## Honeybees and Family trees

See http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Fibonacci/fibnat.html** There are over 30,000 species of bees and in most of them the bees live solitary lives. The one most of us know best is the honeybee and it, unusually, lives in a colony called a hive and they have an unusual Family Tree. In fact, there are many unusual features of honeybees and in this section we will show how the Fibonacci numbers count a honeybee's ancestors (in this section a "bee" will mean a "honeybee").
First, some unusual facts about honeybees such as: not all of them have two parents!
Mily
In a colony of honeybees there is one special female called the queen.
3 There are many worker bees who are female too but unlike the queen bee, they produce no eggs.
$31 y^{2}$
There are some drone bees who are male and do no work.
Males are produced by the queen's unfertilised eggs, so male bees only have a mother but no father!


All the females are produced when the queen has mated with a male and so have two parents. Females usually end up as worker bees but some are fed with a special substance called royal jelly which makes them grow into queens ready to go off to start a new colony when the bees form a swarm and leave their home (a hive) in search of a place to build a new nest.


Queens have 2 parents


Males have 1 parent.

So female bees have 2 parents, a male and a female whereas male bees have just one parent, a female.

Here we follow the convention of Family Trees that parents appear above their children, so the latest generations are at the bottom and the higher up we go, the older people are. Such trees show all the ancestors (predecessors, forebears, antecedents) of the person at the bottom of the diagram. We would get quite a different tree if we listed all the descendants (progeny, offspring) of a person as we did in the rabbit problem, where we showed all the descendants of the original pair.


Let's look at the family tree of a male drone bee.

1. He had 1 parent, a female.
2. He has $\mathbf{2}$ grand-parents, since his mother had two parents, a male and a female.
3. He has $\mathbf{3}$ great-grand-parents: his grand-mother had two parents but his grand-father had only one.
4. How many great-great-grand parents did he have?

Again we see the Fibonacci numbers :

| Number of | parents: | grandparents: | great-grandparents: | great,great grand parents: | gt,gt,gt grand parents: |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Of a MALE bee: | 1 | 2 | 3 | 5 | 8 |
| of a FEMALE bee: | 2 | 3 | 5 | 8 | 13 |

