

WWJMRD 2015; 2(9): 38-48
www.wwjmr.com
Impact Factor MJIF: 4.25
e-ISSN: 2454-6615

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Proposed Expert System for Calculating Inheritance in Islam

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Abstract

The truth of every human being is the end his life with death, and this leads to leaving assets and funds for those after him and can lead to hate between the heirs, it has made a point of Islamic law on all aspects of life, including the subject of the inheritance of the deceased.

The main problem is how to get the knowledge of the basics of inheritance. This paper reviews work done in the use of expert system software to calculate inheritance in Islam. A proposed expert system was designed and developed using CLIPS language to calculate the inheritance in Islam.

Keywords: Rule-based, Expert system, Inheritance, Islamic law

Introduction

The rules of inheritance in Islam are the discipline of obligations of inheritance. The verses in the Quran upon which the rules of inheritance are founded 11th and 12th verses of Surat El-Nisaa of the Quran El-Kareem. They are rendered as follows:-

"Allah instructs you concerning your children: for the male, what is equal to the share of two females. But if there are [only] daughters, two or more, for them is two thirds of one's estate. And if there is only one, for her is half. And for one's parents, to each one of them is a sixth of his estate if he left children. But if he had no children and the parents [alone] inherit from him, then for his mother is one third. And if he had brothers [or sisters], for his mother is a sixth, after any bequest he [may have] made or debt. Your parents or your children - you know not which of them are nearest to you in benefit. [These shares are] an obligation [imposed] by Allah. Indeed, Allah is ever Knowing and Wise.

And for you is half of what your wives leave if they have no child. But if they have a child, for you is one fourth of what they leave, after any bequest they [may have] made or debt. And for the wives is one fourth if you leave no child. But if you leave a child, then for them is an eighth of what you leave, after any bequest you [may have] made or debt. And if a man or woman leaves neither ascendants nor descendants but has a brother or a sister, then for each one of them is a sixth. But if they are more than two, they share a third, after any bequest which was made or debt, as long as there is no detriment [caused]. [This is] an ordinance from Allah, and Allah is Knowing and Forbearing."

The abovementioned basic rules of inheritance are thorough in the next paragraphs.

The belongings of a deceased Moslem is applicable, in the first place, to the expense of his funeral; secondly to the free of his debts; and thirdly, to the expense of legacies as far as one-third of the residue. The remaining two-thirds with so much of the one-third as is not absorbed by legacies are the patrimony of the heirs. A Moslem is, as a result, disabled from disposing of more than one-third of his property by will.

The pure remainder of the state descends to the heirs; and amongst these the first are individuals for whom the regulation has provided definite precise shares or shares and who are thereafter denominated the sharers.

In utmost situations, there should be a remainder after the shares has been fulfilled; and this forwarded to another category of individuals who, under that situation, are named residuaries or 'asaba in Arabic.

It can rarely happen that the deceased should have no individual connected with him/her who would fall under these two classes; but to guard against this possible contingency, the law had provided another class of persons who, by reason of their remote position with respect to the inheritance, have been denominated "distant kindred".

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Inheritance law in Islam has very complicated calculations; most of previous works describe only the theory and frame work, but no application running. Sharia courts are on the top of interest Institutions in Inheritance law.

The purpose of the proposed expert system is to help the concerned people in calculating inheritance.

Literature Review

Expert Systems

With the development of life and massive development of computer technology, the human has become dependent on computers applications heavily in most fields especially that rely on the accounts and required a great speed and the data is very complex for human mind to deal with it.

A. Expert Systems definition

'Legal expert systems' are programs which give advice on the application of the law to a user's particular legal problem [1].

B. Is there any difference between Expert systems and traditional programming?

Of course, Yes. Expert systems are not programmed to follow procedures, as is the case in traditional

programming, but is designed to solve complex problems through the conclusion of knowledge, like a human expert.

C. Domains of Expert systems

Expert systems are used to solve a large number of problems such as decision-making and financial planning, diagnosing diseases[17-35] and in matters of Islamic law such as the appreciation of Zakat [2] and retribution, and these things were all required from human experiences [3]. There is a very good survey paper of expert system (ES) development from 1995 to 2004, support 166 paper on 78 academic journals. [4]

D. Components of an Expert System

- Knowledge base: the representation of expert knowledge, often in IF THEN rules;
- Working storage: hold Specific data to solve the problem;
- Inference engine : derives recommendations from the knowledge base and problem-specific data in working storage;
- User interface: dialog between the user and the system [5].

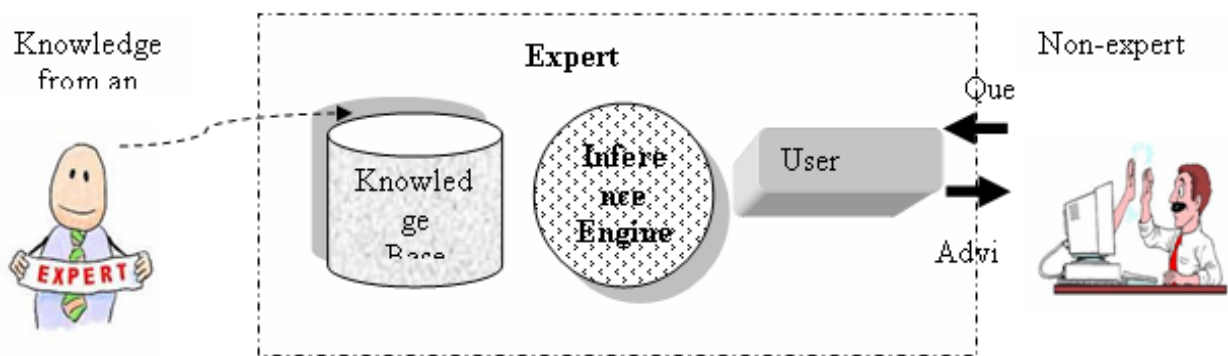


Fig 1: The figure shows the Main Components of an Expert System (Designed by the authors)

Knowledge Acquisition

The used strategies to solicit the knowledge about the laws of Inheritance are through interviews with human expert in the field, questionnaire and case studies.

Inheritance in Islam

A. After Death

The human presence on this earth is for a limited time and must be ended by death, male and female, old and young alike.

Upon the death of an individual estate be divided among his heirs after paying his/her debts and obligations.

B. Beyond the Grave

The human psyche always wants to exercise control even beyond the grave. We try to counsel those who grow up around us, to leave a good memory on us after our death [6,7].

DR Unruh, "Death and Personal History: Strategies of Identity Preservation" 30 Social Problems [8].

There is no more obvious than the commandment law. Knowing that we cannot take our wealth with us, but a lot of us hope at least to control how the use of this legacy after our death [9].

C. Some ways of inheritance' division

To divide the inheritance process there are more than one way, according to religion, according to the customs and traditions and man-made laws [10]. Some of these laws bequeath only males without females, including female inheritance without a male, which is also what combines the two methods.

Expert Systems in Islamic field

A good work has done, "Design of an Expert System to Calculate Inheritance Shares Based on Islamic Law"[11], Expert System for Islamic Punishment [5], but both describe only a frame work and no software was done.

Limitation of the Research

According to Islamic law, Inheritance reaches an heir via two routes, fard or tā'sib [6].

A. FARD (Prescription)

The prescribed shares are the specific allocations determined in the Qur'an or Sunnah. They are one-half (1/2), one-third (1/3), one-fourth (1/4), one-sixth (1/6), one-eighth (1/8), and two-thirds (2/3). They hold for various individuals based on the fulfillment of certain conditions.

B. Tā’sib

Tā’sib is an Arabic word which comes from the verb ‘usbah, which means “clan; paternal relations; agnates”. An individual inheriting through tā’sib is called ‘āsib. Thus, tā’sib arises from kinship relationships. There are three forms of tā’sib[6]:

- Independent tā’sib
- Tā’sib by association
- Tā’sib by joining with others

C. Current Paper Limitation

In this paper, we covered most of the familiar FARD of Islamic law of inheritance.

Materials and Methods

The proposed expert system calculated the Islamic inheritance according to Islamic Sharia. The proposed expert system was designed and developed using CLIPS language [12-16].

The expert system currently contains 43 rules. The proposed expert system asks the user to enter input data related to the family of the deceased such how many sons he/she has whether he/she has parents or not, in each question frame. At the end of the dialogue, the proposed expert system provides the proper share of each person from the Islam inheritance. Figure 2 to Figure 6 shows a snap shot the expert system session.

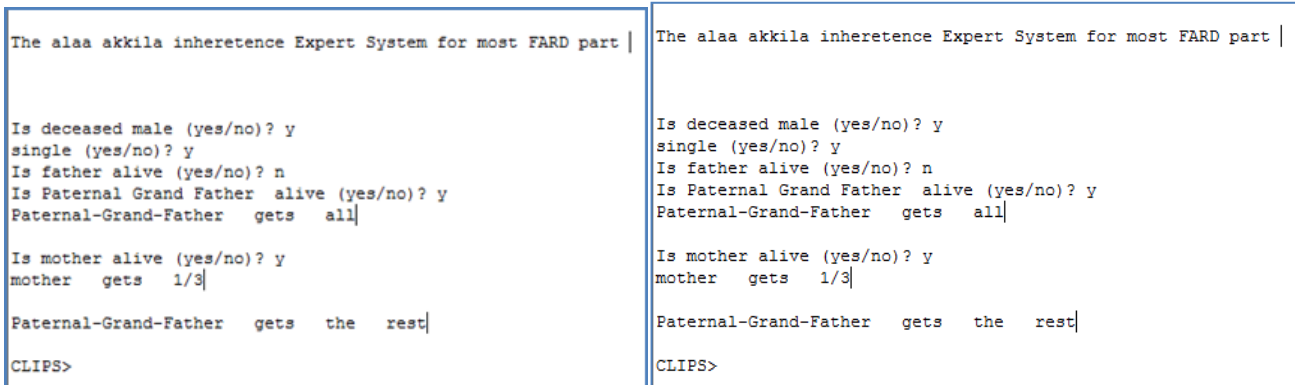


Figure 2: A sample session of the expert system

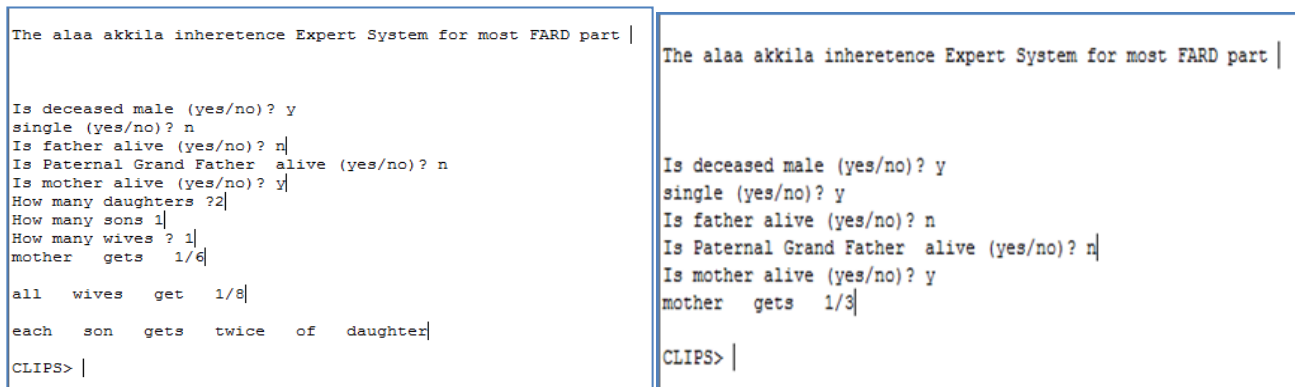


Figure 3: A sample session of the expert system

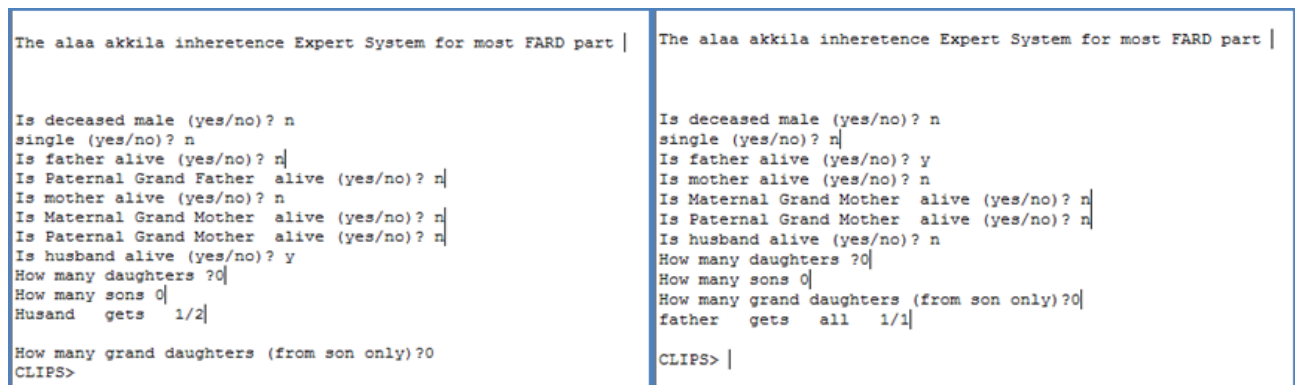


Figure 4: A sample session of the expert system

<pre>The alaa akkila inheretence Expert System for most FARD part Is deceased male (yes/no)? y single (yes/no)? n Is father alive (yes/no)? n Is Paternal Grand Father alive (yes/no)? y Is mother alive (yes/no)? y How many daughters ?1 How many sons 1 How many wives ? 2 mother gets 1/6 all wives get 1/8 Paternal-Grand-Father gets 1/6 each son gets twice of daughter CLIPS></pre>	<pre>The alaa akkila inheretence Expert System for most FARD part Is deceased male (yes/no)? n single (yes/no)? n Is father alive (yes/no)? n Is Paternal Grand Father alive (yes/no)? y Is mother alive (yes/no)? y How many daughters ?2 How many sons 5 mother gets 1/6 Paternal-Grand-Father gets 1/6 each son gets twice of daughter CLIPS> </pre>
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Figure 5: A sample session of the expert system

<pre>The alaa akkila inheretence Expert System for most FARD part Is deceased male (yes/no)? y single (yes/no)? n Is father alive (yes/no)? n Is Paternal Grand Father alive (yes/no)? n Is mother alive (yes/no)? y How many daughters ?3 How many sons 0 How many wives ? 1 mother gets 1/6 all wives get 1/8 all-Daughters get 2/3 each son gets twice of daughter CLIPS></pre>	<pre>The alaa akkila inheretence Expert System for most FARD part Is deceased male (yes/no)? n single (yes/no)? n Is father alive (yes/no)? n Is Paternal Grand Father alive (yes/no)? y Is mother alive (yes/no)? y How many daughters ?3 How many sons 2 mother gets 1/6 Paternal-Grand-Father gets 1/6 each son gets twice of daughter CLIPS> </pre>
---	--

Figure 6: A sample session of the expert system

Conclusion

In this paper, an expert system was designed and developed for aiding People in calculating their inheritance according to Islamic Shariaa. This calculation is done faster than the traditional calculation using a paper and pencil. This expert system does not require rigorous training to be used; it has a straightforward and user friendly interface. It was developed using CLIPS expert system language. The result of the preliminary testing of the expert system was promising.

Future Work

This expert system is considered to be a base of future ones; more rules of Inheritance are planned to be added to the expert system and to make it more accessible to users from anywhere at any time.

Source code of the expert System

```
;;;=====
=====
;;; Inheritance Expert System
;;; This expert system calculate mirath
;;; CLIPS Version 6.0 Example
;;; To execute, merely load, reset and run.
;;;=====
=====
..*****
;;
;;* DEFFUNCTIONS *
..*****
(deffunction ask-question (?question $?allowed-values)
  (printout t ?question)
  (bind ?answer (read))
  (if (lexemep ?answer)
      then (bind ?answer (lowercase ?answer)))
  (while (not (member ?answer ?allowed-values)) do
    (printout t ?question)
```

```
(bind ?answer (read))
(if (lexemep ?answer)
    then (bind ?answer (lowercase ?answer))))
?answer)
(deffunction ask-no (?question ?a1 ?a2 )
  (printout t ?question)
  (bind ?answer (read))

  (while (or (< ?answer ?a1) (> ?answer ?a2)) do
    (printout t ?question)
    (bind ?answer (read))
  )
  ?answer)
(deffunction yes-or-no-p (?question)
  (bind ?response (ask-question ?question yes no y n))
  (if (or (eq ?response yes) (eq ?response y))
      then TRUE
      else FALSE))
...*****
;;* QUERY RULES *
...*****
; counter of heirs
(defrule question-no-1-0 ""
  (not (no ? ? ?))
  =>
  (assert (no 0 0 0)) )
; deceased male or female
(defrule question-no-1-1 ""
  (not (deceased-male ?))
  =>
  (if (yes-or-no-p "Is deceased male (yes/no)? ")
      then
      (assert (deceased-male male))
      else
      (assert (deceased-male female)) ))
```

```

; single or not
(defrule question-no-1-2 ""
  (not (ms single ?))
  =>
  (if (yes-or-no-p "single (yes/no)? ")
    then
      (assert (ms single yes))
    else
      (assert (ms single no)))
)
; if single no offsprings
(defrule question-no-1-3 ""
  (ms single yes)
  =>
  (assert (offspring no)) )
; father alive yes or no
(defrule question-no-1-4 ""
  (not(father ?))
  =>
  (if (yes-or-no-p "Is father alive (yes/no)? ")
    then
      (assert (father yes 0))
    else
      (assert (father no))) )
(defrule question-no-1-3 ""
  (ms single yes)
  =>
  (assert (offspring no)) )
; Paternal Grand Father alive yes or no
(defrule question-no-6-1 ""
  (father no)
  (not(Paternal-Grand-Father ?))
  =>
  (if (yes-or-no-p "Is Paternal Grand Father alive (yes/no)? ")
    then
      (assert (Paternal-Grand-Father yes 0))
    else
      (assert (Paternal-Grand-Father no))) )
; if there is father add 1 to heirs counter
(defrule question-no-1-5 ""
  (father yes 0)
; (no ?c)
?p <- (no ?c ?m ?f)
?b <- (father yes 0)
=>
  (retract ?p)
  (assert (no (+ 1 ?c) ?m ?f))

  (retract ?b)
  (assert (father yes)) )
; if there is Paternal-Grand-Father add 1 to heirs counter
(defrule question-no-5-5 ""
  (Paternal-Grand-Father yes 0)
; (no ?c)
?p <- (no ?c ?m ?f)
?b <- (Paternal-Grand-Father yes 0)
=>
  (retract ?p)
  (assert (no (+ 1 ?c) ?m ?f))
  (retract ?b)
  (assert (Paternal-Grand-Father yes)) )
; mother alive yes or no
(defrule question-no-2-1 ""

```

```

(not(mother ?))
=>
  (if (yes-or-no-p "Is mother alive (yes/no)? ")
    then
      (assert (mother yes 0))
    else
      (assert (mother no)) ) )
; if there is mother add 1 to heirs counter
(defrule question-no-12-5 ""
  (mother yes 0)
; (no ?c)
?p <- (no ?c ?m ?f)
?b <- (mother yes 0)
=>
  (retract ?p)
  (assert (no (+ 1 ?c) ?m ?f))
  (retract ?b)
  (assert (mother yes)) )
; Maternal Grand Mother alive yes or no
(defrule question-no-9-2 ""
  (mother no)
  (not(Maternal-Grand-Mother ?))
  =>
  (if (yes-or-no-p "Is Maternal Grand Mother alive (yes/no)? ")
    then
      (assert (Maternal-Grand-Mother yes 0))
    else
      (assert (Maternal-Grand-Mother no))) )
; if there is Maternal-Grand-Mother add 1 to heirs counter
(defrule question-no-9-5 ""
  (Maternal-Grand-Mother yes 0)
; (no ?c)
?p <- (no ?c ?m ?f)
?b <- (Maternal-Grand-Mother yes 0)
=>
  (retract ?p)
  (assert (no (+ 1 ?c) ?m ?f))
  (retract ?b)
  (assert (Maternal-Grand-Mother yes)) )
; Paternal Grand Mother alive yes or no
(defrule question-no-12-3 ""
  (mother no)
  (not(Paternal-Grand-Mother ?))
  =>
  (if (yes-or-no-p "Is Paternal Grand Mother alive (yes/no)? ")
    then
      (assert (Paternal-Grand-Mother yes 0))
    else
      (assert (Paternal-Grand-Mother no))) )
; if there is Paternal-Grand-Mother add 1 to heirs counter
(defrule question-no-9-7 ""
  (Paternal-Grand-Mother yes 0)
?p <- (no ?c ?m ?f)
?b <- (Paternal-Grand-Mother yes 0)
=>
  (retract ?p)
  (assert (no (+ 1 ?c) ?m ?f))
  (retract ?b)
  (assert (Paternal-Grand-Mother yes)) )
; if deceased female, is husband alive
(defrule question-no-11-1 ""
  (not (ms single yes))

```

```

(deceased-male female)
(not(husband ?))
(father ?)
(mother ?)
(Maternal-Grand-Mother ?)
(Paternal-Grand-Mother ?)
=>
(if (yes-or-no-p "Is husband alive (yes/no)? ")
  then
    (assert (husband yes 0))
  else
    (assert (husband no))) )
;if there is husband add 1 to heirs counter
(defrule question-no-2-5 ""
  (husband yes 0)
  ?p <- (no ?c ?m ?f)
  ?b <- (husband yes 0)
=>
  (retract ?p)
  (assert (no (+ 1 ?c) ?m ?f))
  (retract ?b)
  (assert (husband yes)) )
;if deceased male, How many wives
(defrule question-no-10 ""
  (ms single no)
  (deceased-male male)
  (father ?)
  (mother ?)
  (offspring ?)
; (Maternal-Grand-Mother ?)
; (Paternal-Grand-Mother ?)
  (not (wives ?))
=>
  (bind ?response
    (ask-no "How many wives ? " 0 4))
    (assert (wives ?response 0)) )
;if there is wives add 1 to heirs counter
(defrule question-no-2-6 ""
  (wives ? 0)
  ?p <- (no ?c ?m ?f)
  ?b <- (wives ?w 0)
=>
  (retract ?b)
  (assert (wives ?w))
  (if (> ?w 0)
    then
      (retract ?p)
      (assert (no (+ 1 ?c) ?m ?f)) ) )
;How many daughters
(defrule question-daughters ""
  (not (ms single yes))
=>
  (bind ?response
    (ask-no "How many daughters ?" 0 20))
    (assert (daughters ?response 0)) )
;if there is daughters add 1 to heirs counter
(defrule question-no-2-7 ""
  (daughters ? 0)
  ?p <- (no ?c ?m ?f)
  ?b <- (daughters ?w 0)
  (father ?)
  (mother ?)
; (Maternal-Grand-Mother ?)
=>

```

```

  (retract ?b)
  (assert (daughters ?w))
  (if (> ?w 0)
    then
      (retract ?p)
      (assert (no (+ 1 ?c) ?m (+ 1 ?f))) ) )
  (defrule question-sons ""
    (not (ms single yes))
    =>
      (bind ?response
        (ask-no "How many sons " 0 20))
        (assert (sons ?response 0)) )
    ;if there is sons add 1 to heirs counter
    (defrule question-no-2-8 ""
      (daughters ?)
      (sons ? 0)
      ?p <- (no ?c ?m ?f)
      ?b <- (sons ?w 0)
    =>
      (retract ?b)
      (assert (sons ?w))
      (if (> ?w 0)
        then
          (retract ?p)
          (assert (no (+ 1 ?c) (+ 1 ?m) ?f)) ) )
    (defrule question-offspring ""
      (daughters ?d)
      (sons ?s)
    =>
      (if (and(eq ?d 0) (eq ?s 0))
        then
          (assert (offspring no))
        else
          (assert (offspring yes))) )
    ;How many grand-daughters
    (defrule question-grand-daughters ""
      (offspring no)
      (daughters 0)
      (sons 0)
      (not (ms single yes))
    =>
      (bind ?response
        (ask-no "How many grand daughters (from son
          only)?" 0 20))
        (assert (grand-daughters ?response 0)) )
    ;if there is grand-daughters add 1 to heirs counter
    (defrule question-no-6-11 ""
      (grand-daughters ? 0)
      ?p <- (no ?c ?m ?f)
      ?b <- (grand-daughters ?w 0)
      (father ?)
      (mother ?)
    =>
      (retract ?b)
      (assert (grand-daughters ?w))
      (if (> ?w 0)
        then
          (retract ?p)
          (assert (no (+ 1 ?c) ?m (+ 1 ?f))) ) )
    ; calculate
    ; for Husband Final
    (defrule husband-fl ""
      (husband yes)
      (offspring ?o)

```

```

=>
(if (eq ?o no)
  then
    (printout t Husand " " gets " " 1/2)
    (printout t crlf crlf)
  else
    (printout t Husand " " gets " " 1/4)
    (printout t crlf crlf)))
; for Wives Final
(defrule wives-f1 ""
  (deceased-male male)
  (father ?)
  (mother ?)
  (wives ?)
(not(wives 0))
(offspring ?o)
=>
(if (eq ?o no)
  then
    (printout t all " " wives " " get " " 1/4)
    (printout t crlf crlf)
  else
    (printout t all " " wives " " get " " 1/8)
    (printout t crlf crlf) ) )
; for daughter Final
(defrule daughter-f ""
  (sons 0)
  (daughters ?d)
  (offspring yes)
=>
(if (eq ?d 1)
  then
    (printout t Daughter " " gets " " 1/2)
    (printout t crlf crlf)
  else
    (printout t all-Daughters " " get " " 2/3)
    (printout t crlf crlf)))
; for Father Final
(defrule father-f ""
  (father yes)
  (no ?c ?m ?f)
  (offspring yes)
=>
  (if (> ?m 0)
    then
      (printout t father " " gets " " 1/6)
      (printout t crlf crlf)
    else
      (printout t father " " gets " the rest " )
      (printout t crlf crlf) ) )
(defrule mother-f1 ""
  (mother yes)
  (no ?c ?m ?f)
  (offspring ?p)
=>
  (if (eq ?p yes)
    then
      (printout t mother " " gets " " 1/6)
      (printout t crlf crlf)
    else
      (printout t mother " " gets " " 1/3)
      (printout t crlf crlf) ) )
(defrule father-f1 ""
  (father yes)

```

```

(mother ?)
(no ?c ?m ?f)
(offspring no)
=>
  (if (eq ?c 1)
    then
      (printout t father " " gets " " all " " 1/1)
      (printout t crlf crlf) ) )
(defrule Paternal-Grand-Father-f ""
  (father no)
  (offspring yes)
  (Paternal-Grand-Father yes)
=>
  (printout t Paternal-Grand-Father " " gets " " 1/6)
  (printout t crlf crlf) )
(defrule Paternal-Grand-Father-f7 ""
  (father no)
  (offspring no)
  (Paternal-Grand-Father yes)
  (no ?c ?m ?f)
=>
  (if (eq ?c 1)
    then
      (printout t Paternal-Grand-Father " " gets " " all)
      (printout t crlf crlf)
    else
      (printout t Paternal-Grand-Father " " gets " "
the " " rest)
      (printout t crlf crlf) ) )
(defrule Paternal-Grand-Mother-f ""
  (father no)
  (mother no)
  (Maternal-Grand-Mother no)
  (Paternal-Grand-Mother yes)
  (offspring ?)
=>
  (printout t Paternal-Grand-Mother " " gets " "
1/6)
  (printout t crlf crlf))
(defrule Paternal-Grand-Mother-f5 ""
  (father no)
  (mother no)
  (Maternal-Grand-Mother yes)
  (Paternal-Grand-Mother yes)
  (offspring ?)
=>
  (printout t Paternal-Grand-Mother " " gets " "
1/12)
  (printout t crlf crlf))
(defrule Maternal-Grand-Mother-f2 ""
  (father no)
  (mother no)
  (Maternal-Grand-Mother yes)
  (Paternal-Grand-Mother ?p)
  (offspring ?)
=>
  (if (eq ?p yes)
    then
      (printout t Maternal-Grand-Mother " " gets " "
1/12)
      (printout t crlf crlf)
    else
      (printout t Maternal-Grand-Mother " " gets " "
1/6)

```

```

(printout t crlf crlf))) ) )
(defrule grand-daughter-f2 ""
(son no)
(daughter no)
(grand-daughter ?g)
(grand-daughter yes)
=>
(if (eq ?g 1)
then
(printout t grand-daughter " " gets " " 1/2)
(printout t crlf crlf)
else
(printout t grand-daughter " " gets " " 2/3)
(printout t crlf crlf) ) )
(defrule sons-daughter-f4 ""
(offspring yes)
(not(son 0))
(not(daughter 0))
(ms single no)
=>
(printout t each " " son " " gets " " twice " " of
" " daughter)
(printout t crlf crlf) )
;;;*****
;;;* STARTUP ALAA AKKILA RULES *
;;;*****
(defrule system-banner ""
(declare (salience 10))
=>
(printout t crlf crlf)
(printout t crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf crlf )
(printout t "The Aaa Akkila inheritance Expert System for
most FARD part ")
(printout t crlf crlf) )
(printout t crlf crlf)
)

```

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