Interpolation is the process of estimating unknown values that fall between known values.
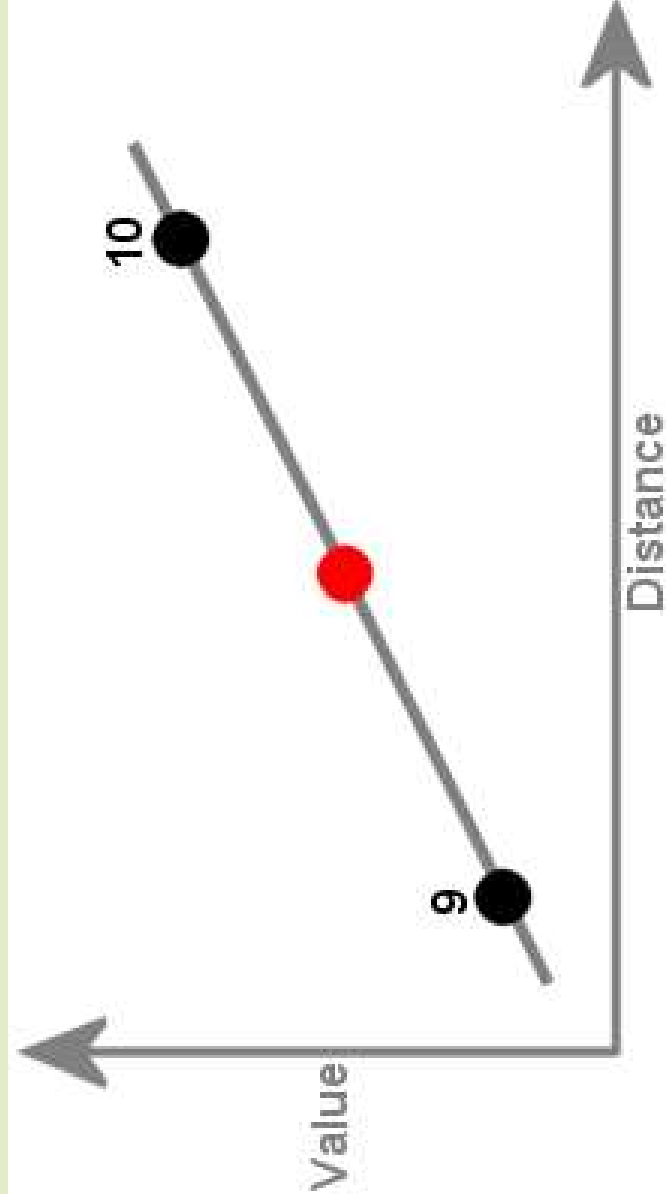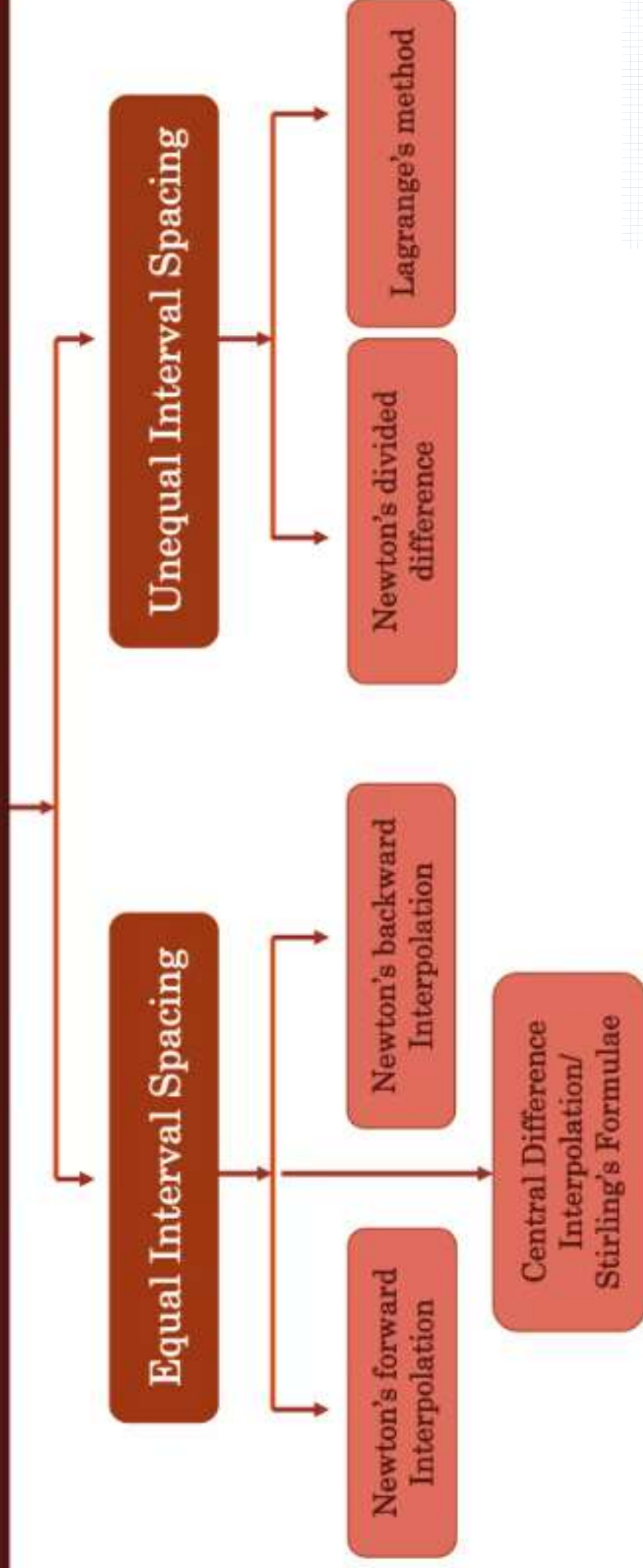
In this example, a straight line passes through two points of known value. You can estimate the point of unknown value because it appears to be midway between the other two points. The interpolated value of the middle point could be 9.5.

Value

10

9

Distance

INTERPOLATION METHODS

Equal Interval Spacing
- Newton's forward Interpolation
- Newton's backward Interpolation
- Central Difference Interpolation/ Stirling's Formulae

Unequal Interval Spacing
- Newton's divided difference
- Lagrange's method

Why is Interpolation important?

This helps to determine the data points in between the given data ones. This method is always needed to compute the value of a function for an intermediate value of the independent function. In short, interpolation is a process of determining the unknown values that lie in between the known data points. It is mostly used to predict the unknown values for any geographical related data points such as noise level, rainfall, elevation, and so on.
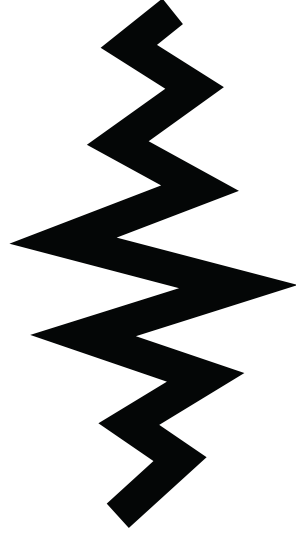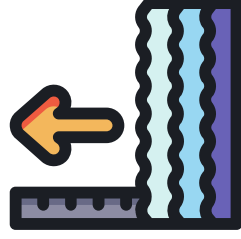
Criticism of Interpolation

One of the biggest criticisms of interpolation is that although it's a fairly simple methodology that's been around for eons, it lacks precision. Interpolation in ancient Greece and Babylon was primarily about making astronomical predictions that would help farmers time their planting strategies to improve crop yields.

APPLICATIONS

- In the context of **computer animation**, interpolation is filling in frames between the key frames.

- It typically calculates the in between frames through use of piecewise **polynomial interpolation** to draw images semi-automatically.

- For all applications of this type, a set of "key points" is defined by the graphic artist. These are values that are rather widely separated in space or time, and represent the desired result, but only in very coarse steps.

- The computed interpolation process is then used to insert many new values in between these key points to give a "smoother" result.

Interpolation Methods

There are different types of interpolation methods. They are:

Linear Interpolation Method – This method applies a distinct linear polynomial between each pair of data points for curves, or within the sets of three points for surfaces.

Nearest Neighbour Method – This method inserts the value of an interpolated point to the value of the most adjacent data point. Therefore, this method does not produce any new data points.

Cubic Spline Interpolation Method – This method fits a different cubic polynomial between each pair of data points for curves, or between sets of three points for surfaces.

Shape-Preservation Method – This method is also known as Piecewise Cubic Hermite Interpolation (PCHIP). It preserves the monotonicity and the shape of the data. It is for curves only.

Thin-plate Spline Method – This method consists of smooth surfaces that also extrapolate well. It is only for surfaces only

Biharmonic Interpolation Method – This method is applied to the surfaces only.

Interpolation and Extrapolation
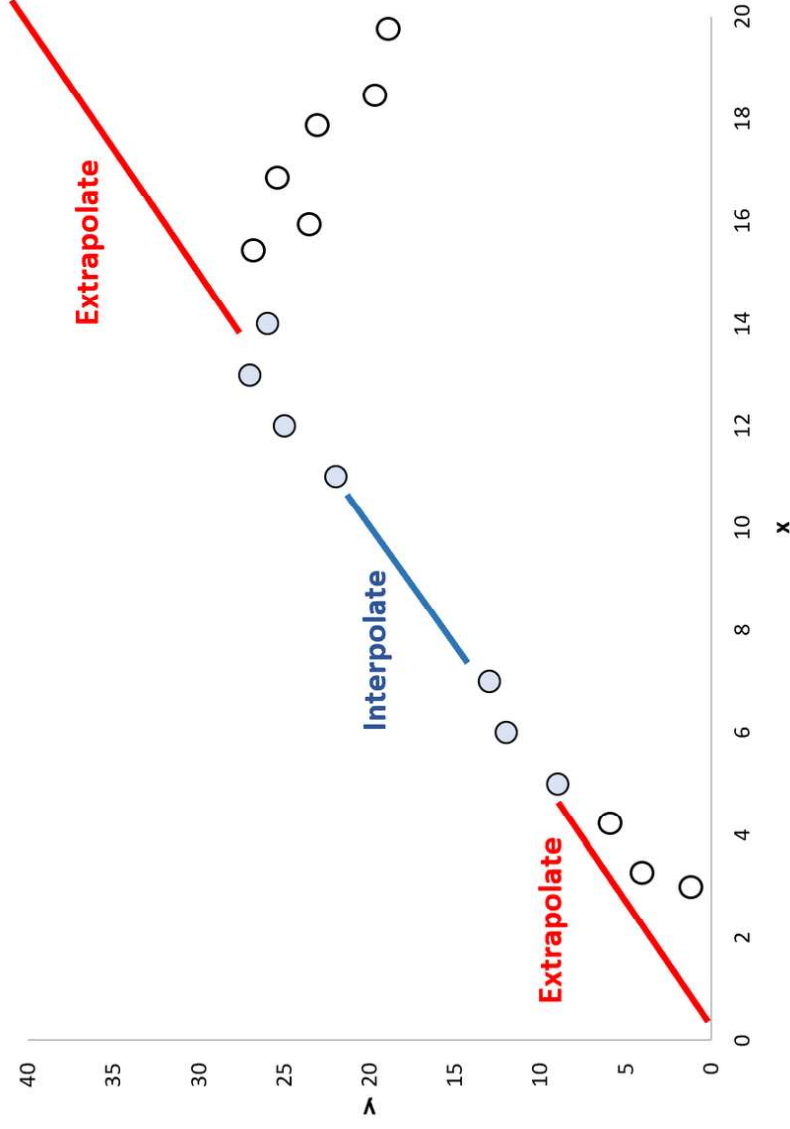
Interpolation is an estimation of value between two known points. Intuitively, interpolation (green dot on the image) is somewhat safe due to the range provided by the known surrounding points.

Extrapolation is an estimate of a value outside the range of known data points. Domain knowledge about the phenomena can make it safe to use – you know the relationship holds for some range outside the data points. Without that knowledge, you get deeper into trouble the further you go from known data points.

Extrapolating values for the orange dot on the right is potentially more dangerous than the left one due to the proximity to the other (blue) data points.

Extrapolate

Interpolate

Extrapolate

x

Spatial interpolation calculates an unknown value from a set of sample points with known values that are distributed across an area. The distance from the cell with unknown value to the sample cells contributes to its final value estimation.

You can use spatial interpolation to create an entire surface from just a small number of sample points;
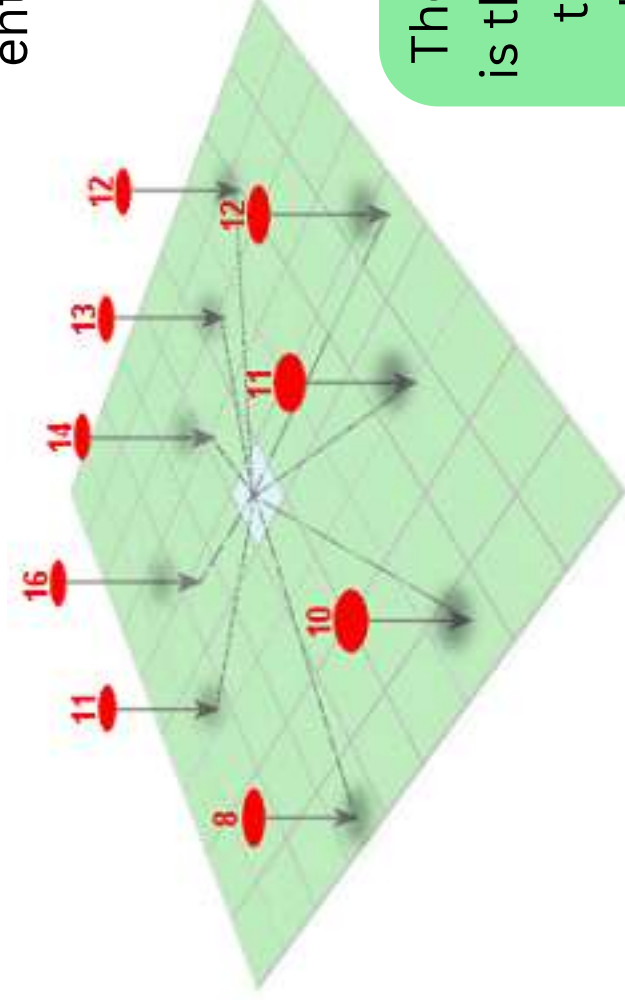
The primary assumption of spatial interpolation is that points near each other are more alike than those farther away; therefore, any location's values should be estimated based on the values of points nearby.

References

- http://www.geography.hunter.cuny.edu/~jochen/gtech361/lectures/lecture1/concepts/What%20is%20interpolation.htm
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