A Framework for Quantum Character Recognition

Aman Chawla

March 31, 2024

Abstract

In this note the authors propose the use of the quantum perceptron algorithm. It is proposed to train the quantum perceptron to detect a classical signal, namely that generated by various characters of the Sanskrit alphabet.

Consider the problem of recognition of Sanskrit alphabet by a quantum perceptron. A classical perceptron is usually thought of as a linear classifier, meaning that if the sets to be considered for classification are separable by a hyperplane, then the problem is tractable. A corresponding study of the quantum perceptron algorithm proposed in would open up new understanding of this paradigm.

In this paper, we begin with the Sanskrit alphabet. The script is the Devanagari script. The first problem we encounter is how to decompose each character for recognition purposes. It is clear that one could proceed with a decomposition into straight strokes, horizontal or vertical, loops and so on. But a framework which encompasses all these possibilities might not be very simple. Another way to proceed is to consider the process of writing a character on a sheet of paper. As the pencil tip moves across the paper, it moves in various "directions" sequentially. A digitzed character can be therefore thought of as a sequence of angles. Each angle is held for a fixed delta time interval. The next question that comes up is that of the discontinuities in this sequence. These could be encoded as "trace curves" which are drawn in a different, very light marking, but with the same general angular encoding procedure as above. One could add a fixed multiple of 360 degrees to the trace markings. This would clarify that one is in a trace curve portion and not in the general marking region. With the encoding clarified, we proceed to the next step, that of converting the encoded angle sequence into a voltage. For theory, the angle-encoding can be treated directly as a voltage in the microvolt range, thus ensuring that the overall character lies in the range [-10 mV, +10 mV]. The advantage of these small voltages is that they are amenable for experimental work and application to monovalent ions.

The next step is to apply this angle-encoding voltage as the dynamic environment voltage of the Schrodinger Equation for each of the N ions of the quantum perceptron. The entire "text" is thus converted to a signal that interfaces with the quantum particles. As the text is applied, the particle motion is influenced. Following the complete application of the text, but before it is complete, the three step "perceptron control" voltage sequence discussed in [1] is applied at the same position, namely the environment of each Schrodinger equation. This ensures that there is overlap between the input data and the perceptron operation. In future work, the amount of overlap necessary will need to be investigated.

The final state of the ions thus gets created and it in turn generates an electric field pattern at some distance. This is treated as the classification "result." If the result is not in line with the known mean result for a known character or character-sequence, the quantum perceptron is said to have failed in classification. The difference between the desired and actual classification is passed back as feedback to "perceptron control." The process is repeated until the weights of the controller begin to converge. Once the *quperceptron* is deemed to have been trained, it can be tested and its performance in text recognition can be quantified.

References

[1] Aman Chawla. Quantum perceptrons and evolution. March 2024.