1. Parametrize implicitly given curves below:
   (a) $x^2 - y = 0$
   (b) $x = f(y)$, where $f\colon \mathbb{R} \to \mathbb{R}$ is a continuous function,
   (c) $(x-p)^2 + (y-q)^2 = r^2$ for fixed $p, q, r \in \mathbb{R}$,
   (d) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

2. Parametrizations

$$\begin{aligned} &\mathbf{p}_1(t) = (\cos t, \sin t, t) \\ \text{in} \quad &\mathbf{p}_2(t) = (\sin t, \cos t, t) \end{aligned}$$

   determine two *helices* in $\mathbb{R}^3$.

   Find the points of intersection of these two curves. What is the angle of intersection at these points?

3. The curve K is parametrized by $\mathbf{r}(t) = [x(t), y(t)]^\mathsf{T} = [t^3 - 4t, t^2 - 4]^\mathsf{T}$.
   (a) Find the intersections of the curve with the coordinate axes x and y.
   (b) Write down the equation of the tangent to K at $t = 1$.
   (c) Find the points where the tangents are parallel to the coordinate axes.
   (d) Is there a point of self-intersection on K?
   (e) Sketch the curve K.

4. Find a parametrization of the epicycloid (and the hypocycloid), i.e. the curve formed by tracing a point on the circumference of a circle with radius r which rolls around (inside) a fixed circle of radius R.

5. **Intersection points of planar polygonal chains.** Write an octave function `P = presecisce(A, B)` that determines whether two line segments $\overline{A_1A_2}$ and $\overline{B_1B_2}$ intersect and if so returns the intersection. The line segments are represented by matrices

$$A = \begin{bmatrix} x_1 & x_2 \\ y_1 & y_2 \end{bmatrix} \text{ in } B = \begin{bmatrix} u_1 & u_2 \\ v_1 & v_2 \end{bmatrix}.$$

   Two polygonal chains K and L are defined by the sequence of line segments $\overline{A_1A_2}, \overline{A_2A_3}, \ldots$ and $\overline{B_1B_2}, \overline{B_2B_3}, \ldots$. Write a function `P = presecisca(A, B)` that returns all the intersections of the polygonal chains K and L. The points that define the curves K and L and the return value P are represented by matrices:

$$A = \begin{bmatrix} x_1 & x_2 & \cdots & x_k \\ y_1 & y_2 & \cdots & y_k \end{bmatrix}, B = \begin{bmatrix} u_1 & u_2 & \cdots & u_\ell \\ v_1 & v_2 & \cdots & v_\ell \end{bmatrix} \text{ and } P = \begin{bmatrix} s_1 & s_2 & \cdots & s_m \\ t_1 & t_2 & \cdots & t_m \end{bmatrix}.$$

6. **Intersection points of two parametrically given curves.** We are given parametrizations of two curves, K and L, in the plane $\mathbb{R}^2$. Our task is to find all the points of intersection of K and L.

   Let $\mathbf{p}(t)$ and $\mathbf{q}(t)$ be the parametrizations of K and L defined on intervals $I = [a, b]$ and $J = [c, d]$ respectively.

   Find the points of intersection using the following procedure:

   (a) Divide the intervals I and J into subintervals of length $h > 0$, where h is sufficiently small.

   (b) Approximate K and L with polygonal chains determinned by evaluating the parametrizations at subdivision points of I and J and find the intersections of the polygonal chains.

   (c) Use the points of intersection of the polygonal approximations as an initial guess for Newton's iteration, which will determine the actual intersection points of K and L (much) more accurately.

   You will also need the derivatives of the parametrisations $\dot{\mathbf{p}}$ and $\dot{\mathbf{q}}$ in order to use Newton's iteration. Write the function `P = presekKrivulj(p, pdot, intp, q, qdot, intq, h)` which returns the intersections of two parametrized curves.