Program Assignment 1

2021/03/18 by Mark Chang

Outlines

- CPP Tutorial
- PA1 Introduction

CPP Tutorial

- https://www.tutorialspoint.com/cplusplus/index.htm
- CPP Variable
- CPP Pointer
- CPP Dynamic Memory
- CPP Class & Object
- Pointer to Classes

CPP Variable

- https://www.tutorialspoint.com/cplusplus/cpp_variable_types.htm
- Variable definition:
  - type variable_name;
  - type variable_name = value;
- Variable initialization:
  - variable_name = value;

```
// Variable definition:
int a, b;
int c;
float f;

// actual initialization
a = 10;
b = 20;
c = a + b;

cout << c << endl ;

f = 70.0/3.0;
cout << f << endl ;
```

```
30
23.3333
```

CPP Pointer

- https://www.tutorialspoint.com/cplusplus/cpp_pointers.htm
- Variable address:
  - & variable_name

```
int  var1;
char var2[10];

cout << "Address of var1 variable: ";
cout << &var1 << endl;

cout << "Address of var2 variable: ";
cout << &var2 << endl;
```

```
Address of var1 variable: 0xbfebd5c0
Address of var2 variable: 0xbfebd5b6
```

CPP Pointer

- https://www.tutorialspoint.com/cplusplus/cpp_pointers.htm
- Pointer
  - type* pointer_name;
  - type pointer_name = &variable_name;
- Pointer value
  - *pointer_name

```
int  var = 20;   // actual variable declaration.
int  *ip;        // pointer variable

ip = &var;       // store address of var in pointer variable

cout << "Value of var variable: ";
cout << var << endl;

// print the address stored in ip pointer variable
cout << "Address stored in ip variable: ";
cout << ip << endl;

// access the value at the address available in pointer
cout << "Value of *ip variable: ";
cout << *ip << endl;
```

```
Value of var variable: 20
Address stored in ip variable: 0xbfc601ac
Value of *ip variable: 20
```

CPP Dynamic Memory

- https://www.tutorialspoint.com/cplusplus/cpp_dynamic_memory.htm
- Allocate new memory
  - pointer_name = new type;
- Free up the memory
  - delete pointer_name;

```
double* pvalue  = NULL; // Pointer initialized with null
pvalue  = new double;   // Request memory for the variable

*pvalue = 29494.99;     // Store value at allocated address
cout << "Value of pvalue : " << *pvalue << endl;

delete pvalue;         // free up the memory.
```

```
Value of pvalue : 29495
```

CPP Class & Object

- https://www.tutorialspoint.com/cplusplus/cpp_classes_objects.htm

Class

```
class Box {
   public:
      double length;   // Length of a box
      double breadth;  // Breadth of a box
      double height;   // Height of a box
};
```

Object

```
Box Box1;        // Declare Box1 of type Box
Box Box2;        // Declare Box2 of type Box
double volume = 0.0;     // Store the volume of a box here
```

```
  // box 1 specification
  Box1.height = 5.0;
  Box1.length = 6.0;
  Box1.breadth = 7.0;

  // box 2 specification
  Box2.height = 10.0;
  Box2.length = 12.0;
  Box2.breadth = 13.0;

  // volume of box 1
  volume = Box1.height * Box1.length * Box1.breadth;
  cout << "Volume of Box1 : " << volume <<endl;

  // volume of box 2
  volume = Box2.height * Box2.length * Box2.breadth;
  cout << "Volume of Box2 : " << volume <<endl;
```

```
Volume of Box1 : 210
Volume of Box2 : 1560
```

Pointer to Classes

- https://www.tutorialspoint.com/cplusplus/cpp_pointer_to_class.htm
- ptr_name->class_member;

```
class Box {
   public:
      // Constructor definition
      Box(double l = 2.0, double b = 2.0, double h = 2.0) {
         cout <<"Constructor called." << endl;
         length = l;
         breadth = b;
         height = h;
      }
      double Volume() {
         return length * breadth * height;
      }

   private:
      double length;     // Length of a box
      double breadth;    // Breadth of a box
      double height;     // Height of a box
};
```

```
Box Box1(3.3, 1.2, 1.5);    // Declare box1
Box Box2(8.5, 6.0, 2.0);    // Declare box2
Box *ptrBox;                // Declare pointer to a class.

// Save the address of first object
ptrBox = &Box1;

// Now try to access a member using member access operator
cout << "Volume of Box1: " << ptrBox->Volume() << endl;

// Save the address of second object
ptrBox = &Box2;

// Now try to access a member using member access operator
cout << "Volume of Box2: " << ptrBox->Volume() << endl;
```

```
Constructor called.
Constructor called.
Volume of Box1: 5.94
Volume of Box2: 102
```

PA1 Introduction

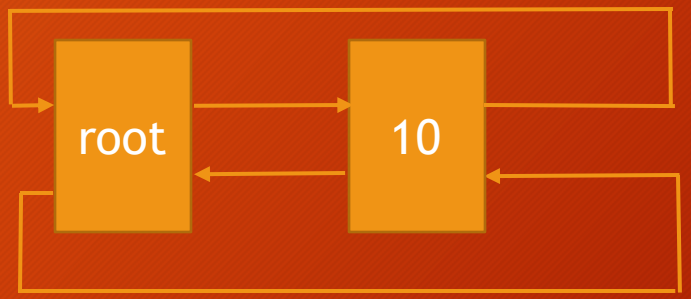
- Problem Statement
- Input/Output Specification
- Submission
- Evaluation

Problem Statement

- This programming assignment asks you to read in a series of commands e.x.(PUSH 10, PUSH 9, PUSH8, ……), and execute it using stack.

Stack

Data structure



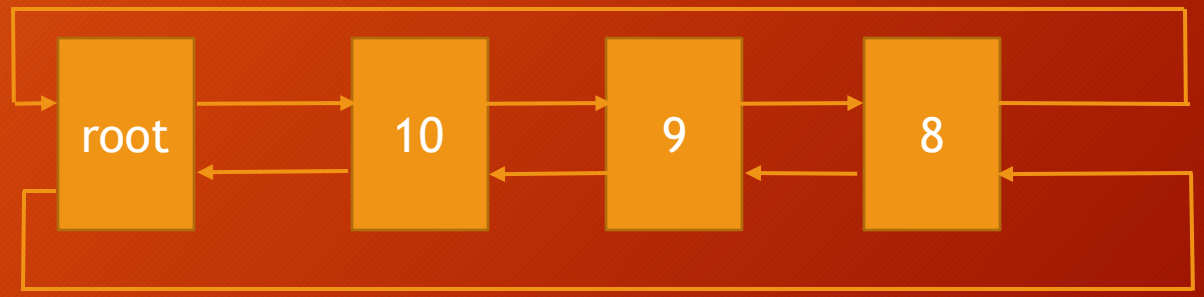
Problem Statement

- This programming assignment asks you to read in a series of commands e.x.(PUSH 10, PUSH 9, PUSH8, ……), and execute it using stack.

Stack

PUSH 10
PUSH 9
PUSH 8

Data structure



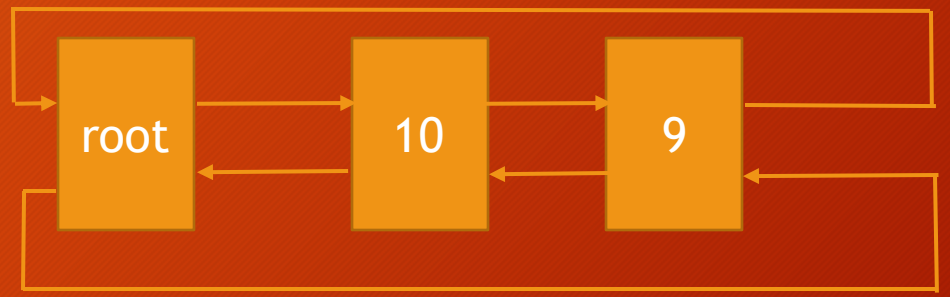
Problem Statement

- This programming assignment asks you to read in a series of commands e.x.(PUSH 10, PUSH 9, PUSH8, ……), and execute it using stack.

Stack

```
PUSH 10
PUSH 9
PUSH 8
POP
```

Data structure



Problem Statement

- You should only fill in the TODO in stack.py and stack.cpp.

stack.py

```python
def pop(self):
    if self.num_element == 0:
        raise ValueError('Can not execute pop() on
    else:
        self.num_element -= 1
        # ---TODO:
        # Connect the second last element >> root
        # Connect root >> the second last element
        # ---
def push(self, node):
    self.num_element += 1
    # ---TODO:
    # Connect the last element >> inserted node
    # Connect the inserted node >> root
    # ---
```

stack.cpp

```cpp
void pop() {
    if(_num_element==0){
        throw invalid_argument( "Can not execute pop
    }
    else{
        _num_element -= 1;
        // ---TODO:
        // Connect the second last element >> root
        // Connect root >> the second last element
        // ---
    }
}
void push(MyNode* node) {
    _num_element += 1;
    // ---TODO:
    // Connect the last element >> inserted node
    // Connect the inserted node >> root
    // ---
}
```

Notice

- For stack.py, please use python3.7 to run, while the cpp version for stack.cpp is not limited.
- You should not modify the codes which are not specified by TODO.
- You should call the class node() when storing your data structure. That is, your data structure is limited to linked lists.
- You should be able to implement stacks with O(1).
- For stack.cpp, you should avoid memory leak.

Input/Output Specification

input

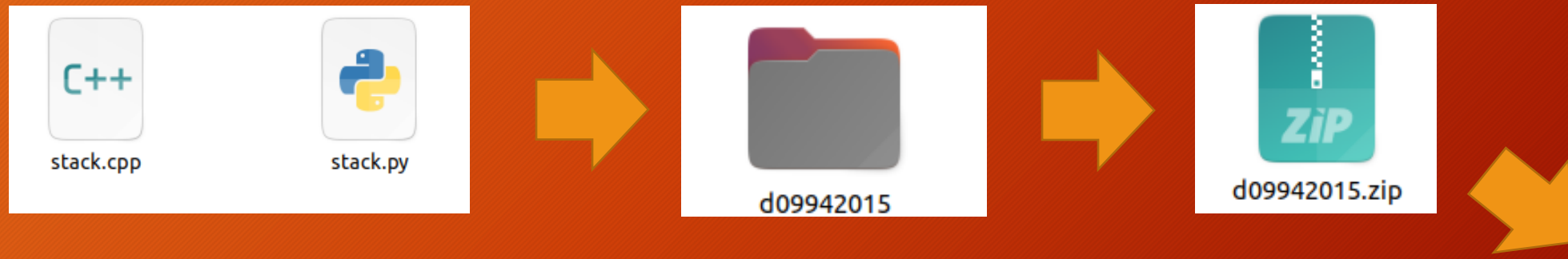
```
 1 PUSH 1
 2 PUSH 2
 3 POP
 4 POP
 5 PUSH 3
 6 POP
 7 PUSH 4
 8 POP
 9 PUSH 5
10 POP
```

output

```
 1 >>Node1
 2 >>Node1>>Node2
 3 >>Node1
 4
 5 >>Node3
 6
 7 >>Node4
 8
 9 >>Node5
10
```

Submission

- Due on 4/1, at 4:00 am
- Please put stack.py and stack.cpp into a directory named studentID and compress the directory into studentID.zip, and then upload this file to ceiba



Evaluation

- All of our test cases will not execute **pop()** on an empty stack. You won't need to handle this exception.

in our testcase

```
PUSH 10
PUSH 9
PUSH 8
POP
```

not in our testcase

```
PUSH 10
POP
POP
POP
```

Evaluation

- Correctness and Time Complexity : 80%
- Memory Management : 20%

Evaluation (Correctness and Time Complexity)

- We will evaluate your code on five test cases.

Input :
input_1.txt
input_2.txt
input_3.txt
input_4.txt
input_5.txt

```
1  PUSH 1
2  PUSH 2
3  POP
4  POP
5  PUSH 3
6  POP
7  PUSH 4
8  POP
9  PUSH 5
10 POP
```

Golden output:
golden_1.txt
golden_2.txt
golden_3.txt
golden_4.txt
golden_5.txt

```
1  >>Node1
2  >>Node1>>Node2
3  >>Node1
4
5  >>Node3
6
7  >>Node4
8
9  >>Node5
10
```

Evaluation (Correctness and Time Complexity)

- Command line argument for correctness:
  - `python stack.py --input input_1.txt --output output_py_1.txt`
  - `g++ -g -o stack stack.cpp; ./stack input_1.txt input_2.txt`
- Command line argument for time complexity:
  - `python stack.py --input input_1.txt`
  - `g++ -g -o stack stack.cpp; ./stack input_1.txt`

Evaluation (Correctness and Time Complexity)

- Evaluation script : evaluation.sh
- Command for evaluation.sh:
  - bash evaluation.sh

python & cpp are incorrect

```
==evaluating correctness==
stack.py is incorrect in test case: input_1.txt
stack.cpp is incorrect in test case: input_1.txt
stack.py is incorrect in test case: input_2.txt
stack.cpp is incorrect in test case: input_2.txt
stack.py is incorrect in test case: input_3.txt
stack.cpp is incorrect in test case: input_3.txt
```

python & cpp are correct

```
==evaluating correctness==
stack.py is correct in test case: input_1.txt
stack.cpp is correct in test case: input_1.txt
stack.py is correct in test case: input_2.txt
stack.cpp is correct in test case: input_2.txt
stack.py is correct in test case: input_3.txt
stack.cpp is correct in test case: input_3.txt
```

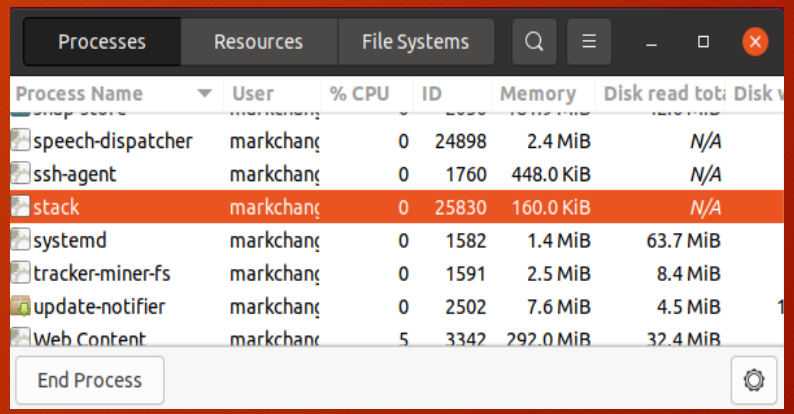
Evaluation (Correctness and Time Complexity)

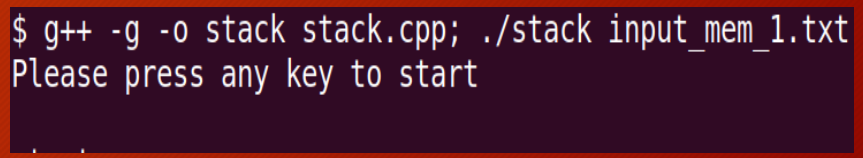
- Time Complexity:
  - **You should manually check the time complexity**
  - input_2.txt : 100 commands, input_3.txt : 10,000 commands
  - Python runtime of input_3.txt: 0.00992s ~ 0.00019s*100 = 0.019s
  - CPP runtime of input_3.txt: 0.00427s ~ 0.00007s*100 = 0.007s

```
==evaluating runtime==
stack.py run time of input_1.txt: 0.00012s
stack.cpp run time of input_1.txt: 0.00004s
stack.py run time of input_2.txt: 0.00019s
stack.cpp run time of input_2.txt: 0.00007s
stack.py run time of input_3.txt: 0.00992s
stack.cpp run time of input_3.txt: 0.00427s
```

Evaluation (Memory Management)

- Command line argument for memory management:
  - `g++ -g -o stack stack.cpp; ./stack input_mem_1.txt`
- Steps:
  - 1. enter the above command
  - 2. open "System Monitor", search for "stack"
  - 3. press any key on terminal to start "stack"
  - 4. open "System Monitor", search for "stack"
  - 5. press any key on terminal to end "stack"

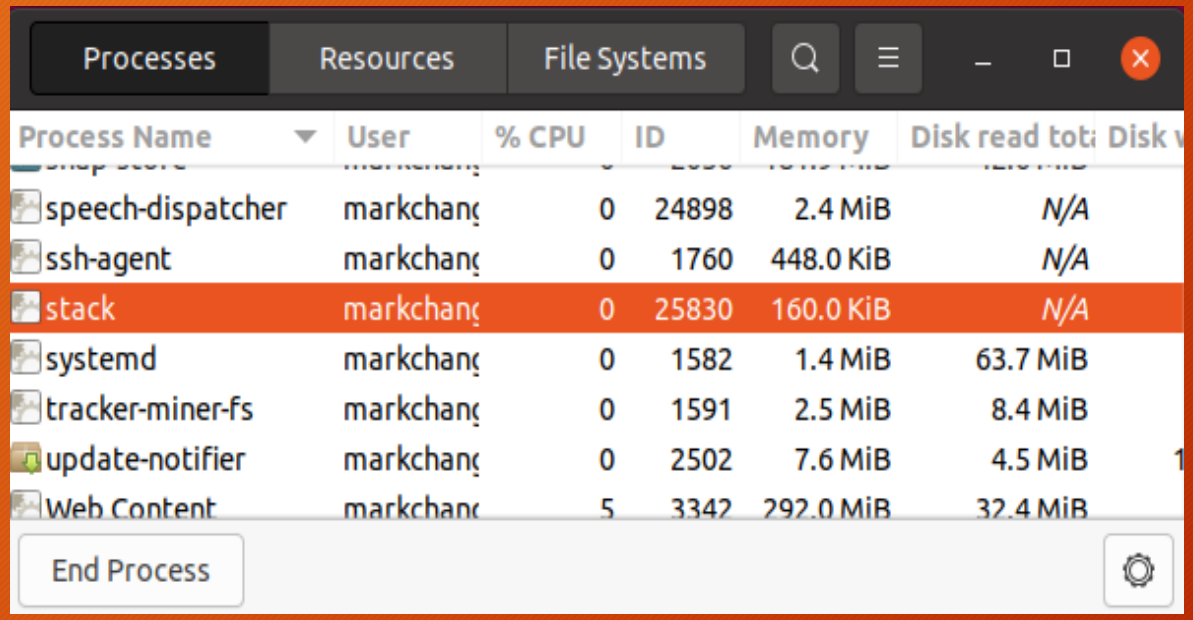




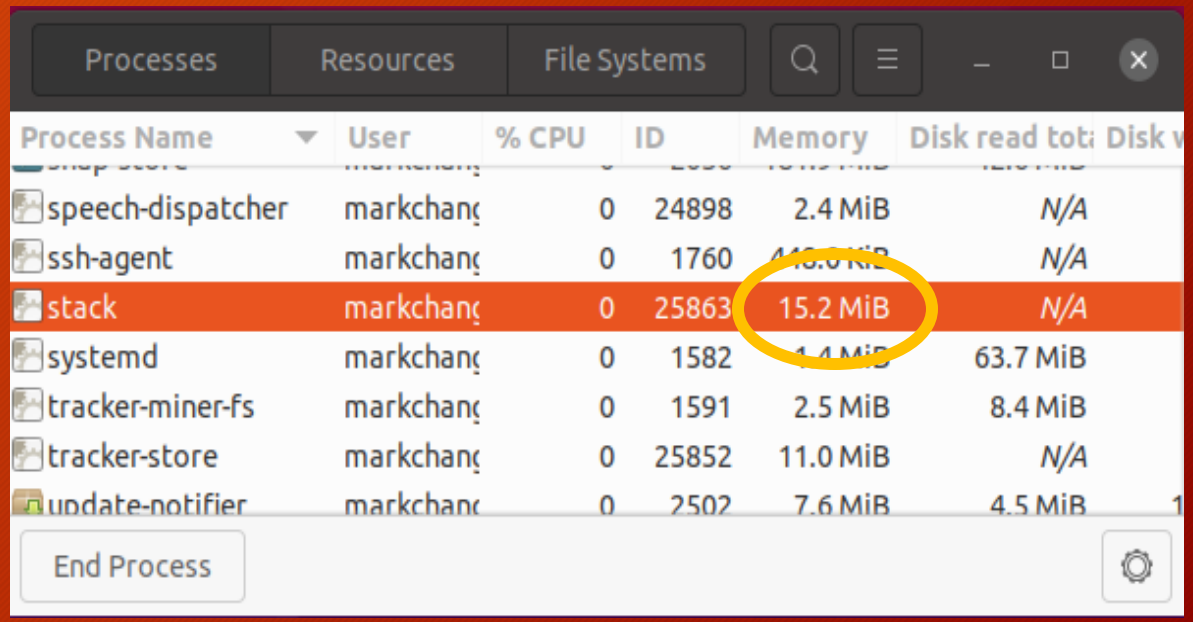
Evaluation (Memory Management)

- Memory Leak

Before press key to start



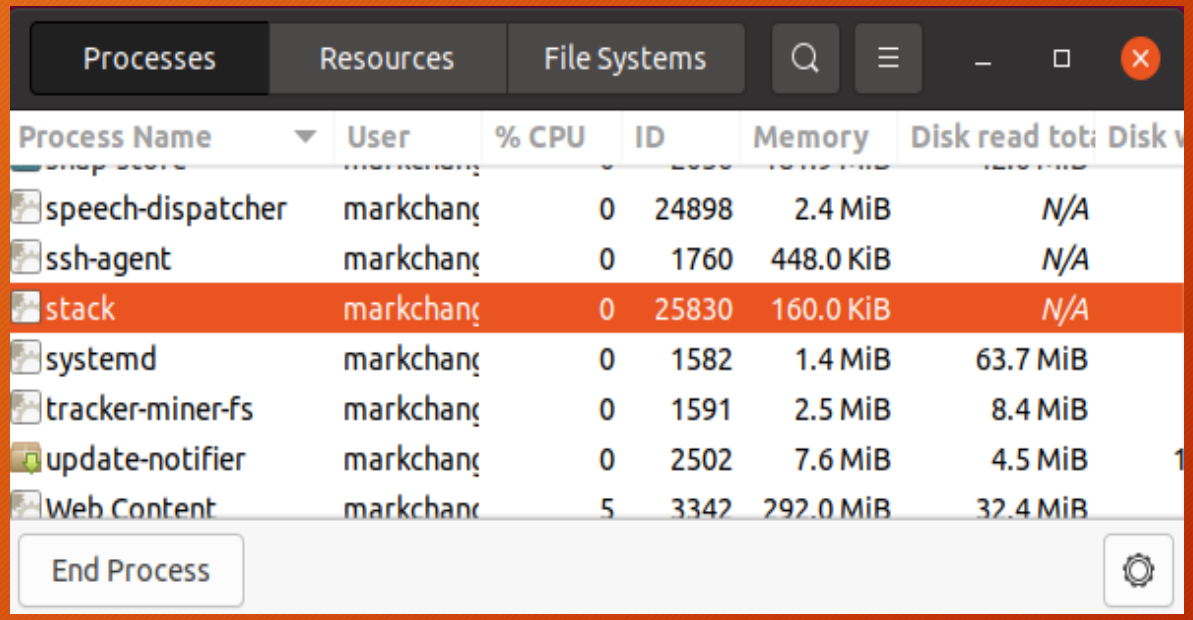
After press key to start



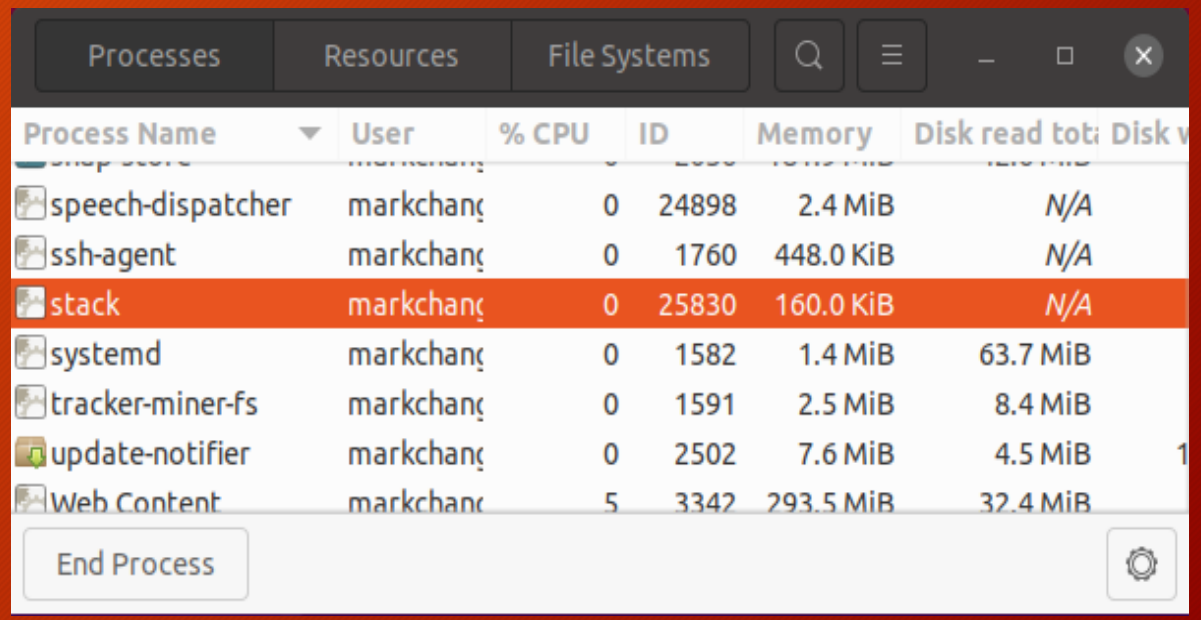
Evaluation (Memory Management)

- No Memory Leak

Before press key to start



After press key to start



Scoring Criteria

1. Correctness and Time Complexity : 80%

	input_1.txt 20 lines PUSH only	input_2.txt 100 lines PUSH & POP	input_3.txt 10,000 lines PUSH & POP	input_4.txt 2,000 lines PUSH only	input_4.txt 50,000 lines PUSH & POP
stack.py	8%	8%	8%	8%	8%
stack.cpp	8%	8%	8%	8%	8%

2. Memory Management : 20%

	input_mem_1.txt 1,000,000 lines PUSH & POP	input_mem_2.txt 5,000,000 lines PUSH & POP
stack.cpp	10%	10%

Any Questions?

- If you have any questions, feel free to contact TA.
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  - email : d09942015@ntu.edu.tw
  - office hour: 週四(17:30~18:20)at博理530
  - phone : 0989922753