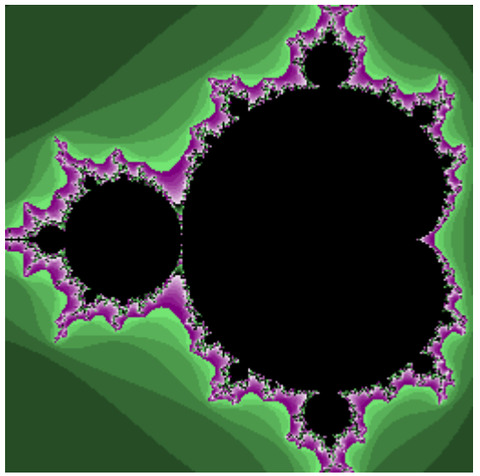
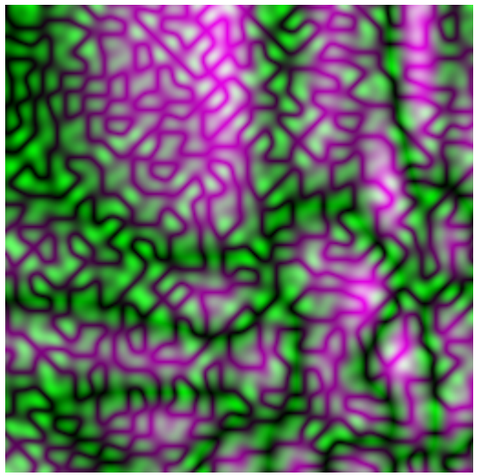
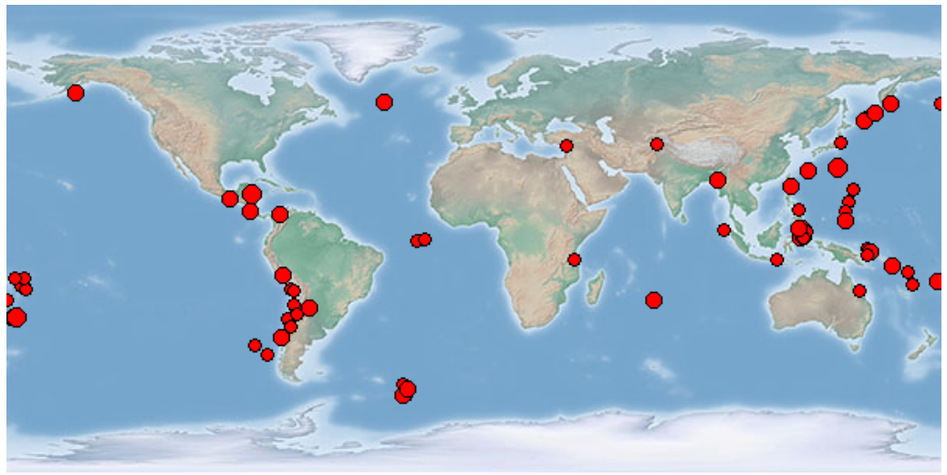
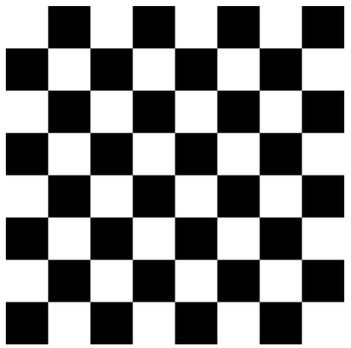
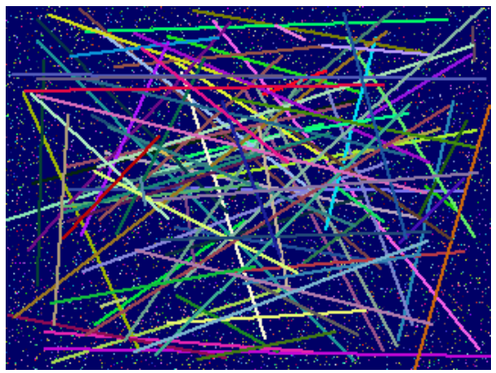
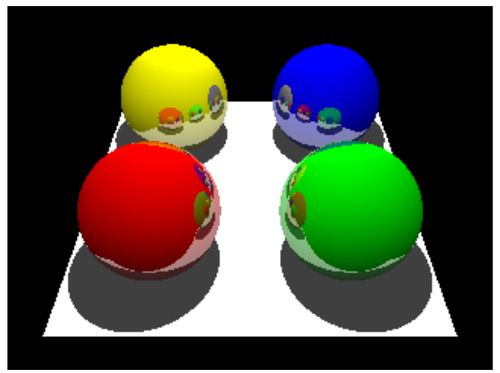
University of Applied Sciences and Arts Northwestern Switzerland
School of Architecture, Civil Engineering and Geomatics

europython
Jul 23 - 26 2020 Online

# pyRT - Computer Graphics in Jupyter Notebooks for Fun and Teaching

## Image Generation using Pure Python

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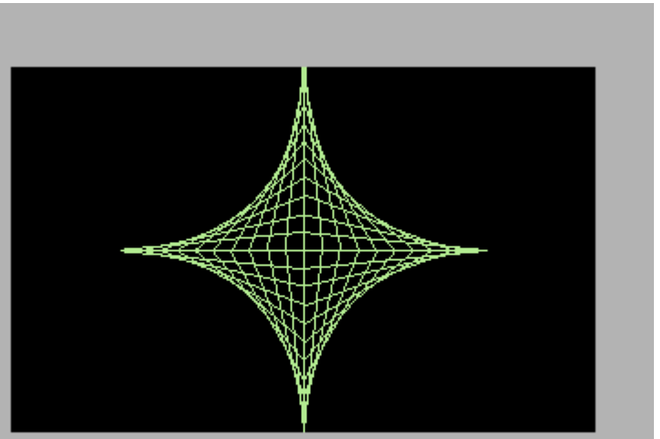
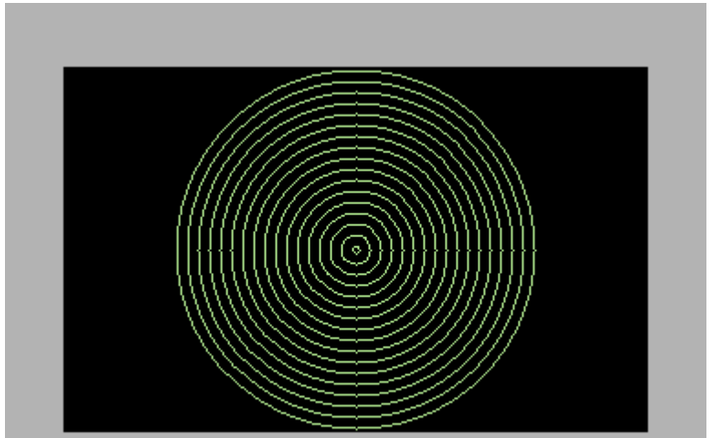
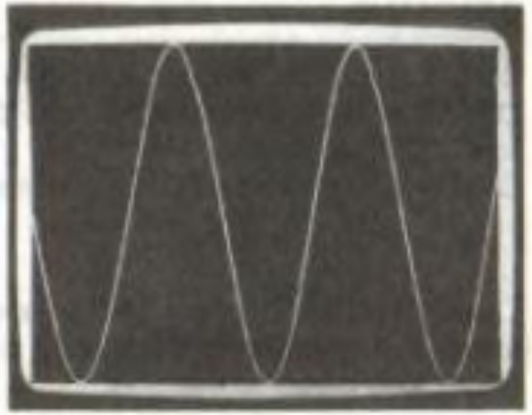
# Motivation





```
NEW
10 COLOR 0,1
20 COLOR 1,2
30 GRAPHIC 1,1
40 LOCATE 0,100
50 FOR X=1 TO 319
60 Y = INT (100+99 * SIN(X/20))
70 DRAW 1 TO X,Y
80 NEXT X
90 FOR L=1 TO 5000
100 NEXT L
110 GRAPHIC 0
```



Source: retro64, Manual C16

```
10 COLOR 0,1
20 COLOR 1,2
30 GRAPHIC 1,1
40 A = RND(1)* 20+ 10
50 FOR L=0 TO 359 STEP A
60 CIRCLE 1, 160, 100, 80, 40,,,L
70 NEXT L
80 FOR L=1 TO 2000: NEXT L
90 GRAPHIC 0,1
```

## Why do we want more Computer Graphics in Python?

### Game Development

### Severside Graphics Generation

- Simple to complex
- Speichern von Filmen z.B. als animiertes gif
- Teaching
  - Loops
  - Sorting Algorithms
  - …

### Streaming Content on Twitch / YouTube / …

- Creating Real-Time Content (Demo will follow)

## Other Modules (selection)

### 2D Graphics

- Gizeh ( https://github.com/Zulko/Gizeh )
- Pygame (https://github.com/pygame/pygame )
- Arcade (https://github.com/pvcraven/arcade)
- Pyxel (https://github.com/kitao/pyxel)
- Kivy (https://github.com/kivy/kivy)
- PyQt5 (and other GUI-Toolkits)
- **MoviePy** (https://github.com/Zulko/moviepy)
  **und Proglog** (https://github.com/Edinburgh-Genome-Foundry/Proglog )

## Other Modules (Selection)

### 3D Graphics

- Vapory (https://github.com/Zulko/vapory)
- pythreejs (https://github.com/jupyter-widgets/pythreejs )
- three.py (https://github.com/stemkoski/three.py)
- PyOpenGL (https://github.com/mcfletch/pyopengl)
- ModernGL (https://github.com/moderngl/moderngl)
- VTK (https://vtk.org/, https://gitlab.kitware.com/vtk/vtk)
- PyQt5 (+ ModernGL oder QtOpenGL)
- Blender / Cinema 4D and Scripting

## pyRT - https://github.com/martinchristen/pyRT

PyRT (pronounced **pirate**) is a raytracer/image generator for Python 3.5 and higher. This project is mainly done with the following in mind:

- Ray tracing in the Jupyter notebook
- Teaching computer graphics and ray tracing
- Exploring ray tracing concepts for geo data using Python.
- Rendering geo data, including large point clouds.
- Implementing new algorithms for rendering large 3D city models.
- Creating 3D-Maps from OpenStreetMap data
- Server-side rendering / cloud based rendering
- Having fun programming graphics stuff

## Installation

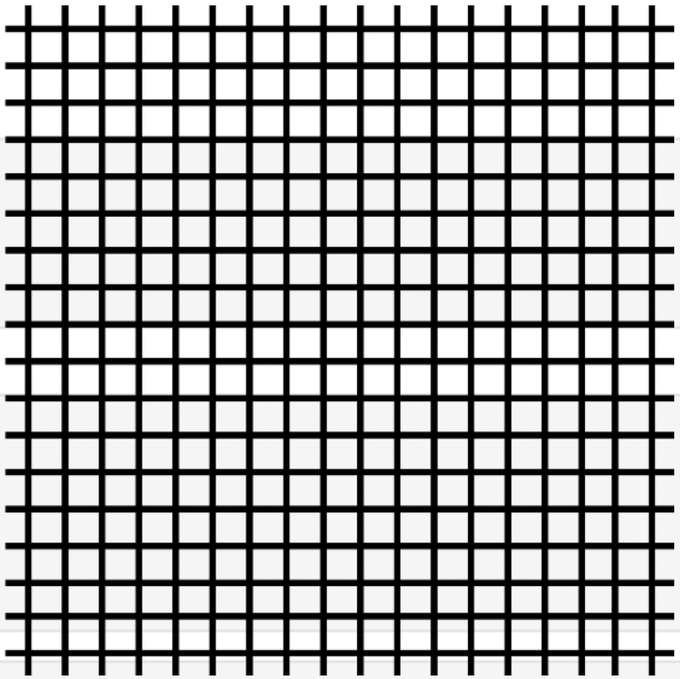
pip install pyrt

(numpy & pillow are highly recommended, in therory nothing is required, but that makes displaying images hard)

# First Steps: pyRT & Virtual Framebuffer

```
from pyrt.renderer import RGBImage
from pyrt.math import Vec2, Vec3
import random
```

```
w = 320
h = 240
image = RGBImage(w, h)
image.clear(Vec3(0.0,0.0,0.4))
```



```
for i in range(5000):
    position = Vec2(random.randint(0, w - 1), random.randint(0, h - 1))
    color = Vec3(random.uniform(0, 1), random.uniform(0, 1), random.uniform(0, 1))

    image.drawPoint(position, color, 1)
```

```
image.framebuffer()
```

## Let's switch to Jupyter

Seeing this all in action makes more sense!

So let's go!

Yay! Live Demo!!!

Source will be located at: https://github.com/martinchristen/EuroPython2020