```
(*       Computer Graphics with Applications of Dr. Makhanov.
                          Lab 3
               "Flying" Objects and Rotations. *)
```

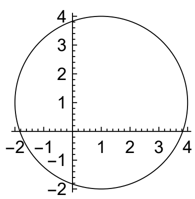
```
SetOptions[EvaluationNotebook[], ShowCellLabel → False];
```

```
SetOptions[{Graphics, Plot, Plot3D, ContourPlot, ContourPlot3D, DensityPlot, ParametricPlot,
   ParametricPlot3D, ListPlot, ListLinePlot, VectorPlot, VectorPlot3D, StreamPlot,
   ListPointPlot3D, RegionPlot, RegionPlot3D, Graphics, Graphics3D}, ImageSize → Small];
```

```
(* This introduces graphics primitives such as  Circle[{x,y},Rc],
Sphere[{x,y,z},Rs], Cuboid[{xc,yc,zc}] (there aree many others) where {x,y} and
 {x,y,z} is the center of the circle and sphere/cuboid respectively and Rc
 Rs the radius. Cuboid[{xc,yc,zc}] represents a unit cuboid with a corner at
 {xc,yc,zc}. These functions must be called with displaying functions Graphics
 and Graphics3D. See the examples below (you do not need to replicate them) *)
```

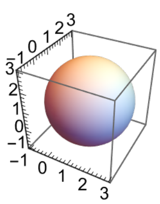
```
(* Circle, radius 3 and the center at {1,1} use Graphics *)
```

```
Graphics[Circle[{1, 1}, 3], Axes → True, ImageSize → Tiny]
```



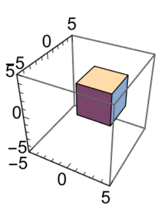
```
(* Sphere radius 2 and the center at {1,1,1} use Graphics3D*)
```

```
Graphics3D[Sphere[{1, 1, 1}, 2], Axes → True, ImageSize → Tiny]
```



```
(* Cube, centered at {1,1,1} with the side 4 *)
```

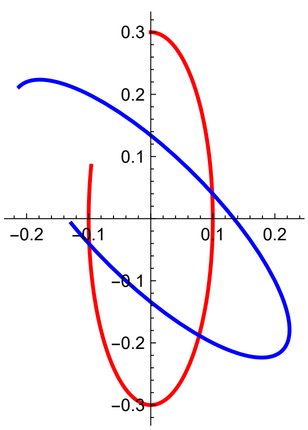
```
Graphics3D[Cube [{1, 1, 1}, 4], Axes → True,
 ImageSize → Tiny, PlotRange → {{-5, 5}, {-5, 5}, {-5, 5}}]
```



```
(* ------------------ PART 2 ------------------*)
```

```
(* Problem (8) Rotations in 2D are performed by rotation matrices given by
 RotationMatrix[θ]. Using the rotation matrix to R[a] to rotate a curve c[t] is
 accomplished by R[a].c[t], where . denotes the matrix-vector maltiplication
   Let us rotate the curve given by x8[t_]:=0.1*Sin[t] y8[t_]:=0.3*Cos[t]
   for {t,0,5} by 45 deg around
   the origin. Show the original and the rotated curve *)
```

```
x8[t_] := 0.1 * Sin[t]

y8[t_] := 0.3 * Cos[t]

RM[a_] := RotationMatrix[a]

s8[t_] := {x8[t], y8[t]}

srotated8[t_] := RM[45 * Degree].s8[t]

ParametricPlot[{s8[t], srotated8[t]}, {t, 0, 5}, PlotStyle → {{Red, Thick}, {Blue, Thick}}]
```

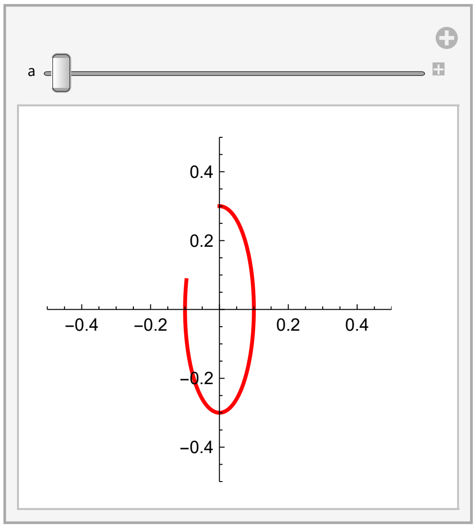



```
(* Problem (9). Animate a curve from
 Problem 8 rotating continuously around the origin *)
```

```
srotated91[t_, a_] := RM[a].s8[t]
```

[redacted]

```
Manipulate[plotg91[a], {a, 0, 360 * Degree, 1 * Degree}]
```




```
(* Problem (10). Rotating Pold around a point Paround=
 {x,y} is performed by the following transformation
   Pnew=RM[a].(Pold-Paround)+Paround.
      Using the transformation above animate rotation of the parametric curve from
     problem 9 around Paround={1,0.5}. On animation plot display Paround using
    ListPlot[{Paround},PlotStyle→{Blue,PointSize[0.05]}]
    Fix the PlotRange *)
```

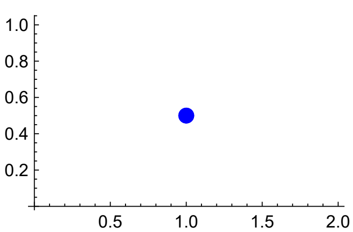
```
Paround = {1, 0.5}
```

```
{1, 0.5}
```

```
srotated10[t_, a_] := RM[a].(s8[t] - Paround) + Paround
```

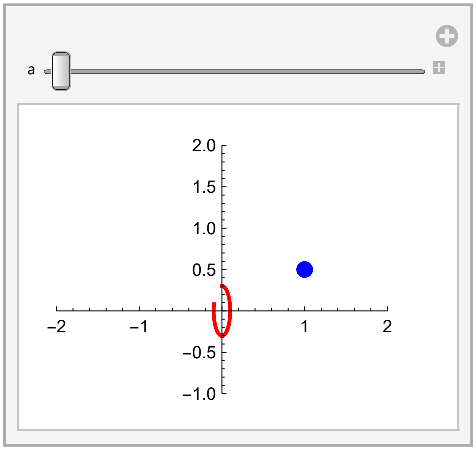
```
plotg10[a_] := ParametricPlot[srotated10[t, a],
  {t, 0, 5}, PlotStyle → {{Red, Thick}}, PlotRange → {{-2, 2}, {-1, 2}}]
```

```
plotl10 = ListPlot[{Paround}, PlotStyle → {Blue, PointSize[0.05]}]
```




```
plotg10show[a_] := Show[{plotg10[a], plotl10}]
```

```
Manipulate[plotg10show[a], {a, 0, 360 * Degree, 1 * Degree}]
```




```
(* Problem (11). Using transformations from
     Problem 10 animate the rotation of a  parametric spline based on
     data11={1,1},{2,3},{2,4},{7,7},{8,6},{7,3},{7,-1},{5,-1}}
  around the point Paround11={1,1.5}. *)
```

[redacted]

```
{1, 1.5}
```

```
data11 = {{1, 1}, {2, 3}, {2, 4}, {7, 7}, {8, 6}, {7, 3}, {7, -1}, {5, -1}}
{{1, 1}, {2, 3}, {2, 4}, {7, 7}, {8, 6}, {7, 3}, {7, -1}, {5, -1}}
```

[redacted]

```
{1, 2, 2, 7, 8, 7, 7, 5}
```

[redacted]

```
{1, 3, 4, 7, 6, 3, -1, -1}
```

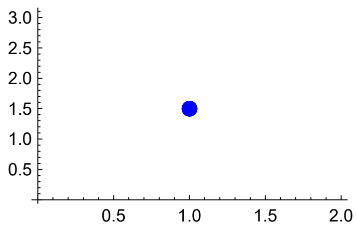
[redacted]

```
InterpolatingFunction[ Domain: {{1, 8}} Output: scalar ]
```

[redacted]

```
InterpolatingFunction[ Domain: {{1, 8}} Output: scalar ]
```

[redacted]



[redacted]