插值是比拟合更复杂的一种场景，因为多了“过点”的要求。

NURBS: Non-Uniform Rational Basic-Spline

\begin{displaymath}{\bf P}_H(t) = \sum_{i=1}^{n+1} N_{i,k}(t) {\bf C}_i, t_{\min} \leq t <
t_{\max}
\end{displaymath}

Nik(t) ：基函数，Ci 含权控制点

* Non-uniform: knot vector 不均匀
* Rational： 含有权重，不含权就是“常见的”B-spline
* Basic：其他样条曲线都可由b-spline得到
* Spline：用低阶**分段**多项式通过连续拼接得到高阶多项式。

**Input**: control points, knot vector (e.g. 0,0,0,0,0.1,0.5,0.8,1,1,1,1), weight vector (对于每个点)

Text, letter

Description automatically generated<https://www.bilibili.com/video/BV13441127CH?p=13> 5:30

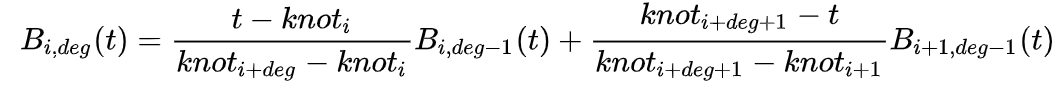
In mathematics, a spline is a special function defined piecewise by polynomials.

The B in B-spline stands for ”basis”, and the basis is specified by the Cox-de Boor formula for computing the basis function.

What uniquely sets them apart from Bezier curves is that a vector of scalars called **a knot vector is figured into the computation of the basis functions**.

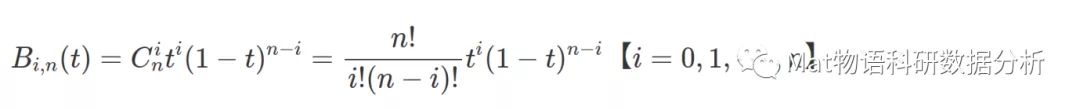
https://fei.edu.br/~psergio/CG\_arquivos/IntroSplines.pdf

B-Spline 基函数：



（此处B(t)即N(t)，因出处不同，故标记未统一）

Bezier curve/spline基函数（Bernstein）：



贝塞尔方法有很多优点，但也有几个不足之处：

（1）一旦确定了特征多边形的顶点数，就决定了曲线的阶数。当数据点的数量太多时，计算量急剧增加。

（2）由于光滑性很高，反而导致拼接比较复杂。

（3）无法做局部修改，这是一个很大的局限性，牵一发而动全身。

https://zhuanlan.zhihu.com/p/369753167

Radar chart

Description automatically generated

Graphical user interface, text

Description automatically generated

https://www.youtube.com/watch?v=bE1MrrqBAl8

A "spline" is a more general term than a “bezier curve”.

A Bezier curve is a particular polynomial function, usually either cubic or quadratic, that defines a curve that goes from point A to point B given some control points in between. A Bezier spline is n of these concatenated together.

A general spline can be a concatenation of other kinds curves; for example, a B-spline is composed of a bunch of curves that are generalizations of Bezier curves.

https://www.quora.com/What-is-the-difference-between-a-Bezier-curve-and-a-spline

当节点数和多项式次数相等时，B样条退化为[贝兹曲线](https://zh.wikipedia.org/wiki/%E8%B2%9D%E8%8C%B2%E6%9B%B2%E7%B7%9A)。即函数的形状由节点的位置决定。[缩放](https://zh.wikipedia.org/wiki/%E7%BC%A9%E6%94%BE)或者[平移](https://zh.wikipedia.org/wiki/%E5%B9%B3%E7%A7%BB)[节点向量](https://zh.wikipedia.org/w/index.php?title=%E8%8A%82%E7%82%B9%E5%90%91%E9%87%8F&action=edit&redlink=1)不会改变基函数。

Text

Description automatically generated

<https://zh.wikipedia.org/>wiki/B样条

Diagram

Description automatically generated

https://blog.csdn.net/wang15061955806/article/details/52621268

**What can you do to control the shape of a B-spline?**

* Move the control points. (zzz: 插值点不能动，该教材讲的是拟合)
* Add or remove control points.
* Use multiple control points.
* Change the order, k. (zzz: 一般常用k=4阶/cubic b-spline. Ni,k is a polynomial of order k (degree k-1))
* Change the type of knot vector. (zzz: 顺序节点或clamped节点)
* Change the relative spacing of the knots. (zzz: 均匀/非均匀)
* Use multiple knot values in the knot vector.

What should the defaults be?

If there are no pressing reasons for doing otherwise, your B-spline should be defined as follows:

* k=4 (cubic);
* no multiple control points;
* uniform (for a closed curve) or open uniform (for an open curve) knot vector.

<https://www.cl.cam.ac.uk/teaching/2000/AGraphHCI/SMEG/node5.html>