

# Artificial Intelligence

## Assignment 1: CLIPS family knowledge representation

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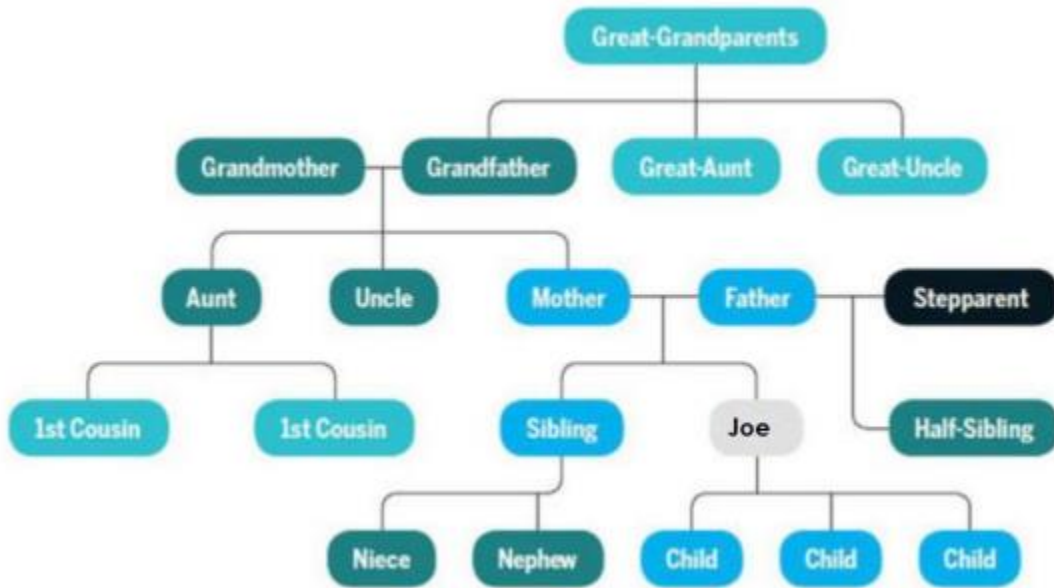
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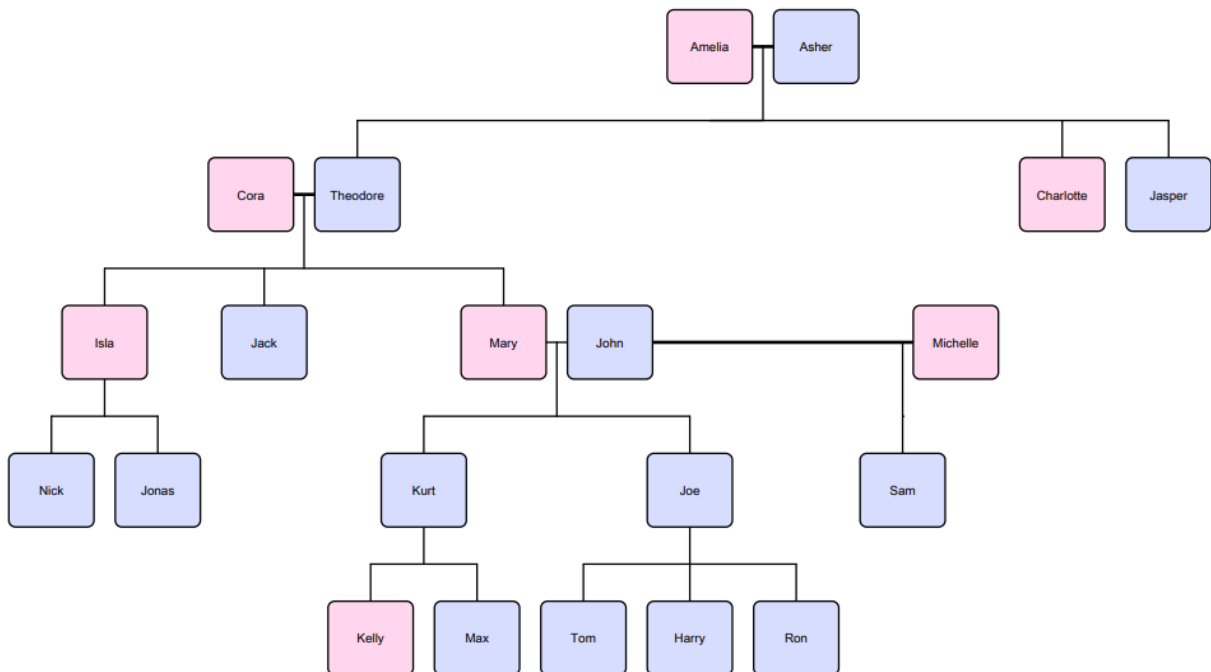
## Assignment Task:

Using CLIPS to represent the below family tree. In this exercise assume that you are Joe and define the below given family relations.

## Joe's Family Tree:



Joe's family



## **Idea of Program:**

The core idea of the program is to create an abstract knowledge-base with the relationship of parents, stepparent and Gender of each and every member in the family. Program then works on this knowledge-base and with rules defined starts finding relationships and stores them into knowledge-base.

## **Defining templates to build relationships:**

Following relationships are defined in program:

- 1) Father-of: Defines who is the father of a person
- 2) Mother-of: Defines who is the mother of a person
- 3) AreBrothers: Defines two siblings who are male as Brothers
- 4) AreSisters: Defines two siblings who are female as Brothers
- 5) AreBrotherSister: : Defines two siblings as Brothers and Sister if they are male and female
- 6) AreHusbandWife: Defines parent of a child as Husband and wife.
- 7) Aunt-of: Defines Sister of parents as Aunt.
- 8) Uncle-of: Defines Brother of parents as Uncle.
- 9) Cousins: Defines child of Aunt or Uncle as Cousins.
- 10) Grandfather: Defines Father of parents as Grandfather.
- 11) Grandmother: Defines Mother of parents as Grandmother.
- 12) Greataunt: Defines Sister of Grandparents as Great-aunt.
- 13) Greatuncle: Defines Brother of Grandparents as Great-uncle.
- 14) GreatGrandmother: Defines Mother of Grandparent as Great-grandmother.
- 15) GreatGrandFather: Defines Father of Grandparent as Great-Grandfather.
- 16) Neice-of: Defines neice of a person.
- 17) Nephew-of: Defines Nephew of a person.
- 18) Stepparent-of: Defines stepparent of a person.
- 19) Halfsibling-of: Defines halfsibling of a person.

This are some intermediate relationships used in the program to define other relationships:

- 1) Parent-of: Defines who is the parent of a person
- 2) Siblings-of: Defines two people as siblings

## Defining Relationships via rule:

### **1. Father and Mother:**

Given that parents are in facts and Gender of every one is defined, we can derive mother and father relationship:

Assumption1: if the person is a parent of a child and is male then he is his/her father.

Assumption2: If the person is a parent of a child and is female then she is his/her mother.

### **2. Grand-Father and Grand-Mother:**

Given that father and mother of every one are defined, we can derive Grand-mother and father relationship:

Assumption1: if the person is a parent of a child and is male then he is his/her father.

Assumption2: If the person is a parent of a child and is female then she is his/her mother.

### **3. Siblings (intermediate relationship):**

Given that parents have two children, we can derive them as Siblings.

### **4. Brothers:**

Given that both the siblings are male, we can derive that they are brothers.

### **5. Sisters:**

Given that both the siblings are female, we can derive that they are sisters.

### **6. Brother and sister:**

Given that there are two siblings, one is male and other is female, we can derive that they are brother and sister.

### **7. Husband and wife:**

Given that a child has father and mother, we can derive that they are Husband and Wife. Here stepfather is also a father and stepmother is also a mother, so we can derive that they are also husband and wife.

### **8. Uncle and Aunt:**

Given that parents are in facts, we can define sibling of parents as uncle and aunt.

Assumption1: Brother of any parent is uncle

Assumption2: If the person is a parent of a child and is female then she is his/her mother.

### **9. Niece and nephew:**

Given that a person is uncle or aunt of a child and we have gender of child, we can define that child is niece or nephew.

Assumption1: if the child is female, then she is niece.

Assumption2: If the child is male, then he is nephew.

#### **10. Great-Aunt and Great-Uncle:**

Given that a person has Grandparents, siblings of Grandparent are Great-Aunt or Great-Uncle of the person.

Assumption1: if the sibling of grandparent is female, then she is Great-Aunt.

Assumption2: If the sibling of grandmother is male, then he is Great-Uncle.

#### **11. Great-Grand-Mother and Great-Grand-Father:**

Given that a person has Grandparents, then parents of their Grandparents are Great-Grand-Parents.

Assumption1: Father of Grandparent is Great-Grand-Father.

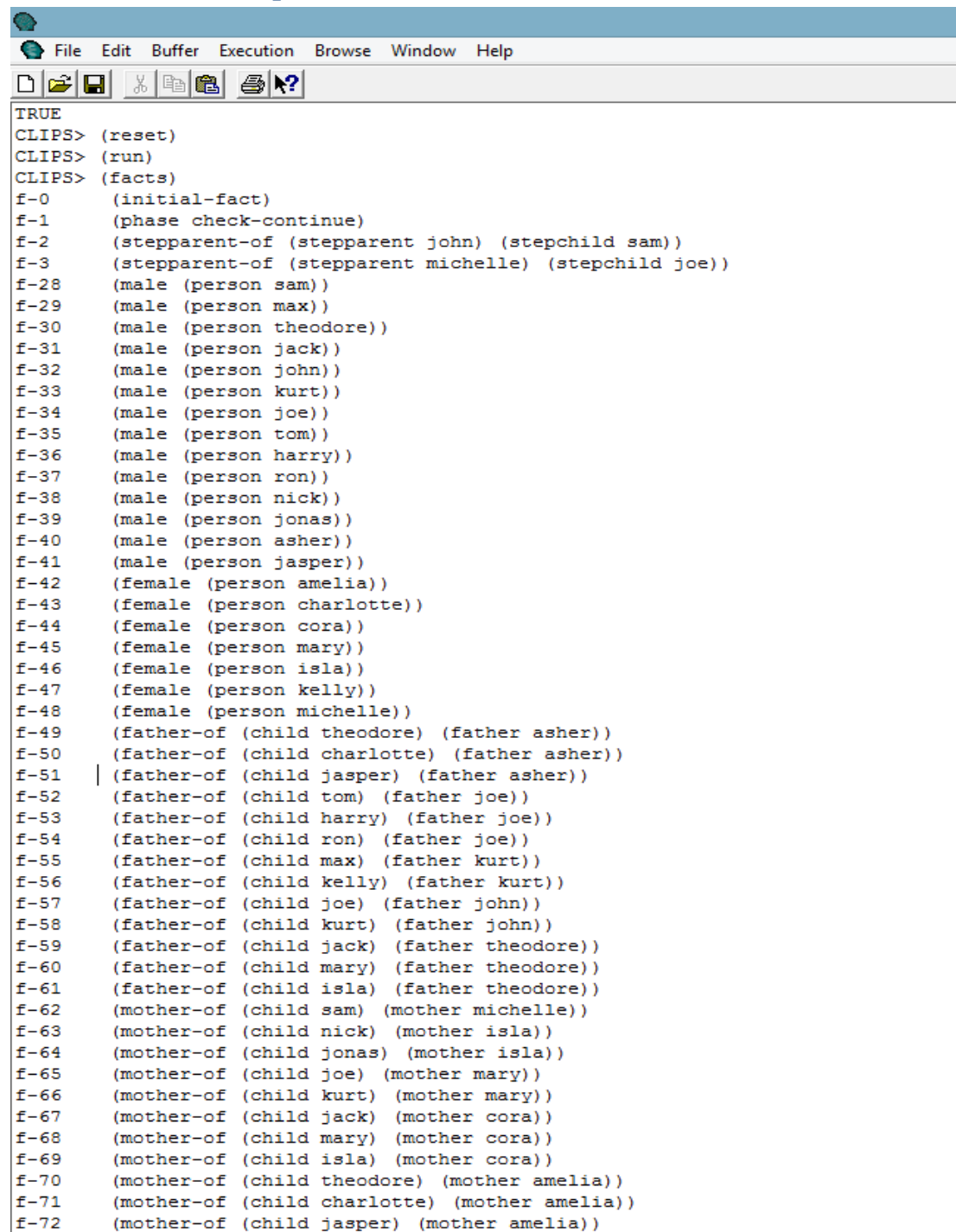
Assumption2: Mother of Grandparent is Great-Grand-Mother.

#### **12. Half-sibling:**

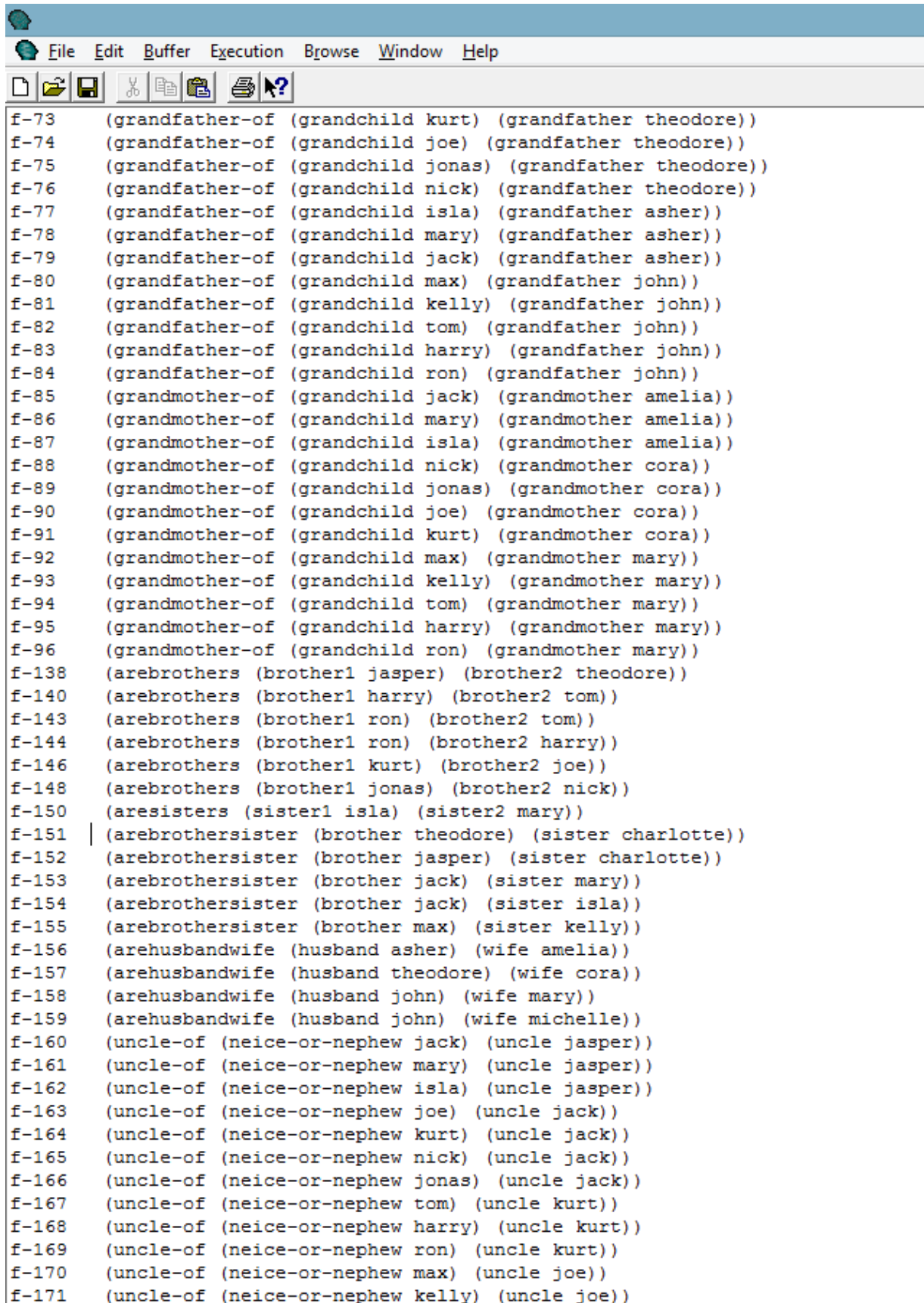
Given that a person has step-parent, then child of the step-parent is person's half-sibling.

Assumption1: if stepparent of one child is parent of other and vice-versa, they are Half-Siblings.

## Screenshot of Output:



```
TRUE
CLIPS> (reset)
CLIPS> (run)
CLIPS> (facts)
f-0      (initial-fact)
f-1      (phase check-continue)
f-2      (stepparent-of (stepparent john) (stepchild sam))
f-3      (stepparent-of (stepparent michelle) (stepchild joe))
f-28     (male (person sam))
f-29     (male (person max))
f-30     (male (person theodore))
f-31     (male (person jack))
f-32     (male (person john))
f-33     (male (person kurt))
f-34     (male (person joe))
f-35     (male (person tom))
f-36     (male (person harry))
f-37     (male (person ron))
f-38     (male (person nick))
f-39     (male (person jonas))
f-40     (male (person asher))
f-41     (male (person jasper))
f-42     (female (person amelia))
f-43     (female (person charlotte))
f-44     (female (person cora))
f-45     (female (person mary))
f-46     (female (person isla))
f-47     (female (person kelly))
f-48     (female (person michelle))
f-49     (father-of (child theodore) (father asher))
f-50     (father-of (child charlotte) (father asher))
f-51     (father-of (child jasper) (father asher))
f-52     (father-of (child tom) (father joe))
f-53     (father-of (child harry) (father joe))
f-54     (father-of (child ron) (father joe))
f-55     (father-of (child max) (father kurt))
f-56     (father-of (child kelly) (father kurt))
f-57     (father-of (child joe) (father john))
f-58     (father-of (child kurt) (father john))
f-59     (father-of (child jack) (father theodore))
f-60     (father-of (child mary) (father theodore))
f-61     (father-of (child isla) (father theodore))
f-62     (mother-of (child sam) (mother michelle))
f-63     (mother-of (child nick) (mother isla))
f-64     (mother-of (child jonas) (mother isla))
f-65     (mother-of (child joe) (mother mary))
f-66     (mother-of (child kurt) (mother mary))
f-67     (mother-of (child jack) (mother cora))
f-68     (mother-of (child mary) (mother cora))
f-69     (mother-of (child isla) (mother cora))
f-70     (mother-of (child theodore) (mother amelia))
f-71     (mother-of (child charlotte) (mother amelia))
f-72     (mother-of (child jasper) (mother amelia))
```



The screenshot shows a text editor window with a menu bar (File, Edit, Buffer, Execution, Browse, Window, Help) and a toolbar. The main text area contains a list of family relationships, each preceded by a label (f-73 to f-171). The relationships are defined using a set notation: (relationship (person1) (person2)).

```

f-73 (grandfather-of (grandchild kurt) (grandfather theodore))
f-74 (grandfather-of (grandchild joe) (grandfather theodore))
f-75 (grandfather-of (grandchild jonas) (grandfather theodore))
f-76 (grandfather-of (grandchild nick) (grandfather theodore))
f-77 (grandfather-of (grandchild isla) (grandfather asher))
f-78 (grandfather-of (grandchild mary) (grandfather asher))
f-79 (grandfather-of (grandchild jack) (grandfather asher))
f-80 (grandfather-of (grandchild max) (grandfather john))
f-81 (grandfather-of (grandchild kelly) (grandfather john))
f-82 (grandfather-of (grandchild tom) (grandfather john))
f-83 (grandfather-of (grandchild harry) (grandfather john))
f-84 (grandfather-of (grandchild ron) (grandfather john))
f-85 (grandmother-of (grandchild jack) (grandmother amelia))
f-86 (grandmother-of (grandchild mary) (grandmother amelia))
f-87 (grandmother-of (grandchild isla) (grandmother amelia))
f-88 (grandmother-of (grandchild nick) (grandmother cora))
f-89 (grandmother-of (grandchild jonas) (grandmother cora))
f-90 (grandmother-of (grandchild joe) (grandmother cora))
f-91 (grandmother-of (grandchild kurt) (grandmother cora))
f-92 (grandmother-of (grandchild max) (grandmother mary))
f-93 (grandmother-of (grandchild kelly) (grandmother mary))
f-94 (grandmother-of (grandchild tom) (grandmother mary))
f-95 (grandmother-of (grandchild harry) (grandmother mary))
f-96 (grandmother-of (grandchild ron) (grandmother mary))
f-138 (arebrothers (brother1 jasper) (brother2 theodore))
f-140 (arebrothers (brother1 harry) (brother2 tom))
f-143 (arebrothers (brother1 ron) (brother2 tom))
f-144 (arebrothers (brother1 ron) (brother2 harry))
f-146 (arebrothers (brother1 kurt) (brother2 joe))
f-148 (arebrothers (brother1 jonas) (brother2 nick))
f-150 (aresisters (sister1 isla) (sister2 mary))
f-151 (arebrotherssister (brother theodore) (sister charlotte))
f-152 (arebrotherssister (brother jasper) (sister charlotte))
f-153 (arebrotherssister (brother jack) (sister mary))
f-154 (arebrotherssister (brother jack) (sister isla))
f-155 (arebrotherssister (brother max) (sister kelly))
f-156 (arehusbandwife (husband asher) (wife amelia))
f-157 (arehusbandwife (husband theodore) (wife cora))
f-158 (arehusbandwife (husband john) (wife mary))
f-159 (arehusbandwife (husband john) (wife michelle))
f-160 (uncle-of (neice-or-nephew jack) (uncle jasper))
f-161 (uncle-of (neice-or-nephew mary) (uncle jasper))
f-162 (uncle-of (neice-or-nephew isla) (uncle jasper))
f-163 (uncle-of (neice-or-nephew joe) (uncle jack))
f-164 (uncle-of (neice-or-nephew kurt) (uncle jack))
f-165 (uncle-of (neice-or-nephew nick) (uncle jack))
f-166 (uncle-of (neice-or-nephew jonas) (uncle jack))
f-167 (uncle-of (neice-or-nephew tom) (uncle kurt))
f-168 (uncle-of (neice-or-nephew harry) (uncle kurt))
f-169 (uncle-of (neice-or-nephew ron) (uncle kurt))
f-170 (uncle-of (neice-or-nephew max) (uncle joe))
f-171 (uncle-of (neice-or-nephew kelly) (uncle joe))

```



The screenshot shows a software application window with a menu bar (File, Edit, Buffer, Execution, Browse, Window, Help) and a toolbar with icons for file operations and execution. The main area displays a list of family relationships, each on a new line, starting from f-172 and ending at f-239. The relationships are defined using a set of terms: (aunt-of, neice-of, nephew-of, arecousins, greataunt-of, greatuncle-of, greatgrandmother-of) followed by the names of the individuals involved in the relationship.

```

f-172 (aunt-of (neice-or-nephew jack) (aunt charlotte))
f-173 (aunt-of (neice-or-nephew mary) (aunt charlotte))
f-174 (aunt-of (neice-or-nephew isla) (aunt charlotte))
f-175 (aunt-of (neice-or-nephew joe) (aunt isla))
f-176 (aunt-of (neice-or-nephew kurt) (aunt isla))
f-177 (aunt-of (neice-or-nephew nick) (aunt mary))
f-178 (aunt-of (neice-or-nephew jonas) (aunt mary))
f-179 (neice-of (neice isla) (uncle-or-aunt charlotte))
f-180 (neice-of (neice mary) (uncle-or-aunt charlotte))
f-181 (neice-of (neice kelly) (uncle-or-aunt joe))
f-182 (neice-of (neice isla) (uncle-or-aunt jasper))
f-183 (neice-of (neice mary) (uncle-or-aunt jasper))
f-184 (nephew-of (nephew jonas) (uncle-or-aunt mary))
f-185 (nephew-of (nephew nick) (uncle-or-aunt mary))
f-186 (nephew-of (nephew kurt) (uncle-or-aunt isla))
f-187 (nephew-of (nephew joe) (uncle-or-aunt isla))
f-188 (nephew-of (nephew jack) (uncle-or-aunt charlotte))
f-189 (nephew-of (nephew max) (uncle-or-aunt joe))
f-190 (nephew-of (nephew ron) (uncle-or-aunt kurt))
f-191 (nephew-of (nephew harry) (uncle-or-aunt kurt))
f-192 (nephew-of (nephew tom) (uncle-or-aunt kurt))
f-193 (nephew-of (nephew jonas) (uncle-or-aunt jack))
f-194 (nephew-of (nephew nick) (uncle-or-aunt jack))
f-195 (nephew-of (nephew kurt) (uncle-or-aunt jack))
f-196 (nephew-of (nephew joe) (uncle-or-aunt jack))
f-197 (nephew-of (nephew jack) (uncle-or-aunt jasper))
f-202 (arecousins (cousin1 kurt) (cousin2 jonas))
f-203 (arecousins (cousin1 kurt) (cousin2 nick))
f-204 (arecousins (cousin1 joe) (cousin2 jonas))
f-205 (arecousins (cousin1 joe) (cousin2 nick))
f-212 (arecousins (cousin1 ron) (cousin2 kelly))
f-213 (arecousins (cousin1 ron) (cousin2 max))
f-214 (arecousins (cousin1 harry) (cousin2 kelly))
f-215 (arecousins (cousin1 harry) (cousin2 max))
f-216 (arecousins (cousin1 tom) (cousin2 kelly))
f-217 (arecousins (cousin1 tom) (cousin2 max))
f-218 (greataunt-of (person kurt) (greataunt charlotte))
f-219 (greataunt-of (person joe) (greataunt charlotte))
f-220 (greataunt-of (person jonas) (greataunt charlotte))
f-221 (greataunt-of (person nick) (greataunt charlotte))
f-222 (greataunt-of (person max) (greataunt isla))
f-223 (greataunt-of (person kelly) (greataunt isla))
f-224 (greataunt-of (person tom) (greataunt isla))
f-225 (greataunt-of (person harry) (greataunt isla))
f-226 (greataunt-of (person ron) (greataunt isla))
f-227 (greatuncle-of (person kurt) (greatuncle jasper))
f-228 (greatuncle-of (person joe) (greatuncle jasper))
f-229 (greatuncle-of (person jonas) (greatuncle jasper))
f-230 (greatuncle-of (person nick) (greatuncle jasper))
f-231 (greatuncle-of (person max) (greatuncle jack))
f-232 (greatuncle-of (person kelly) (greatuncle jack))
f-233 (greatuncle-of (person tom) (greatuncle jack))
f-234 (greatuncle-of (person harry) (greatuncle jack))
f-235 (greatuncle-of (person ron) (greatuncle jack))
f-236 (greatgrandmother-of (person ron) (greatgrandmother cora))
f-237 (greatgrandmother-of (person harry) (greatgrandmother cora))
f-238 (greatgrandmother-of (person tom) (greatgrandmother cora))
f-239 (greatgrandmother-of (person kelly) (greatgrandmother cora))

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```

f-240    (greatgrandmother-of (person max) (greatgrandmother cora))
f-241    (greatgrandmother-of (person nick) (greatgrandmother amelia))
f-242    (greatgrandmother-of (person jonas) (greatgrandmother amelia))
f-243    (greatgrandmother-of (person joe) (greatgrandmother amelia))
f-244    (greatgrandmother-of (person kurt) (greatgrandmother amelia))
f-245    (greatgrandfather-of (person ron) (greatgrandfather theodore))
f-246    (greatgrandfather-of (person harry) (greatgrandfather theodore))
f-247    (greatgrandfather-of (person tom) (greatgrandfather theodore))
f-248    (greatgrandfather-of (person kelly) (greatgrandfather theodore))
f-249    (greatgrandfather-of (person max) (greatgrandfather theodore))
f-250    (greatgrandfather-of (person nick) (greatgrandfather asher))
f-251    (greatgrandfather-of (person jonas) (greatgrandfather asher))
f-252    (greatgrandfather-of (person joe) (greatgrandfather asher))
f-253    (greatgrandfather-of (person kurt) (greatgrandfather asher))
f-255    (halfsibling-of (halfsibling1 sam) (halfsibling2 joe))
For a total of 174 facts.
CLIPS>

```

### Relationships of Joe in Output:

1. Joe's stepparent: fact 3
2. Joe's Children: facts 52,53 and 54
3. Joe's Father: fact 57
4. Joe's Mother: fact 65
5. Joe's Brother: fact 146
6. Joe's Niece: fact 181
7. Joe's Nephew: fact 189
8. Joe's Cousin: facts 204 and 205
9. Joe's Half sibling: fact: 255
10. Joe's Uncle: fact 163
11. Joe's Aunt: fact 175
12. Joe's Grandfather: fact 74
13. Joe's Grandmother: fact 90
14. Joe's Great-aunt: fact 219
15. Joe's Great-uncle: fact 228
16. Joe's Great-Grand-father: fact 252
17. Joe's Great-Grand-mother: fact 243

Total relationships of Joe: 20