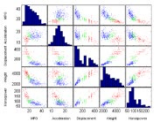
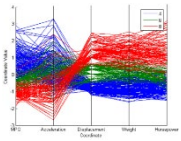
Multidimensional data can be as simple as 2-D representation using x-y coordinates but is high dimensional data is generally defined for 4 or more dimensions (Ref: A Survey on Multivariate Data Visualization , Winnie Wing-Yi Chan). Fe methods to visualize such high dimensional data are:

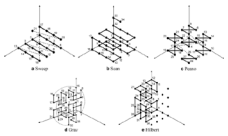
Scatterplot Matrix: This consists of a collection of 2-D scatterplots along the x-y axes of Cartesian coordinates in a matrix form with each scatterplot displaying data for 2 discrete attributes of the multi-dimensional data. While this allows for identifying relation of the 2 attributes within each scatterplot, relationship in higher dimensions cannot be recognized.



Parallel coordinates: This uses multiple vertical axes which are parallel and are scaled to the data range. Each axis represents an attribute and a polygonal line which will intersect each vertical axis at the level corresponding to its data value. However, higher the dimension the visual clutter hinders the interpretation.



Space filling curves: This is a pixel-based representation in a non-cartesian coordinate system which clusters the closely related datapoints and represents multi-dimensional data in one dimension. It represents a line that passes through every single datapoint and does so only once.



Circle segment: In this pixel-based visualization, data attributes are assigned to the segments of the circles and the datapoints are arranged in such a way that the datapoint appears at the same position at different segment. Each data point is identified by a colored pixel, which are then positioned orthogonally based on the line halving the segment.

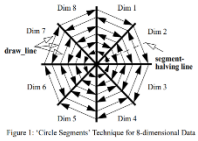
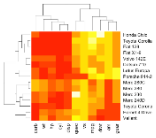


Figure 1: 'Circle Segments' Technique for 8-dimensional Data

Hierarchical structure of a data allows visualization in a tier/tree fashion. Two types of tiers are the parent level and child level. The basic principle being, a parent can have >1 child but a child cannot have >1 parent. Data starts with the top tier or the root node which further branches into leaf (terminal node) or interior nodes (have child nodes). There are multiple ways to visualize these structures.

Dendrogram: This type visualization is close to the structure of a tree or a flowchart representing the hierarchical clustering structure of the data. The height of the arms connecting the datapoint to the parent node indicates the level of dissimilarity of the clusters. It is essentially a summary of the distance matrix.

Heatmaps: This visualization relies on displaying datapoints based on a color spectrum. The most dissimilar datapoints receive the extreme opposite colors of a color spectrum and the similar datapoints receive colors in-between. These are almost always used along with dendrograms when there is hierarchical clustering.



Sunburst Diagram: This is a ring like visualization starting with the root node at the center. As we move centrifugally more rings are added with each representing a level. The partition layout is for this diagram is generated by creating arcs based on polar coordinates of the display area.

Tree map: This area-based visualization method uses an underlying structure of a tree diagram and simultaneously displays the size of each cluster. As series of rectangles are nested based on the clustering level. The higher level of clustering (parent node) is represented by a larger rectangle which is further subdivided into smaller rectangles representing the lower level of clustering (child node).