Introduction

Treatment Considerations
- who is Alice? (black swan theory)
- missing information
- Alice’s medical history
- nature of the prescription
- who is administering the drug?
- knowledge & time constraints

Objectives
- patient-centric evidence-based medical decision support
- tolerant to noise in patient data → information challenge
- automated machine-processable decision making
- operates in constraint environments
- decisions are easy to explain & verify

Proposed Construction

1) Knowledge-based Decision Support System
- structured data representation (knowledge base)
- expert knowledge → inference rules
- mimics human thinking
- heuristic based, evidence based etc.
- reasoning capability (inference engine)
- decisions are based on rules (axioms) and can be easily explained
- decisions are easy to verify/validate
- quite powerful & robust
- only when knowledge-base is complete

2) Learning-based Decision Support System
- learns from raw data and past past examples/cases
- patterns in the clinical data
- utilizes machine learning techniques
- requires training process to create inference models
- - training is specific to a line of inquiry
- - training is expensive
- - system decisions are often hard to explain & verify
- - tolerant to noise in data
- effective in finding latent relationships between data attributes

Holmes
- automatizes reasoning
- using semantic knowledge representation and inference
- system-made decisions are easy to verify & explain
- extremely tolerant to noise in data
- suitable for a diverse set of medical personal & settings

Architectural Components, Knowledge Representation and Automated Reasoning


Result Summary

1. Machine learning techniques performed poorly on their own to be used as the decision support engine.
2. Performance of the knowledge-based solution (OMeD) degrades quite rapidly as data “missingness” increases.
3. Ada-Boost based classifier is very resilient to data “missingness”.
4. The hybrid construction of Holmes is noise resilient and performs better than both OMeD and the best machine learning classifier.

Step 1: Selection of a machine learning algorithm for BRFSS

Training Performance with SGB Training Examples

Test Performance with SGB Training Examples

Step 2: Impact of data “missingness” on the selected machine learning algorithm

Result: (a) in general machine learning techniques perform poorly.
(b) AdaBoost classifiers performs the best

Step 3: Performance of the Hybrid Solution (Holmes Vs. OMeD)

Result: AdaBoost classifier performance is highly tolerant to noise in data