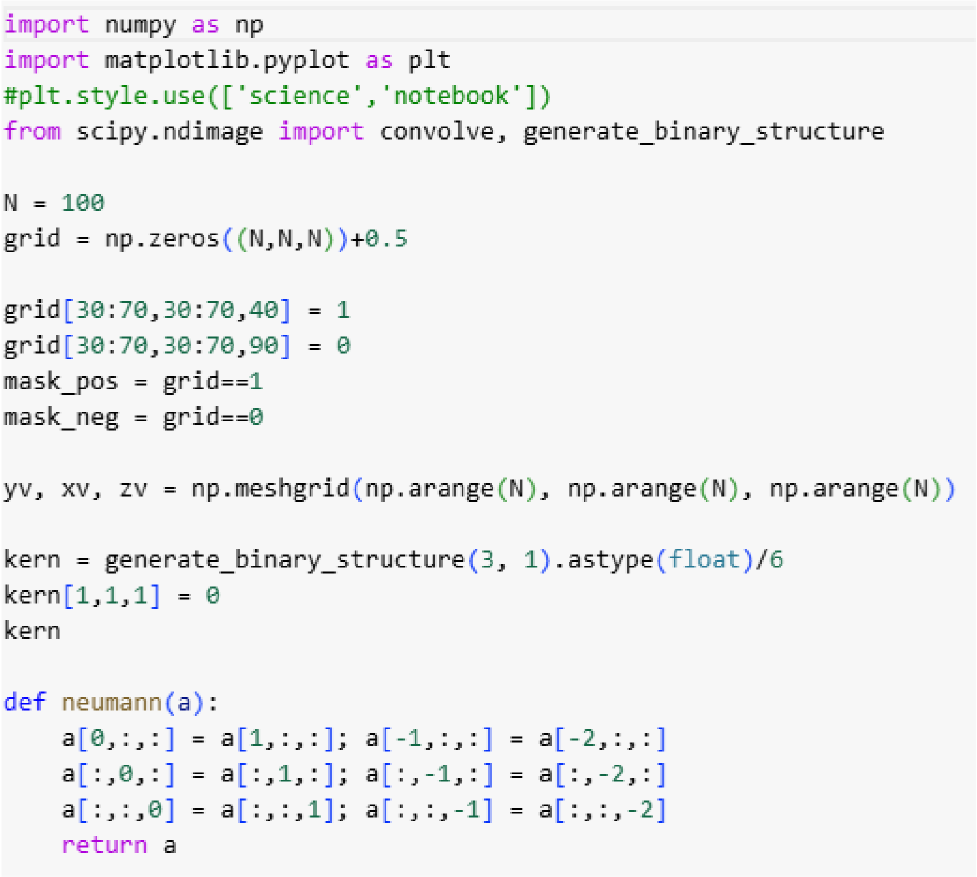
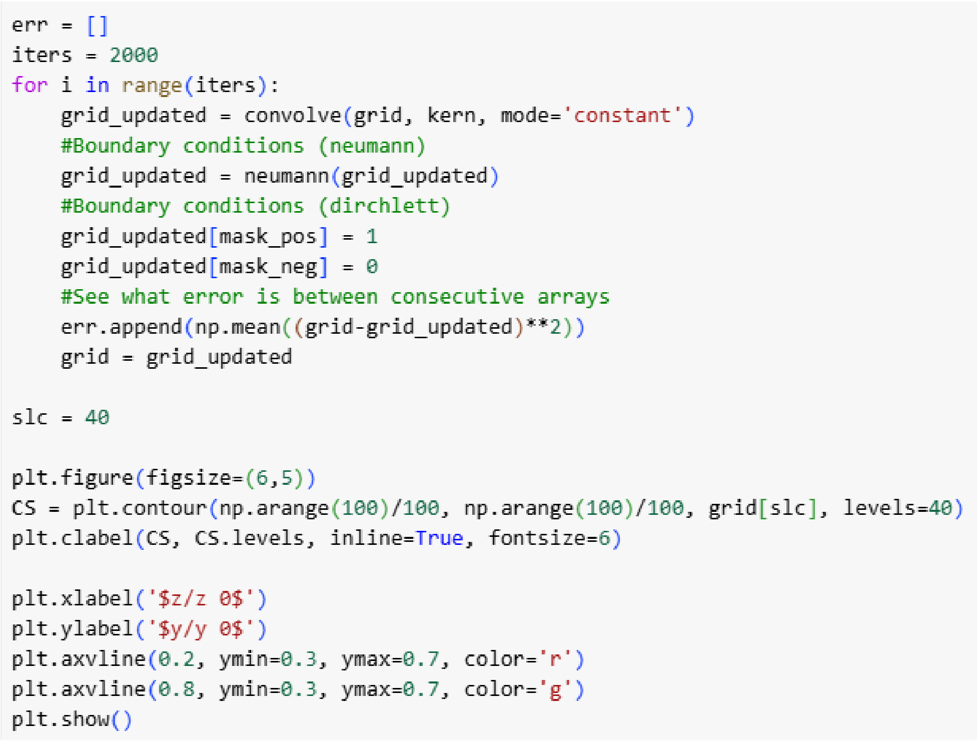
Nama : Ulfah Hasanah
NIM: 1227030036
KODE PEMROGRAMAN DAN HASIL SIMULASI

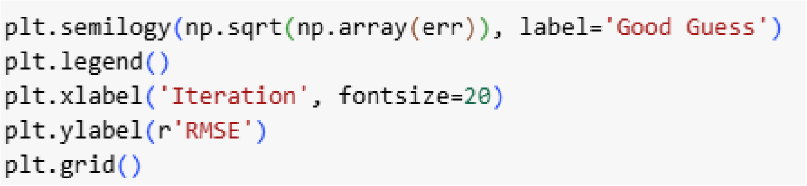


```
import numpy as np
import matplotlib.pyplot as plt
#plt.style.use(['science','notebook'])
from scipy.ndimage import convolve, generate_binary_structure

N = 100
grid = np.zeros((N,N,N))+0.5

grid[30:70,30:70,40] = 1
grid[30:70,30:70,90] = 0
mask_pos = grid==1
mask_neg = grid==0

yv, xv, zv = np.meshgrid(np.arange(N), np.arange(N), np.arange(N))

kern = generate_binary_structure(3, 1).astype(float)/6
kern[1,1,1] = 0
kern

def neumann(a):
    a[0,:,:] = a[1,:,:]; a[-1,:,:] = a[-2,:,:]
    a[:,0,:] = a[:,1,:]; a[:,-1,:] = a[:,-2,:]
    a[:,:,0] = a[:,:,1]; a[:,:,-1] = a[:,:,-2]
    return a
```

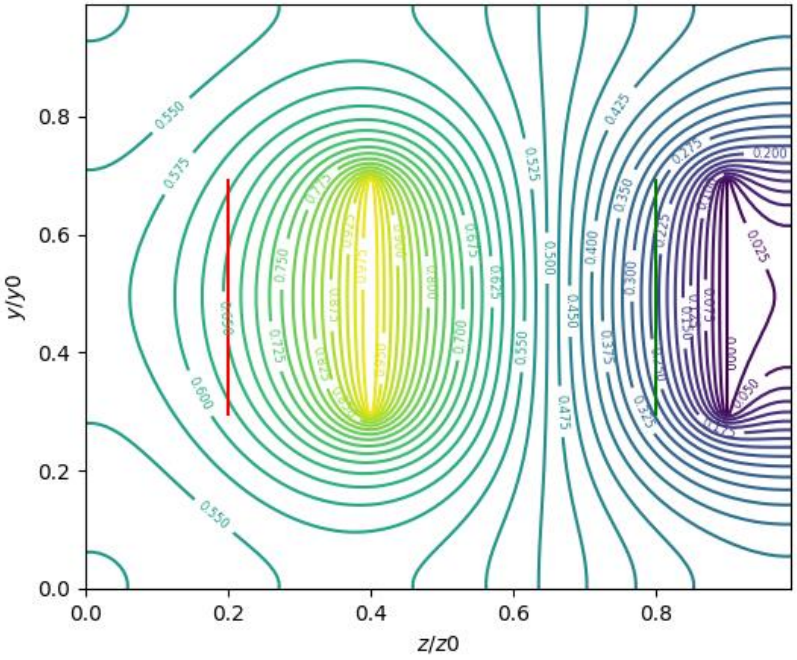


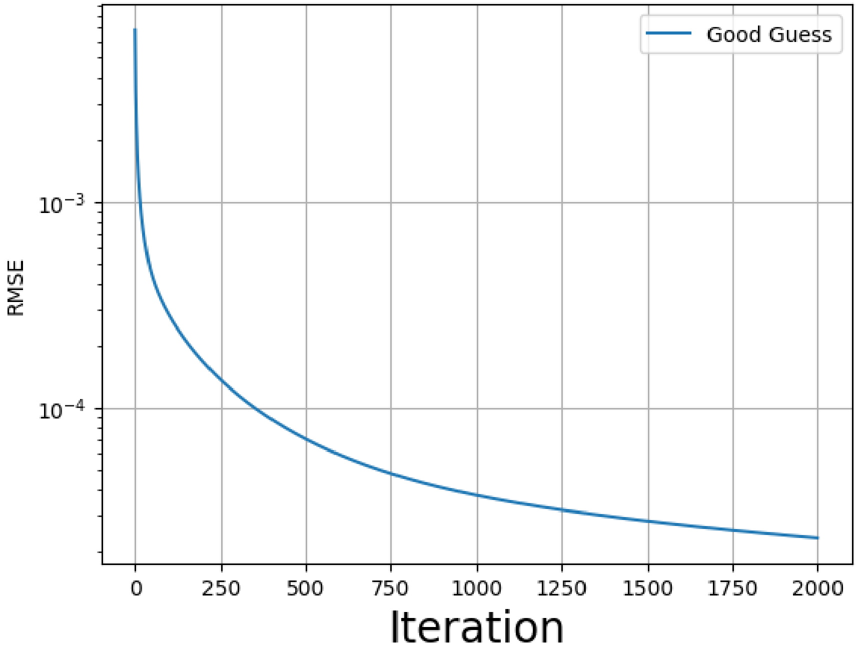
```
err = []
iters = 2000
for i in range(iters):
    grid_updated = convolve(grid, kern, mode='constant')
    #Boundary conditions (neumann)
    grid_updated = neumann(grid_updated)
    #Boundary conditions (dirchlett)
    grid_updated[mask_pos] = 1
    grid_updated[mask_neg] = 0
    #See what error is between consecutive arrays
    err.append(np.mean((grid-grid_updated)**2))
    grid = grid_updated

slc = 40

plt.figure(figsize=(6,5))
CS = plt.contour(np.arange(100)/100, np.arange(100)/100, grid[slc], levels=40)
plt.clabel(CS, CS.levels, inline=True, fontsize=6)

plt.xlabel('$z/z 0$')
plt.ylabel('$y/y 0$')
plt.axvline(0.2, ymin=0.3, ymax=0.7, color='r')
plt.axvline(0.8, ymin=0.3, ymax=0.7, color='g')
plt.show()
```

Nama : Ulfah Hasanah
NIM: 1227030036
KODE PEMROGRAMAN DAN HASIL SIMULASI



```
plt.semilogy(np.sqrt(np.array(err)), label='Good Guess')
plt.legend()
plt.xlabel('Iteration', fontsize=20)
plt.ylabel(r'RMSE')
plt.grid()
```


0.8
0.6
0.4
0.2
0.0
y/y0
0.0
0.2
0.4
0.6
0.8
z/z0
0.550
0.575
0.600
0.650
0.725
0.750
0.775
0.825
0.875
0.925
0.950
0.900
0.800
0.700
0.675
0.625
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.100
0.075
0.050
0.025
0.000


Good Guess
10^{-3}
10^{-4}
RMSE
Iteration