CART:
Classification and Regression Trees

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Outline

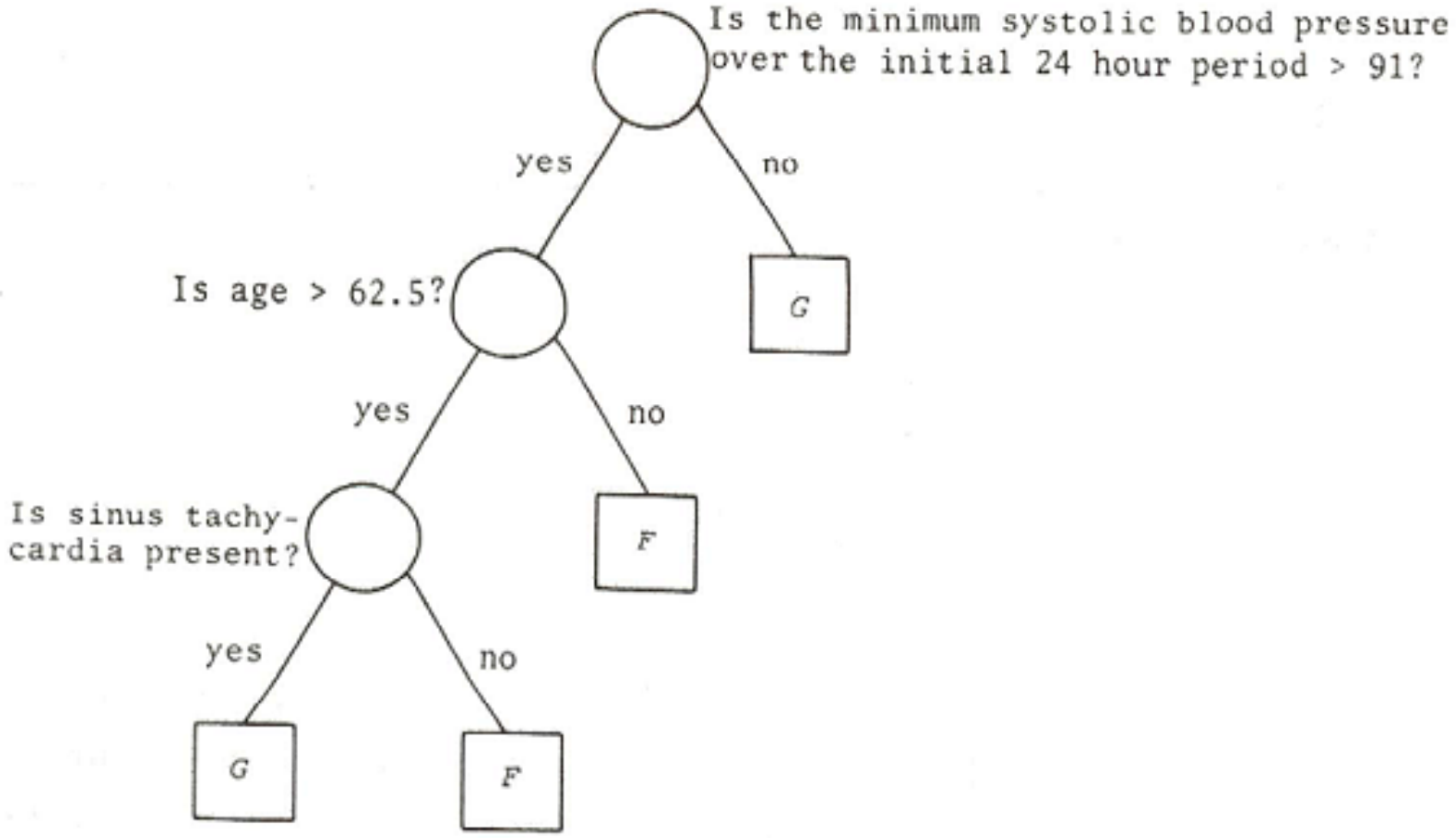
- Purpose of CART
- Background
- Why use CART?
- Splitting Rules
- Developing a Classification or Regression Tree
- Missing values

Purpose of CART

- “The CART decision tree is a binary recursive partitioning procedure capable of processing continuous [regression] and nominal [classification] attributes as targets and predictors.” (Top ten algorithms)
- Recursive:
  using a rule or procedure that can be applied repeatedly

Background

- *Classification and Regression Trees*
- Leo Breimen
- Richard A. Olshen
- Charles J. Stone
- Jerome H. Friedman
- UCSD Heart Disease Study



F ➡ Not high risk G ➡ High risk

Why use CART?

- Originally designed to mimic thought process of a doctor when diagnosing a patient
- Easy to create tree (software creates tree using given data)
- Easy to understand result

Splitting Rules

- The Gini coefficient determines which variable to split node on.
- $G(t) = 1 - p(t)^2 - (1 - p(t))^2$
  - p(t) is the possibility of having 1 "class" in a node t.
- The Gini coefficient ranges between 0 and 1.
- Reaches a value of zero when only one class is present at a node
- An instance goes left if CONDITION, and goes right otherwise.

Developing a Classification or Regression Tree

- Divide data into test and training sets
- Root Node
- Binary split using Gini- value closest to zero.
  - Entropy is an alternative
- Continue to split until no other data is available.
  - Gives maximal tree.
- Prune- using cross validation (test data)
- gets rid of nodes that do not contribute to lowering error
  - Avoids overfitting
  - Gives optimal tree

Missing values

- Surrogate split- if optimal splitting value is missing, the value with the “highest measure of predictive association” with the optimal value is used

Re-cap

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sources

- http://people.hofstra.edu/geotrans/eng/ch4en/meth4en/ch4m1en.html
- http://www.statsoft.com/textbook/classification-and-regression-trees/#details
- http://filipspagnoli.wordpress.com/2008/05/05/human-rights-facts-4/
- Dictionary.reference.com