

CS206A Data Structure

HW3

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Problem1.

< pseudocode for a recursive function to compute powerset(S) >

```
function powerset(S)
    n = len(S)
    if ( n = 0 )
        return { {} }
    else
        addition = { }
        for i in range(n-1):
            addition.append(powerset(S[:n-1])[i] + S[n])
        return powerset(S[:n-1]) + addition
```

< explanation >

The method is to combine powerset of $S[:n-1]$ and powerset that is added $S[n]$ to all elements of $\text{powerset}(S[:n-1])$.

When n decreases to zero, the function finishes, so there is no infinite recursion.

Problem2.

Complexity depends on many factors like data representation, kind of computer, and computer language used but the order of an algorithm is generally more important than the speed of processor. The reason is that the order of an algorithm is more efficient for reducing complexity and the capacity of processor is limited. Also, the order of an algorithm is machine independent so it is applicable to any machine.

Problem3.

Time Formula	Big-O
$10n$	$O(n)$
$2n^2$	$O(n^2)$
3 times log (base 2) of n	$O(\log_2 n)$
$2n^2 + 10n$	$O(n^2)$

$$10n \leq 11n \quad \text{for } n \geq 1$$

By taking $C=11$, we get $10n = O(n)$

$$2n^2 \leq 3n^2 \quad \text{for } n \geq 1$$

By taking $C=3$, we get $2n^2 = O(n^2)$

$$3\log_2 n \leq 4\log_2 n \quad \text{for } n \geq 1$$

By taking $C=4$, we get $3\log_2 n = O(\log_2 n)$

$$2n^2 + 10n \leq 2n^2 + 10n^2 = 12n^2 \quad \text{for } n \geq 1$$

By taking $C=12$, we get $2n^2 + 10n = O(n^2)$

Problem5.

$$1+2+3+\dots+n = \frac{n(n+1)}{2} \leq n^2 \quad \text{for } n \geq 1$$

By taking $C=1$, we get $1+2+3+\dots+n = O(n^2)$

Problem6.

$$n^2 + 35n + 6 \leq n^2 + 35n^2 + 6n^2 = 42n^2 \quad \text{for } n \geq 1$$

By taking $C=42$, we get $n^2 + 35n + 6 = O(n^2)$

Problem7.

Worst case 는 $n = 10^k$ (k 는 정수) 인 경우이다. $(k+2)$ 회 comparison, $(k+1)$ 회 assignment, $(k+1)$ 회 division를 하면 total execution time은 $3k+4 = 3\log_{10} n + 4 = O(\log_{10} n)$ 이다.

Problem8.

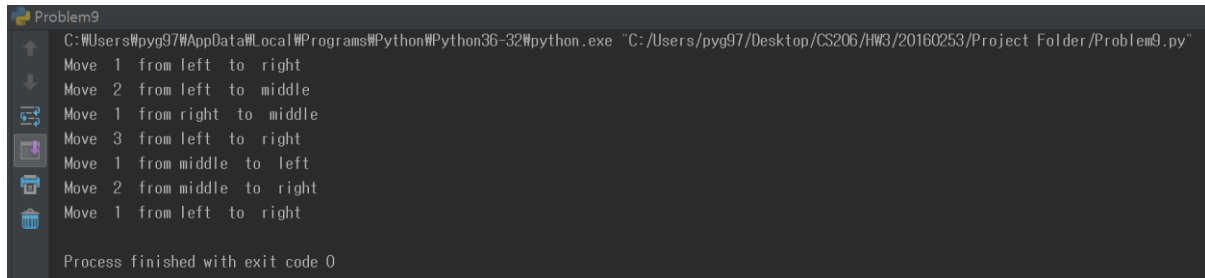
$$(n-2)*(n-4) = n^2 - 6n + 8 \leq n^2 + 6n + 8 \leq n^2 + 6n^2 + 8n^2 = 15n^2 \quad \text{for } n \geq 1$$

By taking $C=15$, we get $(n-2)*(n-4) = O(n^2)$

Problem9.

I made two function: move and Hanoi. The function move print string and the function Hanoi recursive function that contains move and Hanoi.

The result of Hanoi(3, "left", "middle", "right") is the below.



```
Problem9
C:\Users\pyg97\AppData\Local\Programs\Python\Python36-32\python.exe "C:/Users/pyg97/Desktop/CS206/HW3/20160253/Project Folder/Problem9.py"
Move 1 from left to right
Move 2 from left to middle
Move 1 from right to middle
Move 3 from left to right
Move 1 from middle to left
Move 2 from middle to right
Move 1 from left to right
Process finished with exit code 0
```