65011277_Lab7_Chanasorn

Task 1 :

Code :

```java
static int minNumCoin(int amount) {
    // System.out.println("call for " + amount);
    if (amount == 0) return 0; //base case

    int coinsNeeded = Integer.MAX_VALUE;

    int numCoin = 0;
    // int[] coinUsed = new int[amount + 1];
    // int size = 0;
    for (Coins c : Coins.values()) {
        if (c.value() <= amount) {
            numCoin = 1 + minNumCoin(amount - c.value());
            if (numCoin < coinsNeeded)coinsNeeded = numCoin; // This is the best because it finds the smallest amount of coins needed.
        }
    }
    return coinsNeeded;
}
```

Result :

```
[Running] cd "d:\Main
amount 4 uses 4
amount 5 uses 1
amount 6 uses 2
amount 7 uses 3
amount 8 uses 4
amount 9 uses 5
amount 10 uses 1
amount 11 uses 2
```

Task 2 :

Code :

```java
static int minNumCoin(int amount, int [] residual) {
    if (amount == 0) return 0; //base case

    int coinsNeeded = Integer.MAX_VALUE;

    int numCoin = 0;
    for (Coins c : Coins.values()) {
        if (c.value() <= amount) {
            if (residual[amount -  c.value()] > 0)
                numCoin = 1 + residual[amount - c.value()];
            else
                numCoin = 1 + minNumCoin(amount - c.value(), residual);
            if (numCoin < coinsNeeded)
                coinsNeeded = numCoin;
            residual[amount] = coinsNeeded; // This avoids the repeated calls.
        }
    }
    return coinsNeeded;
}
```

Result :

```
[Running] cd "d:\Main\Work\KM
amount 4 uses 4
amount 5 uses 1
amount 6 uses 2
amount 7 uses 3
amount 8 uses 4
amount 9 uses 5
amount 10 uses 1
amount 11 uses 2


[Done] exited with code=0 in
```

Task 3 :

Results :

```
[Running] cd "d:\Main\Work\KMITL\Yr2_Sem1\Da
amount = 59 uses 10 elapse time = 735
amount = 59 uses 10 elapse time = 0

[Done] exited with code=0 in 1.809 seconds

[Running] cd "d:\Main\Work\KMITL\Yr2_Sem1\Da
amount = 60 uses 6 elapse time = 988
amount = 60 uses 6 elapse time = 1

[Done] exited with code=0 in 2.189 seconds

[Running] cd "d:\Main\Work\KMITL\Yr2_Sem1\Da
amount = 70 uses 7 elapse time = 16314
amount = 70 uses 7 elapse time = 0

[Done] exited with code=0 in 17.319 seconds
```