Homework #1 – Tools and Fundamentals

Problem 1(a)

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In [1]:
```python
# Imports
import random
import matplotlib.pyplot as plt
```

In [2]:
```python
# Constants
P_HEAD = 0.7
```

In [3]:
```python
def is_head():
    return random.uniform(0, 1) < P_HEAD
```

In [4]:
```python
def get_trials(num_trials):
    return [is_head() for i in range(num_trials)]
```

In [5]:
```python
def get_longest_run_heads(trials):
    max_run = 0
    curr_run = 1 if trials[0] else 0

    for i in range(1, len(trials)):
        if trials[i]:
            if trials[i] == trials[i - 1]:
                curr_run += 1
            else:
                curr_run = 1
        else:
            max_run = max(max_run, curr_run)
            curr_run = 0
    return max_run
```

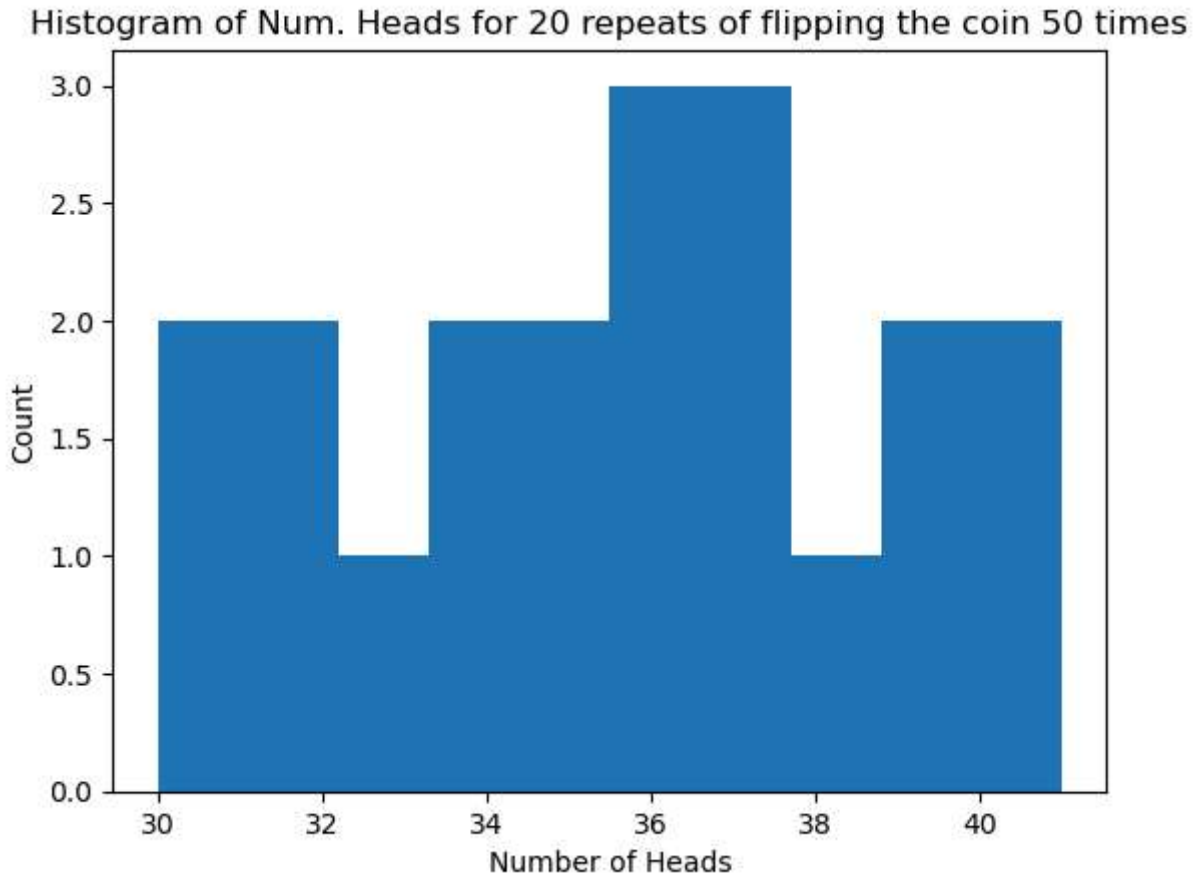
In [6]:
```
num_trials = 50
trials = get_trials(num_trials)
num_heads = sum(trials)
print(f"For 50 trials, the number of Heads = {num_heads}")
```

```
For 50 trials, the number of Heads = 38
```

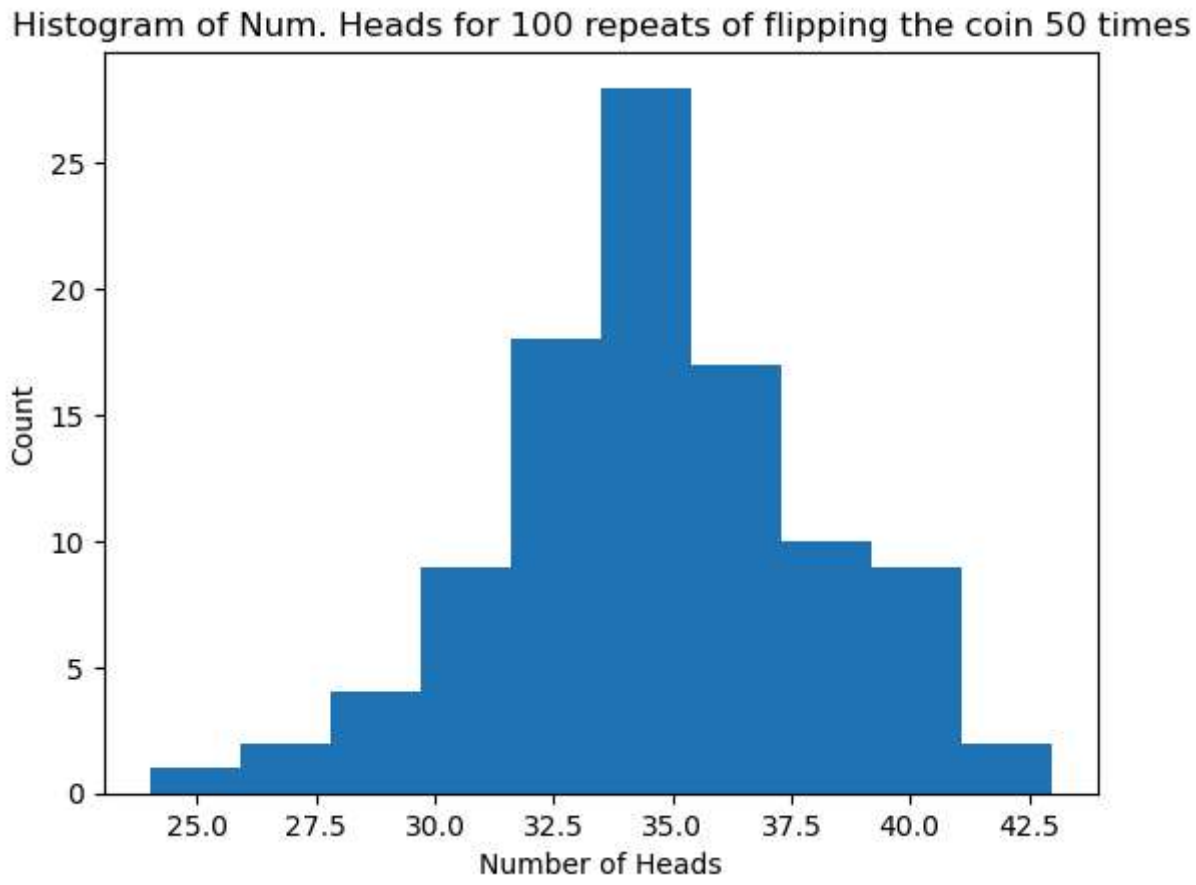
In [7]:
```
longest_run_heads = get_longest_run_heads(trials)
print(f"For 50 trials, the longest run of heads = {longest_run_heads}")
```

```
For 50 trials, the longest run of heads = 20
```

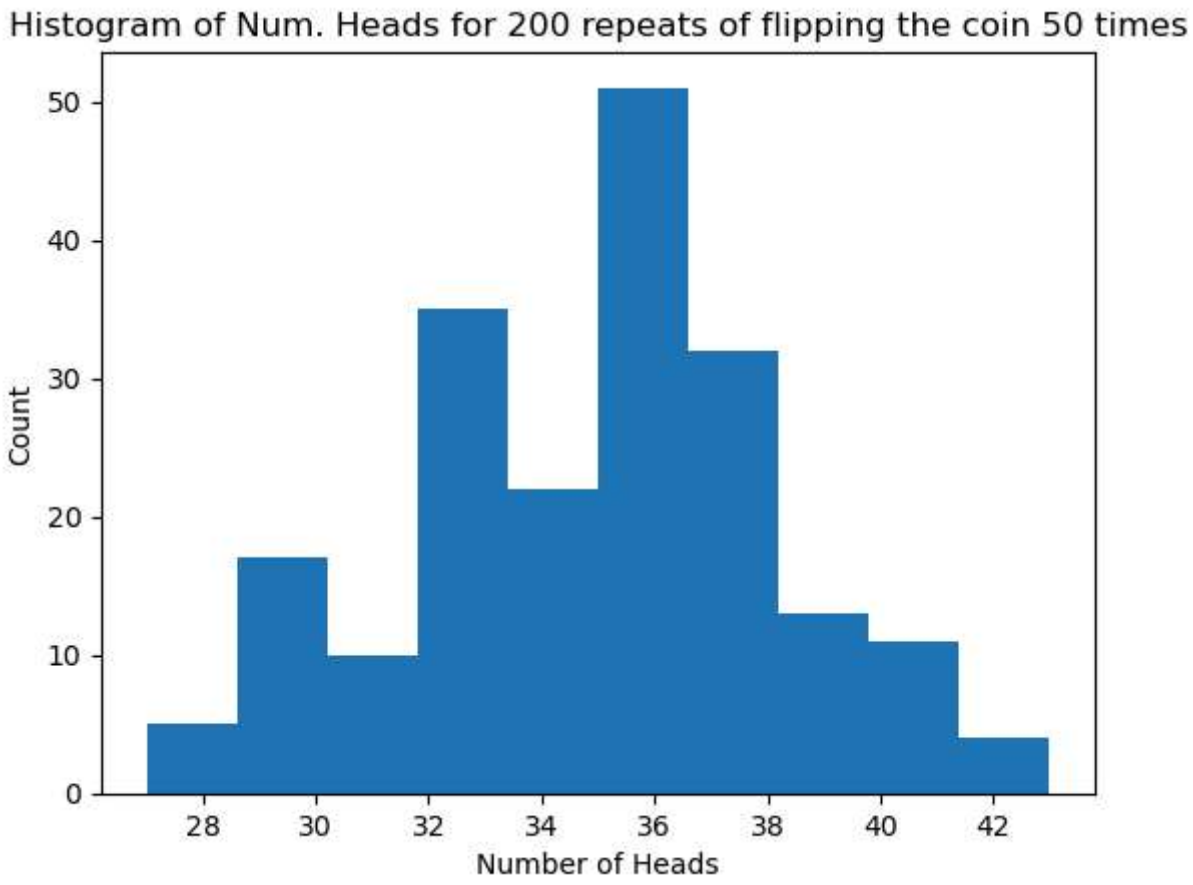
In [8]:
```
num_repeats = 20

num_heads_list = [sum(get_trials(num_trials)) for i in range(num_repeats)]

plt.figure()
plt.hist(num_heads_list)
plt.xlabel("Number of Heads")
plt.ylabel("Count")
plt.title(f"Histogram of Num. Heads for {num_repeats} repeats of flipping the coin {num_trials} times")
plt.show()
```



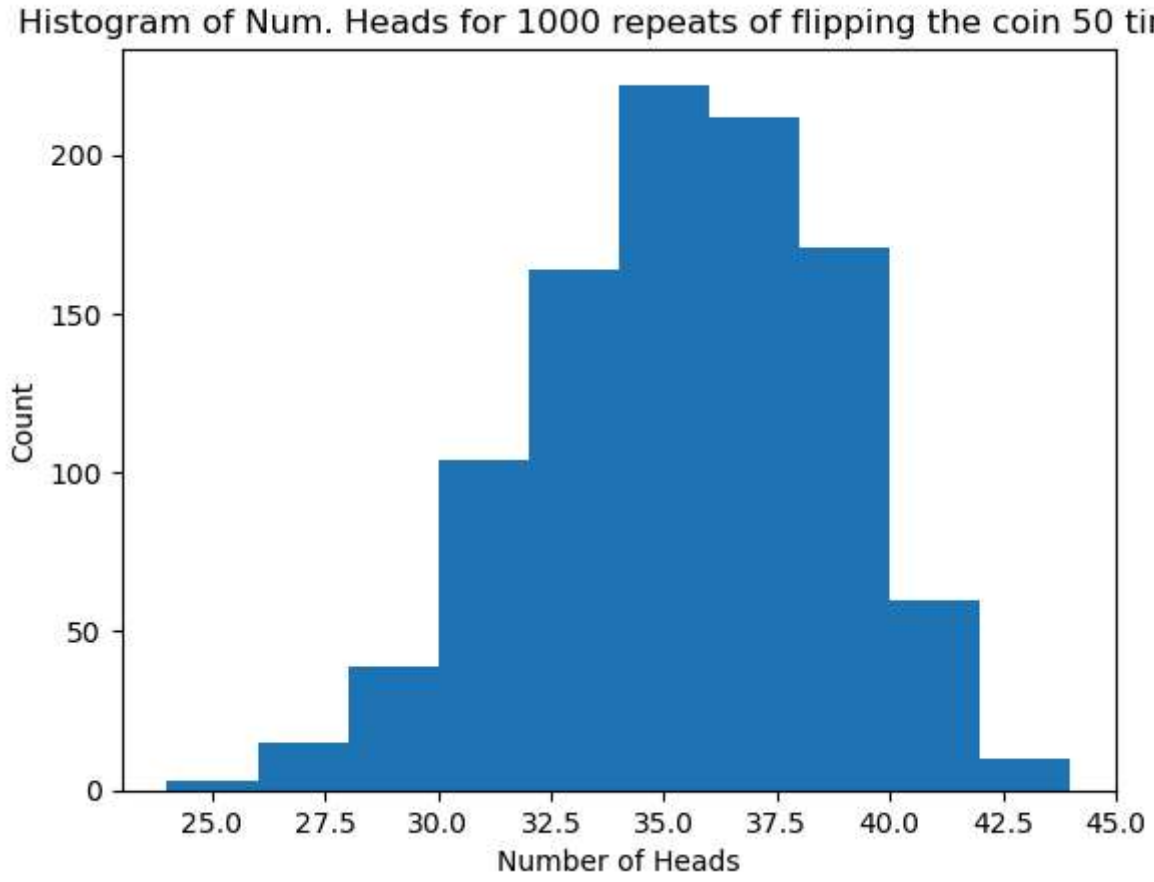
In [9]:
```
num_repeats = 100

num_heads_list = [sum(get_trials(num_trials)) for i in range(num_repeats)]

plt.figure()
plt.hist(num_heads_list)
plt.xlabel("Number of Heads")
plt.ylabel("Count")
plt.title(f"Histogram of Num. Heads for {num_repeats} repeats of flipping the coin {num_trials} times")
plt.show()
```



In [10]:
```
num_repeats = 200

num_heads_list = [sum(get_trials(num_trials)) for i in range(num_repeats)]

plt.figure()
plt.hist(num_heads_list)
plt.xlabel("Number of Heads")
plt.ylabel("Count")
plt.title(f"Histogram of Num. Heads for {num_repeats} repeats of flipping the coin {num_trials} times")
plt.show()
```



In [11]:
```
num_repeats = 1000

num_heads_list = [sum(get_trials(num_trials)) for i in range(num_repeats)]

plt.figure()
plt.hist(num_heads_list)
plt.xlabel("Number of Heads")
plt.ylabel("Count")
plt.title(f"Histogram of Num. Heads for {num_repeats} repeats of flipping the coin {num_trials} times")
plt.show()
```



In [12]:
```
print(f"X-Axis limit: {min(num_heads_list)} to {max(num_heads_list)}")
```

```
X-Axis limit: 24 to 44
```