

Information Systems in Healthcare – Michel Kana, PhD - Homework

Solution by Katarzyna Dunikowska

1. Elaborate on the computing techniques underlying clinical decision support systems (Rule-based(expert) systems, Artificial neural networks, Bayesian networks, Model based systems, Data mining, Genetic algorithms).

Decision support system (DSS) is a powerful tool which can be used to support decision makers in making strategic decisions.

Rule-based(expert) system is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge.

A classic example of a rule-based system is the domain-specific expert system that uses rules to make deductions or choices. For example, an expert system might help a doctor choose the correct diagnosis based on a cluster of symptoms.

Artificial Neural networks can be employed as data analysis tools for forecasting and prediction based on historical data in a data-driven DSS. Artificial neural networks are computational models inspired by animal central nervous systems that are capable of machine learning and pattern recognition.

Artificial neural networks can be considered to play the role of the "quantitative model" in model-driven decision support systems. Five categories based on the dominant component of the decision support system: communication/group-driven, data/document-driven, knowledge-driven, model driven, and web-based/inter-organizational decision support systems.

Bayesian networks is a probabilistic graphical model that represents a set of random variables and their conditional dependencies via a directed acyclic graph. For example, a Bayesian network could represent the probabilistic relationships between diseases and symptoms. Given symptoms, the network can be used to compute the probabilities of the presence of various diseases.

Medicine has so far been the most popular field for the application of Bayesian networks. Bayesian network methods have been applied: diagnostic reasoning, prognostic reasoning and treatment selection, and the discovery of functional interactions.

Model based systems which uses individualized computational models of human pathophysiology to model the dynamics of a wide variety of tissues and organs. Integrated into CDSSs it has a potential to even further improve diagnosis and optimize clinical treatment by predicting outcomes of therapies and surgical interventions. It is being pursued in well-funded projects, like the Virtual Physiological Human initiative.

Data mining an interdisciplinary subfield of computer science, is the computational process of discovering patterns in large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics, and database systems. The overall goal of the data mining process is to extract information from a data set and transform it into an understandable structure for further use.

Data mining is well suited to provide decision support in the healthcare setting. Healthcare organizations face increasing pressures to improve the quality of care while reducing costs. Because of the large volume of data generated in healthcare settings, it is not surprising that healthcare organizations have been interested in data mining to enhance physician practices, disease management, and resource utilization.

Genetic algorithm is a search heuristic that mimics the process of natural selection. Genetic algorithms belong to the larger class of evolutionary algorithms, which generate solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover. There are many benefits of genetic algorithms. One of the major advantage is that a genetic algorithm almost always guarantees finding some reasonable solution to problems, particularly those that we have no idea how to solve. Another benefit is that genetic algorithms tend to arrive at a solution much faster than other optimization techniques.

2. Create your own clinical decision rule in our test system following the below guidelines:

http://open-emr.org/wiki/images/c/ca/Clinical_Decision_Rules_Manual.pdf

<http://smsos.fbmi.cvut.cz/openemr>

Patient: Ms. Anna Julia Brown

1. Handbook on Decision Support Systems 1, Basic Themes
Authors: Frada Burstein, Clyde W. Holsapple
2. Data Mining and Clinical Decision Support Systems
J. Michael Hardin and David C. Chhieng
<http://cs.engr.uky.edu/~goldsmi/cdm/DMCDSS.pdf>
3. "Clinical decision support systems"
Eta S. Berner