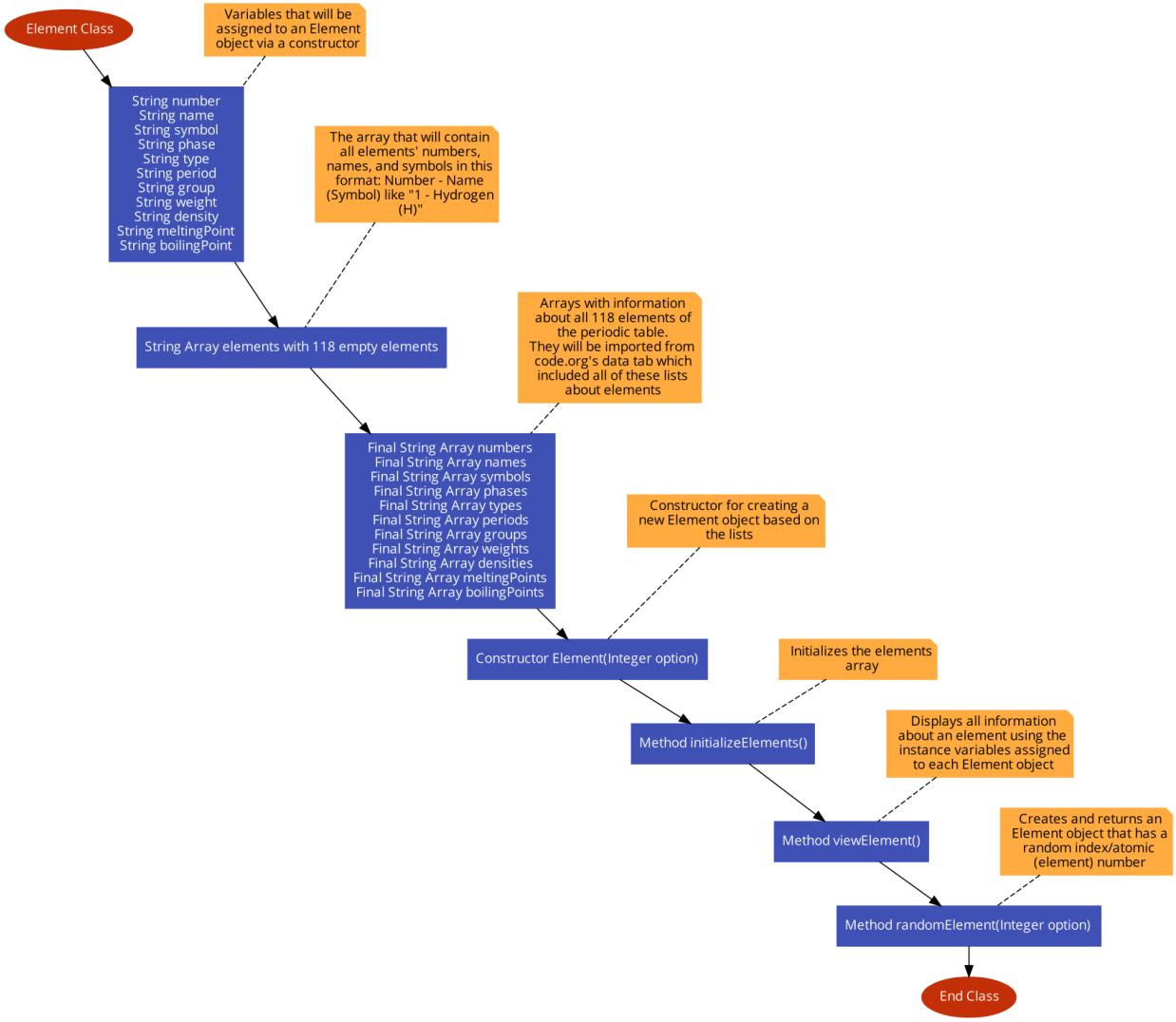
Criterion B: Design

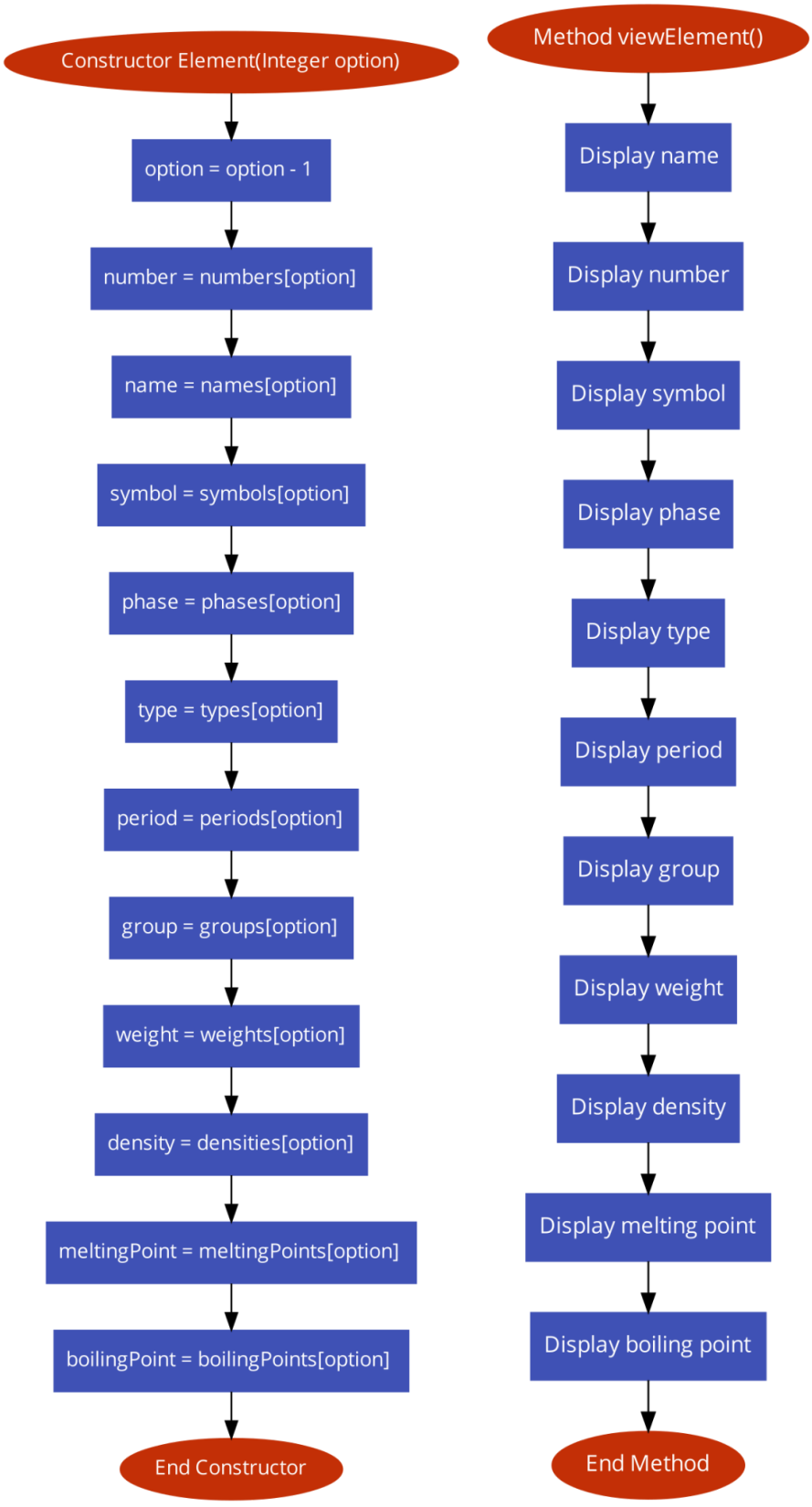
Overview

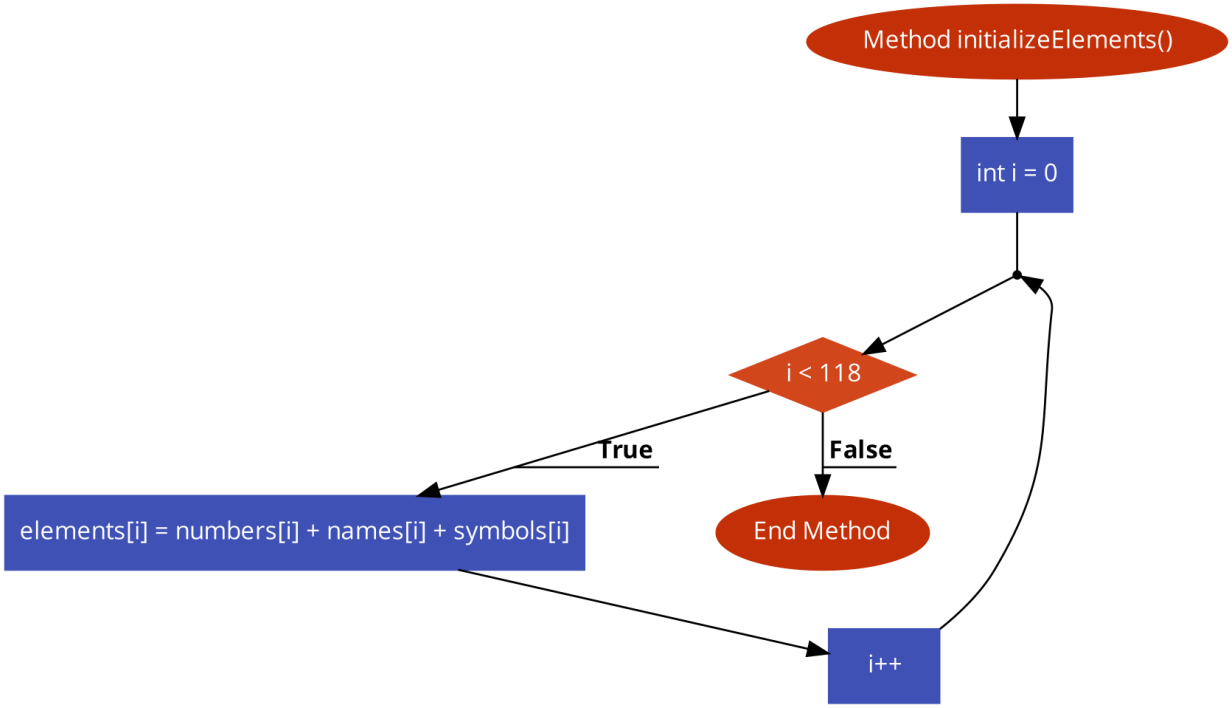
My program does not have an interface and depends on the user interacting with the console. My program will use Java, which is object-oriented, and will have 5 classes. Only one of these classes will revolve around an object which is the Element class that creates an element object with an element's attributes as its instance variables. The other 4 classes will be static classes (all methods and variables are static), with there being a main class that contains methods and variables that all the other classes will use. There other 3 static classes are View, Search, and Test (each one being the option that a student can choose from the home screen) and it has all the methods to do what the student desires.

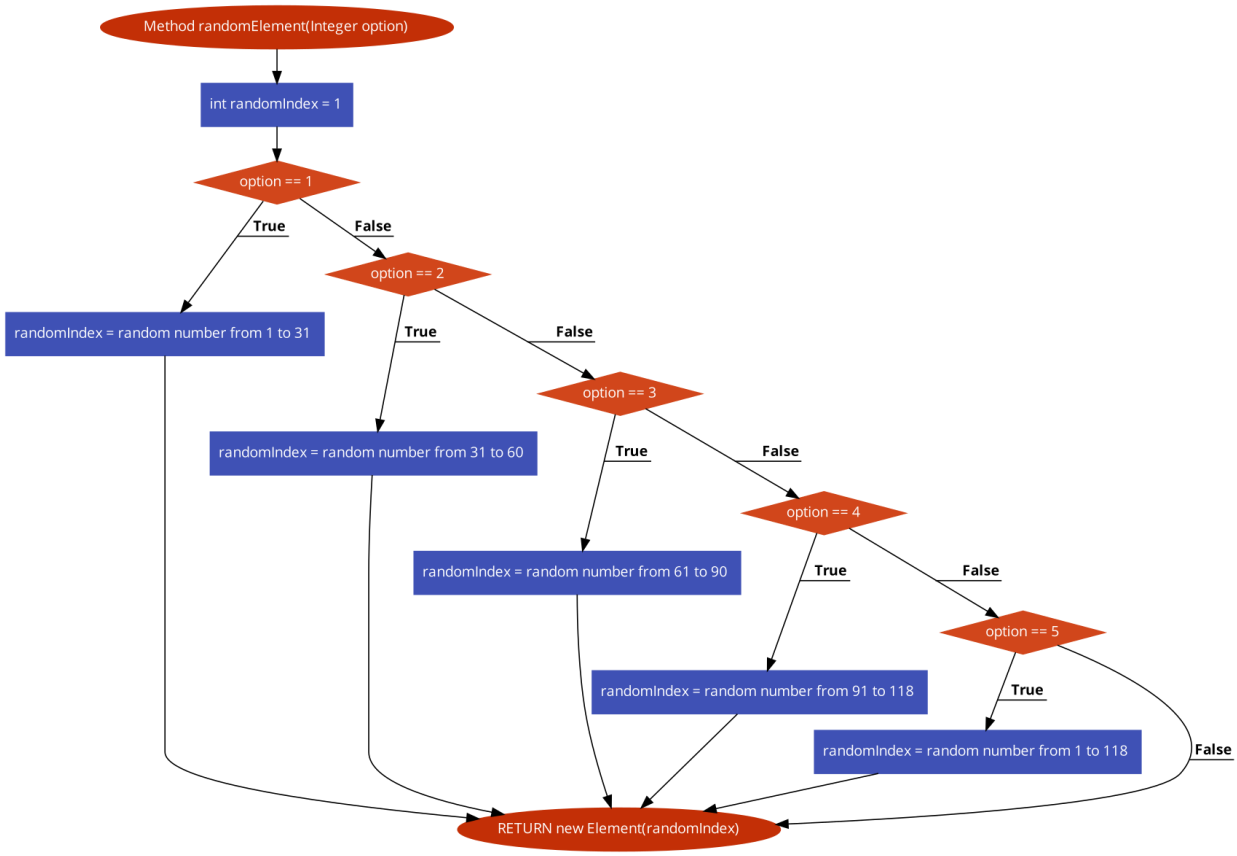
Element Class

Class Flowchart



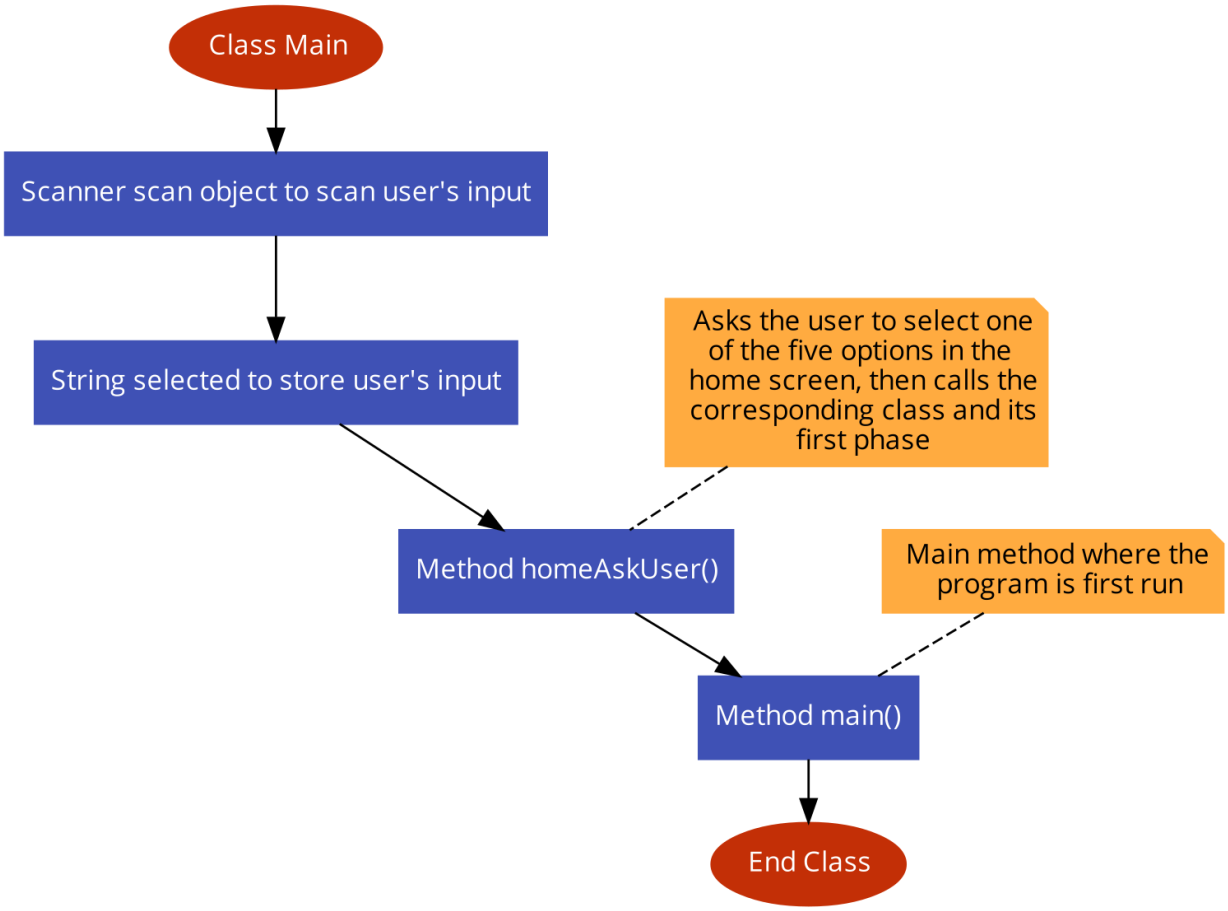

Constructor Element(Integer option)
option = option - 1
number = numbers[option]
name = names[option]
symbol = symbols[option]
phase = phases[option]
type = types[option]
period = periods[option]
group = groups[option]
weight = weights[option]
density = densities[option]
meltingPoint = meltingPoints[option]
boilingPoint = boilingPoints[option]
End Constructor
Method viewElement()
Display name
Display number
Display symbol
Display phase
Display type
Display period
Display group
Display weight
Display density
Display melting point
Display boiling point
End Method

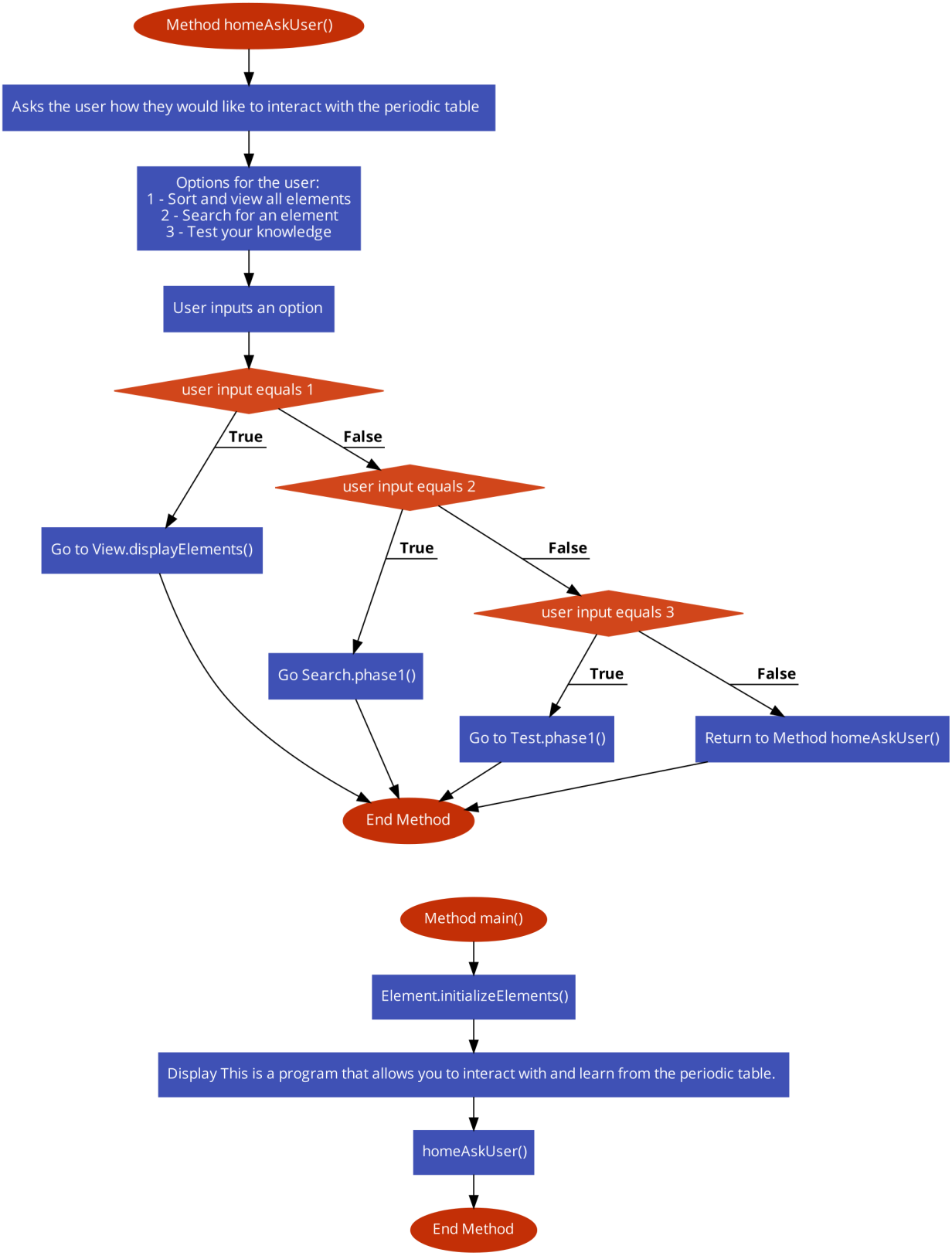

Method initializeElements()
int i = 0
i < 118
True
False
elements[i] = numbers[i] + names[i] + symbols[i]
End Method
i++


Method randomElement(Integer option)
int randomIndex = 1
option == 1
True
False
option == 2
randomIndex = random number from 1 to 31
True
False
option == 3
randomIndex = random number from 31 to 60
True
False
option == 4
randomIndex = random number from 61 to 90
True
False
option == 5
randomIndex = random number from 91 to 118
True
randomIndex = random number from 1 to 118
False
RETURN new Element(randomIndex)

Main Class

Class Flowchart




Method homeAskUser()
Asks the user how they would like to interact with the periodic table
Options for the user:
1 - Sort and view all elements
2 - Search for an element
3 - Test your knowledge
User inputs an option
user input equals 1
True
False
Go to View.displayElements()
user input equals 2
True
False
Go Search.phase1()
user input equals 3
True
False
Go to Test.phase1()
Return to Method homeAskUser()
End Method
Method main()
Element.initializeElements()
Display This is a program that allows you to interact with and learn from the periodic table.
homeAskUser()
End Method

Original Interface

Type the number of the option you want:
1 - View all elements
2 - Search for an element
3 - Test your knowledge

Problems

The prompting of the console was not very explicit, so it was very likely that a student would use this and get confused.

New Interface

This is a program that allows you to interact with and learn from the periodic table.

How would you like to interact with the elements of the periodic table?
---
1 - Sort and view all elements
2 - Search for an element
3 - Test your knowledge

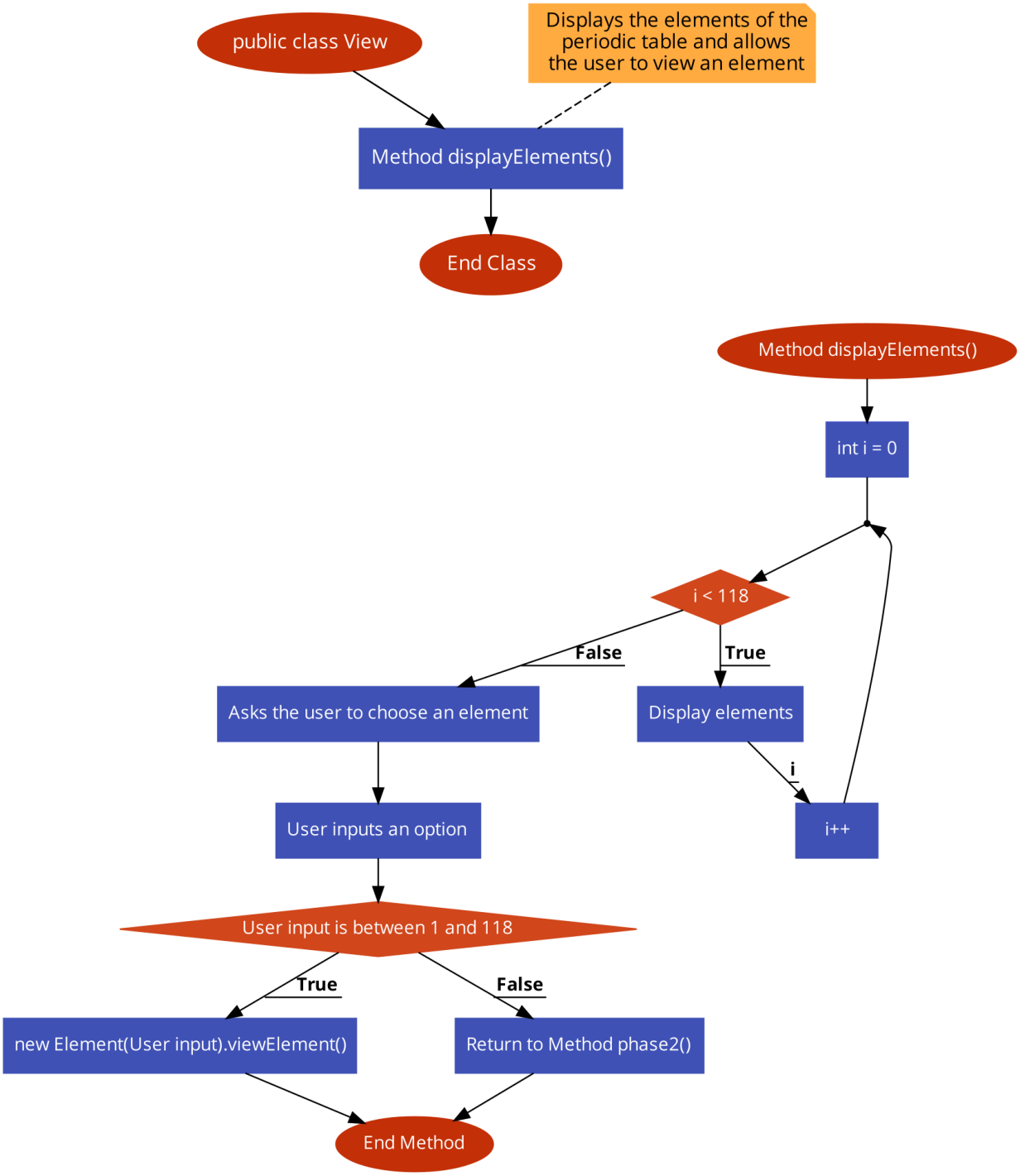
Type and enter the number of the option you want:

Inputs and outputs

- If the user inputs 1, then the user will go to screen 1, which uses the view class.
- If the user inputs 2, then the user will go to screen 2, which uses the search class.
- If the user inputs 3, then the user will go to screen 3, which uses the test class.
- If anything else is inputted, then the screen will be repeated.

Screen 1 (View Class)

Class Flowchart



Interface

---

1 - Hydrogen (H)
2 - Helium (He)
3 - Lithium (Li)
4 - Beryllium (Be)
5 - Boron (B)
6 - Carbon (C)
7 - Nitrogen (N)
8 - Oxygen (O)
9 - Fluorine (F)
10 - Neon (Ne)
11 - Sodium (Na)
12 - Magnesium (Mg)
13 - Aluminum (Al)
14 - Silicon (Si)
15 - Phosphorus (P)
16 - Sulfur (S)
17 - Chlorine (Cl)
18 - Argon (Ar)
19 - Potassium (K)
20 - Calcium (Ca)
21 - Scandium (Sc)
22 - Titanium (Ti)
23 - Vanadium (V)
24 - Chromium (Cr)
25 - Manganese (Mn)
26 - Iron (Fe)
27 - Cobalt (Co)
28 - Nickel (Ni)
29 - Copper (Cu)
30 - Zinc (Zn)
31 - Gallium (Ga)
32 - Germanium (Ge)
33 - Arsenic (As)
34 - Selenium (Se)
35 - Bromine (Br)
36 - Krypton (Kr)
37 - Rubidium (Rb)
38 - Strontium (Sr)
39 - Yttrium (Y)
40 - Zirconium (Zr)
41 - Niobium (Nb)
42 - Molybdenum (Mo)
43 - Technetium (Tc)
44 - Ruthenium (Ru)
45 - Rhodium (Rh)
46 - Palladium (Pd)
47 - Silver (Ag)
48 - Cadmium (Cd)

49 - Indium (In)
50 - Tin (Sn)
51 - Antimony (Sb)
52 - Tellurium (Te)
53 - Iodine (I)
54 - Xenon (Xe)
55 - Cesium (Cs)
56 - Barium (Ba)
57 - Lanthanum (La)
58 - Cerium (Ce)
59 - Praseodymium (Pr)
60 - Neodymium (Nd)
61 - Promethium (Pm)
62 - Samarium (Sm)
63 - Europium (Eu)
64 - Gadolinium (Gd)
65 - Terbium (Tb)
66 - Dysprosium (Dy)
67 - Holmium (Ho)
68 - Erbium (Er)
69 - Thulium (Tm)
70 - Ytterbium (Yb)
71 - Lutetium (Lu)
72 - Hafnium (Hf)
73 - Tantalum (Ta)
74 - Tungsten (W)
75 - Rhenium (Re)
76 - Osmium (Os)
77 - Iridium (Ir)
78 - Platinum (Pt)
79 - Gold (Au)
80 - Mercury (Hg)
81 - Thallium (Tl)
82 - Lead (Pb)
83 - Bismuth (Bi)
84 - Polonium (Po)
85 - Astatine (At)
86 - Radon (Rn)
87 - Francium (Fr)
88 - Radium (Ra)
89 - Actinium (Ac)
90 - Thorium (Th)
91 - Protactinium (Pa)
92 - Uranium (U)
93 - Neptunium (Np)
94 - Plutonium (Pu)
95 - Americium (Am)
96 - Curium (Cm)
97 - Berkelium (Bk)
98 - Californium (Cf)
99 - Einsteinium (Es)

100 - Fermium (Fm)
101 - Mendelevium (Md)
102 - Nobelium (No)
103 - Lawrencium (Lr)
104 - Rutherfordium (Rf)
105 - Dubnium (Db)
106 - Seaborgium (Sg)
107 - Bogrium (Bh)
108 - Hassium (Hs)
109 - Meitnerium (Mt)
110 - Darmstadtium (Ds)
111 - Roentgenium (Rg)
112 - Copernicium (Cn)
113 - Nihonium (Nh)
114 - Flerovium (Fl)
115 - Moscovium (Mc)
116 - Livermorium (Lv)
117 - Tennessine (Ts)
118 - Oganesson (Og)

Type and enter the element number you want to view:

Inputs and Outputs

- If the user inputs a number between 1 and 118, like for example, 1, then this will be displayed (depending on the user's input):

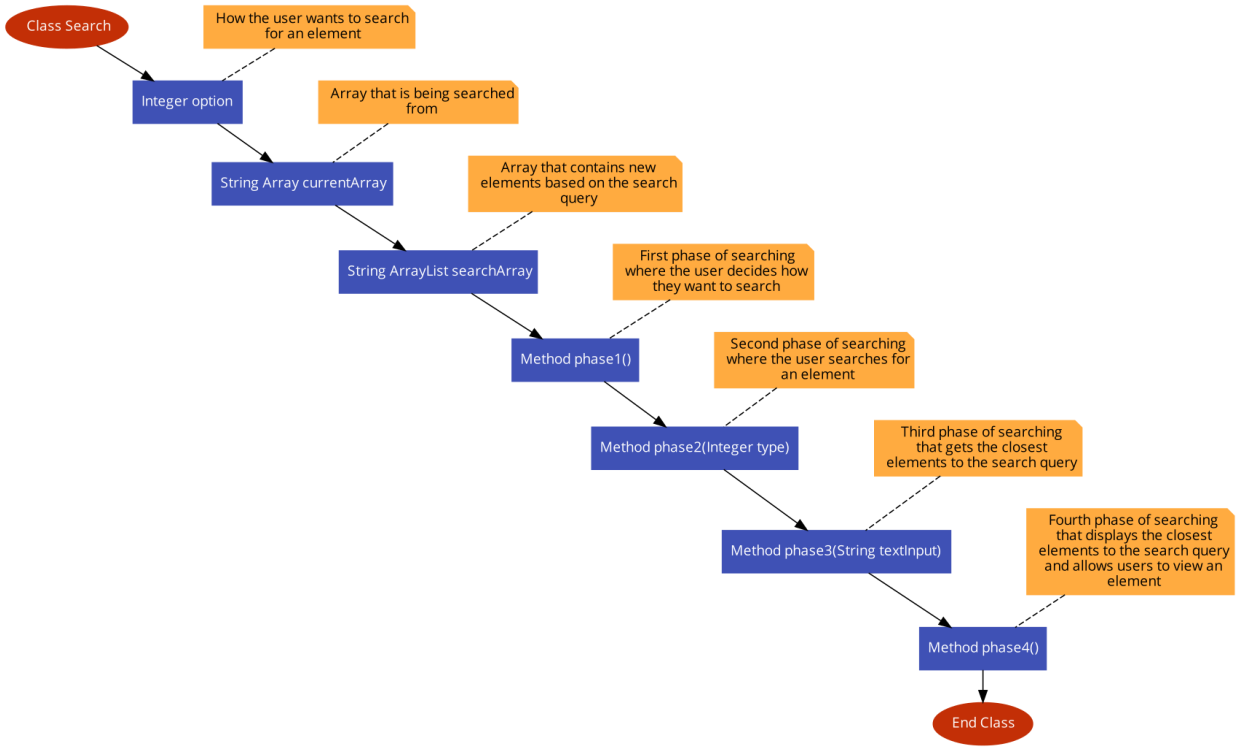
---
1 - Hydrogen (H):
Element Name: Hydrogen
Atomic Number: 1
Element Symbol: H
Phase type: Gas
Element type: Non-Metal
Element Period: 1
Element Group: No definitive group
Weight: 1.00794 amu
Density: 0.00008988 g/L
Melting Point: -434.81°F
Boiling Point: -423.17°F

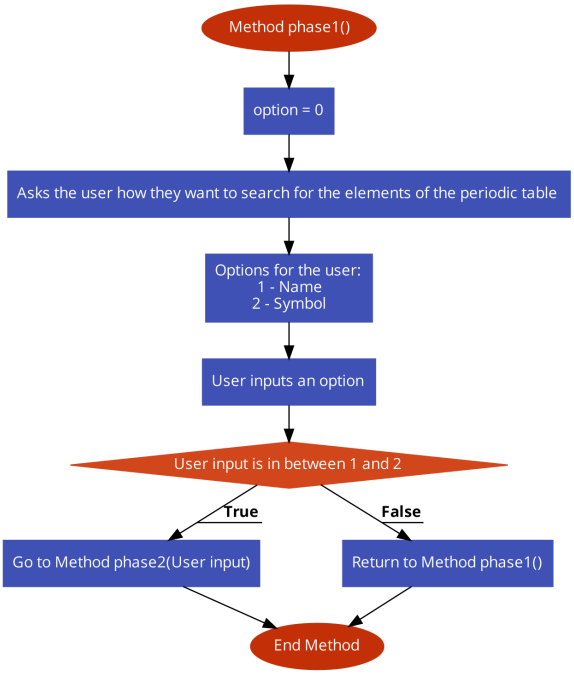
Type and enter anything when you want to go home:

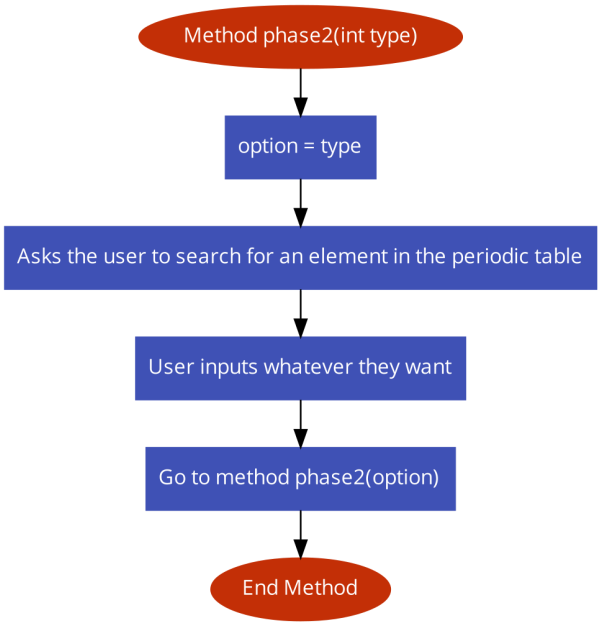
- If anything else is inputted, then the previous screen will be repeated.

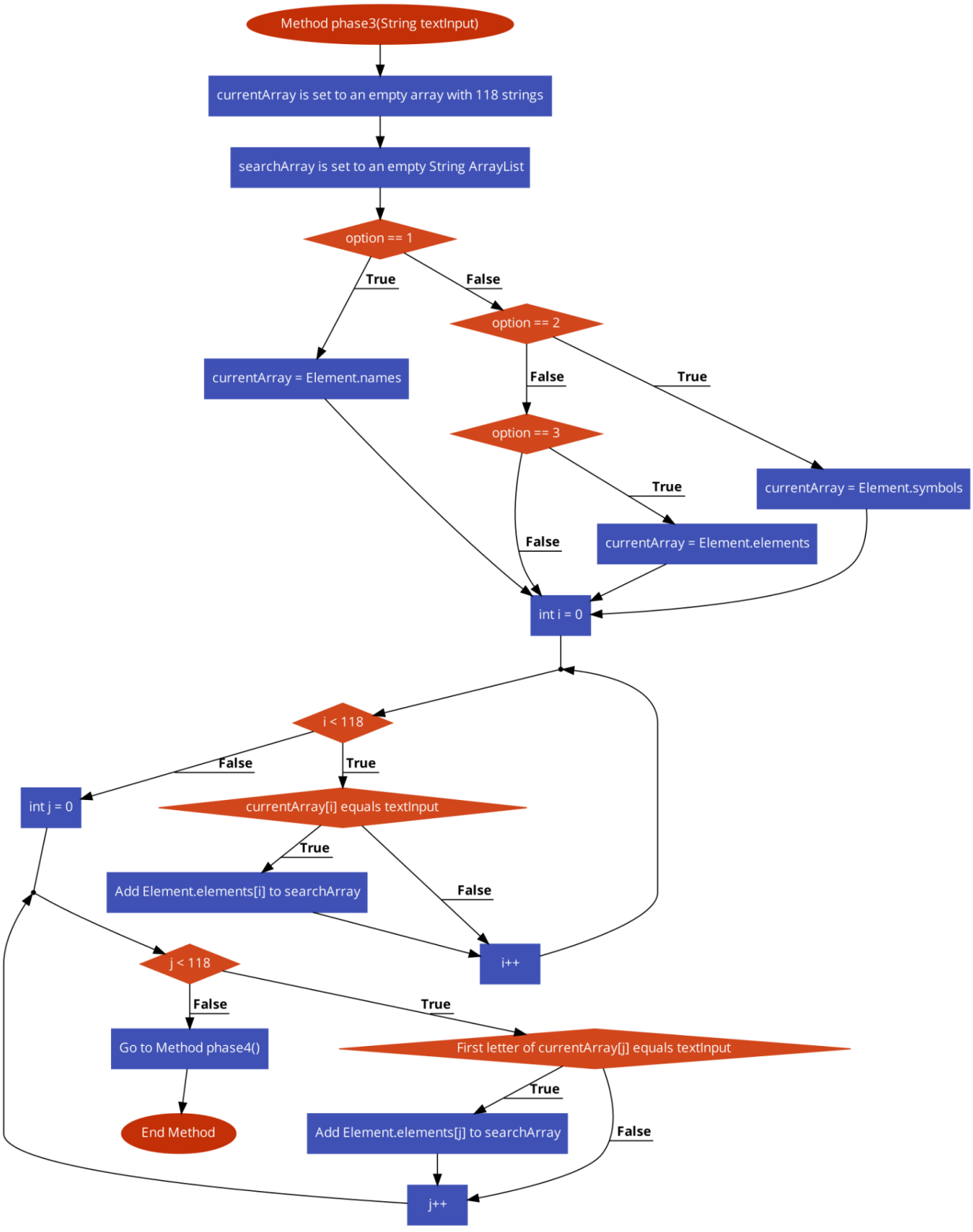
Screen 2 (Search Class)

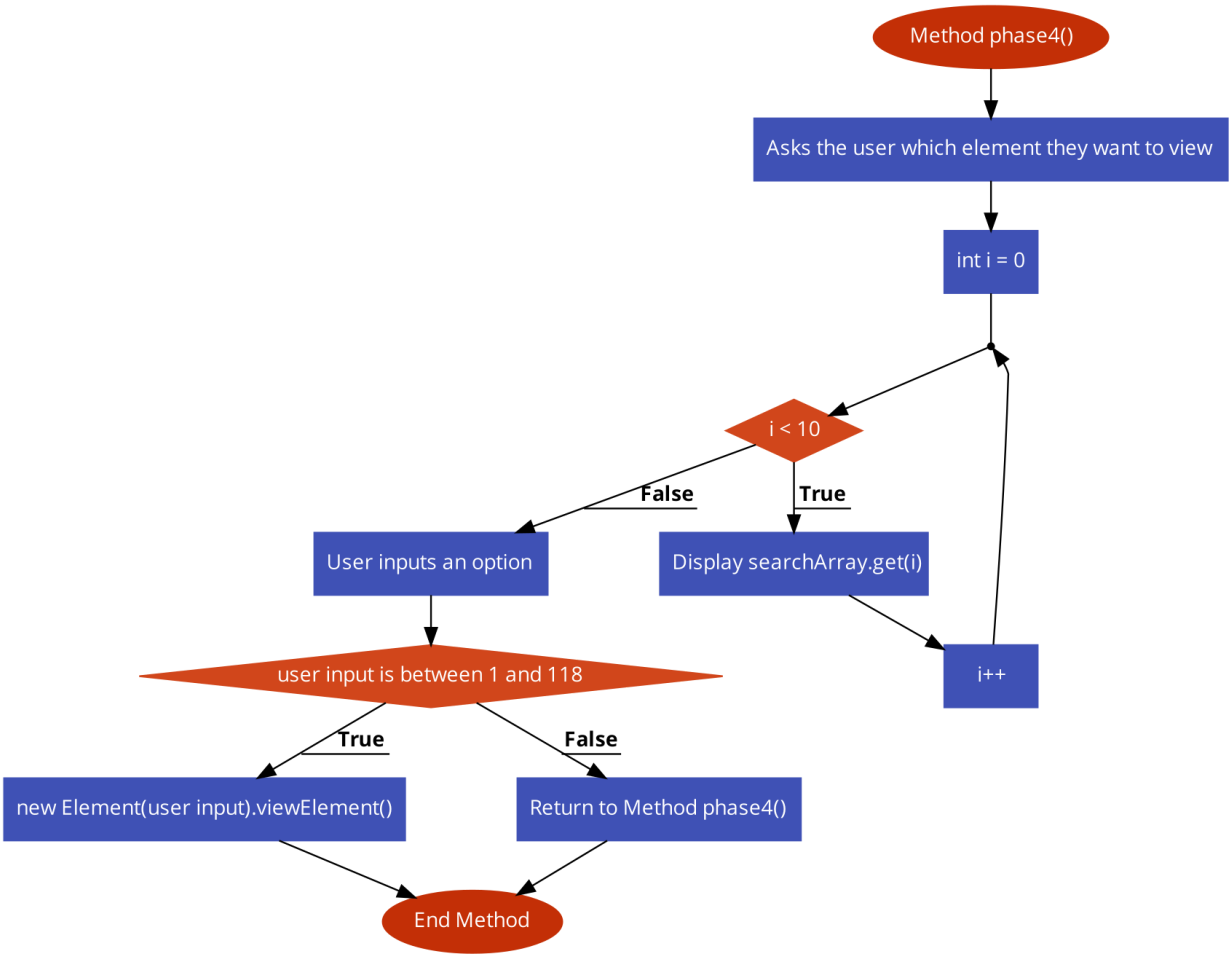
Class Flowchart








Method phase3(String textInput)
currentArray is set to an empty array with 118 strings
searchArray is set to an empty String ArrayList
option == 1
True
False
option == 2
currentArray = Element.names
False
True
option == 3
currentArray = Element.symbols
True
False
currentArray = Element.elements
int i = 0
i < 118
False
True
int j = 0
currentArray[i] equals textInput
True
Add Element.elements[i] to searchArray
False
i++
j < 118
False
True
Go to Method phase4()
First letter of currentArray[j] equals textInput
End Method
True
Add Element.elements[j] to searchArray
False
j++



Original Interface

Type whatever you want to search:

Problems

The original search function would search for just names, however, I thought that maybe students would only want to search for either names or symbols.

New Interface

How would you like to search for the elements of the periodic table?
---
1 - Name
2 - Symbol

Type and enter the option you want or type and enter -1 to go back:

Inputs and Outputs

- If the user inputs 1 or 2, then this will be displayed:

Type and enter whatever you want to search for:

    - Anything that the user inputs will be searched for, and at most 11 elements will be displayed. If the user, for example, inputs Hydro, this will be displayed:

---
1 - Hydrogen (H)
2 - Helium (He)
67 - Holmium (Ho)
72 - Hafnium (Hf)
108 - Hassium (Hs)
3 - Lithium (Li)
4 - Beryllium (Be)
5 - Boron (B)
6 - Carbon (C)
7 - Nitrogen (N)
8 - Oxygen (O)

        - If the user inputs a number between 1 and 118, like for example, 1, then this will be displayed (depending on the user's input):

---
1 - Hydrogen (H):
Element Name: Hydrogen
Atomic Number: 1
Element Symbol: H
Phase type: Gas
Element type: Non-Metal
Element Period: 1
Element Group: No definitive group
Weight: 1.00794 amu
Density: 0.00008988 g/L
Melting Point: -434.81°F
Boiling Point: -423.17°F

Type and enter anything when you want to go home:

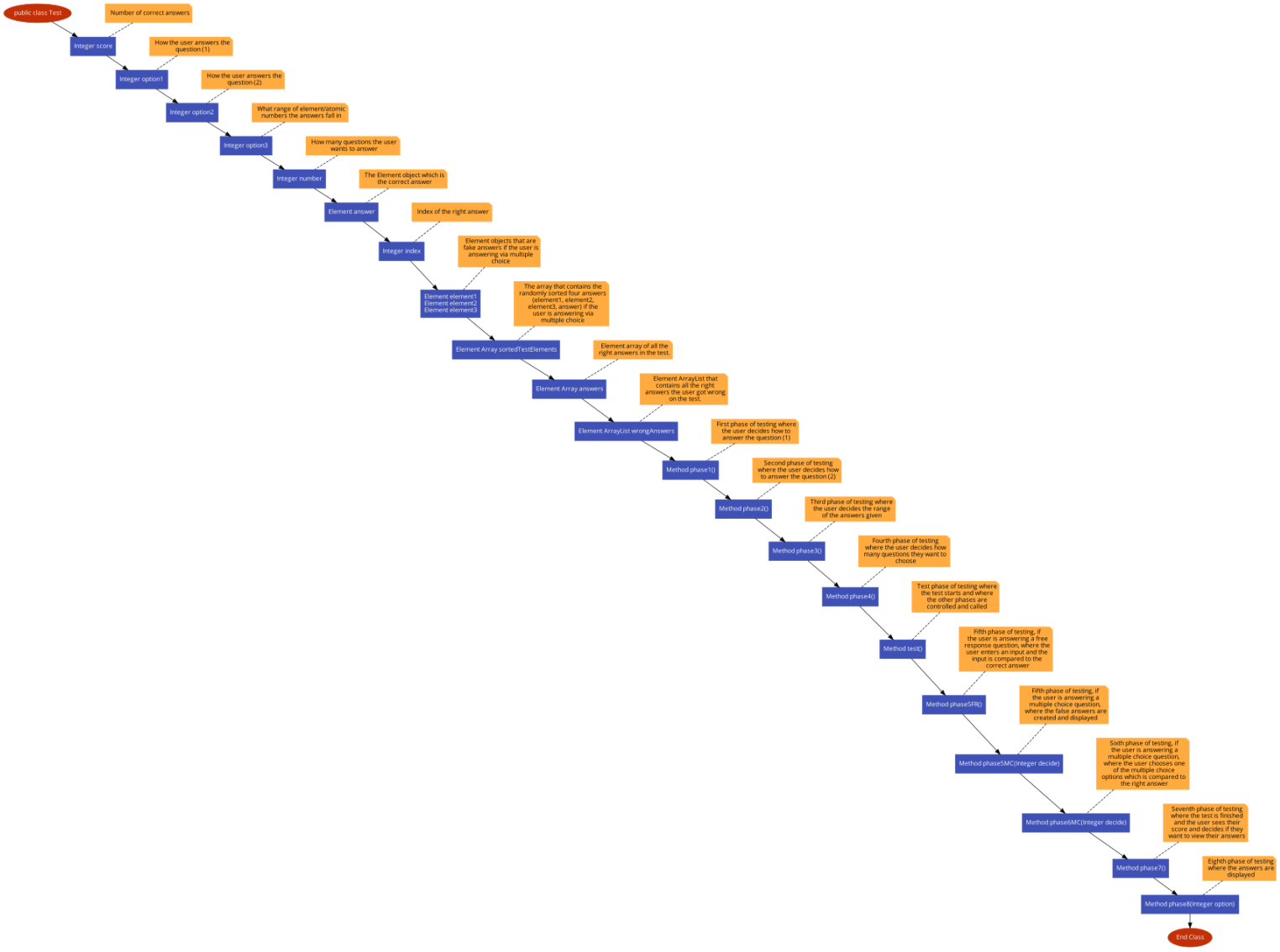
            - If the user inputs anything, then the user will go back to the first screen.

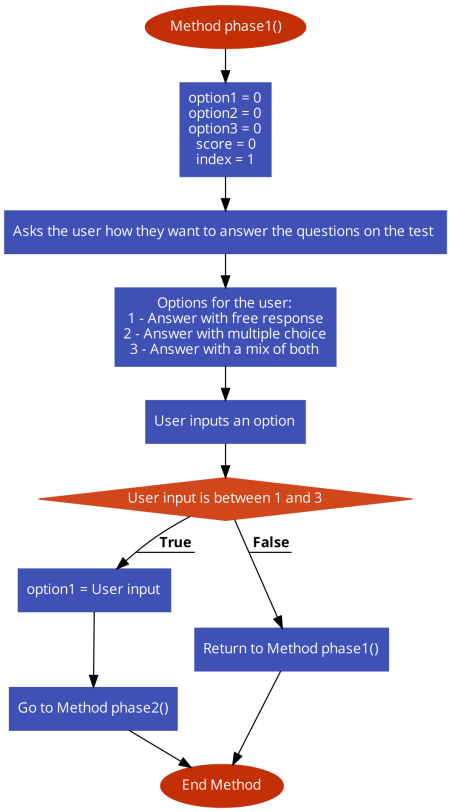
        - If anything else is inputted, then the previous screen will be repeated.

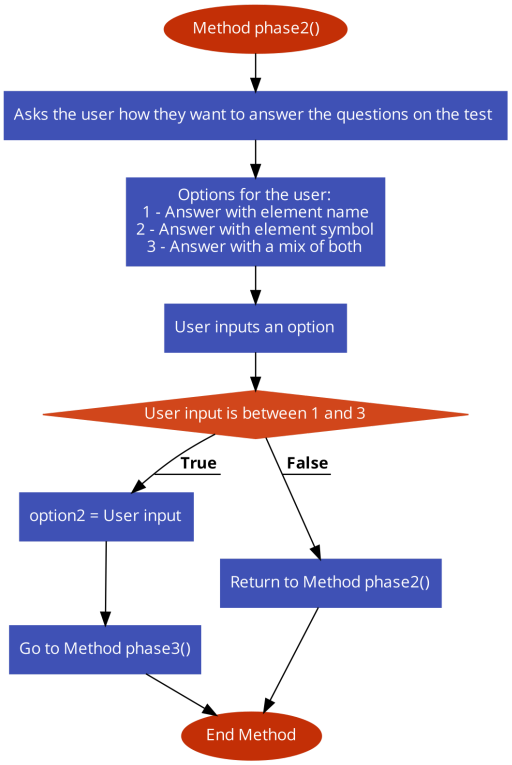
- If anything else is inputted, then the previous screen will be repeated.

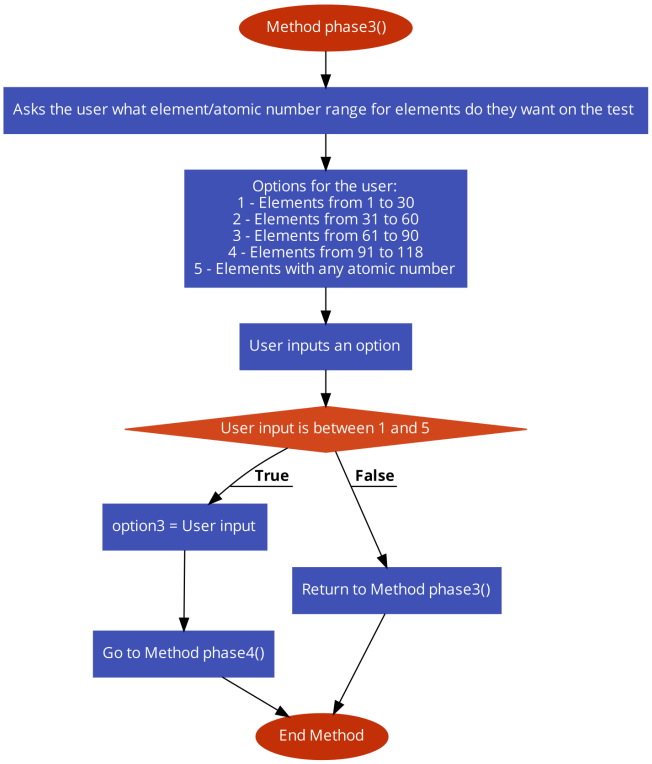
Screen 3 (Test Class)

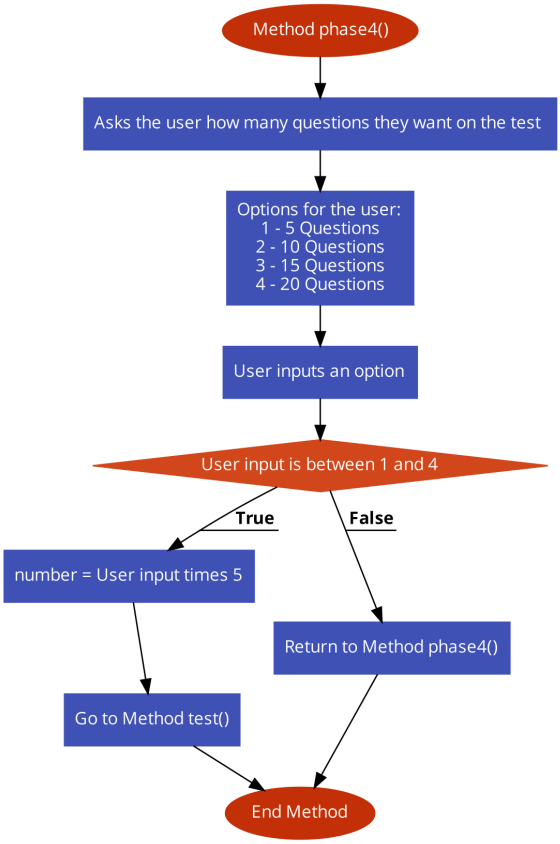
Class Flowchart

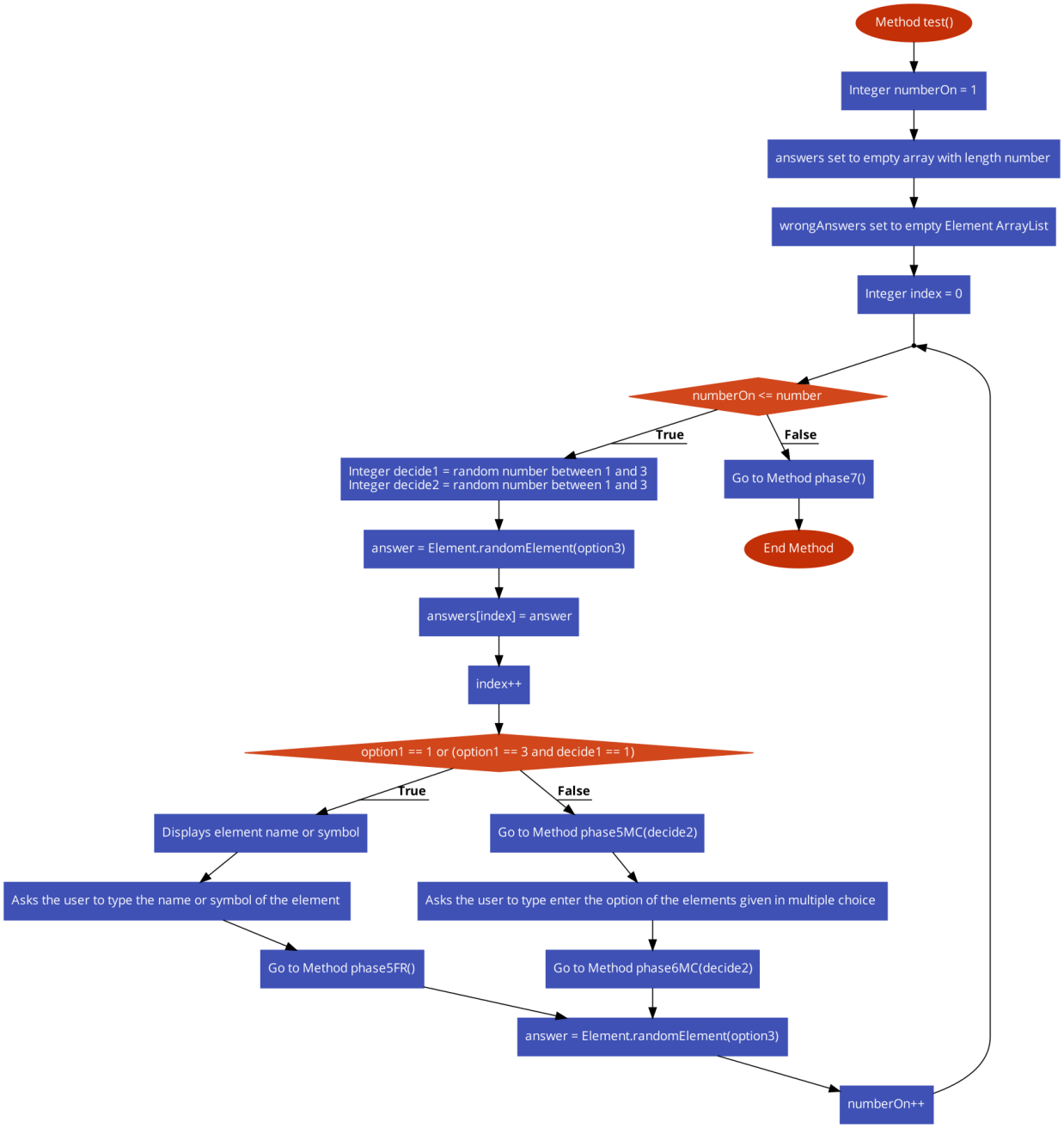


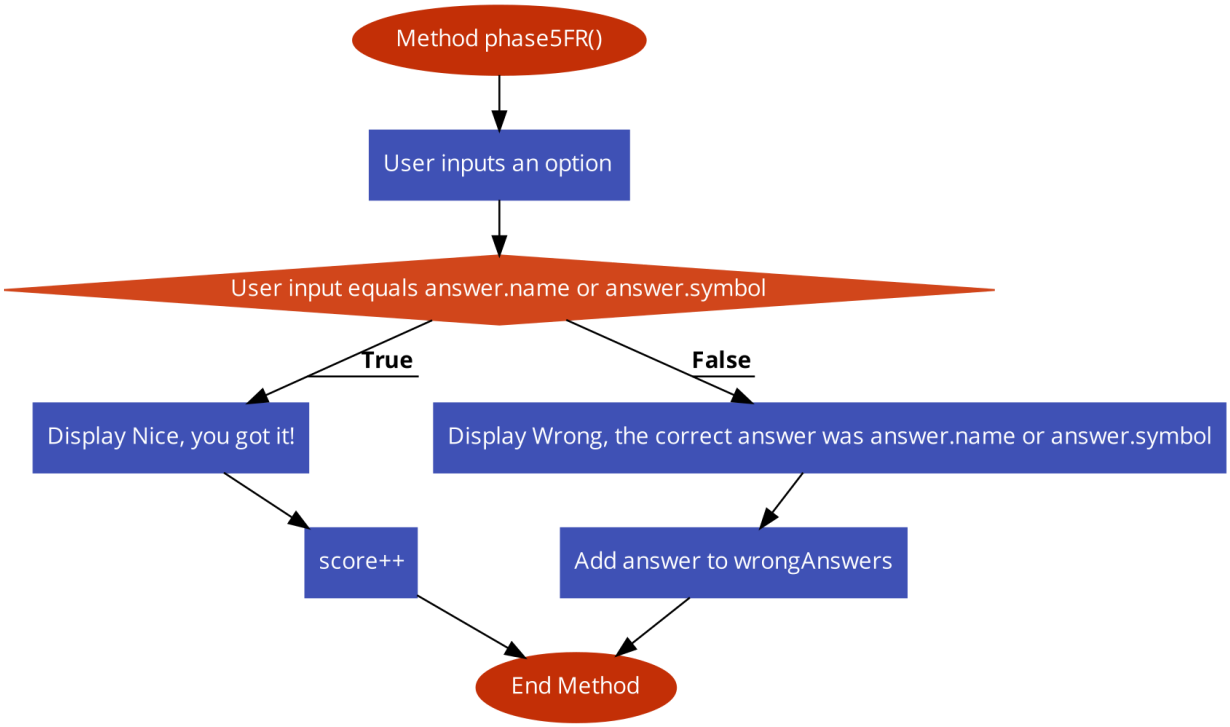

Method phase1()
option1 = 0
option2 = 0
option3 = 0
score = 0
index = 1
Asks the user how they want to answer the questions on the test
Options for the user:
1 - Answer with free response
2 - Answer with multiple choice
3 - Answer with a mix of both
User inputs an option
User input is between 1 and 3
True
False
option1 = User input
Return to Method phase1()
Go to Method phase2()
End Method

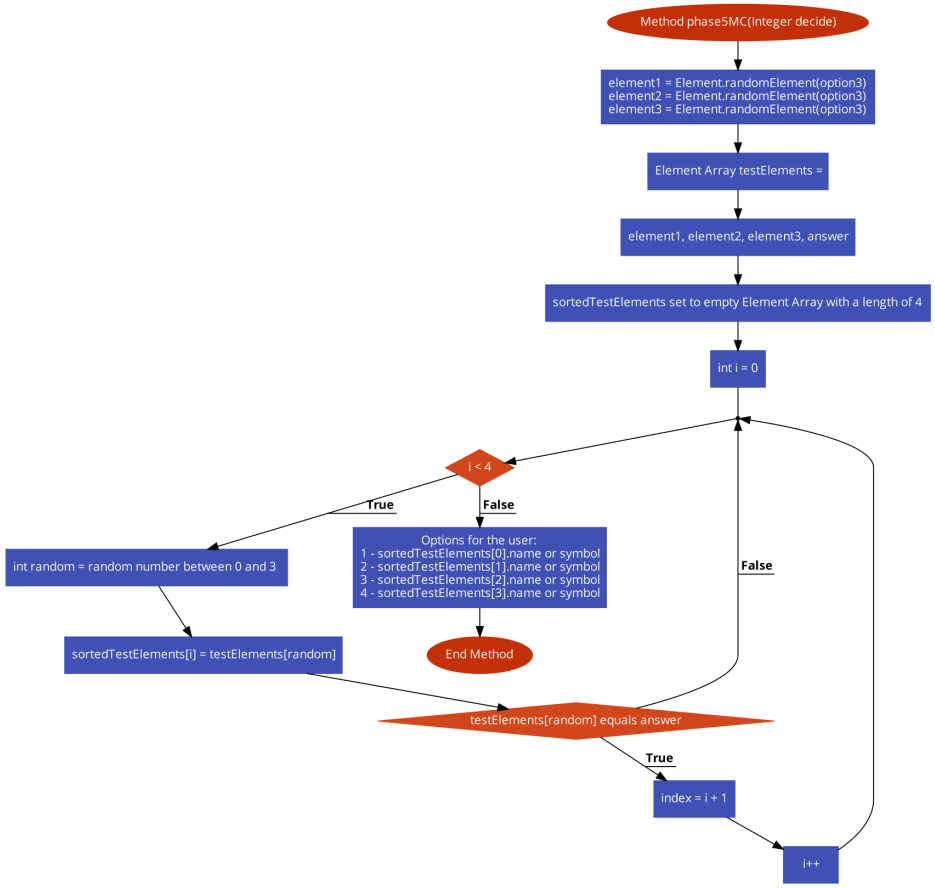

Method phase2()
Asks the user how they want to answer the questions on the test
Options for the user:
1 - Answer with element name
2 - Answer with element symbol
3 - Answer with a mix of both
User inputs an option
User input is between 1 and 3
True
False
option2 = User input
Return to Method phase2()
Go to Method phase3()
End Method

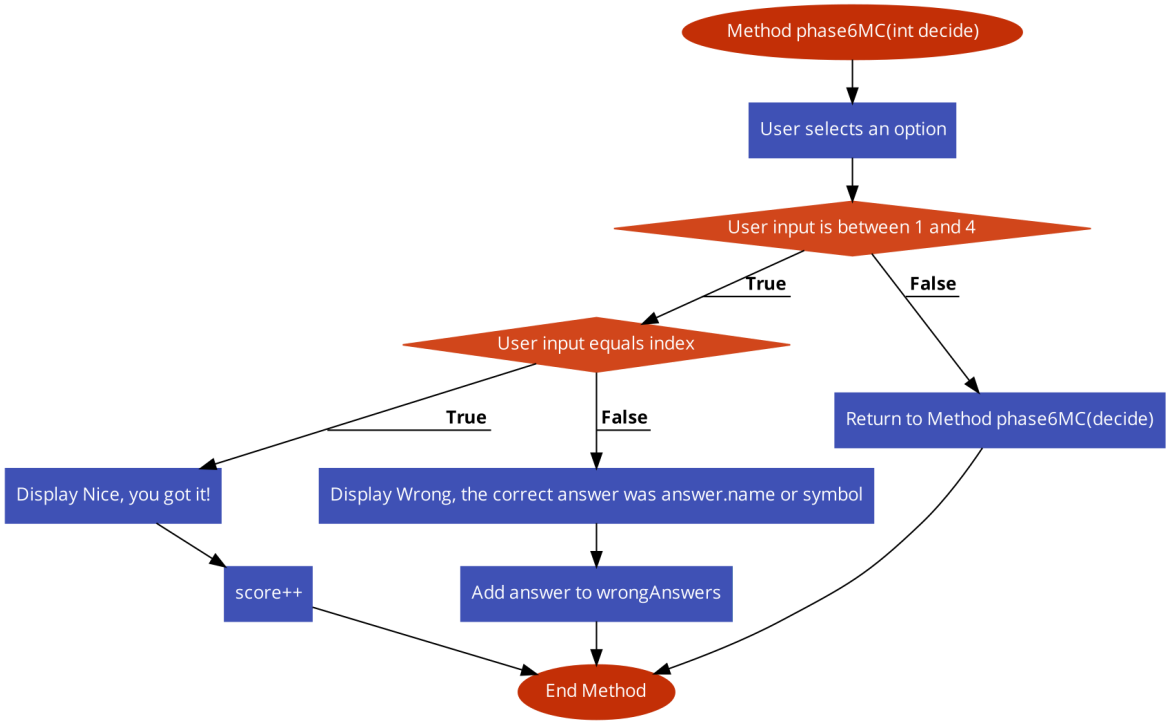

Method phase3()
Asks the user what element/atomic number range for elements do they want on the test
Options for the user:
1 - Elements from 1 to 30
2 - Elements from 31 to 60
3 - Elements from 61 to 90
4 - Elements from 91 to 118
5 - Elements with any atomic number
User inputs an option
User input is between 1 and 5
True
False
option3 = User input
Return to Method phase3()
Go to Method phase4()
End Method

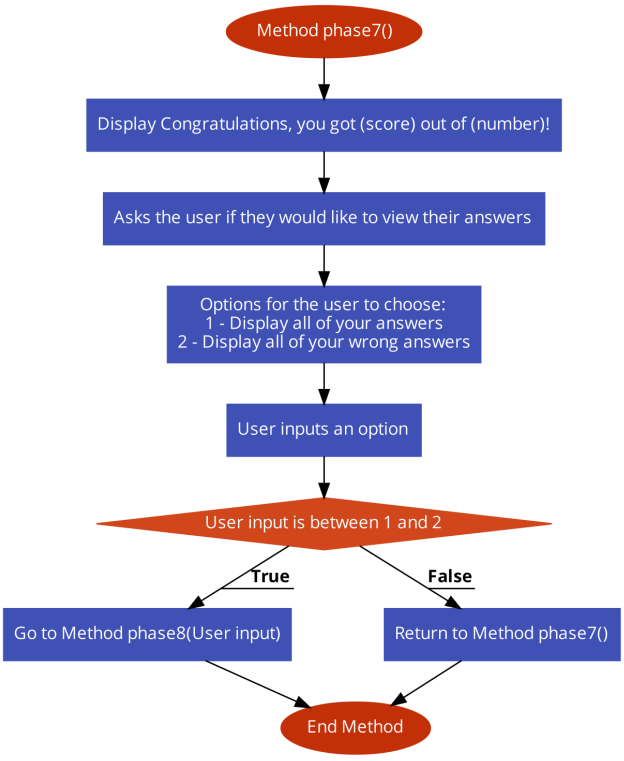

Method phase4()
Asks the user how many questions they want on the test
Options for the user:
1 - 5 Questions
2 - 10 Questions
3 - 15 Questions
4 - 20 Questions
User inputs an option
User input is between 1 and 4
True
False
number = User input times 5
Return to Method phase4()
Go to Method test()
End Method

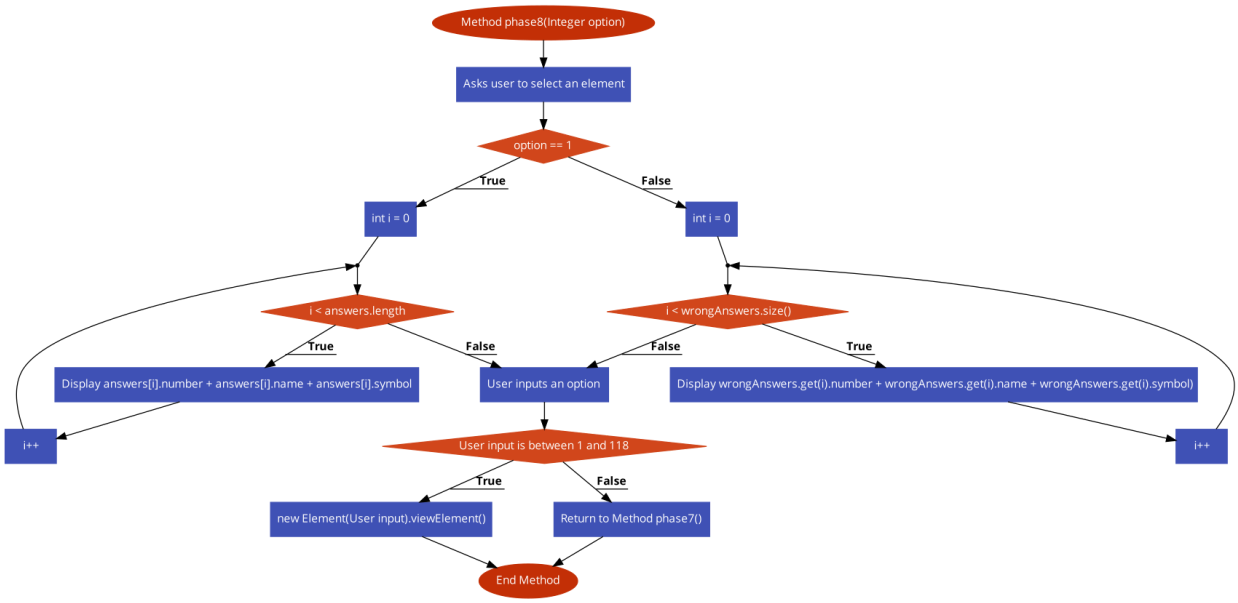

Method test()
Integer numberOn = 1
answers set to empty array with length number
wrongAnswers set to empty Element ArrayList
Integer index = 0
numberOn <= number
True
False
Integer decide1 = random number between 1 and 3
Integer decide2 = random number between 1 and 3
Go to Method phase7()
End Method
answer = Element.randomElement(option3)
answers[index] = answer
index++
option1 == 1 or (option1 == 3 and decide1 == 1)
True
False
Displays element name or symbol
Go to Method phase5MC(decide2)
Asks the user to type the name or symbol of the element
Asks the user to type enter the option of the elements given in multiple choice
Go to Method phase5FR()
Go to Method phase6MC(decide2)
answer = Element.randomElement(option3)
numberOn++


Method phase5FR()
User inputs an option
User input equals answer.name or answer.symbol
True
False
Display Nice, you got it!
Display Wrong, the correct answer was answer.name or answer.symbol
score++
Add answer to wrongAnswers
End Method


Method phase5MC(Integer decide)
element1 = Element.randomElement(option3)
element2 = Element.randomElement(option3)
element3 = Element.randomElement(option3)
Element Array testElements =
element1, element2, element3, answer
sortedTestElements set to empty Element Array with a length of 4
int i = 0
i < 4
True
False
int random = random number between 0 and 3
Options for the user:
1 - sortedTestElements[0].name or symbol
2 - sortedTestElements[1].name or symbol
3 - sortedTestElements[2].name or symbol
4 - sortedTestElements[3].name or symbol
sortedTestElements[i] = testElements[random]
End Method
testElements[random] equals answer
False
True
index = i + 1
i++


Method phase6MC(int decide)
User selects an option
User input is between 1 and 4
True
False
User input equals index
True
False
Return to Method phase6MC(decide)
Display Nice, you got it!
Display Wrong, the correct answer was answer.name or symbol
score++
Add answer to wrongAnswers
End Method


Method phase7()
Display Congratulations, you got (score) out of (number)!
Asks the user if they would like to view their answers
Options for the user to choose:
1 - Display all of your answers
2 - Display all of your wrong answers
User inputs an option
User input is between 1 and 2
True
False
Go to Method phase8(User input)
Return to Method phase7()
End Method



Original Interface

Type the option of the number of questions you want to answer:
1 - 5 Questions
2 - 10 Questions
3 - 15 Questions
4 - 20 Questions
5 - Custom

Problems

The test function was way too simple for the main feature of the program, so I added more customizability to help students memorize elements of the periodic table.

New Interface

How would you like to answer the questions on the test?
---
1 - Answer with free response
2 - Answer with multiple choice
3 - Answer with a mix of both

Type and enter the number of the option you want:

Inputs and Outputs

- If the user inputs 1, 2, or 3, then this will be displayed:

How would you like to answer the questions on the test?
---

1 - Answer with element name
2 - Answer with element symbol
3 - Answer with a mix of both

Type and enter the number of the option you want:

- If the user inputs 1, 2, or 3, then this will be displayed:

What atomic number range for elements do you want to be on the test?
---
1 - Elements from 1 to 30
2 - Elements from 31 to 60
3 - Elements from 61 to 90
4 - Elements from 91 to 118
5 - Elements with any atomic number

Type and enter the number of the option you want:

- If the user inputs 1, 2, 3, 4, or 5, then this will be displayed:

How many questions do you want on the test?
---
1 - 5 Questions
2 - 10 Questions
3 - 15 Questions
4 - 20 Questions

Type and enter the number of the option you want:

- If the user inputs 1, 2, 3, or 4, then the test will begin. Depending on what the user chose previously, the test will act differently. For example, if the user inputted 1, 1, 5, and 1, then this will be displayed 5 times with different random elements:

Type and enter the name of the element "Ni" (or type and enter 0 to receive a hint):

- Another example would be if the user inputted 2, 1, 5, and 1, then this will be displayed 5 times with different random elements:

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1 - Germanium
2 - Dubnium
3 - Lawrencium
4 - Copernicium

Type and enter the option of the element "Lr" (or type and enter 0 to receive a hint):

- In the multiple choice part, if anything other than 0, 1, 2, 3, or 4 is inputted, then the previous screen will be displayed.

- If the number, for multiple choice, or the name/symbol, for free response, is correct, then something like this will be displayed:

Nice, you got it!

- If the number, for multiple choice, or the name/symbol, for free response, is wrong, then something like this will be displayed:

Wrong, the correct answer was Barium.

- After the test, the user will see their score then something like this will be displayed:

Congratulations, you got 4 out of 5! Would you like to view your answers?
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1 - Display all of your answers
2 - Display all of your wrong answers

Type and enter the number of the option you want:

- If the user inputs 1, then something like this will be displayed (depending on the user's results on the test):

These were all the elements asked for in the test:
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85 - Astatine (At)
103 - Lawrencium (Lr)
39 - Yttrium (Y)
47 - Silver (Ag)
81 - Thallium (Tl)

Type and enter the element number you want to view:

- If the user inputs 2, then something like this will be displayed (depending on the user's results on the test):

These were all the elements you got wrong on the test:
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81 - Thallium (Tl)

Type and enter the element number you want to view:

- If anything else is inputted, then the previous screen will be repeated.

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Action Test	Method of Testing	Expected Results
Check if the home screen works	Run the program	The main menu is displayed
Check if screen 1 works	Input 1 in the home screen	The screen goes to screen 1
Check if viewing elements works in screen 1	Try inputting multiple random numbers between 1 and 118	See if the corresponding elements show up and their attributes are correct
Check if improper user input is caught in screen 1	Try inputting negative numbers, zero, numbers bigger than 118, decimals, letters, and special characters.	The program says that the user inputted an invalid option and prompts whatever it asked before
Check if I can go back and view all the elements when in screen 1	When an element is being viewed, input -1	All the elements of the periodic table are displayed again
Check if screen 2 works	Input 2 in the home screen	The screen goes to screen 2
Check if choosing an option works in screen 2	When screen 2 is displayed, try inputting 1 and 2	The next screen should be displayed, allowing me to search.
Check if improper user input is caught in screen 2	In the next screen, try entering negative numbers, numbers greater than 2, decimals, letters, and special characters	The program says that the user inputted an invalid option and prompts whatever it asked before
Check if searching by name works	Search for something using only letters.	Check to make sure that elements are displayed and that I can view elements
Check if improper user input is caught in screen 2 while searching	When I am about to search, try inputting anything that is not a letter like numbers and special characters.	The program says that the user inputted an invalid option and prompts whatever it asked before
Check if screen 3 works	Input 3 in the home screen	The screen goes to screen 3
Check if choosing options works in screen 3	Try choosing different options in the test that are in the range.	The screen keeps on changing to the next option screens and eventually, the test starts
Check if improper user input is caught in screen 3	Go through each subsequent screen before the test and try entering negative numbers, big positive numbers, decimals, letters, and special characters	The program says that the user inputted an invalid option and prompts whatever it asked before

Check that the test grades properly in screen 3	Go through the test in different options and get questions right.	My score goes up and the program says I got it right.
Make sure that there are no duplicates in the test	Go through the test multiple times and check if there are duplicate questions	There should be no duplicates
Check that the test works properly in screen 3	Count the questions that I am answering	The number of questions I answered are the same number of questions I chose
Check that hints work	Check with the free response and multiple choice and go through different phases	The hint changes every time and eventually stops when I run out of hints. The hint phase resets in the next question.

Word Count: 125