```python
#!/usr/bin/python
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__question__="hw1_q10"


import matplotlib.pyplot as plt
from math import log, factorial, sqrt, pi


def stirlings_approx( N ):
    return ( N * log( N ) ) - N


ii = 2
good_approx = False
diffs = []
x_val = []
while not good_approx:
    x_val.append( ii )
    diff = log( factorial( ii ) ) - stirlings_approx( ii )
    diffs.append( diff )
    error = diff / log( factorial( ii ) ) * 100
    if error < 0.05:
        good_approx = True
        N = ii
    ii += 1
print "N must be about %s for Stirling's approximation to be valid
(less than 5%s error).\n" %( N, "%" )

lnsqrt_2piN = [ log(sqrt(2*pi*n)) for n in x_val ]
plt.plot( x_val, diffs, label="Stirling's diff" )
plt.plot( x_val, lnsqrt_2piN, label="ln(sqrt(2*pi*N))" )
```