

CS 202 Iditarod Challenge: Rainy Pass

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- Repository Link: <https://github.com/imthegngrbrdmn/cs-202/tree/master/iditarod-rainypass>
- Git Commits: <https://github.com/imthegngrbrdmn/cs-202/commits/master>
- This homework took approximately 06 hours to complete.

1 Design

I designed this program by simply incorporating the stopwatch class I had previously created in order to not have to write a new stopwatch from scratch, and then I wrote the ackermann function in its own file so that it wouldn't clutter the main.cpp file with unnecessary code.

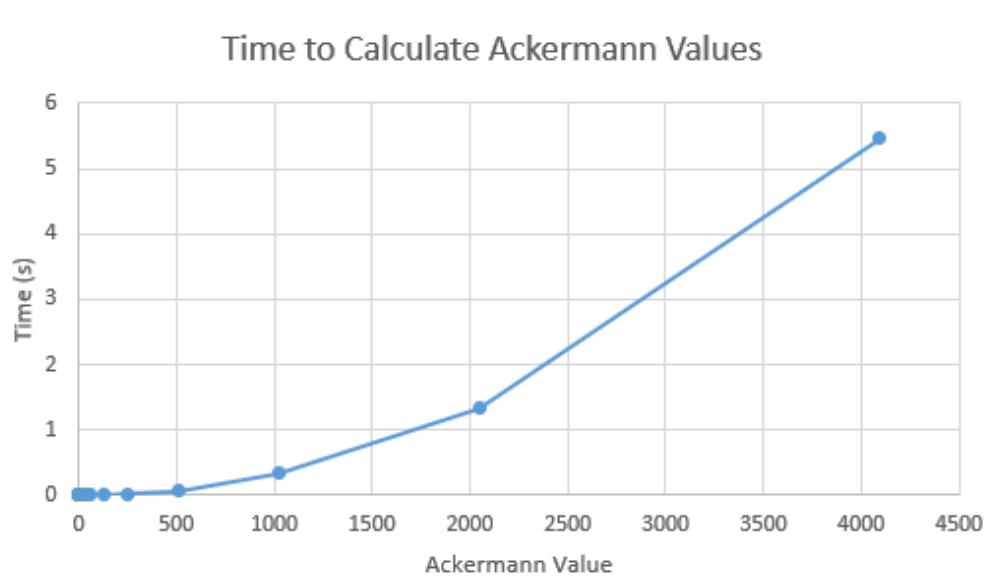
2 Post Mortem

Overall, there were very few errors that I identified. It took me a few tries to format the output so that I could read it easily while inputting it into my Excel document, but it was overall quite straightforward. Graphing in Excel is something I have a lot of experience with, so that was quite straightforward as well. The

only thing that could have improved anything would be using the Catch2 library in order to make sure that the ackermann function was returning the correct values, but I just confirmed my results with Rebecca, and that worked. I couldn't really include Catch2 for this project because I didn't know what the results I needed to be getting were, and I needed it to take as little overhead with time as possible to make sure the timer was timing as little as possible that wasn't the ackermann function as possible.

3 Results

3.1 Graph



3.2 chart

M	N	Result	Time (s)
2	0	3	0
2	1	5	0
2	2	7	0
2	3	9	0
2	4	11	0
2	5	13	0
2	6	15	0
2	7	17	0
2	8	19	0
2	9	21	0
3	0	5	0
3	1	13	0
3	2	29	0
3	3	61	0
3	4	125	0
3	5	253	0.01
3	6	509	0.06
3	7	1021	0.33
3	8	2045	1.33
3	9	4093	5.47

4 Program

4.1 Sample Output

Listing 1: Sample Program Output

```
ack(3,9):      4093
Took:          3.73 seconds

ack(3,8):      2045
Took:          0.9 seconds

ack(3,7):      1021
Took:          0.23 seconds
```

ack(3,6): 509
Took: 0.05 seconds

ack(3,5): 253
Took: 0.01 seconds

ack(3,4): 125
Took: 0 seconds

4.2 Git Commit Messages

Date	Message
2020-03-31	Set Up Project in Visual Studio
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2020-03-31	Write ack(m,n)
2020-03-31	Test ack(m,n)
2020-03-31	Integrate a stopwatch
2020-04-01	Use stopwatch to time ack(m,n)
2020-04-01	Find largest numbers computable with this machine
2020-04-01	Time Largest Numbers
2020-04-01	Create a chart of times for largest numbers
2020-04-01	Graph times
2020-04-01	Create a chart of times for largest numbers

4.3 Source Code

4.4 Ackermann Header

```
1 #ifndef ACKERMANN_H
2 #define ACKERMANN_H
3
4 int ack(int m, int n);
5
6 #endif
```

4.5 Ackermann Source

```
1 #include "ackermann.h"
2
3 int ack(int m, int n)
4 {
5     if (m == 0)
6     {
7         return n + 1;
8     }
9     else if (m > 0 && n == 0)
10    {
11        return ack(m - 1, 1);
12    }
13    else if (m > 0 && n > 0)
14    {
15        return ack(m - 1, ack(m, n - 1));
16    }
17    return -5;
18 }
```

4.6 Main

```
1 #include "ackermann.h"
2 #include "../stopwatch.h"
3 #include <iostream>
4
5 int main(int argc, char** argv)
6 {
7     //int m = 3, n = 9;  m<4  n<10
8     Stopwatch watch;
9     double time;
10    int result;
11    for (int m=3; m >= 0; m--)
12    {
13        for (int n=9; n >= 0; n--)
14        {
15            watch.start();
16            result = ack(m, n);
17            time = watch.stop();
18            std::cout << "ack(" << m << ", "
19                << n << "):\t" << result
20                << "\nTook:\t\t" << time
21                << " seconds\n\n";
22        }
23    }
24    return 0;
25 }
```
