Lab2_problem_4

October 30, 2024

0.1 Problem 4

[8]:
```
import matplotlib.pyplot as plt
import numpy as np
```

[2]:
```
#A
def log_sequence(x0, r, n):
    sequence = [x0]
    for _ in range(n - 1):
        x_next = r * sequence[-1] * (1 - sequence[-1])
        sequence.append(x_next)
    return sequence

x0 = 0.5
r = 3.5
n = 10

sequence = log_sequence(x0, r, n)
print("Logistic sequence:", sequence)
```

```
Logistic sequence: [0.5, 0.875, 0.3828125, 0.826934814453125,
0.5008976948447526, 0.87499717950388, 0.3828199037744718, 0.826940887670016,
0.500883795893397, 0.8749972661668659]
```

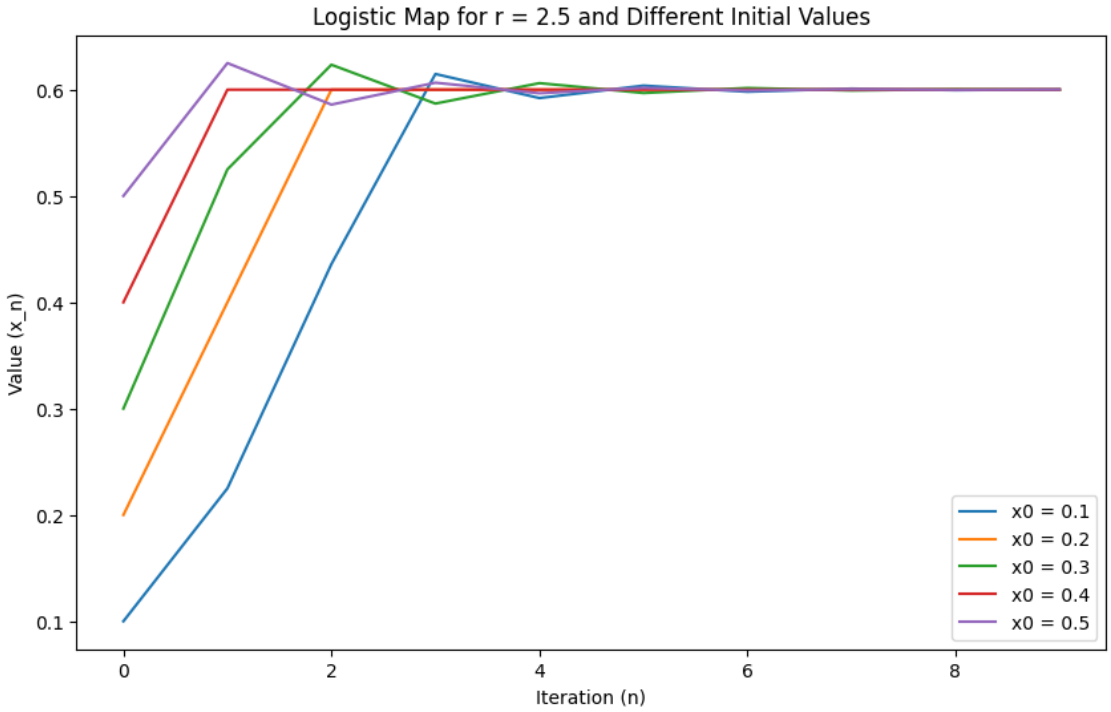
[5]:
```
# B
r = 2.5
n = 10
initial_values = [0.1, 0.2, 0.3, 0.4, 0.5]

# Plot each sequence for different initial values
plt.figure(figsize=(10, 6))

for x0 in initial_values:
    sequence = log_sequence(x0, r, n)
    plt.plot(range(n), sequence, label=f"x0 = {x0}")

plt.xlabel("Iteration (n)")
plt.ylabel("Value (x_n)")
plt.title("Logistic Map for r = 2.5 and Different Initial Values")
```

```
plt.legend()
plt.show()
```

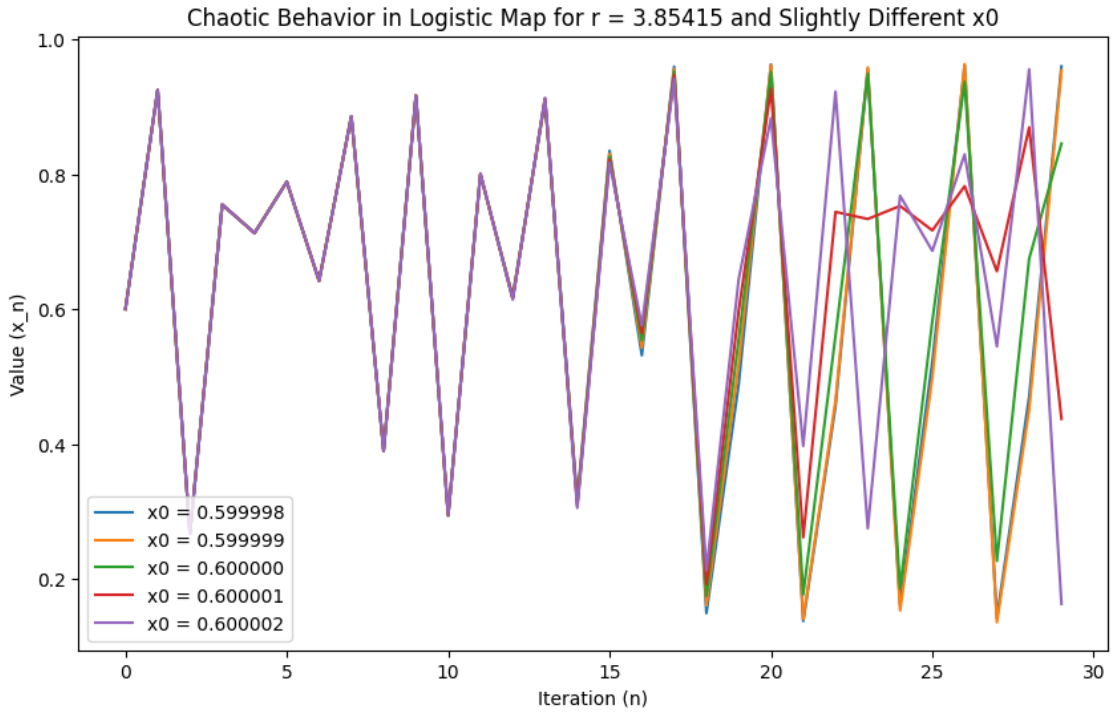


[6]:
```
#C
# Parameters for chaotic behavior
r = 3.85415
n = 30
initial_values = [0.6 + i * 1e-6 for i in range(-2, 3)]  # Slight variations␣
 ↪around 0.6

# Plot each sequence for slightly different initial values
plt.figure(figsize=(10, 6))

for x0 in initial_values:
    sequence = log_sequence(x0, r, n)
    plt.plot(range(n), sequence, label=f"x0 = {x0:.6f}")

plt.xlabel("Iteration (n)")
plt.ylabel("Value (x_n)")
plt.title("Chaotic Behavior in Logistic Map for r = 3.85415 and Slightly␣
 ↪Different x0")
plt.legend()
plt.show()
```

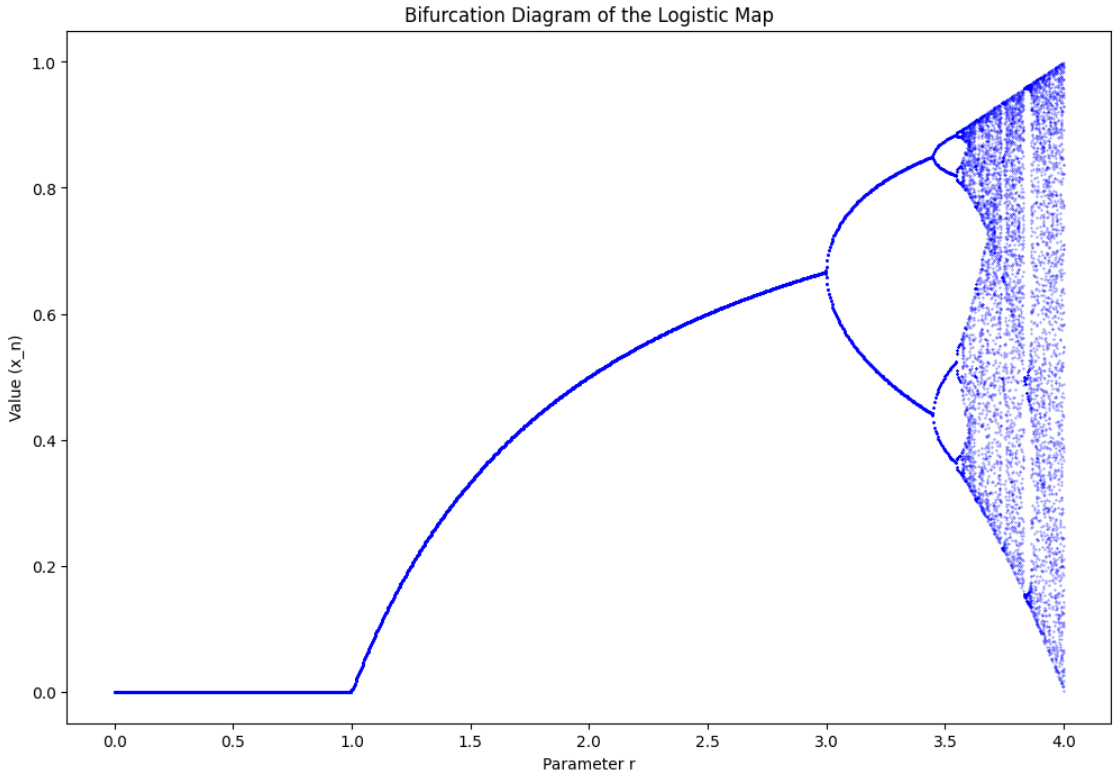


[9]:
```
# Parameters for bifurcation diagram
n = 512
last_n_values = 64  # Only plot the last 64 values to show the steady-state␣
 ↪behavior
r_values = np.linspace(0, 4, 1000)
x0 = 0.6  # Fixed initial value for all sequences

# Prepare a plot
plt.figure(figsize=(12, 8))

# Generate sequences for each value of r and plot the last 64 values
for r in r_values:
    sequence = log_sequence(x0, r, n)
    plt.plot([r] * last_n_values, sequence[-last_n_values:], 'b.', markersize=0.
 ↪5)

plt.xlabel("Parameter r")
plt.ylabel("Value (x_n)")
plt.title("Bifurcation Diagram of the Logistic Map")
plt.show()
```


Bifurcation Diagram of the Logistic Map
Value (x_n)
Parameter r
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0