prob3

January 20, 2025

```python
[56]: import numpy as np
      import scipy as sp
      import matplotlib.pyplot as plt
```

```python
[57]: x = np.linspace(0, 10, 101)
      analytical_solution = lambda x : np.exp(-x)

      fig, ax = plt.subplots()
      ax.plot(x, analytical_solution(x), label='Analytical solution')

      ax.set_xlabel('x (cm)')
      ax.set_ylabel(r"$\psi(x)$")


      ##

      initial_value = 1
      cross_section = 1

      step = 0.1
      n = 100

      A = sp.sparse.diags([1, cross_section * step - 1], [0, -1], shape=(n, n),␣
       ↪format='csc')
      b = [initial_value] + [0 for _ in range(n - 1)]
      solution = sp.sparse.linalg.spsolve(A, b)



      x = [i * step for i in range(n)]
      ax.scatter(x, solution, label="Numerical solution (n=100)")
      ax.legend();
```
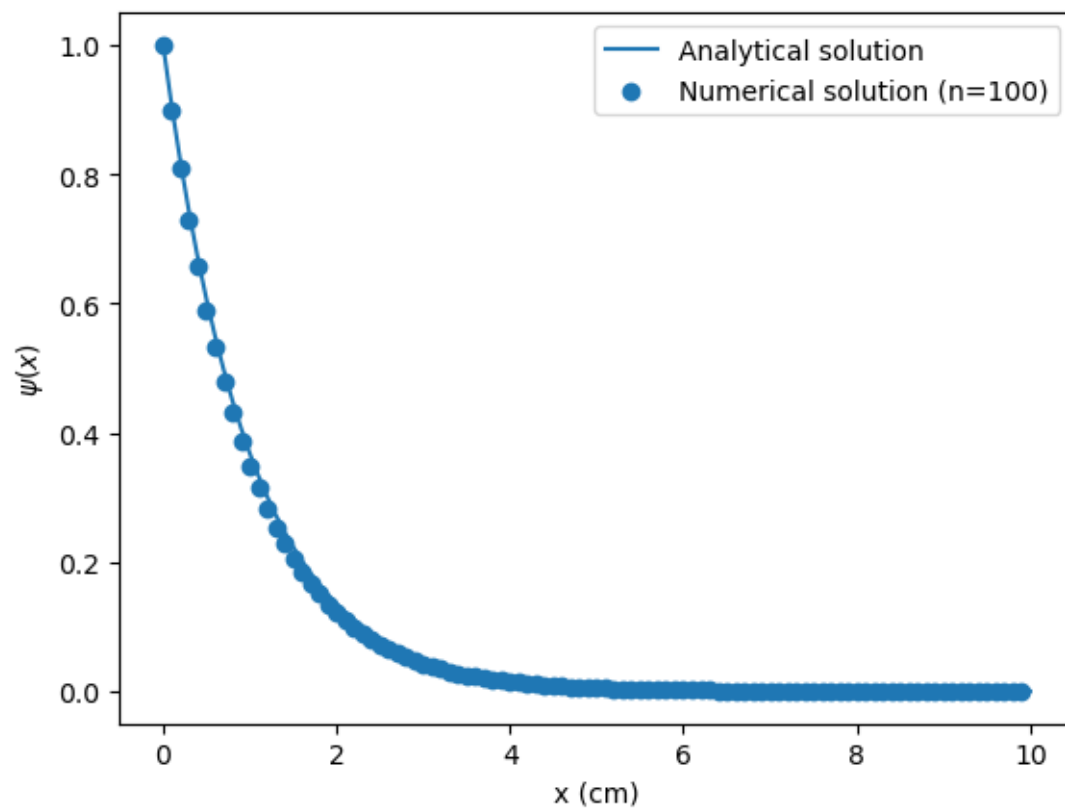
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