2022 Differential Equation Quiz2(Python)

- The test is based on the practice. You are asked to graphs.
- Internet and book are allowed!

1) **Plot Fig 1 (70 points)**
   - Restraints:
   - **Contour and eyes.(50 points)**
     - **Use 1200 uniform random samples for the circle that forms the face(20 points)**
       Origin at $(x, y) = (0, 0)$ **and radius** $= 5$
     - **Eyes are just constant line** $y = 2$ **with 2 intervals as domains.**
     - **Can only use matplotlib.pyplot.plot for plotting**
   - **Use Sympy symbols for define the smile equation, but still need to plot with matplotlib.pyplot.plot**
     - **To plot a sympy symbolic equation with matplotlib.pyplot.plot,you can use the function sympy.utilities.lambdify.**
     - **Your equation for smile need to be cubic.You can base it on your homeworks equation.**
       i.e.$(y = \alpha(-x^3 + x^2) - \beta)$ **for some** α, β

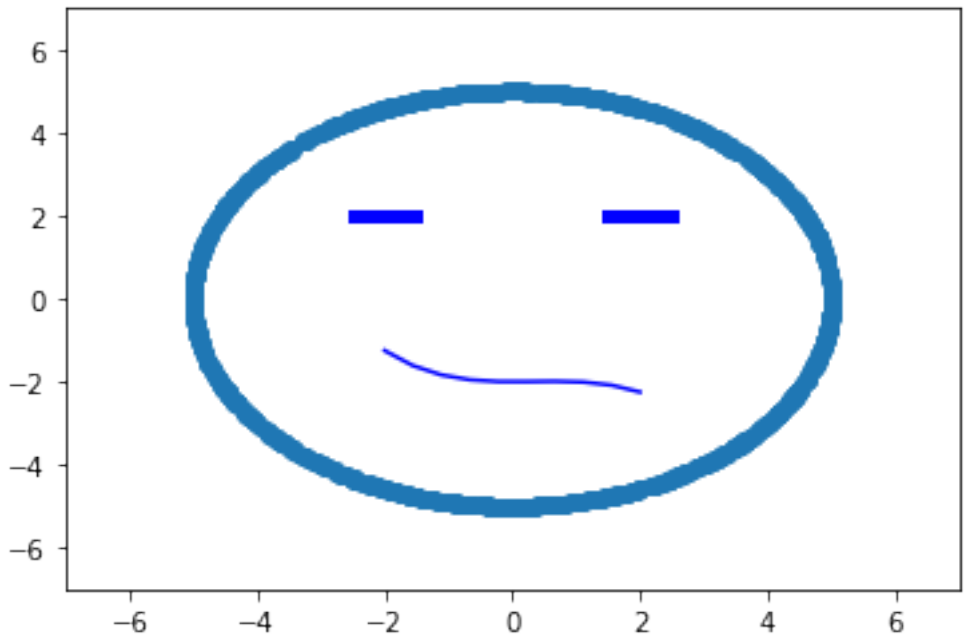
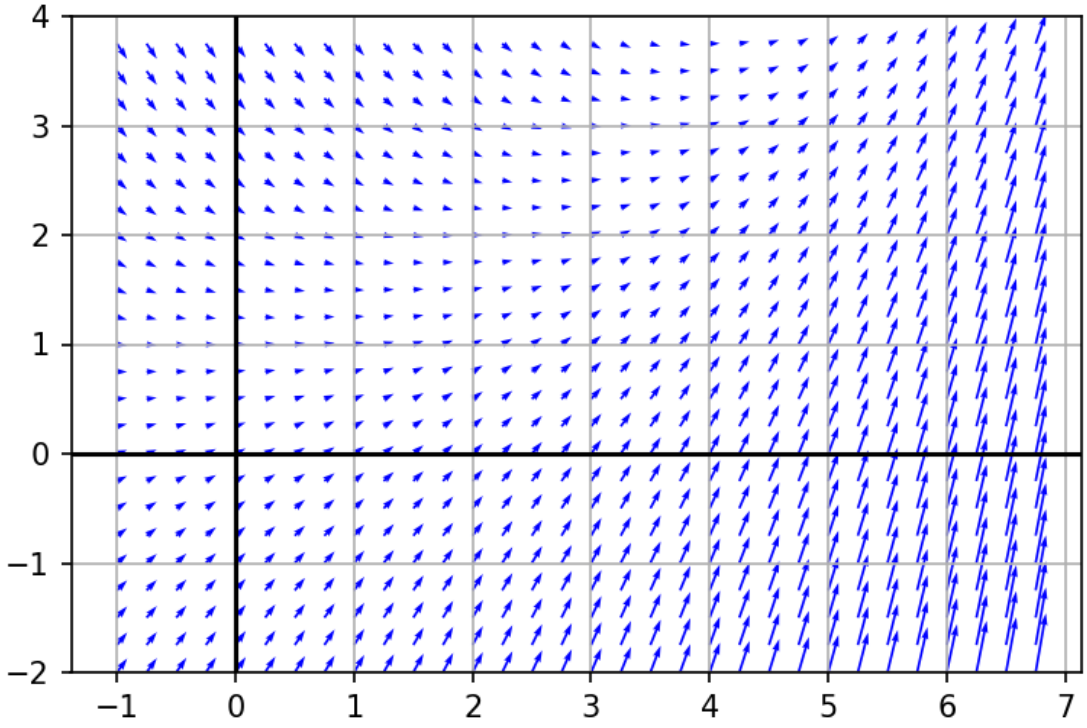


Fig. 1: Face

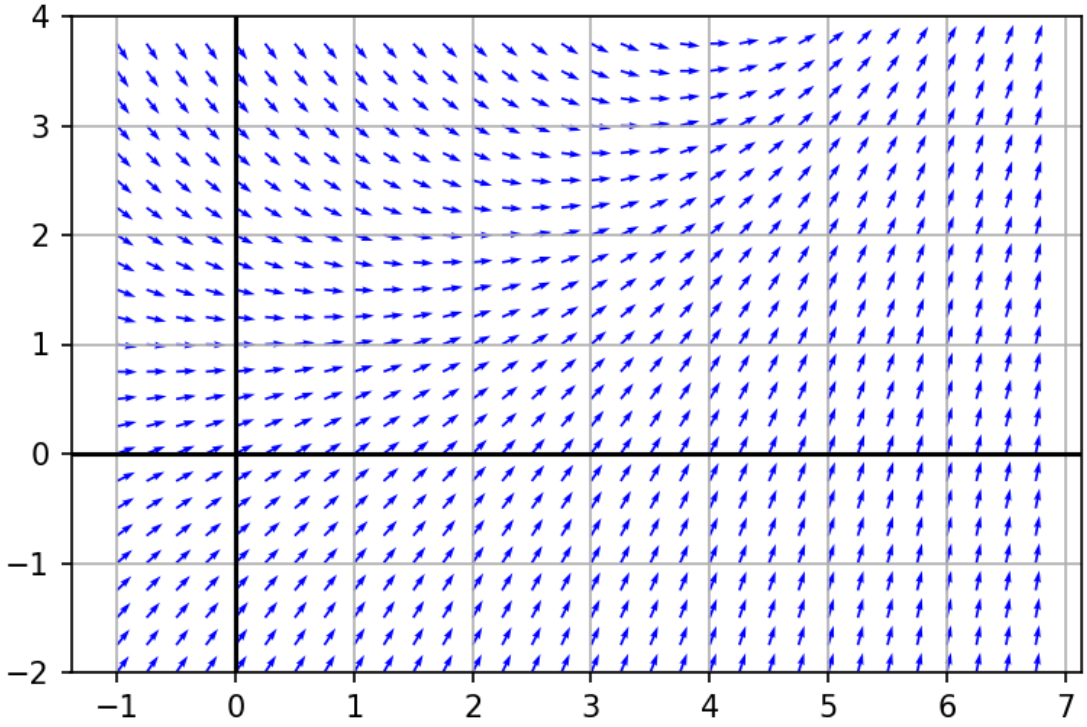
2) **Plot a direction field for the equation** $\frac{dy}{dt} + frac22y = \frac{1}{2}e^{t/3}$**.See Figure 2a (30 points)**
   - Restraints:
   - **Samples should be at 0.25 step interval. i.e.(15 points)**

```
dt = 0.25
t = np.arange(-1,7,dt)
y = np.arange(-2,4,dt)
...
#meshgrid
...
#dydt = <your differential equation>
...
#quiver
```

   - Use `meshgrid`
   - Use `quiver`
   - **if you can normalize your arrows (See Figure 2b)(15 points)**



(a) Unnormalized direction field



(b) Normalized direction field

Fig. 2: Direction fields for $\frac{dy}{dt} + \frac{1}{2}y = \frac{1}{2}e^{t/3}$