

Brennan McFarland

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Problem Set 5

Perfectly Recoverable Memories

With the happyworld, clubspade, printrtrash, handheart and winhelp bitmaps all loaded, the network is able to perfectly recover all five of them without any error from their corrupted counterparts. However, as soon as the computersum bitmap is added to the weight matrix (after of course being converted), only clubspade and winhelp can be perfectly recovered.

Bitmaps loaded	Able to perfectly recover
Happyworld, clubspade, printrtrash, handheart, computersum, winhelp	Clubspade, winhelp
Happyworld, clubspade, printrtrash, handheart, winhelp	Happyworld, clubspade, printrtrash, handheart, winhelp

Convergence to Perfect Recall

Below is illustrated the convergence of recall for the err_printrtrash bitmap:



0 iterations



200 iterations, 21 additional changes



500 iterations, 18 additional changes



1000 iterations, 12 additional changes



2000 iterations, 19 additional changes



3000 iterations, 4 additional changes

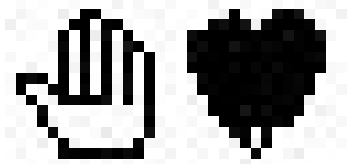


4000 iterations, 0 additional changes (convergence)

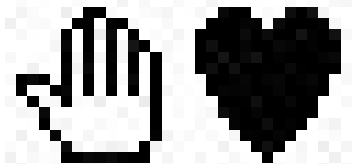
Memory Interference

It is notable that even when the network was not able to accurately recall all memories, it was still able to do so with some and not others. In the observed case, it can be inferred that

clubspade, printtrash, and handheart all interfered with computersum in attempts at recall. This is likely due to the fact that these images all had a fair amount of overlap in their bitmap values, as all of them contained two objects side-by-side with a general shape closer to the computer and sum objects than say happyworld, whose objects are more regular and rotund involving less straight lines. Thus it is most likely that overlapping pixel values between the unrecallable images and the computersum bitmap simply reduced the orthogonality of the encoded vectors by too much, making it difficult for the network to distinguish between them due to their interference with each other. It is important to note, and supports the previously stated hypothesis, that although the network is not able to completely recover these images, it does not completely fail and is still able to approximate them, and in fact still comes quite close. For example, the recalled vector for handheart is only off by a few pixels after it converges (and it still does converge) after 4000 iterations:



As opposed to the original image:



Thus, although filling the weight matrix with less-than-orthogonal encoded vectors does not guarantee they will be perfectly recalled even on convergence, they can still be greatly restored from the original corrupted input.