

PERSON $\varnothing$	
bioMother $\rightarrow$ WOMAN	
bioFather $\rightarrow$ MAN	
mother $\equiv$ bioMother $\cup$ bioFather.wife	
father $\equiv$ bioFather $\cup$ bioMother.husband	
parents $\equiv$ father $\cup$ mother	
grandparents $\equiv$ parents.parents	
this $\notin \sim$ (bioMother $\cup$ bioFather)	

-- a person has [0..1] biological mothers  
 -- and [0..1] biological fathers  
 -- human parent = biological + social parents  
 -- no time machines/temporal anomalies: you  $\notin$  your ancestors

2. WOMAN $\sqsubset$ PERSON	3. MAN $\sqsubset$ PERSON
husband $\mapsto$ MAN	wife $\mapsto$ WOMAN

-- **Monogamy** mɔ'ngəmi noun ...married to *one* person...

- wife = ~husband
- (wife  $\cup$  husband)  $\cap \sim$  (bioMother  $\cup$  bioFather)  $\neq \varnothing$
- bioMother  $\neq \varnothing \wedge$  bioFather  $\neq \varnothing$
- $\exists p \in \text{MAN}: p \in p.\text{grandparents}$

-- symmetric monogamy: wife and husband are inverse  
 -- by ancient taboo: marriage and parenting relations are disjoint  
 -- ignore empty solutions  
 -- could a man be their own grandpa?

Alloy model

abstract sig PERSON {  
 father: lone MAN,  
 mother: lone WOMAN  
 } ( **this not in** ~ (mother + father) )

some sig MAN extends PERSON { wife: WOMAN }  
 some sig WOMAN extends PERSON { husband: MAN }

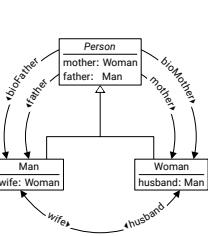
fact symmetricMonogamy { wife = ~husband }  
 fact ancientTaboo { disj [ wife + husband, ~ (mother + father) ] }  
 fact nonEmpty { some father && some mother }

fun parents: PERSON  $\rightarrow$  PERSON  
 { { p: PERSON, q: p.(mother + father + father.wife + mother.husband) } }

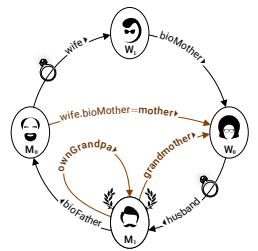
fun grandparents: PERSON  $\rightarrow$  PERSON { { p: PERSON, q: p.parents.parents } }

pred PERSON.ownGrandpa { **this in this**.grandparents & MAN }

Alloy source code for grandpa.als module



Model atoms and relations



Solution sets and relations: bioFather.mother.husband = grandpa

Person	Woman	solved relations				computed relations			
		W <sub>0</sub>	W <sub>1</sub>	wife	husband	mother	father	parents	grandparents
					M <sub>1</sub>		M <sub>0</sub>	M <sub>0</sub>	W <sub>0</sub>
		W <sub>0</sub>			M <sub>0</sub>	W <sub>0</sub>	M <sub>1</sub>	W <sub>0</sub> , M <sub>1</sub>	W <sub>1</sub> , M <sub>0</sub>
	Man	M <sub>0</sub>		W <sub>1</sub>		W <sub>0</sub>		W <sub>0</sub>	M <sub>0</sub>
		M <sub>1</sub>			M <sub>0</sub>	W <sub>1</sub>	M <sub>0</sub>	W <sub>1</sub> , M <sub>0</sub>	W <sub>0</sub> , M <sub>1</sub>

Solution sets and relations table

**M**any, many years ago when I was 23,  
 I was married to a widow, who was pretty as could be.  
 This widow had a grown-up daughter who had hair of red  
 My father fell in Love with her and soon they too were wed.

This made my dad my son-in-law and changed my very life!  
 For my daughter was my mother 'cause she was my father's wife!  
 To complicate the matter even though it brought me joy,  
 I soon became the father of a bouncing baby boy.

My little baby then became a brother-in-law to Dad.  
 And so became my uncle though it made me very sad!  
 Where if he was my uncle then that also made him brother  
 To the widow's grown-up daughter, who, 'course was my stepmother.

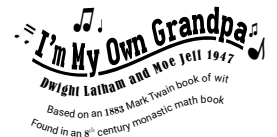
My father's wife then had a son who kept them on the run.  
 And he became my grandchild 'cause he was my daughter's son.  
 My wife is now my mother's mother and it makes me blue  
 Because although she is my wife, she's my grandmother too!

If my wife is my grandmother, then I am her grandchild,  
 And every time I think of it, it nearly drives me wild!  
 This is got to be the strangest thing I ever saw  
 As husband of my grandmother, I am my own grandpa!

I'm my own grandpa! I'm my own grandpa!  
 It sound' funny, I know, but it really is so!  
 Hey! I'm my own grandpa!

The lyrics

Legend	
Fonts	Serif ..... Signature fields, predicates, functions, facts, assertions, and definitions (#) Small Caps ..... Signature names Italics ..... Quantifiers & comprehension variables Sans-serif ..... Commands Bold Sans-Serif ..... Alloy keywords
Boxes	Definitions ..... Facts are true in the environment Facts ..... given by the definitions
Notation	Alloy code      Description
Alloy	SIG? ..... some sig ..... Signature of [1..n] SIG $\varnothing$ ..... abstract sig ..... Abstract signature # ..... = ..... Definition $\sqsubset$ ..... extends ..... Inherits from
Logic	$\wedge$ ..... &&, and ..... Conjunction $\exists$ ..... some ..... There exists : ..... : ..... Such that
Sets	$\varnothing$ ..... none ..... Empty set $\cup$ ..... + ..... Set union $\cap$ ..... & ..... Set intersection $\in$ ..... in ..... Set membership $\notin$ ..... not in ..... Is not member of
Relations	$\sim$ ..... ~ ..... Transitive closure ..... .. Relational join $\rightarrow$ ..... set $\rightarrow$ lone ..... Partial functional relation $\mapsto$ ..... lone $\rightarrow$ one ..... Injective functional relation



Based on an 1885 Mark Twain book of wit  
 Found in an 8<sup>th</sup> century monastic math book