Lab 1

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LAB 1

[1]:
```
# importing libraries
from numpy import *
import matplotlib.pyplot as  plt
from scipy.fftpack import fft, ifft, fftfreq
```

Data Analysis

[2]:
```
# Define the spatial grid
Lx = 1  # domain size
Nx = 96  # number of spatial grid points
dx = Lx / (Nx - 1)  # spatial grid spacing
x = linspace(0, Lx, Nx)

# Define the advection velocity
c = 0.01  # m/s

# Define the initial condition
a = 0.1 * Lx
f = exp(-((x - Lx/2)**2) / a**2)

# Define the time
t = 0.5 * Lx / c

# Define the Fourier Transform of the initial condition
F = fft(f)

# Define the Fourier Transform of the spatial operator
k = 2*pi*fftfreq(Nx, d=dx)
K = 1j*k

# Define the time-stepping operator
t_step = exp(-c*t*K)
```

```
# Define the Fourier Transform of the analytical solution
Psi = t_step*F

# Define the analytical solution
psi = ifft(Psi)
```

Plotting

[3]:
```
# Plot the solution
plt.figure(figsize=(5.5,4))
plt.plot(x, f, label='t=0', color='blue', linewidth=2.5)
plt.plot(x, psi, label='t=0.5Lx/c)', color='red', linewidth=2.5)
plt.xlim([0, max(x)])
plt.ylim([0, max(psi)])
plt.xlabel('x')
plt.ylabel('ψ')
plt.legend(loc='upper right', borderpad=0.4)
plt.savefig('lab1.jpg', dpi=300)
plt.show()
```