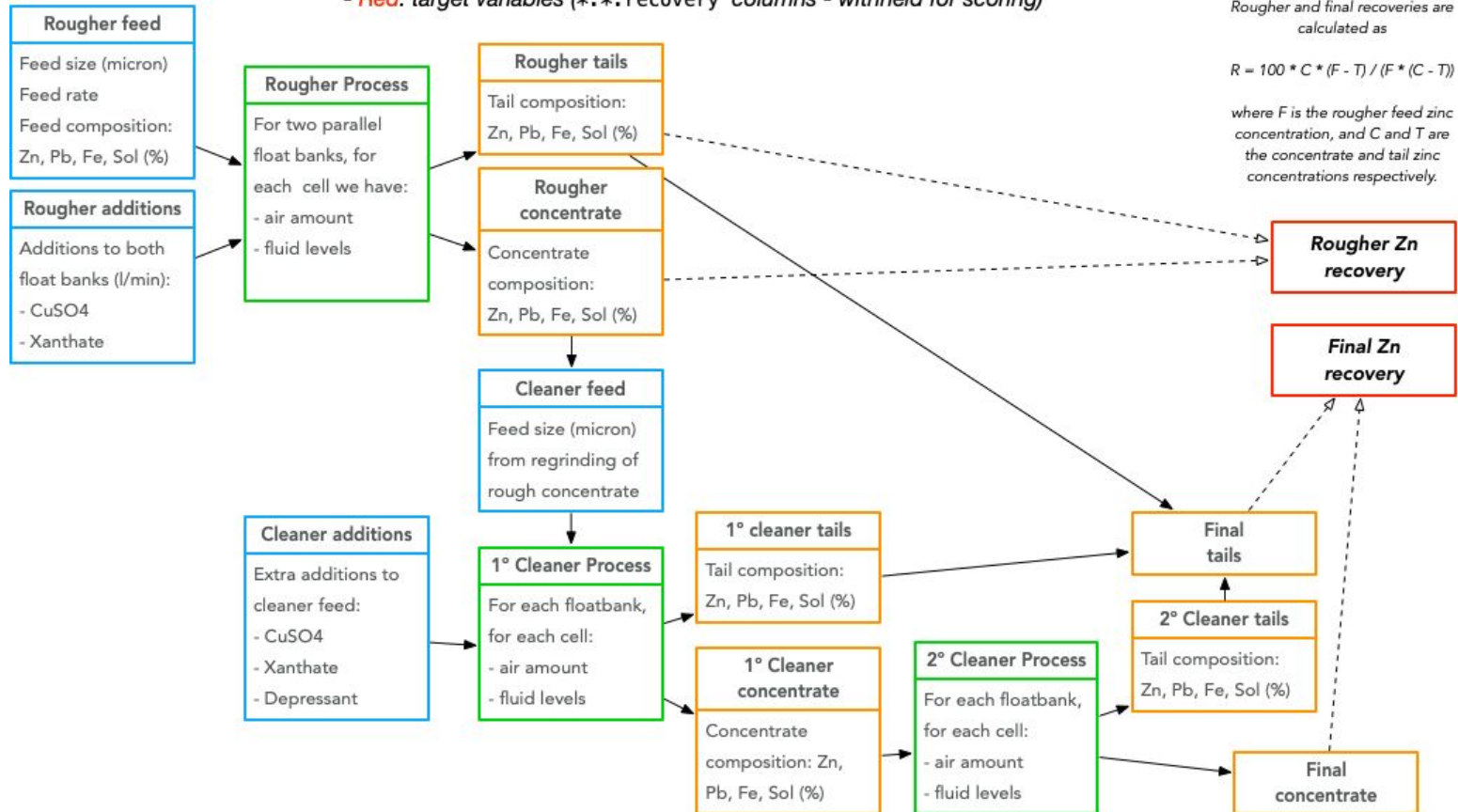# Turn Up the Zinc

Predicting zinc recovery at McArthur River Mine

Simplified process flow:

- *Blue: Input variables (`*.input.*` columns in dataset)*
- *Green: Process state variables (`*.state.*` columns)*
- *Orange: output variables (`*.output.*` columns - withheld for scoring)*
- *Red: target variables (`*.*.recovery` columns - withheld for scoring)*

Rougher feed

Feed size (micron)

Feed rate

Feed composition:

Zn, Pb, Fe, Sol (%)

Rougher additions

Additions to both float banks (l/min):

- CuSO4
- Xanthate

Rougher Process

For two parallel float banks, for each cell we have:
- air amount
- fluid levels

Rougher tails

Tail composition:
Zn, Pb, Fe, Sol (%)

Rougher concentrate

Concentrate composition:
Zn, Pb, Fe, Sol (%)

Cleaner feed

Feed size (micron) from regrinding of rough concentrate

Cleaner additions

Extra additions to cleaner feed:
- CuSO4
- Xanthate
- Depressant

1° Cleaner Process

For each floatbank, for each cell:
- air amount
- fluid levels

1° cleaner tails

Tail composition:
Zn, Pb, Fe, Sol (%)

1° Cleaner concentrate

Concentrate composition: Zn, Pb, Fe, Sol (%)

2° Cleaner Process

For each floatbank, for each cell:
- air amount
- fluid levels

2° Cleaner tails

Tail composition:
Zn, Pb, Fe, Sol (%)

Final tails

Final concentrate

Rougher Zn recovery

Final Zn recovery

Rougher and final recoveries are calculated as

$$R = 100 * C * (F - T) / (F * (C - T))$$

where F is the rougher feed zinc concentration, and C and T are the concentrate and tail zinc concentrations respectively.

The Problem

- Estimate 2 values (Rougher Recovery, Final Recovery) from 80+ inputs
- Supervised learning
- Some time dependence/state
- Recovery = 100 * C * (F-T) / (F * (C - T))
    - C = concentrate
    - T = tailings
   - F = Feed

Scoring

- Public leaderboard, 5 submissions a day
  - Based on 1 month data
- Private leaderboard - the final score, only revealed after comp finished
  - Based on 1 different month data
- Cash prizes!
- Big shakeup in final order

Results...

	Team	Location	Attempts	Best Score	Last Score
	Public Leaderboard **Private Leaderboard**				
1	Brass	🇷🇺	56	4.63898	5.34458
2	forlulz	🇨🇦	69	4.68505	4.69438
3	Newcomer	🇨🇳	22	4.84765	4.88775
4	🙆🙆 name? 🙆🙆	🇦🇺	63	4.86797	4.86797
5	Couching Tiger	🇦🇺	74	4.89997	5.08383

	Team	Location	Attempts	Best Score	Last Score
1	DL	🇸🇬	8	5.10572	5.57354
2	MWA	🇦🇺	20	5.11123	7.76025
3	forlulz	🇨🇦	69	5.13869	6.21528
4	Couching Tiger	🇦🇺	74	5.13869	6.29411
5	AnalogCoffee	🇨🇦	54	5.17438	5.77845

Public Leaderboard | **Private Leaderboard**

Lessons Learnt

- Jupyter notebooks are easy to run, but require discipline to use scientifically.
  - Good file naming is a good start
    - BigMoLin256WholeS2T6bn3.csv
  - Think about a system early.
- Entering often is an unfair advantage, so use it
- Have a go - you will get something out of it - even if it is not financial

Let's look as some code...

https://github.com/cyency/zinc-recovery

Conclusions

- Find a system to work with notebooks
- Trust your instincts
- Give yourself an unfair advantage
  - You make your own luck
- Learn by doing