

**SC1007 Data Structures and Algorithms**
**Lab 8: Dynamic Programming**
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- Q1** Write the recursive function, top-down dynamic programming, and bottom-up dynamic programming to calculate the value of  $\text{Fibonacci}(n)$ . 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  $\text{Fibonacci}(n)$  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 rod. 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.