

Name \_\_\_\_\_

## Python for Math and Stat Fall 2022 Final Exam

This exam is worth 75 points. Assume that all necessary packages have been imported. When done with the exam, please **scan and upload to Gradescope**, then hand in the paper version.

1. (12 pts) Let

```
arr = np.array([[ 7, 13,  3,  2],  
                [12,  6,  9,  5]])
```

For the following 4 problems, write down what each code block would display if executed in a Jupyter cell.

(a) `arr[1, ::-1]`

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(b) `arr[:, 3] ** 2`

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(c) `arr[arr // 10 > 0]`

\_\_\_\_\_

(d) `(lambda x: x+10)(arr[1, 2: ])`

\_\_\_\_\_





4. (8 pts)

```
def func(n):  
    return ...
```

Suppose `func` is an increasing function and you wish to find a value of `n` such that `func(n)` is greater than a threshold value. Write a function `exceed(thresh)` that checks the integers `n=1, 2, 4, 8, ...`, one at a time, and stops when `func(n)` is greater than `thresh`, returning the successful value of `n`. Each iteration doubles the previous value of `n`. (Assume that the domain and range of `func` include all positive real numbers.)

Example:

Suppose `func(n)` returns `n + 2**n`. Then `exceed(25)` returns 8 because `4 + 24 < 25` and `8 + 28 > 25`.

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5. (8 pts) Consider the nested square root expression

$$\sqrt{a_1 + \sqrt{a_2 + \cdots + \sqrt{a_n}}}$$

Write a **recursive** function `roots(nums)` that takes a non-empty list of positive numbers  $a_i$  and returns the value of the corresponding nested square root expression.

Example: `roots([7, 2, 4])` returns 3.0 because  $\sqrt{7 + \sqrt{2 + \sqrt{4}}} = 3$ .

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7. (19 pts)

(a) Create a class called `Point`. Each object in the class represents a point in the  $xy$ -plane. It has two attributes:

- `x`: the  $x$ -coordinate of the point
- `y`: the  $y$ -coordinate of the point

and the following methods:

- `dist(pt)`

