.7
The magnitude of electric field at point: P2 due to charge point #: 2 is 269.7
The charge is: $3.0\text{E-}8$
cosine of the angle= 0.0
The value of the x component of the Electric field at point: P2 due to charge point #: 2 is 0.0
sine of the angle= 1.0
The value of the y component of the Electric field at point: P2 due to charge point #: 2 is 269.7
The magnitude of the resultant field is: 539.4 for point: P2

The magnitude of electric field at point: P3 due to charge point #: 1 is -15.86
The charge is: $-3.0\text{E-}8$
cosine of the angle= -0.9701425001453319
The value of the x component of the Electric field at point: P3 due to charge point #: 1 is 15.39
sine of the angle= 0.24253562503633297
The value of the y component of the Electric field at point: P3 due to charge point #: 1 is 3.85
The magnitude of electric field at point: P3 due to charge point #: 2 is 15.86
The charge is: $3.0\text{E-}8$
cosine of the angle= -0.9701425001453319
The value of the x component of the Electric field at point: P3 due to charge point #: 2 is -15.39
sine of the angle= 0.24253562503633297
The value of the y component of the Electric field at point: P3 due to charge point #: 2 is 3.85
The magnitude of the resultant field is: 7.7 for point: P3

Do you want to have the .ser binary coded file read?

Yes

The data read from the binary coded file is:

Note: There will be a separate file posted with additional sample outputs.

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