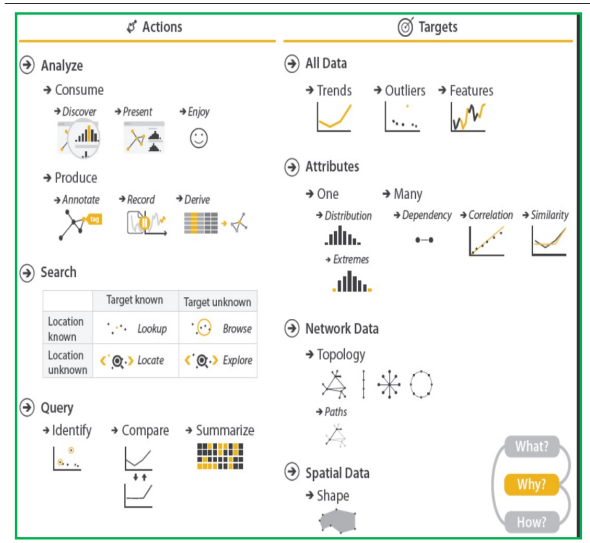
Visualisation tasks



From "Visualisation Analysis & Design", T. Munzner, CRC Press, 2015 (Chapter 3)

Three different **actions**

- Given a visualisation of a data set, a user can:
  - **Analyse**:
    - consume or produce
  - **Search:**
    - location/target is known/unknown?
  - **Query:**
    - find specific information

The **Analyse** action

- **Consuming:** user simply accesses the data using the visualisation
  - to **discover** information not known before
  - to **present** information to another person
  - **enjoy** and find something interesting
- **Producing**: user actively creates something
  - **annotations** of the data or the visualisation
  - a persistent **record** of a visualisation (or aspects thereof)
  - **derive** new data based on existing data

Running example: Analyse

- **Discover:** did anyone win both the TBHR and the Highland Fling in 2010?
- **Present:** here are the first Swandling club finishers for the TBHR in 2012
- **Enjoy**: a racer, seeing how races have changed in many years, and looking for anyone they know

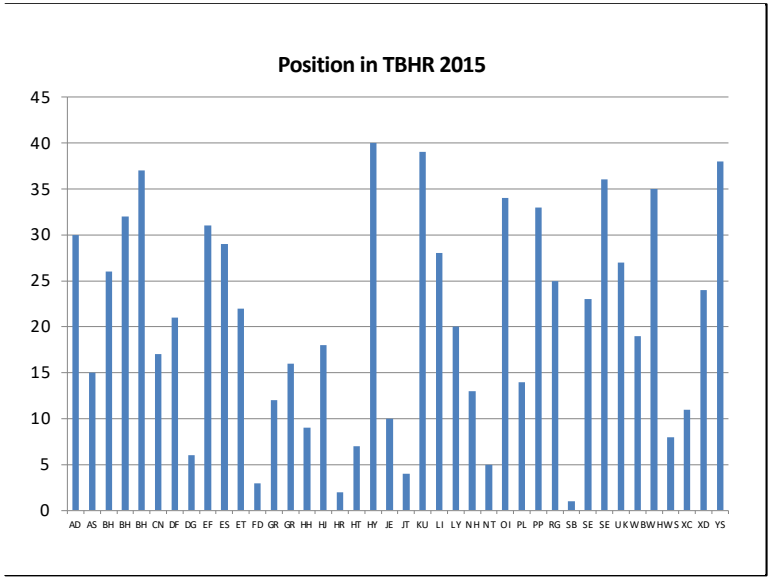
- **Annotate:** Mary Smith is the same person as Mary Bernados
- **Record:** this chart on my wall shows how much faster I have become in the Ben Lomond race over the past ten years
- **Derive**: calculate the percentage of active women in each club in each year

The **Search** action

Locating target of interest in the visualisation

- **Lookup**: target known & location known *(where and what)*
- **Browse:** target unknown & location known *(where)*
- **Locate:** target known & location unknown *(what)*
- **Explore:** target unknown & location unknown

	Target known	Target unknown
Location known	 *Lookup*	 *Browse*
Location unknown	 *Locate*	 *Explore*

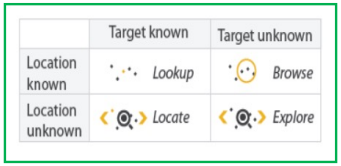


Imagine this was the race data that you were looking at… with position as the height of the bar, and the initials of the name of the runner as the label below each bar.

There are many kinds of searches that a system could support, and we can map out examples of them here

Running example: Search

- **Lookup**: what position did John Thomas (JT) come in? *(4)*
- **Browse:** who won the race? *(SB)*
- **Locate:** did CG run this year? *(no)*
- **Explore:** is there any noticeable pattern? *(no)*

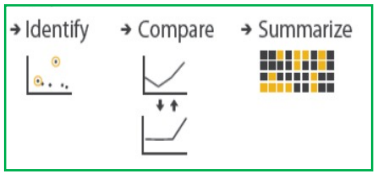


Noting that it is the nature/form of the visualisation that will determine what is meant by 'location' – if it is location in the perceived visualisation (or simply a location in a data source)

The **Query** action

Once you have found the data you are interested in, what will you do with it?

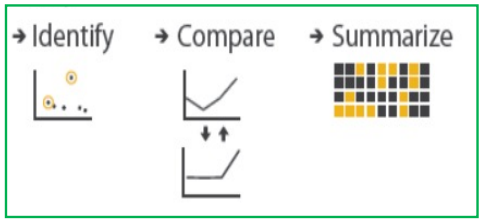
- **Identify:** get all the information about it
- **Compare:** differences between more than one data item
- **Summarise:** produce an overview of more than one data item



Summarise here means creating something new, in a semi-automatic way, from the raw data items in the set of query results. It might, for example, be a heat map or chart that compresses the set in some useful way, or a simple statistic based on that data set, or even representative sample.

Running example: Query

- **Identify:** What club was the TBHR 2015 winner from?
- **Compare:** Was ND faster than DF?
- **Summarise:** Of the first ten finishers, three were women



Targets

- Targets are the ‘things of interest’ in a visualisation
- Targets are not necessarily just the individual data points (although this is common)
  - for all data: **trends, outliers, features**
  - for attributes: **distributions, dependencies, correlations, similarities**
  - for network data: **topology, paths**
  - for spatial data: **shape**

Targets (things of interest) over *all data*

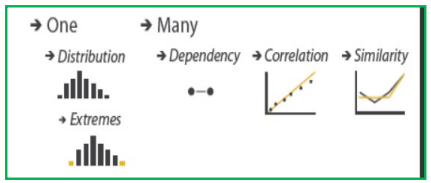
- **Trends:**
  - patterns: e.g. increase, decrease, plateau, etc.
- **Outliers:**
  - data points that don't fit into an obvious pattern
- **Features:**
  - other structures of interest, depending on the domain

Running example: Targets over *all data*

- **Trends:**
  - JD's finishing time in the TBHR decreased suddenly in the early 2010's , but recovered later in the decade
- **Outliers:**
  - the winner's time in 2015 was much slower than in all other years
- **Features:**
  - there are more females finishing in the first 25 places in the past four years than in the whole decade before that

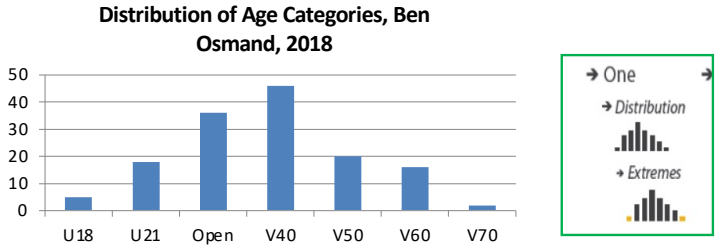
Targets (things of interest) relating to *Attributes*

- For the values of one attribute:
  - **distribution**
- For the values of more than one attribute
  - **dependency, correlation, similarity**



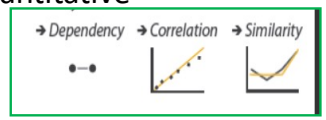
Running example: one attribute target

- **Distribution:** the number of runners per *age category*
- **Extremes:** the number of runners *over 70yrs*



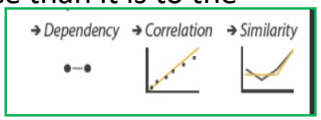
Many Attribute Targets

- **Dependency:** the value of one attribute can be determined directly by the value of another
- **Correlation:** there is a tendency for the value of one attribute to be linked to the value of another
- **Similarity**: attributes ranked according to their similarly (as defined by quantitative aggregates)



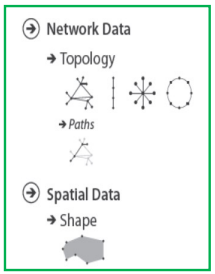
Running example: many Attribute Targets

- **Dependency:** a runner's category (e.g. M40) is directly dependent on age & gender (e.g 42yrs, male)
- **Correlation:** there is a trend for a runner's finishing time to relate to their weight
- **Similarity:** the average finish time for the Ben Osmand Race is closer to the average finish time for the Ben Styles Race than it is to the Ben Rinnes Race



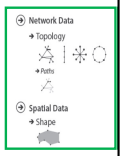
Targets (things of interest) *in Specific data sets*

- For network data
  - **topology** (structure of the network)
  - **paths** (sequnces of connections between nodes)
- For spatial data
  - **shape**



Running example: Specific data set targets

- Network of run-buddies
  - **topology:** are there small groups of runners who always train with each other? If so, how many?
  - **paths:** if JH has training advice that he gives to the people he trains with, will that advice get to BK?
- A race where runners have to pass through a set of checkpoints
  - **shape:** what is the shape created by these checkpoints when they are connected by straight lines on a map?



Why is it useful to describe data types and visualisation tasks in such an abstract way?

Why is it useful to describe data types and visualisation tasks in such an abstract way?

- It is always good to pause and think about your data, and its use
- Decisions you make in your visualisation for one domain can be compared or used with those needed for another domain

Running example scenario

I want to join a Hill Running Club that has an equal balance of gender membership, a wide distribution of members with different age categories, some very fast runners, and a dense network of run-buddies.

A generic visualisation tool that supports a good variety of tasks should allow me to find this information easily

This is to make us consider what should be in a generic system that supports the varied tasks described in this lecture

Looking for a data item (club) which is a categorical attribute of other data items (runners).

- Looking at the frequencies of an attribute (distribution of the genders of the members) for each of a set of data items in a table (clubs), and compare.
- Looking at the frequencies of an attribute (distribution of the age categories of the members) for each of a set of data items in a table (clubs), and compare.
- Deriving new data (calculating the average) of a quantitative attribute (finishing position) for each of a set of data items in a multi-dimensional table (runners in clubs), and compare.
- Looking at the structure of a set of networks (run-buddies) to identify information about them (the extent of connectivity), and compare.

A similar example

I need to choose which companies to apply to for a job. I want a company that offers relatively high salaries for the sector and has strong social ties between its employees. I would like there to be an equal gender balance, and for there to be options for me to work in different countries.

If I load the relevant data into the same visualisation system, will I be able to find this information easily?

I'd hope so… as the high level tasks here are basically the same, even if the data and terminology are not the same

Summary

- **Actions** (verbs): things a user can do
  - analyse, search, query
- **Targets** (nouns): things a user can be interested in
  - all data
    - **trends, outliers, features**
  - attributes
    - **distribution, dependency, correlation, similarity**
  - networks
    - **topology, paths**
  - spatial data
    - **shape**

Visualisation tasks