2019 – 1 자료구조 과제 (최종)

과 목 명 : 자료구조

과 제 명 : 열차 재배치 외 3 개

사용언어 : 파이썬(jupyter notebook)

학　　과 : 심리학과

학　　번 : 20141963

이　　름 : 박승완

제 작 일 : 20190412

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열차 재배치

- 문제 내용 : 들어오는 열차의 번호를 입력하면 열차들이 순차적으로 나갈 수 있도록 명령하는 기지 내 열차 컨트롤 프로그램을 작성하라.

    - 사용자는 철도로 들어오는 열차의 번호를 입력한다. 열차는 1번부터 9번까지 있다.
    - 철도 스택을 이용해 출구로 나가는 열차는 1번부터 차례대로 나가야 한다. 이를 위해 열차 스택을 이용한다.
    - 화면에는 다음의 내용을 표시한다.
    - 기지에 열차가 한 대씩 들어오는 상황 (3번 열차가 들어옴 : IN 3)
    - 철도 스택에 열차가 들어가는 상황(스택 번호 명시해야 함) (3번 열차가 1번 스택에 들어감 : PUSH 1, 3)
    - 철도 스택에서 열차가 나가는 상황(1번 스택에서 열차가 나감 : POP 1)
    - 대기 장소의 열차를 출구로 내보내는 상황 (OUT 1:1번 열차를 출구로 내보냄)
    - 우리는 적은 횟수만큼 움직이는 것이 좋지만, 최적이 아니어도 괜찮다.
    - 각 IN, PUSH, POP, OUT 앞에는 순서를 나타내는 수를 표시하고 최종 횟수도 표시해야함.

- 실행 예)
  열차 번호 입력 : **397182645**

  01 : IN(3)   3번 들어옴
  02 : PUSH(1, 3)   3번을 1번 스택에
  03 : IN(9)   9번 들어옴
  04 : PUSH(2, 9)   9번을 2번 스택에
  05 : IN(7)   7번 들어옴
  06 : PUSH(2, 7)   7번을 2번 스택에
  07 : IN(1)   1번 들어옴
  08 : OUT(1)
  09 : IN(8)
  10 : PUSH(2, 8)
  11 : IN(2)
  12 : OUT(2)
  13 : IN(6)
  14 : PUSH(2, 6)
  15 : POP(1)
  16 : OUT(3)
  17 : IN(4)
  18 : OUT(4)
  19 : IN(5)
  20 : OUT(5)
  21 : POP(2)

22 : OUT(6)

23 : POP(2)

24 : PUSH(1, 8)

25 : POP(2)

26 : OUT(7)

27 : POP(1)

28 : OUT(8)

29 : POP(2)

30 : OUT(9)

종료(총 30회)

- 해결 방안 :

하나의 메서드(rearrangeTrain)을 사용한다.

(rearrangeTrain)

전체적인 흐름.

1. 인풋(trains)을 받아서 rearrange에 파라미터로 전달한다.

2. 출력할 기차의 번호를 체크할 1~10 까지 i 로 돌아가는 for 문

3. trians에서 하나씩 읽는 for문

4-1. 읽은 train == i 이면 IN출력후 바로 OUT하기

4-2. 읽은 train != i 이면 stack의 상태를 확인

5-1. stack_1 과 stack_2가 모두 비어있으면 stack_1에 넣기

5-2. stack_2만 비어있다면 읽은 train을 stack_2에 넣고 stack_1에 있는 요소들을 POP하며 i와 같은지 비교

5-2-1. i와 같다면 OUT해주기

5-2-2. i와 같지 않다면 stack_1에 PUSH한다.

5-3. stack_1만 비어있다면 읽은 train을 stack_1에 넣고 stack_2에 있는 요소들을 POP하며 i와 같은지 비교

5-3-1. i와 같다면 OUT해주기

5-3-3. i와 같지 않다면 stack_2에 PUSH한다.

+ 5-2-1과 5-3-1이 발생하면 trains = trains[index + 1 :] 를 이용하여 trains 자체의 길이를 줄여서 3.의 for문에 다시 들어갈 때 처음부터 train들을 넣지 않도록 해준다.
6. 위의 방식으로 진행하면 trians의 길이가 0이되는 문제가 생기는데 이는   3.의 for문을 else로 분기를하고 앞에   if int(len(trains)) == 0: (15줄)을 하여 더이상 trains에서 train을 읽어서 확인하지 않고 스택에 있는 값들만 한쪽에서 다른 쪽으로 옮기면서 i와 비교하는 방법을 사용한다.

추가정보 : jupyter notebook에서 코딩하였습니다. 확장자도 .ipynb입니다.
추가정보 : 교수님께서 문제에 제시하셨듯 최적의 코드는 아닙니다. 그렇지만 stack이라는 것을 최대로 이용해보기위해 이런 알고리즘으로 문제를 해결해봤습니다.

- 결과 표시 :

Test case
397182645


```
In [109]: r = rearrange()
          r.rearrangeTrain(397182645)

1 : IN(3)
2 : PUSH(1, 3)
3 : IN(9)
4 : PUSH(2, 9)
5 : POP(3)
6 : PUSH(2, 3)
7 : IN(7)
8 : PUSH(1, 7)
9 : POP(3)
10 : PUSH(1, 3)
11 : POP(9)
12 : PUSH(1, 9)
13 : IN(1)
14 : OUT(1)
15 : IN(8)
16 : PUSH(2, 8)
17 : POP(9)
18 : PUSH(2, 9)
19 : POP(3)
20 : PUSH(2, 3)
21 : POP(7)
22 : PUSH(2, 7)
23 : IN(2)
24 : OUT(2)
25 : IN(6)
26 : PUSH(1, 6)
27 : POP(7)
28 : PUSH(1, 7)
29 : POP(3)
30 : OUT(3)
31 : POP(9)
32 : PUSH(1, 9)
33 : POP(8)
34 : PUSH(1, 8)
35 : IN(4)
36 : OUT(4)
37 : IN(5)
38 : OUT(5)
39 : POP(8)
40 : PUSH(2, 8)
41 : POP(9)
42 : PUSH(2, 9)
43 : POP(7)
44 : PUSH(2, 7)
45 : POP(6)
46 : OUT(6)
47 : POP(7)
48 : OUT(7)
49 : POP(9)
50 : PUSH(1, 9)
51 : POP(8)
52 : PUSH(1, 8)
53 : POP(8)
54 : OUT(8)
55 : POP(9)
56 : PUSH(2, 9)
57 : POP(9)
58 : OUT(9)
```

Test case

859347261

```
In [113]:  r = rearrange()
           r.rearrangeTrain(859347261)
```

```
1 : IN(8)
2 : PUSH(1, 8)
3 : IN(5)
4 : PUSH(2, 5)
5 : POP(8)
6 : PUSH(2, 8)
7 : IN(9)
8 : PUSH(1, 9)
9 : POP(8)
10 : PUSH(1, 8)
11 : POP(5)
12 : PUSH(1, 5)
13 : IN(3)
14 : PUSH(2, 3)
15 : POP(5)
16 : PUSH(2, 5)
17 : POP(8)
18 : PUSH(2, 8)
19 : POP(9)
20 : PUSH(2, 9)
21 : IN(4)
22 : PUSH(1, 4)
23 : POP(9)
24 : PUSH(1, 9)
25 : POP(8)
26 : PUSH(1, 8)
27 : POP(5)
28 : PUSH(1, 5)
29 : POP(3)
30 : PUSH(1, 3)
31 : IN(7)
32 : PUSH(2, 7)
33 : POP(3)
34 : PUSH(2, 3)
35 : POP(5)
36 : PUSH(2, 5)
37 : POP(8)
38 : PUSH(2, 8)
39 : POP(9)
40 : PUSH(2, 9)
41 : POP(4)
42 : PUSH(2, 4)
43 : IN(2)
44 : PUSH(1, 2)
45 : POP(4)
46 : PUSH(1, 4)
```

```
47 : POP(9)
48 : PUSH(1, 9)
49 : POP(8)
50 : PUSH(1, 8)
51 : POP(5)
52 : PUSH(1, 5)
53 : POP(3)
54 : PUSH(1, 3)
55 : POP(7)
56 : PUSH(1, 7)
57 : IN(6)
58 : PUSH(2, 6)
59 : POP(7)
60 : PUSH(2, 7)
61 : POP(3)
62 : PUSH(2, 3)
63 : POP(5)
64 : PUSH(2, 5)
65 : POP(8)
66 : PUSH(2, 8)
67 : POP(9)
68 : PUSH(2, 9)
69 : POP(4)
70 : PUSH(2, 4)
71 : POP(2)
72 : PUSH(2, 2)
73 : IN(1)
74 : OUT(1)
75 : POP(2)
76 : OUT(2)
77 : POP(4)
78 : PUSH(1, 4)
79 : POP(9)
80 : PUSH(1, 9)
81 : POP(8)
82 : PUSH(1, 8)
83 : POP(5)
84 : PUSH(1, 5)
85 : POP(3)
86 : PUSH(1, 3)
87 : POP(7)
88 : PUSH(1, 7)
89 : POP(6)
90 : PUSH(1, 6)
91 : POP(6)
92 : PUSH(2, 6)
93 : POP(7)
94 : PUSH(2, 7)
95 : POP(3)
96 : OUT(3)
```

```
97 : POP(5)
98 : PUSH(2, 5)
99 : POP(8)
100 : PUSH(2, 8)
101 : POP(9)
102 : PUSH(2, 9)
103 : POP(4)
104 : PUSH(2, 4)
105 : POP(4)
106 : OUT(4)
107 : POP(9)
108 : PUSH(1, 9)
109 : POP(8)
110 : PUSH(1, 8)
111 : POP(5)
112 : PUSH(1, 5)
113 : POP(7)
114 : PUSH(1, 7)
115 : POP(6)
116 : PUSH(1, 6)
117 : POP(6)
118 : PUSH(2, 6)
119 : POP(7)
120 : PUSH(2, 7)
121 : POP(5)
122 : OUT(5)
123 : POP(8)
124 : PUSH(2, 8)
125 : POP(9)
126 : PUSH(2, 9)
127 : POP(9)
128 : PUSH(1, 9)
129 : POP(8)
130 : PUSH(1, 8)
131 : POP(7)
132 : PUSH(1, 7)
133 : POP(6)
134 : OUT(6)
135 : POP(7)
136 : OUT(7)
137 : POP(8)
138 : PUSH(2, 8)
139 : POP(9)
140 : PUSH(2, 9)
141 : POP(9)
142 : PUSH(1, 9)
143 : POP(8)
144 : OUT(8)
145 : POP(9)
146 : OUT(9)
```

입력 큐 만들기

- 문제 내용 : 키보드로부터 문자를 입력 받아 사용자가 원하면 그 개수만큼 빼서 사용자에게 돌려주는 표준입력 큐를 만들고 동작을 표시하는 프로그램.
  입력 큐는 20 글자 크기를 갖는다. 입력 큐의 범위를 초과하면 받아들일 수 없다(에러 표시).

- 실행 예)

>>> **HELLOWORLD**

ADDQUEUE(H)   Queue Size=1/20

ADDQUEUE(E)   Queue Size=2/20

...

ADDQUEUE(D)   Queue Size=10/20

>>> **3**

DELETEQUEUE( ) = H, Queue Size=9/20

DELETEQUEUE( ) = E, Queue Size=8/20

DELETEQUEUE( ) = L, Queue Size=7/20

>>> **GOODMORNING**

ADDQUEUE(G)   Queue Size=8/20

ADDQUEUE(O)   Queue Size=9/20

...

ADDQUEUE(G)   Queue Size=18/20

>>> **PYTH**

ADDQUEUE(P)   Queue Size=19/20

ADDQUEUE(Y)   Queue Size=20/20

ADDQUEUE(T) Fail : Queue Full   Queue Size=20/20

ADDQUEUE(H) Fail : Queue Full   Queue Size=20/20

>>> **2**

DELETEQUEUE( ) = L, Queue Size=19/20

DELETEQUEUE( ) = O, Queue Size=18/20

- 해결 방안 :

클래스 : myQueue (안에 addQ메서드와 delQ메서드 sizeQ메서드가 있음

메서드 : addQ메서드와 delQ메서드 sizeQ메서드

변수 : main 안에있는 queue, user로 부터 input 받는 word

전체적인 흐름 :

    1. main을 실행하면 queue를 생성하고 while문이 계속 돈다 #(탈출 조건" : no를 입력"을 만들었었지만 과제에는 없기에 주석처리)

    2. user로 부터 input을 받아 word에 저장한다.

    3-1. word가 숫자면 delQ메서드를 실행한다.
        이 때 파라미터로 word값을 전달한다.

    3-2. word가 string이면 addQ메서드를 실행한다.
        이 때 파라미터로 word값을 전달한다.

    4-1. delQ메서드에서는 입력받은 word(int)의 크기만큼 for문을 돌며 queue에 들어있는 값을 출력한다.- delQ() (비어있으면 오류 출력)

    4-2. addQ메서드에서는 입력받은 word(str)를 하나씩 읽으며 for문을 돌며 queue에 넣는다 - addQ(char) (꽉 차있으면 오류 출력)

    5. 각각의 메서드에서는 print를 이용하여 실행 예)와 동일한 문장들을 출력한다.

추가정보 : jupyter notebook에서 코딩하였습니다. 확장자도 .ipynb입니다.

- 결과 표시 :

Test case

HELLOWORLD, 3, GOODMORNING, PYTH, 2.

```
In [*]: main()

HELLOWORLD
ADDQUEUE( H )  Queue Size=  1 /20
ADDQUEUE( E )  Queue Size=  2 /20
ADDQUEUE( L )  Queue Size=  3 /20
ADDQUEUE( L )  Queue Size=  4 /20
ADDQUEUE( O )  Queue Size=  5 /20
ADDQUEUE( W )  Queue Size=  6 /20
ADDQUEUE( O )  Queue Size=  7 /20
ADDQUEUE( R )  Queue Size=  8 /20
ADDQUEUE( L )  Queue Size=  9 /20
ADDQUEUE( D )  Queue Size=  10 /20
3
DELETEQUEUE() =  H  Queue Size= 9 /20
DELETEQUEUE() =  E  Queue Size= 8 /20
DELETEQUEUE() =  L  Queue Size= 7 /20
GOODMORNING
ADDQUEUE( G )  Queue Size=  8 /20
ADDQUEUE( O )  Queue Size=  9 /20
ADDQUEUE( O )  Queue Size=  10 /20
ADDQUEUE( D )  Queue Size=  11 /20
ADDQUEUE( M )  Queue Size=  12 /20
ADDQUEUE( O )  Queue Size=  13 /20
ADDQUEUE( R )  Queue Size=  14 /20
ADDQUEUE( N )  Queue Size=  15 /20
ADDQUEUE( I )  Queue Size=  16 /20
ADDQUEUE( N )  Queue Size=  17 /20
ADDQUEUE( G )  Queue Size=  18 /20
PYTH
ADDQUEUE( P )  Queue Size=  19 /20
ADDQUEUE( Y )  Queue Size=  20 /20
ADDQUEUE( T ) Fail : Queue Full  Queue Size= 20 /20
ADDQUEUE( H ) Fail : Queue Full  Queue Size= 20 /20
2
DELETEQUEUE() =  L  Queue Size= 19 /20
DELETEQUEUE() =  O  Queue Size= 18 /20
```

Queue Empty를 확인

```
: main()

hithisisseungwanpark
ADDQUEUE( h )  Queue Size=  1 /20
ADDQUEUE( i )  Queue Size=  2 /20
ADDQUEUE( t )  Queue Size=  3 /20
ADDQUEUE( h )  Queue Size=  4 /20
ADDQUEUE( i )  Queue Size=  5 /20
ADDQUEUE( s )  Queue Size=  6 /20
ADDQUEUE( i )  Queue Size=  7 /20
ADDQUEUE( s )  Queue Size=  8 /20
ADDQUEUE( s )  Queue Size=  9 /20
ADDQUEUE( e )  Queue Size=  10 /20
ADDQUEUE( u )  Queue Size=  11 /20
ADDQUEUE( n )  Queue Size=  12 /20
ADDQUEUE( g )  Queue Size=  13 /20
ADDQUEUE( w )  Queue Size=  14 /20
ADDQUEUE( a )  Queue Size=  15 /20
ADDQUEUE( n )  Queue Size=  16 /20
ADDQUEUE( p )  Queue Size=  17 /20
ADDQUEUE( a )  Queue Size=  18 /20
ADDQUEUE( r )  Queue Size=  19 /20
ADDQUEUE( k )  Queue Size=  20 /20
hi
ADDQUEUE( h ) Fail : Queue Full  Queue Size= 20 /20
ADDQUEUE( i ) Fail : Queue Full  Queue Size= 20 /20
23
DELETEQUEUE() =  h  Queue Size= 19 /20
DELETEQUEUE() =  i  Queue Size= 18 /20
DELETEQUEUE() =  t  Queue Size= 17 /20
DELETEQUEUE() =  h  Queue Size= 16 /20
DELETEQUEUE() =  i  Queue Size= 15 /20
DELETEQUEUE() =  s  Queue Size= 14 /20
DELETEQUEUE() =  i  Queue Size= 13 /20
DELETEQUEUE() =  s  Queue Size= 12 /20
DELETEQUEUE() =  s  Queue Size= 11 /20
DELETEQUEUE() =  e  Queue Size= 10 /20
DELETEQUEUE() =  u  Queue Size= 9 /20
DELETEQUEUE() =  n  Queue Size= 8 /20
DELETEQUEUE() =  g  Queue Size= 7 /20
DELETEQUEUE() =  w  Queue Size= 6 /20
DELETEQUEUE() =  a  Queue Size= 5 /20
DELETEQUEUE() =  n  Queue Size= 4 /20
DELETEQUEUE() =  p  Queue Size= 3 /20
DELETEQUEUE() =  a  Queue Size= 2 /20
DELETEQUEUE() =  r  Queue Size= 1 /20
DELETEQUEUE() =  k  Queue Size= 0 /20
DELETEQUEUE() Fail, Queue Empty Queue Size= 0 /20
DELETEQUEUE() Fail, Queue Empty Queue Size= 0 /20
DELETEQUEUE() Fail, Queue Empty Queue Size= 0 /20
```

선택정렬/ 퀵정렬/ 힙정렬

- 문제 내용 :

  다음의 구성을 가진 데이터 5만 명분을 랜덤하게 생성한다.

  – 학번(13-19년도에 입학한 학생의 9자리 숫자), 이름(10자 크기의 영문자 임의의 문자), 전화번호(010 으로 시작하는 11자리 숫자)

  동일한 데이터에 대해 선택 정렬, 퀵 정렬, 힙 정렬을 수행한 후 결과를 비교하자.

  – 정렬의 기준은 학번으로 1회, 이름으로 1회 한다. 정렬이 잘 되었는지 확인하자.

  – 5만 명의 데이터를 모두 화면에 출력하면 시간이 너무 오래 걸리니 정렬이 잘 되었음을 증명하는 방법을 알아보자(적당히 건너뛰며 100개만 표시한다든지).

  – 정렬에 소요되는 시간이 얼마나 되는지 화면에 표시하자. 학번으로 정렬할 때와 이름으로 정렬할 때 각각 표시한다.

- 해결 방안 :

클래스 : 메서드로만 진행하자

메서드 : selection_sort_name, selection_sort_stdnum,
　　　　 Quick_sort_name, quick_sort_stdnum,
　　　　 Heap_sort_name, adjust_name,
　　　　 Heap_sort_stdnum, adjust_stdnum
　　　　 전체적으로 난수생성하고 위의 정렬 메서드들 불러내는 Main함수

변수 : 시간계산을 위한 time관련, 인덱스/학번/이름/전화번호를 각각 담을 이중리스트(myList)
　　　 데이터의 개수를 수정할 lim_num, 학번에서 입학년도를 위한 year리스트

- 결과 표시 :

```
----                        ----
selection_sort_stdnum       selection_sort_name

[190411] 23:07:38           [190411] 23:15:38
[190411] 23:15:35           [190411] 23:23:30
소요시간 : 476.9746초        소요시간 : 472.0928초
                            ----
                            quick_sort_name
----
quick_sort_stdnum           [190411] 23:23:30
                            [190411] 23:23:30
[190411] 23:15:35           소요시간 : 0.4666초
[190411] 23:15:36           ----
소요시간 : 1.0084초          heap_sort_name
----
heap_sort_stdnum            [190411] 23:23:30
                            [190411] 23:23:31
[190411] 23:15:36           소요시간 : 1.1019초
[190411] 23:15:38
소요시간 : 1.5227초
```

데이터 5만개의 소요시간 (선택정렬이 몹시 느리다.)

데이터 뽑기.

```
lim_num = 50000
step = 500
```

5만개의 데이터를 500개씩 건너뛰며 100개를 뽑는다.

그런데 만든 알고리즘에서는 selection sort를 출력 할 때에 같은 seletionsort를 한 번 더 돌려서 출력하기에 각 라인의 출력시 476초가 더 걸린다.

즉 약 500의 제곱 초만큼의 시간이 걸리므로 출력하기에 부적절하다.

그러므로 selection sort에 한에서 만은 데이터 50000개가 아니라 1000개에 10개씩 건너뛰며 100개를 뽑는 것으로 대체한다.

```
total_start = time.time()
total_start_time = time.strftime("[%y%m%d] %X", time.localtime())
lim_num = 1000
step = 10
year = [13, 14, 15, 16, 17, 18, 19]
myList = [[] for i in range(lim_num)]
```

Selection_sort_stdnum (데이터 1000개)

```
selection_sort_stdnum

[190414] 08:40:36
[190414] 08:40:36
소요시간 : 0.1273초
[320, '130265156', 'kxvyemuofw', '01029942068']
[733, '130966417', 'lffjvoiskf', '01009831631']
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[80, '134697807', 'mgbfyyryee', '01074829622']
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Selection_sort_name (데이터 1000개)

```
selection_sort_name

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[190414] 08:40:36
소요시간 : 0.1249초
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[666, '164496534', 'uqjcveconc', '01030120797']
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```

Quick_sort_stdnum(데이터 5만개)

```
quick_sort_stdnum

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[190412] 10:19:14
소요시간 : 0.806초
[24225, '130000055', 'ilbnlllory', '01030786049']      [49841, '165749069', 'rxrrrrwkci', '01042264859']
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[7807, '134079101', 'wokgurortu', '01055093781']       [1173, '169868127', 'aseyatswee', '01026655699']
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[3109, '137550136', 'jqnpouhnsg', '01030454281']       [36718, '173403255', 'dzpvmfsqwu', '01098730490']
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heap_sort_stdnum (데이터 5만개)

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Heap_sort_name (데이터 5만개)

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[28726, '176566869', 'nvdvxfvrbo', '01000003644']    [14399, '162191210', 'zthdvkbptz', '01005222318']
[6065, '182361524', 'ocecbmfrdt', '01077635598']
[39705, '184026883', 'oijkxixuth', '01099759485']
```

추가적으로 데이터를 추출하여 저장하는 방법은 이중 리스트를 사용하였다.
주요코드 :
year = [13, 14, 15, 16, 17, 18, 19] #학번 앞자리의 년도
myList = [[] for i in range(lim_num)] #이중리스트

```python
for i in range(lim_num):
    myList[i].append(int(i)) #인덱스 값 (시각적으로 편함)
        #학번
    myList[i].append(str(random.choice(year)) + ''.join(random.choice(string.digits) for _ in range(7)))
        #이름
    myList[i].append(''.join(random.choice(string.ascii_lowercase) for _ in range(10)))
        #전화번호
    myList[i].append("010" + ''.join(random.choice(string.digits) for _ in range(8)))
```

퀵정렬의 비재귀 호출버전

- 문제 내용

퀵 정렬을 만들되, 재귀 호출을 쓰지 않도록 만든다.

힌트 : 스택

5)에 있는 퀵 정렬(재귀 호출)과 성능을 비교하자(학번으로 정렬하는 경우만 생각하자).

어느 것이 얼만큼 빠른지 결과를 비교하라.

- 해결 방안 :

클래스 : 메서드로만 진행하자

메서드 : quick_sort_stdnum, quick_sort_iter_stdnum

　　　　전체적으로 난수생성하고 위의 정렬 메서드들 불러내는 Main함수

변수 : 시간계산을 위한 time관련, 인덱스/학번/이름/전화번호를 각각 담을 이중리스트(myList)

　　　　데이터의 개수를 수정할 lim_num, 학번에서 입학년도를 위한 year리스트

- 결과 표시 :

적은 데이터!

Data 7개 일 때 : 대체적으로 recursive가 더 빠르지만, 인풋의 상태에 따라 다르다

```
----
quick_sort_stdnum

[190412] 09:20:42
[190412] 09:20:42
소요시간 : 0.0003초


----
quick_sort_iter_stdnum

[190412] 09:20:42
[190412] 09:20:42
소요시간 : 0.0004초
```

1~50000개의 데이터를 정렬하고 500단위로 넘기며 100개 출력 (recursive 사용)

```
quick_sort_stdnum

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[2267, '131456234', 'tffcipbzuq', '01038049101']
[28139, '132189404', 'bggshheukk', '01049467937']
[38690, '132854683', 'mcamaibspv', '01068902530']
[3897, '133497385', 'evyidlpief', '01050844213']
[33056, '134192488', 'huhclldkdn', '01066377034']
[2563, '134938986', 'fuowzqsypv', '01066907499']
[4094, '135672192', 'nfhlaqkhlb', '01081860838']
[26760, '136403059', 'jgoxakcxwl', '01079439563']
[47690, '137112597', 'fiksflrjls', '01088756807']
[2006, '137841029', 'jreivlnfwh', '01040027820']
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[8628, '139241379', 'uwfikqbxfo', '01011228077']
[19215, '139967623', 'fzpakoleun', '01044098729']
[25653, '140656544', 'ievnbwzkbh', '01070209698']
[13501, '141349437', 'izwotqkide', '01085887237']
[25319, '142064503', 'tejssabexg', '01079784980']
[13907, '142764471', 'dirvlfzvhw', '01095765501']
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[10353, '146267894', 'yrpkyohvam', '01004036933']
[29189, '146994526', 'wlpiohacfl', '01042734113']
[39767, '147684076', 'slwkuzdalc', '01040687783']
[48933, '148417393', 'ctacozgjpy', '01066022803']
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[23781, '149816426', 'dnqntehdoj', '01093306534']
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[33693, '151898511', 'ryuetzkqbg', '01009401822']
[42016, '152594471', 'ptpawmsrxp', '01041776939']
[16276, '153271394', 'vmitzsjeoj', '01078409778']
[6136, '153960077', 'ecghplgfej', '01044059255']
[30094, '154685234', 'ntivqaijlc', '01080858504']
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[19047, '156006572', 'rztdfpyvux', '01034935643']
[29896, '156719526', 'yeuvyjkwuh', '01086197475']
[38994, '157481144', 'jjjjnuyief', '01010253901']
[29120, '158181560', 'lcbtfahfur', '01098428919']
[22534, '158904462', 'vkbkeliiuv', '01039596874']
[47860, '159608102', 'gmeicxdsly', '01050888739']
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[43362, '167940658', 'uutztgbpcg', '01022358729']
[36394, '168644442', 'muxqdxeybc', '01034912674']
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```
[4423, '169323043', 'kmewbrzyfh', '01074228317']
[7054, '169984647', 'qplkxvafdw', '01090856402']
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[2698, '171413775', 'kgdiyupnvs', '01023618824']
[8141, '172144009', 'ekfoffkvgo', '01098141099']
[35629, '172836779', 'bqbhxwryrl', '01099694195']
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[7445, '177674713', 'hvdvroumdg', '01032847880']
[6226, '178364663', 'pgydbebnny', '01083571225']
[31686, '179106890', 'fielxklhrz', '01042498887']
[40325, '179773591', 'bgkxuolciz', '01017886426']
[16418, '180412985', 'cvnsigkgis', '01051390426']
[28210, '181106268', 'popkqidsun', '01010457068']
[45886, '181764743', 'zsricwlydn', '01055423961']
[41645, '182475625', 'uubybhvahi', '01043977553']
[35912, '183154719', 'coubsarbbj', '01011068562']
[8297, '183927777', 'ylyutgtyoz', '01075592270']
[36514, '184618982', 'hoieqfgcxa', '01067294462']
[45479, '185301435', 'bzlsmsrdpn', '01076727865']
[28034, '185988856', 'nbthwgsnbg', '01038988252']
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[38810, '188081567', 'xpssvgbwmm', '01092949076']
[18107, '188781695', 'fzcarijmyz', '01001860903']
[5769, '189508486', 'hqxzqitxfu', '01025112387']
[37170, '190187224', 'hhyveomqmo', '01022378050']
[37897, '190895522', 'pzkqwcenxq', '01054729574']
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[17273, '192343547', 'uxxpxkngwn', '01018890952']
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[19648, '193827893', 'ltadoywedu', '01008853730']
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[12162, '195157641', 'nukgrdbdln', '01088863482']
[3965, '195826191', 'xrmkurzomj', '01047433684']
[37062, '196529865', 'vhknljegps', '01088337816']
[1759, '197219385', 'qlhfhygvsm', '01019599281']
[15684, '197878982', 'gworbydjjf', '01004021426']
[838, '198577977', 'rgoenevslv', '01059751916']
[20041, '199294724', 'liubucffbh', '01022769135']
[24686, '199999981', 'todjalvnzh', '01031719705']
```

1~50000개의 데이터를 정렬하고 500단위로 넘기며 100개 출력 (iterative 사용)

```
quick_sort_iter_stdnum

[190412] 09:16:38
[190412] 09:16:38
소요시간 : 0.4174초
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[33056, '134192488', 'huhclldkdn', '01066377034']
[2563, '134938986', 'fuowzqsypv', '01066907499']
[4094, '135672192', 'nfhlaqkhlb', '01081860838']
[26760, '136403059', 'jgoxakcxwl', '01079439563']
[47690, '137112597', 'fiksflrjls', '01088756807']
[2006, '137841029', 'jreivlnfwh', '01040027820']
[17778, '138557706', 'dfshskakde', '01048890990']
[8628, '139241379', 'uwfikqbxfo', '01011228077']
[19215, '139967623', 'fzpakoleun', '01044098729']
[25653, '140656544', 'ievnbwzkbh', '01070209698']
[13501, '141349437', 'izwotqkide', '01085887237']
[25319, '142064503', 'tejssabexg', '01079784980']
[13907, '142764471', 'dirvlfzvhw', '01095765501']
[16095, '143446750', 'vxsrkzefxe', '01087849086']
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[48933, '148417393', 'ctacozgjpy', '01066022803']
[14296, '149080243', 'cqcqtmjxjo', '01049659164']
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[49761, '150469485', 'rxjsujwmld', '01028851348']
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[42016, '152594471', 'ptpawmsrxp', '01041776939']
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[5502, '155338674', 'lfrwmqorhj', '01003191404']
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[29996, '156719526', 'yeuvyjkwuh', '01086197475']
[38994, '157481144', 'jjjjnuyief', '01010253901']
[29120, '158181560', 'lcbtfahfur', '01098428919']
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[3855, '166490220', 'zghokeirnf', '01003490917']
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[43362, '167940658', 'uutztgbpcg', '01022358729']
[36394, '168644442', 'muxqdxeybc', '01034912674']
```

```
[4423, '169323043', 'kmewbrzyfh', '01074228317']
[7054, '169984647', 'qplkxvafdw', '01090856402']
[17479, '170691313', 'lvqkkpuhzd', '01068016723']
[2698, '171413775', 'kgdiyupnvs', '01023618824']
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[38810, '188081567', 'xpssvgbwmm', '01092949076']
[18107, '188781695', 'fzcarijmyz', '01001860903']
[5769, '189508486', 'hqxzqitxfu', '01025112387']
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[24686, '199999981', 'todjalvnzh', '01031719705']
```

결론 :
많은 양의 데이터를 처리할 Iterative가 recursive보다 더 빠름을 알 수 있다.
(각각 0.41s, 0.88s)

감사합니다.