

## MA453/553 – Classwork 2.

### Rewriting Particle Simulator code in NumPy

Due: 09/23/2024

1. Copy (cp) the pure Python code `particle_simulator.py` to `particle_simulator_numpy.py`, rewrite it using NumPy, and compare its performance with the original code using `time.process_time()` for timing. *Just work on the function `evolve()` in `ParticleSimulator` class.*

```
1  def evolve(self, tmax, dt=0.00001):
2      nsteps = int(tmax/dt)
3      for i in range(nsteps):
4          for p in self.particles:
5              norm = (p.x**2 + p.y**2)**0.5
6              v_x = (-p.y)/norm
7              v_y = p.x/norm
8              d_x = dt * p.ang_speed * v_x
9              d_y = dt * p.ang_speed * v_y
10             p.x += d_x
11             p.y += d_y
```

**Hint:** Store particle positions ( $x$ -, and  $y$ - coordinates) and speeds ( $v_x, v_y$ ) in arrays of shape `(nparticles,2)` and the angular speed in an array of shape `(nparticles,)`, where `nparticles` is the number of particles. For example:

```
1  r_i = np.array([[p.x, p.y] for p in self.particles])
2  ang_speed_i = np.array([p.ang_speed for p in self.particles])
3  v_i = np.empty_like(r_i)
```

2. Prepare a log of your work using `script` command, rename typescript file to `cw2_script.txt`, and clean it. *You may use the script `clnM` to get rid of some unwanted control characters in the file.*

3. Mail it to me using the following command:

```
$ mail -s "ma453:cw2" 453 < cw2_script.txt
```

*Note:* You have to be in `wxsession` to use the `mail` command. Rewrite the function `simpson_rule()` from Cw1 in NumPy and compare its performance with the original code.