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Data Visualization and Techniques

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Abstract

Data visualization is the graphical representation of information. Bar charts scatter graphs, and maps are examples of simple data visualizations that have been used for decades. Information technology combines the principles of visualization with powerful applications and large data sets to create sophisticated images and animations. A tag cloud, for instance, uses text size to indicate the relative frequency of use of a set of terms. In many cases, the data that feed a tag cloud come from thousands of Web pages, representing perhaps millions of users. All of this information is contained in a simple image that you can understand quickly and easily. More complex visualizations sometimes generate animations that demonstrate how data change over time. In an application called Gap minder, bubbles represent the countries of the world, with each nation's population reflected in the size of its bubble. You can set the x and y axes to compare life expectancy with per capita income, for example, and the tool will show how each nation's bubble moves on the graph over time. You can see that higher income generally correlates with longer life expectancy, but the visualization also clearly shows that China doesn't follow this trend—in 1975, the country had one of the lowest per capita incomes but one of the longer life expectancies. The animation also shows the steep drop in life expectancy in many sub-Saharan African countries starting in the early 1990s (corresponding to the AIDS epidemic in that part of the world) and the plummeting of life expectancy in Rwanda at the time of that nation's genocide.

Keywords: Data visualizations, Graph Theory,Data Mining

Introduction

Data visualization is the graphical representation of information. Bar charts scatter graphs, and maps are examples of simple data visualizations that have been used for decades. Information technology combines the principles of visualization with powerful applications and large data sets to create sophisticated images and animations. A tag cloud, for instance, uses text size to indicate the relative frequency of use of a set of terms. In many cases, the data that feed a tag cloud come from thousands of Web pages, representing perhaps millions of users. All of this information is contained in a simple image that you can understand quickly and easily. More complex visualizations sometimes generate animations that demonstrate how data change over time. In an application called Gap minder, bubbles represent the countries of the world, with each nation's population reflected in the size of its bubble. You can set the x and y axes to compare life expectancy with per capita income, for example, and the tool will show how each nation's bubble moves on the graph over time. You can see that higher income generally correlates with longer life expectancy, but the visualization also clearly shows that China doesn't follow this trend—in 1975, the country had one of the lowest per capita incomes but one of the longer life expectancies. The animation also shows the steep drop in life expectancy in many sub-Saharan African countries starting in the early 1990s (corresponding to the AIDS epidemic in that part of the world) and the plummeting of life expectancy in Rwanda at the time of that nation's genocide.

Who's doing it?

Data visualizations have long been used in academic settings, but many instructors are using new technologies to

Concepts more quickly and deeply [4]. A history professor, for example, could use a visualization that shows which industries prospered and which suffered during the wars and economic cycles of the 20th century to explain demographic shifts and the social changes that followed. An economics professor might use the same visualization to explain the financial connections in the national or global economy[6]. Working with the visualization team at the Renaissance Computing Institute, a faculty member in the Department of Soil Science at North Carolina State University created an animated, interactive visualization that shows how fertilizer nitrates enter groundwater. The project combines data from a network of GIS mapping systems and remote sensors and generates a visualization that shows where nitrates concentrate in soil and how different modes of fertilizer delivery—coupled with variables such as precipitation—affect the rates and locations of groundwater pollution. Acuity and researchers in a wide range of academic disciplines use visualizations to present data in ways that help generate new knowledge and understanding. What Can Be Achieved through Using Visualization Data visualization has many applications within business intelligence? On the surface, tools such as dashboards and scorecards provide the bridge to deeper analysis as well as a bird's eye view of what is happening within the organization. A common example exists within sales departments to identify how sales staff measure up to targets and to identify any discrepancies that may exist within the targets set. Additionally, organizations can determine success factors for products and/or services and identify which strategies are working and which ones should be revised. This type of data visualization represents the entry point into a wider world of the benefits of data visualization. Although the key purpose is to monitor metrics (KPIs) and to provide a front-end tool that acts as a first point of contact, this first point of contact helps BI reposition itself as a user-friendly tool. Whether organizations are using embedded analytics on top of their operational solutions or sales and marketing dashboards, the fact remains the same – the use of data visualization directly affects the expansion of BI within the organization. Organizations no longer need a super user to analyze OLAP cubes. Decision makers can look at how they are performing against set targets, whether projects are meeting those targets, and how individual and departmental goals match the overall performance of the organization. In a sense, data visualization tools are becoming the face of business intelligence. These tools and various applications let decision makers slice and dice information in multiple ways to gain insights that that would otherwise be impossible to glean [6]. Add this to the fact that these insights can be delivered visually and the attraction of these solutions expands. After all, a manager is more likely to develop forecast scenarios if the only activity required is moving a gauge.

The Future of the Data Visualization Craze

As the adoption of BI expands towards enterprise-wide deployments and small and mid-sized companies, the use of data visualization tools will expand. Not only is data visualization the entry point to BI, but organizations can forecast and create what-if analyses to identify what needs to occur to help increase profits and plan for future product and service success. With impending continual financial upheaval, the importance of managing performance through scorecards and dashboards will only increase. Even though organizations will be forced to tighten their belts and reduce spending, the reality remains that the only way to decrease expenses while maintaining revenues is by analyzing performance within the organization and how that relates to a company's management of resources, expenditures [7].

Data Visualization Techniques

Bare the above in mind; we have some commonly used representation ways in data Visualization, they include (but not limited to): Charts: bar or pie Graphs: good for structure, relationships Plots: 1- to n-dimensional Maps: one of most effective Images: use color/intensity instead of distance (surfaces 3-D surfaces and solids Is surfaces/slices We also have some common steps in data visualization, they include:

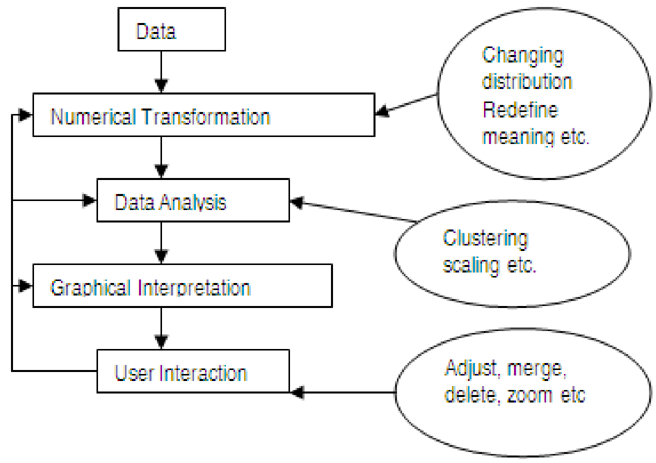

Figure 1 Data Visualization Techniques

Numerical Transformation

Visualization is a kind of transformation of numerical data. Numbers are abstract Concepts, and to represent them as points and lines requires a transformation. Transformations include:
1) Changing the distribution: modify the distribution of numbers so that they are more suitable for analysis or visual presentation. Some frequently used ways include:
Linear transformation, Logarithmic transformation
Normalizing transformation, Arc sin transformation
Square root transformation Inverse transformation
2) Redefining the Meaning: adjust numbers so that they are more meaningful, or more representative of the concept that the data analyst is interested in.

Data Analysis

Data analysis is the process of applying various methods to data to assist in Interpretation. Some of the exploratory data analysis methods are: statistical support, Cluster analysis, multidimensional scaling, and factor analysis. Data analysis can be used to transform data or to summarize the data itself or its statistical properties [8].

Graphical Interpretation

Graphical interpretation consists of a few key activities such as judgment of Magnitude (and relative magnitude), judgment of proportion (and relative proportion), Judgment of trend and slope, and judgment of grouping. It may also use some ways
Such as: Use scaling and offset to fit in range Use derived values (residuals, logs) to emphasize changes Use projections, other combinations, to compress information, get statistics Use random jiggling to separate overlaps Use multiple views to handle hidden relations, high dimensions Use effective grids, keys and labels to aid understanding User Interaction When presented with the visualization results, users may find it does not fit their minds

properly. Users may be want to do the followings, which may require to re-do some earlier steps. Dynamically adjust mapping Tour data by varying views labeling to get original data deleting to eliminate clutter Brushing/Highlighting to see correspondence in multiple views zooming to focus attention panning to explore neighborhoods .

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