Preparing for the Final Exam 2022 in Neurocomputation

After consulting with a few students,I have scheduled tentatively a review/question session on Wed June 29 at 6 PM on zoom. I will be happy to answer your questions then. (Moed Aleph is July 5 .) The alternative time is Sunday July 3 at 10 AM.

I remind you that your final grade will be 50 % from the two projects together (25% each) and 50% from the final. You must pass the final for the projects to count in the grade. (That is, you have to pass the final to pass the course.)

Overall most of the material of the course is covered in the Faussett book (a pointer to which is on the moodle), chapters 1, 2,3, 4 and 6 and of course in the videos of my lectures as well as the powerpoints and pdfs posted on the moodle. In addition SDM (Sparse Distributed Memory) you can obtain from my presentation or from the Wikipedia article.

---------------------------------------------------------------------------------------------------------------------------

The following informal short guide may help you prepare for the exam. There is also the powerpoint on the moodle where I listed subjects.

Basically, you need to know the following models: Mc-Cullough Pitts Neuron, Perceptron, Adaline, Feed-forward Networks, Hamming Net, Max Net, Kohonen Net, (Counter-Propagation is an application as is the material on project 2) Hopfield Network, BAM (Bidirectional Associative Memory) Network (I will not ask you about applications to combinatorial problems like the traveling salesman problem which appear in some of the powerpoints).

This means knowing the architecture (be able to sketch a model), the algorithms, and in general what you can expect to happen when running one of these models. You should understand the ways these models relate to two-class classification, one class classification, clustering and associative memory.

On these networks, you need to know what they are; what use they have, what issues went into designing or using them and some mathematical issues relating to them (See below).

In the Faussett Book the appropriate chapters are Chapters I – IV, and VI. Further material is in the videos, powerpoints and pdfs on the moodle.

**Mathematical Issues and Proofs**

Understand the difference between training and testing; and accuracy on each case

1. What does linearly separable mean and how is it related to various models?
2. The proof that if a Boolean function can be linearly separated, then the Perceptron theorem is guaranteed to converge to a solution that works for the network.
3. The proof that every Boolean function can be represented by a feed-forward network of three levels (actually, depending on how you count, we proved it for four levels; which is all you are responsible for)
4. The conditions and proof under which either the Hopfield Network will be guarantee to always converge to a stable state, as well as its relationship with an energy (Lyapunov) function. (I will not ask you about using the model to solve combinatorial questions, eg TSP).
5. What is “crosstalk”?
6. The same as the above for the BAM network.
7. I will \*NOT\* ask you to derive the backpropagation algorithm, but you need to understand its basic aspects and the relationship with gradient descent.
8. Representation of Sparse Distributed Memory as a 3 level neural network and as a generalized random access memory
9. \*\*\*NOT ON EXAM TSDM (Temporal Sparse Distributed Memory)
10. \*\*NOT ON EXAM Reservoir Computing
11. \*\* NOT ON EXAM Special Techniques for “Deep Learning” e.g . “dropout”