

Introduction: [Did He Do it?](#)
“Evaluating Evidence Using Bayesian
Networks” *

L.G. de Pillis and A.E. Radunskaya
Student Assistants: Dani Mata, Tony Sevold, PO('05)

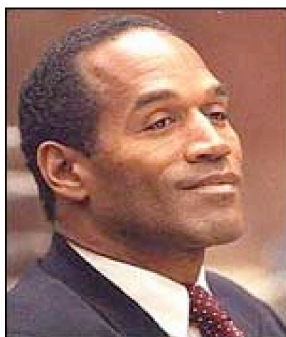
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Most people have heard about the OJ Simpson case, which took place in the summer of 1994. Simpson had been a famous professional football player, considered by some to have been one of the greatest running backs in American football history. He had won the Heisman Trophy in 1968 and had the most rushing yards gained in one season, most rushing yards gained in a single game and most touchdowns scored in a season. But now he was accused of killing his ex-wife and her friend, Ronald Goldman, by stabbing them both to death. When police first tried to talk to Simpson there was a bloodstain on the door of his car, and a trail of blood that led to his house, and when they finally got to talk to him he had a cut on his left hand. By this time crime scene analysts had already collected multiple blood samples from the crime scene and they had identified blood from both the victims but they also found blood that belonged to the killer, which made Simpson's cut look very suspicious. So after a few weeks the LA County Police Department charged OJ Simpson with the murder of Nicole Simpson and Ronald Goldman. At the time, it seemed clear to the prosecution that with the large amount of forensic evidence against OJ Simpson and the peculiar way he had been acting (see Additional Information) that he was guilty. However, Simpson hired an expensive defensive team of lawyers that focused the case not only on racial issues but also claimed that the DNA evidence was mishandled and therefore unreliable. The defense claimed that the blood evidence from the

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scene was, first, planted, and then secondly, contaminated. The trial became not only about OJ Simpsons innocence or guilt but the validity of forensic science was also on trial.

The Accused



O. J. Simpson (AP)

The Victim



Ronald Lyle Goldman (AP)

The Victim



Nicole Brown Simpson (AP)

The accuracy of DNA testing and the assumption that the blood could only come from the one offender became very important. When identifying the origin of DNA in paternity tests, the following fundamental theory is used. An individuals DNA profile consists of measurements on several markers, each yielding a genotype which consists of a pair of alleles, one inherited from the father and the other from the mother. It is impossible, however, to tell which allele came from the mother, and which came from the father. This theory can be used at crime scenes when there is mixed trace blood. The alleles can help to distinguish the people who have contributed DNA to the mixture. This module will explore the following problem: Given a DNA mixture at a crime scene and given the DNA of a suspect, how likely is it that the suspect was in fact the offender? You will have to consider possible contamination and whether the fact that the suspect might be a close relative of the offender might affect the analysis. Bayesian networks will be used to model the different scenarios, and to produce likelihoods for the guilt (or innocence) of the suspect. In order to use Bayesian networks, you will also learn the basics of conditional probability and Bayes Rule.

The actual computations of the probabilities can be quite cumbersome to do by hand. Fortunately, they can be also be done using computer software. We provide some sample code written in Matlab, and briefly describe

the algorithms used. There are many other uses of Bayesian networks in criminology, medicine, and other fields. These networks can also be made to “learn, and so provide an example of neural networks used in artificial intelligence. Some references are given in case you are interested in pursuing the topic farther.

References

[1] **[OJ Simpson Background Information:](#)**

<http://www.crimelibrary.com/classics4/oj/>

<http://www.cnn.com/US/OJ/index.html>

<http://www.bobaugust.com/photo.htm> (These are actual Crime Scene Photos, so if you don't like blood, don't go here)

<http://www.bobaugust.com/bronco.htm> (Pictures of blood in Simpsons Suburban)

[2] **[Forensic Science and Probability Background Information:](#)**

[3] Mortera J., Dawid A.P., and S.L. Lauritzen. “ Probabilistic expert systems for DNA mixture profiling”. *Theoretical Population Biology*. 63, (2003), 191-205.

[4] Garbolino, Paolo, and Taroni, Franco. “ Evaluation of scientific evidence using Bayesian networks”. *Forensic Science International*. 125, (2002), 129-155.

[5] Lee, Jae Won; Lee, Hye-Seung; Park, Mira and Juck-Joon Hwang. “ Evaluation of DNA match probability in criminal case”. *Forensic Science International*. 166, (2001) 139-148.