

1. _____/15
2. _____/15
3. _____/10
4. _____/20
5. _____/20
6. _____/10
7. _____/10

Athena User Name-----
Recitation hour

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**, and your user name and the hour of the recitation you attend on the first page. Answer all questions in the boxes provided.

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

- ☐
- 1.1. Let D1 and D2 be two different normal distributions. If a sample, s1, is one standard deviation from the mean of D1 and a sample, s2, is two standard deviations from the mean of D2, then s2 is always further (in an absolute sense) from the mean of D2 than s1 is from the mean of S1.
- ☐
- 1.2. In Python, a function **cannot** be used as a class variable.
- ☐
- 1.3. Increasing the number of buckets in a hash table typically **decreases** the number of collisions.
- ☐
- 1.4. For a Gaussian distribution decreasing the confidence interval (e.g., from ± 5 to ± 4) decreases the confidence level (e.g., from 95% to 90%).
We'll cover this on tuesday
- ☐
- 1.5. In Python, none of the standard methods of class `object` can be overridden by subclasses of `object`.

2) Consider the following code:

```
def oneTest():
    tries = 0
    while True:
        tries += 1
        ind1 = random.choice(range(52))
        ind2 = random.choice(range(52))
        if ind1 == ind2: break
    return tries

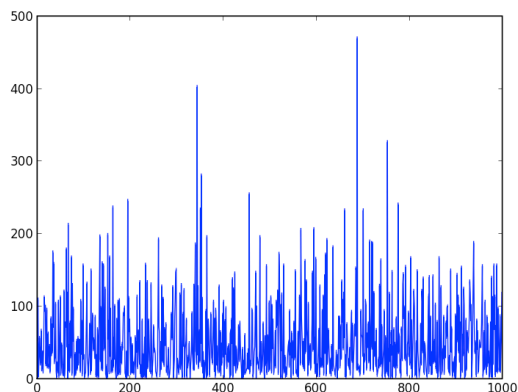
def makePlots(numTrials, oneTest):
    numTries = []
    for t in range(numTrials):
        numTries.append(oneTest())
    pylab.plot(numTries)
    pylab.figure()
    pylab.hist(numTries, bins = 10)

makePlots(10000, oneTest)
```

2.1. Write Python code that calculates the width of each bar (they are all the same width) in the histogram. (5 points)

2.2. Assuming that the width of each bar is w , describe the range of values on the x axis covered by the tallest bar in the histogram. (5 points)

2.3. Is it likely that the call to `pylab.plot` would produce a plot similar to one below? (5 points)



3) John had a strategy for eventually winning a lottery with 1000 tickets. The first time he entered he would buy one ticket. If he didn't win he would double the number of tickets (to two) he bought the next time he entered. If he didn't win that time, he would double the number of tickets (to four) again. Etc. What is the probability that John wins the lottery **before** playing it 4 times? (10 points)

4) Write a function that uses a Monte Carlo simulation to estimate the probability of John winning the lottery within n attempts, assuming he uses the strategy of problem 3. Assume that 10,000 trials are sufficient to provide an accurate answer. You may call the function:

```
def runLottery(ticketsSold, ticketsBought):  
    """ticketsSold is the number of tickets sold in a lottery and  
    ticketsBought is the number of tickets bought by John. It  
    returns 1 if John won the lottery and 0 otherwise."""
```

(20 points)

```
def sim(n, ticketsSold): #write your code below
```

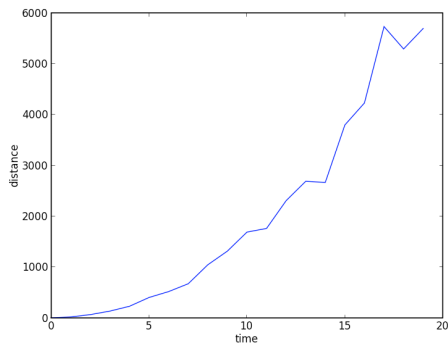
5) What does the following code print? (20 points)

```
class Shape(object):
    def __lt__(s1, s2):
        return s1.area() < s2.area()
    def __str__(self):
        try:
            return 'Shape with area ' + str(self.area())
        except:
            return 'Shape'
class Rectangle(Shape):
    def __init__(self, h, w):
        self.height = h
        self.width = w
    def __lt__(r1, r2):
        return r1.height < r2.height
class Square(Rectangle):
    def __init__(self, s):
        Rectangle.__init__(self, s, s)
    def __str__(self):
        return 'Square with side ' + str(self.height)
class Circle(Shape):
    def __init__(self, radius):
        self.radius = radius
    def area(self):
        return 3*(self.radius**2)

def reorder(L):
    for e in L:
        if L[0] < e: L[0] = e

s = Square(5)
s1 = s
s = Square(4)
r = Rectangle(3, 4)
c = Circle(0.5)
L = [s, s1, r, c]
try:
    reorder(L)
except:
    print 'here'
for e in L: print e
```

6) An experiment was run that involved collecting one data value every second for 20 seconds. When plotted the data looked like,



Write code that finds an appropriate model for this data, and then uses that model to plot projected values for the next 80 time units. Assume that the 20 data points **are in an array named `vals`**. (10 points)

Don't worry about this question; we won't cover this until after the quiz.

7) 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, and no box should contain more than one letter. (10 points)

inheritance

a) $O(n \log n)$

standard deviation

b) $O(n^2)$

half-life

c) $O(n)$

exception

d) try

merge sort

e) polymorphism

f) exponential

g) variance