

2801ICT Computing Algorithms – Assignment 1 (20%)

Due Week 6: 23 April 2021 Friday 11:59 PM

This assignment must be done individually. The submission date is as specified in the Course Profile and the submission method will be communicated during trimester.

Problem Description

Samsung and *Apple* are two tech giants and the biggest rivals of each other. Recently, *Samsung* has lost a lawsuit against *Apple* and the court asked *Samsung* to pay one billion dollars to *Apple*. *Samsung* has no option other than paying the money, but the *Samsung CEO* has come up with an innovative idea to take revenge on *Apple*. He decided to pay the money in coins. There are unlimited coins in *Samsung's* vault and the values of coins are all primes e.g. 2, 3, 5, 7, ... including 1 and a *Gold coin*. The *Gold coin* is equivalent to the amount to be paid.

Assume that you are the principal software engineer at Samsung. One morning, the *CEO* called you and described his plan to pay the money to *Apple* in coins. He wants you to write a program that can calculate the total number of ways a given amount can be paid using a specified number of coins. For example, \$5 can be paid in 6 different ways: 5 (Gold coin), 2+3, 1+1+3, 1+2+2, 1+1+1+2 and 1+1+1+1+1 using all possible coins. However, \$8 can be paid in two ways 2+3+3 and 5+2+1 if three coins are used only.

Input format

Input.txt is a file that contains inputs in every line. An input may have a single integer which represents the money you have to pay using all possible combinations of coins. An Input may have two integers where the first integer represents the amount to be paid and the second integer represents the number of coins you should use to pay the amount. Additionally, if an input contains 3 integers, the first integer is the amount to be paid, the second and the third integers represent the range of number of coins that can be used. For example, if the second number is 5 and the third number is 8, then your program should display the total number of ways the amount can be paid using 5, 6, 7 and 8 coins.

Output format

Output.txt contains corresponding outputs to every line of *Input.txt*. The output is an integer number that shows the total number of ways the money can be paid.

Sample Input	Sample Output
5	6
8 3	2
8 2 5	10

Explanation of Sample Output:

6---> 5, 2+3=5, 1+1+3=5, 1+2+2=5, 1+1+1+2=5, 1+1+1+1+1=5

2---> 5+2+1=8, 3+3+2=8

10---> 1+7=8, 5+3=8, 3+3+2=8, 5+2+1=8, 2+2+2+2=8, 5+1+1+1=8, 3+2+2+1=8, 3+3+1+1=8, 1+1+2+2+2=8, 1+1+1+2+3=8

Results for C++ Implementation

Input	Output	CPU Time (Secs)	Input	Output	CPU Time (Secs)
5	6	0.000000	20 10 15	57	0.000000
6 2 5	7	0.000000	100 5 10	14839	0.000000
6 1 6	9	0.000000	100 8 25	278083	0.006000
8 3	2	0.000000	300 12	4307252	2.155000
8 2 5	10	0.000000	300 10 15	32100326	22.968000

Results for Python Implementation

Input	Output	CPU Time (Secs)	Input	Output	CPU Time (Secs)
5	6	0.000523	20 10 15	57	0.007611
6 2 5	7	0.001361	100 5 10	14839	0.912590
6 1 6	9	0.001741	100 8 25	278083	39.795810
8 3	2	0.000537	300 12	4307252	372.670860
8 2 5	10	0.001271	300 10 15	32100326	3992.311160

Notes

1. You must design your own algorithm and write the program code submitted. The program must be able to be run from the command line passing the path to the *Input.txt* file as an argument. The naming convention for your program file is:
<student_number>_Pay_in_Coins.py (or <student_number>_Pay_in_Coins.cpp or <student_number>_Pay_in_Coins.java)(without the <>) and try and keep the program within a single file.
2. You must produce a report describing your algorithm (including the **pseudocode**), **correctness** of your algorithm, the **results** of the problem (sample *Input.txt* is provided) and **performance analysis**.

Marking

This assignment is worth 20% of your final grade. The assignment will be marked out of 100 and marks will be allocated as follows:

1. **(Algorithmic Design) Overview** (describe the problem in your own words), Algorithm Description (the main **idea behind your solution**), Algorithm **Pseudo-Code: 5+15+15=35 marks**
2. **(Implementation) Quality of code** (e.g., appropriate naming conventions, code comments, class structure, method structure, appropriate use of data structures etc.): **25 marks**
3. **(Result and Algorithm Analysis)** The **results** of the problem (sample *Input.txt* is provided) and performance **analysis: 20+20=40 marks**

Student should submit a zip file (<student_number>_Algorithm_Assignment_1.zip) consisting of the following:

1. A document covering 1 and 3: <student_number>_Algorithm_Assignment_1.pdf and
2. Source code file: <student_number>_Pay_in_Coins.py (cpp/java) and

Please note that all submitted assignments will be analysed by a plagiarism detector including the submitted source code of the program. If any form of plagiarism is found, it will be dealt with in accordance with university policy: <https://www.griffith.edu.au/academic-integrity/academic-misconduct>.