Genealogy and Mathematics

Roger Herz-Fischler

Genealogical listings fall into two main categories: ascending and descending. An ascending listing (or tree) would typically involve as many ancestors of a person, or a couple, as it is possible to determine. A descending listing (or tree) would typically involve as many descendants of a person, or a couple, as it is possible to determine. An ascending listing answers the question, "Where do I (we) come from?", whereas a descending list is, in the first instance, of interest in cases of monarchies or in the distribution of estates. Of course, if one can find an ancestor in a descending list, then the construction of the ascending list is facilitated.

The following is about a method of designating people in *ascending* genealogies.[1] Several designation systems exist, but none of those that I found described answered all of the following criteria:

1. The sex of an ancestor should be immediately evident from the numbering system.
2. The number of generations (the "ancestral generations") from the starting person to the listed person should be immediately evident from the numbering system.
3. For a couple whose parents come from the same town or region it would not be surprising to find that they have ancestors in common. If this is the case it also not surprising to find that that the common ancestors belong to different ancestral generations for the wife and husband.[2] The numbering system should easily apply to such a situation.

A Binary Ancestor Designation System

To illustrate the system I will use my wife Eliane and I as the starting couple.

In the system that I propose the number "1" indicates that the person is a female and the number "2" a male.[3] As we go back in ancestral generations we simply add a "1" or a "2" at each stage. Thus Eliane is 1, her father is 12, and her father's mother is 121 (Eliane's paternal grandmother). To find the designation of the parents of particular person, just add a "1" or "2" to the number. Thus the parents of Eliane's paternal grandmother (121) are 1211 and 1212. To find the child of any person just take off the last digit, the child of 1211 and 1212 is the female 121.

If we consider, for convenience, the starting person eliane (1) as belonging to the 0th ancestral generation, then her parents are represented by two numbers (11 and 12) and they belong to the 1st ancestral generation. The four grandparents are represented by three numbers (111, 112, 121, 122) and belong to the 2nd ancestral generation. So the ancestral generation is always one less than the number of terms in the representation.

What about the case of a common relative? In our case Eliane's paternal grandmother (121) was the sister of one of Roger's maternal two *great* grandmothers (2111).[4] This generational gap occurred because Roger is descended from the oldest sister in a large family, whereas Eliane is descended from the youngest daughter. The mother of these two daughters thus will have a *double* designation: 1211 / 21111 and is at the same time a great-grandmother of Eliane and a great-great-grandmother of Roger. From that point on the two ascending lines are identical.

How Many Ancestors?

The number of ancestors increases by a factor of 2 every time that we go back a generation. This enables us to calculate directly the number of ancestors in each ancestral generation and the total number of ancestors if we go back a certain number of generations. I will illustrate the pattern using the third ancestral generation, but the same rules hold for any ancestral generation.

Great-grandparents—the third ancestral generation—are indicated by the form 2XXX (2 representing Roger). Here there are three Xs, with 3 being the number of the ancestral generation. The number of the generation—one less than the number of terms—is always 2 more than the number of "greats", here $1 + 2 = 3$ and conversely the number of "greats" is always 2 less than the number of the generation here $3 - 2 = 1$.

In the 1st ancestral generation (parents) there are $2 = 2^1$ ancestors. In the 2nd ancestral generation (grand parents) there are $2 \times 2 = 4 = 2^2$ ancestors. The number of people in this third ancestral generation (great-grandparents) is $2 \times 4 = 2^3 = 8$.

How many ancestors do we have to deal with if we go back to the third ancestral generation? The total number of ancestors in the 1st, 2nd and 3rd ancestral generations is $2 + 4 + 8 = 14 = 16 - 2$. But $16 = 2^4$ is the number of ancestors in the next ancestral generation, i.e. in the 4th ancestral generation (the great-great-grandparents). So the total number of ancestors in the 1st, 2nd and 3rd ancestral generations is two less than 2^4, the number of ancestors in the the 4th ancestral generation.

Another way of looking at this is that if we include the starting person Roger then the 16 people of the 4th ancestral generation have $16 - 1 = 15$ descendants (one person is lost along the way, so to speak!).

Notes

1. Descending listings—by their very nature—becoming quickly overwhelming and difficult to follow.
2. Note that it is entirely possible that the same physical person represents two different ancestors of the starting person. This would happen if at one point first cousins married. These cousins would have the same two grandparents (going back through their parents who were siblings) and the names of these two grandparents would appear twice in a chart of ancestors of the starting person.
3. Normally one uses 0 and 1 in binary represention, but their use in family situations might not be appreciated by one and all!
4. The other maternal *great* grandmother is (2121). Similarly Roger has two paternal *great* grandmothers (2211, 2221).