

## The AURA Technology.

The AURA technology provides tools for the storage and retrieval of imprecise data. Unlike traditional database systems and indexing methods, AURA is based in associative memory (sometimes known as content addressable memory) which allows a user to search a large amount of data for items (e.g. data records) similar to a users query. Put simply, AURA allows a user to compare an unknown item against every item stored, and retrieve the examples that are the most similar very quickly. One example could be a set of names and addresses: you could take a name, match it against all the names in the set, find the best matches and retrieve the corresponding address (or any other data).

Of course it is possible to achieve this using existing search methods and many similarity measures are possible. However, when the data becomes large (i.e. individual items and/or the number of items may be large) the process can get very slow and impractical. Typically  $O(n*P)$  where n is the number of items and P is the size of each item.

Traditionally, database systems have overcome this by maintaining an index recording the location of each data item as it is stored. The index mechanism allows a user to find matching items directly without having to compare the input query with every item to find out which items match. In our simple example above, names would be indexed and an input query would use the index to directly find the matching address data. Unfortunately, in order to construct such an index clean data is required, plus knowledge of how the data is to be accessed. For example, unless the index takes into account every spelling variation of each name, it will fail if the names are not spelled correctly. Furthermore, if the user has an address and wants to find the corresponding name, the system would need an additional index for the address field (which again is required to be clean data). Without this it would be inflexible and not very useful in many applications.

The AURA technology overcomes this by allowing the user to match on **any** part of the stored item and allows errors in the input. Using AURA, the input need only be **similar** to the stored item. For example the system could find matches where every letter is different, but only one character position away from the query!

AURA is unique as it is designed specifically to allow very large (e.g. Terabyte) associative memories to be built on conventional hardware but still operate very quickly, faster than any other methods. They have been designed to exploit computer memory for fast searching and bit level representations. AURA runs on conventional computers but scales to very large parallel machines. Cybula also offers bespoke parallel technology based on DSP and FPGA hardware for the most demanding of problems in the form of the CortexOne parallel machine.

How does AURA achieve its world beating performance? The technology uses ideas from biology on how the brain organises information, especially neural network methods. However, unlike other neural networks, AURA allows data to be 'trained' (stored) very quickly while retaining the pattern matching ability of neural networks. AURA uses a combination of methods that, together, overcome the usual limitations of neural networks.

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