Discussion 12: Procedures as Data

Lambda Functions

1. Write a lambda function called \( f \) that takes in a number and outputs that number squared.

\[ f = \ldots \]

2. Now, use a list comprehension and your lambda function \( f \) to return a list the squares of all numbers between 1-5, inclusive.

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Functions as Data

What would the Python interpreter display for the following lines of code? If you believe a line errors, just write “Error.” Each subproblem is independent and does not depend on the other subproblems.

```python
>>> lst = [1, 2, [3, 4]]
>>> lst[2].pop()
>>> lst

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>>> [x * 2 for x in range(4) if x % 2 == 1]

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>>> ".join([word[0] for word in "Univ of Calif at Berkeley".split() ... if not(len(word) == 2)])

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>>> ".join([word[0] for word in "Univ of Calif at Berkeley" ... if not(len(word) == 2)])

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>>> f1 = lambda x: x + x
>>> f2 = lambda x: x > 9
>>> [f(10) for f in [f1, f2]]

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>>> f = lambda x: lambda: x + x
>>> f(2)

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2. Now, continue the exercise, instead assuming that each subproblem is a continuation of the previous subproblems.

```python
>>> def make_adder(x):
...    def inner(y):
...        return x + y
...    return inner
>>> make_adder(5)
```

```python
>>> make_adder(5)(6)
```

```python
>>> functions = [lambda x: x, lambda x: x * x, lambda x: x * 3]
>>> functions[2](3)
```

```python
>>> def returnMax():
...    return max
... returnMax()
```

```python
>>> returnMax()(2, 3)
```

```python
>>> max = min
>>> max(5, 4)
```

```python
>>> returnMax()
```

```python
returnMax()(2, 3)
```
3. Write a function called `functionList` that takes in a list of functions, `functions`, and a number, `n`, and returns a list of the results of calling each function on `n`.

```python
>>> functionList([lambda x: x + x, lambda x: x * x], 4)
[8, 16]
```

3. Write a recursive function called `recursiveSum` that takes in a function `func` and a number `n`, and returns the summed results of `func` applied from 1 to `n`.

```python
>>> recursiveSum(lambda x: x * x, 3)
14  # 3*3 + 2*2 + 1*1
```

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**Tree Recursion in Python**

1. The Fibonacci sequence is a sequence of numbers where each number is the sum of the previous two. Here is the start of the Fibonacci sequence: 1, 1, 2, 3, 5, 8, 13, ...

In the space below, write the function `fib(n)` that returns the nth Fibonacci number in the sequence, assuming the first one is `n = 0`. 
2. We find ourselves at the bottom of a staircase with `num_steps` steps. We can either climb the stairs one at a time or two at a time (or a mix of the two). Fill in the function below to return the number of ways you can climb the staircase.

```python
def climb_staircase(num_steps):
    if num_steps == 0:
        return ___________________________________________________________
    elif num_steps < 0:
        return ___________________________________________________________
    else:
        return ___________________________________________________________
```

3. Now, when we are climbing the staircase, we can take any from 1 to `max_steps` number of steps at a time (not just 1 or 2). Fill in the blanks below to write rewrite `climb_staircase` to return the number of ways you can now climb the staircase.

```python
def climb_staircase(num_steps):
    if num_steps == 0:
        return ___________________________________________________________
    elif num_steps < 0:
        return ___________________________________________________________
    else:
        return ___________________________________________________________
```