Bezier Curve

In[1]:=
```
cp = {{0, 20}, {10, 40}, {20, 0}, {30, 20}};
```

Bernstein Basis

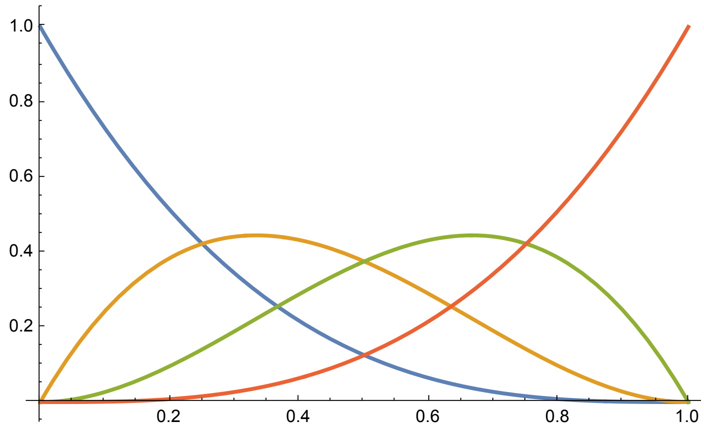
In[20]:=
```
Bernstein[n_, i_, t_] := n! / i! / (n-i)! (1-t)^(n-i)t^i
```

In[21]:=
```
Bernstein[4, 2, 0.5]
```

Out[21]=
```
0.375
```

```
Plot[Evaluate[Table[Bernstein[Length[cp] - 1, i, t], {i, 0, Length[cp] -  1}]], {t, 0,
```

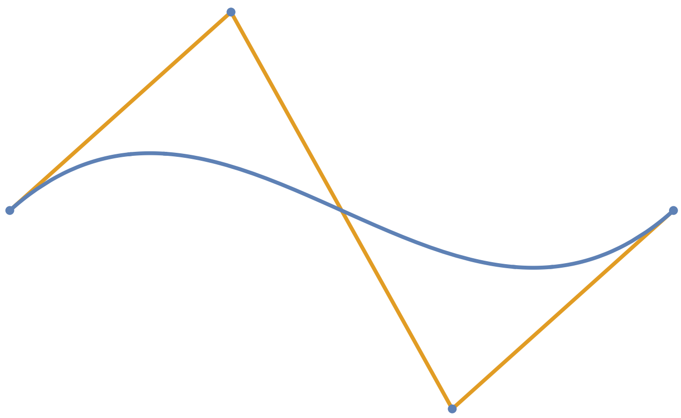
Out[30]=



Linear combination of Bernstein basis and control points

In[84]:=
```
Show[
    ListPlot[{cp, cp}, Joined→{False, True}],
    ParametricPlot[
        Sum[
            cp⟦i + 1⟧ * Bernstein[Length[cp] - 1, i, t]
            ,{i, 0, Length[cp] - 1}
        ]
        ,{t, 0, 1}
    ],
    PlotRange→All,
    Axes→False
]
```

Out[84]=



Monomial Matrix of Bezier curve

In[82]:=
```
monomialMatrix = Table[Reverse[PadRight[CoefficientList[Bernstein[Length[cp] - 1, x, t
monomialMatrix // MatrixForm
```

Out[83]//MatrixForm=

$$\begin{pmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 3 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix}$$

Implementation of Bezier curve using DeCasteljau Algorithm

In[81]:=

```
DeCasteljau[cp_, t_] := Module[{points = cp, n = Length[cp], i, j},
    For[i = 1, i < n, i++,
        For[j = 1, j ≤ n - i, j++,
            points⟦j⟧ = (1 - t) points⟦j⟧ + t points⟦j + 1⟧;
        ]
    ];
    points⟦1⟧
]
```

In[75]:=

```
DeCasteljau[cp, t]
```

Out[75]=

$$\{(1-t)\,(10\,(1-t)\,t+t\,(10\,(1-t)+20\,t))+t\,((1-t)\,(10\,(1-t)+20\,t)+t\,(20\,(1-t)+30\,t)),\; t\left(40\,(1-t)^2+20\,t^2\right)+(1-t)\,(40\,(1-t)\,t+(1-t)\,(20\,(1-t)+40\,t))\}$$

In[76]:=

```
cpList = {
            {{161, 244}, {147.83, 256.811}, {141.058, 271.922}, {141, 290}},
            {{141, 290}, {146.024, 309.687}, {146.024, 309.687}, {150, 329}},
            {{150, 329}, {149.108, 329.942}, {148.216, 331.187}, {147, 331}},
            {{163, 307}, {166.627, 317.753}, {158.656, 328.461}, {147, 331}},
            {{163, 317}, {161.78, 343.934}, {193.385, 366.479}, {203, 387}},
            {{174, 253}, {158.461, 281.973}, {178.863, 313.231}, {203, 331}},
            {{244, 243}, {256.067, 254.265}, {264.774, 268.759}, {266, 286}},
            {{266, 286}, {264.682, 298.326}, {258.436, 314.45}, {256, 327}},
            {{256, 327}, {256.675, 328.85}, {257.838, 329.859}, {259, 331}},
            {{244, 307}, {241.698, 318.677}, {248.848, 326.535}, {260, 331}},
            {{244, 316}, {245.64, 343.407}, {213.858, 366.481}, {203, 387}},
            {{231, 253}, {249.172, 281.975}, {226.195, 313.054}, {203, 331}}
};
```

In[80]:=

```
Show[
    Table[
        ParametricPlot[DeCasteljau[cpList[[i]], t], {t, 0, 1}]
        ,{i, 1, Length[cpList]}
    ], PlotRange→All, Axes→False
]
```

Out[80]=