toy_notebook_en

October 22, 2022

1 On the computation of π

1.1 Asking the maths library

My computer tells me that π is *approximatively*

[3]:
```
from math import *
print(pi)
```

```
3.141592653589793
```

1.2 Buffon's needle

Applying the method of Buffon's needle, we get the **approximation**

[6]:
```
import numpy as np

np.random.seed(seed=42)
N = 10000
x = np.random.uniform(size=N, low=0, high=1)
theta = np.random.uniform(size=N, low=0, high=pi/2)
2/(sum((x+np.sin(theta))>1)/N)
```

[6]: `3.128911138923655`

1.3 Using a surface fraction argument

A method that is easier to understand and does not make use of the sin function is based on the fact that if $X \sim U(0,1)$ and $Y \sim U(0,1)$, then $P[X^2 + Y^2 \leq 1] = \pi/4$ (see "Monte Carlo method" on Wikipedia). The following code uses this approach:

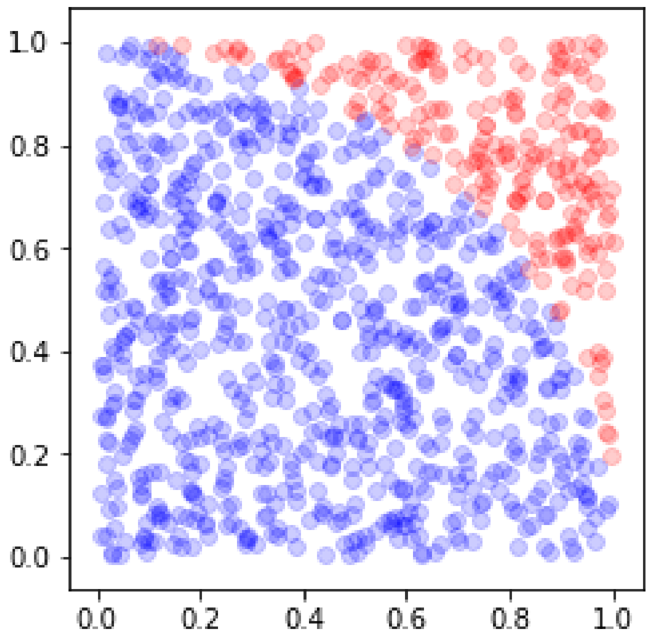
[8]:
```
%matplotlib inline
import matplotlib.pyplot as plt

np.random.seed(seed=42)
N = 1000
```

```
x = np.random.uniform(size=N, low=0, high=1)
y = np.random.uniform(size=N, low=0, high=1)

accept = (x*x+y*y) <= 1
reject = np.logical_not(accept)

fig, ax = plt.subplots(1)
ax.scatter(x[accept], y[accept], c='b', alpha=0.2, edgecolor=None)
ax.scatter(x[reject], y[reject], c='r', alpha=0.2, edgecolor=None)
ax.set_aspect('equal')
```



It is then straightforward to obtain a (not really good) approximation to π by counting how many times, on average, $X^2 + Y^2$ is smaller than 1:

[9]:
```
4*np.mean(accept)
```

[9]: 3.112

[ ]:
```

```