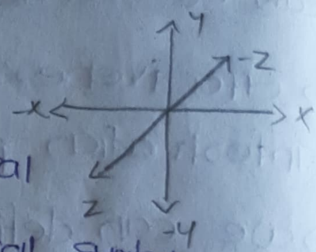
2-unit

Visualization Foundations

SEMIOLOGY OF GRAPHICAL SYMBOLS :-

→ The science of graphical symbols and marks is called semiology.



→ every possible construction in the Euclidean plane is a graphical representation made up of graphical symbols.

→ this includes diagrams, networks, maps, plots, and other common visualizations.

→ semiology uses the qualities of the plane and objects on the plane to produce similarity features, ordering features, and proportionality features of the data that is visible for human consumption.

→ there are numerous characteristics of visualization, of images, or of graphics made up of symbols.

Symbols and visualization :-

(a)
symbol with obvious meaning

(b)
Representation with complex meaning.

→ figure (a) contains an image that is universally recognizable (Yield sign). Such images become preattentively recognizable with experience.

→ figure(b), on the other hand, requires a great deal of attention to understand; the first steps are to recognize patterns within that figure.

→ figure(a) is preceived in onestep, and that step is simply an association of its meaning.

→ figure(b) takes two steps for understanding.

visualization steps:-

*· first identifies the major elements of the image, with the second identifying the various relationships betweeen these. with attentive effort, the symbols are perceived (transferred from long-term memory)

*· patterns, mostly subsets of groups or information having perceptual or cognitive commonality, are extracted from the overall image.

*· the last step is identifying the most interesting things (such as the most interesting point clusters, genes, countries, or products.) that is, those having the most interesting or special features.

EXTERNAL COGNITION :-

→ Important: Without external (cognitive) identification, a graphic is unusable.

→ the external identification must be directly readable and understandable.

→ since much of our perception is driven by physical interpretations, meaningful images must have easily interpretable x-, y-, and z- dimensions and the graphics elements of the image must be clear.

8 visual variables :- (diagrams ppt 9)

1) POSITION
2) MARK
3) SIZE (LENGTH, AREA, VOLUME)
4) BRIGHTNESS
5) COLOR
6) ((BRIGHTNESS)) MOTION
7) ORIENTATION
8) TEXTURE

1) Position :- the first and most important visual variable is that of position, the placement of representative graphics within some display space, be it one-, two-, or three-dimensional.

→ In addition to selecting appropriate variables to organize the display space and to present values with representative graphics, scales can be applied to variables to remap to reveal structures.

2) MARK :- the second visual variable is the mark or shape : points, lines, areas, volumes, and their compositions. Marks are graphic primitives that represent data.

→ this visualization uses shapes to distinguish between different car types in a plot comparing highway MPG and horsepower. clusters are clearly visible, as well as some outliers.

3) SIZE :-

the previous two visual variables, position and marks, are required to define a visualization. without these two variables there would not be much to see.

→ the remaining visual variables affect the way individual representations are displayed; these are the graphical properties of marks other than their shape.

→ the third visual variable and first graphic property is size. size determines how small or large a mark will be drawn.

4) BRIGHTNESS :-

→ the fourth visual is brightness or luminance. Brightness is the second visual variable used to modify marks to encode additional data variables.

→ while it is possible to use the complete numerical range of brightness values, Human perception cannot distinguish between all pairs of brightness values.

→ consequently, brightness can be used to provide relative difference for large interval and continuous data variables.

→ Another visualization of the 1993 car models data set, this time illustrating the use of brightness to convey car width (the darker the points, the wider the vehicle).

5) COLOR :-

→ while brightness affects how white or black colors are displayed, it is not actually color. color can be defined by the two parameters. hue and saturation.

A visualization of the 1993 car models, showing the use of color to display the car's length. Here length is also associated with the y-axis and is plotted against wheelbase. In this figure, blue indicates a shorter length, while yellow indicates a longer length.

6) ORIENTATION:

orientation is a principal graphic component behind iconographic stick figure displays and is tied directly to preattentive vision. this graphic property describes how a mark is rotated in connection with a data variable.

→ sample visualization of the 1993 car models data set depicting using highway miles-per-gallon versus fuel tank capacity (position) with the additional data variable, midrange price, used to adjust mark orientation.

7) TEXTURE :-

→ The seventh visual variable is texture. Texture can be considered as a combination of many of the other visual variables, including marks (texture elements), color (associated with each pixel in a texture region), and orientation (conveyed by changes in the local color).

→ Dashed and dotted lines, which constitute some of the textures of linear features, can be readily differentiated, as long as only a modest number of distinct types exist.

→ Varying the color of the segments or dots can be preceived as a texture.

→ Example visualization using texture to provide additional information about the 1993 car models data set, showing the relationship between wheelbase versus horsepower (position) as related to car types, depicted by different textures.

8) MOTION :-

→ The eigth visual variable is motion. In fact, motion can be associated with any of the other visual variables, since the way variable changes over time can convey more information.

→ One common use of motion is in varying the speed at with a change is occurring (such as position change or flashing, which can be seen as changing the capacity).

TAXONOMY:

-> Taxonomy was defined by 3 scientists

1) Taxonomy by keller and keller

2) Taxonomy by KEIM

3) Taxonomy shneiderman

Taxonomy:- (diagram ppt 10) pg 13

Taxonomy represents the foundation upon which information architecture stands, and all well-rounded developers should have at least a basic understanding of taxonomy to ensure that they can create organized, logical applications.

TAXONOMOIES:-

→ A taxonomy is a means to convey a classification.

often hierarchical in nature, a taxonomy can be used to group similar objects and define relationships.

→ In visualization, we are interested in many forms of taxonomies, including data, visualizations techniques, tasks, and methods for interaction.

1) TAXONOMY OF VISUALIZATION GOAL BY KELLER AND KELLER:-

keller and keller, in their book visual cues [205] classify visualization techniques based on the type of data being analyzed and the user's tasks

→ similar to those identified earlier in the book, the data types they consider are:

* scalar (or scalar field);
* nominal;
* direction (or direction field);
* shape;
* position;
* spatially extended region or object (SERO).

→ the authors also define a number of tasks that a visualization user might be interested in performing while some of the tasks seem interrelated, their list is a useful starting position for someone setting out to design a visualization for a particular application - their task list consists of:

1) TASK LIST:

identify - establish characteristics by which an object is recognizable;

locate - ascertain the position (absolute or relative);

distinguish - recognize as distinct or different (identification is not needed);

categorize - place into divisions or classes;

cluster - group similar objects;

rank - assign an order or position relative to other objects;

compare - notice similarities and differences;

associate - link or join in a relationship that may or may not be of the same type;

correlate - establish a direct connection, such as causal or reciprocal

ii) DATA TYPE BY TASK TAXONOMY BY SHNEIDERMAN

→ A related strategy was proposed by shneiderman[319].

→ His list of data types was somewhat different from keller and keller's, and included more types from the information visualization field. His list of datatypes consisted of:

* one-dimensional linear;
* two-dimensional map;
* three-dimensional world;
* temporal;
* multidimensional;
* tree;
* network

→ For his tasks, shneiderman looked more at the behavior of analysts as they attempt to extract knowledge from the data. His task set consisted of the following:

overview: Gain an overview of the entire collection,

Eg: using a fish eye strategy for network browsing

Zoom: zoom in items of interest to gain a more detailed view, e.g., holding down a mouse button to enlarge a region of the display.

Filter: Filter out uninteresting items to allow the user to reduce the size of a search, e.g., dynamic queries that can be invoked via sliders.

Details-on-demand: select an item or group and get details when needed, e.g., a pop-up window can show more attributes of a specific object on the screen.

Relate: view relationships among items, e.g., select a particular object that can then show all other objects related to it.

History: keep a history to all undo, replay, and progressive refinement, such as allowing a mistake to be undone, or a series of steps to be replayed.

Extract: Extract the items or data in a format that would facilitate other uses, i.e., saving to file, sending via e-mail, printing, or dragging into another application (statistical or presentation package).

→ Shneiderman suggested that an effective visual exploration tool should support most or all of these tasks in an easy-to-use manner.

KEIM TAXONOMY:

Keim designed a classification scheme for visualization systems based on three dimensions: data types, visualization techniques, and interaction distortion methods.

Classification of Data Types. 6 types of data exist:

1. One-dimensional data - i.e., temporal data, news data, stock prices, text documents
2. Two-dimensional data - i.e., maps, charts, floorplans newspaper layout.
3. Multidimensional data - i.e., spreadsheets, relational tables.
4. Text and hypertext - i.e., new articles, web documents.
5. Hierarchies and graphs - i.e., telephone/network traffic, systems dynamics models.
6. Algorithm and software - i.e., software, execution traces, memory dump.

CLASSIFICATION OF VISUALIZATION TECHNIQUES:

5 classes of visualization techniques exist:

1. Standard 2D/3D display - i.e., x, y- or x, y, z-plots, bar charts, line graphs,
2. Geometrically-transformed displays - i.e., landscapes, scatterplot matrices, project pursuit techniques, prosection views, hyperslice

Parallel coordinates;

3. Iconic displays -i.e., chernoff faces, needle icons, star icons, stick figure icons, color icons, tilebars;

4. Dense pixel displays -i.e., recursive pattern, circle segments, graph sketches;

5. Stacked displays - i.e., dimensional stacking, hierarchical axes, worlds - within - worlds, treemaps, cone trees.

Visualization Techniques for spatial Data:

SPATIAL DATA: (diagram ppt 11)

spatial data is the data portrayed in points, lines and it can be represented in two dimensional and three dimensional forms.

→ spatial data is any type of data that directly or indirectly references a specific geographical area or location. sometimes called geospatial data or geographic information, spatial data can also numerically represent a physical object in a geographic coordinate system. However, spatial data is much more than a spatial component of a map.

1) ONE DIMENTIONAL SPATIAL DATA:-

one dimensional spatial data is often the result of accumulating samples or readings of some phenomenon while moving along a path in space.

Given a one-dimensional sequence of univariate data (only one value per data item), we can map the spatial data to one of the screen dimensions and the data value itself to either the other screen dimension or to the colour of a mark or region long the spatial axis (to form a color bar).

The data needs to be scaled to fit within the range of the display attribute.