exercise9

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0.1 Tutorial 9

Tom Carron, Clara Kretzschmar, & Timon Danowski

[ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import matplotlib
import pandas as pd
from ex9 import *
matplotlib.rcParams["figure.dpi"]=200
```

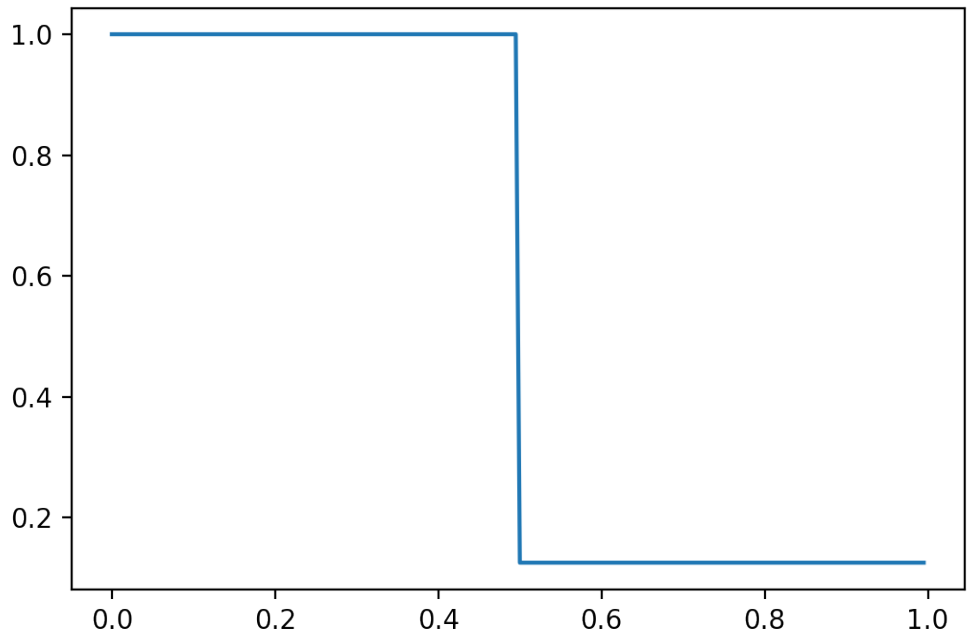
[ ]:
```
N = 200
a, b = 0, 1 # Domain size
shock_loc = 0.5 #Shock location
'''
1: Left of the shock
2: right of the shock
'''
density_1, density_2 = 1, 0.125
pressure_1, pressure_2 = 1, 0.1
momentum_1, momentum_2 = 0, 0
t_max = 0.2
gamma = 1.4

# w = [rho, vx, vy, vz, p]
w_1 = [density_1, momentum_1, momentum_1, momentum_1, pressure_1]
w_2 = [density_2, momentum_2, momentum_2, momentum_2, pressure_2]
run_N=200
```

0.2 Initial sod shock

[ ]:
```
#Plot of initial setup
plt.plot(np.arange(a, b, dx(a, b, run_N)),initial(a, b, run_N, q_function(w_1,␣
↪gamma), q_function(w_2, gamma), shock_loc)[:,0])
```

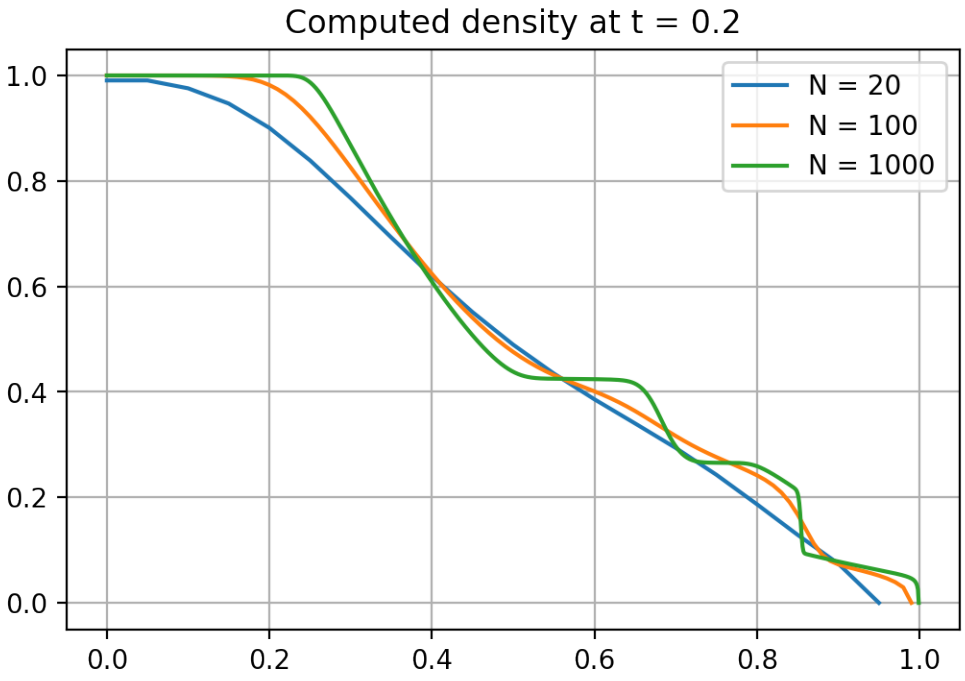
[ ]:
```
[<matplotlib.lines.Line2D at 0x7f09fbbfae80>]
```



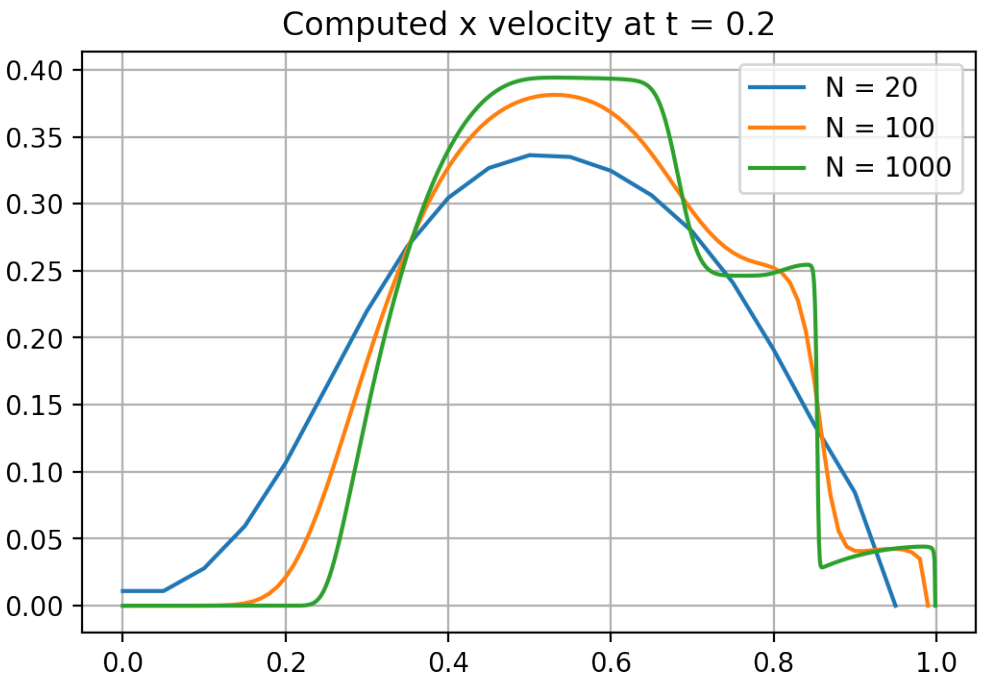
[ ]:
```
Ns=[20,100,1000]
densities=[]
x_velocities=[]
energies=[]
pressures=[]
for i in range(len(Ns)):
    densities.append(np.zeros(Ns[i]))
    x_velocities.append(np.zeros(Ns[i]))
    energies.append(np.zeros(Ns[i]))
    pressures.append(np.zeros(Ns[i]))
    q=run(Ns[i], a, b, shock_loc, gamma, w_1, w_2, t_max)
    w=np.zeros_like(q)
    for k in range(Ns[i]):
        w[k]=invert_q(q[k],gamma)
    densities[i]=q[:,0]
    x_velocities[i]=q[:,1]
    energies[i]=q[:,4]
    pressures[i]=w[:,4]
```

[ ]:
```
for i in range(len(Ns)):
    plt.plot(np.arange(a, b, dx(a, b, Ns[i])), densities[i],label="N =␣
 ↪"+str(Ns[i]))
plt.title("Computed density at t = "+str(t_max))
plt.legend()
plt.grid()
```

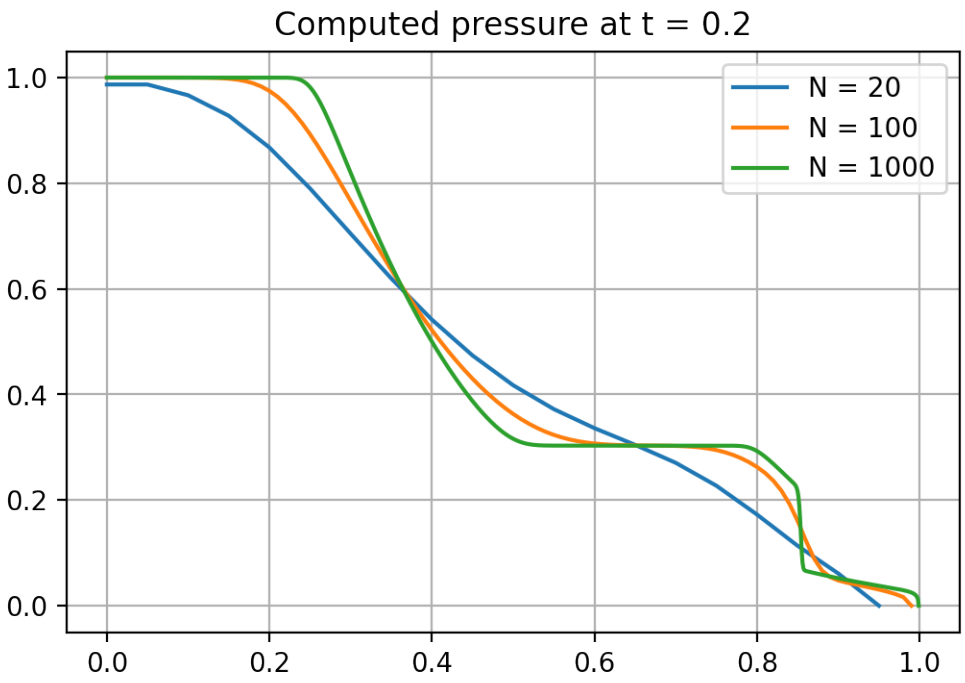
```
plt.savefig("plots/density.png",dpi=300,bbox_inches="tight")
```



[ ]:
```
#x-velocity plot
for i in range(len(Ns)):
    plt.plot(np.arange(a, b, dx(a, b, Ns[i])), x_velocities[i],label="N =␣
 ↪"+str(Ns[i]))
plt.title("Computed x velocity at t = "+str(t_max))
plt.legend()
plt.grid()
plt.savefig("plots/x_velocity.png",dpi=300,bbox_inches="tight")
```



[ ]:
```
#pressure plot
for i in range(len(Ns)):
    plt.plot(np.arange(a, b, dx(a, b, Ns[i])), pressures[i],label="N =␣
 ↪"+str(Ns[i]))
plt.title("Computed pressure at t = "+str(t_max))
plt.legend()
plt.grid()
plt.savefig("plots/pressure.png",dpi=300,bbox_inches="tight")
```


Computed pressure at t = 0.2
N = 20
N = 100
N = 1000
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0