

Full Name: _____

AID: _____

CS 331 Midterm Exam Worksheet

WP1 (/8) :
WP2 (/8) :
WP3 (/8) :
TOTAL (/24) :

Linked Stack

WP1

```
class Stack:
    class Node:
        def __init__(self, val, next=None):
            self.val = val
            self.next = next

    def __init__(self):
        self.top = None

    def push(self, val):
        self.top = Stack.Node(val, self.top)

    def pop(self):
        val = self.top.val
        self.top = self.top.next
        return val

    def remove_all(self, val):
        while self.top and self.top.val == val:
            self.top = self.top.next
        n = self.top
        while n:
            if n.next and n.next.val == val:
                n.next = n.next.next
            else:
                n = n.next
```

Hashtable

WP2

```
class Hashtable:
    class Node:
        def __init__(self, key, val, next=None):
            self.key = key
            self.val = val
            self.next = next

    def __init__(self, n_buckets=1000):
        self.buckets = [None] * n_buckets

    def __setitem__(self, key, val):
        bucket_idx = hash(key) % len(self.buckets)
        b = self.buckets[bucket_idx]
        while b:
            if b.key == key:
                b.val = val
                return
            b = b.next
        else:
            n = Hashtable.Node(key, val, next=self.buckets[bucket_idx])
            self.buckets[bucket_idx] = n

    def collision_ratio(self):
        n_occupied = 0
        n_has_collisions = 0
        for b in self.buckets:
            if b:
                n_occupied += 1
                if b.next:
                    n_has_collisions += 1
        return n_has_collisions / n_occupied
```

Heaps

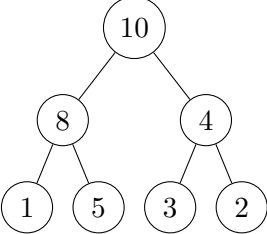
WP3 (a)

(a) After adding 4	(b) After adding 6	(c) After adding 8

(d) After adding 3	(e) After adding 5	(f) After adding 7

(g) After adding 9

WP3 (b)

Start	(a) After removing max	(b) After removing max
 <pre>graph TD; 10((10)) --- 8((8)); 10 --- 4((4)); 8 --- 1((1)); 8 --- 5((5)); 4 --- 3((3)); 4 --- 2((2));</pre>		

(c) After removing max	(d) After removing max	(e) After removing max

(f) After removing max	(g) After removing max