Bulldozers II

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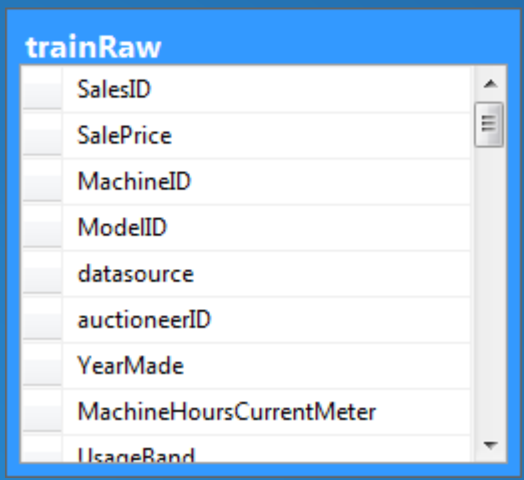
Building database

- CSV -> SQL
  - Table trainRaw
    - 1 : 1 parsed csv data input

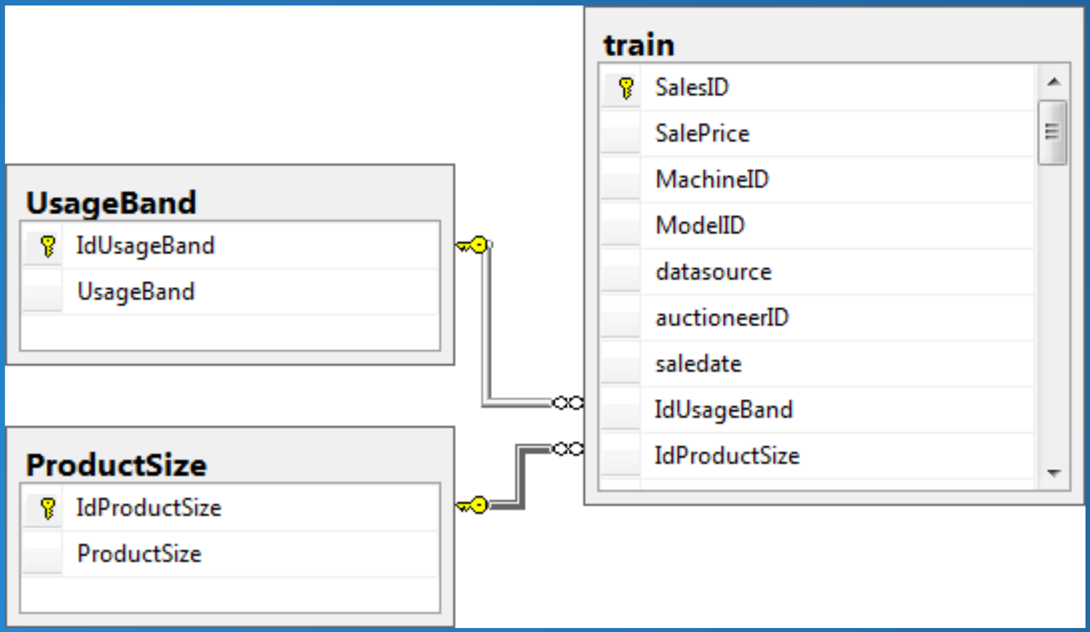


Building database

- table trainRaw
  - Columns need transformed into the form for effective use
  - Foreach column:
    - Distinct analysis
    - String data into separate table
    - Replace with int indexed value
    - Create relation constraint

Structuring database

- trainRaw -> train table
  - fast access to data
  - useless data in detached tables



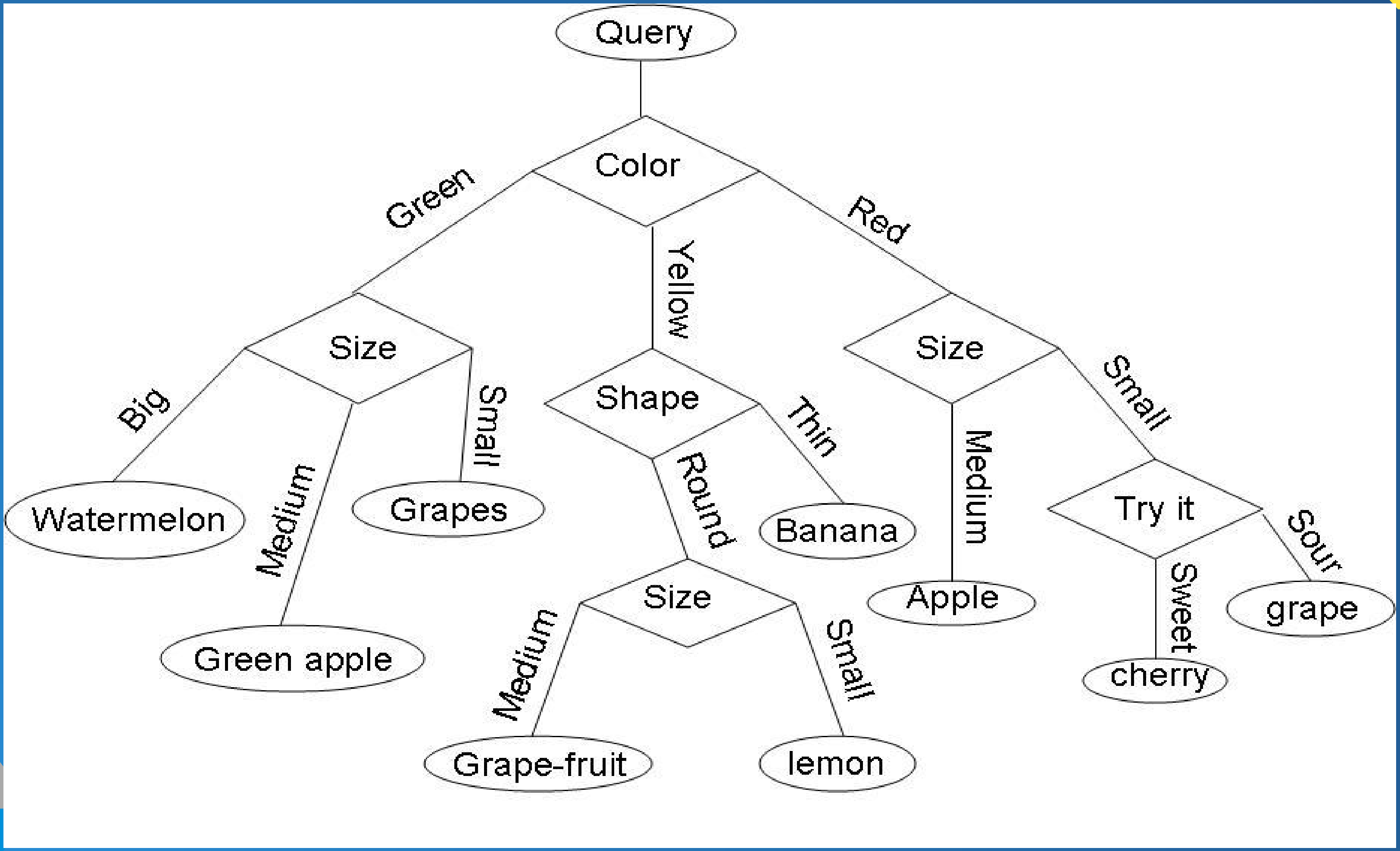
Using database

- SQL stored & compiled procedures and functions for data analysis
  - getBestEnum
  - GetMedian
  - GetAvgVar

First solution - Decision tree

- solution for generic categorization problem
- category
  - = price interval
- tree nodes
  - switches for Enums

Decision tree - example



Our data

- 39 different enums
- avg value range = 10
- choosing best enum for node
  - Variance vs. Count
  - counted in sql
    - first iteration takes ~10 min

Categories

- how big ?
    - no categories
    - fix size
        - according to fit function is $100 ok
    - variable size
        - 100 bulldozers for cat
    - use some genetic to find best size :)

Decision tree results

- depth 4
- runtime 2:34:02
- result 0.5431

To do

- don't use irrelevant enums
- sql optimizations
- multi core processing
- find some very strong Machine

Statistics

- Some columns give no usable information
- About half columns are machine type specific

Second solution - genetic

- Population member
  - Expression tree
    - Evaluates price
  - Nodes
    - [Price] -> Price
    - Constant, Arithmetic, Sql Aggregation, Switch
- Fit function
  - Challenge official: RMSLE
- Reproduction
  - switching subtrees between father and mother

Second solution - genetic

- Mutation
  - Specific per node type
    - Only few types can mutate
  - Random added members
    - Avoids of local extremes

Genetics - use & experience

- Original input parameters
    - Population size
        - Very large is not needed
        - For performance
        - Actual value 50 members
    - Max depth
        - For performance and convergence
        - 10 seems to be enough, actual value 12
    - Train data sample
        - Size
            - Performance & miscellany, actual 25%
        - Select every generation / Keep same

Genetics - use & experience

- Added parameters
  - Min depth
    - Avoidance of
      - One-node trees
      - Train data specific expressions
  - Action probabilities
    - Reproduction
      - Makes variety, actually 0.6
    - Clone
      - Not important, actually 0.3
    - Mutation
      - Important is high value, actually 0.7
      - Helps with convergence
      - Needs to upgrade in several node types

Genetics - use & experience

- Node type implementation & specific tuning
  - Abstract node
    - Mutation is called recursively to children
  - Constant
    - Finite universum
      - { k / 100 | k in **N** U {0} & k < 101 } U { pi, e }
    - Mutation
      - **+ d** where d is from {-0.01, 0, 0.01}
  - Arithmetic
    - +-*/ only binary

Genetics - use & experience

- Node type implementation & specific tuning
  - SqlAgg
    - Defined by agg. function and selected data columns
    - Returns aggregated price of database table rows what have same values in selected columns
    - Mutation changes agg. function
      - Maybe change of selected column is needed
  - Switch
    - Defined by one data column
    - k children
      - k is loaded only once by column variety

Genetics - use & experience

- Evolution process implementation
  - For every generation
    - Selection
    - Reproduction & cloning
    - Mutation
  - Evaluating train data sample by each member
  - Fit calculation
  - Best one serialisation
  - GC.Collect()
- Genetic process is very slow
  - Threadpool implemented
    - by member

Genetics - results

- First whole night run on full train data
  - 294 generations
  - Best result fit **0.49** (381 / 454)
    - Challenge leader has 0.22
    - Median benchmark has 0.74
  - Lesson
    - Min depth constraint
      - Very simple data specific nodes broke population development
    - Smaller train data sample
      - More data-specific results and more performance
    - More mutation
    - More sql query parallelism
    - Sql results caching

Genetics - example

Neural networks

What have we tried?

- single MLP
- 10 classes of equal magnitude
- 18 / 51 features
- network structure 18 - 10 - 10

Neural networks

What have we tried ?(cont.)
- backpropagation learning algorithm
- different minimization techniques
  - gradient descent
  - conjugated gradient ((C) Andrew Ng)
- different values of regularization
- different training set sizes

How did it go?


Science
nature
LOOKING GOOD
Daily
Journal of Negative Data
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Actual results

Best experiment:

- trained 10000 samples
- 50 iterations of Conjugate gradient
- classification *accuracy* on all training data:

0.224

RMSLE on Validation data:

0.773

(mean benchmark: 0.74745)

What went wrong?

Non-numerical features
- overall: 8 comparable features
- 43 non-numerical features

Missing features
- not all features are available for all samples
- sometimes less than half
- => inaccurate guesswork

Time constraints
- not trained on all data (100k samples ~ 1 night)

What do we do about it?

Non-comparable features
- set up indicator variables

Missing features
- better guesswork (mean of class)

Further work

- multiple MLPs + agreement algorithm
- vary amount of classes
- vary class size
  (equal magnitude vs. equal width)
- more detailed (class -> price) conversion
- different cost function
  - factor in cost of misclassification
- different learning algorithm?