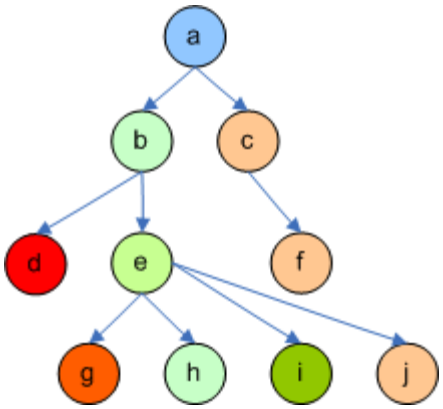
Intelligence grows on trees

It's time to think about intelligence, what it is, how it works, and how it can be measured.

I always considered that IQ tests are subjective, allowing you to reveal only one or several aspects of a personality. In the long run they fail to give you a clear picture, and if you're holding the results of a person's test in your hand, and the label says *"IQ=87"*, what can you really say about that person, except *"this test says that this person has an IQ of 87"*?

No, this story will not tell you how to measure one's intelligence, instead it will provide an abstract model which tries to explain how intelligence works at a high level. I don't know how this was implemented in our brains, so don't ask, because this is not the objective of this story.

The idea is that intelligence is a function of a tree's depth, width and color ;-)



Take a look at this picture, what you see is a chart that illustrates the possible states of a system (the system is a person). Assume that the person has to solve a problem, such as "buy potato-chips". The person will think about the possible ways of solving the problem, and divide them into steps (i.e. analyze by dividing the whole into smaller components).

The current state is marked with blue (it is state A).

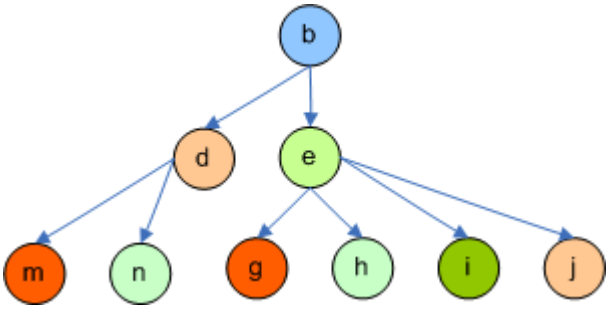
At each step, things can evolve in different ways, thus different possible evolution scenarios have to be studied. On the picture they look as paths from A to an end-point, ex: A-C, A-B-D, A-B-E-G, ...

At each step, one can determine which scenarios are more likely to happen, and which ones are less likely to happen, thus priorities are set. Obviously, a scenario with a greater priority will be paid more attention to, while the less realistic ones will be ignored or studied less thoroughly. On the picture, more probable scenarios are highlighted with different flavors of green (the darker the green, the greater the probability), while less realistic scenarios are highlighted with red and its derivatives (the 'redder', the less probable).

We can see that the scenario that will be chosen by the person is A-B-E-I, because the entire path is made of tones of green. In a perfect case, the tint gets darker at each increment of the depth, but in the real world it is possible that by the time a state is reached, the chart priorities are updated in such a way that a scenario that seemed less probable at the start will end up being chosen as the final solution.

How can we spot the difference between an intelligent person and a less intelligent one? The tree of an intelligent person's thinking process is:
- deeper
- wider
- well-prioritized
- backed-up at each step (i.e. a copy is made, it can be used later)

It means that from a given state (in our case it is A) the person is able to foresee the potential problems and adapt to the environment in a way that damage is minimized while the benefits are maximized.



Ok, the person is in A, and it seems that B is the optimal choice at the moment, thus the next chosen state is B. Once there, the person will make another assessment and re-set the priorities. See the other picture; since the person is in B, the entire C-branch can be chopped-off because it is not relevant anymore (though it will be a good idea to keep a history of previously made steps, so that if in the future one is forced to go back, they will be able to re-use the tree that was generated earlier). Notice the other change: once the current state is B, it was determined that D is not as bad as it seemed, thus it became 'less red', hence possibilities that derive from D are computed (and prioritized) as well.

The next state will be E, and if everything goes by the plan, the last step is I, the chips are in the bag, and *"mission complete*" will appear on the screen :-)

If it turns out that A-B-E-I didn't work out, nor did any other scenario from the E-branch, the person can use the archive and revert to one of the previous steps; ex: go back to B and try B-D-N; if that fails, go back to A and try A-C-F.

Other things that have to be mentioned

An experienced person will have to perform less *"restore from a backup*" procedures, because the priorities they set are computed thoroughly (i.e. if it is green, then it is damn sure it'll stay green). An inexperienced person will have to revert to an earlier backup more often, but this experience will then be used in the future, resulting in more correct predictions. It is clear that backups are important.

How are priorities set? Well, in theory, the decisions are based on the data which the person holds. In other words, decisions are made to the best of one's knowledge. This explains why sometimes a less intelligent person will solve a task faster than an intelligent one: they simply knew something the others didn't know, which gave them a strategic advantage. Note that a truly intelligent person will quickly realize that "revert to backup" happens because of lack of knowledge, thus they will do their best to be as well-informed as possible, making them more successful in decision-making processes. It means that at one point an intelligent person will determine what the factors that have an impact on their accuracy rate are, and afterwards they will do their best to gather all the required components.

A less intelligent person will not do that, because they don't understand what are the things that lead to correct decisions. This explains why less intelligent persons are less successful - they were probably tipped by someone (or found something out being extremely lucky), but since it is not in their habit to harvest information - they won't be able to deal with future problems when they are less lucky *(luck is ephemeral; and so is beauty... we may get back to this in one of the future episodes, when the possible connection between beauty and intelligence will be dissected)*.

This brings us to another point: **intelligence vs knowledge**. In theory, they are different; most often an intelligent person possesses knowledge, because at some point in the past they realized that a rich knowledgebase yields in better predictions about the possible ways of a scenario's evolution. There are also cases in which a person knows something but they are unable to process and use that information. For instance, you can ask them what the result of 2x2 is and they'll say 4, because they memorized the whole multiplication table; but when you ask them how much is 18x24, they will fail to use the knowledge they have (due to lack of intelligence), thus be unable to provide an answer.

This explains why some children have good results in the initial phases of school but become 'average' a few years later: at a young age they outperform the intelligent ones who have no knowledge; but afterwards the others catch up by gathering information and combining it with their intelligence.

Bugs and debugging:

What about the cases when a less intelligent person solves a problem faster than an intelligent person? According to the theory we are now examining, a less intelligent person has a smaller tree, and if we take it to the extreme: the person will only think about the next possible step (i.e. NOT think several steps ahead). If we take it to the real extreme: they will only think about the next possible step, and if they have several solutions, they will not sort them by priorities and choose one randomly (or by some other criterion which is not the probability of that scenario to become reality).

In this case it is perfectly possible that the dumb person will find the optimal solution by **being lucky enough** to make the correct decision at each step; while the intelligent person spends more time because they invest into computations dedicated to the non-optimal branches of the tree.

But in the long run it is obvious that an intelligent person is more successful; luck may get you out of trouble once or twice, but since the things that happen in real life vary a lot, you can't count on luck.

Besides luck, there is another possibility, it was mentioned earlier - **external intervention**. This is simple: imagine that at one point somebody gives a dumb person a free hint, providing them a critical detail that will have a major impact on their ability to solve the problem. Ex: *"the shares will go +5% in the next two days*", such a tip can be used by a dumb person to make a good investment, thus earn more. Another possibility is that the hint is incorrect, and it was used without being examined, resulting in money loss. In contrast, an intelligent person would "hook-up" the hint to their tree and examine it along with the other branches - giving them a chance to avoid a problem if the tip is false.

Anomalies - cases which don't follow the pattern. Let us analyze this C program that prints dots on the entire screen *(sorry if you are not into computers and programming, but I'll try to keep it simple)*:

```
... int i=0, j=0;

while (i++ < screen_height)
__{
____while (j++ < screen_width)
_____putpixel(i, j);
____j=0;
__}
...
```

One can say *"but this program will not work correctly if i (or j) is negative*"; indeed - this means that the dot will be printed off the bounds of the screen, which is impossible, and the behaviour of the system is undefined in such a case. But take a closer look at the code: in the beginning i and j are set to zero, and the while loop ensures that the values of i or j will never get outside the edge of the screen *(i.e. the condition is "i is smaller than the height of the screen)*; this means that the hypothetical situation when i or j is negative cannot occur.

Hold on for a second, it can, if something has entered the memory of the program and modified the values of its variables in one way or another. Imagine that i is set to -45 before it is being used by the putpixel function - we'll end up in one of those 'impossible situations'. This requires a small rectification: *"impossible situation in normal circumstances"*. Let's face it, if the program runs on an operating system that cannot guarantee that its memory will not be altered by an external process, we cannot guarantee that the program will run smoothly. But this is not a problem with the program, instead it is a problem of the underlying operating system - it may have vulnerabilities, the computer may be infected with a virus, someone may deliberately change the values of a variable with a debugger, and so on.

The same can be applied to our life - normally things work as they should, thus patterns are followed; but in some cases the system in which we exist does not behave correctly, and that's when anomalies occur. The material presented so far explains that anomalies are '**external interventions**'.

There is another interesting detail: why should an intelligent person generate a wide tree, when it is clear that many of its branches are not

realistic? Well, a possible explanation is that an intelligent person anticipates cases in which *"the world doesn't work right*", i.e. takes into account the fact that i may somehow become negative, and if it does - there is plan B.

Boy, that was a long one... Let me summarize; an intelligent person will generate a tree that is
- wide
- deep
- prioritized
- backed up
- the tree should also include less realistic scenarios as well, so that the person doesn't panic when it turns out that there is no ground beneath their feet
- the tree shouldn't be too wide or too deep, because this way the person gets stuck with thoughts and does not act (we all know that time is precious). Note that it is possible for a person to be so quick at extrapolating, that they are able to generate a wide and deep tree within a reasonable amount of time.

Notes for myself:
- potential diseases: when one's trees are always red (pessimist), or too green (naive, or blind optimist)
- uber-mega-hitech individuals who can rely on a tree which has the width of 1; if it turns out to be wrong, they are able to generate another one in no time