Could Decision Making be Recognition

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I.

Defining recognition is a dicey business. We know what a person means when they say that they 'recognize the painting on the wall' or that they 'recognize the person on the couch' or that they 'recognize that pattern of behavior'. To say exactly what this 'recognition' amounts to, and in a unified way, is more difficult. A cursory attempt may be 'the application of a concept to our perceptions'. I find this a good initial attempt, but it begs the question of what concepts and perceptions are. I will give concepts and perceptions something of a simplified mathematical form.

I will understand by perceptions, 'qualities in a perceptual space'. We need not get into the questions of dualism. It suffices to say that a perceptual space has a geometry and qualities are values at a location in that geometry. We may therefore idealize and say that perceptual space has a Euclidean geometry and qualities in that space take values, say, on the interval (0,1). I will understand by a concept, a pattern, which can be said to apply to a portion of perceptual space when it – or a portion of it – 'fits' the qualities of that region. This is best explained with a simple, discrete example.

Consider a five by five grid. In each location there is a data point. A concept is some pattern which applies to the data in the grid. The simplest of patterns are collections of intervals at relative locations, so that in the following grid:

1	3	2	7	7
4	4	1	6	6
4	5	4	3	3
2	2	8	6	4
5	2	5	3	4

The pattern

[4, 8]	[5, 7]
	[3, 5]
	[4, 5]

applies at position (4, 2), (column, row). Where the interval indicates the value in which the quality must fall. This is a simple example in which we don't allow for permutations of the pattern in space, though we could allow this with an indicator specified on the pattern.

This perceptual space is flat, but we can still consider the partial application of patterns. The above pattern applies partially in the aqua blue squares, with two places in the pattern spilling over the edge. If this perceptual space was not flat, but in three dimensions, then we could consider the partial application of patterns which extended behind other qualities. Finally, if the perceptual space was not only three dimensional, but n-dimensional, we could consider the partial application of n-dimensional patterns which extended into all dimensions. In all, the possibility of partial applications asks us to

extend the notion of 'space' beyond perceptual space, to a space of recognitions, in which perceptual space is embedded (what after all would *actual* hidden qualities be?)

Finally, we consider the possibility that one of our dimensions is temporal. Then the partial application of patterns turns quickly into *expectation*. Suppose that the rows in our previous table represent moments in time in the recent past, the most recent at the top. Then the partial application of the pattern at the aqua blue positions represents an expectation, namely that at the next instant

[4, 8]   [5, 7]

will apply at position (0, 0) (extending to (1, 0)).

This notion of recognition as patterns applied over qualities would be in need of extension to cover all types of recognition, but it is an initial step towards raising the question of whether decision is recognition. What is needed to make the full case is an understanding of action which fits with our picture of recognition.

II.
Suppose for the moment that certain columns in our perceptual space are designated 'action' columns, because we have some measure of possible control over them. Then patterns apply equally to action columns in the same way as we have indicated above. Now imagine that a partial recognition involving action extends into the future; then as time rolls into the present, what happens with the actions? One answer is that the actions are decided upon by a different process and executed independently of recognition, and recognition then fits or it does not. Another answer is that the action column is at least influenced by the recognition itself, and that this influence is what decision amounts to. I will give a picture of how this could be the case.

It is fair to assume that the patterns that get stored and applied are done so based on their association with rewards, which then gets transformed into an update to the value of a pattern (as with Bellman's equation). The values of competing patterns then determine which patterns get applied in a given case. Initially actions are 'decided' upon randomly. In the language of reinforcement learning, this is 'exploration'. As time goes on, we hit upon patterns of value which involve actions, and in applying patterns to experience (recognition) we execute the actions that are part of these patterns. In the language of reinforcement learning, this is 'exploitation'.

This leaves a lot of questions unanswered. It says nothing of how patterns take shape or how values are specified for patterns. But more importantly for our cause, it only covers a very basic form of decision. It is fair to assume that algorithms for trading off between exploitation and exploration are sufficient to cover basic decision making of the above form, but it does not say how decision making in the form of deliberation takes place. There are quite a lot of difficulties in specifying algorithms, not least of which is created by the shear numbers of patterns. Even if we limit the window from which patterns can be drawn, there is an explosion of patterns based on e. g. the intervals which can be formed, and this does not begin to consider patterns over aggregations. If it is the case that cognition generally follows this system, it is not at all clear how the human mind handles such complexity. Still, it is possible to see how decision *could* be recognition.

III.
Our model of decision would not be complete without an understanding of deliberation. The object of deliberation may be a single action or a plan. We understand a plan simply as patterns connecting from the present and into the future, involving actions. Deliberation can be understood with a theory of how patterns are combined in applications, based on their coherence and values. With real time rudimentary data, there is no time for deliberation, so proper deliberation should be understood to take place over aggregated data. If data over time is aggregated, it is subject to fewer updates.

A simple understanding, using interval patterns over aggregated data, would combine patterns, first and foremost, only if they *could* be part of a single recognition. This means that if two patterns are "tried" at two different locations, leading to overlap in the patterns at a certain hypothetical data point in the future, then the patterns can only be 'kept' in the event that their intervals covering this hypothetical data point actually overlap. (And if this data point is an action data point, then the value which is 'decided upon' in exploitation, must fall within the intersection of these intervals).

We can say that the patterns which come together in deliberation, should we be rational, are those with the greatest expected value. This entails that we maintain measures of the probability of patterns in addition to their value. This seems reasonable, though it is not reasonable to assume that people always act rationally. The process is likely greedy, in which patterns are applied at first according to their probability and value, and subsequent patterns are chosen based on their fit with those patterns also according to their probability and value.

IV.
It is not unreasonable to assume that our recognitions have dimensionality. Anyone who has played with gestalt figures will find it clear that there is something more to recognition than the quality surface to which our concepts are being applied. That as it is, I think it also reasonable to believe that the actions which we execute also result from recognitions of this kind. What I find difficult to believe is that the results of planning and deliberation are held in the mind as firm as a recognition of an object or action before us. It seems that recognitions extending only so far into the future already have a fragility or weakness to them, which needs to be accompanied by something more stable – e. g. writing – for them not to be lost. It is interesting to consider the importance of writing in planning, but this must wait for another day.