

Estimate pi

By choosing random points and checking whether they are inside a circle in a square.

- Area circle: $\pi * r^2$
- Area square: $(2 * r)^2$
 - where r is half the diameter and half a side

Ratio: $\pi / 4 = \text{circle} / \text{square}$, so $\pi = 4 * \text{circle} / \text{square}$

1. Draw two random numbers from $\text{random uniform}(0, 1)$
2. Square and sum them
3. If < 1 , it means they are within the circle

We observe only a quarter of the circle but also only a quarter of the square so ratio is the same.

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In [1]: import numpy as np
import matplotlib.pyplot as plt
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In [2]: np.random.seed(0)
n = int(1e7)
r = np.random.random((n, 2))
r2 = ((r**2).sum(axis=1) < 1)
r3 = r2.cumsum()
inside_square = np.arange(1, n+1)
r4 = 4 * r3 / inside_square
```

```
In [3]: plt.semilogx(r4)
plt.hlines(np.pi, 0, n, color='orange', linestyle='--')
# plt.ylim([2, 4])
plt.ylabel('estimate of pi')
plt.xlabel('# random numbers')
plt.show()
```

