

Bonaparte: Bayesian networks for victim identification on the basis of DNA profiles

W. Burgers¹, W. Wiegerinck¹, C.J. van Dongen², K. Slooten²

¹SNN Adaptive Intelligence, Geert Grooteplein 21, 6525 EZ Nijmegen, The Netherlands

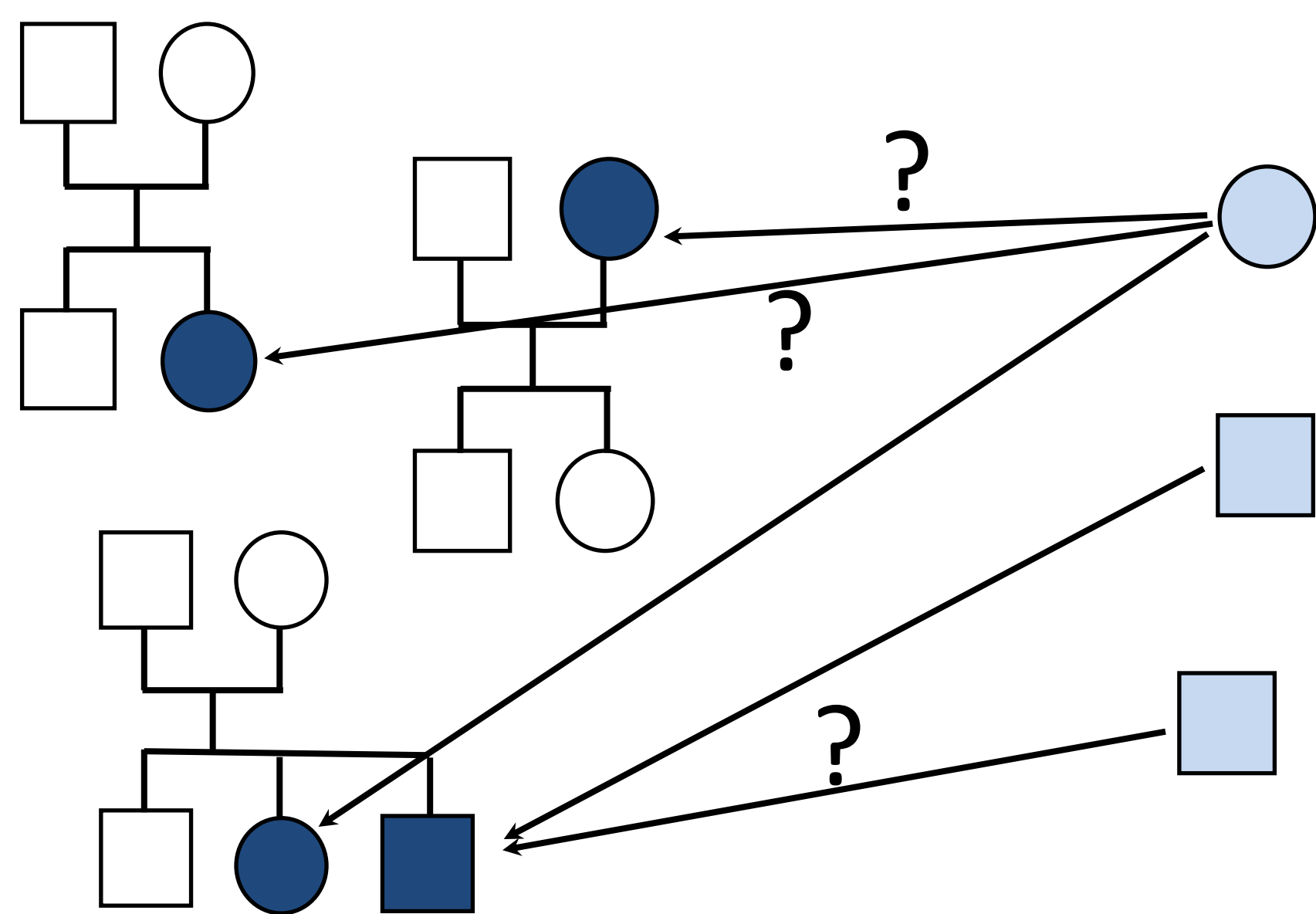
²Netherlands Forensic Institute, Laan van Ypenburg 6, 2497 GB Den Haag, The Netherlands

ABSTRACT

We have developed software to improve screening and matching routine for victim identification based on DNA profiles. The software (“Bonaparte”) uses Bayesian networks for analysis. It is designed for effective handling of the identification process in case of a large disaster with many victims and can be applied in the missing person program.

INTRODUCTION

In Disaster Victim Identification (DVI), the problem is finding matches between lists of pedigrees (which contain profiles from relatives) and lists of unidentified individuals as depicted by the figure below—where yellow indicates an Unidentified Individual (UI) and blue a Missing Person (MP)



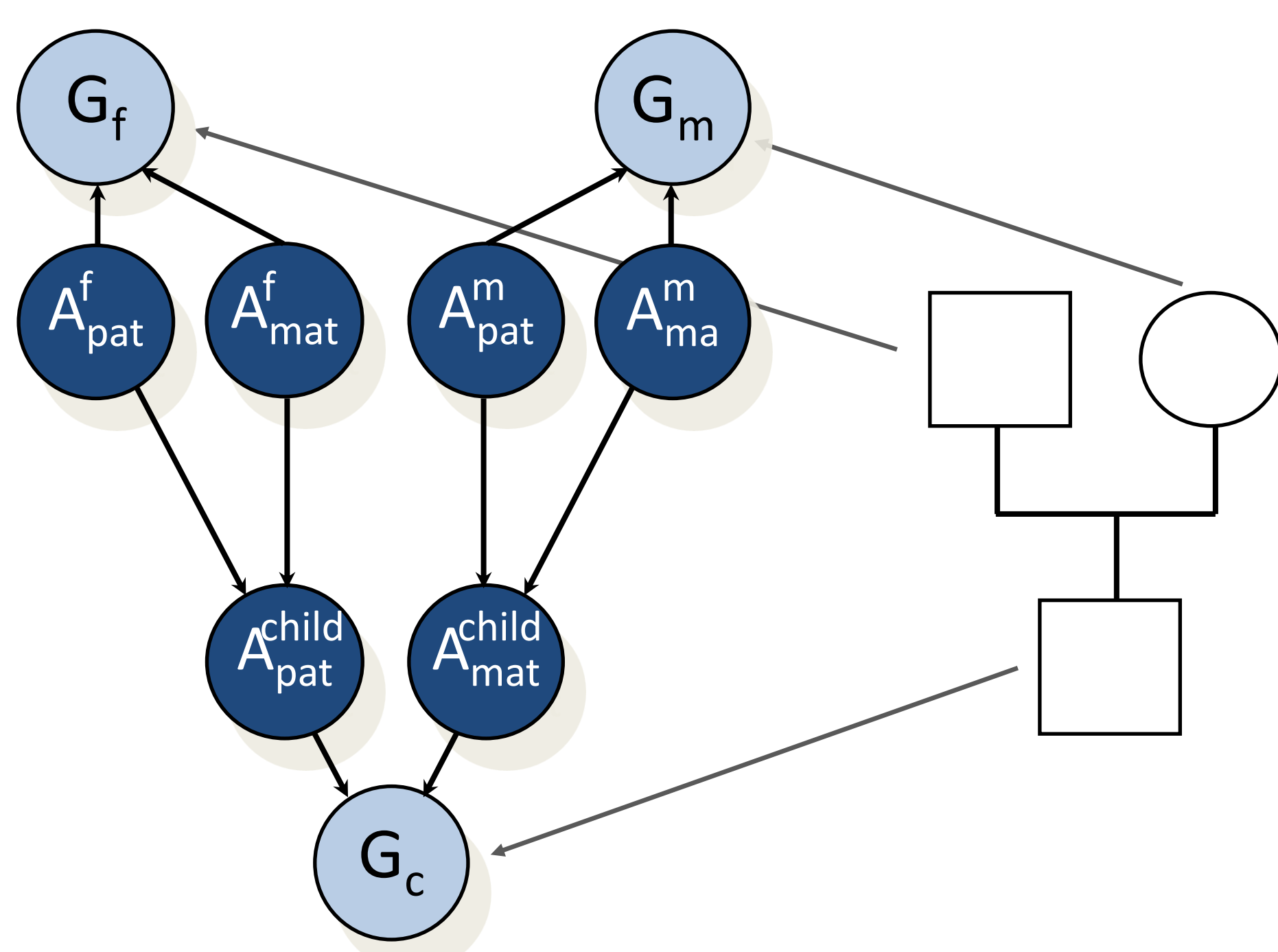
A measure for how well the UI fits in a MP slot (the match) is given by the likelihood ratio (LR)

$$LR = \frac{P(E|H_p)}{P(E|H_d)}$$

H_p (cq. H_d) is the hypothesis that missing person MP is (cq. is not related to) UI; E contains a DNA-profile of UI, a pedigree of which MP is a member and which contains at least one typed relative. Bonaparte uses Bayesian networks to compute these quantities.

BAYESIAN NETWORKS

- Whole pedigrees of relatives of the missing persons are used in the screening phase (fewer false hits)
- Analysis tool is transparent and flexible; easily incorporate other factors such as new models for mutation, size bias corrections, measurement error probabilities, missing data, etc.



2010 TRIPOLI AIR CRASH

On May 12 2010, flight 8U771 crashed upon landing in Tripoli International Airport, Tripoli Libya. Of the 103 victims 70 were of Dutch nationality. The Netherlands Forensic Institute was asked to assist in DVI. Bonaparte was used in the identification process.



Relatives donated 195 reference samples, from which 57 pedigrees were constructed. These pedigrees contained 84 missing persons (no reference material for the 19 others). Bonaparte matched 129 of the 149 tissue samples to missing persons.

SYSTEM

The clients interact with Bonaparte via web browsers. Bonaparte has its own internal database that can be rewind to any point back in time and it also keeps track of object modification (who, when and what). The system can import data from any data source via its XML import protocol, or by using Excel files via the web GUI. Pedigrees can be created using a drag and drop pedigree editor (or imported as XML).

