120040025

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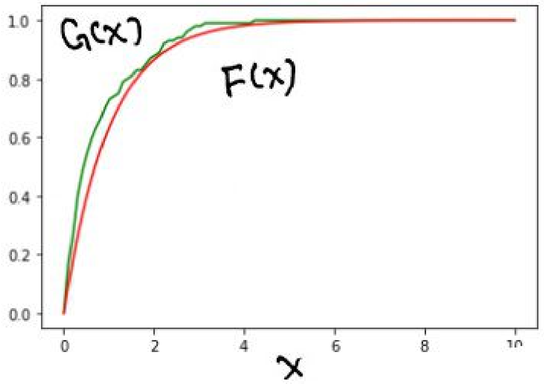
yohandi - assignment 9 (computer-based)

Theorem [Random Number Generator],

Let $Y \sim U(0,1)$ and $F(x)$ have the properties of a cdf of a continuous RV with $F(a) = 0$, $F(b) = 1$. Moreover, $F(x)$ is strictly increasing such that $F(x) : (a, b) \to [0,1]$, where a could be $-\infty$, b could be ∞. Then $X = F^{-1}(Y)$ is continuous RV with cdf $F(x)$

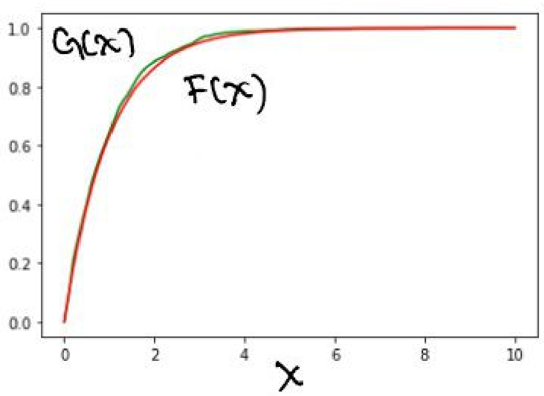
- case $N = 100$:



here,
- green color represents $G(x) = \frac{N(x)}{100}$
- red color represents $F(x) = 1 - e^{-x}$

from those two functions it can be seen how $F(x)$ is able to "represent" the scattered points $(x_i, G(x_i))$ with $i \in [1, 100]$.

- case $N = 1000$:



here,
- green color represents $G(x) = \frac{N(x)}{1000}$
- red color represents $F(x) = 1 - e^{-x}$

similar with the case where $N = 100$. However, the value error for every $i \in [1, 1000]$ such that $|F_{1000}(x_i) - G_{1000}(x_i)| < \varepsilon_{1000} < |F_{100}(x_i) - G_{100}(x_i)|$.

```python
import math
import matplotlib.pyplot as plt
import numpy as np

def simulateExperiment(N):
    def G(x0):
        return len([i for i in range(N) if x_i[i] < x0]) / N

    y_i = np.random.uniform(0, 1, N)
    x_i = [-math.log(1 - y_i[i]) for i in range(N)]

    x = np.linspace(0, 10, 100)
    G_x = [G(i) for i in x]
    F_x = [1 - math.exp(-i) for i in x]

    plt.plot(x, G_x, color = 'green')
    plt.plot(x, F_x, color = 'red')
    plt.show()

simulateExperiment(100)
simulateExperiment(1000)
```