Social Data Science: Machine Learning & Econometrics

Exercise class 7

April 3, 2020

Todays quick warmup

Q: The number of primes less than n, $\pi(n)$ are well approximated by the logarithmic integral

$$\pi(n) \approx Li(n) = \int_2^n \frac{1}{\log t} dt \tag{1}$$

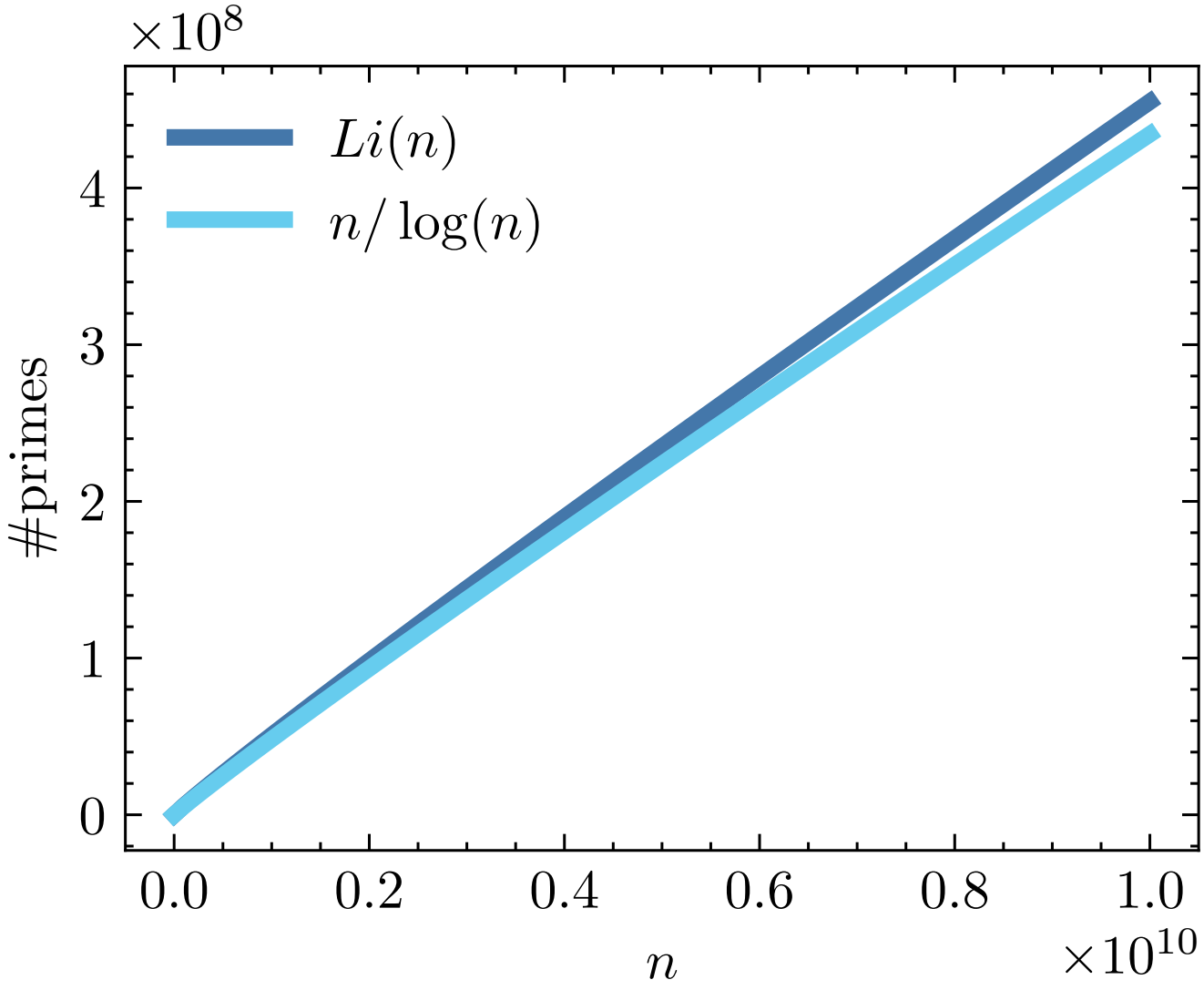
Write a function `Integrate(f,a,b)` that uses `scipy.integrate.quad` to integrate `f` from `a` to `b`. Use this function to plot $Li(n)$ along 100 values of $n \in [10, 10^{10}]$.

Pick a stylesheet for your matplotlib figure from here (or make your own):

https://github.com/topics/matplotlib-style-sheets

and properly format it with axis labels, a legend etc.

Todays quick warmup - solution



Todays quick warmup - solution

```
from scipy import integrate
from numpy import log, linspace
import matplotlib.pyplot as plt

def Integrate(f, a, b):
    I, _ = integrate.quad(f, a, b)
    return I

n = linspace(10,10**10, 100)
Li = [Integrate(lambda x: 1/log(x), 2, k) for k in n]
pi = [k/log(k) for k in n]

with plt.style.context(['science', 'bright']):
    fig, ax = plt.subplots()
    ax.plot(n, Li, linewidth = 3, label = '$Li(n)$')
    ax.plot(n, pi, linewidth = 3, label = 'n/log(n)')
    ax.set_xlabel('$n$')
    ax.set_ylabel('\#primes')
    ax.legend()
    plt.show()
```