Blue Book for Bulldozers

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Problem - description

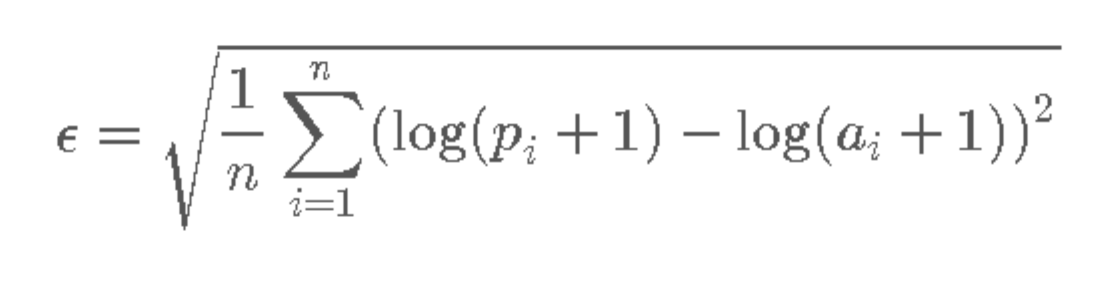
- https://www.kaggle.com/c/bluebook-for-bulldozers
- The goal of the contest is to predict the sale price of heavy equipment at auction

Source data

- all data are stored in simple csv
- but there is huge amount of noise in these data
  - some bulldozers are made in year 1000
  - different YearMades attached to the same MachineID
  - strange MachineHoursCurrentMeter values
    - example:
      - SalesID 2318649
      - Value 2 483 300
      - Year made 2005
      - (2013-2005)*24*365 = 70 080 :)

Evaluation

- Root Mean Squared Logarithmic Error ("RMSLE")



$$\epsilon = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\log(p_i + 1) - \log(a_i + 1))^2}$$

- p_i - your predicted value
- a_i - real value
- n - count

Source data - relevancy

- show excel description
- is fork type or transmission relevant for final price ?
- how can we find out ?
- can we find it out manually or using some magic machine learning ?

Possible solutions

- Question-form
  - FHS style
  - ask people in Prague
- Genetic programming
- Neural networks

Statistics - observations

- 3/4 only once
- one piece sold 26 times
- data aren't complete
-

Statistics - solution

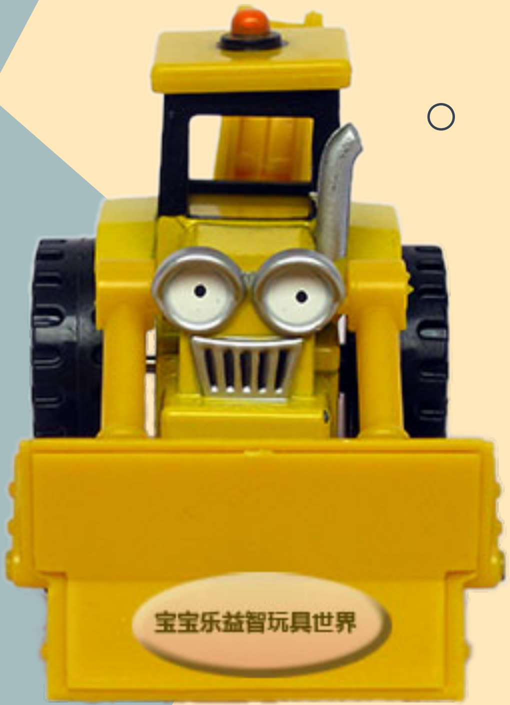
- Regression
    - According to observation linear is not enough
    - Polynomial is needed
        - grade about 3-4 will be enough

Statistic - what's completed

- Parsing script
- Analyzing scripts
- Observation picture diagrams generator
  - Currently running in lab

Solution?

- We don't know how to solve this problem
  - Let's cultivate the solution -> **genetic programming**
    - The buyer will be product of evolution
  - Inspiration / literature:
    - Tomáš Křen: Genetic functional programming presentation
    - Genetic programming research group http://www.genetic-programming.com



Genetic programming

- Population
    - Member = **Price calculation function**
        - Tree of functions :: [Price] -> Price
            - Arithmetical / logical / load / SQL history aggregation
    - Fit function = difference from actual price in DB
        - same as the official
    - Reproduction
        - Switch subtrees on random layer
        - ... picture diagram
    - Mutation
        - change function in specific node

Genetic solution - data

- Input data (training data)
  - Structured in SQL database
  - Special nullary function nodes access the data
  - Bulldozers table
    - Stores known bulldozers specification and price
- Input object
  - Bulldozer for auction
  - Structure = database table row without price specified
    - [Int] numeric values
    - [Enum] enum values

Genetic solution - node functions

- Constant
  - :: Price
- Arithmetical
  - Classical operations
  - :: [Price] -> Price
    - Price is numeric type - double/real
- Logical
  - if-then-else
    - <, <= ...
  - :: [Price] -> Price

Genetic solution - node functions

- Load
  - :: Price
  - Loads specific cell from input object
    - number value
      - mask as price and returns for next operation (usually arith.)
    - enum value
      - mask as price for only logical functions
- SQL Aggregation
  - :: Price
  - Selects from history database values
    - using aggregation function (count, max, sum...)
    - using **where** based on input object

Genetic solution - convergence

- Solution is very generic
    - Needs optimizations, heuristics, constraints...

Genetic solution - subproblems

- Not all data columns are dependent
- Split price calculation by column groups
  - k separated evolution runs with smaller members]
    - using only few columns for loading and sql agg. functions
  - One small function for aggregation
- Columns
  - globals
  - specials
  - ... picture diagram

Genetic solution - confidence

- During the process is calculated confidence of returned price
  - effects final aggregation
  - effects selection in evolution process
- Example
  - confidence is low when database history doesn't contains data similar to input object

Genetic solution - constraints

- Constants
    - Take from final universum
        - example: equally taken subset of [0,1]
- Type constraints
    - Input object
        - arithmetical operations for number values
        - for enum values only logical
            - special switch
- Generic
    - Max deep

Genetic solution - heuristic

- Startup population member
    - Not only random generated
    - Based on human racional guess
        - From SQL agg. uses only avg, median...
    - Based on other team member's results
- Small column groups

Genetic solution - what's done

- Team foundation server
- Generic node abstraction
- Arithmetical nodes
- Data parsing in SQL

Jakub's presentation

http://www.youtube.com/watch?v=SJI5v9QoPus