# Using Java™ Technology-Based Neural Networks to Predict Trauma Mortality

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# Goal of This Presentation

## What you can expect to gain

Learn how a real world problem was tackled using Java technology-based neural networks, harnessing the power of distributed processing using Java technology

# Agenda

Research Overview

Overview of the NTDB

NTDB Coverage

Overview of Neural Networks

Justification for a Java Technology-Based Neural Network

Survey of Java Technology-Based Neural Network Implementations

Criteria for Selection of the Neural Network

# Agenda

Overview of the JOONE Framework

Neural Network Using JOONE

Topology of the Distributed Computing Environment

Lessons Learned During Development and Implementation

Future Research Directions

Summary

Q&A

# Research Overview

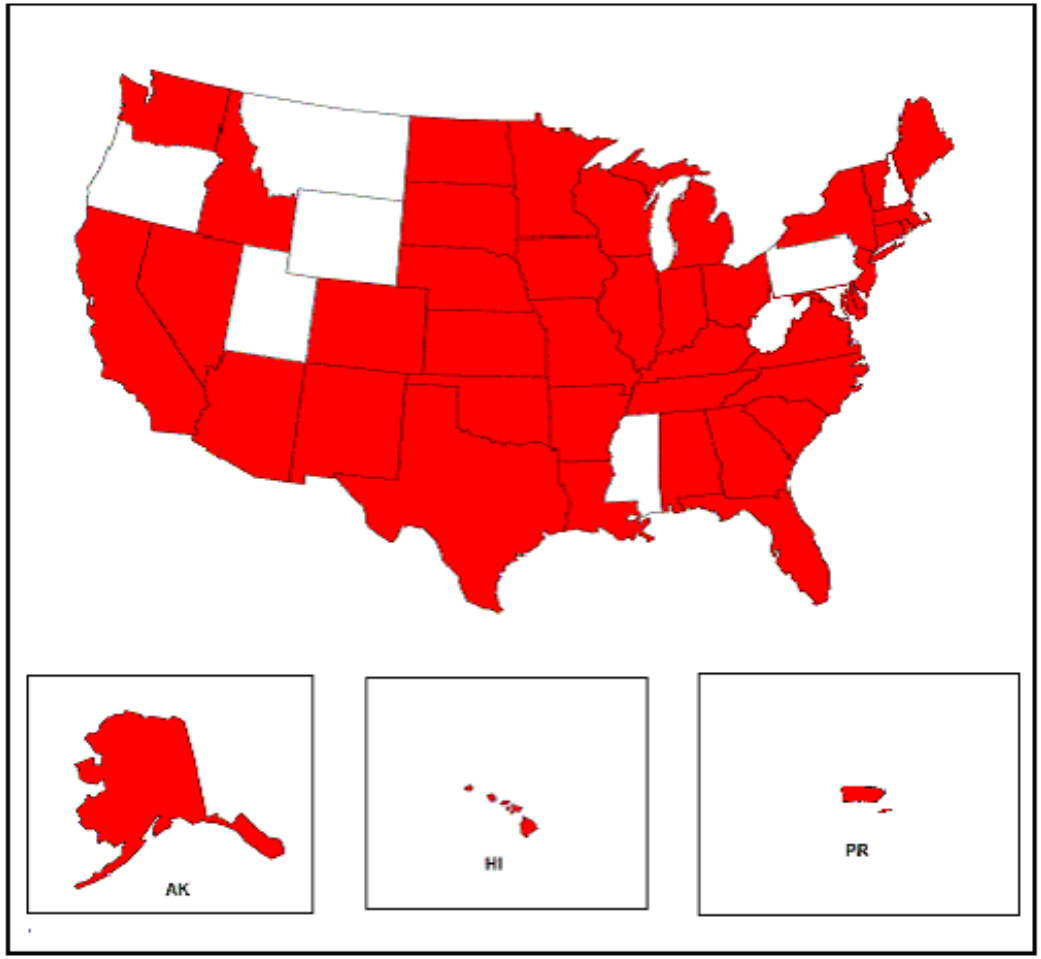
- Prediction of mortality in trauma cases is usually based on the experience of an individual physician
- It is impossible for any single physician to review every actual trauma case and find/conceptualize patterns within the data
- The idea of our research is to apply the power of a distributed neural network to analyze all available trauma data
- Our end goal is to create a tool that can assist physicians with making better decisions

# Overview of the NTDB

- The National Trauma Data Bank (NTDB)
  - Established by the American College of Surgeons
  - NTDB Contents:
    - Over over 1.5 million trauma records
    - Collected from over 400 trauma centers
    - Data includes trauma scores, vital statistics, specific injuries
  - Purpose is threefold:
    - Quality assurance
    - Research
    - Public policy
  - The NTDB maintains full patient and physician confidentiality

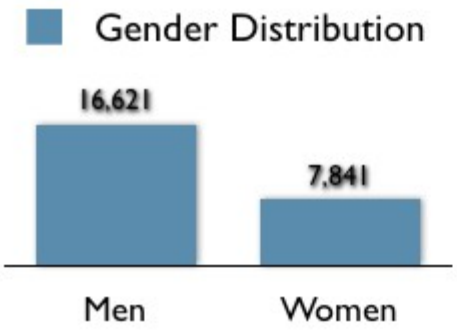
http://www.facs.org/trauma/ntdbwhatis.html

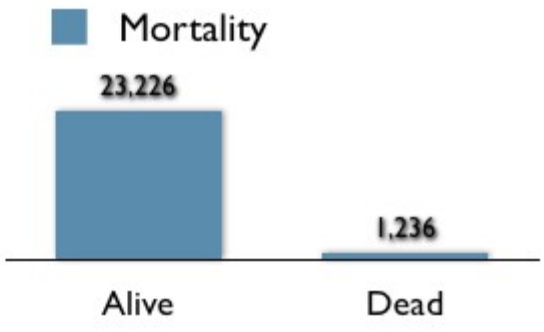
# NTDB Coverage

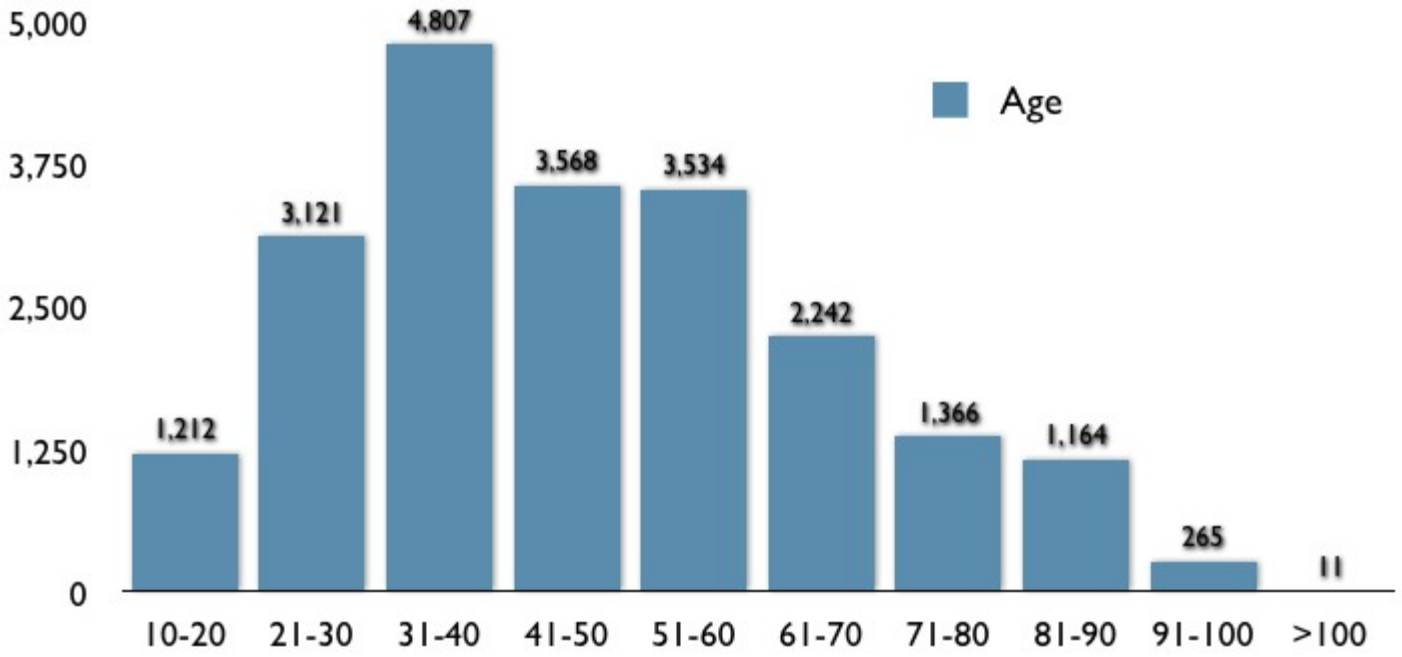



http://www.facs.org/trauma/ntdbwhatis.html

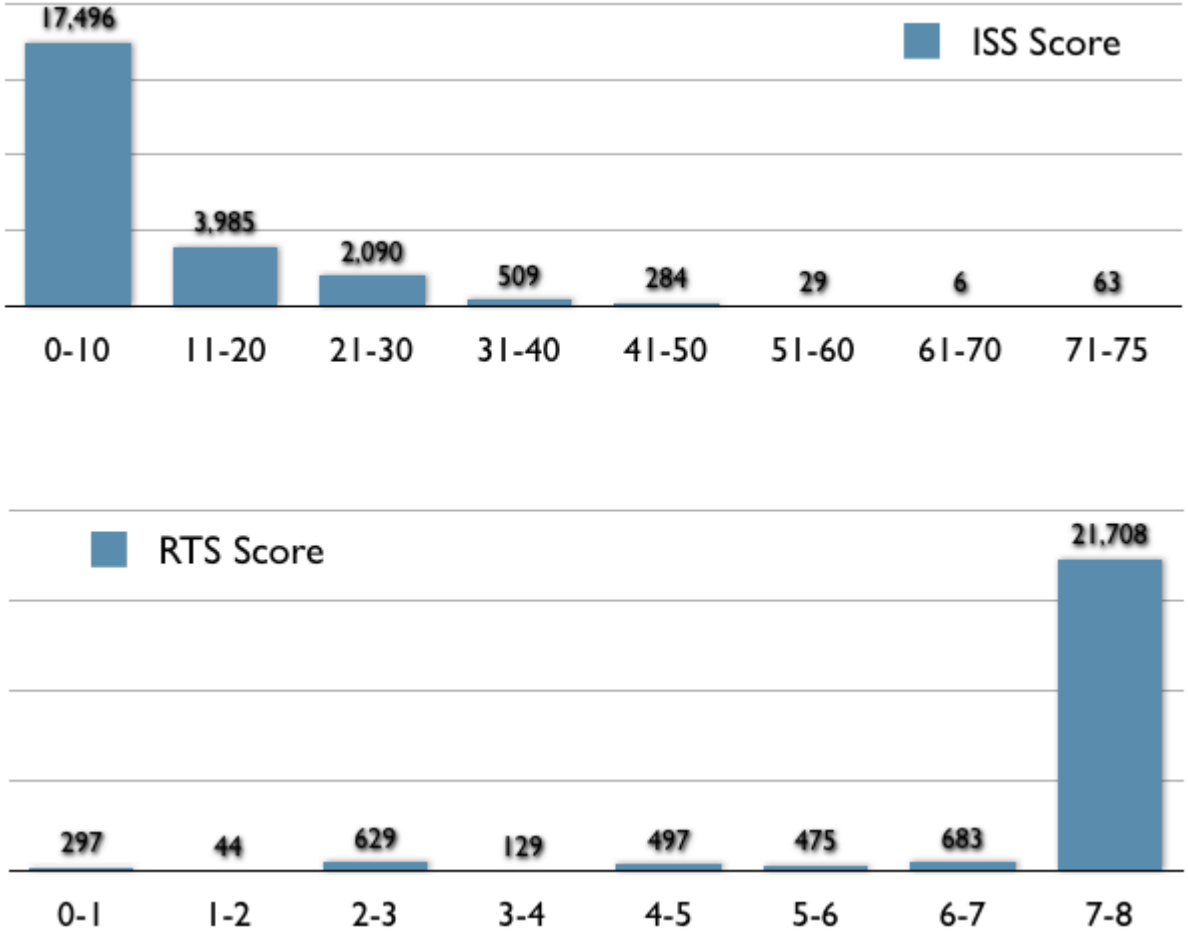
# Patient Demographics



# Trauma Demographics



# Overview of Neural Networks

## Neural Network Basics

- Definition: a computer system that loosely attempts to approximate the operation of the brain
- A neural network is modeled as layers of neurons connected via synapses as simple processing elements based on statistical functions
- A neural network must go through a training period before if can be effectively used
- Neural network architectures
  - Single layer networks
    - Adaline, Perceptron or Backpropagation
  - Multi-layer networks
    - Multi-layer Perceptron, feed forward back propagation, hopfield networks, Kohonen Self Organizing Maps (SOM)

# Justification for a Java Technology-Based Neural Network

(Other than just because it's Java technology!)

- Need to leverage the power of distributed computing to compute the neural network output and find the optimal network for a given problem
- Java technology is "write once, run anywhere™"
  - The same neural network will be able to run on basically any hardware
- Java technology has a wide variety of built-in Networking capabilities
  - RMI, Java RMP, NIO
  - Jini™ and JavaSpaces ™ technologies

# Survey of Java Technology-Based Neural Networks

- JOONE
  - http://www.jooneworld.com
- http://www-ra.informatik.uni-tuebingen.de/software/JavaNNS/welcome_e.html
- OpenAI
  - http://openai.sourceforge.net/
- JMSL Numerical Library for Java Technology-Based Applications
  - http://www.vni.com/products/imsl/jmsl/jmsl.html

# Criteria for Selection of the Neural Network

- Open source
  - Ability to review the source code
  - Ability to extend the base implementation as necessary
- Widely used
  - Potentially better quality software
  - Groups to talk with and troubleshoot problems with
- Well documented
  - Easier to get started using the software
  - Shows maturity of the software
- Distributed networking capabilities
  - Ideally have the ability to train many networks in parallel

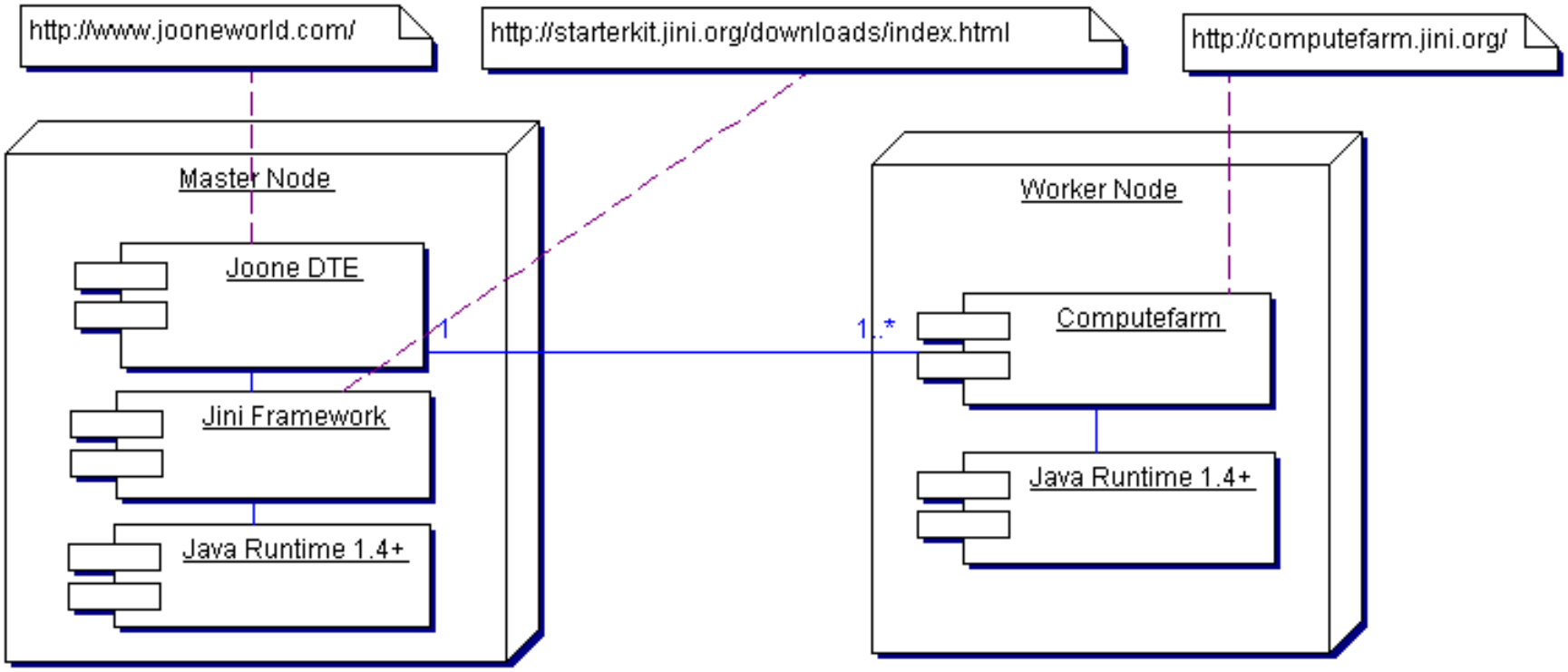
# Overview of the JOONE Framework

- JOONE is a free neural network framework
- Available at: http://www.jooneworld.com
- JOONE consists of:
  - API to the core engine
  - GUI editor
  - Distributed Training Environment
- JOONE is open source
- JOONE is widely used
- JOONE is well documented
- JOONE includes a Distributed Training Environment which leverages the Jini technology framework

# DEMO

## Neural Network Using JOONE

# Topology of the Distributed Computing Environment



# Lessons Learned During Development and Implementation

- Data access
  - Problem: The amount of time it takes to access data can be significant with a large sample size
  - Solution: Don't try to load all of the data at once, and use memory mapped data when performance is absolutely critical

# Lessons Learned During Development and Implementation

- Inability of the neural network to justify its predictions
  - Problem: The trained network can be used to make a prediction of the mortality of a case, but due to the nature of the neural network, it cannot justify how it comes to that particular decision
  - Solution: Other forms of neural networks are better able to “explain” their reasoning, so we need to investigate other neural network forms

# Lessons Learned During Development and Implementation

- Missing data
  - Problem: In our data set, it is fairly common to have incomplete data regarding a trauma case
  - Solution: Use the expertise of a statistician to impute values
    as necessary, but in a manner that doesn't statistically alter
    the results

# Lessons Learned During Development and Implementation

- Duplicate data
  - Problem: In our data set, it is possible for two patients to have the exact same vital statistics and injuries, but ultimately have different outcomes
  - Solution: Use the expertise of a statistician to determine what records should be used and which may be omitted without statistically altering the results

# Future Research Directions

- Investigate alternate neural network architectures
  - Bayesian Networks
- Apply our knowledge to other data sources
  - Hospital-specific databases
  - Specialized databases
  - Other forms of medical data where the quantity of data available overwhelms the ability of a human to analyze it

# Summary

- Research and NTDB overview
- Neural networks in Java technology
- The JOONE framework
- Distributed computing using Jini technology
- Lessons and future research directions

# For More Information

- The National Trauma Data Bank (NTDB), http://www.facs.org/trauma/ntdb.html
- The JOONE Framework, http://joone.sourceforge.com
- Jini Community℠ Website, http://www.jini.org
- Fundamentals of Neural Networks, Laurene Fausett, Prentice-Hall, Inc. 1994
- Neural Smithing, Russell Reed and Robert Marks II, MIT Press, 1999

# Q&A

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