

# Fuzzy Logic and the Decision Matrix

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## Clear Categories

Western logic is based on clear categories in which it is possible to decide what is in and not in a category. If you can clearly define categories, there are all sorts of logic rules you can apply to come to new conclusions.

So ancient Greek philosophers (especially Aristotle) worked hard to come up with the defining criteria for everything. Trying to uniquely define humans, they needed to distinguish it from other animals. One pointed out that most animals had four feet, while humans only had two, so humans were bipeds. But another philosopher pointed out that birds also had two feet. After some discussion, it was pointed out that all birds have feathers, so the final definition was that humans were "featherless bipeds."

So just for fun, one of their colleagues went home, got a chicken out of the backyard, plucked out all its feathers and brought it in to the discussion the next day -- "is this then a human?"

A more recent case was the discovery in Australia of strange animal called the platypus. As Robert Pirsig tells the story in his book *Lila*, scientists had figured out the defining characteristics of various kinds of animals. Mammal was the label given to those who nursed the young with their milk. Reptiles were the ones which laid eggs. This great classification worked for years, but the mother platypus lays eggs, and when the young hatch, nurses them with her milk.

People were angry at this discovery. Religious preachers labeled it an abomination before God. Any educated person knew such an animal was impossible, but without education the platypus keeps laying eggs and nursing babies.

The point is that category systems are figments of human imagination. Some work better than others and get labeled as "truth" until another classification system comes across that fits reality better.

For example, in terms of relativity theory, it is no more correct to say that the earth revolves around the sun than to say the sun travels around the earth. But putting the earth as the central reference point makes the math incredibly more complicated.

One of the functions of creativity is to find those better schemes, another is to discover the ideas hidden from others by the currently accepted "true" categories.

## Fuzzy Logic

There is a way of defining things that is as old as Plato, but which is extremely powerful today as a control technology. Instead of trying to build the box around a category, we define it as how close we are to an ideal.

A good example would be defining who owns what land. Clear Aristotelian logic tells us to draw lines between various fixed points and everything inside those lines is your property. A fuzzier, more Platonic method would be to say that everything by the big tree is yours. The closer to the tree, the more it is yours.

This may sound like an inferior approach but our minds work quite effectively with fuzzy categories. We can look around the room at various objects and decide which ones are more like a chair, which ones are more like an orange. We can look at people and judge which are more like John Wayne and which are more like Gandhi.

Analysis of these judgments shows that we are actually considering lots of different criteria in these judgments, measuring a kind of distance from the ideal on each criteria.

Theorists in this area use multidimensional calculations to figure out this distance. As the more mathematically inclined know, since the Pythagorean formula of the distance between two points equaling the square root of the sum of the squares of the sides applies no matter how many

dimensions, it is possible to calculate the distances between different choices on many different criteria at once and an ideal, as long as the units can be matched.

So, if you describe your perfect house in terms of the many dimensions listed in the real estate listings, it is possible to compute the relative closeness of different houses in the database to your ideal. In fact, researchers can have you organize twenty houses in your order of preference and infer your preferences and their priorities, then find the best house of all in their inventory. (Unfortunately, couples never agree on the sequencing or the priorities, so this technology never became commercially utilized.)

A simpler method with similar results is the decision matrix which has been taught in management classes for a long time.

### Decision matrix

The decision matrix was developed to handle the kinds of decisions which have many dimensions which can not be translated into each other. It lets you think about choices one criteria at a time, then combine those judgments. A common example is the choice of a car to purchase or where to go on vacation.

To build the matrix:

- { list your alternatives and list your criteria.
- { list the alternatives down the left side of the matrix and the criteria across the top.
- { taking the criteria one at a time, evaluate all the alternatives on that criteria alone. While it is possible to use available numbers like dollars or feet, it is generally better to chose the best alternative on that criteria and label it a 10 and the worst alternative on that criteria and label it a 1. Now that you have anchored each end of the spectrum, give relative evaluation numbers to each of the rest.
- { since some criteria are more important than others, people often list weighting numbers along the top. Some criteria are 1's, but others a 2's because they are seen as twice as important.
- { multiply the weighting criteria by each evaluation number and add those numbers together to get a total for the total.

The following example compares vacations. Given these ratings and weights, it seems to recommend staying home. although Orlando would seem to be a close second.

<b>Vacations</b>	Cost	Have Fun	Stories to tell	Total points
<b>Weights</b>	5	2	1	
Home	10/50	2/4	1	55
Cancun	2/10	10/20	8	38
Peoria	8/40	1/2	1	43
Orlando	6/30	8/16	6	52
Paris	1/5	6/12	10	27

Many who use the matrix are very careful not to use it as an absolute. An MIT professor, Leo Moore used to tell the story of a student in his management class, which required them to use the matrix on a problem of their choice. One of his best students handed in the assignment late, obviously upset. Asked for details, the student pointed out that as a senior in engineering, he expected to be married in June, so he decided to list all his candidates and evaluate them with his criteria. Leo agreed that it was an interesting application, with a clear result. So he asked the student why he was so distraught, and was told "but I don't like her!"

Matrices are approximations of complex fuzzy decisions. If your gut and the numbers match, it is probably a good decision. But if they don't match, check both your insight and your math. You may have omitted some of the most important criteria.

### Decision Matrix and Insight

In my own research into cross functional teams, I found that those who used this matrix had more highly creative and insightful ideas. Even though this is generally used after the brainstorming phase, it seems to give the team members a way to more complexly understand the problem in full.

A second finding of my research was that the best ideas seemed to come when the team was preparing the report, after using the decision matrix to examine ideas. Apparently, after examining the best ideas with the matrix, it is common for even better ideas to occur to the team.

So, especially for complex problems, this matrix may be a most powerful tool for improving the effective creativity of teams.

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