HEURISTICS

Heuristics

(from Greek word meaning to discover) are any approach to a problem solving or self-discovery that uses shortcuts to produce good-enough solutions given in a limited time frame or deadline. In other words, it employs a practical method that is not guaranteed to be optimal, perfect, or rational, but is nevertheless sufficient for reaching an immediate, short-term goal or approximation. Where finding an optimal solution is impossible or impractical, heuristic methods can be used to speed up the process of finding a satisfactory solution. We can say that heuristics are a flexibility technique for quick decisions, particularly when working with complex data.

Heuristics can be mental shortcuts that ease the cognitive load of making a decision. **In simpler words, heuristics are conclusions we addopt from previous experiences we had with similar problems. We can use this approach of problem solving in human beings, machines and abstract issues. We usually use it if:**

- we are having difficulty understanding a problem, we try drawing a picture.
- we can't find a solution, we try assuming that we have a solution and seeing what we can derive from that ("working backward").
- the problem is abstract, we try examining a concrete example.
- we try solving a more general problem first (the "inventor's paradox": the more ambitious plan may have more chances of success).

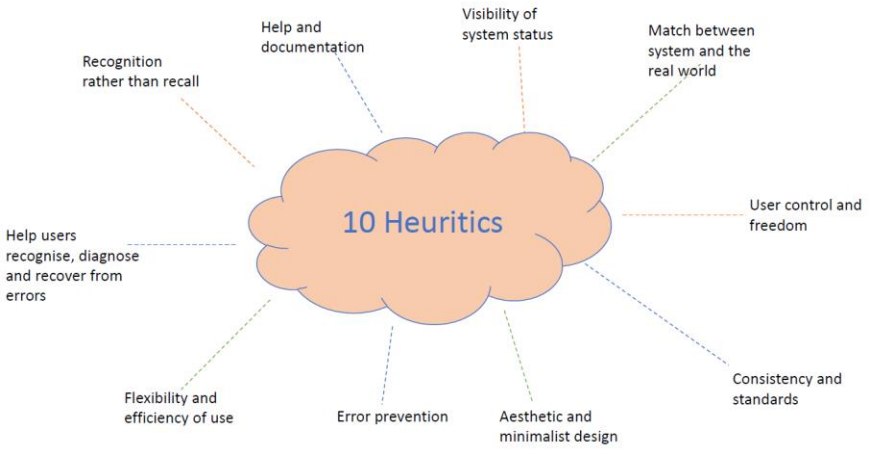
(from George Pólya's 1945 book, How to Solve It)

Today, heuristics are most widely used in the AI and UX development.

Examples that employ heuristics include using trial and error, a rule of thumb or an educated guess.

The most fundamental heuristic is trial and error, which can be used in everything from matching nuts and bolts to finding the values of variables in algebra problems. In mathematics, some common heuristics involve the use of visual representations, additional assumptions, forward/backward reasoning and simplification.

In psychology, heuristics are simple, efficient rules, learned or inculcated by evolutionary processes, that have been proposed to explain how people make decisions, come to judgments, and solve problems typically when facing complex problems or incomplete information. Researchers test if people use those rules with various methods. These rules work well under most circumstances, but in certain cases can lead to systematic errors or cognitive biases.



**Example of heuristic evaluation on a web development*

Some models of heuristics used the most:

Take-the-best

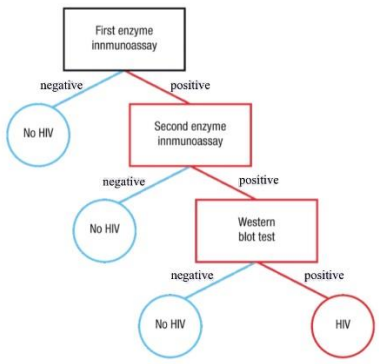
The take-the-best heuristic **exploits the basic psychological capacity for retrieving cues from memory in the order of their validity**. Based on the cue values, it infers which of two alternatives has a higher value on a criterion (choosing the alternative based on the first cue that discriminates between the alternatives, where cues are ordered by cue validity (highest to lowest). In the original formulation, the cues were assumed to have binary values (yes or no) or have an unknown value. The logic of the heuristic is that it bases its choice on the best cue (reason) only and ignores the rest.

Fast-and-frugal trees

A fast-and-frugal tree is a heuristic that allows to make classifications, such as whether a patient with severe chest pain is likely to have a heart attack or not, or whether a car approaching a checkpoint is likely to be a terrorist or a civilian**. It is called "fast and frugal" because, just like take-the-best, it allows for quick decisions with only few cues or attributes.** It is called a "tree" because it can be represented like a decision tree in which one asks a sequence of questions. Unlike a full decision tree, however, it is an incomplete tree – to save time and reduce the danger of overfitting.

Figure 1 shows a fast-and-frugal tree used for screening for HIV (human immunodeficiency virus). Just like take-the-best, the tree has a search rule, stopping rule, and decision rule:

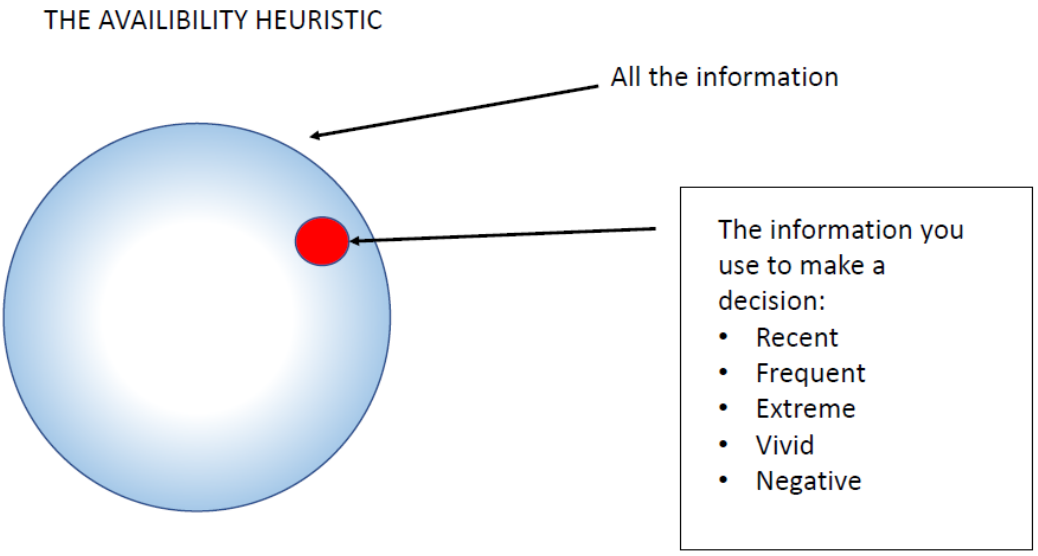
Search rule: Search through cues in a specified order. *Stopping rule*: Stop search if an exit is reached. *Decision rule*: Classify the person according to the exit (here: No HIV or HIV).

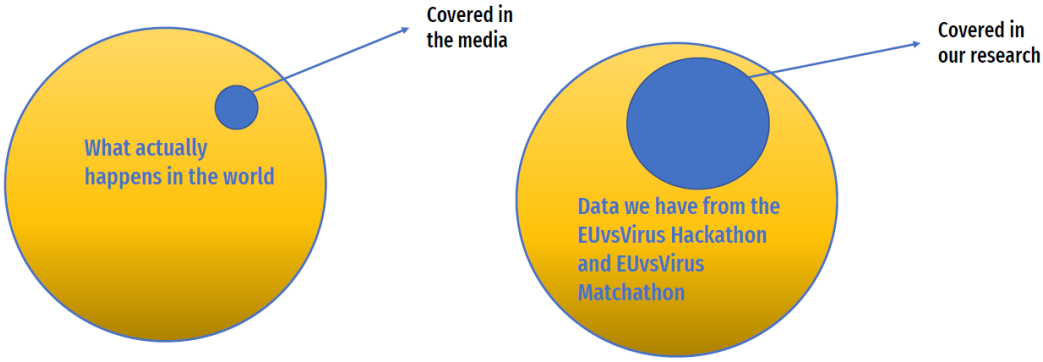


Fast-and-frugal trees are descriptive or prescriptive models of decision making under uncertainty. For instance, an analysis or court decisions reported that the best model of how London magistrates make bail decisions is a fast and frugal tree. The HIV tree is both prescriptive– physicians are taught the procedure – and a descriptive model, that is, most physicians actually follow the procedure.

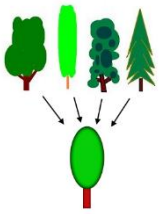
Availability

In psychology, ***availability*** **is the ease with which a particular idea can be brought to mind**. When people estimate how likely or how frequent an event is on the basis of its availability, they are using the availability heuristic. When an infrequent event can be brought easily and vividly to mind, this heuristic overestimates its likelihood. For example, people overestimate their likelihood of dying in a dramatic event such as a tornado or terrorism. Dramatic, violent deaths are usually more highly publicised and therefore have a higher availability. On the other hand, common but mundane events are hard to bring to mind, so their likelihoods tend to be underestimated. These include deaths from suicides, strokes, and diabetes. **This heuristic is one of the reasons why people are more easily swayed by a single, vivid story than by a large body of statistical evidence**. It also plays a huge role in the games of chance like sports betting or casinos. Where people often hear stories of huge winnings but no player likes to disclose how many time they lost to witness that one amazing win they often brag about.





Representativeness



The **representativeness heuristic is seen when people use categories**, for example when deciding whether or not a person is a criminal. **An individual thing has a high *representativeness* for a category if it is very similar to a prototype of that category**. When people categorise things on the basis of representativeness, they are using the representativeness heuristic. **"Representative" is here meant in two different senses: the prototype used for comparison is representative of its category, and representativeness is also a relation between that prototype and the thing being categorised.** Simply speaking we are using a prototype to compare all others towards the prototype. This can be seen when we re doing market research and we devise a prototype buyer of our certain product.

Anchoring and adjustment

Anchoring and adjustment is a heuristic method used in many situations where people estimate a number. According to Tversky and Kahneman's original description, it involves starting from a readily available number—the "anchor"—and shifting either up or down to reach an answer that seems plausible. In experiments, people did not shift far enough away from the anchor. Hence the anchor contaminates the estimate, even if it is clearly irrelevant. In one experiment, subjects watched a number being selected from a spinning "wheel of fortune". They had to say whether a given quantity was larger or smaller than that number. For instance, they might be asked, "Is the percentage of African countries which are members of the United Nations larger or smaller than 65%?" They then tried to guess the true percentage. Their answers correlated well with the arbitrary number they had been given. Insufficient adjustment from an anchor is not the only explanation for this effect. An alternative theory is that people form their estimates on evidence which is selectively brought to mind by the anchor

The effect is stronger when people have to make their judgments quickly. Subjects in these experiments lack introspective awareness of the heuristic, denying that the anchor affected their estimates.

Anchoring is often used as a good tool for barter in middle eastern countryies. Where the seller trys to anchor you to a higher price by setting the original price way to high. Even if you know the price is too high you are more likely to take a higher price and be content with it.

Affect heuristic

"Affect", in this context, is a feeling such as fear, pleasure or surprise. It is shorter in duration than a mood, occurring rapidly and involuntarily in response to action. While reading the words "lung cancer" might generate an affect of dread, the words "mother's love" can create an affect of affection and comfort. **When people use affect ("gut responses") to judge benefits or risks, they are using the affect heuristic**. The affect heuristic has been used to explain why messages framed to activate emotions are more persuasive than those framed in a purely factual way. We see a lot of examples of this practices being used for marketing products.

Attribute substitution

According to this theory, when somebody makes a judgment (of a *target attribute*) which is computationally complex, a rather more easily calculated *heuristic attribute* is substituted. In effect, a difficult problem is dealt with by answering a rather simpler problem, without the person being aware this is happening. This explains why individuals can be unaware of their own biases, and why biases persist even when the subject is made aware of them. It also explains why human judgments often fail to show regression toward the mean
This substitution is thought of as taking place in the automatic *intuitive* judgment system, rather than the more self-aware *reflective* system. Hence, when someone tries to answer a difficult question, they may actually answer a related but different question, without realizing that a substitution has taken place.
One example of subtitution is, if a shopper is intending to make some form of complicated purchase, they will often ignore the technical and mentally challenging details (emissions, consumption... for a car) and instead make the decision based on a much simpler aspect, such as “I like the colour”. Although many will not admit this in focus groups.

Simon's satisficing strategy

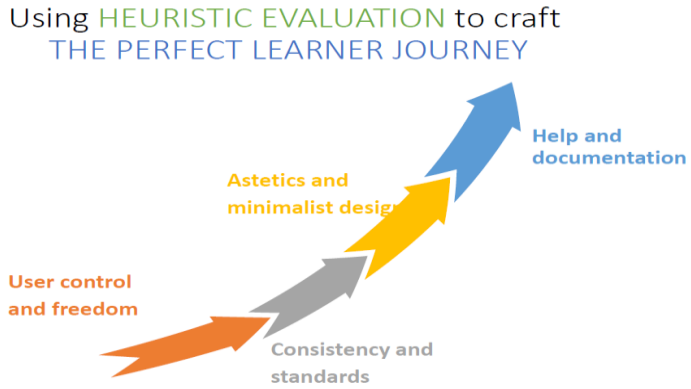
Herbert Simon's satisficing heuristic can be used to choose one alternative from a set of alternatives in situations of uncertainty. Here, uncertainty means that the total set of alternatives and their consequences is not known or knowable. For instance, professional real-estate entrepreneurs rely on satisficing to decide in which location to invest to develop new commercial areas: "If I believe I can get at least x return within y years, then I take the option

In general, satisficing is defined as:

- Step 1: Set an aspiration level A
- Step 2: Choose the first alternative that satisfies A

If no alternative is found, then the aspiration level can be adapted.

- Step 3: If after time B no alternative has satisfied A, then decrease α by some amount C and return to step 1



Cognitive maps

Heuristics were also found to be used in the manipulation and creation of cognitive maps. These internal representations are used by our memory as a guide in our external environment. It was found that when questioned about maps imaging, distancing, etc., people commonly made distortions to images. These distortions took shape in the regularization of images (i.e., images are represented as more like pure abstract geometric images, though they are irregular in shape).

There are several ways that humans form and use cognitive maps, with visual intake being an especially key part of mapping: the first is by using **landmarks**, whereby a person uses a mental image to estimate a relationship, usually distance, between two objects. The second is **route-road** knowledge, and is generally developed after a person has performed a task and is relaying the information of that task to another person. The third is a **survey**, whereby a person estimates a distance based on a mental image that, to them, might appear like an actual map. This image is generally created when a person's brain begins making image corrections. These are presented in five ways:

1. **Right-angle bias**: when a person straightens out an image, like mapping an intersection, and begins to give everything 90-degree angles, when in reality it may not be that way.
2. **Symmetry heuristic**: when people tend to think of shapes, or buildings, as being more symmetrical than they really are.
3. **Rotation heuristic**: when a person takes a naturally (realistically) distorted image and straightens it out for their mental image.
4. **Alignment heuristic**: similar to the previous, where people align objects mentally to make them straighter than they really are.
5. **Relative-position heuristic**: people do not accurately distance landmarks in their mental image based on how well they remember that particular item.

Another method of creating cognitive maps is by means of auditory intake based on verbal descriptions. Using the mapping based from a person's visual intake, another person can create a mental image, such as directions to a certain location.

1. The Disadvantages of Using Heuristics

As in any method, there are some very straight forward disadvantages to the heuristics since they are prone to bias and errors in judgment. The user's final decision may not be the optimal or best solution, the decision made may be inaccurate and the data selected might be insufficient leading to an imprecise solution to a problem. For example, copycat investors often imitate the investment pattern of successful investment managers to avoid researching securities and the associated quantitative and qualitative information on their own.

Example: Suppose you are sitting in a meeting and listening to a speaker who talks about a topic that you know nothing about.
Even if the speaker doesn't really say anything particularly clever, after a while, you will start to have a certain amount of confidence in him given that you do not know anything about the subject.
Just the fact that the speaker is able to talk about something in a certain amount of time (say 20 minutes) in a coherent manner gets your heuristic decision making to conclude that the speaker probably actually does know what he's talking about, and that the content probably actually is clever, though perhaps you cannot understand its meaning. Furthermore, if the speech was really as bad as you suspected at first, wouldn't you have just left?

2. Grounded theory and & or heuristic approach:

In academia diffusion team we have already been talking about the grounded theory approach as the qualitative methodology of choice for our work and in regard to heuristic apporach it sound very similar. In fact, it is contrasting heuristic inquiry as a very different but equally useful form of qualitative methodology.
The differences and simlarities yet to be researched.

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