DM Community Rule Modeling Challenge June 2016

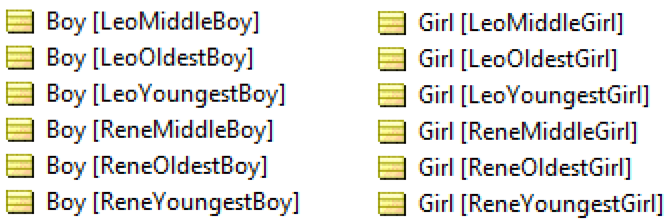
Let's assume that Rene and Leo are both heads of household, and, what a coincidence, both families include three girls and three boys. The youngest child in Leo's family is a girl, and in Rene's family, a little girl has just arrived. In other words, there is a girl in Rene's family whose age is less than one year. Neither family includes any twins, nor any children closer in age than a year. All the children are under age ten. In each family, the sum of the ages of the girls is equal to the sum of the ages of the boys. The sum of the ages of all these children is 60.

Question: *What are the ages of the children in these two families?*

This is basically a constraint problem.
We have seen constraint type problems before here and the technique is still the same.
The idea is to represent the constraints as rule conditions and then allow the rule engine to find a combination that meets the conditions.

Corticon Solution (Mike Parish)

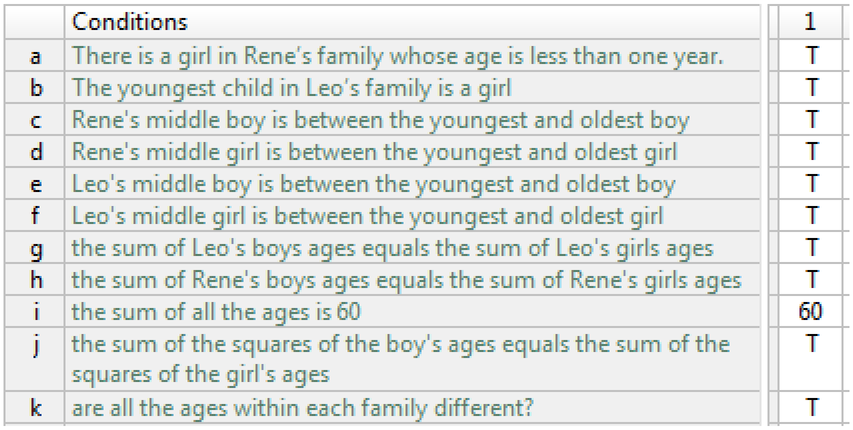
Let's first identify all the children in this puzzle. Since we are not given their names let's name them as follows:



Boy [LeoMiddleBoy]
Boy [LeoOldestBoy]
Boy [LeoYoungestBoy]
Boy [ReneMiddleBoy]
Boy [ReneOldestBoy]
Boy [ReneYoungestBoy]
Girl [LeoMiddleGirl]
Girl [LeoOldestGirl]
Girl [LeoYoungestGirl]
Girl [ReneMiddleGirl]
Girl [ReneOldestGirl]
Girl [ReneYoungestGirl]

We start by restating the problem , in plain English, as a set of conditions to be met:

NOTE: The original problem (which can be found with Google's help) had an additional requirement that the sum of the squares of the boy's ages equals the sum of the squares of the girl's ages. Without this requirement there are a lot of possible solutions. With this requirement added there are fewer solutions so I've added it here (j).

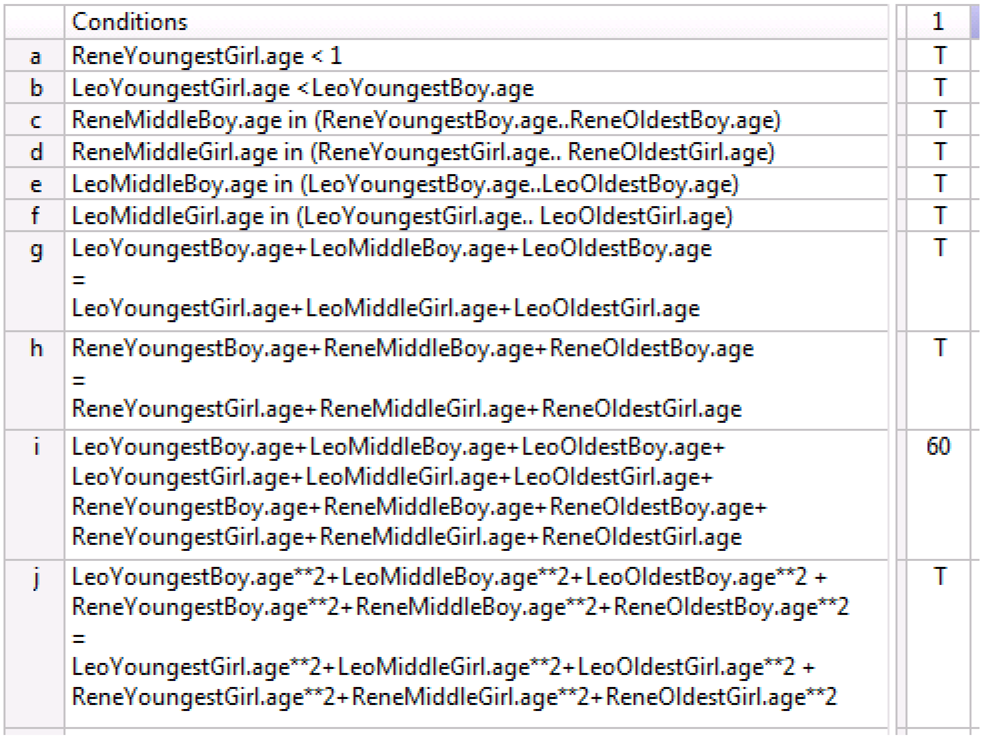


	Conditions	1
a	There is a girl in Rene's family whose age is less than one year.	T
b	The youngest child in Leo's family is a girl	T
c	Rene's middle boy is between the youngest and oldest boy	T
d	Rene's middle girl is between the youngest and oldest girl	T
e	Leo's middle boy is between the youngest and oldest boy	T
f	Leo's middle girl is between the youngest and oldest girl	T
g	the sum of Leo's boys ages equals the sum of Leo's girls ages	T
h	the sum of Rene's boys ages equals the sum of Rene's girls ages	T
i	the sum of all the ages is 60	60
j	the sum of the squares of the boy's ages equals the sum of the squares of the girl's ages	T
k	are all the ages within each family different?	T

This one is interesting because the search space is particularly large but we'll find we can address that by adding some constraints (c,d,e,f) that are not explicitly stated but which can be inferred from the problem statement. This puts some ordering on the ages and also ensures that the ages of the boys are different and that the ages of the girls are different.

By adding these conditions we can reduce the search space considerably

A Possible Implementation



	Conditions	1
a	ReneYoungestGirl.age < 1	T
b	LeoYoungestGirl.age <LeoYoungestBoy.age	T
c	ReneMiddleBoy.age in (ReneYoungestBoy.age..ReneOldestBoy.age)	T
d	ReneMiddleGirl.age in (ReneYoungestGirl.age.. ReneOldestGirl.age)	T
e	LeoMiddleBoy.age in (LeoYoungestBoy.age..LeoOldestBoy.age)	T
f	LeoMiddleGirl.age in (LeoYoungestGirl.age.. LeoOldestGirl.age)	T
g	LeoYoungestBoy.age+LeoMiddleBoy.age+LeoOldestBoy.age = LeoYoungestGirl.age+LeoMiddleGirl.age+LeoOldestGirl.age	T
h	ReneYoungestBoy.age+ReneMiddleBoy.age+ReneOldestBoy.age = ReneYoungestGirl.age+ReneMiddleGirl.age+ReneOldestGirl.age	T
i	LeoYoungestBoy.age+LeoMiddleBoy.age+LeoOldestBoy.age+ LeoYoungestGirl.age+LeoMiddleGirl.age+LeoOldestGirl.age+ ReneYoungestBoy.age+ReneMiddleBoy.age+ReneOldestBoy.age+ ReneYoungestGirl.age+ReneMiddleGirl.age+ReneOldestGirl.age	60
j	LeoYoungestBoy.age**2+LeoMiddleBoy.age**2+LeoOldestBoy.age**2 + ReneYoungestBoy.age**2+ReneMiddleBoy.age**2+ReneOldestBoy.age**2 = LeoYoungestGirl.age**2+LeoMiddleGirl.age**2+LeoOldestGirl.age**2 + ReneYoungestGirl.age**2+ReneMiddleGirl.age**2+ReneOldestGirl.age**2	T

We just need to add a few more conditions to ensure that the boys have different ages from the girls in each family. Fortunately conditions c, d, e and f take care of the boys and girls separately

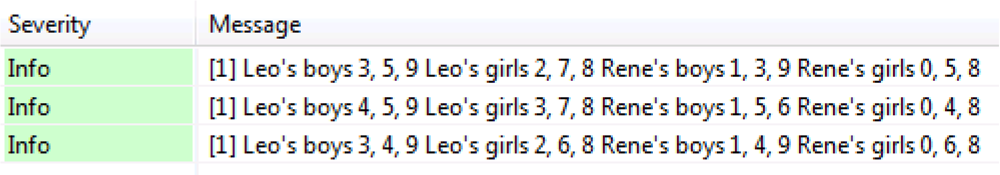
In the test input we just need to supply the possible values that the boys and girls ages can take:

Girls can be 0..9, but boys can only be 1..9

This is because the youngest child in Leo's family is a girl and there is a girl in Rene's family whose age is less than one year. So no boy can be age 0.

Answer

This results in three possible solutions (takes about 4 seconds)



Severity	Message
Info	[1] Leo's boys 3, 5, 9 Leo's girls 2, 7, 8 Rene's boys 1, 3, 9 Rene's girls 0, 5, 8
Info	[1] Leo's boys 4, 5, 9 Leo's girls 3, 7, 8 Rene's boys 1, 5, 6 Rene's girls 0, 4, 8
Info	[1] Leo's boys 3, 4, 9 Leo's girls 2, 6, 8 Rene's boys 1, 4, 9 Rene's girls 0, 6, 8