프로그래밍 실습 #7

2023년 11월 1주차

□ 다음 탐색 알고리즘을 파이썬으로 구현해 보라.

(1) bitskey 클래스

bitskey 클래스에서 비트 단위 연산을 어떻게 수행하는지 확인한다.

```
-----------------------------------------------------------------
class bitskey:
    def __init__(self, x):
        self.x = x

    def get(self):
        return self.x

    def bits(self, k, j):
        return (self.x >> k) & ~(~0 << j)

a = int(input('입력 : '))
while a != 999:
    v = bitskey(a)
    print('키값 :',  v.get())
    print(v.bits(4, 1))
    print(v.bits(3, 1))
    print(v.bits(2, 1))
    print(v.bits(1, 1))
    print(v.bits(0, 1))
    a = int(input('a = '))
-----------------------------------------------------------------
```

(2) 디지털 탐색 트리

Dict 클래스에 check(self, v) 함수를 추가하여 디지털 탐색 트리가 제대로 생성되었는지 검사한다.

```
----------------------------------------------------------------
[1, 19, 5, 18, 3, 26, 9]
key :  1, parents:  1
key :  3, parents:  5
key :  5, parents:  1
key :  9, parents:  5
key :  18, parents:  19
key :  19, parents:  1
key :  26, parents:  19
----------------------------------------------------------------
```

```
----------------------------------------------------------------
```

```
maxb = 5

class bitskey:
    def __init__(self, x):
        self.x = x

    def get(self):
        return self.x

    def bits(self, k, j):
        return (self.x >> k) & ~(~0 << j)

class node:
    def __init__(self, key):
        self.key = bitskey(key)
        self.left = None
        self.right = None
```

```
class Dict:
    itemMin = bitskey(0)

    z = node(itemMin)
    head = node(itemMin)
    head.left = z
    head.right = z

    def search(self, v):
        v = bitskey(v)
        x = self.head.left
        b = maxb
        self.z.key = v
        while v.get() != x.key.get():
            b -= 1
            if v.bits(b, 1):
                x = x.right
            else:
                x = x.left
        if x == self.z:
            return -1
        else:
            return x.key.get()

    def insert(self, v):
        v = bitskey(v)
        b = maxb-1
        x = self.head.left
        p = self.head

        while x.key.get() != self.z.key.get():
            p = x
            if v.bits(b, 1):
```

```
                x = x.right
            else:
                x = x.left
            b -= 1
        x = node(self.itemMin)
        x.key = v
        x.left = self.z
        x.right = self.z
        if v.bits(b+1, 1):
            p.right = x
        else:
            p.left = x

    def check(self, v):
        pass

N = 7
key = [1, 19, 5, 18, 3, 26, 9]
s_key = [1, 19, 5, 18, 3, 26, 9]
s_key.sort()

d = Dict()
for i in range(N):
    d.insert(key[i])
print(key)
for i in range(N):
    d.check(s_key[i])
```

---

(3) 기수 탐색 트라이

Dict 클래스에 check(self, v) 함수를 추가하여 기수 탐색 트라이가 제대로 생성되었는지 검사한다.

```
----------------------------------------------------------------
[1, 19, 5, 18, 3, 26, 9]
1 left left left left
3 left left left right
5 left left right
9 left right
18 right left left right left
19 right left left right right
26 right right
----------------------------------------------------------------
```

```
----------------------------------------------------------------
maxb = 5

class bitskey:
    def __init__(self, x):
        self.x = x

    def get(self):
        return self.x

    def bits(self, k, j):
        return (self.x >> k) & ~(~0 << j)

class node:
    def __init__(self, key):
        if key.get() == 0:
            self.key = bitskey(0)
            self.external = False
```

```
        else :
            self.key = key
            self.external = True
        self.left = 0
        self.right = 0

class Dict:
    itemMin = bitskey(0)
    head = 0
    head_check = False

    def search(self, v):
        v = bitskey(v)
        return self.searchR(self.head, v, maxb-1)

    def insert(self, v):
        v = bitskey(v)
        self.insertR(self.head, v, maxb-1)

    def insertR(self, h, v, d):
        if h == 0:
            h = node(v)
            if self.head_check == False:
                self.head = h
            return h
        if h.external:
            leaf = node(v)
            h = self.split(leaf, h, d)
            if self.head_check == False:
                self.head = h
                self.head_check = True
            return h
        if v.bits(d, 1) == 0:
            h.left = self.insertR(h.left, v, d-1)
```

```
            else:
                h.right = self.insertR(h.right, v, d-1)
            return h

        def split(self, p, q, d):
            t = node(self.itemMin)
            if ((p.key.bits(d, 1))*2 + (q.key.bits(d, 1))) == 0:
                t.left = self.split(p, q, d-1)
            elif ((p.key.bits(d, 1))*2 + (q.key.bits(d, 1))) == 1:
                t.left = p
                t.right = q
            elif ((p.key.bits(d, 1))*2 + (q.key.bits(d, 1))) == 2:
                t.right = p
                t.left = q
            elif ((p.key.bits(d, 1))*2 + (q.key.bits(d, 1))) == 3:
                t.right = self.split(p, q, d-1)
            return t

        def searchR(self, h, v, d):
            if h == 0:
                return self.itemMin
            if v.get() == h.key.get():
                return v
            if v.bits(d, 1) == 0:
                return self.searchR(h.left, v, d-1)
            else:
                return self.searchR(h.right, v, d-1)

        def check(self, v):
            pass

N = 7
key = [1, 19, 5, 18, 3, 26, 9]
s_key = [1, 19, 5, 18, 3, 26, 9]
```

```
s_key.sort()

d = Dict()
for i in range(N):
    d.insert(key[i])
print(key)
d.head.external = True
for i in range(N):
    d.check(s_key[i])
-----------------------------------------------------------------------
```

(4) 패트리샤 트리

Dict 클래스에 check(self, v) 함수를 추가하여 패트리샤 트리가 제대로 생성되었는지 검사한다.

```
------------------------------------------------------------------
[1, 19, 5, 18, 3, 26, 9]
key : 1, parents: 3, number: 0
key : 3, parents: 5, number: 1
key : 5, parents: 9, number: 2
key : 9, parents: 19, number: 3
key : 18, parents: 26, number: 0
key : 19, parents: 19, number: 4
key : 26, parents: 19, number: 3
------------------------------------------------------------------

------------------------------------------------------------------
maxb = 5

class bitskey:
    def __init__(self, x):
        self.x = x

    def get(self):
        return self.x

    def bits(self, k, j):
        return (self.x >> k) & ~(~0 << j)

class node:
    def __init__(self, key):
        self.key = key
        self.b = None
        self.left = None
```

```
            self.right = None

class Dict():
    itemMin = bitskey(0)
    head = node(itemMin)
    head.b = maxb
    head.left = head.right = head

    def search(self, v):
        v = bitskey(v)
        p = self.head
        x = self.head.left
        while p.b > x.b:
            p = x
            if self.bits(v, x.b, 1):
                x = x.right
            else:
                x = x.left
        if v.get() != x.key.get(): return self.itemMin
        return x.key

    def insert(self, v):
        v = bitskey(v)
        i = maxb
        p = self.head
        t = self.head.left
        while p.b > t.b:
            p = t
            if self.bits(v, t.b, 1):
                t = t.right
            else:
                t = t.left
        if v.get() == t.key.get(): return
        while self.bits(t.key, i, 1) == self.bits(v, i, 1):
```

```
            i -= 1
        p = self.head
        x = self.head.left
        while p.b > x.b and x.b > i:
            p = x
            if self.bits(v, x.b, 1):
                x = x.right
            else:
                x = x.left
        t = node(self.itemMin)
        t.key = v
        t.b = i
        if self.bits(v, t.b, 1):
            t.left = x
            t.right = t
        else:
            t.left = t
            t.right = x

        if self.bits(v, p.b, 1):
            p.right = t
        else:
            p.left = t

    def bits(self, item, bit, cmp):
        if item.bits(bit, 1) == cmp:
            return 1
        else:
            return 0

    def check(self, v):
        pass

import random, time
```

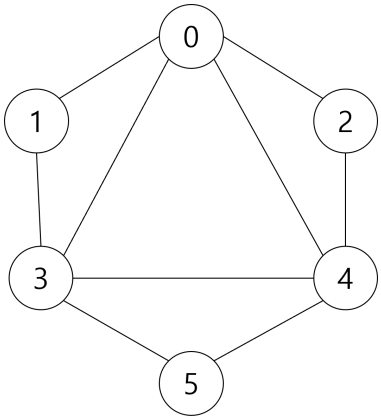
```
N = 7
key = [1, 19, 5, 18, 3, 26, 9]
s_key = [1, 19, 5, 18, 3, 26, 9]
#key = [7, 20, 17, 4, 9, 21, 23, 13]
#s_key = [7, 20, 17, 4, 9, 21, 23, 13]
s_key.sort()

d = Dict()
for i in range(N):
    d.insert(key[i])
print(key)
for i in range(N):
    d.check(s_key[i])
```

□ 그래프 탐색 알고리즘

(1) 깊이 우선 탐색 (Depth First Search: DFS) 알고리즘

다음과 같은 그래프를 파이썬 리스트로 표현하면 다음과 같다.



```
a = [[1, 2, 3, 4, None],
     [0, 3, None],
     [0, 4, None],
     [0, 1, 4, 5, None],
     [0, 2, 3, 5, None],
     [3, 4, None]]
```

다음과 같은 소스 코드를 사용하여 DFS 알고리즘을 파이썬으로 구현하라.

```
-----------------------------------------------------------------
def dfs(v):



n = 6
a = [[1, 2, 3, 4, None], [0, 3, None], [0, 4, None], [0, 1, 4, 5, None], [0, 2,
3, 5, None], [3, 4, None]]
for i in range(n):
    visited = [False] * n
    print('dfs(%d) : '%i, end='')
    dfs(i)
    print()
-----------------------------------------------------------------
```

[실행 예]

```
-----------------------------------------------------------------
dfs(0) : 0 1 3 4 2 5
dfs(1) : 1 0 2 4 3 5
dfs(2) : 2 0 1 3 4 5
dfs(3) : 3 0 1 2 4 5
dfs(4) : 4 0 1 3 5 2
dfs(5) : 5 3 0 1 2 4
-----------------------------------------------------------------
```

(2) 너비 우선 탐색 (Breadth First Search: DFS) 알고리즘

다음과 같은 소스 코드를 사용하여 BFS 알고리즘을 파이썬으로 구현하라. BFS 알고리즘을 구현할 때 queue 라이브러리를 사용하라.

```
-----------------------------------------------------------------
def bfs(v):



import queue
q = queue.Queue()
n = 6
a = [[1, 2, 3, 4, None], [0, 3, None], [0, 4, None], [0, 1, 4, 5, None], [0, 2, 3, 5, None], [3, 4, None]]
for i in range(n):
    visited = [False] * n
    print('bfs(%d) : '%i, end='')
    bfs(i)
    print()
-----------------------------------------------------------------
```

[실행 예]

```
-----------------------------------------------------------------
bfs(0) : 0 1 2 3 4 5
bfs(1) : 1 0 3 2 4 5
bfs(2) : 2 0 4 1 3 5
bfs(3) : 3 0 1 4 5 2
bfs(4) : 4 0 2 3 5 1
bfs(5) : 5 3 4 0 1 2
-----------------------------------------------------------------
```