

Redes Neurais Artificiais

98

São: sistemas computacionais, de implementação em hardware ou software, que imitam as habilidades computacionais do sistema nervoso biológico, usando um grande número de processadores simples (neurônios artificiais) e interconectados entre si.

Emprestam da biologia:

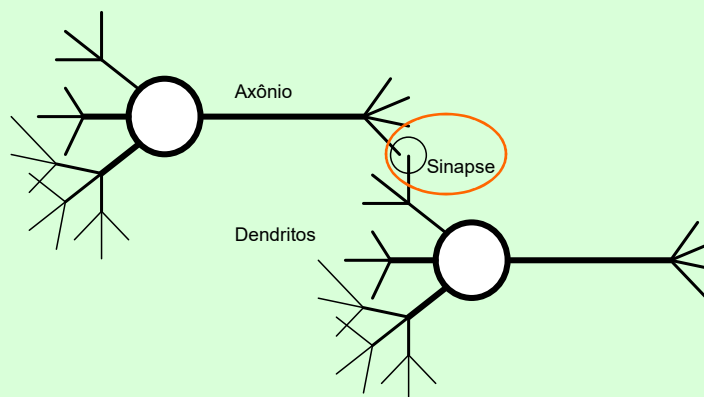
- A estrutura de processamento microscópico (processamento de informação de neurônios individuais)
- Em algum grau, aspectos da organização de redes neurais biológicas – como os neurônios se interligam
- O aprendizado através de exemplos (através de casos)

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98

Cômputos mais complexos ... são realizados pelo encadeamento de vários neurônios

99



A conexão entre um axônio de um neurônio e um dendrito de outro é denominada **Sinapse**

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99

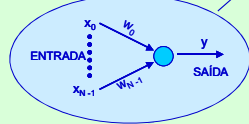
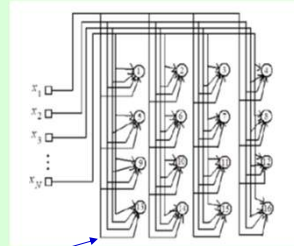
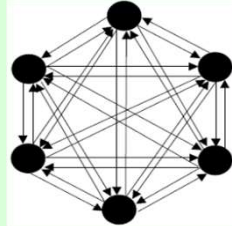
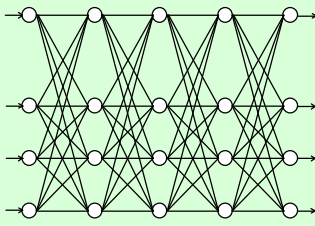
Três arquiteturas neurais importantes (abordadas em pósgrad – PSI 5886)

100

1) MLP
- Multi Layer
Perceptron

2) Memória
Associativa
de Hopfield

3) Mapas Auto-
Organizáveis
de Kohonen



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100

Três arquiteturas neurais importantes (abordadas em pósgrad – PSI 5886)

101

Nosso Foco aqui

1) MLP
- Multi Layer
Perceptron

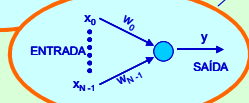
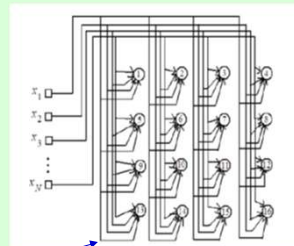
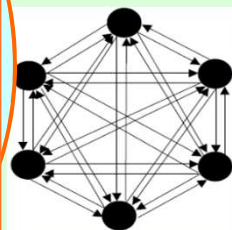
2) Memória
Associativa
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3) Mapas Auto-
Organizáveis
de Kohonen

Foco deste Curso:
o Multi Layer Perceptron (MLP)

- Múltiplas entradas / Múltiplas saídas / Múltiplas camadas
- Variáveis (internas e externas) analógicas ou digitais
- Relações lineares ou não lineares entre elas

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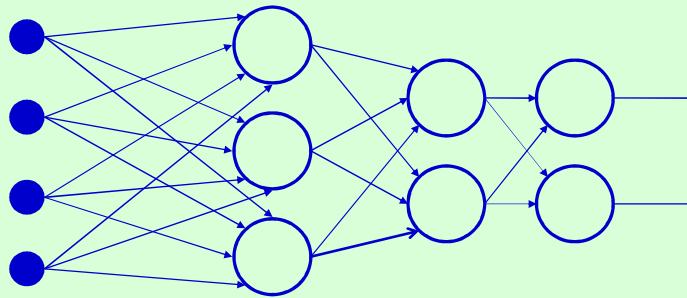
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101

Foco deste Curso: o Multi Layer Perceptron (MLP)

103

- Múltiplas entradas / Múltiplas saídas / Múltiplas camadas
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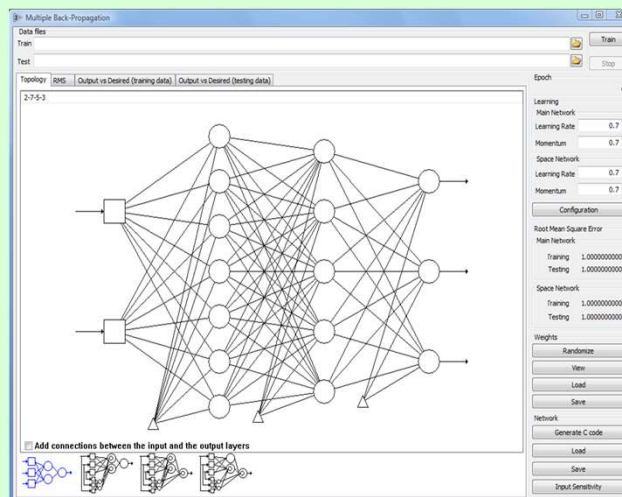


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103

Exemplo de tela do ambiente MBP definindo uma Rede Neural do tipo MLP – Topology “2-7-5-3”

104

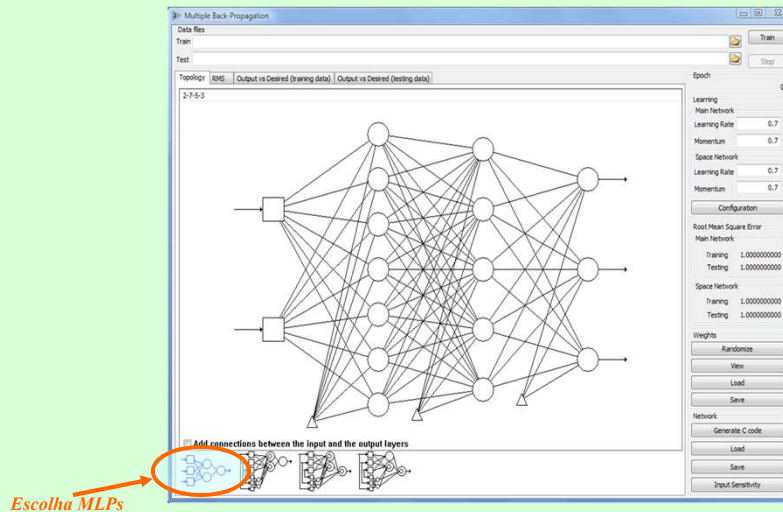


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104

Exemplo de tela do ambiente MBP definindo uma Rede Neural do tipo MLP – Topology “2-7-5-3”

105



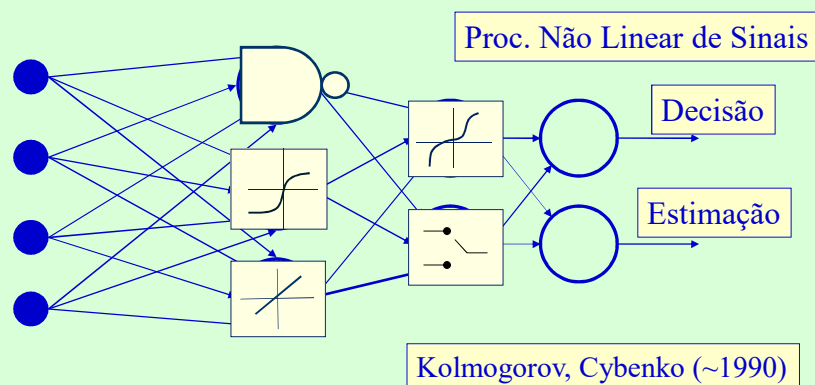
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105

O Multi Layer Perceptron (MLP)

106

- Múltiplas entradas / Múltiplas saídas / Múltiplas camadas
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106

Aparte ...

Vocês já ouviram falar de ...

- Deep Learning?
- Redes Neurais Profundas?
- Redes Neurais Convolucionais?

Pois é ... São temas bem quentes do momento e que têm muito a ver com a arquitetura MLP que vocês estão aprendendo aqui em PSI3471!!

Tutorial 2 – criando 2 conjuntos empíricos, de treino e de teste

Multiple Back-Propagation

Para STOA - Algor ... Multiple Back-Pr ... Multiple Back-Pr ... #bottom x #bottom Nova guia (341) Laboratoric +

← → ↻ mbp.sourceforge.net/tutorial/tutorial2.html#bottom

Multiple Back-Propagation

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Multiple Back-Propagation

Data files
Train: [] Train
Test: [] Stop

Output in desired training data [] Output in desired testing data []

Epoch 0

Learning Rate 0.7
Momentum 0.7
Spice Network Learning Rate 0.7
Momentum 0.7

Configuration

Root Mean Square Error

High Network
Training 1.000000000
Testing 1.000000000

Spice Network
Training 1.000000000
Testing 1.000000000

Weights
Initialize
Load
Save

Network
Generate Code
Load
Save
Input Sensitivity

If you use this program for any scientific work, or related, please cite one of the references below and if possible send me an e-mail with the citation to emod@ipq.pt.

Lopes, N and Ribeiro, B. (2003). An Efficient Gradient-Based Learning Algorithm Applied to Neural Networks with Selective Activation Neurons. In *Neural, Parallel & Scientific Computations*, volume 11, pages 253-272. Dynamic Publishers.

Lopes, N and Ribeiro, B. (2001). Hybrid learning in a multi neural network architecture. In *INNS-IEEE International Joint Conference on Neural Networks, IJCNN01*, ...

In the Articles folder accompanying this program ... note references for the articles.

Thank you.

This program can be freely obtained on the site <http://dx.dig.ge/MBP>. You should not pay or donate any money for this program. Please read the license accompanying the program.

☐ Add connections between the input and the output layers

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109

Para STOA - Alguns : Multiple Back-Propa #bottom Multiple Back-Propa Multiple Back-Propa (342) Laboratorio de +

mbp.sourceforge.net/tutorial/tutorial2.html#bottom

Multiple Back-Propagation

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Multiple Back-Propagation

Date file: Train: Test: Epoch: 0

Learning Rate: 0.7 Momentum: 0.7

Hidden Network: Training: 1.0000000000000000 Testing: 1.0000000000000000

Speed Network: Training: 1.0000000000000000 Testing: 1.0000000000000000

Weights: Randomize: Yes Load: Save: Network: Generate C code: Load: Save: Input Sensitivity:

If you use this program for any scientific work, or related, please cite one of the references below and if possible send me an e-mail with the citation to mbp@igug.pt

Lopes, N. and Ribeiro, B. (2003). An Efficient Gradient-Based Learning Algorithm Applied to Neural Networks with Selective Activation Neurons. In *Neural, Parallel & Scientific Computation*, volume 11, pages 253-272. Dynamic Publishers.

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In the Articles folder accompanying this program you will find links and the BibTex, ACM Ref and EndNote references for the articles.

For MBP to understand the data files, they must obey to the following conditions:

1. The columns containing the data must be separated by white spaces and its number must remain fixed.
2. The first line of the data file may optionally be a title line, where you may have a description of the columns. Just remember that the title columns cannot have white spaces because they are used as column separators. You may however use any other characters, such as the underscore, to separate words in the title columns.
3. MBP recognizes only numbers as data. Moreover only the dot (.) is recognized as the decimal separator and no thousands separator is recognized.

X	Y
0.218959	0.196178
0.047045	0.162958
0.678865	0.833997
0.679296	0.602405
0.934693	0.623243
0.383502	0.838679
0.519416	0.671648

Add connections between the input and the output layers

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109

110

Para STOA - Alguns : Multiple Back-Propa #bottom Multiple Back-Propa Multiple Back-Propa (342) Laboratorio de +

mbp.sourceforge.net/tutorial/tutorial2.html#bottom

Multiple Back-Propagation

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Learning Rate: 0.7 Momentum: 0.7

Hidden Network: Training: 1.0000000000000000 Testing: 1.0000000000000000

Speed Network: Training: 1.0000000000000000 Testing: 1.0000000000000000

Weights: Randomize: Yes Load: Save: Network: Generate C code: Load: Save: Input Sensitivity:

Tetrahydrocortisone Pregnenetriol Type

3.0	1.3	A
1.9	1.4	A
9.1	0.6	B
9.2	7.9	C
2.6	0.1	A
3.9	0.6	B
3.8	0.2	A

Still you can code characteristics that have non-numeric values transforming them into numeric characteristics.

used Learning Algorithm Applied to Neural Networks with

In *Computations*, volume 11, pages 253-272. Dynamic

in neural network architecture. In *INNS-IEEE International Joint*

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Add connections between the input and the output layers

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110

111

Multiple Back-Propagation

For example, if a variable has three possible values (A, B and C) you can replace it with three columns of data, so that each column would have a value of one for all the lines where the characteristic presents the corresponding values and a value of zero for the remaining lines.

Tetrahydrocortisone	Pregnenetriol	Type	Type-A	Type-B	Type-C
3.0	1.3	A	1	0	0
1.9	1.4	A	1	0	0
9.1	0.6	B	0	1	0
9.2	7.9	C	0	0	1
2.6	0.1	A	1	0	0
3.9	0.6	B	0	1	0
3.8	0.2	A	1	0	0

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112

Tutorial 3 – definindo entradas saídas e topologia da rede neural

Multiple Back-Propagation

Tutorial 3
Defining the topology of the neural networks.

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Sobre a pergunta de Lucas em sala de aula ... E se precisarmos de produtos entre as variáveis de entrada?

R: Poderíamos usar redes neurais com nós neurais de maior ordem, que incluem também produtos das entradas ...

Outra possibilidade seria encapsularmos os produtos ($x_j * x_k$) eventualmente desejados no bloco de extração de medidas / características, usando redes neurais de 1ª ordem (sem produtos entre variáveis). É uma opção semelhante a se trabalhar com redes neurais de ordens mais elevadas (que fazem produtos de variáveis). Finalmente, é bom saber que segundo Cybenko, redes neurais MLP com nós neurais de primeira ordem já são aproximadores universais, mesmo com apenas 2 camadas.

