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INM433 Visual Analytics Individual coursework submission:  
Visual Analytics analysis predicting Iron Ore quality in Iron Ore flotation processes

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# Motivation, data and research questions:

## Motivation for study and domain specific research questions for investigation:

The motivation for this study is to assess the quality of Iron ore feed output from an Iron Mining Silica removal froth flotation unit operation based on the quality of its feedstock and unit operation parameters. As a result of this there a number of analytical questions that come from this objective:

* What data from the manufacturing sensors are genuine feedback on the process?
* Is it possible to predict % Silica Concentrate every minute based on the process parameters and feed stream stock?
* How many steps (hours) ahead can we predict % Silica in Concentrate?
* Is it possible to predict % Silica in Concentrate without using % Iron Concentrate column

This analysis is pertinent from a business standpoint as by changing optimising the processing with regards to understanding Silica concentration provides values in 2 ways:

1. Having the ability to reduced down the cost of finish product sampling reduces of the overall manufacturing process and decreases batch release time for each lot of ore.
2. Having a better characterisation of how different processing parameters influence the final silica output leads to the opportunity that silica removal can be further optimised improving downstream processing of iron ore by reducing the energy requirements during pig Iron formation[XX]

## Data suitability:

The data set utilised for this analysis is data directly from the manufacturing shop floor of mining unit operation. As a result it is suitable dataset to utilise for this analysis. One item to be conscious off the time series data output stream results for iron and

## Data Transformations

There were a number of data transformations that where required prior to performing any analysis on this dataset.

1. Removal of all commas with decimal places in the dataset
2. Change date timestamps as the time measurement for the process parameters where taken every 20 seconds and therefore need to be changed to reflect this for any time series analysis.
3. Creating two new parameters
   1. % Iron feed enrichment: This was the subtraction of the final iron feed concentration from the initial feed
   2. % silicon feed removal: This was the subtraction of the final silica feed concentration from the initial feed

# Tasks and approach

## What manufacturing instrumentation signals are genuine processing signals

From a manufacturing standpoint typical issues there a myriad of issues in encountered with regards to poor or noisy feedback from instrumentation due to manufacturing conditions. As a result two activities need to be performed to address this:

1. For noisy time series data with PACF and ACF trends need to be generated to determine where seasonality is present. From this then smoothing moving average smoothing can be performed to remove the associated noise. If no seasonality is present and the distribution of the physical parameters is within quite a tight physical specification the value will be determined to be constant for the process however.
2. Data quality assessments: For poor signal feedback from the data set identifiers within the dataset that can be denoted as poor signal feedback need to be identified characterised and then used to expunge that data from the feature set for modelling.

Is it possible to predict % Silica Concentrate every minute based on the process parameters and feed stream stock?

Due to the process flow present of this process(See figure XX) the analysis of this process can be broken down into two analytical question subtasks:

1. What feed stock parameters influence the removal

## Manufacturing processing parameters

## Output feed steam characterisation.