

VPython - symulacje fizyczne z grafiką 3D dla każdego

wykład 8

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Legenda

```
legend_details.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\legend_details.py (2.7.12)
File Edit Format Run Options Window Help

import numpy as np
import matplotlib.pyplot as plt

plt.rcParams['font.size'] = 18
plt.rcParams['legend.fontsize'] = 18

x = np.linspace(0,10,50)
y1 = np.sin(x); y2 = np.cos(x); y3 = np.exp(-x)

plt.plot(x, y1, 'k-', label='sin(x)', lw=2)
plt.plot(x, y2, 'b', dashes=[20,10], label='cos(x)', lw=2)
plt.plot(x[::2], y3[::2], 'rs-', label='exp(-x)', ms=8, lw=2)

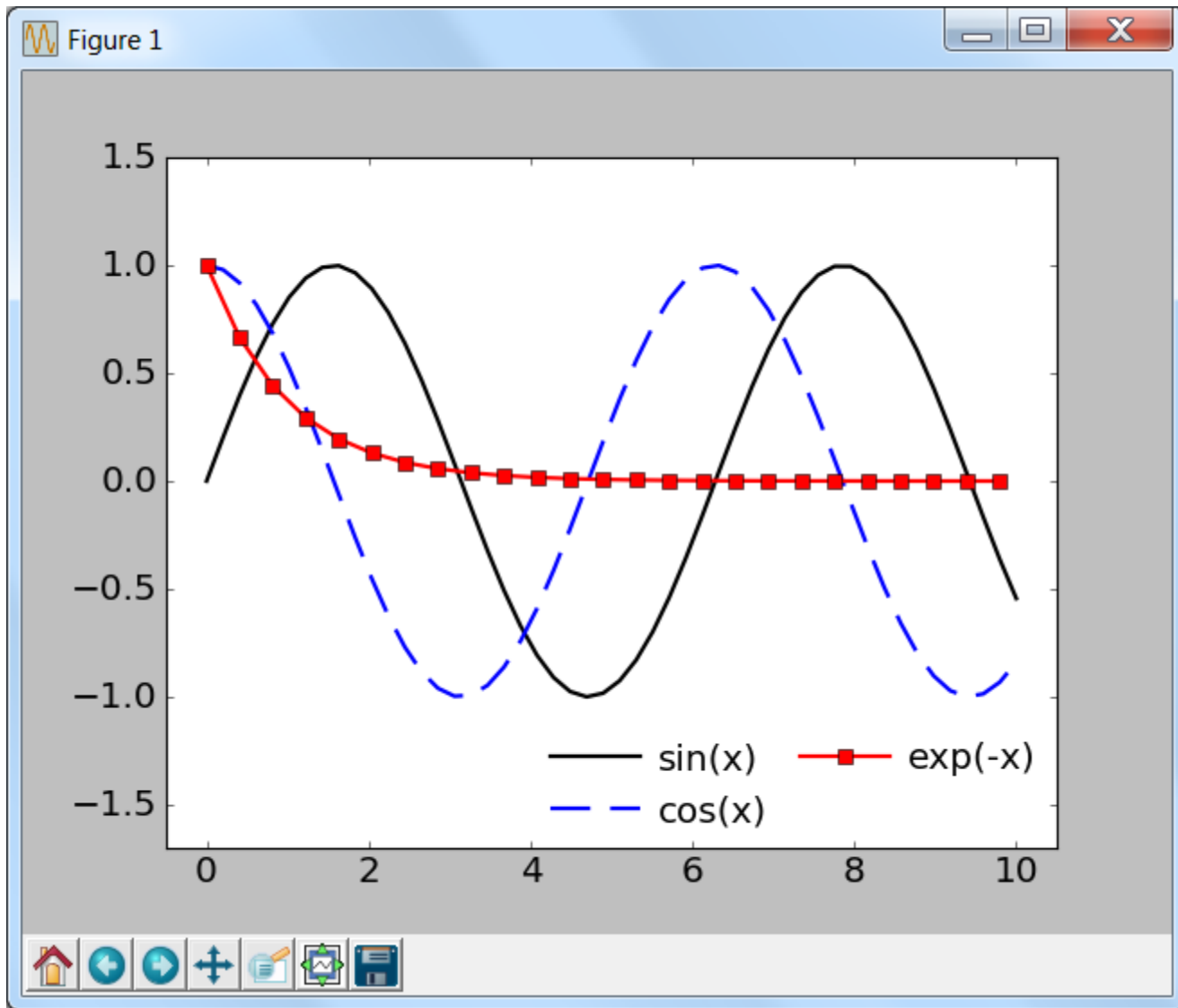
plt.legend(loc = 'lower right',
          ncol=2, numpoints=1, labelspacing=0.5,
          handletextpad=0.5, handlelength=2.5,
          borderaxespadd=0.5, borderpad=0.05,
          columnspacing=0.9, frameon=False)

plt.axis([-0.5, 10.5, -1.7, 1.5])
plt.show()
```

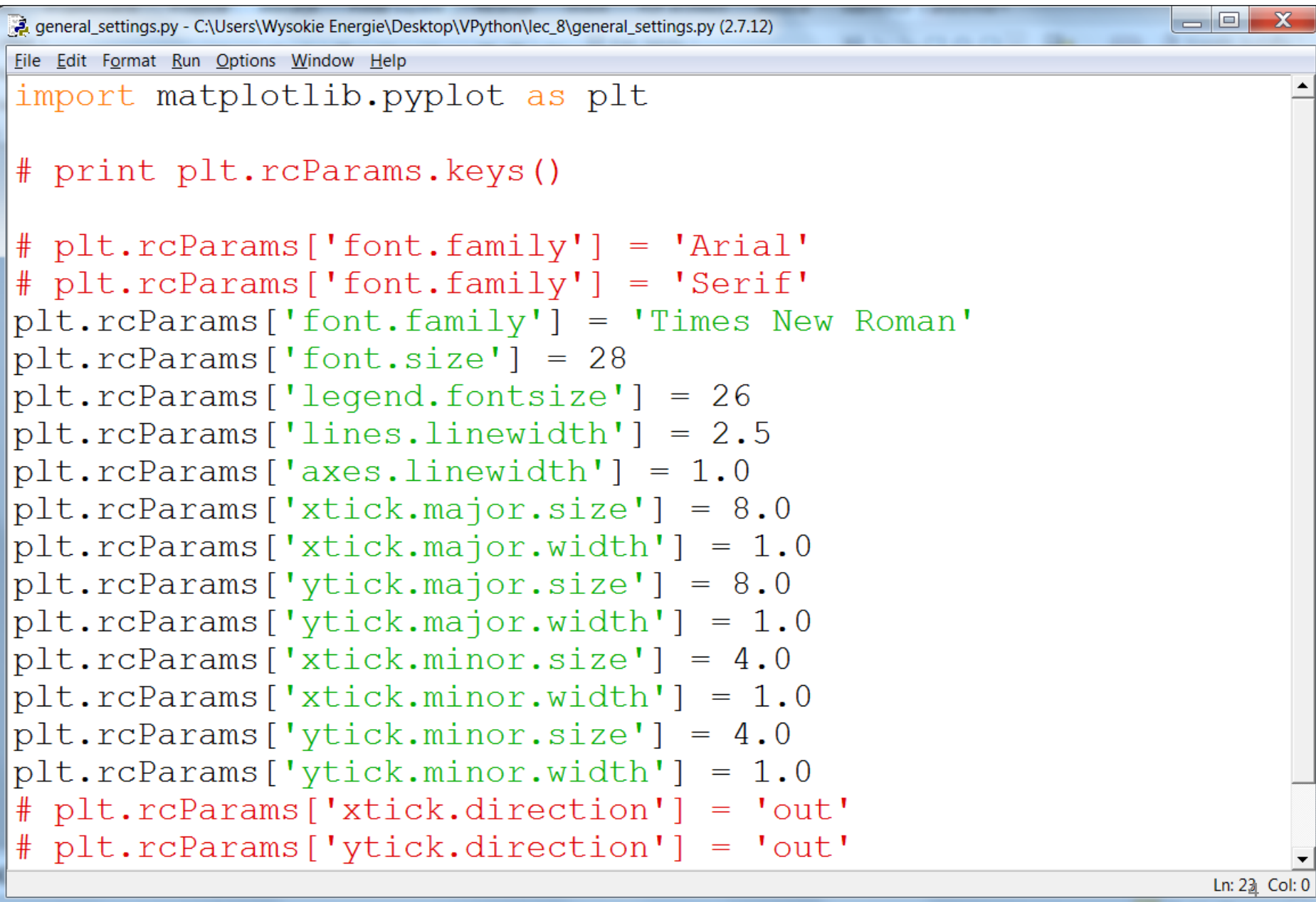
← **plt.style.use('classic')**

↑ ↑
co drugi element

proszę pobawić
się liczbami



Ustawienia



The image shows a screenshot of a Python IDE window titled "general_settings.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\general_settings.py (2.7.12)". The window has a menu bar with "File", "Edit", "Format", "Run", "Options", "Window", and "Help". The main text area contains the following Python code:

```
import matplotlib.pyplot as plt

# print plt.rcParams.keys()

# plt.rcParams['font.family'] = 'Arial'
# plt.rcParams['font.family'] = 'Serif'
plt.rcParams['font.family'] = 'Times New Roman'
plt.rcParams['font.size'] = 28
plt.rcParams['legend.fontsize'] = 26
plt.rcParams['lines.linewidth'] = 2.5
plt.rcParams['axes.linewidth'] = 1.0
plt.rcParams['xtick.major.size'] = 8.0
plt.rcParams['xtick.major.width'] = 1.0
plt.rcParams['ytick.major.size'] = 8.0
plt.rcParams['ytick.major.width'] = 1.0
plt.rcParams['xtick.minor.size'] = 4.0
plt.rcParams['xtick.minor.width'] = 1.0
plt.rcParams['ytick.minor.size'] = 4.0
plt.rcParams['ytick.minor.width'] = 1.0
# plt.rcParams['xtick.direction'] = 'out'
# plt.rcParams['ytick.direction'] = 'out'
```

The status bar at the bottom right indicates "Ln: 23 Col: 0".

Wykres 3D

```
3d_1.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\3d_1.py (2.7.12)
File Edit Format Run Options Window Help

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

plt.rcParams['font.size'] = 18

fig = plt.figure(figsize=(11, 8))
ax = fig.add_subplot(111, projection='3d')

x = np.linspace(-2,2,100)
y = np.linspace(-2,2,100)

(X,Y) = np.meshgrid(x,y)
Z = np.cos(X**2 + Y**2)

f1 = ax.plot_surface(X, Y, Z, rstride=4, cstride=4,
                    linewidth=0.1, cmap='rainbow')

fig.colorbar(f1, shrink=0.5, aspect=15,
            ticks=np.linspace(-1,1,6))
```


1 rząd, 1 kolumna, wykres 1

100/4 linii



Ln: 17 Col: 0

3D plot



```
3d_1.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\3d_1.py (2.7.12)
File Edit Format Run Options Window Help

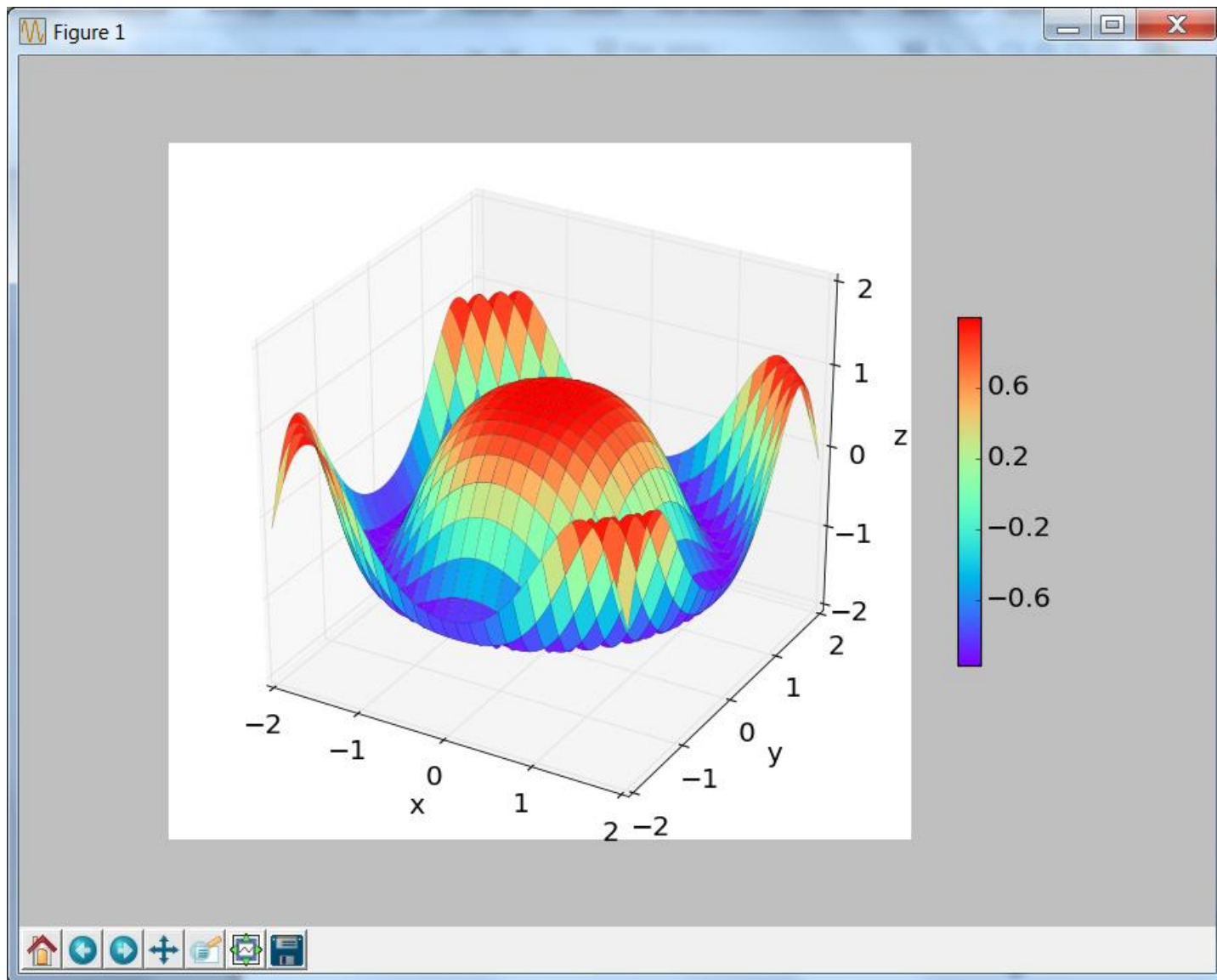
ax.set_xlim(-2,2)
ax.set_ylim(-2,2)
ax.set_zlim(-2,2)

ax.set_xlabel('x', labelpad=10)
ax.set_ylabel('y', labelpad=10)
ax.set_zlabel('z', labelpad=10)

ax.set_xticks(np.linspace(-2,2,5))
ax.set_yticks(np.linspace(-2,2,5))
ax.set_zticks(np.linspace(-2,2,5))

plt.show()

Ln: 36 Col: 0
```



Za pomocą myszki można kręcić, powiększać itp. 7

wykres 3D, wireframe

```
3d_2.py - C:/Users/Wysokie Energie/Desktop/VPython/lec_8/3d_2.py (2.7.12)
File Edit Format Run Options Window Help
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

plt.rcParams['font.size'] = 18

fig = plt.figure(figsize=(11, 8))
ax = fig.add_subplot(111, projection='3d')

x = np.linspace(-2,2,100)
y = np.linspace(-2,2,100)

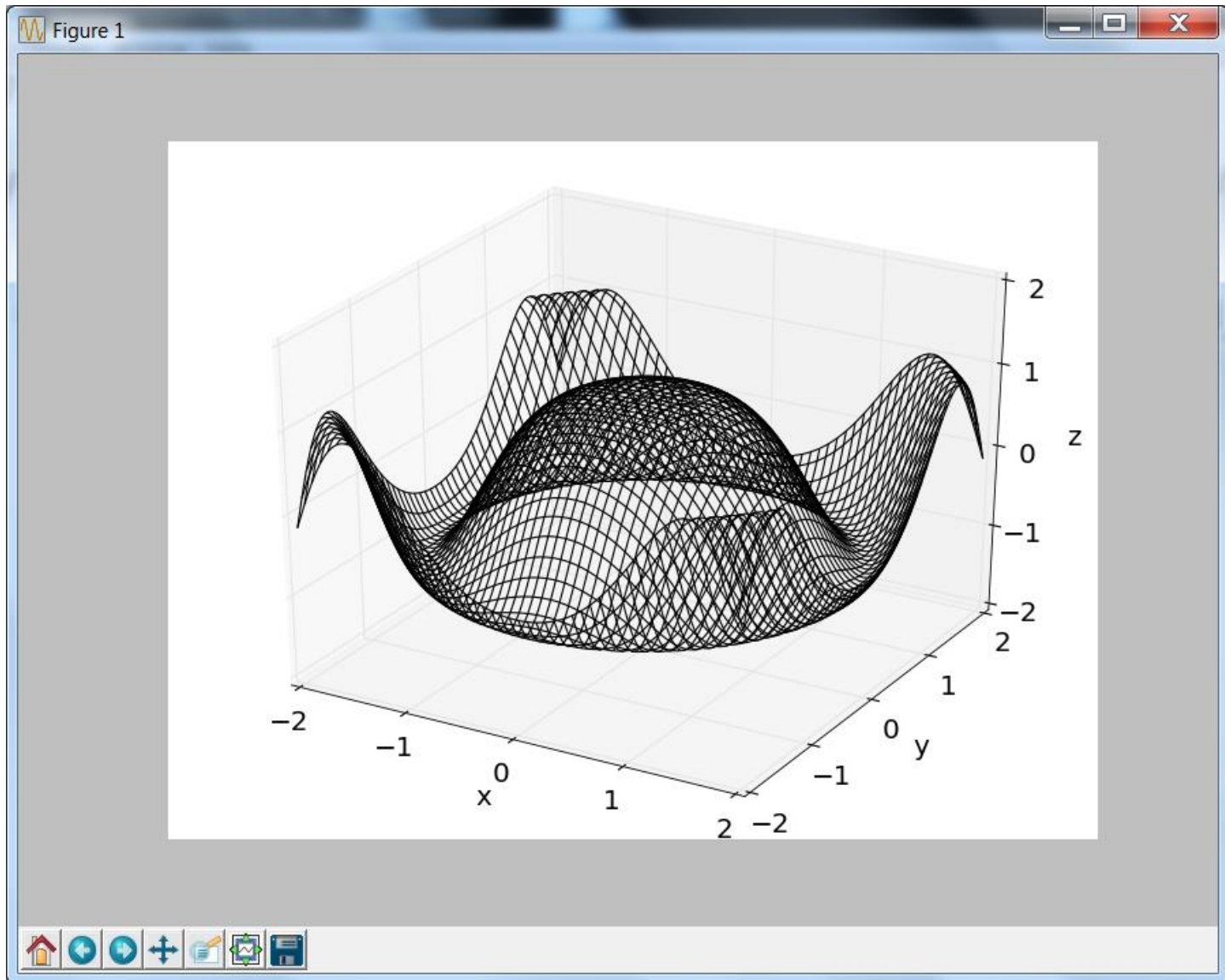
(X,Y) = np.meshgrid(x,y)
Z = np.cos(X**2 + Y**2)

ax.plot_wireframe(X, Y, Z, rstride=2, cstride=2,
                  linewidth=1, color='black')
```

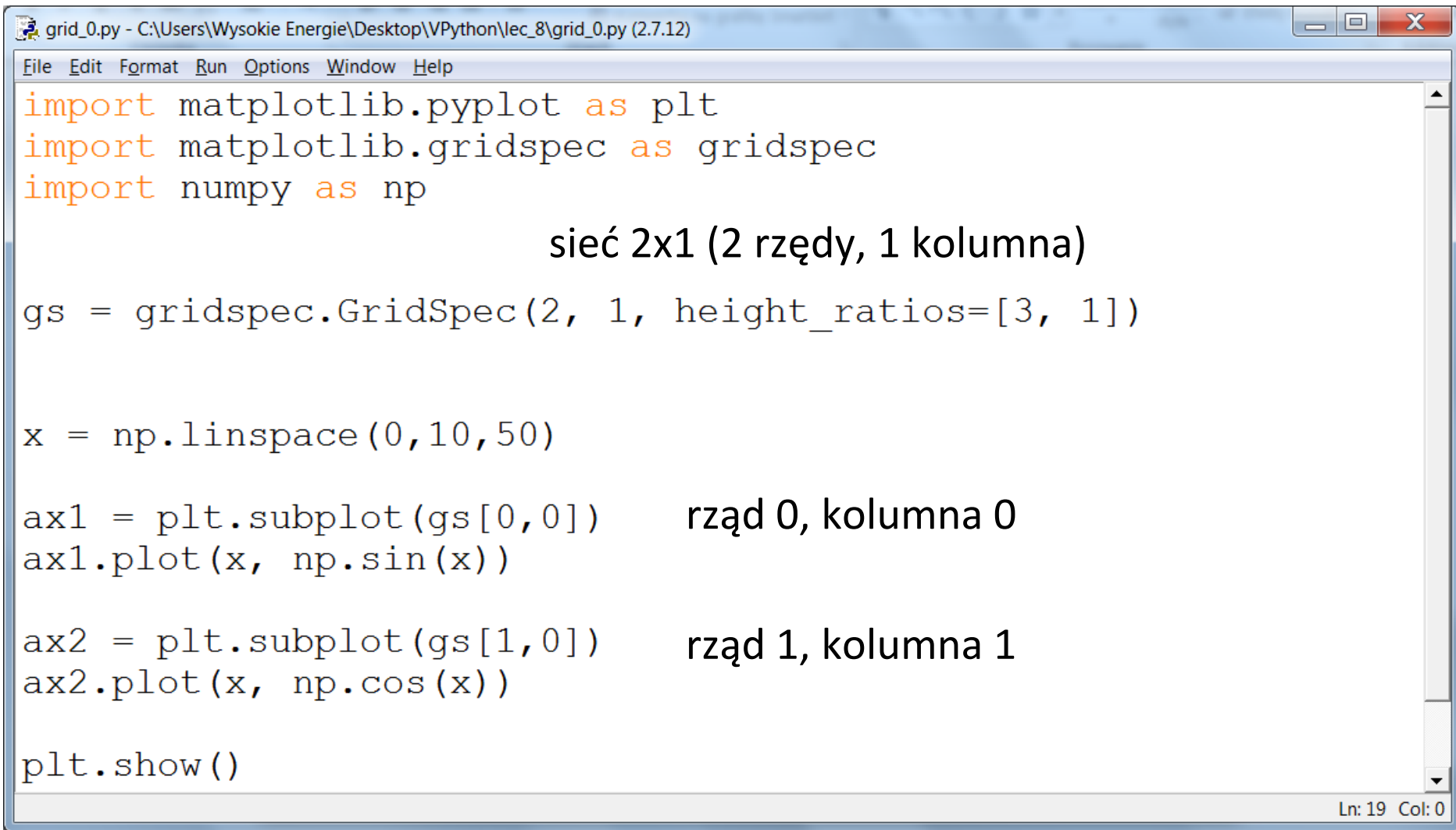
100/2 linii

Ln: 21 Col: 7

reszta jak na str. 6



Siatka wykresów. GridSpec



```
grid_0.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\grid_0.py (2.7.12)
File Edit Format Run Options Window Help
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
import numpy as np

                                sieć 2x1 (2 rzędy, 1 kolumna)

gs = gridspec.GridSpec(2, 1, height_ratios=[3, 1])

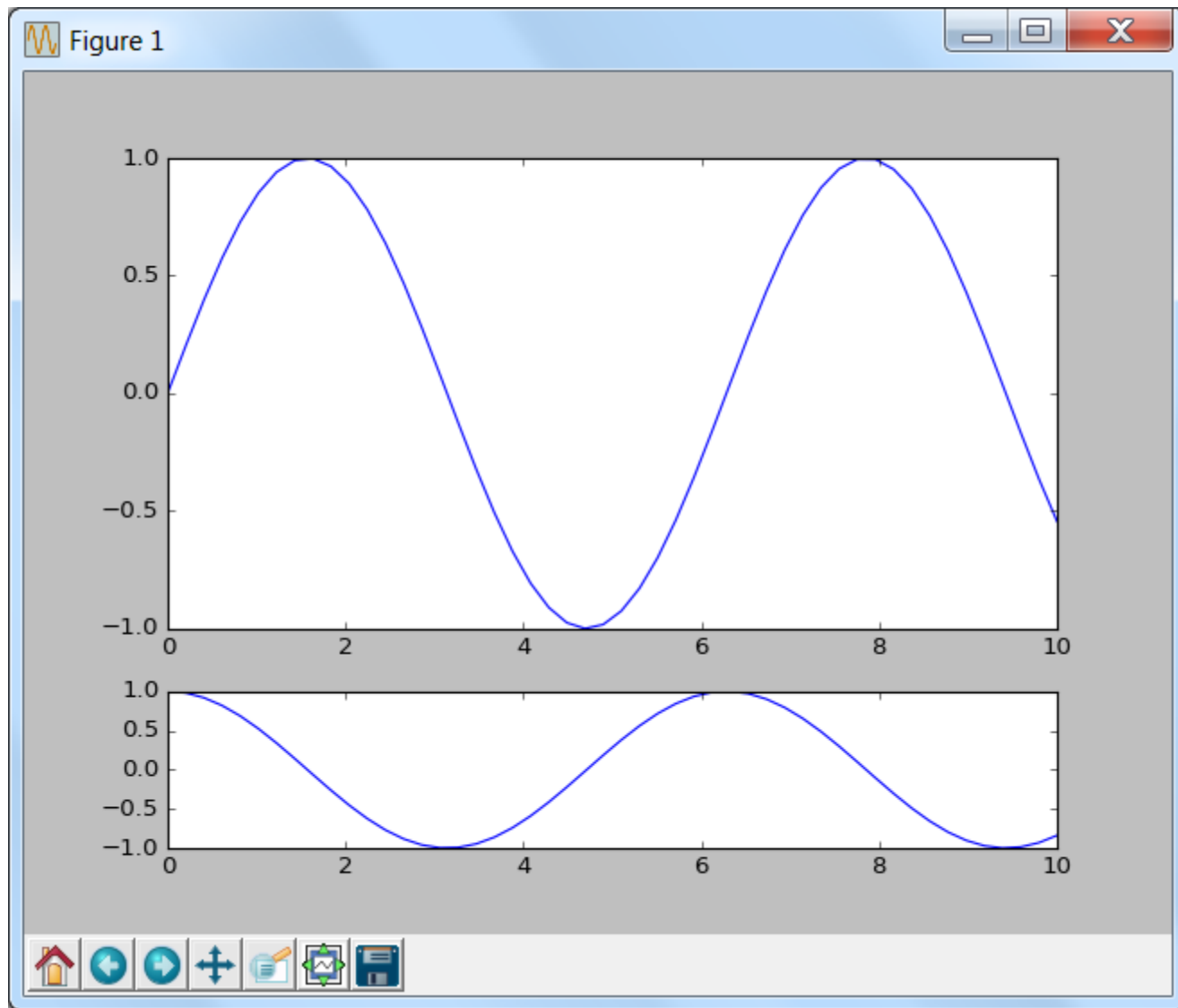
x = np.linspace(0, 10, 50)

ax1 = plt.subplot(gs[0, 0])      rząd 0, kolumna 0
ax1.plot(x, np.sin(x))

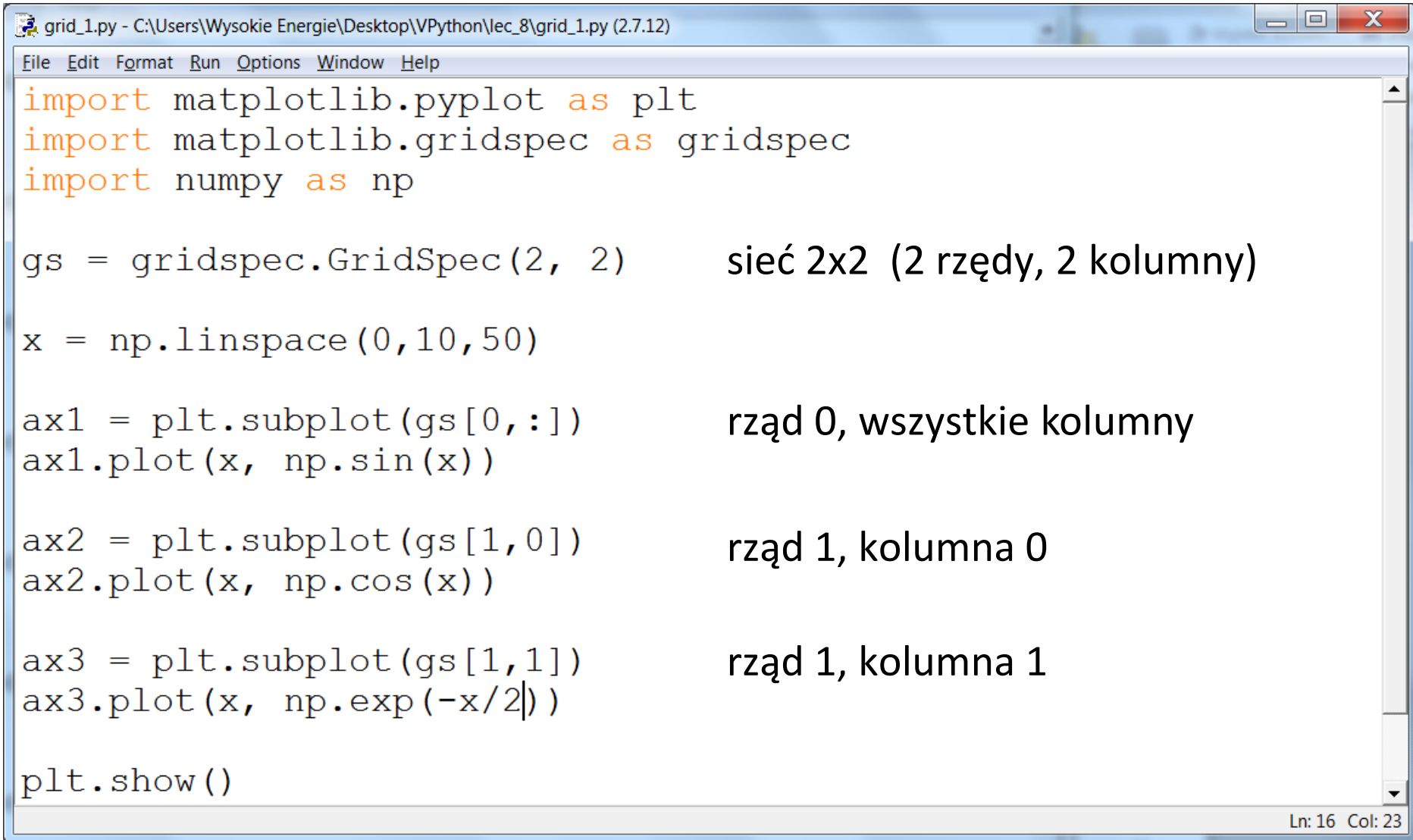
ax2 = plt.subplot(gs[1, 0])      rząd 1, kolumna 1
ax2.plot(x, np.cos(x))

plt.show()
```

Ln: 19 Col: 0



GridSpec



```
grid_1.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\grid_1.py (2.7.12)
File Edit Format Run Options Window Help
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
import numpy as np

gs = gridspec.GridSpec(2, 2)
x = np.linspace(0, 10, 50)

ax1 = plt.subplot(gs[0, :])
ax1.plot(x, np.sin(x))

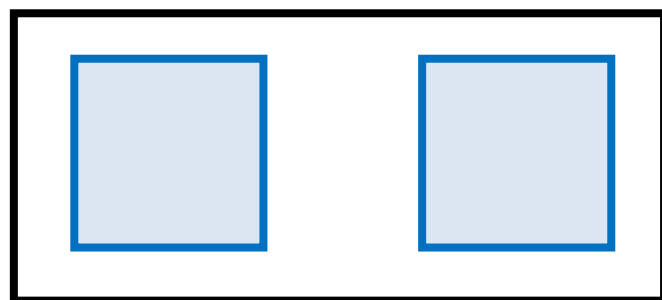
ax2 = plt.subplot(gs[1, 0])
ax2.plot(x, np.cos(x))

ax3 = plt.subplot(gs[1, 1])
ax3.plot(x, np.exp(-x/2))

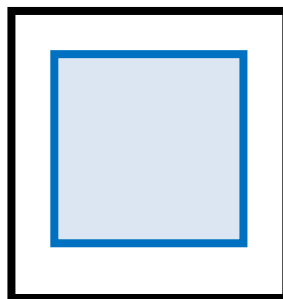
plt.show()
```

Ln: 16 Col: 23

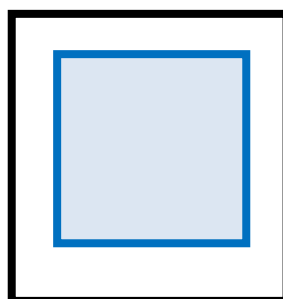
sieć 2x2



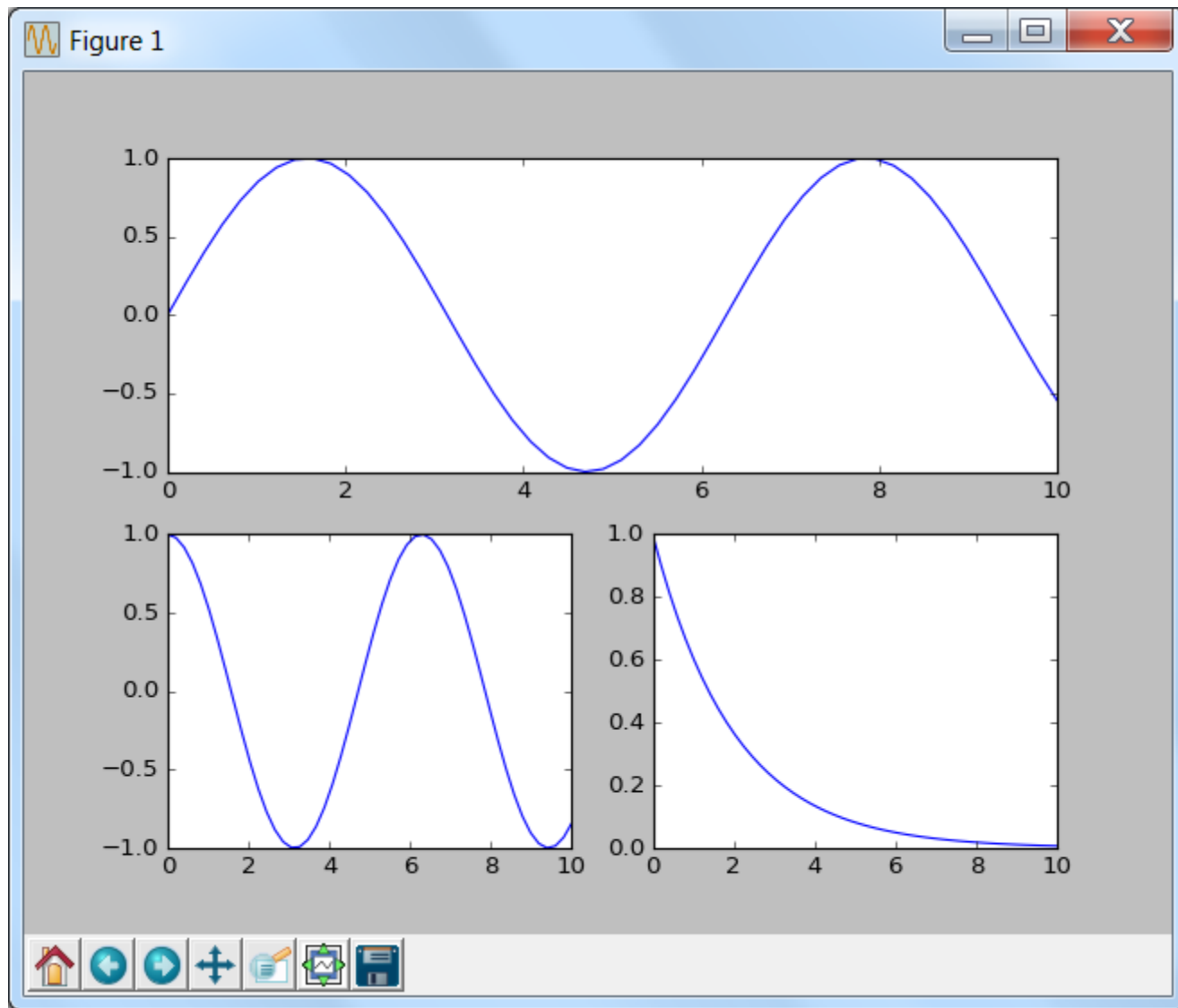
$gs[0, :]$



$gs[1, 0]$



$gs[1, 1]$



GridSpec

grid_2.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\grid_2.py (2.7.12)

File Edit Format Run Options Window Help

```
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
import numpy as np
```

sieć 3x3

```
gs = gridspec.GridSpec(3, 3, wspace=0.3, hspace=0.5,
                        height_ratios=[1, 1, 2])
```

```
x = np.linspace(0, 10, 10**2)
```

```
ax1 = plt.subplot(gs[0,:])
ax1.plot(x, np.sin(x))
ax1.semilogx()
```

rząd 0; kolumny 0,1,2

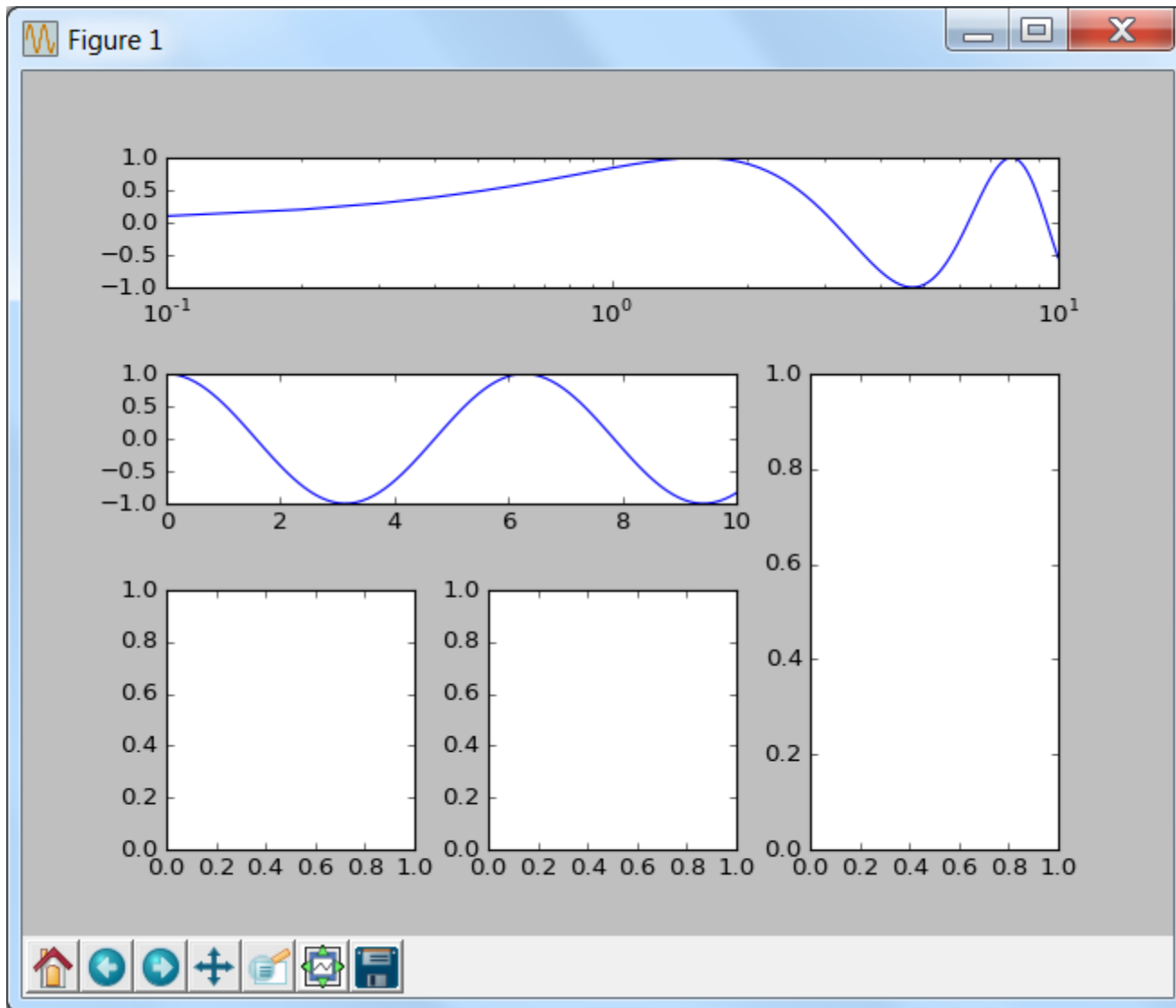
```
ax2 = plt.subplot(gs[1,:-1])
ax2.plot(x, np.cos(x))
```

rząd 1; kolumny 0, 1

```
ax3 = plt.subplot(gs[1:,-1])
ax4 = plt.subplot(gs[2,0])
ax5 = plt.subplot(gs[2,1])
```

rząd 1, 2; kolumna 2

```
plt.show()
```



VPython

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Documentation
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New in VPython 6
Change log
User forum
Contributed programs
For developers
Python web site

VPython 6

3D Programming for Ordinary Mortals

Click [here](#) to return to the main VPython page for instructions on using supported VPython. Or, to install Classic VPython 6, which is no longer supported:

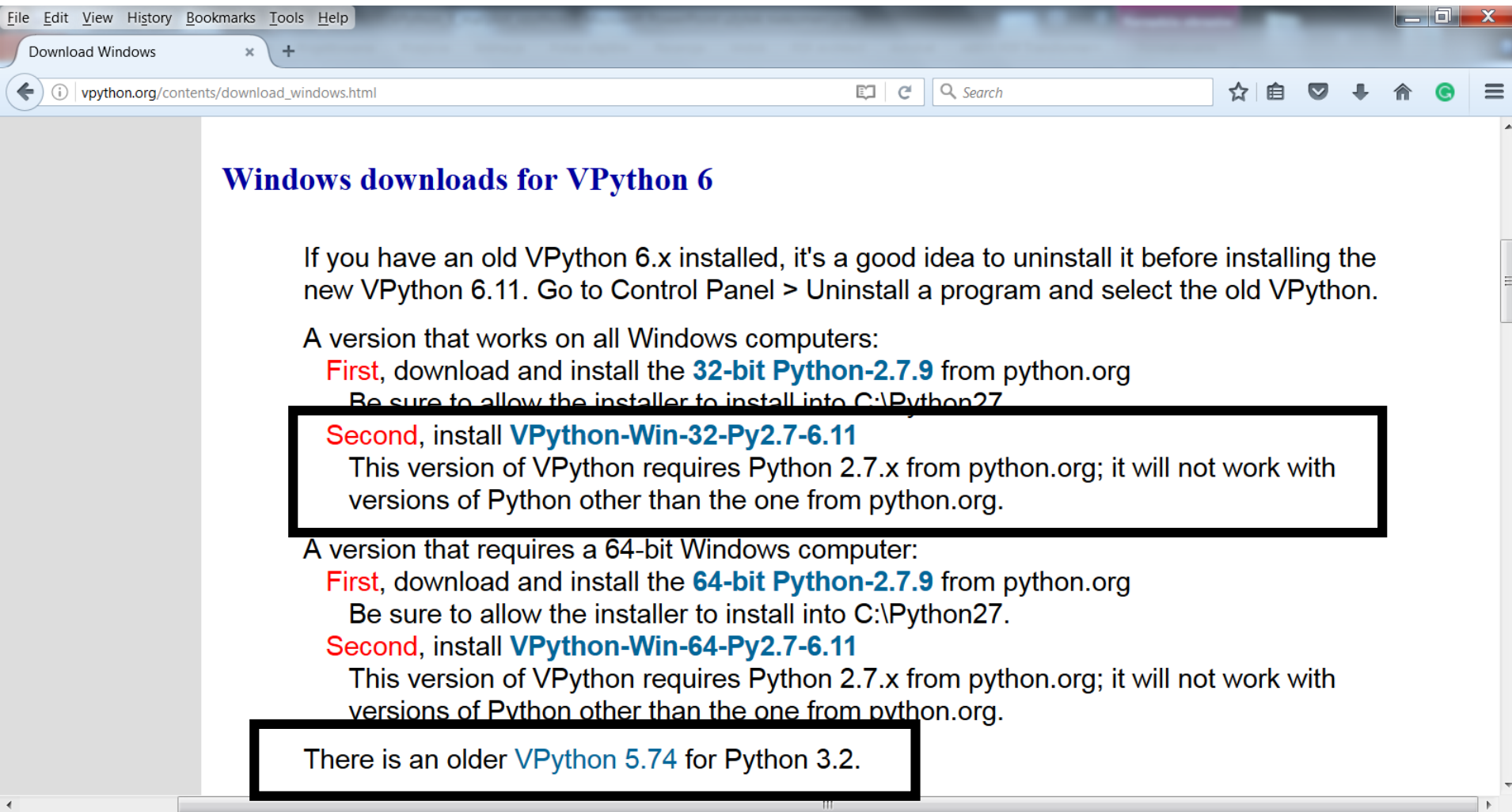
- Follow the instructions given on the Download links in the left margin. Rotating and zooming the camera is the same as for GlowScript VPython except that neither touch nor the mouse scrollwheel are supported.
- Classic VPython 6 will remain available, but will not henceforth be updated.

Descriptions of the Classic VPython 6 options available in the left margin:

Documentation: Overview, tutorials, and detailed documentation

VPython 6 jest na wydziałowych komputerach. Lepiej używać VPython 7 ale dla naszych celów oba są dobre

Windows, dobre dla Python 2.7.x



The screenshot shows a web browser window with the address bar displaying `vpypython.org/contents/download_windows.html`. The page title is "Download Windows". The main heading is "Windows downloads for VPython 6". The text on the page provides instructions for installing VPython 6.11 on Windows, including a warning to uninstall old versions and a list of steps for both 32-bit and 64-bit systems. Two sections of the text are highlighted with black boxes: the 32-bit installation steps and the note about the older 5.74 version for Python 3.2.

Windows downloads for VPython 6

If you have an old VPython 6.x installed, it's a good idea to uninstall it before installing the new VPython 6.11. Go to Control Panel > Uninstall a program and select the old VPython.

A version that works on all Windows computers:

First, download and install the **32-bit Python-2.7.9** from python.org
Be sure to allow the installer to install into C:\Python27.

Second, install **VPython-Win-32-Py2.7-6.11**
This version of VPython requires Python 2.7.x from python.org; it will not work with versions of Python other than the one from python.org.

A version that requires a 64-bit Windows computer:

First, download and install the **64-bit Python-2.7.9** from python.org
Be sure to allow the installer to install into C:\Python27.

Second, install **VPython-Win-64-Py2.7-6.11**
This version of VPython requires Python 2.7.x from python.org; it will not work with versions of Python other than the one from python.org.

There is an older **VPython 5.74** for Python 3.2.

Używamy VIDLE for VPython
Powinno pojawić się na pulpicie

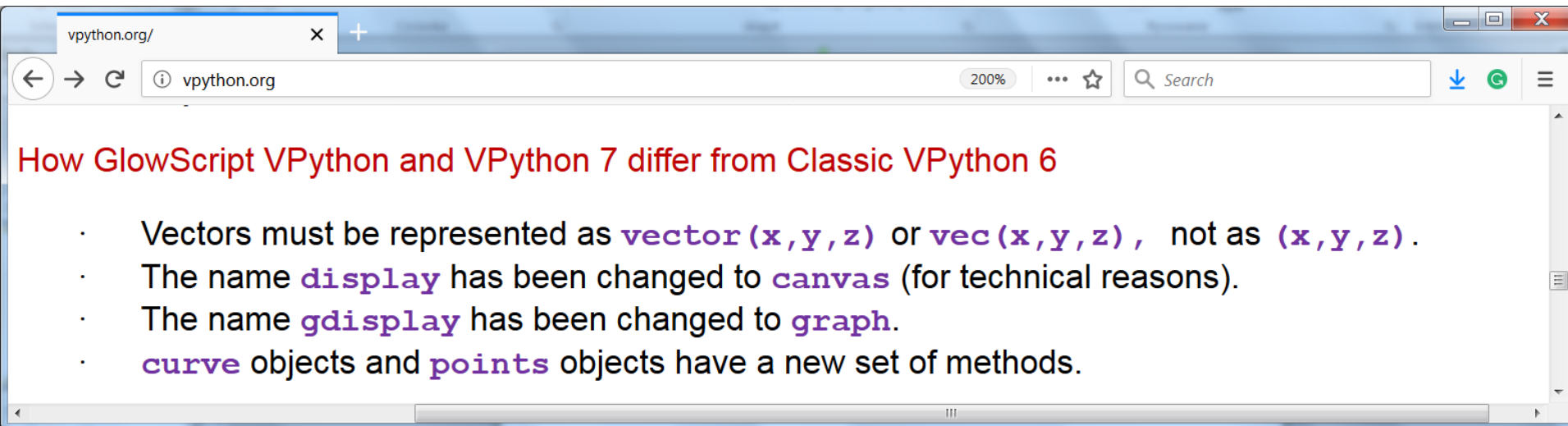
Mając Python 3.x lepiej zainstalować **VPython 7**

Robimy podobnie jak dla NumPy czy Matplotlib

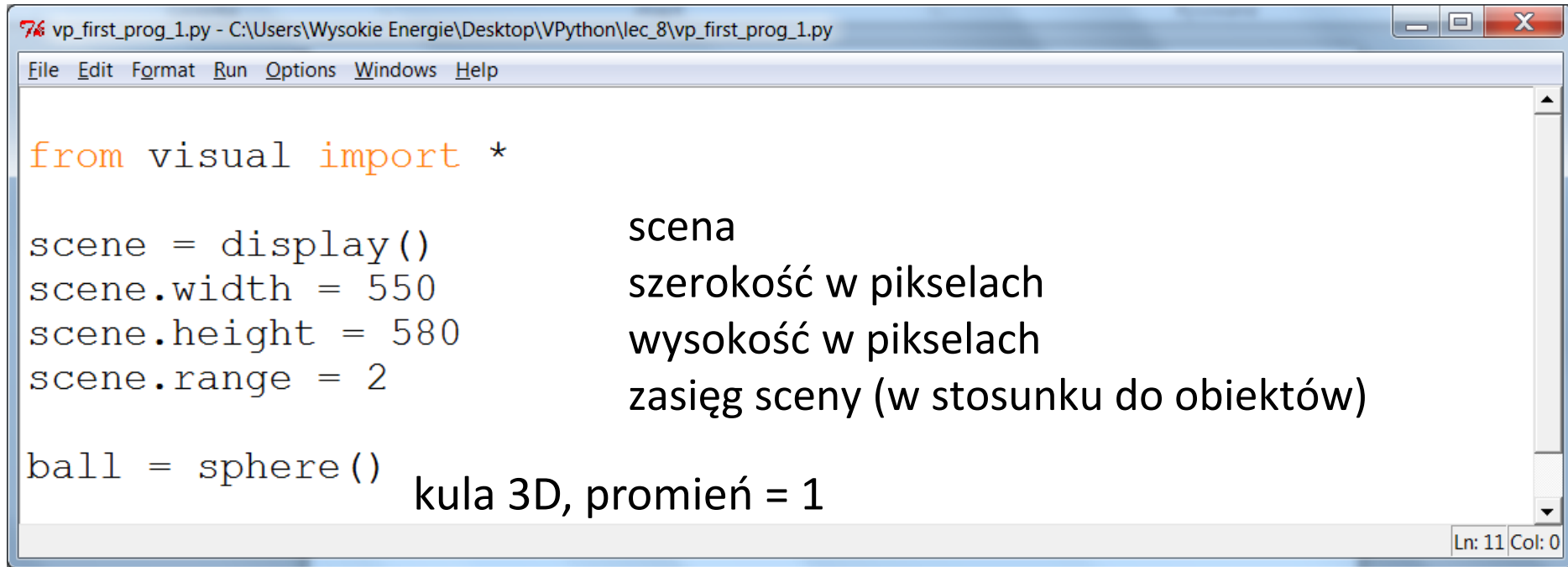
python pip install vpython

Są inne opcje: proszę poczytać na <http://vpython.org/>

Drobne różnice pomiędzy classic a 7



Pierwszy program



The screenshot shows a Python IDE window titled "vp_first_prog_1.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_1.py". The menu bar includes File, Edit, Format, Run, Options, Windows, and Help. The code in the editor is as follows:

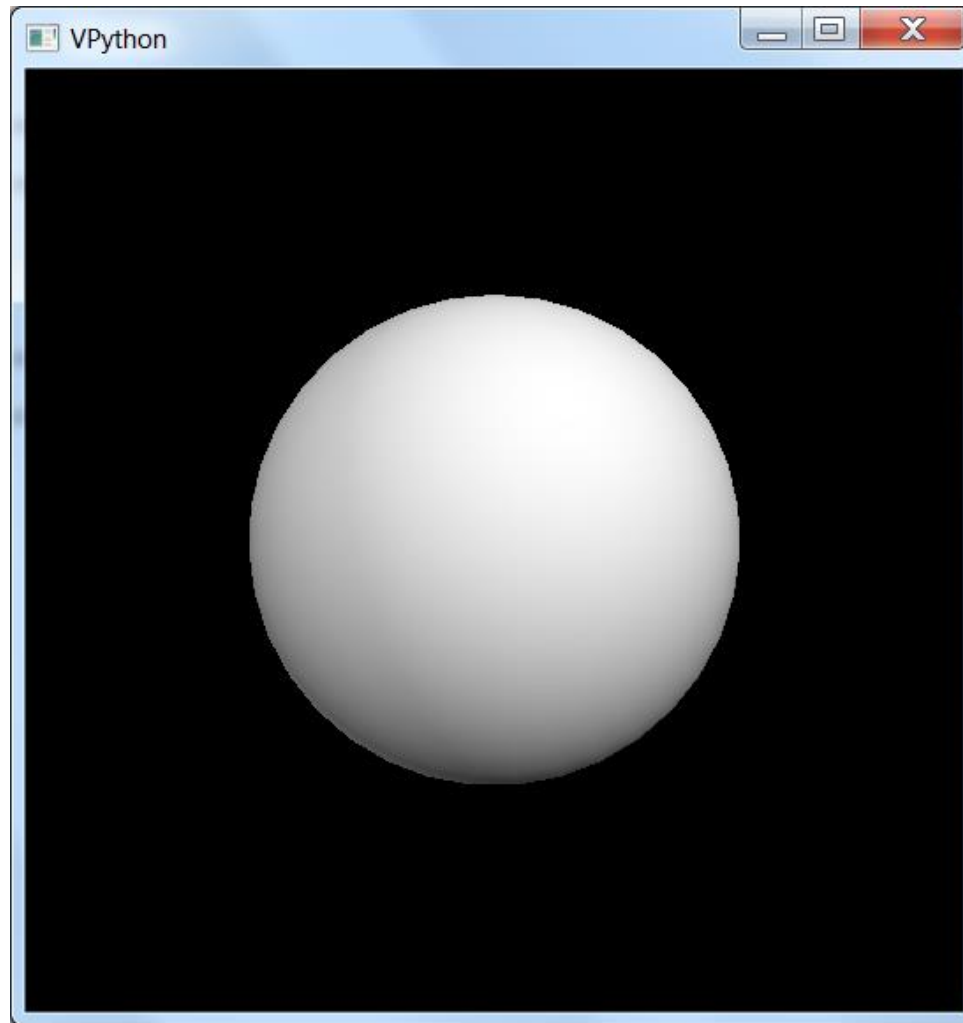
```
from visual import *  
  
scene = display()          scena  
scene.width = 550          szerokość w pikselach  
scene.height = 580         wysokość w pikselach  
scene.range = 2            zasięg sceny (w stosunku do obiektów)  
  
ball = sphere()            kula 3D, promień = 1
```

The status bar at the bottom right indicates "Ln: 11 Col: 0".

VPython 7:

display → canvas

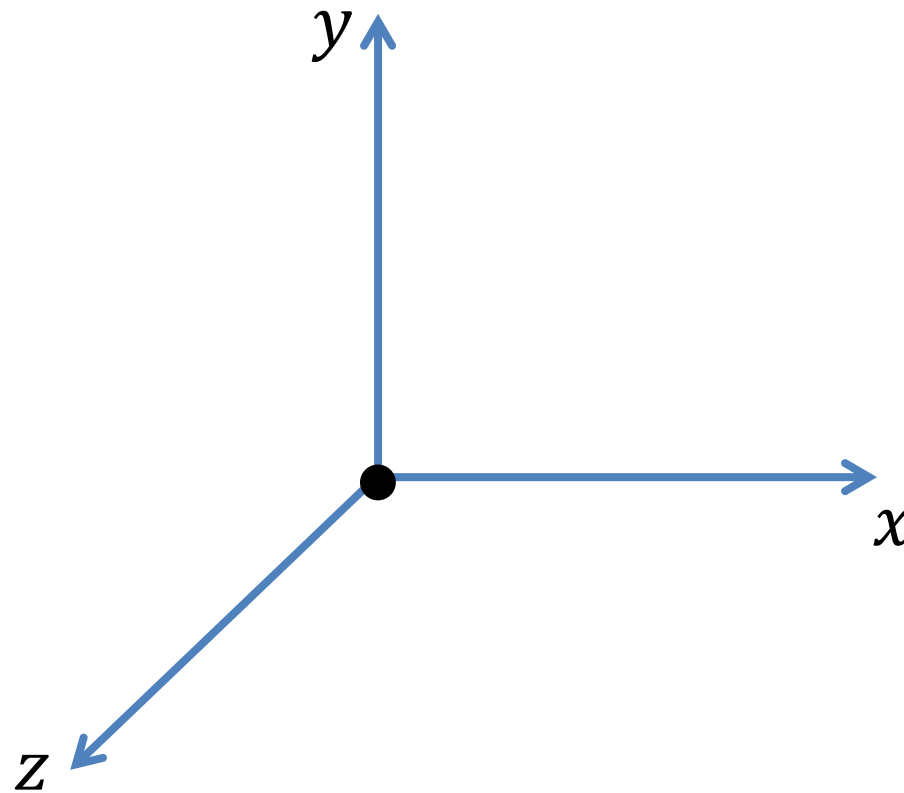
from visual import * → from vpython import *



Używając myszki można ruszać kamerą:

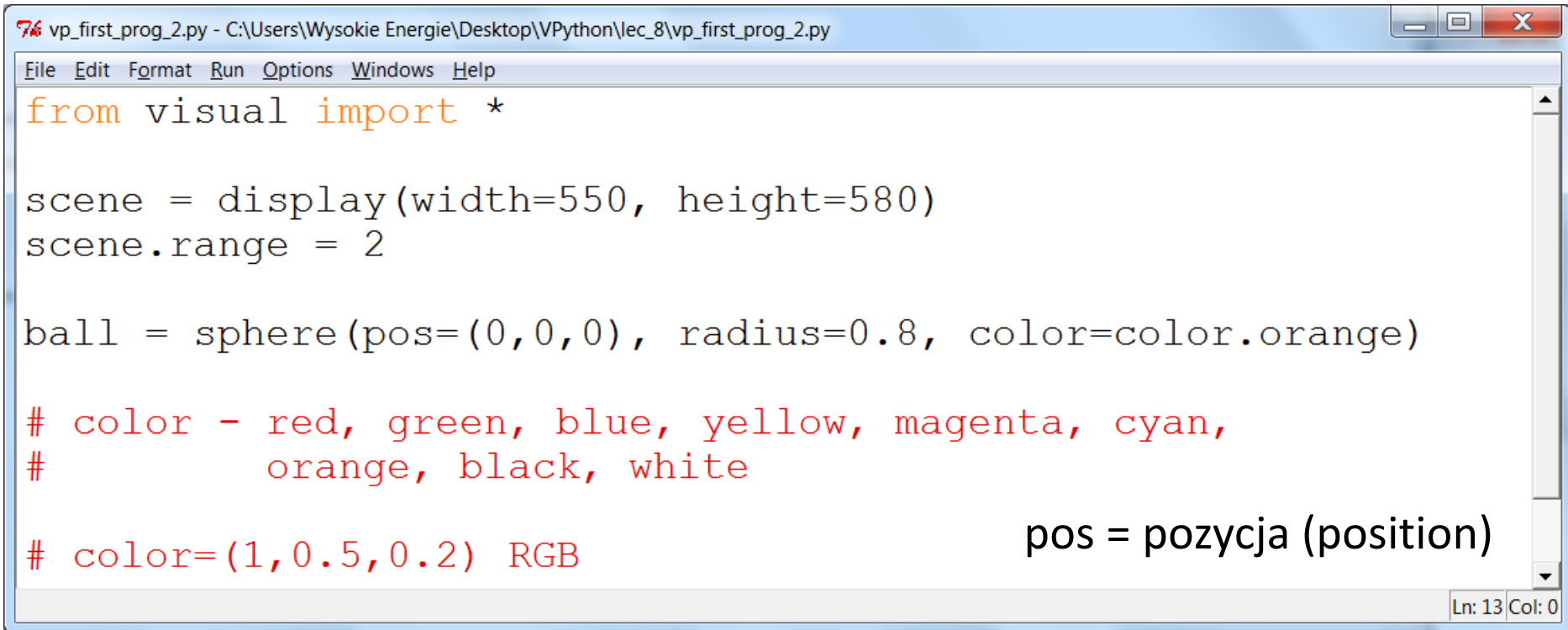
- prawy przycisk do obracania kamery
- dwa przyciski aby przybliżać/oddalać kamerę

Współrzędne w VPython



Kamera patrzy na $(0,0,0)$

Sfera



The screenshot shows a window titled "vp_first_prog_2.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_2.py". The window contains a Python script for creating a sphere in VPython. The script includes imports, scene setup, and sphere creation with a color comment. A status bar at the bottom right indicates "Ln: 13 Col: 0".

```
74 vp_first_prog_2.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_2.py
File Edit Format Run Options Windows Help
from visual import *

scene = display(width=550, height=580)
scene.range = 2

ball = sphere(pos=(0,0,0), radius=0.8, color=color.orange)

# color - red, green, blue, yellow, magenta, cyan,
#           orange, black, white

# color=(1,0.5,0.2) RGB
```

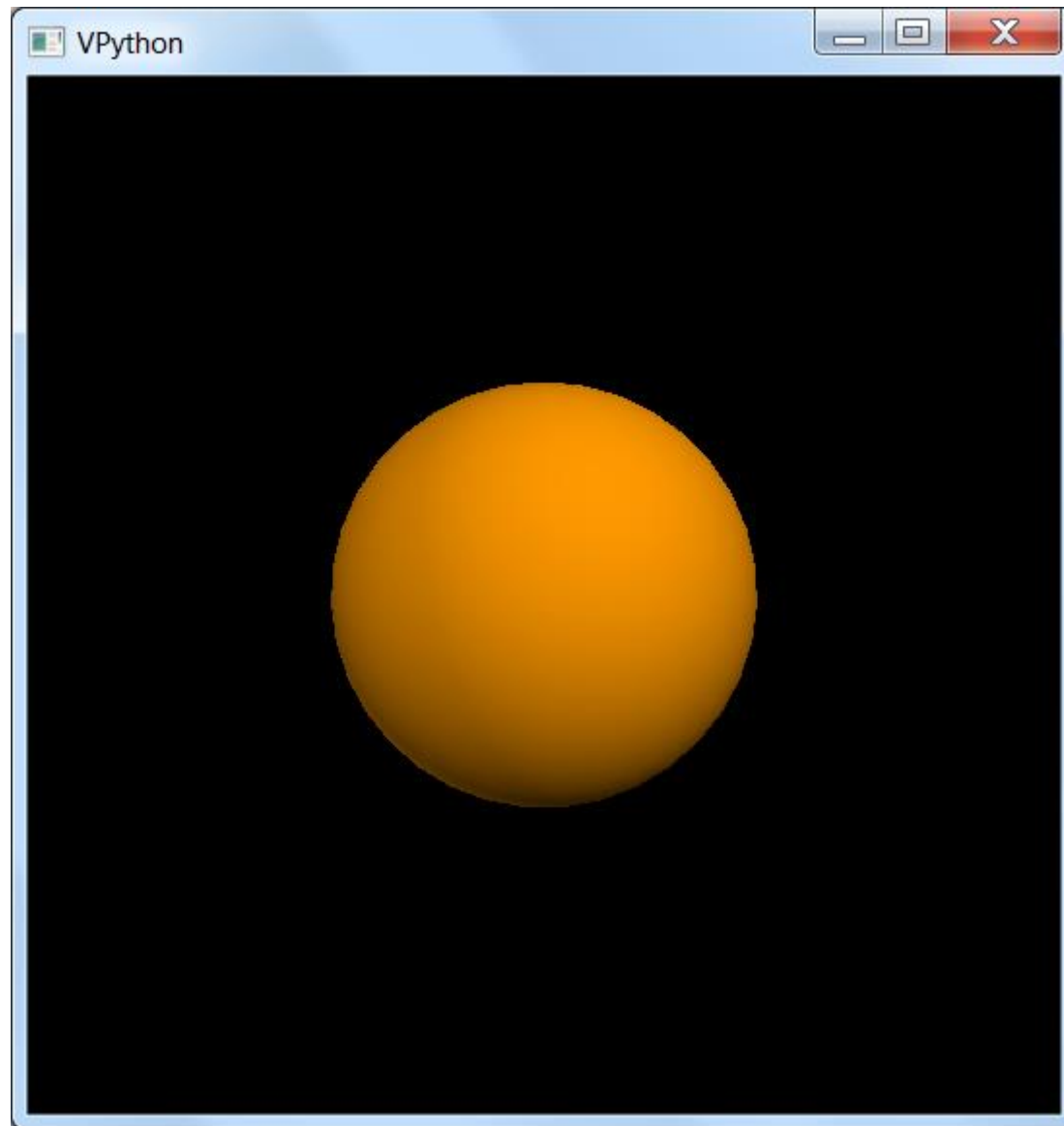
pos = pozycja (position)

Ln: 13 Col: 0

pos = vector(0,0,0) w VPython 7

lub

pos = vec(0,0,0)



sfera

74 vp_first_prog_3.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_3.py

File Edit Format Run Options Windows Help

```
from visual import *
```

```
ball = sphere(pos=(-2,1,0), radius=0.8, color=color.magenta)
```

```
print ball.pos
```

pos = vector(-2,1,0) w VPython 7

```
print ball.x
```

```
print ball.y
```

ball.x = ball.pos.x, ball.y = ball.pos.y

```
print ball.z
```

```
print ball.radius
```

```
print ball.color
```

```
ball.vel = vector(1,0,0)
```

np., prędkość kuli

```
print ball.vel
```

Ln: 16 Col: 0

```
<-2, 1, 0>
```

```
-2.0
```

```
1.0
```

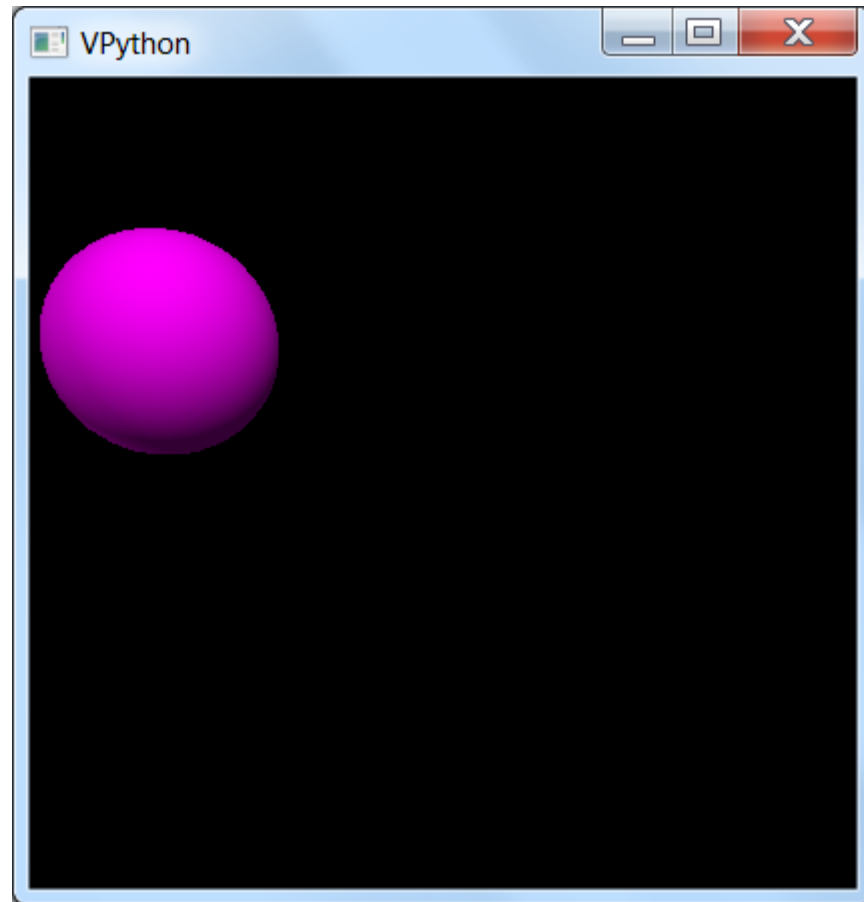
```
0.0
```

```
0.8
```

```
(1.0, 0.0, 1.0) w notacji RGB
```

```
<1, 0, 0>
```

26
Ln: 14 Col: 4



wektory

76 vp_first_prog_3b.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_3b.py

File Edit Format Run Options Windows Help

```
from visual import *
```

```
a = vector(2,0,0)
```

```
b = vector(0,1,4)
```

```
c = a + b
```

```
print c
```

```
print 2*c
```

```
print c.x
```

```
print c.y
```

```
print c.z
```

```
print mag(c)    długość wektora
```

Ln: 17 Col: 0

```
<2, 1, 4>
```

```
<4, 2, 8>
```

```
2.0
```

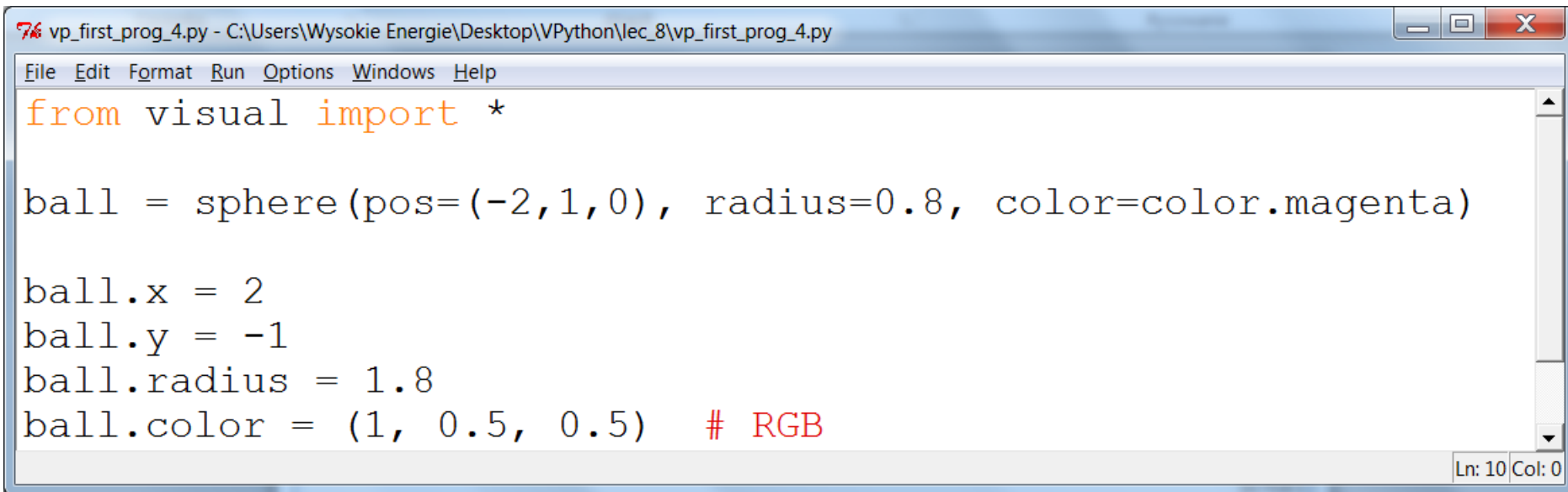
```
1.0
```

```
4.0
```

```
4.58257569496
```

28
Ln: 13 Col: 4

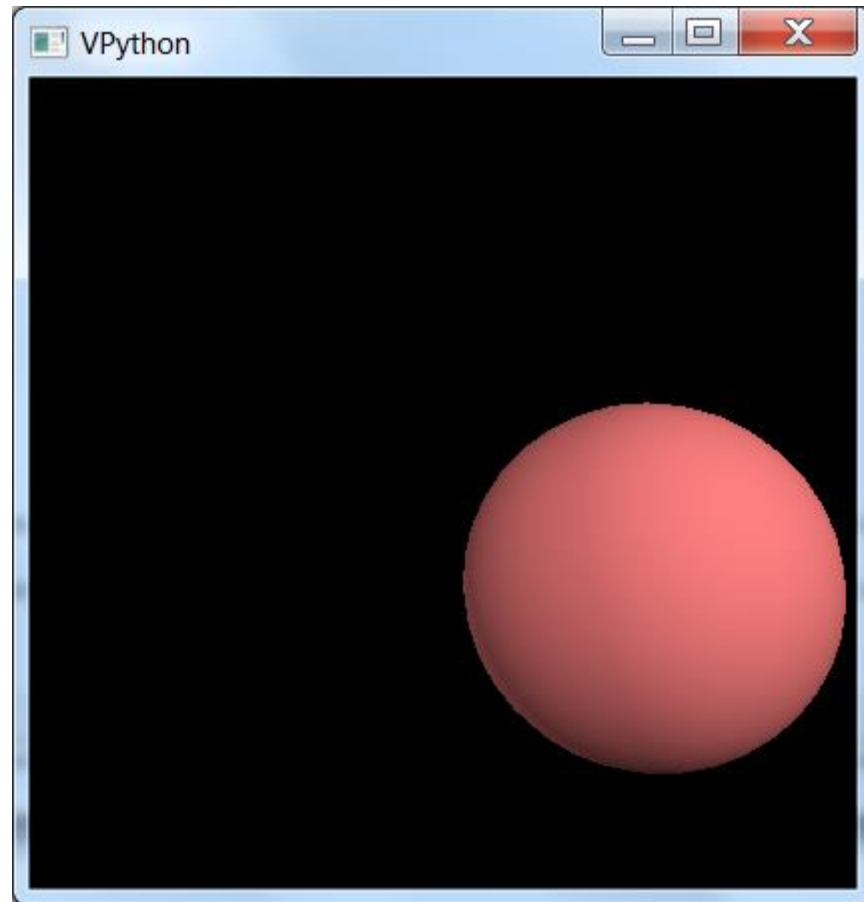
sfera

A screenshot of a Python IDE window titled "vp_first_prog_4.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_4.py". The window has a menu bar with "File", "Edit", "Format", "Run", "Options", "Windows", and "Help". The main text area contains the following Python code:

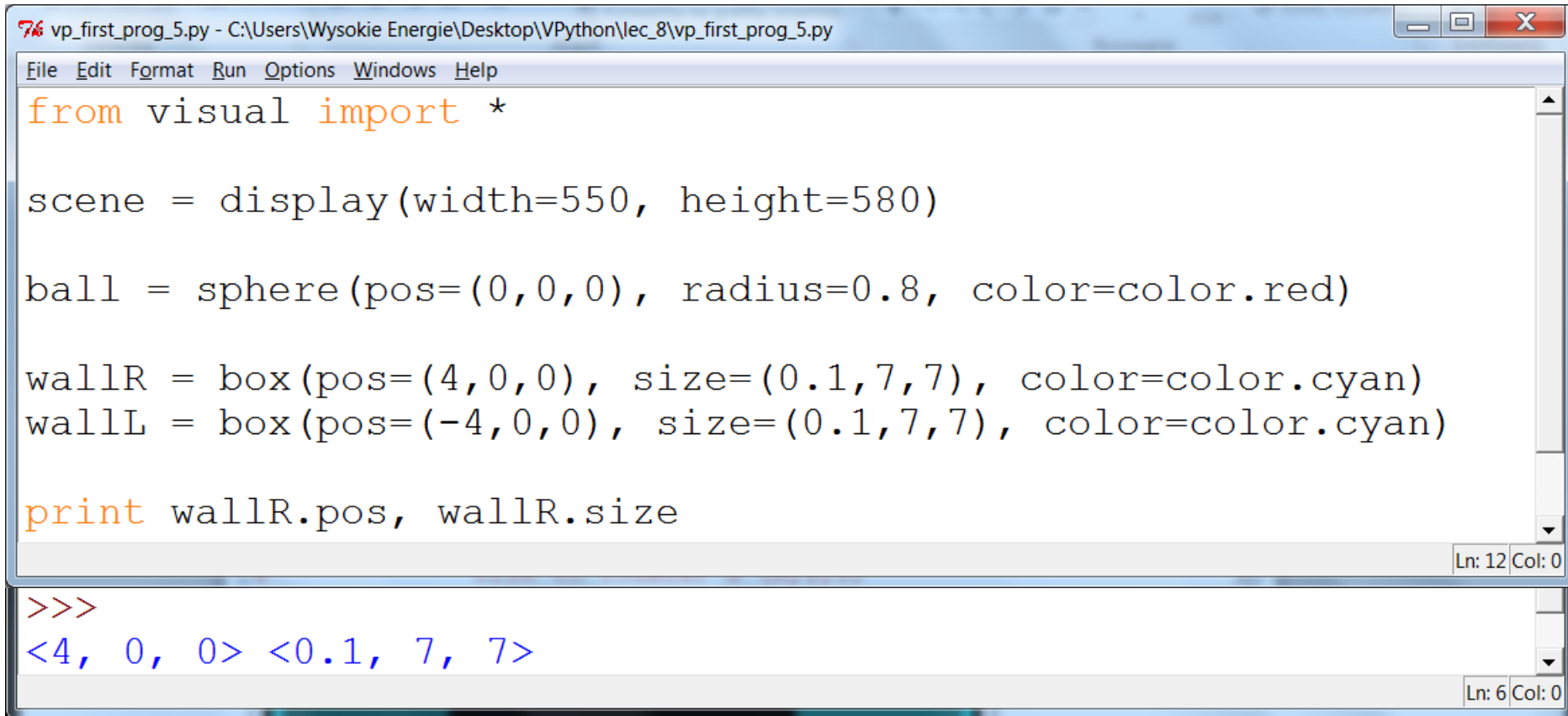
```
from visual import *  
  
ball = sphere(pos=(-2,1,0), radius=0.8, color=color.magenta)  
  
ball.x = 2  
ball.y = -1  
ball.radius = 1.8  
ball.color = (1, 0.5, 0.5) # RGB
```

The status bar at the bottom right shows "Ln: 10 Col: 0".

```
vp_first_prog_4.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_4.py  
File Edit Format Run Options Windows Help  
from visual import *  
  
ball = sphere(pos=(-2,1,0), radius=0.8, color=color.magenta)  
  
ball.x = 2  
ball.y = -1  
ball.radius = 1.8  
ball.color = (1, 0.5, 0.5) # RGB  
Ln: 10 Col: 0
```



sfera, pudełko



The screenshot shows a Python IDE window titled "vp_first_prog_5.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_5.py". The window contains a VPython script and its output. The script defines a scene, a red sphere, and two cyan rectangular boxes. The output shows the position and size of the right box.

```
File Edit Format Run Options Windows Help
from visual import *

scene = display(width=550, height=580)

ball = sphere(pos=(0,0,0), radius=0.8, color=color.red)

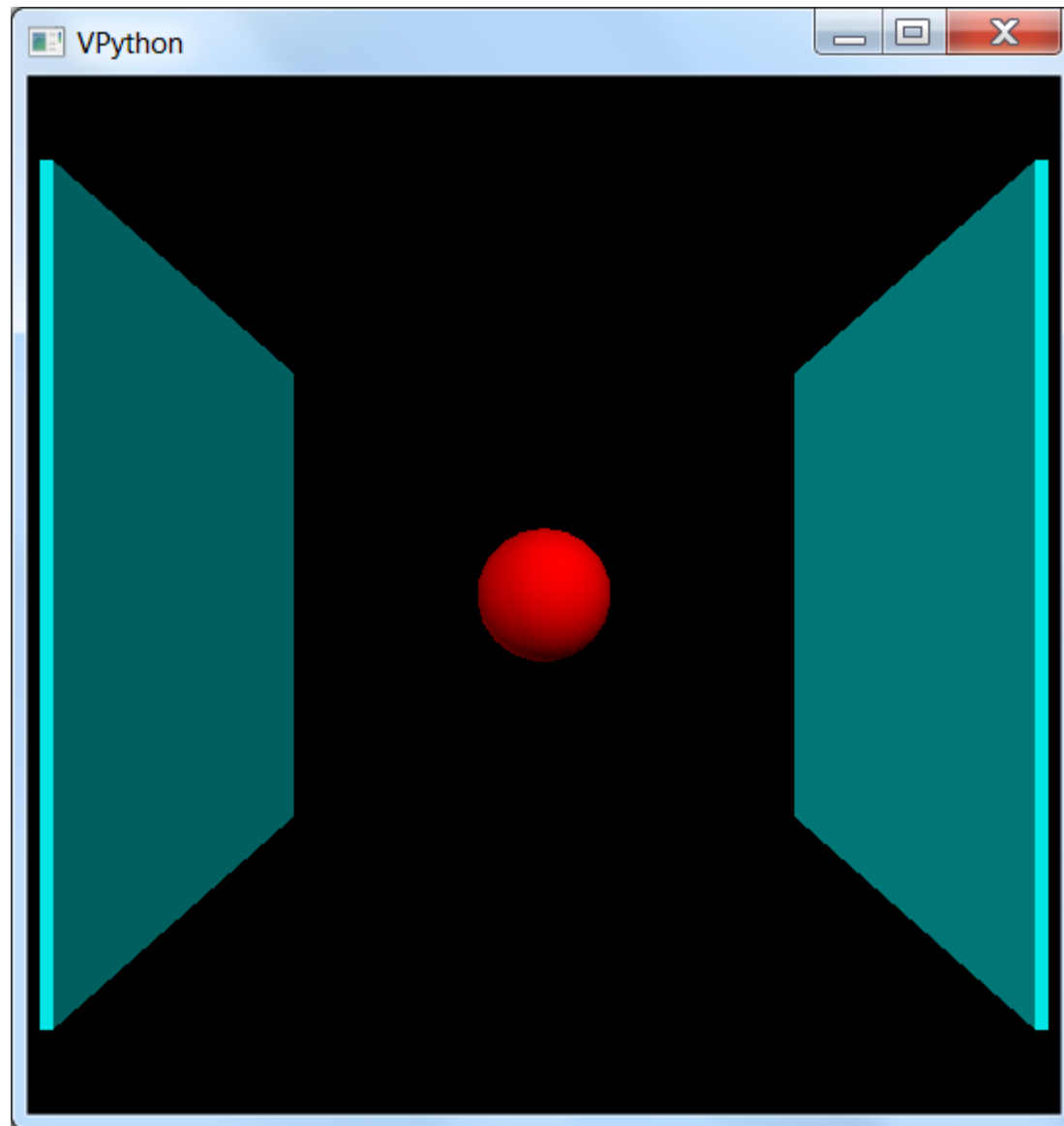
wallR = box(pos=(4,0,0), size=(0.1,7,7), color=color.cyan)
wallL = box(pos=(-4,0,0), size=(0.1,7,7), color=color.cyan)

print wallR.pos, wallR.size

>>>
<4, 0, 0> <0.1, 7, 7>
```

box: pos jest pozycją środka
size jest w (x,y,z)

size = vector(0.1,7,7) w VPython 7




```

76 vp_first_prog_6.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_6.py
File Edit Format Run Options Windows Help

from visual import *

scene = display(width=550, height=580)

ball = sphere(pos=(0,0,0), radius=0.8, color=color.red,
              make_trail=True)

wallR = box(pos=(4,0,0), size=(0.1,7,7), color=color.cyan)
wallL = box(pos=(-4,0,0), size=(0.1,7,7), color=color.cyan)

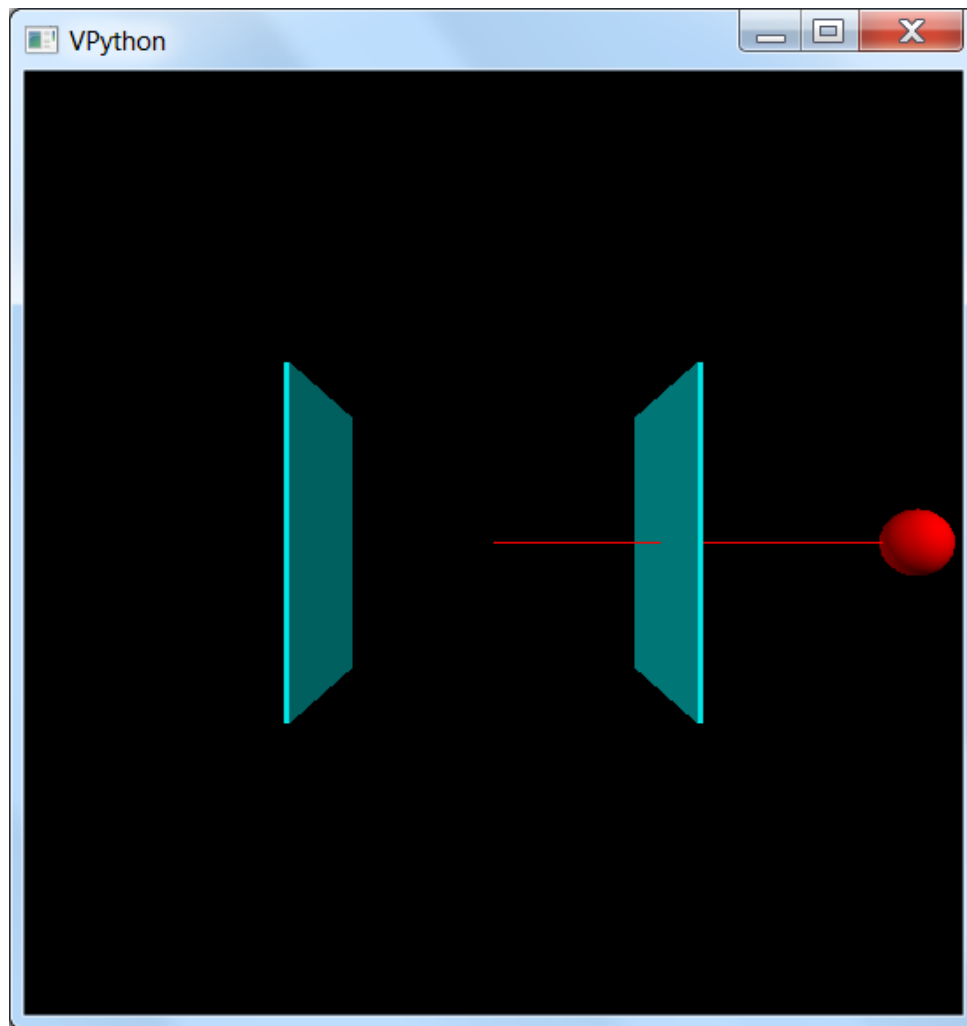
ball.vel = vector(1,0,0)    prędkość

t = 0
dt = 0.005

while t<10:
    rate(1000) ← musi być rate
    ball.pos = ball.pos + ball.vel*dt
    t = t + dt
  
```

Ln: 21 Col: 0

rate(N) – pętla nie będzie wykonana więcej niż N razy na sekundę 33



VPython oddala kamerę aby pokazać całą scenę (autoscaling)

Można wyłączyć

scene.autoscale = False

Po narysowaniu obiektów i przed pętlą

sfera, pudełko

76 vp_first_prog_7.py - C:\Users\Wysokie Energie\Desktop\VPython\lec_8\vp_first_prog_7.py

File Edit Format Run Options Windows Help

```
from visual import *

scene = display(width=550, height=580)

ball = sphere(pos=(0,0,0), radius=0.8, color=color.red,
               make_trail=True)

wallR = box(pos=(4,0,0), size=(0.1,7,7), color=color.cyan)
wallL = box(pos=(-4,0,0), size=(0.1,7,7), color=color.cyan)

ball.vel = vector(1, 0.02, 0)

t = 0
dt = 0.005

while t<50:
    rate(1000)
    ball.pos = ball.pos + ball.vel*dt
    if abs(ball.pos.x) >= wallR.pos.x:
        ball.vel.x = -ball.vel.x
    t = t + dt
```

Ln: 24 Col: 0

