CS 115 - Introduction to Programming in Python
Tutorial 08

Lab Objectives: Searching and Sorting.

a) Download the file `Element.py` which contains the definition for the `Element` type. The class should be in its own file. Do not make any changes to this class.

b) Create a class **ChemicalOrder** in the file **ChemicalOrder.py**, which represents an order for a set of elements. Each **ChemicalOrder** has a private attribute `e_list`, which stores a list of `Elements` to be ordered. A **ChemicalOrder** object should have the following methods.

   Methods:

   - **__init()__ :**
     - takes a string file name as a parameter.
     - Initializes an empty list to store **Elements**.
     - Calls the **load_elements()** method (see below) to load the Elements in the file into the `e_list`.
   - **load_elements()**:takes a filename as a parameter, and loads all elements from the file into the `ChemicalOrder`'s list of `Elements`, `e_list`. **Note:** you should use the algorithm already defined in Lab 07.
   - **get_element_count():** returns the length of the element list (`e_list`)
   - **sort_elements():** sorts the element list by the default `Element` sort field.
   - **selection_sort_by_field():** takes the name of a field/property as a parameter, and sorts the element list by the given field. Method should use the **selection sort algorithm**.
   - **search_element():** takes the name of an element as a parameter, and returns the element with the given name. Method should use the **binary search** algorithm.
   - **get_element_by_quantity():**takes a maximum quantity and the number of elements in the list as parameters. Method returns a list of elements whose quantity is below the value given. You **MUST** use a **recursive algorithm**, and no loop.
   - **repr()__ :** returns a string representation of a `ChemicalOrder` object. See Sample Run for details.

     HINT: for the searching and sorting algorithms, you may copy the algorithms from the class examples and update to reflect the data being sorted.

c) Write an application, **tutorial08.py** that does the following:
   - Create a `ChemicalOrder` using the data from the file `data.txt`.
   - Sort the `ChemicalOrder` by the Atomic Number and display the sorted `ChemicalOrder`.
   - Input an element name from the user and display the `Element` in the `ChemicalOrder` with the given name. Hint: what do you need to do BEFORE you invoke the search method?
   - Input a quantity from the user and display all elements whose quantity is less than the input value. Sort the output list of elements by the Atomic Name.

Sample Run:

```
Elements Sorted by Atomic Number:
| Element Name:       :   Hydrogen
| Chemical symbol     :   H
| Atomic Number       :   1.00
| Atomic mass         :   100794.00
| Density at 20       :   0.08
| Melting point       :   -259.10
| Boiling point       :   -252.90
| Quantity            :   93.00

...
| Element Name:       :   Plutonium
| Chemical symbol     :   Pu
| Atomic Number       :   94.00
| Atomic mass         :   2440642.00
| Density at 20       :   19.74
| Melting point       :   641.00
| Boiling point       :   3327.00
| Quantity            :   23.00


Enter name of element to search: Gold

| Element Name:       :   Gold
| Chemical symbol     :   Au
| Atomic Number       :   79.00
| Atomic mass         :   19696654.00
| Density at 20       :   19.32
| Melting point       :   1064.40
| Boiling point       :   2940.00
| Quantity            :   107.00


Enter a quantity: 25
Elements with quantity below 25.0
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| Element Name:       :   Bismuth
| Chemical symbol     :   Bi
| Atomic Number       :   83.00
| Atomic mass         :   20898037.00
| Density at 20       :   9.80
| Melting point       :   271.40
| Boiling point       :   1560.00
| Quantity            :   22.00

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| Element Name:       :   Chlorine
| Chemical symbol     :   Cl
| Atomic Number       :   17.00
```

```
| Atomic mass            :    354527.00
| Density at 20          :    2.95
| Melting point          :    -34.60
| Boiling point          :    -101.00
| Quantity               :    23.00
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| Element Name:          :    Magnesium
| Chemical symbol        :    Mg
| Atomic Number          :    12.00
| Atomic mass            :    24305.00
| Density at 20          :    1.74
| Melting point          :    648.80
| Boiling point          :    1107.00
| Quantity               :    24.00
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| Element Name:          :    Plutonium
| Chemical symbol        :    Pu
| Atomic Number          :    94.00
| Atomic mass            :    2440642.00
| Density at 20          :    19.74
| Melting point          :    641.00
| Boiling point          :    3327.00
| Quantity               :    23.00
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| Element Name:          :    Selenium
| Chemical symbol        :    Se
| Atomic Number          :    34.00
| Atomic mass            :    79.00
| Density at 20          :    4.82
| Melting point          :    217.00
| Boiling point          :    685.00
| Quantity               :    21.00
]
```