

C++ Program Agile Development

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Time required: 60 minutes

How do you solve a problem in programming? Small step by small step by small step. We are going to develop a math program in incremental pieces. This is a good development process to use. Solve one thing at a time, then move to the next. The process shown is also called refactoring.

NOTE: This type of development process is known as AGILE development.

Let's see how we can convert some math into C++ programming. Let's start with calculating an exponent table.

If n is a positive integer and x is any real number, then x^n corresponds to repeated multiplication:

$$x^n = x \times x \dots x \times x$$

We can call this " x raised to the power of n ," " x to the power of n ," or simply " x to the n ." Here, x is the base and n is the exponent or the power.

How do we convert $x^n = x \times x \dots x \times x$ into a computer program? Step by step.

1. $x * x$ is x^2 , $x * x * x$ is x^3 , etc. Each time we add another exponent (multiply the number one more times itself), we add another base into the calculation.
2. In programming, we have libraries to do some of the heavy lifting for us. The C++ `cmath` `pow` function for example.
3. How do we do repeated things in programming? Loops.

Pseudocode:

```
# Exponent table of 2 to the power of 10
base = 2
for i = 0-10
    num = pow(base, i)
    print(num)
```

1. Simple program with no input

This is the first step. Hard code everything, just get the basic program to work.

```
1  /**
2  * Filename: ExponentTable1.cpp
3  * Written by:
4  * Written on:
5  * Revised:
6  * Calculate exponent table
7  */
8
9  #include <iostream>
10 #include <cmath>
11 using namespace std;
12
13 int main()
14 {
15     int base = 2;
16     for (int i = 0; i < 10; i++)
17     {
18         int num = 0;
19         num = pow(base, i);
20         cout << base << " to the power of " << i << " is: " << num << endl;
21     }
22     return 0;
23 }
```

```
2 to the power of 0 is: 1
2 to the power of 1 is: 2
2 to the power of 2 is: 4
2 to the power of 3 is: 8
2 to the power of 4 is: 16
2 to the power of 5 is: 32
2 to the power of 6 is: 64
2 to the power of 7 is: 128
2 to the power of 8 is: 256
2 to the power of 9 is: 512
```

2. Program with user input

Add user input to the previous program.

```
1  /**
2  * Filename: ExponentTable2UserInput.cpp
3  * Written by:
4  * Written on:
5  * Revised:
6  * Calculate exponent table
7  */
8
9  #include <iostream>
10 #include <cmath>
11 using namespace std;
12
13 int main()
14 {
15     int base = 0;
16     cout << "The Amazing Exponent Table Creator!" << endl;
17     cout << "Please enter a whole number: ";
18     cin >> base;
19     for (int i = 0; i < 10; i++)
20     {
21         int num = 0;
22         num = pow(base, i);
23         cout << base << " to the power of " << i << " is: " << num << endl;
24     }
25     return 0;
```

```
The Amazing Exponent Table Creator!
Please enter a whole number: 2
2 to the power of 0 is: 1
2 to the power of 1 is: 2
2 to the power of 2 is: 4
2 to the power of 3 is: 8
2 to the power of 4 is: 16
2 to the power of 5 is: 32
2 to the power of 6 is: 64
2 to the power of 7 is: 128
2 to the power of 8 is: 256
2 to the power of 9 is: 512
```

3. Add a menu

Add a menu to allow the user to run the program more than once.

```

1  /**
2  * Filename: ExponentTable3Menu.cpp
3  * Written by:
4  * Written on:
5  * Revised:
6  * Calculate Exponent table from base number
7  */
8
9  #include <iostream>
10 #include <cmath>
11 using namespace std;
12
13 int main()
14 {
15     int base = 0;
16     cout << "The Amazing Exponent Table Creator!" << endl;
17     cout << "Please enter a whole number: ";
18     cin >> base;
19     while ((base > 0))
20     {
21         for (int i = 0; i < 10; i++)
22         {
23             int num = 0;
24             num = pow(base, i);
25             cout << base << " to the power of " << i << " is: " << num << endl;
26         }
27         cout << "The Amazing Exponent Table Creator!" << endl;
28         cout << "Please enter a whole number: ";
29         cin >> base;
30     }
31     return 0;
32 }

```

```

The Amazing Exponent Table Creator!
Please enter a whole number: 4
4 to the power of 0 is: 1
4 to the power of 1 is: 4
4 to the power of 2 is: 16
4 to the power of 3 is: 64
4 to the power of 4 is: 256
4 to the power of 5 is: 1024
4 to the power of 6 is: 4096
4 to the power of 7 is: 16384
4 to the power of 8 is: 65536
4 to the power of 9 is: 262144
The Amazing Exponent Table Creator!
Please enter a whole number: 0

```

4. Functions

Divide your code into functions.

```
1  /**
2  * Filename: ExponentTable4Functions.cpp
3  * Written by:
4  * Written on:
5  * Revised:
6  * Calculate exponent table
7  */
8
9  #include <iostream>
10 #include <cmath>
11 using namespace std;
12
13 // Function prototypes
14 int getInput();
15 void displayTable(int base, int i, double num);
16
17 int main()
18 {
19     int base = 0;
20     base = getInput();
21
22     while ((base > 0))
23     {
24         for (int i = 0; i < 10; i++)
25         {
26             int num = 0;
27             num = pow(base, i);
28             displayTable(base, i, num);
29         }
30         cout << "The Amazing Exponent Table Creator!" << endl;
31         cout << "Please enter a whole number: ";
32         cin >> base;
33     }
34     return 0;
35 }
```

```
37 int getInput()
38 {
39     int base = 0;
40     cout << "The Amazing Exponent Table Creator!" << endl;
41     cout << "Please enter a whole number: ";
42     cin >> base;
43     return base;
44 }
45
46 void displayTable(int base, int i, double num)
47 {
48     cout << base << " to the power of " << i << " is: " << num << endl;
49 }
```

5. Function Header File

Move your functions into a header file.

```

1  /**
2  * Filename: ExponentTable.cpp
3  * Written by:
4  * Written on:
5  * Revised:
6  * Calculate exponent table
7  */
8
9  #include <iostream>
10 #include <cmath>
11 // Include header file with functions
12 #include "ExponentTable.h"
13 using namespace std;
14
15 int main()
16 {
17     int base = 0;
18     base = getInput();
19
20     while ((base > 0))
21     {
22         for (int i = 0; i < 10; i++)
23         {
24             int num = 0;
25             num = pow(base, i);
26             displayTable(base, i, num);
27         }
28         cout << "The Amazing Exponent Table Creator!" << endl;
29         cout << "Please enter a whole number: ";
30         cin >> base;
31     }
32     return 0;
33 }

```

```

1  /**
2  * Filename: ExponentTable.h
3  * Written by:
4  * Written on:
5  * Revised:
6  * Calculate exponent program header file
7  */
8
9  #ifndef EXPONENTABLE_H
10 #define EXPONENTABLE_H
11
12 #include <iostream>
13 using namespace std;
14
15 //===== FUNCTION PROTOTYPES =====//
16 int getInput();
17 void displayTable(int base, int i, double num);
18
19 //===== GET INPUT =====//
20 int getInput()
21 {
22     int base = 0;
23     cout << "The Amazing Exponent Table Creator!" << endl;
24     cout << "Please enter a whole number: ";
25     cin >> base;
26     return base;
27 }
28
29 //===== DISPLAY TABLE =====//
30 void displayTable(int base, int i, double num)
31 {
32     cout << base << " to the power of " << i << " is: " << num << endl;
33 }
34
35 #endif // EXPONENTABLE_H

```

Success! You have completed the Agile development process on this program. Use this development process on future projects, you will be glad you did!

Assignment Submission

1. Attach the program files.
2. Attach screenshots showing the successful operation of the program.
3. Submit in Blackboard.