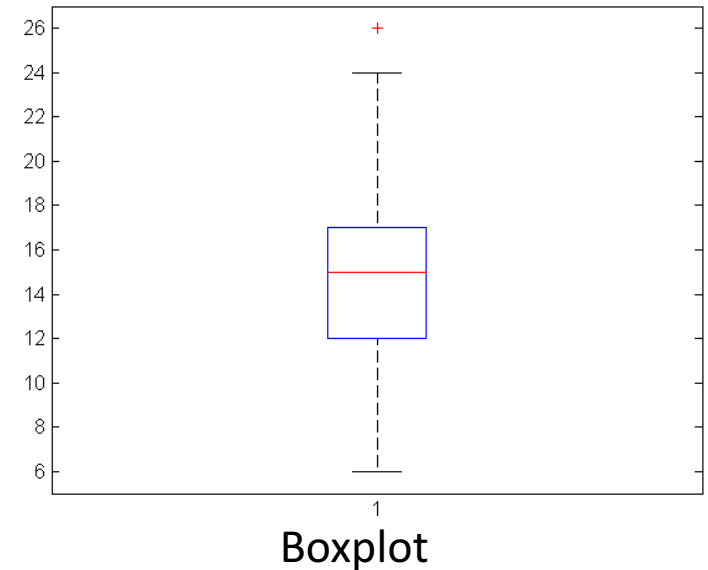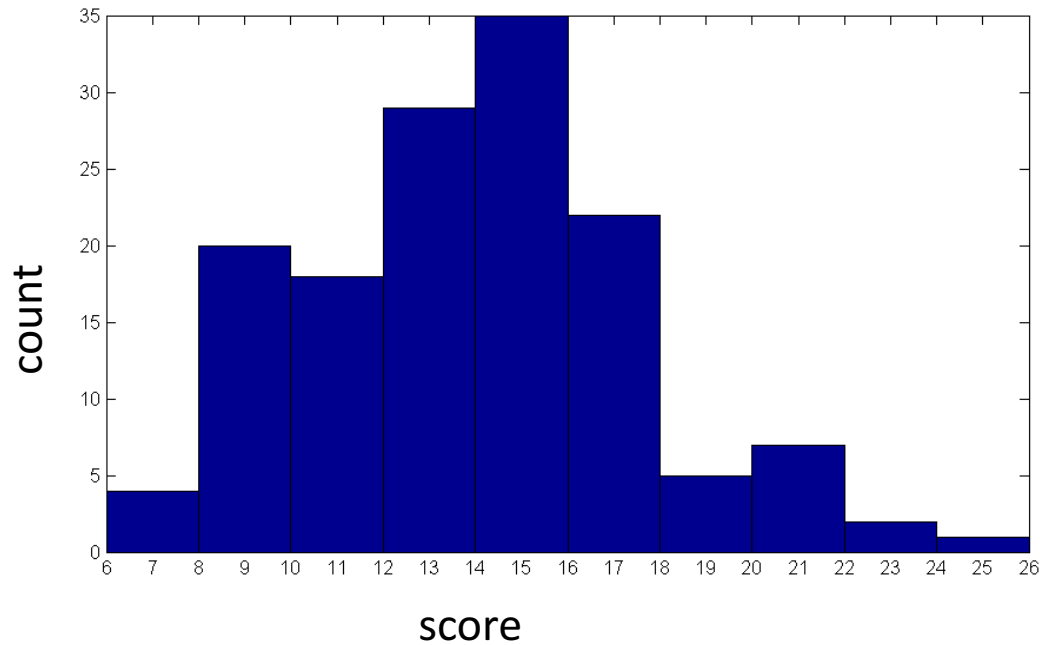# Python Applicaton

Simulation, Monte Carlo methods

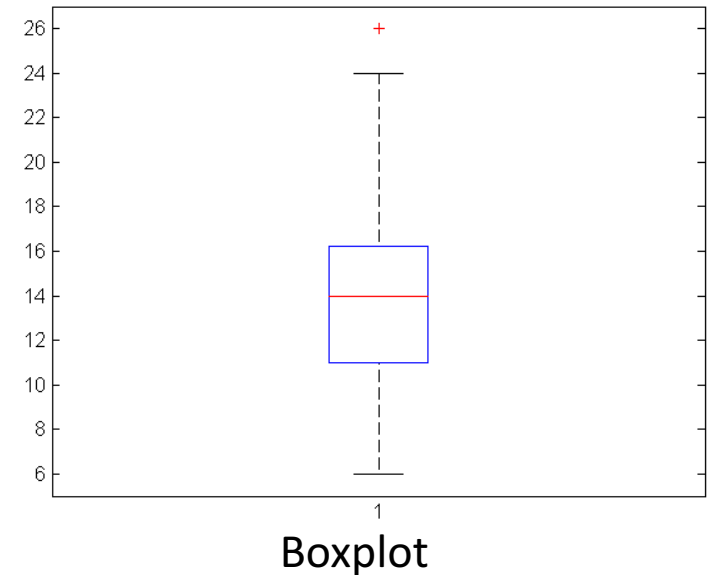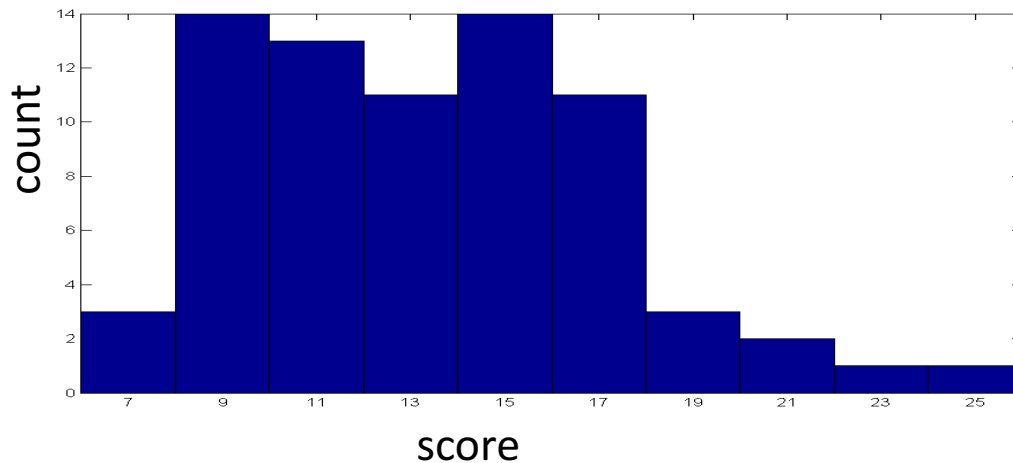## CS101 Lecture #13

Mid-term I statistics (all)

Mean: 14.5
Median: 15
Percentile(25, 50, 75): 12, 15, 17
Highest: **26!**

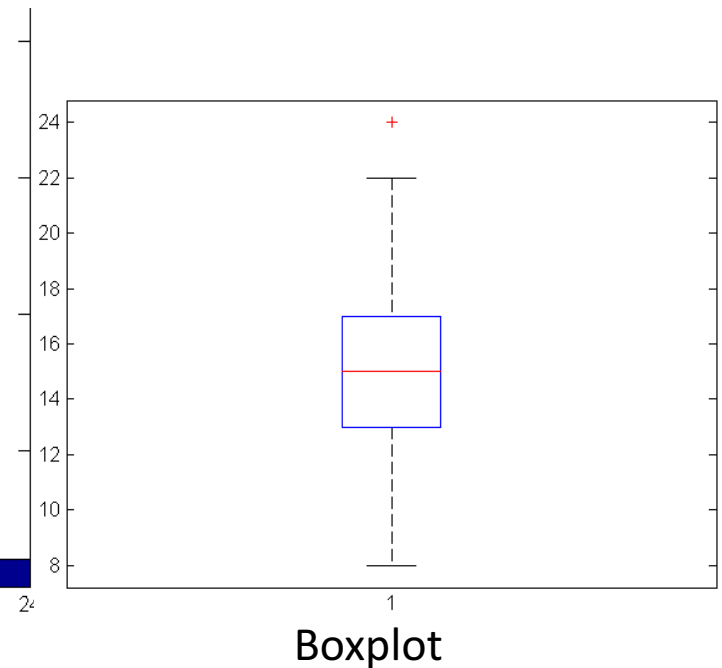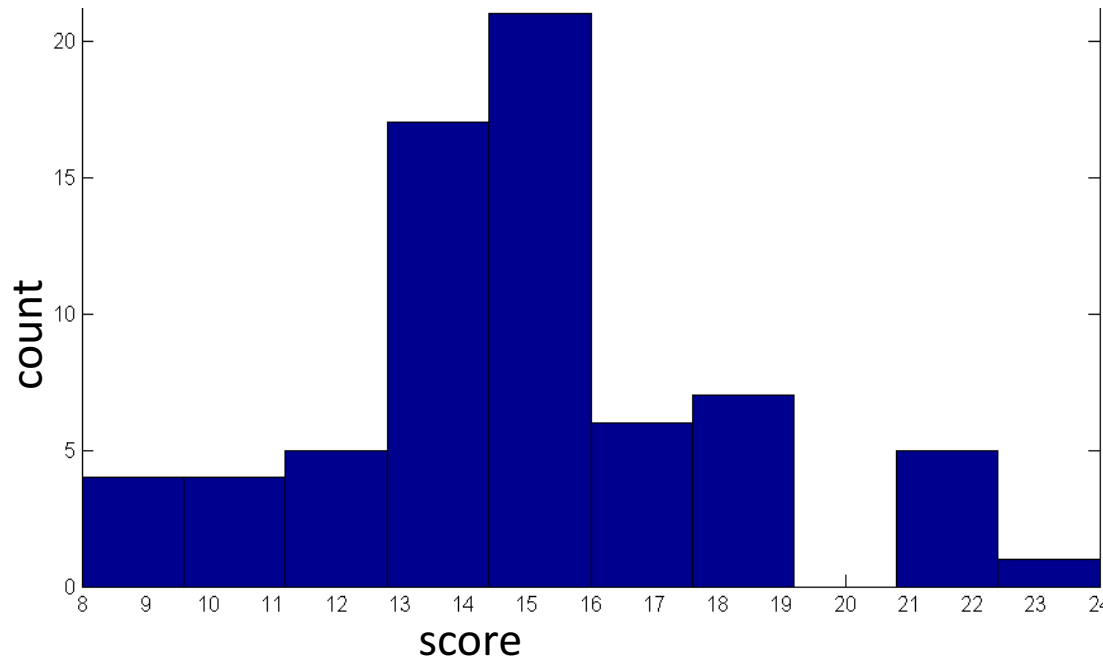# *Mid-term I statistics (session A)*

Mean: 13.9
Median: 14
Percentile(25, 50, 75): 11, 14, 16
Highest: **26!**

Mid-term I statistics (session B)

Mean: 15.0
Median: 15
Percentile(25, 50, 75): 13, 15, 17
Highest: **24**

Find solution by Simulation

- Predict the number of people taking Western/Chinese food in a month
  - Write a python script to simulate it!
  - No complicated mathematics

Find solution by Simulation

```python
import numpy as np
W = 250
C = 250

for day in range(1,31):
    nextW, nextC = W, C
    for i in range(W):
        if np.random.randint(10) < 3:
            nextW -= 1
            nextC += 1
    for i in range(C):
        if np.random.randint(10) < 2:
            nextC -= 1
            nextW += 1
    W, C = nextW, nextC
    print('Day %i: %i for Western food, %i for Chinese foot'%(day, W,C))
```
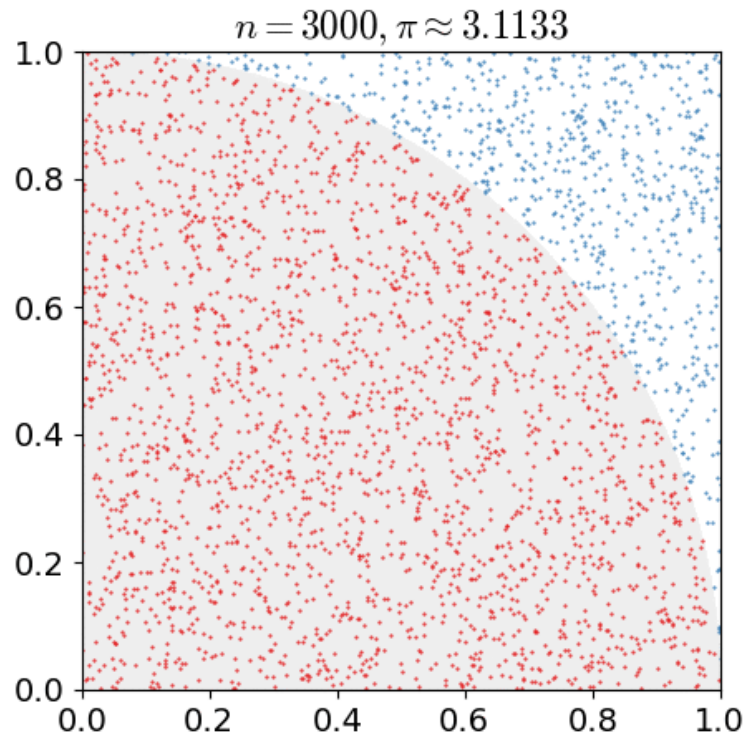
Find out the value of PI

- Historical puzzle in mathematics
- ~1500 years ago
  - 3.1415926 - 3.1415927

Find out the value of PI

- Historical puzzle in mathematics
- ~1500 years ago
  - 3.1415926 - 3.1415927
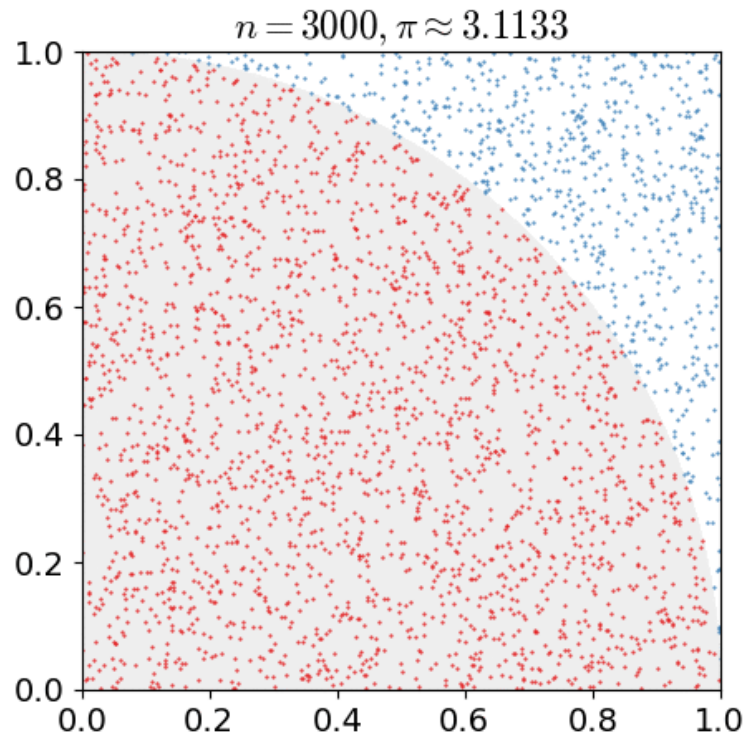- Not that difficult for us...

Find out the value of PI

animation from wikipedia

$$\frac{\#dots\ in\ circle}{total\ dots} = \frac{area\ of\ circle}{area\ of\ square} = \pi/4$$

Find out the value of PI

$n = 3000, \pi \approx 3.1133$

animation from wikipedia

$$\frac{\#dots\ in\ circle}{total\ dots} = \frac{area\ of\ circle}{area\ of\ square} = \pi/4$$

Find out PI by generating a ton of random dots and count!

Find out the value of PI

```python
import numpy as np
def myrand():
    return np.random.rand(1,1)[0][0]

samples = 10000
count = 0
for i in range(samples):
    x, y = myrand(), myrand()
    if (x**2 + y**2)**0.5 < 1:
        count += 1
PI = count/samples*4
print('Pi = %f'%PI)
```

Monte Carlo methods

- Use randomness to solve problems that might be deterministic in principle
  - *optimization, statistical inference, biology, computer graphics*
- Simulating random samples is relatively cheap
- Re-think the nature of computation
  - *Computation vs. mathematics*

Monte Carlo methods