

Deliverables

Your project files should be submitted to Web-CAT by the due date and time specified. In order to avoid a late penalty for the project, you must submit your completed code files to Web-CAT by 11:59 p.m. on the due date. If you are unable to submit via Web-CAT, you should e-mail your project Java files in a zip file to your TA before the deadline.

Files to submit to Web-CAT:

- FormulaSolver.java
- TicketCode.java

Specifications

Overview: You will write two programs this week. The first will solve for the result of a specified expression, and the second will read data for a ticket and then interpret and print the formatted ticket information.

- **FormulaSolver.java**

Requirements: Solve for the result of the expression in the formula below for a value x of type double which is read in from the keyboard, and save the result in a variable of the type double. You must use the `pow()`, `sqrt()`, and `abs()` methods of the `Math` class to perform the calculation. You may use a single assignment statement with a single expression, or you may break the expression into appropriate multiple assignment statements. The latter may easier to debug if you are not getting the correct result.

$$result = (6x^3 - 4)\sqrt{|7x^3 + 5x^2 + 3x + 1|}$$

Next, determine the number of characters (mostly digits) to the left and to the right of the decimal point in the unformatted result. [Hint: You should consider converting the type *double* result into a `String` using the static method `Double.toString(result)` and storing it into a `String` variable. Then, on this `String` variable invoke the `indexOf(".")` method from the `String` class to find the position of the period (i.e., decimal point) and the `length()` method to find the length of the `String`. Knowing the location of the decimal point and the length, you should be able to determine the number of digits on each side of the decimal point.]

Finally, the result should be printed using the class `java.text.DecimalFormat` so that to the right of the decimal there are at most six digits and to the left of the decimal each group of three digits is separated by a comma in the traditional way. Also, there should also be at least one digit on each side of the decimal (e.g., 0 should be printed as 0.0). Hint: Use the pattern `"#,##0.0#####"` when you create your `DecimalFormat` object. However, make sure you know what this pattern means and how to modify and use it in the future.

Design: Several examples of input/output for the FormulaSolver program are shown below.

Line #	Program output
1	----jGRASP exec: java FormulaSolver
2	Enter a value for x: 0
3	Result: -4.0
4	# of characters to left of decimal point: 2
5	# of characters to right of decimal point: 1
6	Formatted Result: -4.0
	----jGRASP: operation complete.

Line #	Program output
1	----jGRASP exec: java FormulaSolver
2	Enter a value for x: 1
3	Result: 8.0
4	# of characters to left of decimal point: 1
5	# of characters to right of decimal point: 1
6	Formatted Result: 8.0
	----jGRASP: operation complete.

Line #	Program output
1	----jGRASP exec: java FormulaSolver
2	Enter a value for x: -2.5
3	Result: -899.220308969109
4	# of characters to left of decimal point: 4
5	# of characters to right of decimal point: 12
6	Formatted Result: -899.220309
	----jGRASP: operation complete.

Line #	Program output
1	----jGRASP exec: java FormulaSolver
2	Enter a value for x: 12.345
3	Result: 1333713.2681123617
4	# of characters to left of decimal point: 7
5	# of characters to right of decimal point: 10
6	Formatted Result: 1,333,713.268112
	----jGRASP: operation complete.

Line #	Program output
1	----jGRASP exec: java FormulaSolver
2	Enter a value for x: 67890
3	Result: 8.78675857902488E22
4	# of characters to left of decimal point: 1
5	# of characters to right of decimal point: 17
6	Formatted Result: 87,867,585,790,248,800,000,000.0
	----jGRASP: operation complete.

When the characters to the right of the decimal in the unformatted result end with E followed by one or more digits (e.g., E11 indicates an exponent of 11), the 'E' should be included in the count of the characters to the right of the decimal point.

Code: In order to receive full credit for this assignment, you must use the appropriate Java API classes and method to do the calculation and formatting. It is recommended as a practice that you do not modify the input value once it is stored.

Test: You will be responsible for testing your program, and it is important to not rely only on the examples above. Assume that the amount entered can be any positive or negative floating-point number.

- **TicketCode**

Requirements: The purpose of this program is to accept coded ticket information as input that includes the price, discount, time, date, section, row, seat, followed by the description. Note that the five digits for price and two digits for discount have an implied decimal point. The program should then print the ticket information including the price, discount, and actual cost, which is the price with discount applied. The last line of the printed information should contain a random "prize number" between 1 and 999 inclusive that should always be printed as three digits (e.g., 1 should be printed as 001). The coded input is formatted as follows:

2100020193001042021030911The Phantom of the Opera

price [21000 has an implied decimal point before the last two digits for 210.00]
 discount [20 has an implied decimal point for 0.20 (or 20%)]
 time
 date
 section
 row
 seat
 description
 (goes through last character on line)

Whitespace before or after the coded information should be disregarded (e.g., if the user enters spaces or tabs before or after the coded information, these should be disregarded). Your program will need to print the description, date, time, section, row, seat number, price, discount, and cost, and a random prize number in the range 1 to 999 as shown in the examples below. If the user enters a code that does not have at least 26 characters, then an error message should be printed. [The 26th character of the code is part of the description.]

Design: Several examples of input/output for the program are shown below.

Line #	Program output
1	Enter ticket code: 2100020193001042021030911
2	
3	Invalid ticket code.
4	Ticket code must have at least 26 characters.
5	

The ticket code entered below (in red font) produces the indicated output except for the prize number which is random. When more than one item is shown on the same line of output (e.g., description, date, and time on line 3), there are three spaces between them (do not use the tab escape sequence \t).

Line #	Program output
1	Enter ticket code: 2100020193001042021030911The Phantom of the Opera
2	
3	Description: The Phantom of the Opera Date: 01/04/2021 Time: 19:30
4	Section: 03 Row: 09 Seat: 11
5	Price: \$210.00 Discount: 20% Cost: \$168.00
6	Prize Number: 836
7	

The ticket code entered below includes a price of \$145 with a 50% discount at time 1400.

Line #	Program output
1	Enter ticket code: 1450050140001042021030911The Phantom of the Opera
2	
3	Description: The Phantom of the Opera Date: 01/04/2021 Time: 14:00
4	Section: 03 Row: 09 Seat: 11
5	Price: \$145.00 Discount: 50% Cost: \$72.50
6	Prize Number: 341
7	

The ticket code below has five leading spaces (be sure you are trimming the input code). It also includes an 80% discount since it is for section 12, row 29, seat 17.

Line #	Program output
1	Enter ticket code: 1450080140001042021122917The Phantom of the Opera
2	
3	Description: The Phantom of the Opera Date: 01/04/2021 Time: 14:00
4	Section: 12 Row: 29 Seat: 17
5	Price: \$145.00 Discount: 80% Cost: \$29.00
6	Prize Number: 397
7	

Code: In order to receive full credit for this assignment, you must use the appropriate Java API classes and methods to trim the input string, to extract the substrings, conversion of substrings of digits to numeric values as appropriate, and formatting. These include the String methods trim, and substring, as well as wrapper class methods such Double.parseDouble which can be used to convert a String of digits into a numeric value for price and discount. The dollar amounts should be formatted so that both small and large amounts are displayed properly, and the prize number should be formatted so that three digits are displayed including leading zeroes, if needed, as shown in the examples above. It is recommended as a practice that you not modify input values once they are stored.

Test: You are responsible for testing your program, and it is important to not rely only on the examples above. Remember, when entering standard input in the Run I/O window, you can use

the up-arrow on the keyboard to get the previous values you have entered. This will avoid having to retype the ticket code each time you run your program.

Grading

Web-CAT Submission: You must submit both “completed” programs to Web-CAT at the same time. Prior to submitting, be sure that your programs are working correctly and that they have passed Checkstyle. **If you do not submit both programs at once, Web-CAT will not be able to compile and run its test files with your programs which means the submission will receive zero points for correctness.** I recommend that you create a jGRASP project and add the two files. Then you will be able to submit the project to Web-CAT from jGRASP. Activity 1 (pages 5 and 6) describes how to create a jGRASP project containing both of your files.

Hints - TicketCode.java

1. The ticket code should be read in all at once using the Scanner’s nextLine method and stored in a variable of type String. Then the individual values should be extracted using the substring method. The String value for price and discount should be converted to type double (using Double.parseDouble) so that it can be used to calculate cost. When printing the values for price, discount, cost, and prize number, they should be formatted properly by creating an appropriate DecimalFormat object (see patterns below) and calling its format method.

To format price and cost, use the pattern "\$#,##0.00" when you create your DecimalFormat object.

To format discount, use the pattern "0%" when you create your DecimalFormat object.

For prize number, use the pattern "000" when you create your DecimalFormat object.
2. Since all items in the ticket code other than the price and discount will not be used in arithmetic expressions, they can and should be left as type String.
3. The time and date should have leading zeros as appropriate. Therefore, these can be printed as String values by concatenating their components with ":" and "/" as needed.

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