1. _______/15
2. _______/10
3. _______/10
4. _______/18
5. _______/8
6. _______/13
7. _______/15
8. _______/9
9. _______/1
10. _______/1

Total _______/100

This quiz is open book and open notes, but do not use a computer.

Please write your name on the top of each page. Answer all questions in the boxes provided.

1) Are each of the following True or False (15 points)

1.1. In Python the values of a dict must be immutable. FALSE. The values of keys must be immutable.

1.2. There exist problems that cannot be solved in Python without using either iteration or recursion. TRUE. Otherwise, the complexity of programs would be bound by the length of the code.

1.3. Floating point arithmetic behaves exactly like normal arithmetic on real numbers. FALSE. Floating point provides only an approximation to real numbers.

1.4. On all inputs, a bisection search will run faster than a linear search. FALSE. It has a higher asymptotic complexity, but there can be inputs on which it will run more slowly. Consider, for example, searching for an element that happens to be the first element of the list.

1.5. Let \( L \) be a list, each element of which is a list of ints. In Python, the assignment statement \( L[0][0] = 3 \) mutates the list \( L \). FALSE, it mutates the list at \( L[0] \).
2) What does the following code print? (10 points)

```python
T = (0.1, 0.1)
x = 0.0
for i in range(len(T)):
    for j in T:
        x += i + j
    print x
print i
```

```
0.1
0.2
1.3
2.4
1
```
3) What does the following code print? (10 points)

```python
def f(s):
    if len(s) <= 1:
        return s
    return f(f(s[1:])) + s[0]  # Note double recursion

print f('mat')
print f('math')

atm
hatm
```
4) Implement the body of the function specified in the box. (18 points)

```python
def findAll(wordList, letters):
    """assumes: wordList is a list of words in lowercase. letters is a str of lowercase letters. No letter occurs in letters more than once returns: a list of all the words in wordList that contain each of the letters in letters exactly once and no letters not in letters."""
    result = []
    letters = sorted(letters)
    for w in wordList:
        w = sorted(w)
        if w == letters:
            result.append(w)
    return result
```
5) The following code does not meet its specification. Correct it. (8 points)

def addVectors(v1, v2):
    """assumes v1 and v2 are lists of ints.
    Returns a list containing the pointwise sum of
    the elements in v1 and v2. For example,
    addVectors([4,5], [1,2,3]) returns [5,7,3], and
    addVectors([], []) returns []. Does not modify inputs."""
    if len(v1) > len(v2):
        result = v1
        other = v2
    else:
        result = v2
        other = v1
    for i in range(len(other)):
        result[i] += other[i]
    return result

insert the lines

v1 = v1[:]
v2 = v2[:]

before the first line of executable code.
6) Consider the following code:

```python
def f(s, d):
    for k in d.keys():
        d[k] = 0
    for c in s:
        if c in d:
            d[c] += 1
        else: d[c] = 0
    return d

def addUp(d):
    result = 0
    for k in d:
        result += d[k]
    return result

d1 = {}
d2 = d1
d1 = f('abbc', d1)
print addUp(d1)
d2 = f('bbcaa', d2)
print addUp(d2)
print f('', {})
print result
```

6.1) What does it print? (9 points)

1
5
{}

6.2) Does it terminate normally? Why or why not? (4 points)

No, it terminates with a NameError exception, because result will not be defined.
7) Consider the following code:

```python
def logBase2(n):
    """assumes that n is a positive int
    returns a float that approximates the log base 2 of n"
    import math
    return math.log(n, 2)

def f(n):
    """assumes n is an int""
    if n < 1:
        return
    curDigit = int(logBase2(n))
    ans = 'n = '  
    while curDigit >= 0:
        if n%(2**curDigit) < n:
            ans = ans + '1'
            n = n - 2**curDigit
        else:
            ans = ans + '0'
        curDigit -= 1
    return ans

for i in range(3):
    print f(i)
```

7.1) What does it print? (10 points)  
None  
n = 1  
n = 10

7.2) Under the assumption that logBase2 is O(n), what is the order (use big Oh notation) of f? (5 points)

O(n)
8) Next to each item in the left column write the letter labeling the item in the right column that best matches the item in the left column. No item in the right column should be used more than once. (9 points)

- Big O notation B
- Newton’s method D
- Recursion A

a) induction
b) upper bound
c) lower bound
d) approximation
e) expected running time
f) exponential

9. Do you think that the lectures are too slow paced, too fast paced, about right? (1 point)

10. Do you think that the problem sets are too short, too long, about right? (1 point)
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