NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

SC1007 Data Structures and Algorithms **2021/22 Semester 2**

Lab 8: Dynamic Programming

School of Computer Science and Engineering *Nanyang Technological University*

Q1 Write the recursive function, top-down dynamic programming, and bottom-up dynamic programming to calculate the value of Fibonacci(n). Run the program with different values of n and compare the running time (the function of measuring the running time is given in the template).

```
int fib_recursive(int n);
int top_down_dp(int n);
int bottom_up_dp(int n);
```

Some values of Fibonacci(n) are given below:

n	Fib(n)
0	0
1	1
2	1
3	2
10	55
20	6765
40	102334155
45	1134903170

The other values can be found here https://www.math.net/list-of-fibonacci-numbers

Q2 Write the recursive function, top-down dynamic programming, and bottom-up dynamic programming to calculate the maximum value for the rod cutting problem.

```
int cr_recursive(int[] p, int n);
int cr_top_down_dp(int[] p, int n);
int cr_bottom_up_dp(int[] p, int n);
```

where p is the price list and n is the length of the rot. For example, if the prices of different lengths are given in the following table, and the length of the rod is 9, the maximum revenue will be 25.

Length	1	2	3	4	5	6	7	8	9
Price	1	4	8	9	10	17	17	20	24

Q3 Modify the bottom up dynamic programming in Q2 to print the list of lengths of cutting pieces (in ascending order) achieved in the optimal solution and return the maximum revenue.

```
int cr_botton_up_dp_print(int[] p, int n);
```

For example, with the example in Q2, the rot will be cut into two pieces with the lengths 3 and 6, and the maximum revenue is 25.