

```
In[ ]:= Clear["Global`*"]
```

Arnav Dani - Period 3 - Project 1

Defining Functions

```
r[t_] = {t, t^2, t^3};  
(*speed, velocity and tangent*)  
v[t_] = r'[t];  
speed[t_] = Sqrt[v[t].v[t]);  
uTan[t_] = v[t] / speed[t];  
absDuTan[t_] = Sqrt(uTan'[t].uTan'[t]);  
(*normal and binormal*)  
uNorm[t_] = uTan'[t] / absDuTan[t];  
biNorm[t_] = Cross[uTan[t], uNorm[t];  
(*curvature*)  
kurv[t_] = absDuTan[t] / speed[t];  
evolute[t_] = r[t] + uNorm[t] * 1 / kurv[t]  
(*defining planes using polygon*)  
  
(*osculating plane is defined by osc vector -  
means that tangent and normal vector are on that plane*)  
oscpl[t_] = Polygon[{ (r[t] + 15 * uNorm[t]),  
  (r[t] + 15 * uTan[t]), (r[t] - 15 * uNorm[t]), (r[t] - 15 * uTan[t]) }];  
  
(*rectifying plane is defined by normal vector -  
means that tangent and binormal vector are on that plane*)  
rectpl[t_] = Polygon[{ (r[t] + 10 * biNorm[t]),  
  (r[t] + 10 * uTan[t]), (r[t] - 10 * biNorm[t]), (r[t] - 10 * uTan[t]) }];  
  
(*normal plane is defined by the tangent vector -  
means that normal and binormal vector are on that plane*)  
norpl[t_] = Polygon[{ (r[t] + 5 * biNorm[t]),  
  (r[t] + 5 * uNorm[t]), (r[t] - 5 * biNorm[t]), (r[t] - 5 * uNorm[t]) }];
```

Graphing

```

In[ ]:= Manipulate[
  (*use graphicsgrid to plot 2 graphs
  and simultaneously control them with 1 manipulate*)
  GraphicsGrid[
    {
      {
        Show[
          ParametricPlot3D[r[t], {t, -3, 3}, PlotStyle -> {Red, Thick}, Axes -> True,
            AxesOrigin -> {0, 0, 0}, PlotRange -> 15], (*plots the function*)

          (*plotting the vectors and point on the function*)
          (*using q to go with the manipulate
          and get a single vector instead of a vector function*)
          Graphics3D[{Black, Arrowheads[0.03], Arrow[{r[q], (r[q] + 5 * uTan[q])}]},],
          Graphics3D[{Purple, Arrowheads[0.03], Arrow[{r[q], (r[q] + 5 * uNorm[q])}]},],
          Graphics3D[{Blue, Arrowheads[0.03], Arrow[{r[q], (r[q] + 5 * biNorm[q])}]},],
          Graphics3D[{PointSize -> 0.025, Blue, Point[r[q]]}],

          (*plotting the relevant planes*)
          Graphics3D[{Red, Opacity[0.17], norpl[q]}],
          Graphics3D[{Purple, Opacity[0.17], rectpl[q]}],
          Graphics3D[{Blue, Opacity[0.17], oscpl[q]}]

        ]
      },
      {
        Show[
          (*2nd graph with curvature -
          this graph is in 2d since curvature at any t value is a scalar value*)
          Plot[kurv[t], {t, -3, 3}, PlotStyle -> {Red, Thick},
            Axes -> True, AxesOrigin -> {0, 0}, PlotRange -> 4],

          (*attaching moving point*)
          Graphics[{PointSize -> 0.025, Blue, Point[{q, kurv[q]}]}]

        ]
      }
    ],
    {q, -3, 3}
  ]

```

Out[*n*]=

