SYSTEMATIC APPROACH TO VISUALIZING DATA

The goal of visualizing data

- Know what you have
- Get ideas for how to investigate the data

Knowing What You Have

- Missing data
- Attribute values that are different orders of magnitude
- Non representative / Skewed attributes or skewed target values

These can affect the quality of what you infer from the data.

How should data be visualized?

There is no recipe.

Here are some guidelines...

1) Get the data into tabular form. Something you can easily manipulate.

- Excel worksheet
- Orange data table

2) Get a handle on the

Structure of the data

- Number of rows
- Number of Columns / features
- Types of features
  - Numerical
  - Categorical
- Types of information
  Contained in the features

3) Visualize numerical features

What

- Summary Statistics
  (Range, Distribution, Percentiles)

How

- Histogram
- Box Plot

Look For

- Outliers
- Skew

4) Visualize relationships between numerical features.

What

- Comparing quantities

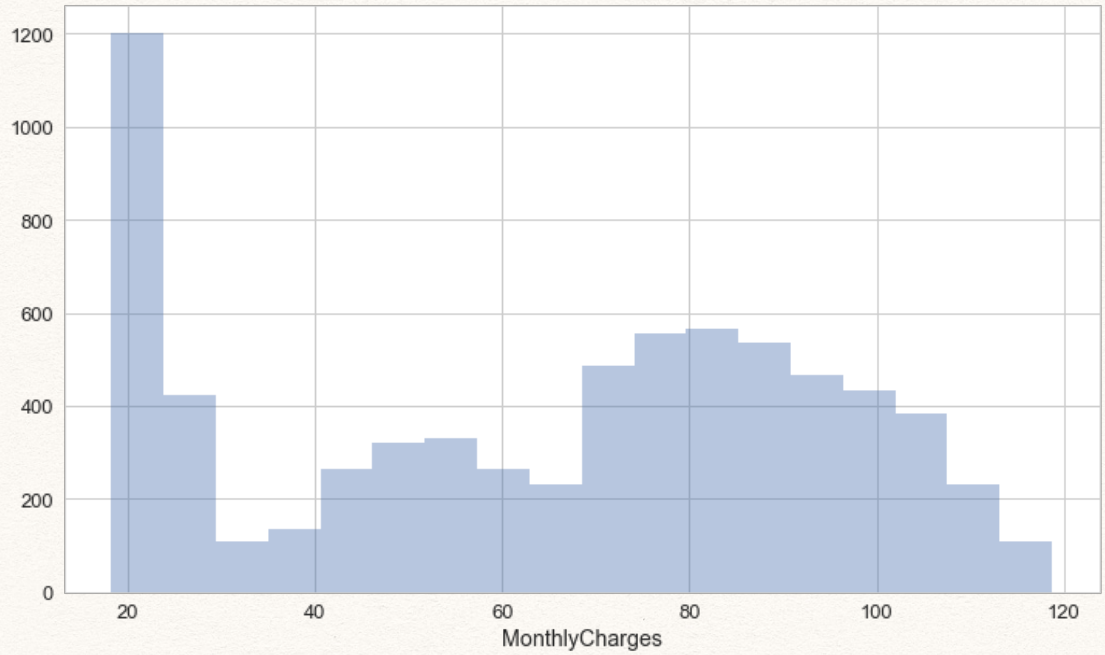
How

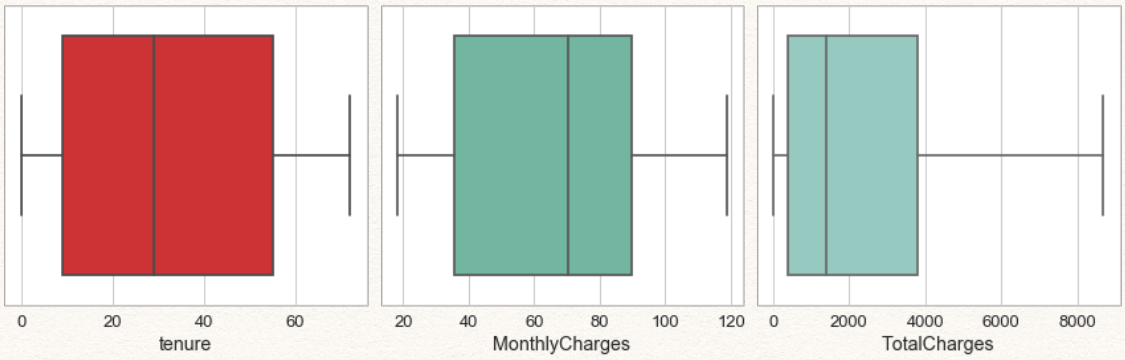
- Scatter plot
- Correlation table
- Bar chart
- Overlapping histograms

Look for

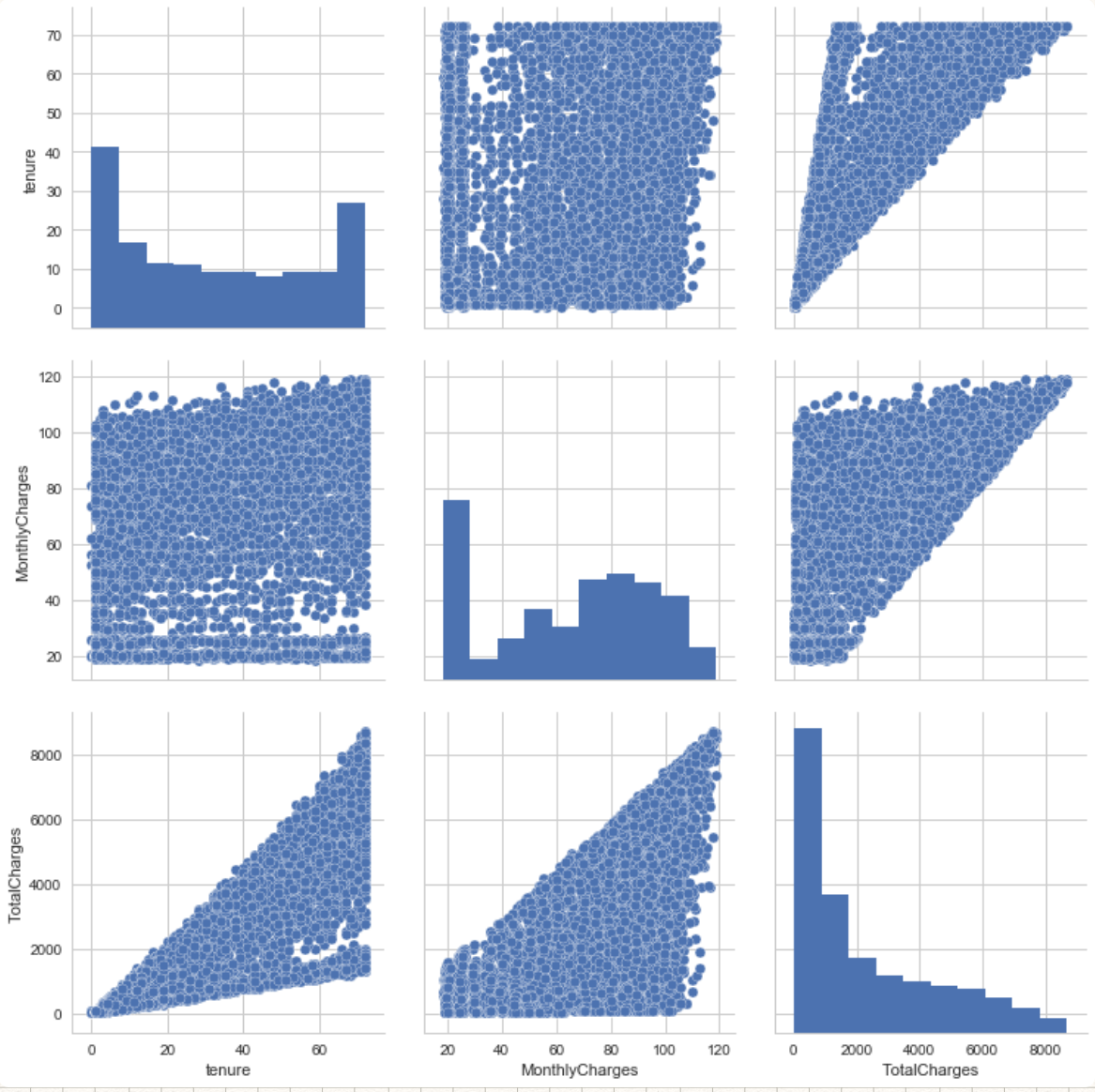
- Correlations and anti-correlations
- Differences in order of magnitude

visualizing data 7





visualizing data ⑨



5) Visualize categorical features.

What

- Unique values within each category
- Distribution of values within each category

How

- Bar graph

Look for

- How values are distributed
- Representativeness of values

6) Visualize relationships between Categorical features

What

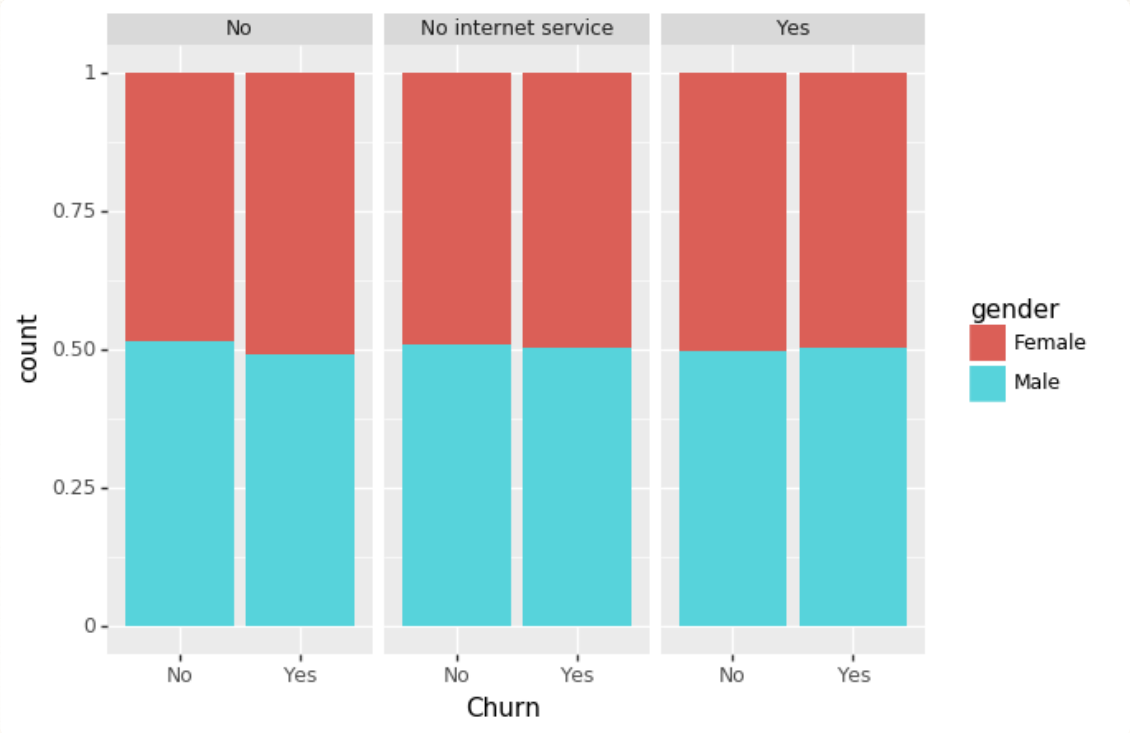
- which values occur together (or not)? How frequently?

How

- 2 x 2
- Grouped bar chart
- Facet / Pivot plot

Look for

- strong and weak relationships
- confounding attributes


No
No internet service
Yes
1
0.75
0.50
0.25
0
count
No
Yes
No
Yes
No
Yes
Churn
gender
Female
Male

7) Visualize relationships between numerical and categorical attributes

What

- Range of numerical values within each category

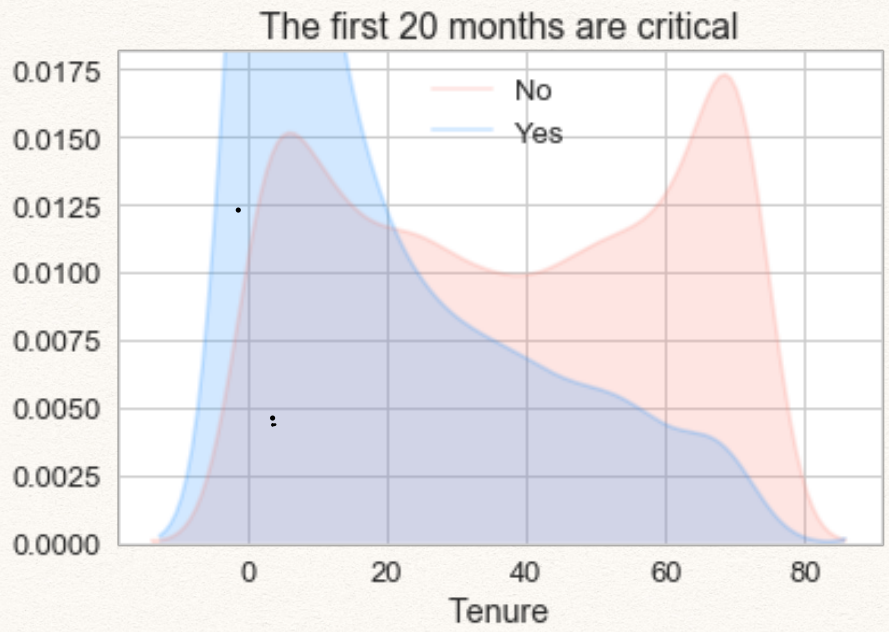
How

- Facet plots
- Density Plots
- Jitter plots

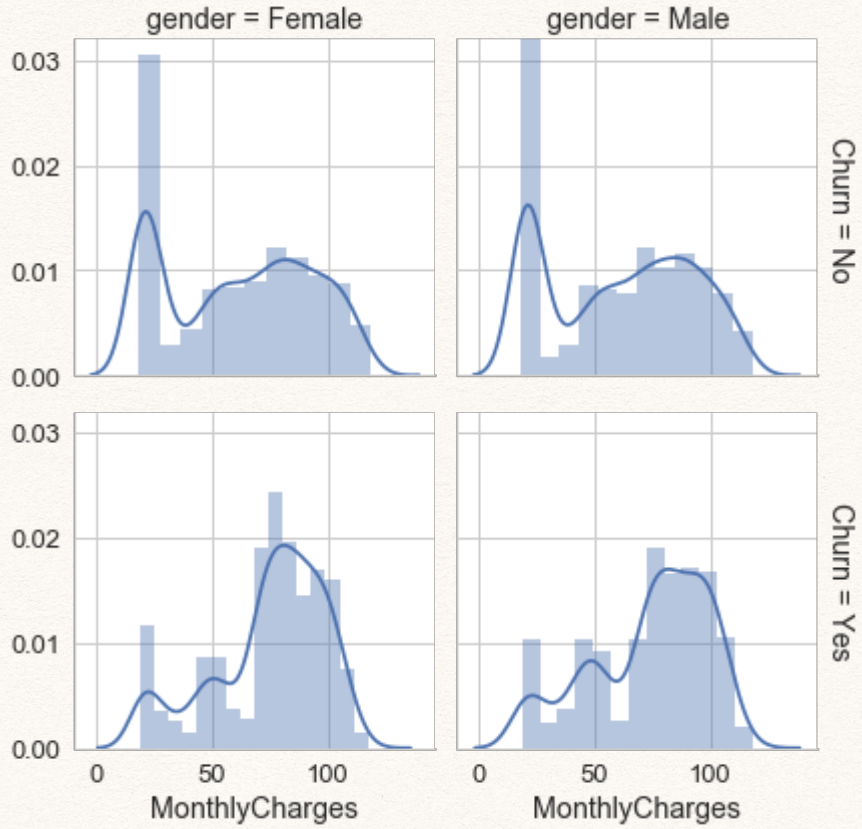
Look for

- How numerical values are distributed as categorical values "switch on" or "switch off"

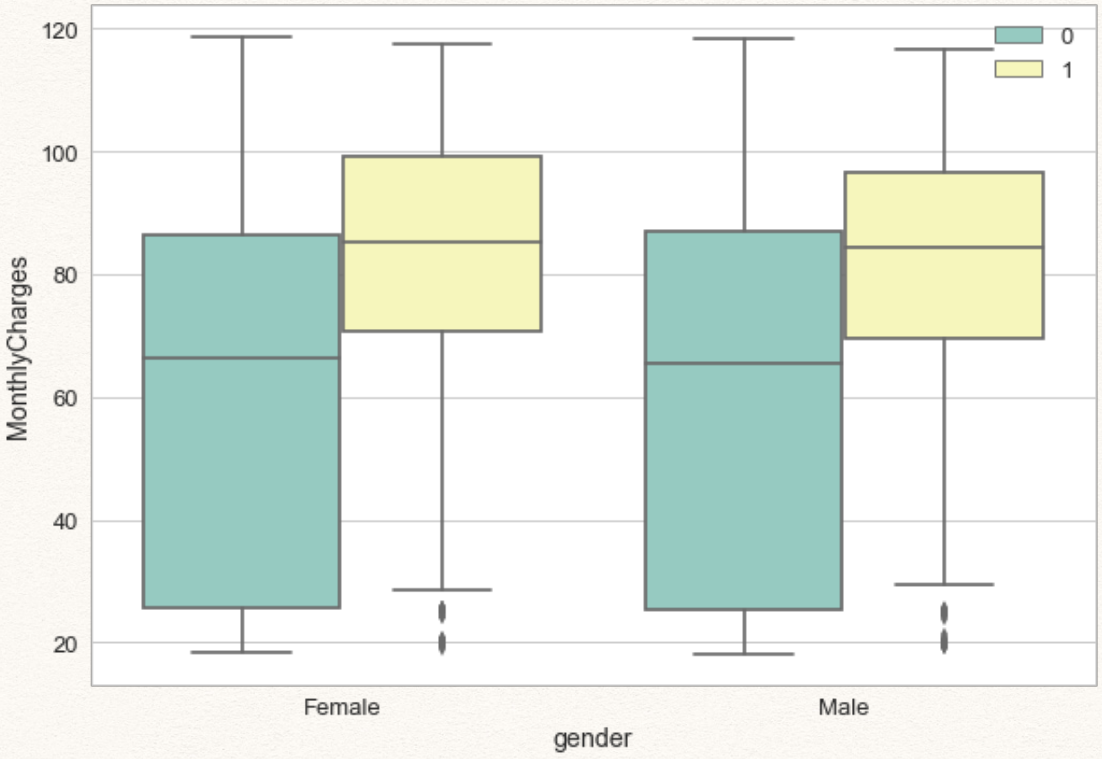
Density plots



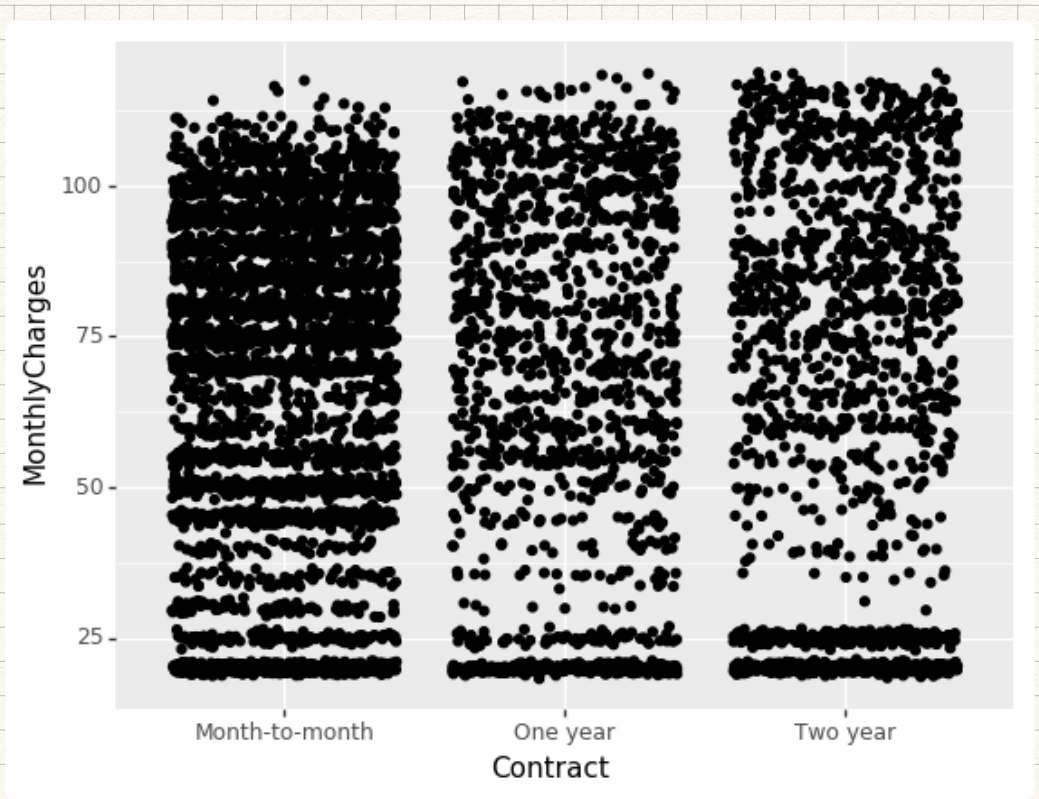
Facet plots



Box plots



Strip plots



8) For both numerical and categorical data, find and handle missing values.

- Empty cells ` , [space character]
- Truly empty cells [Nothing at all]

Figure out how to handle missing values.

- Remove Column(s)
- Remove row(s)
- Impute column aggregate values cells in that column
  - mean (of column)
  - median (of column)
  - mode (of column)

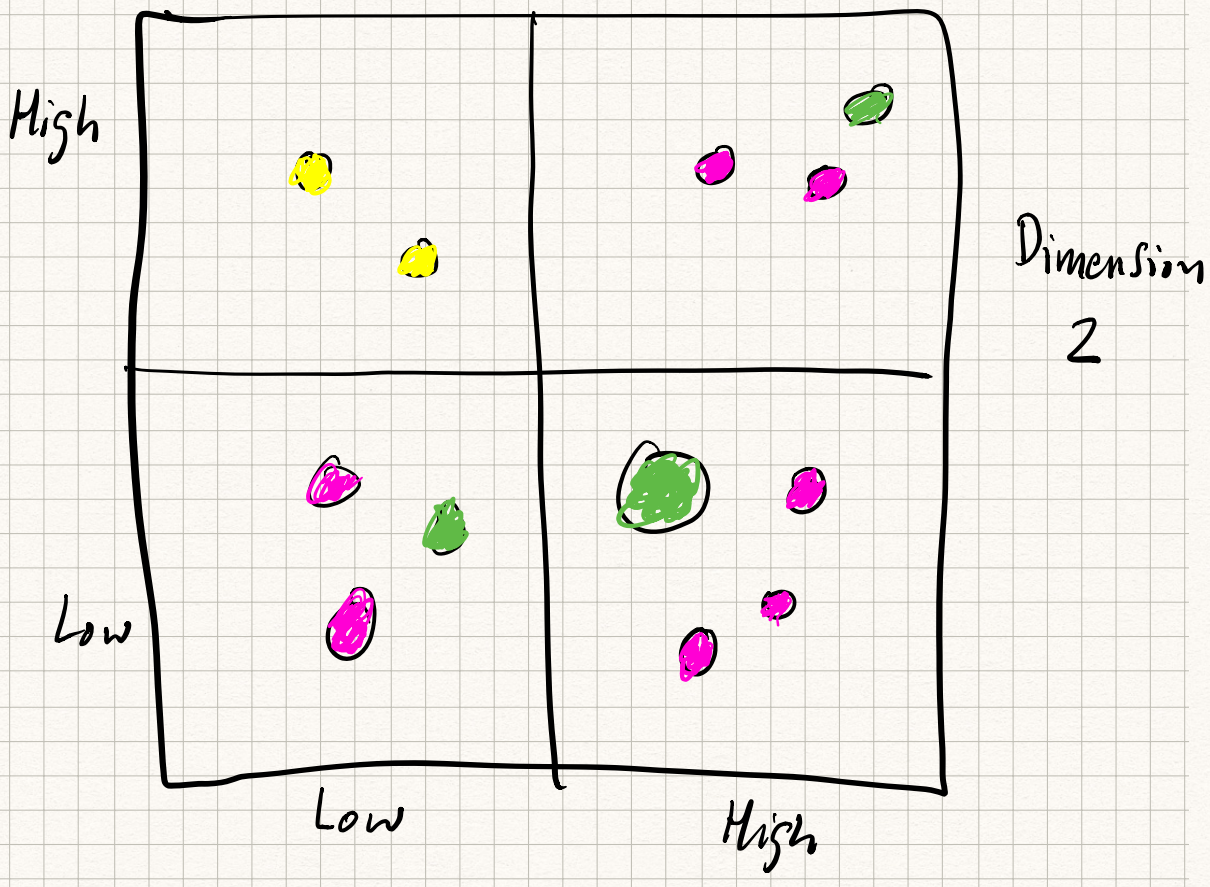
What happens when there are more than 3 features to visualize together?

There are a few tricks we can use to display as many as 7 dimensions (without causing brain/eye strain) on a piece of 2-D paper.

Let's see how...

2 x 2 Chart

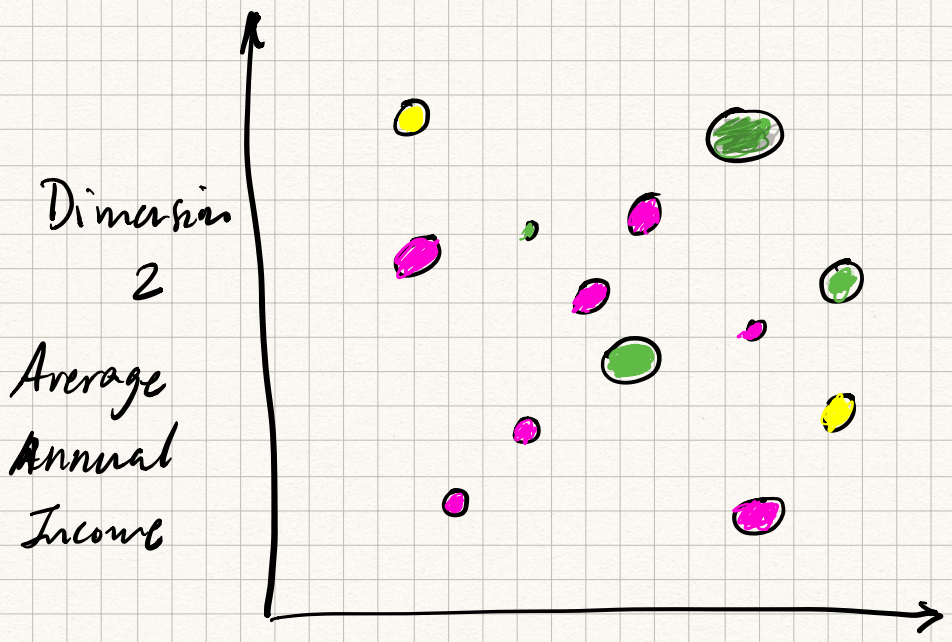
4 Dimensions



Dimension 3 - Bubble Size ○ ○ ○

Dimension 4 - Bubble Color

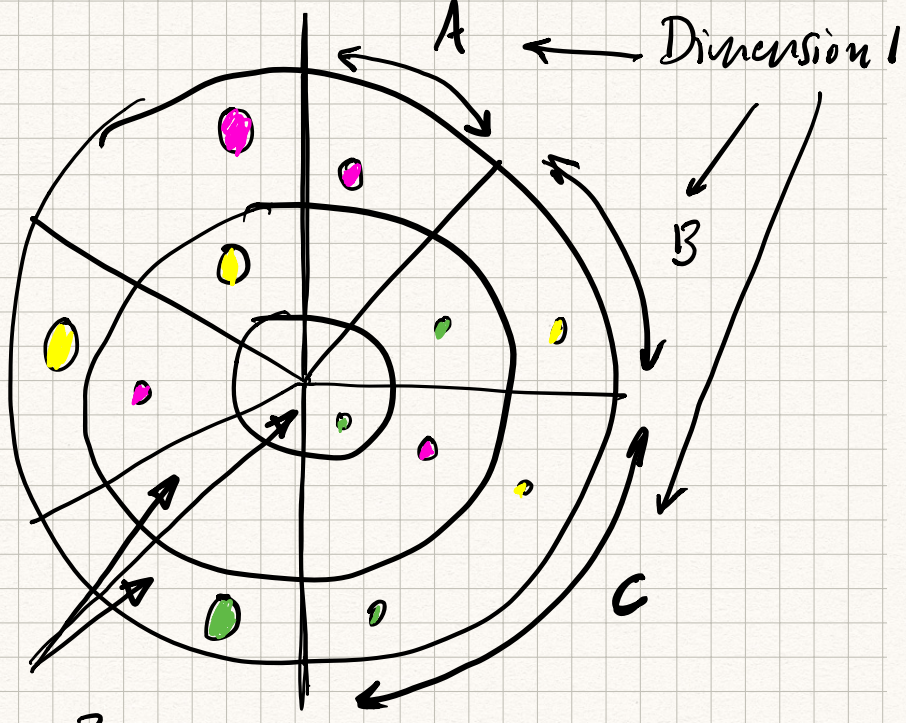
Bubble Chart - 4 Dimensions



Dimension 3 - Bubble Size

Dimension 4 - Bubble Color

Bullseye Chart - 4 Dimensions



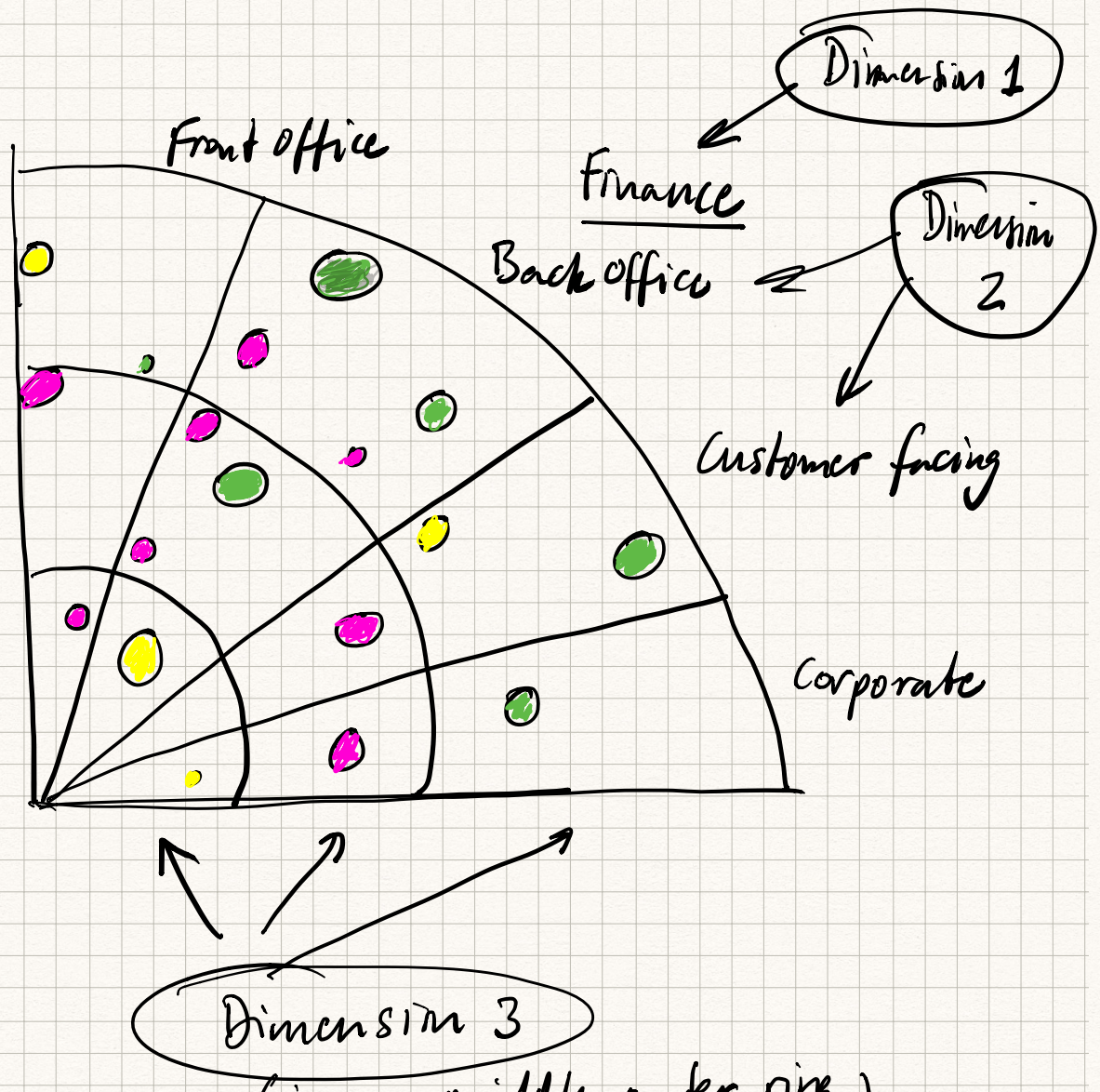
Dimension 2

(Outer, middle, inner ring)

Dimension 3 - Bubble size ○ ○ ○

Dimension 4 - Bubble Color

Bullseye Chart - 5 Dimensions

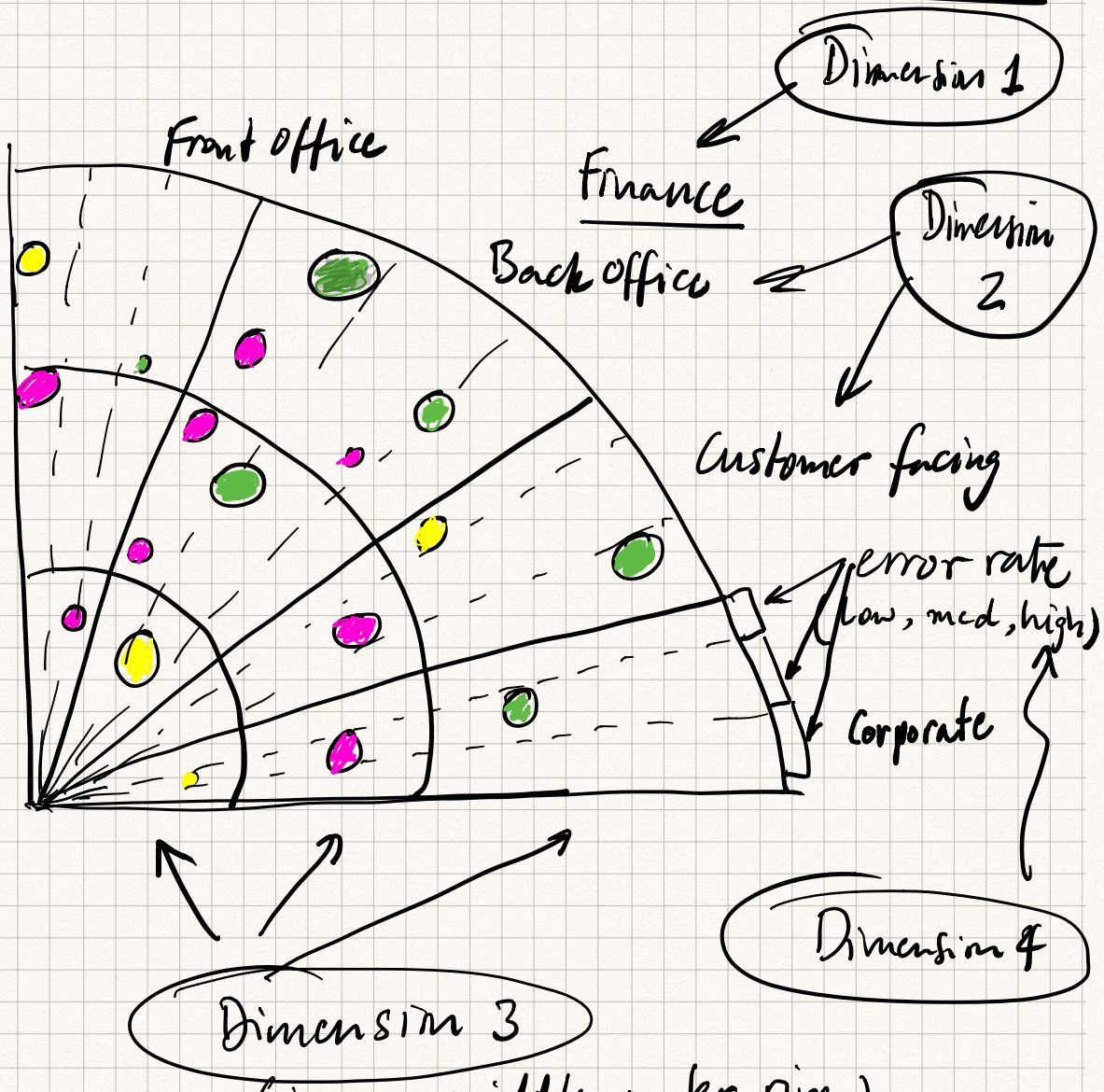


(inner, middle, outer ring)

Dimension 4 - Bubble size ○ ○ ○

Dimension 5 - Bubble color ● ● ●

Bullseye Chart – 6 Dimensions



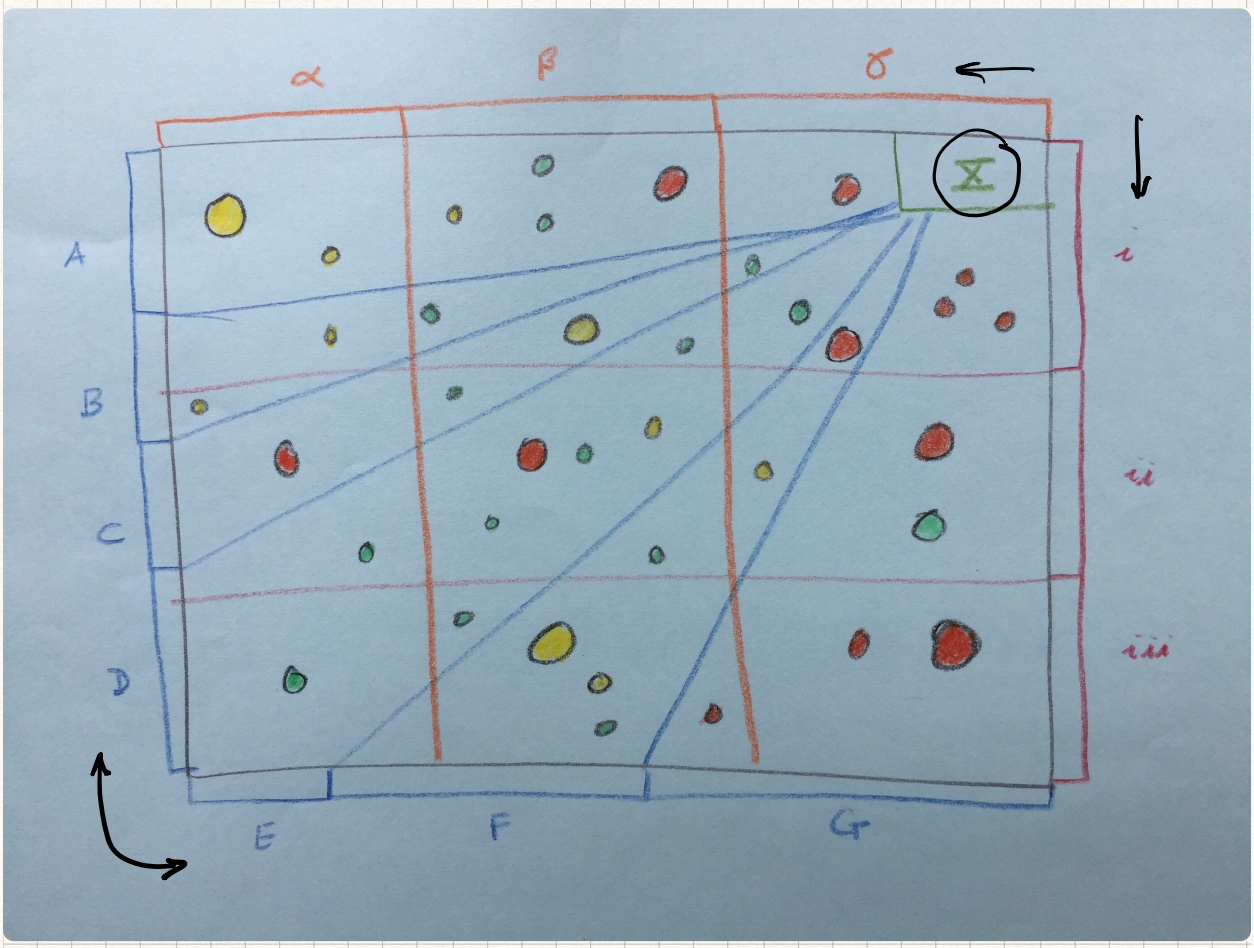
Dimension 5 – Bubble size ○ ○ ○

Dimension 6 – Bubble color

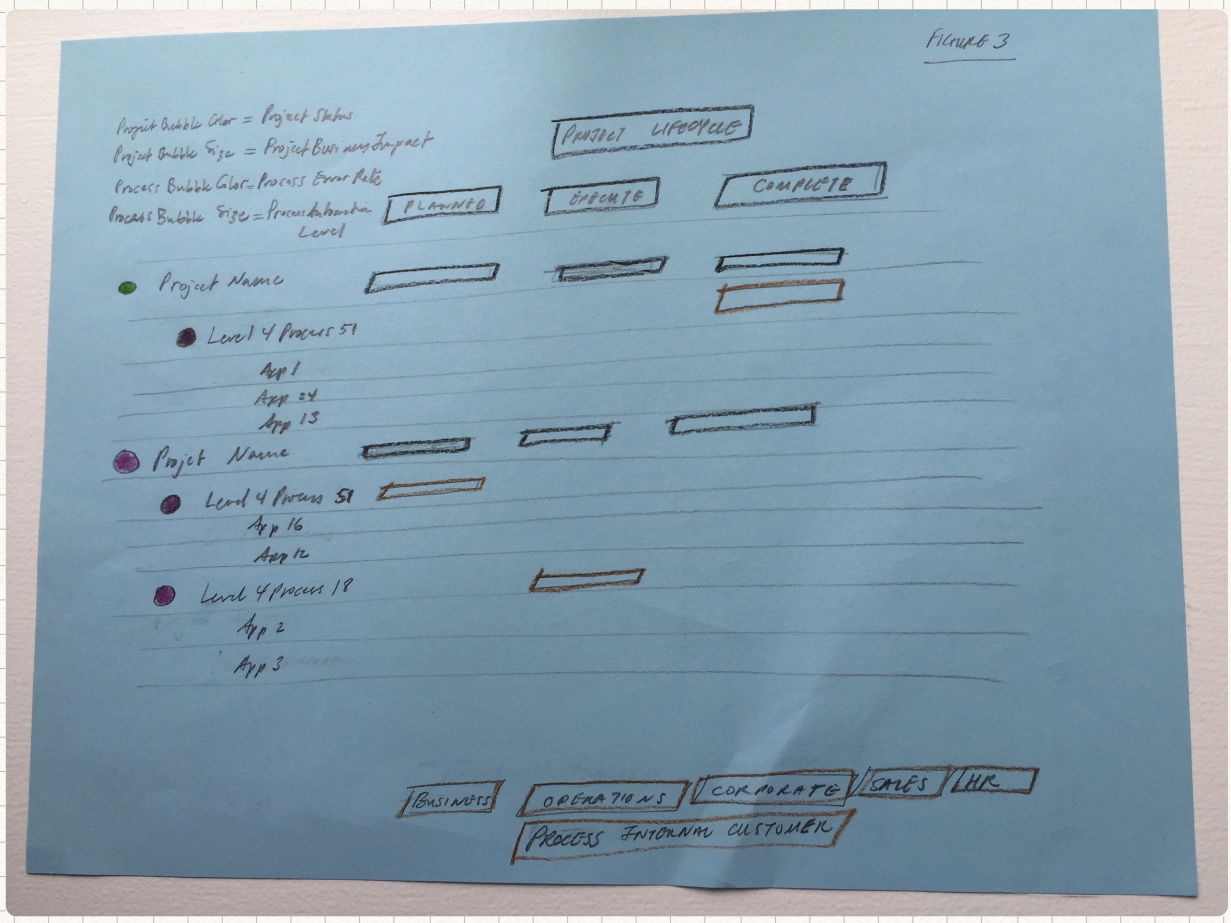
Visualizing data (23)

Roadmap Diagrams

6 + Dimensions



Gantt Chart – 7 Dimensions



Practically, this becomes a tabular view, which makes it less easy to interpret.

But what if you have 10, or 20, or 100 dimensions?

(In machine learning problems it's not unusual to have 100,000 dimensions!)

Answer: Find out if a select handful of features matter more than the rest and use these features to visualize the dataset. Some common techniques are:

- Principal Component Analysis (PCA)
- Locally Linear Embedding (LLE)
- Multidimensional Scaling (MDS)
- t-distributed Stochastic Neighbor Embedding (t-SNE)

Some common techniques for finding relevant features (if they exist).

- Domain knowledge
- Convert / transform certain features and drop the rest
- Combine / transform one or more features
- Reduce the dimensionality of the dataset using compression algorithms.

We'll cover these techniques in the session on Feature Engineering