

Casos de aplicações de RNA Classificação & Regressão

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regressor (taxi)

classificador (tati)

conclusão

analise

otimização

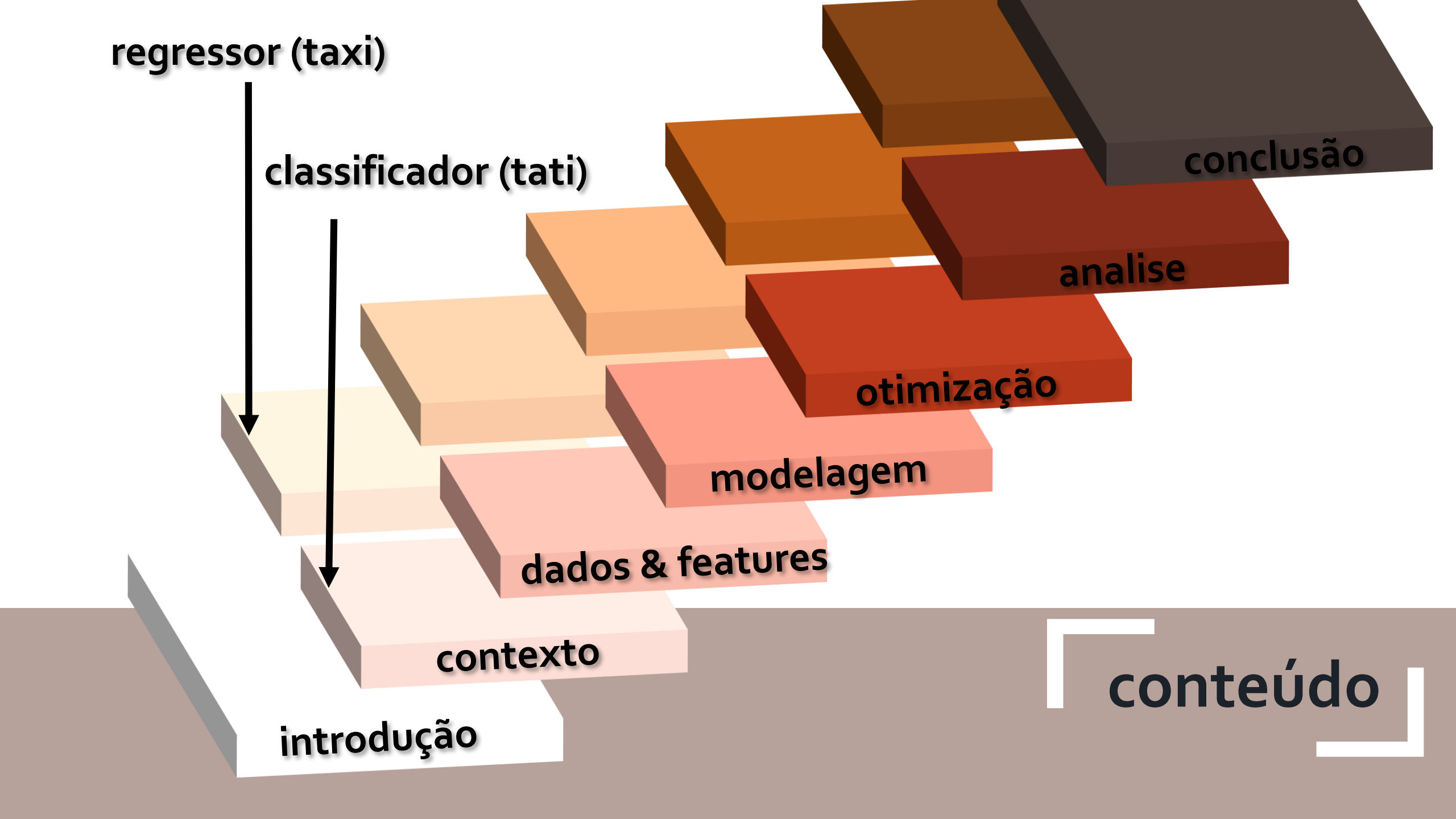
modelagem

dados & features

contexto

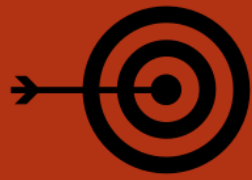
introdução

conteúdo



TAXI – predição da Taxa de Cambio

Regressor



Objetivo

Aplicar as redes neurais num projeto de regressão linear para estimar a taxa de cambio do real frente ao dólar (USD/BRL)



~3,313



Metodología

Coleta dos dados.

Testar diferentes redes neurais usando a interface de MATLAB.

Análise de qualidade

Refinamento.

Procurar melhoras.

Segundo teste.




Coleta de dados

- Mes.
- Dia o mes.
- Dia da semana.
- PIB do Brasil.
- PIB dos E.U.A.
- IPC do Brasil.
- CPI dos E.U.A.
- A taxa de cambio do dia atual.
- Indicador Ibovespa



Pré-processamento

- Taxa de câmbio; @  **BANCO DO BRASIL**
- + todos os demais dados
- Dados de entrada e saída
- Dados de um dia para o dia seguinte

Treino e Testes

- 2526 dados para o **treino**
- 683 dados para **teste**

Ibovespa	Dia do Mes	Dia da Semana	Mes	PIB (BR) R\$ 1.000.000,00	PIB (USA) 1.000.000.000	IPC	CPI	Taxa do dia atual	Taxa do dia seguinte
16930.42	3.00	2.00	1.00	276.93	10031.00	8.85	2.74	1.80	1.83
15851.00	4.00	3.00	1.00	276.93	10031.00	8.85	2.74	1.83	1.85
16245.14	5.00	4.00	1.00	276.93	10031.00	8.85	2.74	1.85	1.85
16106.89	6.00	5.00	1.00	276.93	10031.00	8.85	2.74	1.85	1.83
17022.13	10.00	2.00	1.00	276.93	10031.00	8.85	2.74	1.82	1.82
16572.72	11.00	3.00	1.00	276.93	10031.00	8.85	2.74	1.82	1.83
16616.87	12.00	4.00	1.00	276.93	10031.00	8.85	2.74	1.83	1.82
17298.07	13.00	5.00	1.00	276.93	10031.00	8.85	2.74	1.82	1.80
18053.22	17.00	2.00	1.00	276.93	10031.00	8.85	2.74	1.79	1.79
17903.23	18.00	3.00	1.00	276.93	10031.00	8.85	2.74	1.79	1.80
17470.24	19.00	4.00	1.00	276.93	10031.00	8.85	2.74	1.80	1.78
17176.73	20.00	5.00	1.00	276.93	10031.00	8.85	2.74	1.78	1.78
17105.26	26.00	4.00	1.00	276.93	10031.00	8.85	2.74	1.78	1.77
17081.16	27.00	5.00	1.00	276.93	10031.00	8.85	2.74	1.77	1.79
16388.27	31.00	2.00	1.00	276.93	10031.00	8.85	2.74	1.80	1.79
16522.20	1.00	3.00	2.00	276.93	10031.00	7.86	3.22	1.79	1.79
16868.46	2.00	4.00	2.00	276.93	10031.00	7.86	3.22	1.79	1.78
17457.12	3.00	5.00	2.00	276.93	10031.00	7.86	3.22	1.78	1.78
18125.60	7.00	2.00	2.00	276.93	10031.00	7.86	3.22	1.77	1.76
18685.58	8.00	3.00	2.00	276.93	10031.00	7.86	3.22	1.76	1.76
18361.39	9.00	4.00	2.00	276.93	10031.00	7.86	3.22	1.76	1.77
18603.81	10.00	5.00	2.00	276.93	10031.00	7.86	3.22	1.77	1.76
17819.01	14.00	2.00	2.00	276.93	10031.00	7.86	3.22	1.77	1.78
17920.73	15.00	3.00	2.00	276.93	10031.00	7.86	3.22	1.78	1.77

Análise de qualidade

Redes neurais de provas

7 entradas:

- Mes.
- Dia o mes.
- Dia da semana.
- PIB do Brasil.
- PIB dos E.U.A.
- IPC do Brasil.
- CPI dos E.U.A.

	Tempo	Erro>0.1	Erro<0.05	Erromax	Erromin
Rede 1	19.4285	299	254	1.673	1.12E-04
Rede 2	19.22	247	242	0.6965	6.93E-05
Rede 3	18.9564	220	273	1.002	5.29E-04
Rede 4	20.8592	225	314	0.7833	5.22E-05
Rede 5	20.3453	238	334	0.7677	2.18E-04
Rede 6	20.2541	245	295	2.018	9.55E-05
Rede 7	79.5825	216	345	0.8104	1.87E-04
Rede 8	119.8514	229	332	2.042	7.08E-05
Rede 9	85.7161	222	308	0.625	6.37E-05





Análise de qualidade

Redes neurais de provas

9 entradas:

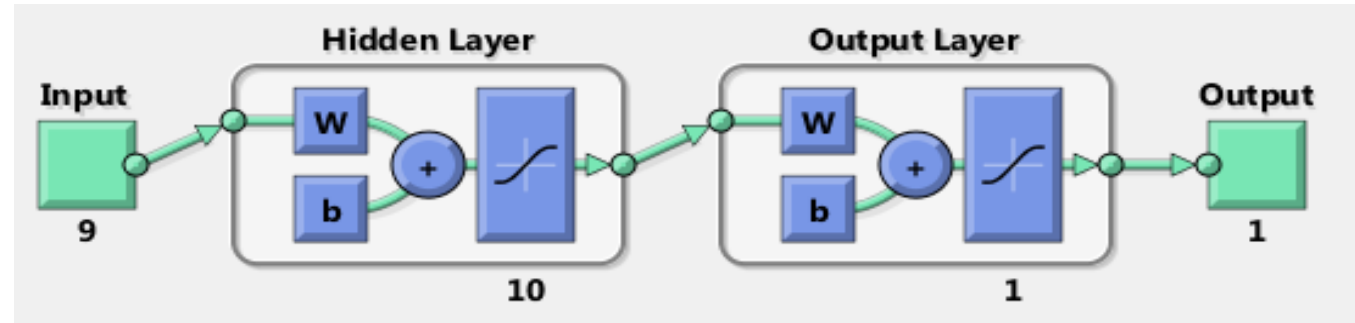
- Mes.
- Dia o mes.
- Dia da semana.
- PIB do Brasil.
- PIB dos E.U.A.
- IPC do Brasil.
- CPI dos E.U.A.
- A taxa de cambio do dia atual.
- Indicador Ibovespa

	Tempo	Erro>0.1	Erro<0.05	Erromax	Erromin
Rede 1	83.2544	8	640	0.154	2.45E-06
Rede 2	68.1752	4	640	0.186	4.31E-05
Rede 3	69.5627	10	631	0.178	2.74E-05
Rede 4	74.8813	9	638	0.168	3.59E-06
Rede 5	75.2985	9	644	0.154	4.08E-05
Rede 6	74.7327	20	610	0.288	1.53E-05
Rede 7	80.2957	11	648	0.157	1.65E-05
Rede 8	78.6203	8	639	0.202	1.55E-04
Rede 9	20.8326	33	593	0.2526	3.09E-05

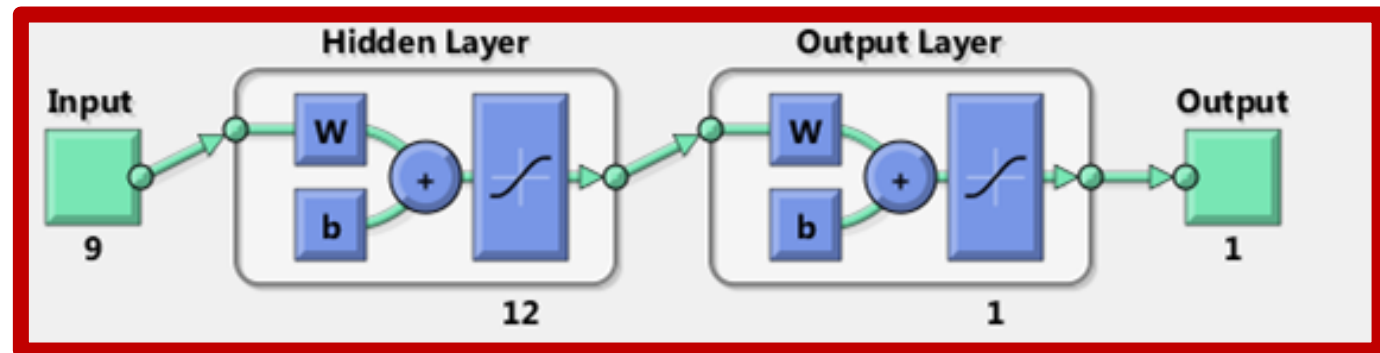


Análise de qualidade

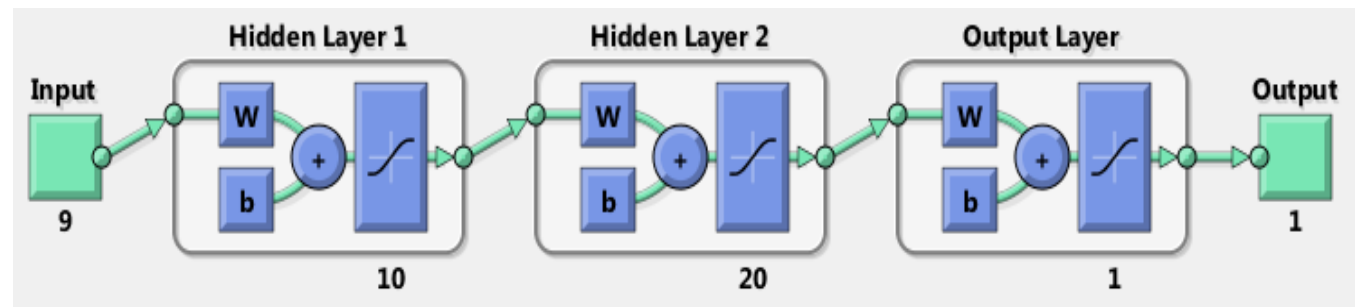
Melhores resultados



Rede 1



Rede 2



Rede 5





RNA resultante


Resumo dos valores absolutos dos pesos

PESOS	Ibovespa	Dia do Mes	Dia da Semana	Mes	PIB (BR)	PIB (USA)	IPC	CPI	Taxa do dia actual
Rede1	4.64371	4.823177	5.78992	4.79288	5.20418	6.12718	6.61365	5.339867	5.140308
Rede2	6.6469518	7.028319	6.92905	7.32682	4.97561	5.36439	6.58665	7.498909	6.78381
Rede3	12.984851	7.940402	10.4927666	10.37681	21.16654	13.933231	12.059381	11.493845	18.456095
Rede4	5.688009	2.4073367	4.828595	2.884101	4.08882	4.0633585	5.162565	3.9121397	8.898573
Rede5	3.952902	2.4400071	1.686545	2.017822	4.751097	6.35375	2.169487	4.227686	9.66278
Rede6	8.102847	5.812005	4.50528	5.913481	6.454829	6.1234427	8.04993	6.0610512	12.83798
Rede7	2.665176	1.661779	0.7215975	2.759647	4.19985	5.47903	4.14533	2.98544	6.6277
Rede8	5.106114	6.024364	3.670187	4.672156	4.051935	8.09675	5.345388	4.9039218	8.79909
Rede9	9.407592	6.777109	7.508091	9.828533	8.588359	13.257233	10.06	10.233277	15.598115



Conclusões - Observações

Relevância dos dados de entrada conforme os pesos

- 
1. CPI
 2. Mes
 3. Dia do mes
 4. Taxa do dia actual
 5. Dia da semana
 6. Ibovespa
 7. IPC
 8. PIB(EUA)
 9. PIB(BR)



Conclusões - Observações

Observações gerais

- Um estudo que precisa de muito tempo
- Melhor resultado com uma rede simples
- Outro tipo de redes

TATI – TAp Touche Interface

Localização de fonte sonoras por meio de RNA classificador

Motivation



Superfície tátil (IHM)

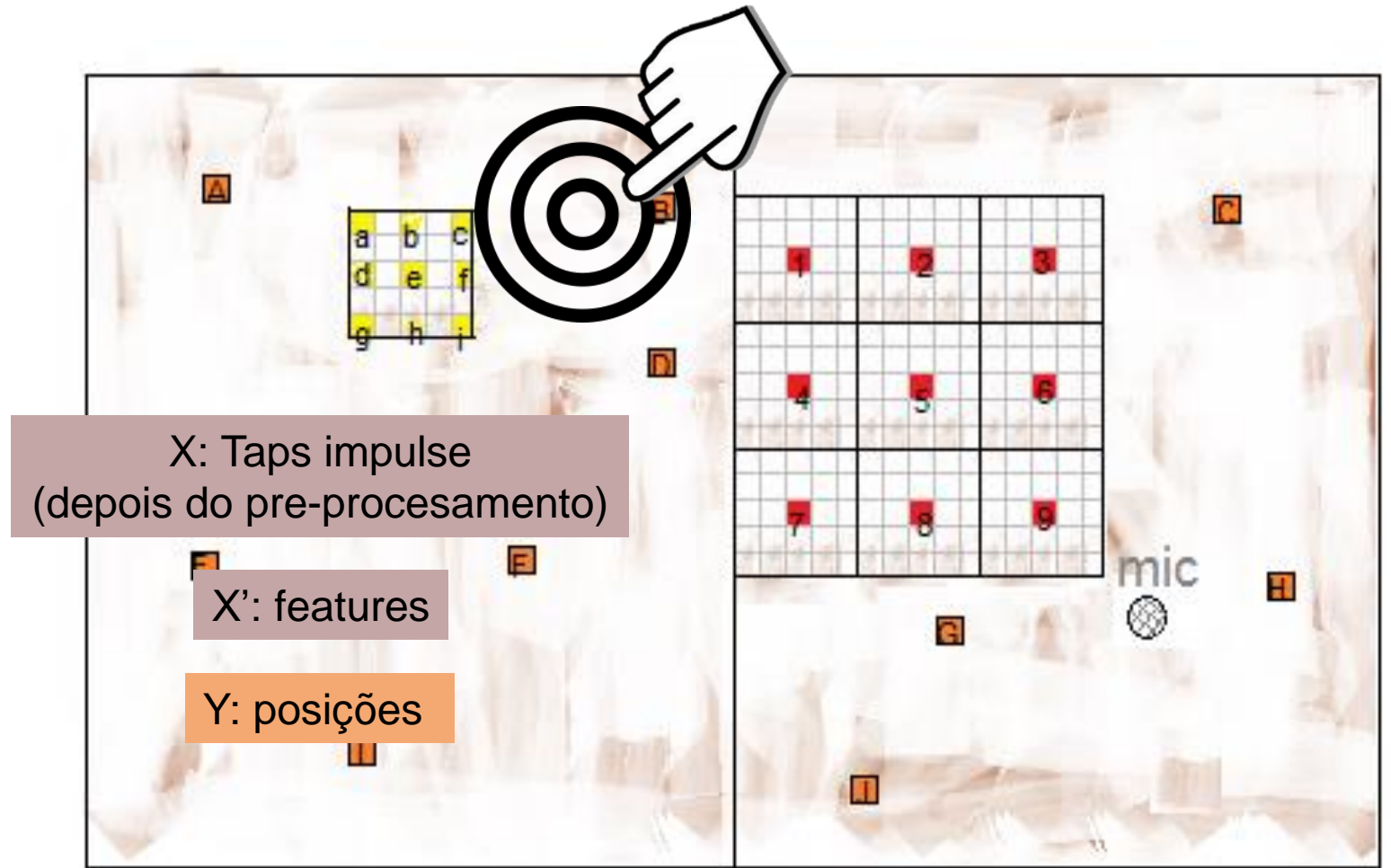
custos

projeto legal

post-integração do sistema



System

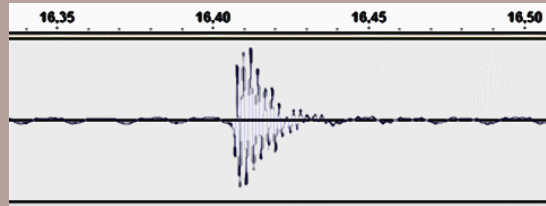


Placa de Madeira (30*50 cm²)
Microfone

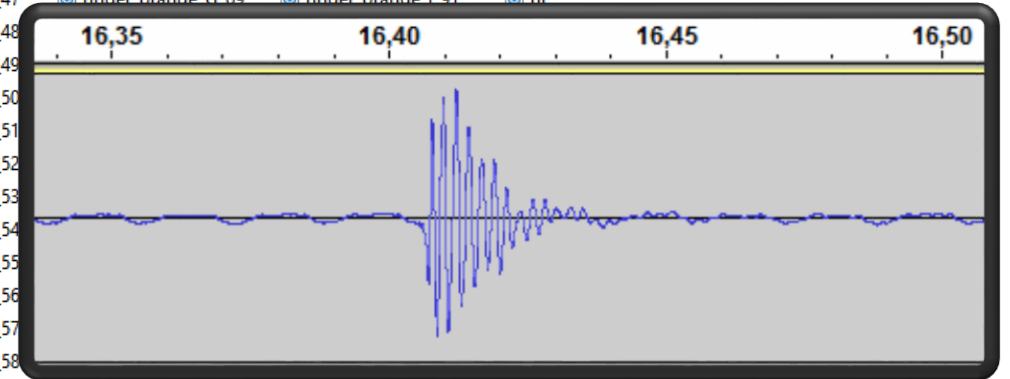


Coleta de dados

$(t; U(t))$



- ☐ finger_orange_A_1
- ☐ finger_orange_A_2
- ☐ finger_orange_A_3
- ☐ finger_orange_A_4
- ☐ finger_orange_A_5
- ☐ finger_orange_A_6
- ☐ finger_orange_A_7
- ☐ finger_orange_A_8
- ☐ finger_orange_A_9
- ☐ finger_orange_A_10
- ☐ finger_orange_B_11
- ☐ finger_orange_B_12
- ☐ finger_orange_B_13
- ☐ finger_orange_B_14
- ☐ finger_orange_B_15
- ☐ finger_orange_B_16
- ☐ finger_orange_B_17
- ☐ finger_orange_B_18
- ☐ finger_orange_B_19
- ☐ finger_orange_B_20
- ☐ finger_orange_C_21
- ☐ finger_orange_C_22
- ☐ finger_orange_C_23
- ☐ finger_orange_C_24
- ☐ finger_orange_C_25
- ☐ finger_orange_C_26
- ☐ finger_orange_C_27
- ☐ finger_orange_C_28
- ☐ finger_orange_C_29
- ☐ finger_orange_C_30
- ☐ finger_orange_D_31
- ☐ finger_orange_D_32
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- ☐ finger_orange_G_69
- ☐ finger_orange_I_89
- ☐ finger_orange_I_90
- ☐ finger_orange_I_91
- ☐ fir
- ☐ fir
- ☐ fir
- ☐ finger_orange_H_81
- ☐ finger_orange_H_82
- ☐ finger_orange_I_83
- ☐ finger_orange_I_84
- ☐ finger_orange_I_85
- ☐ finger_orange_I_86
- ☐ finger_orange_I_87
- ☐ finger_orange_I_88
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- ☐ finger_orange_I_106
- ☐ finger_orange_I_107
- ☐ finger_orange_I_108
- ☐ finger_orange_I_109
- ☐ finger_red_1_1
- ☐ fir
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- ☐ fir
- ☐ fir
- ☐ fir
- ☐ fir
- ☐ fir
- ☐ fir

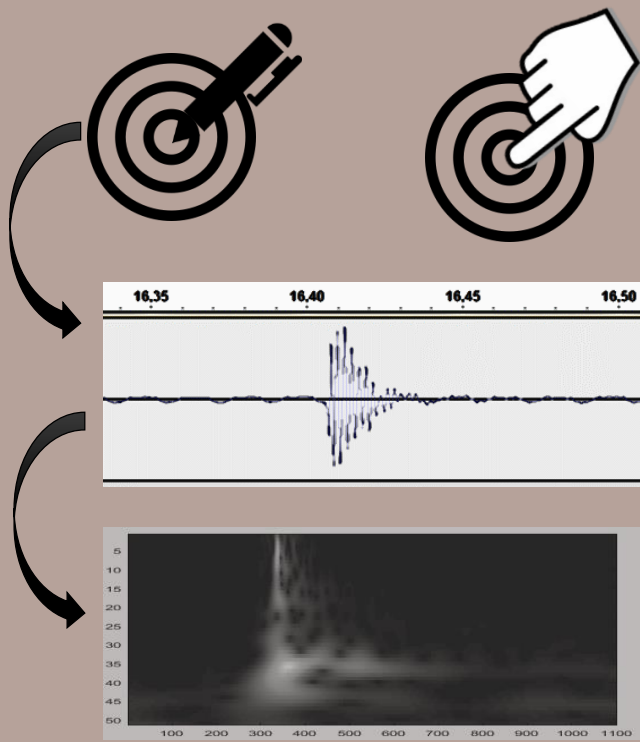


Mode x2 (pen ; finger)

Position x28

Amostras x10

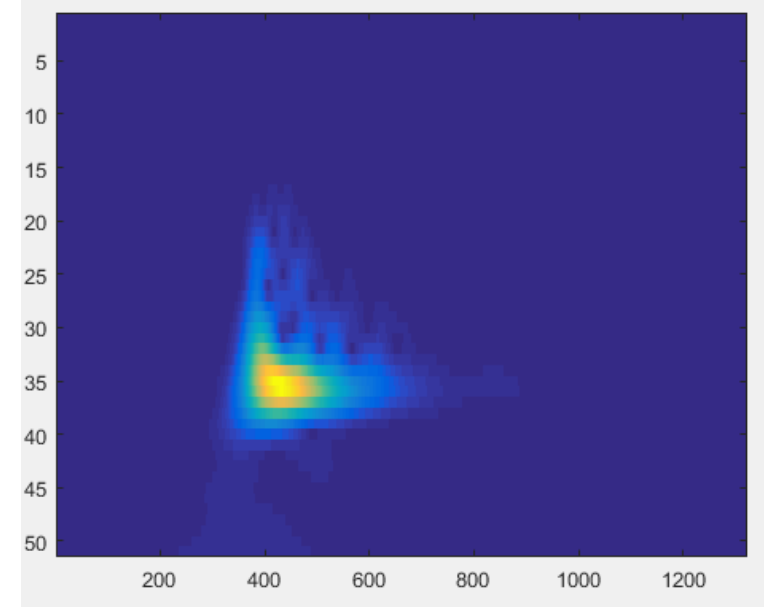
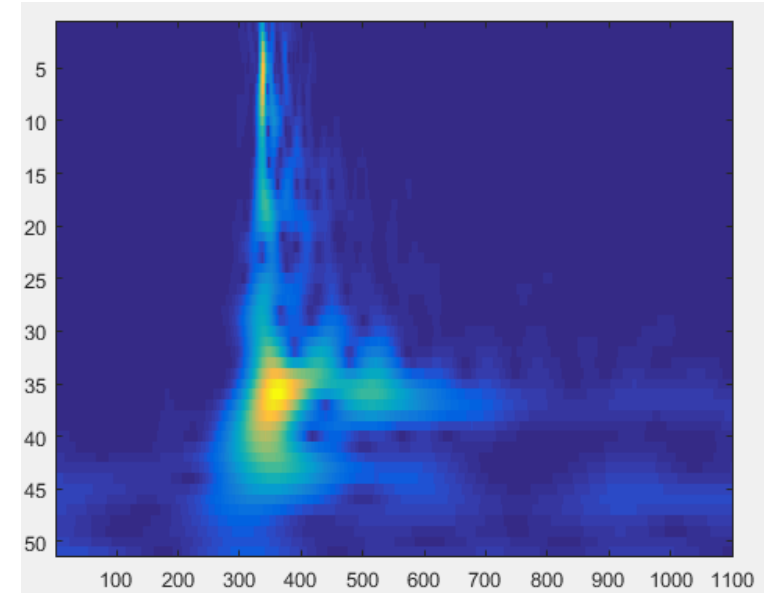
575 sinais gravados

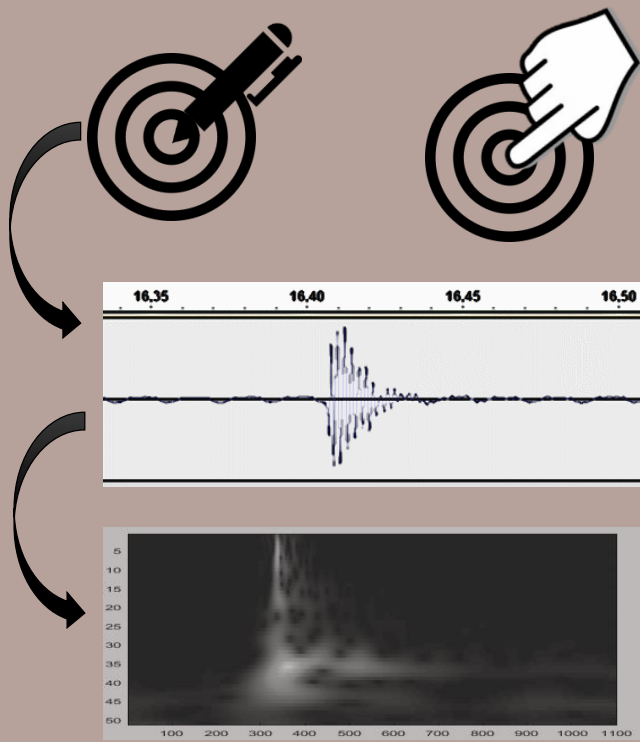


Processamentos de dados

Passagem do domínio tempo-
amplitude ao domínio tempo-
frequência.

$$(t, U_t) \longrightarrow (t, f_t)$$





Processamentos de dados

Passagem do domínio tempo-
amplitude ao domínio tempo-
frequência.

$$(t, U_t) \longrightarrow (t, f_t)$$

Extracted Features (17)

Frequencies (Fundamental, Mean, Median)

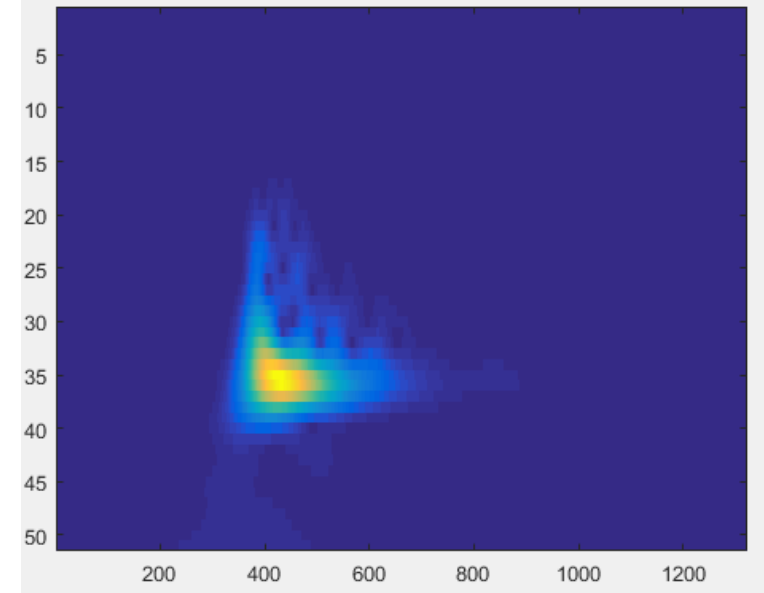
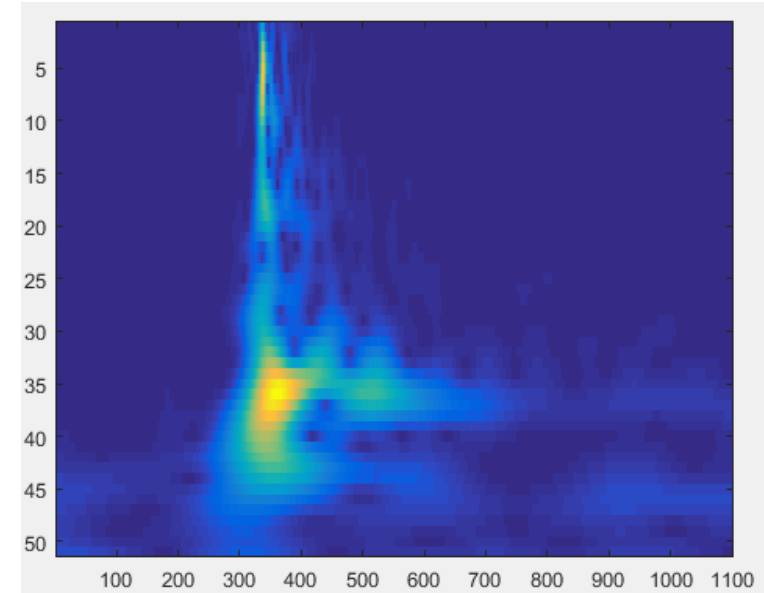
Perceptual **Spectral Centroid**

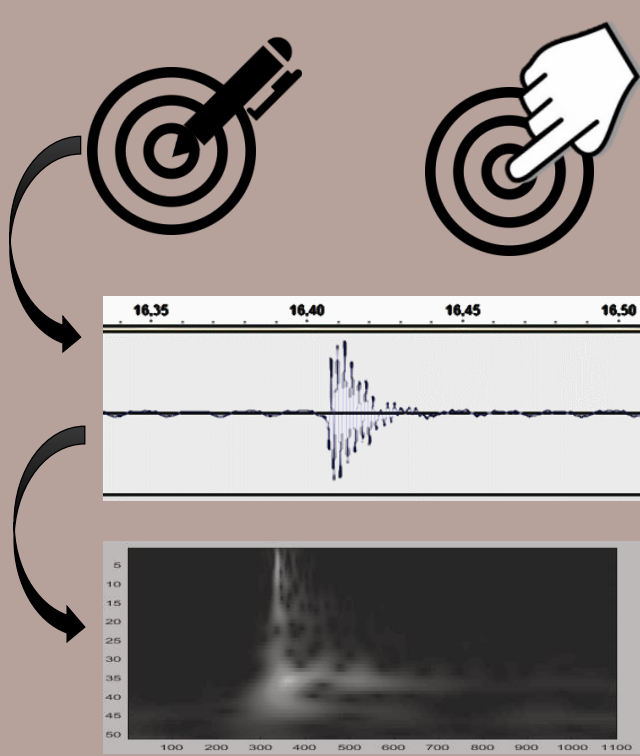
3db Band Width & Center

Energy (*root mean square*)

Relative Energy in Given Frequency Bands

Linear Predictive Coding Coefficients





Processamentos de dados

Passagem do domínio tempo-
amplitude ao domínio tempo-
frequência.

$$(t, U_t) \longrightarrow (t, f_t)$$

Extracted Features (17)

Frequencies (Fundamental, Mean, Median)

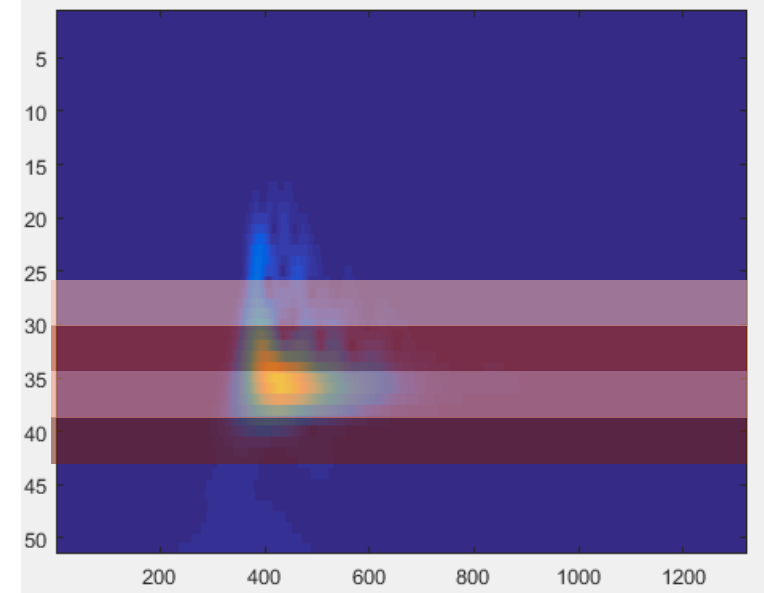
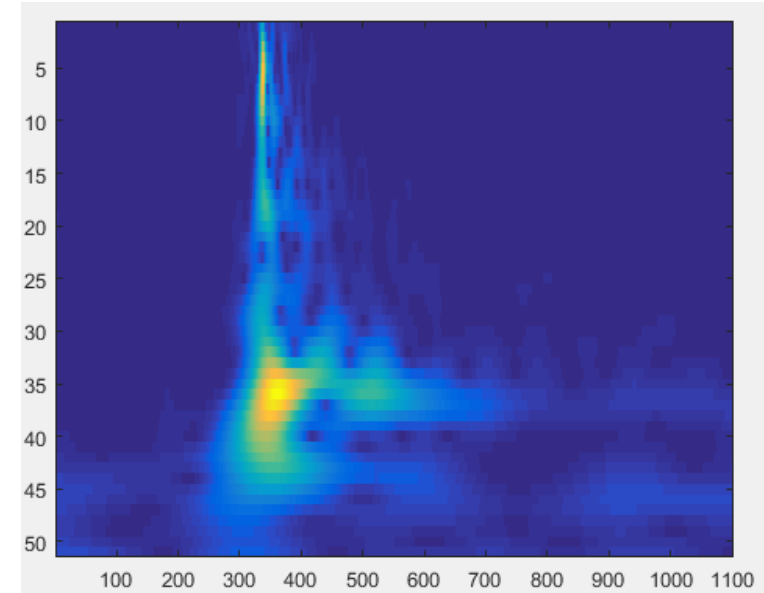
Perceptual **Spectral Centroid**

3db Band Width & Center

Energy (*root mean square*)

Relative Energy in Given Frequency Bands

Linear Predictive Coding Coefficients



Avaliação da extração

Extracted Features (17)

Frequencies (Fundamental, Mean, Median)

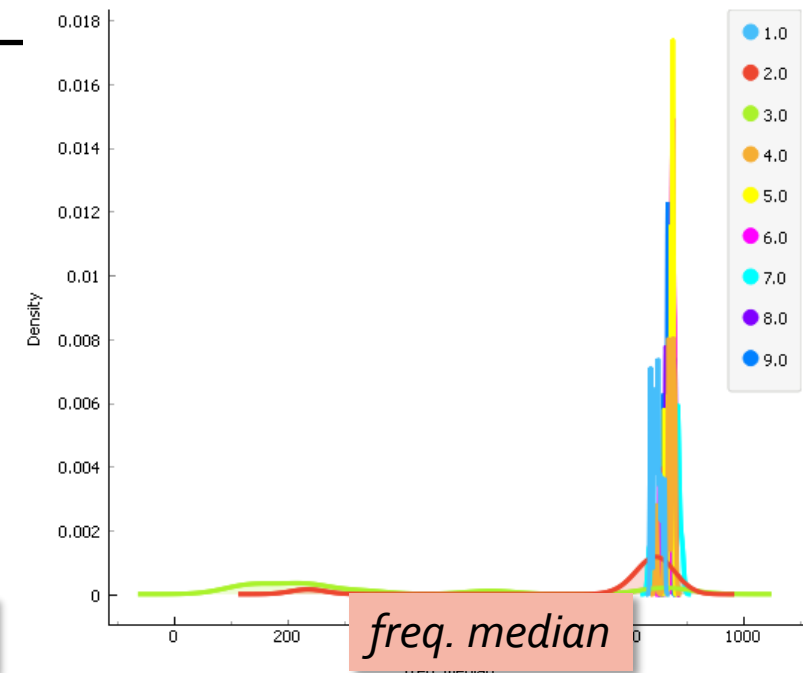
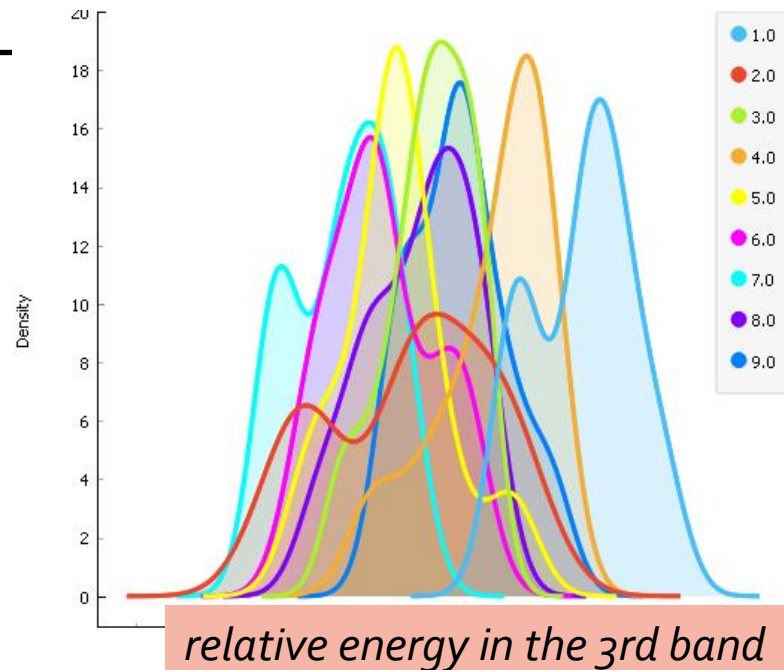
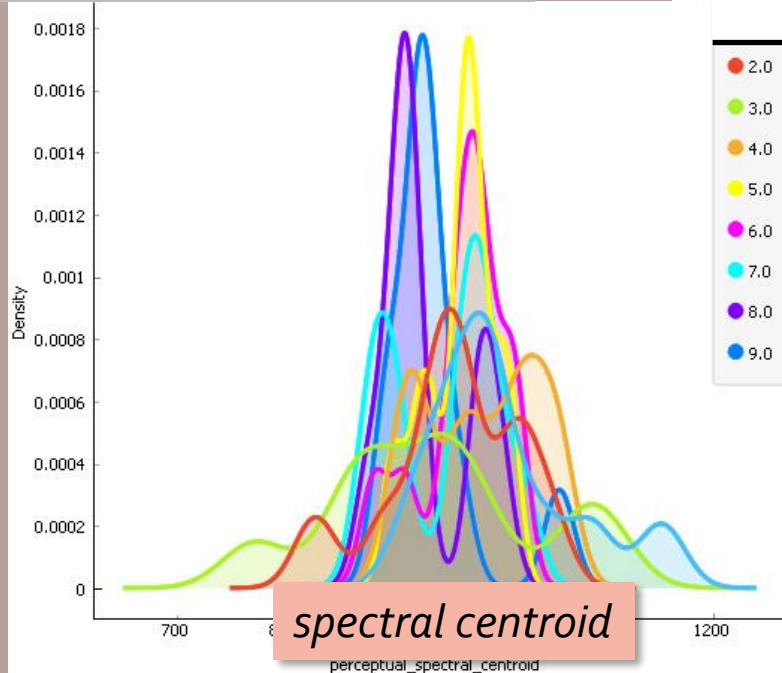
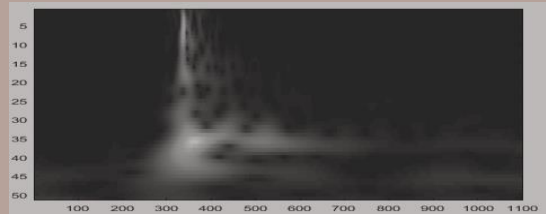
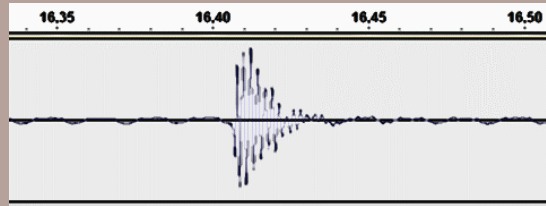
Perceptual Spectral Centroid

3db Band Width & Center

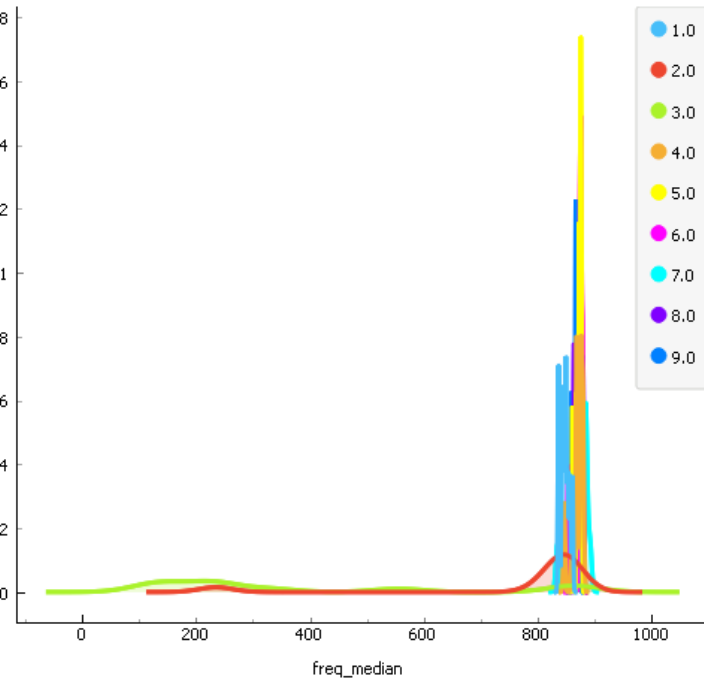
Energy (*root mean square*)

Relative Energy in Given Frequency Bands

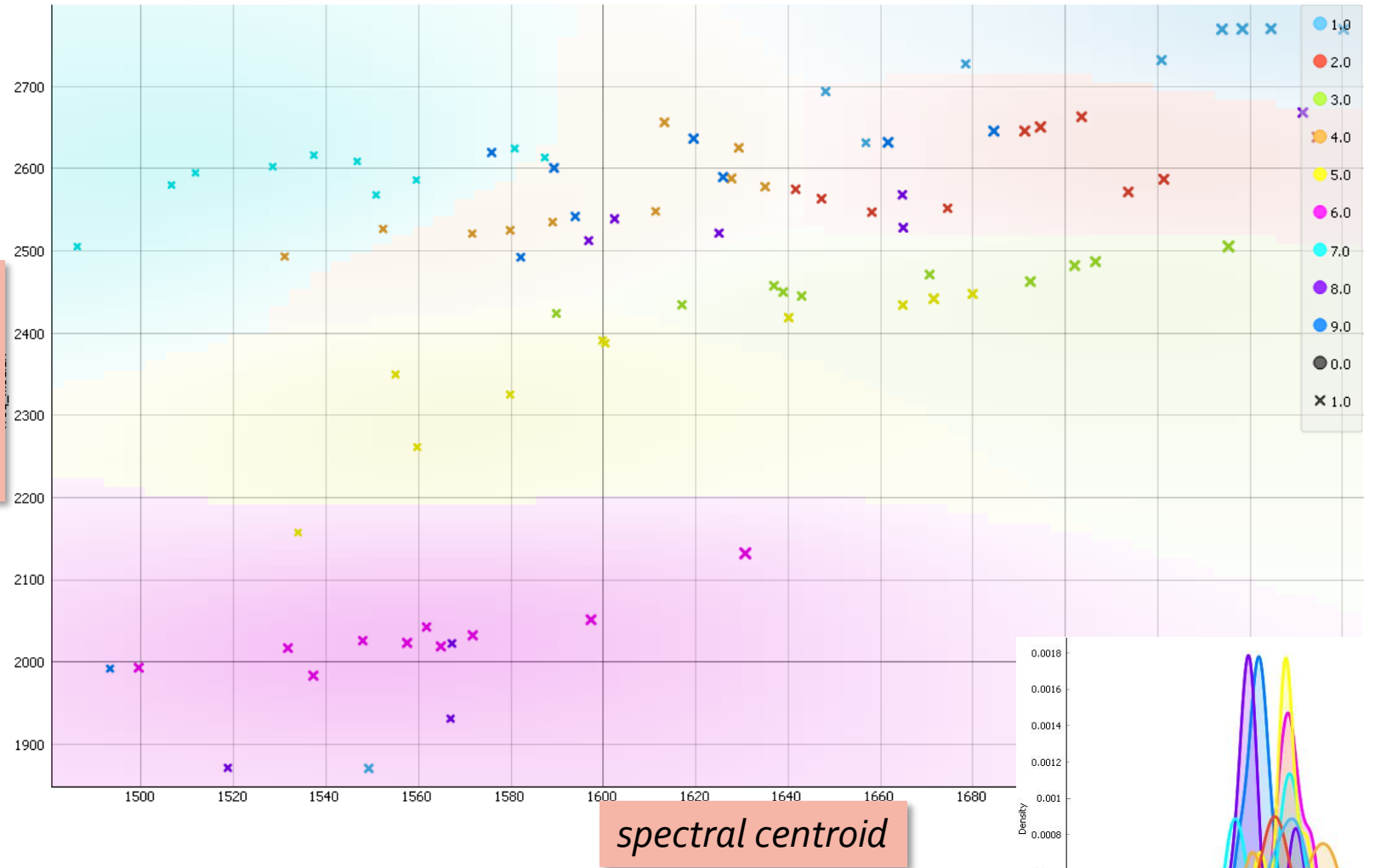
Linear Predictive Coding Coefficients



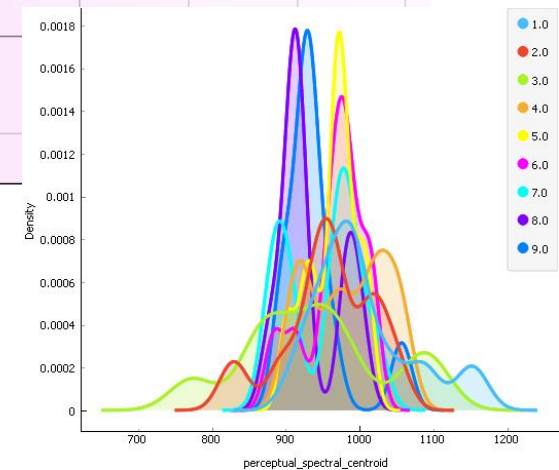
Avaliação da extração



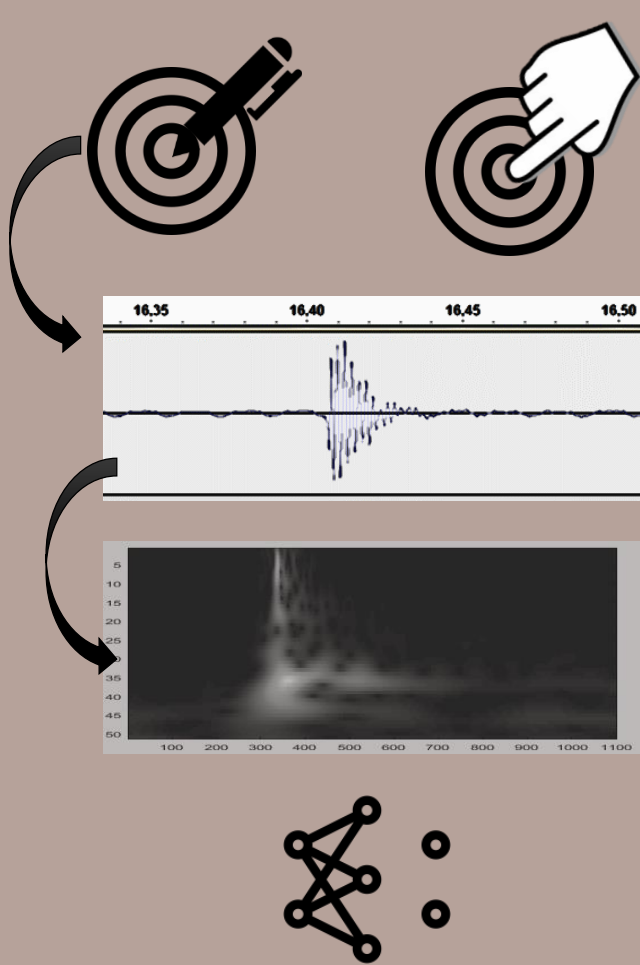
freq. median



spectral centroid



Modelagem da RNA

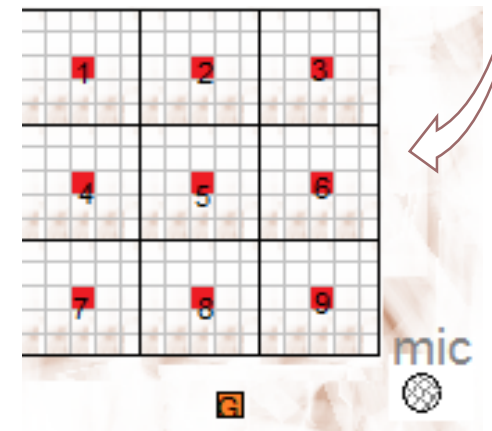
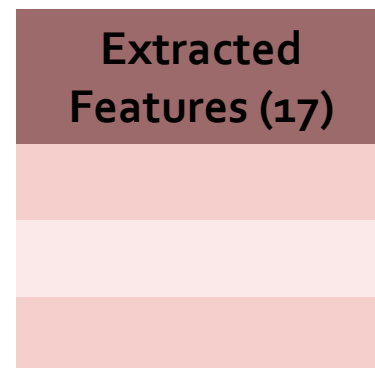
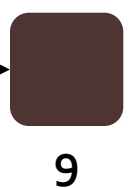
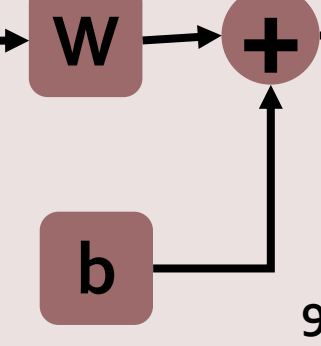
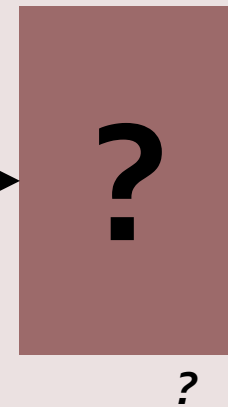
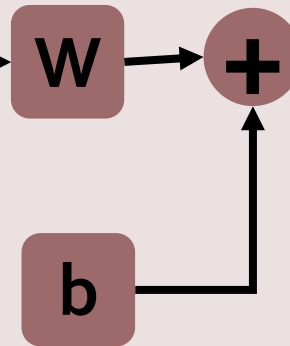


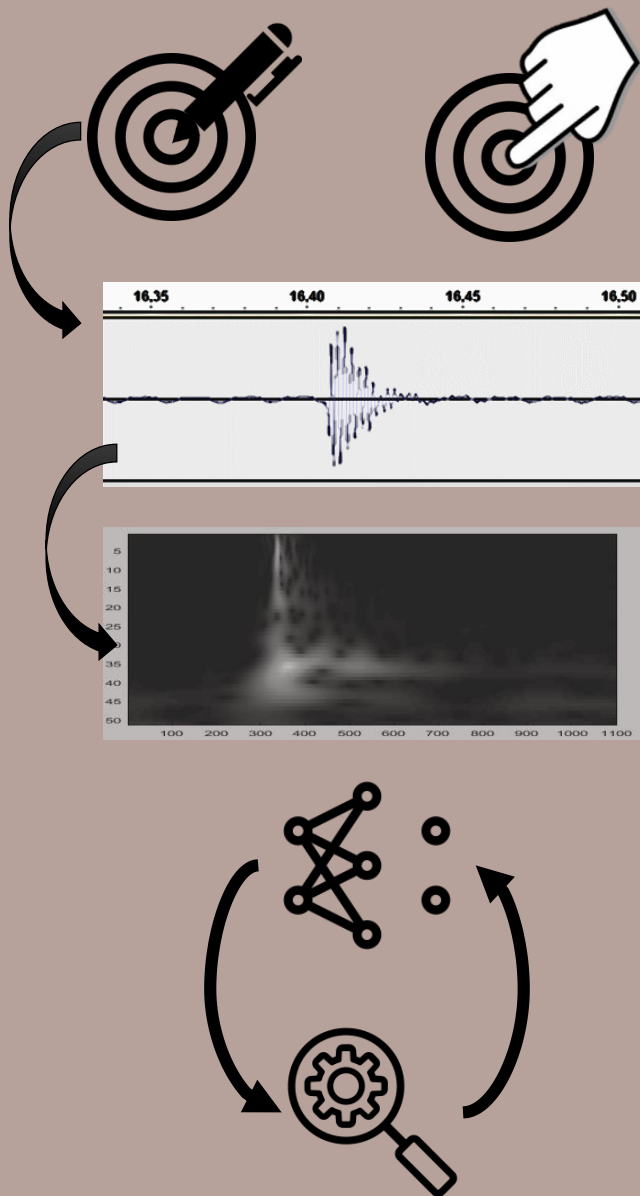
input

hidden layer

output layer

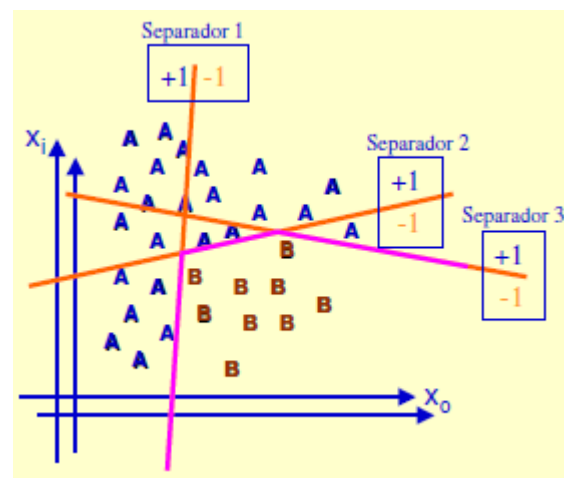
output

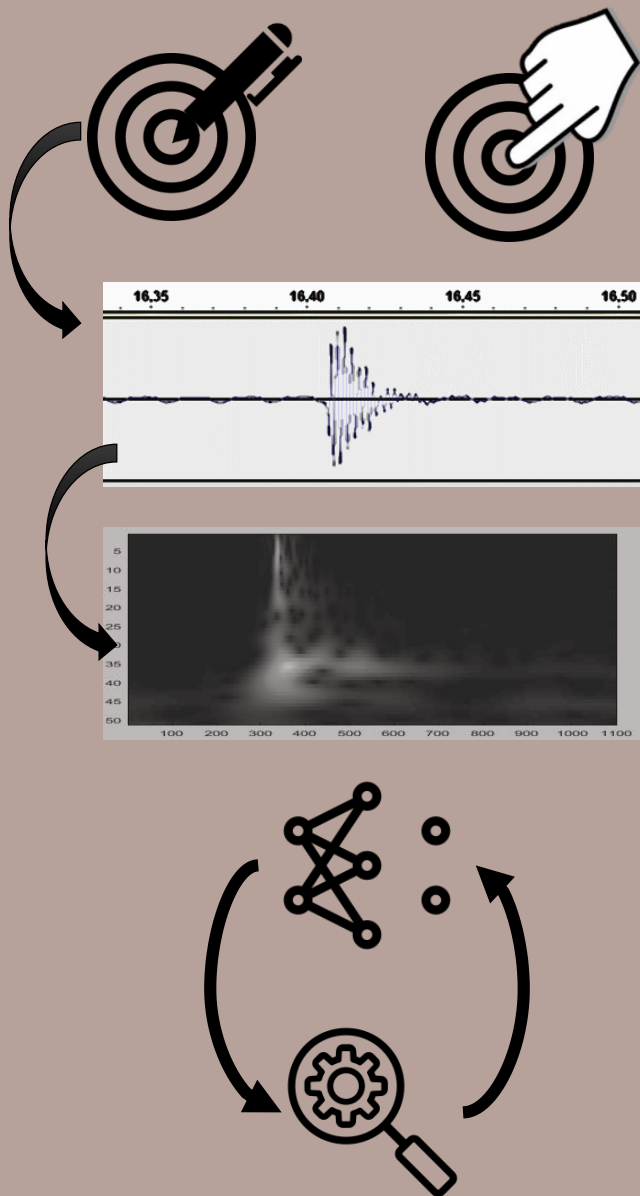




Otimização da RNA

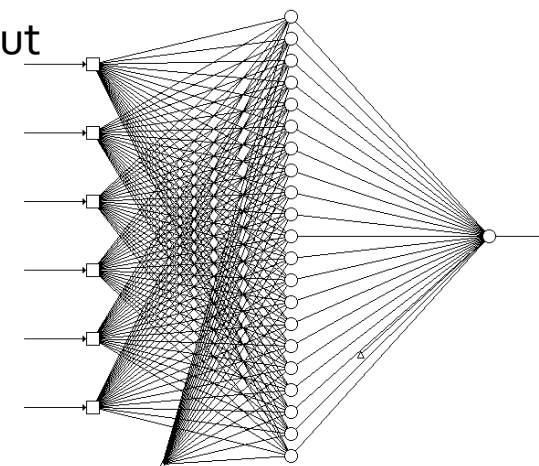
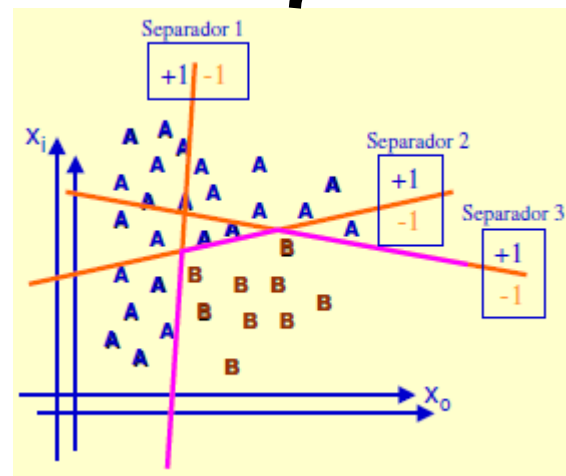
Important : Neural Network Output
Linear Separator





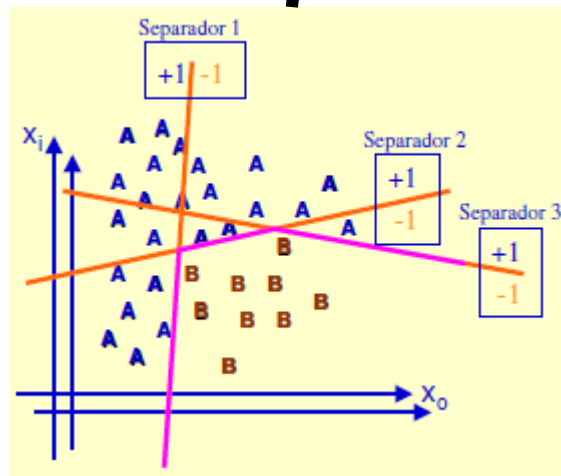
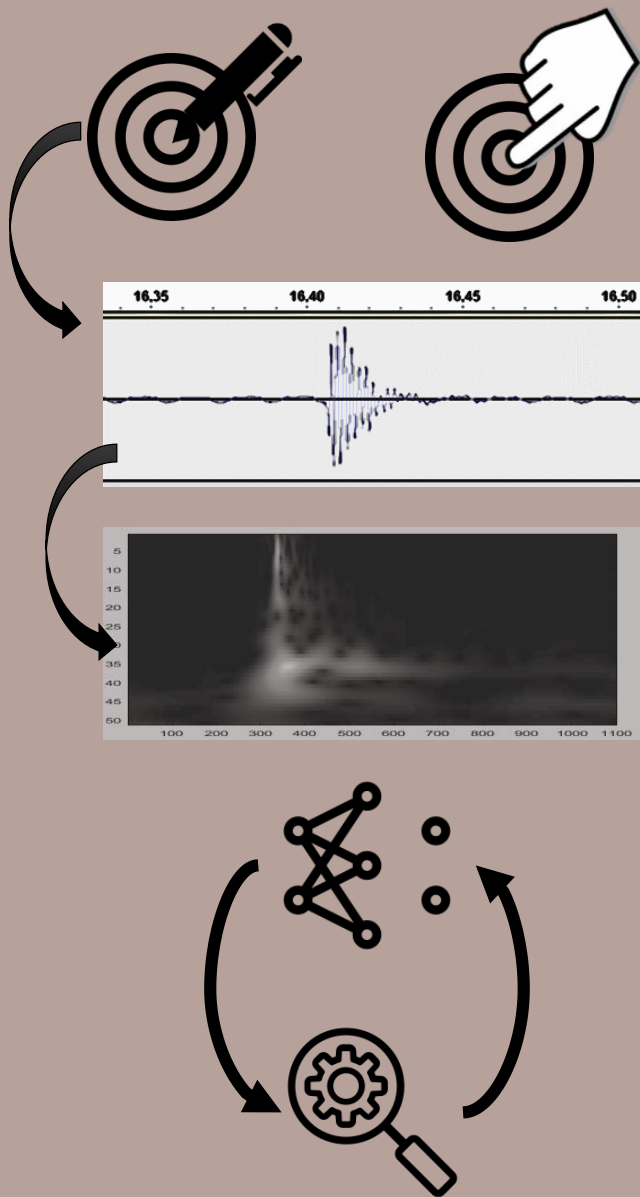
Otimização da RNA

Important : Neural Network Output
Linear Separator

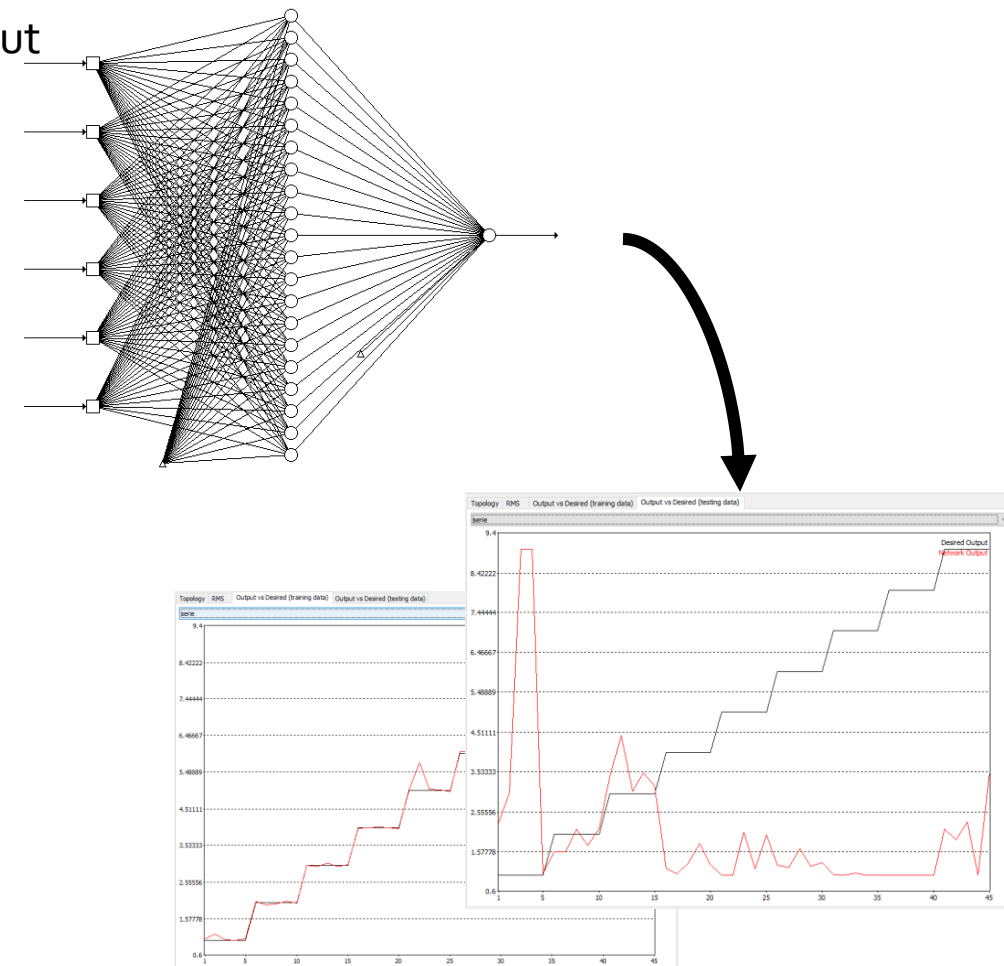


Otimização da RNA

Important : Neural Network Output
Linear Separator

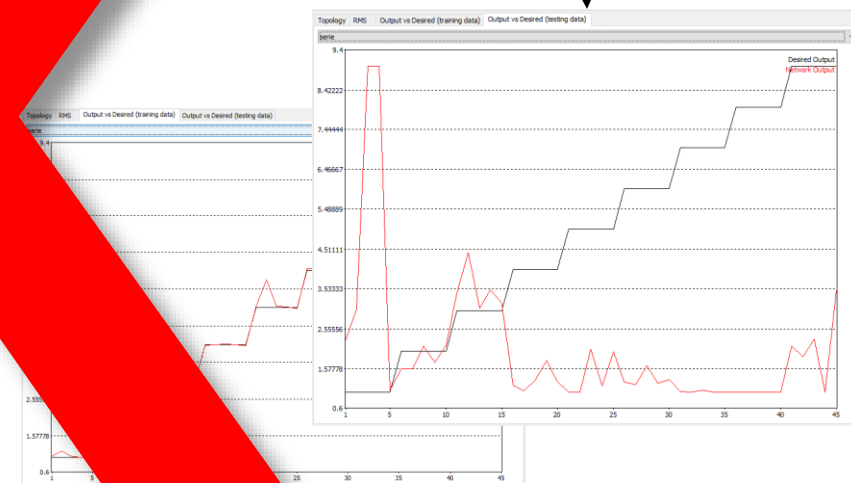
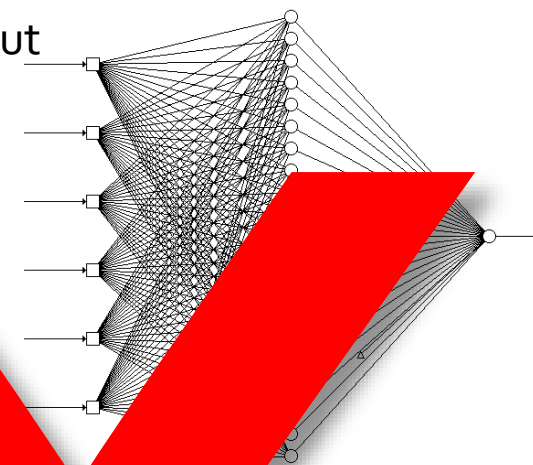
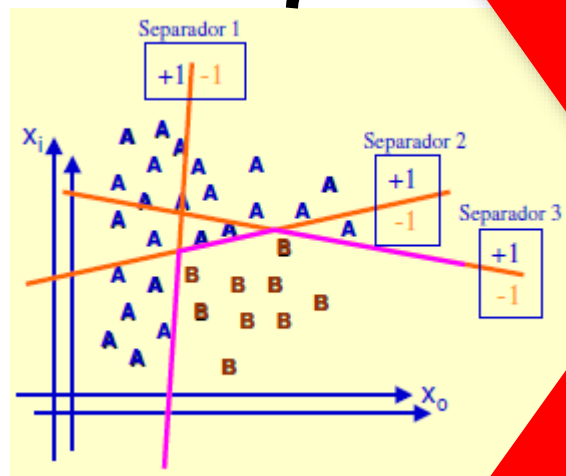
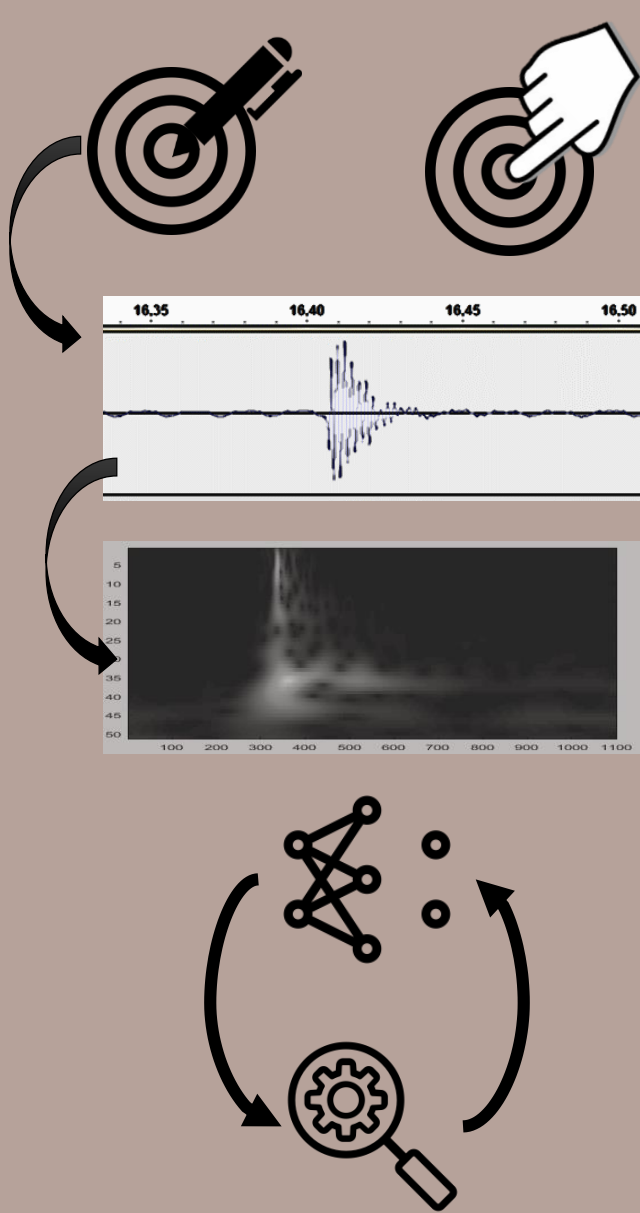


Treinamento : 0.01
Teste : 0.3



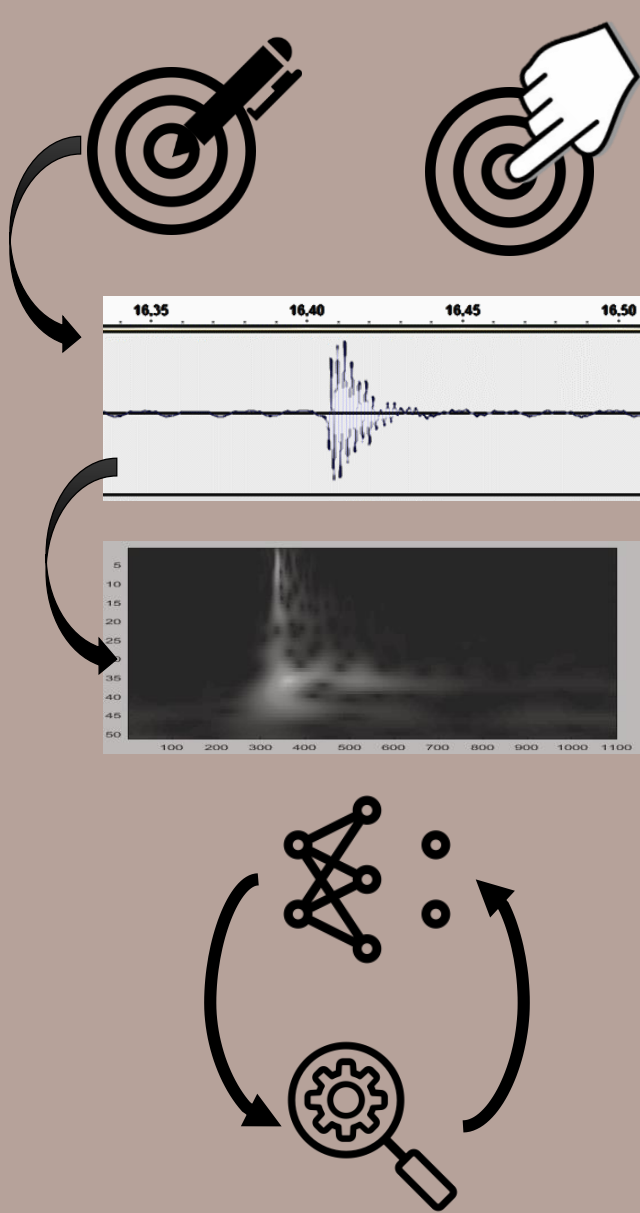
Otimização da RNA

Important : Neural Network Output
Linear Separator



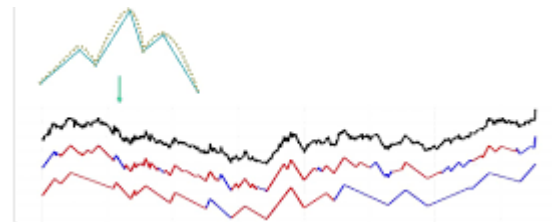
- Treinamento : 0.01
- Teste : 0.3

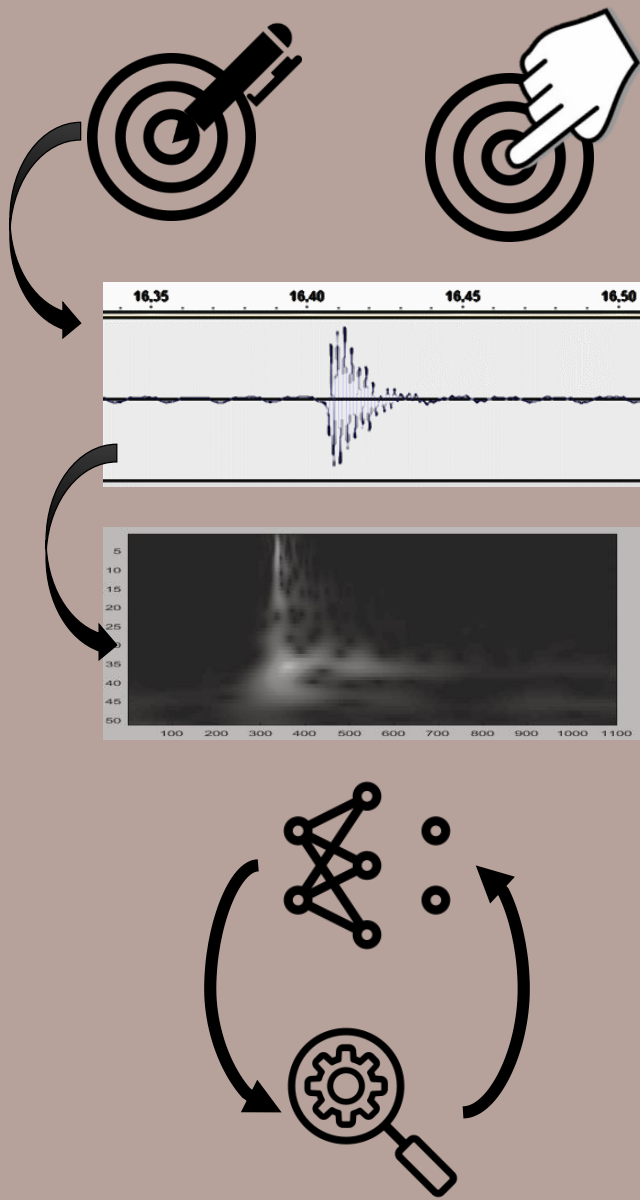
*implementation & iteration realized through MBP
* transfer function: tan-sigmoid



Otimização da RNA

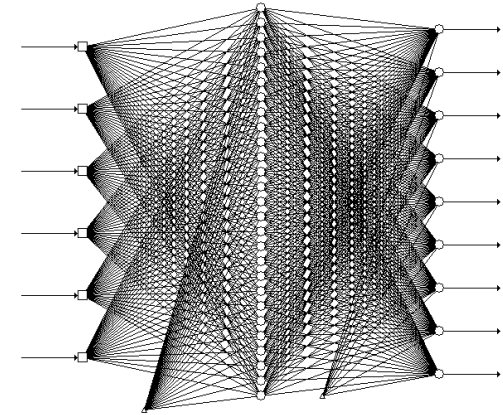
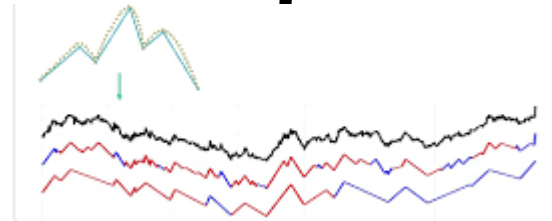
Important : Neural Network Output
Spectrum Patterns Matching





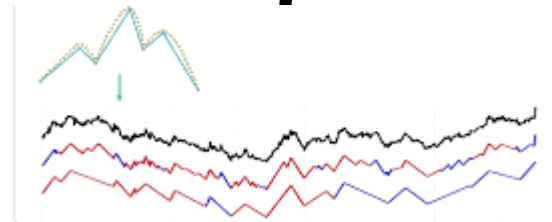
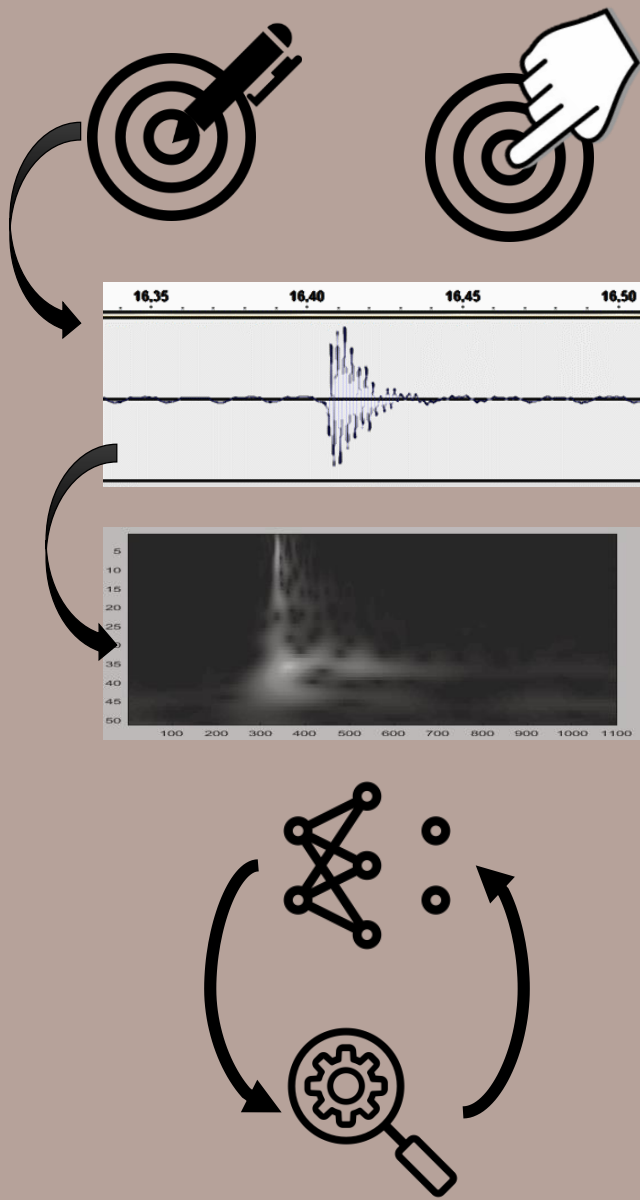
Otimização da RNA

Important : Neural Network Output
Spectrum Patterns Matching

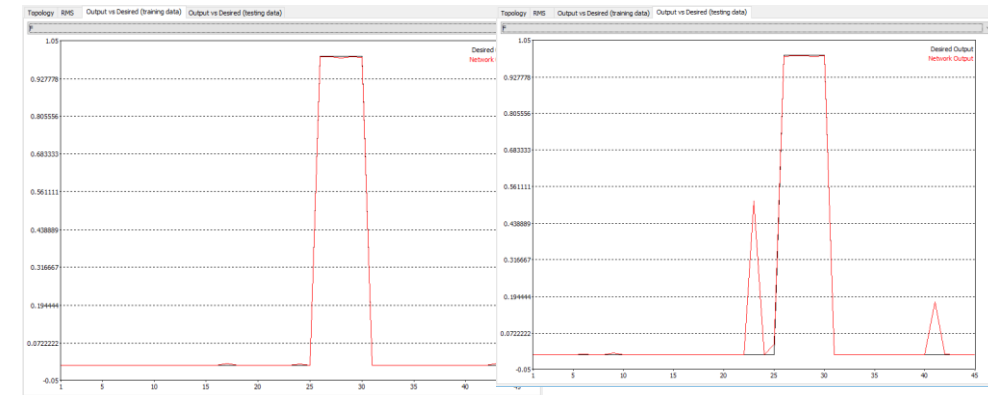
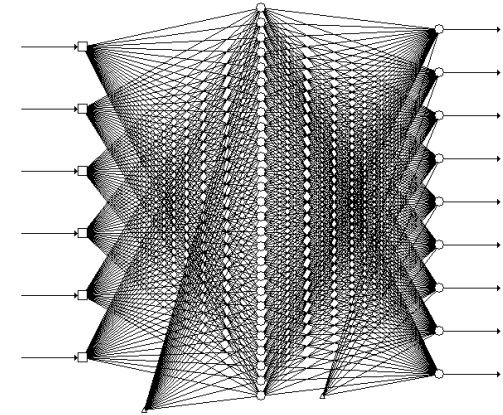


Otimização da RNA

Important : Neural Network Output
Spectrum Patterns Matching

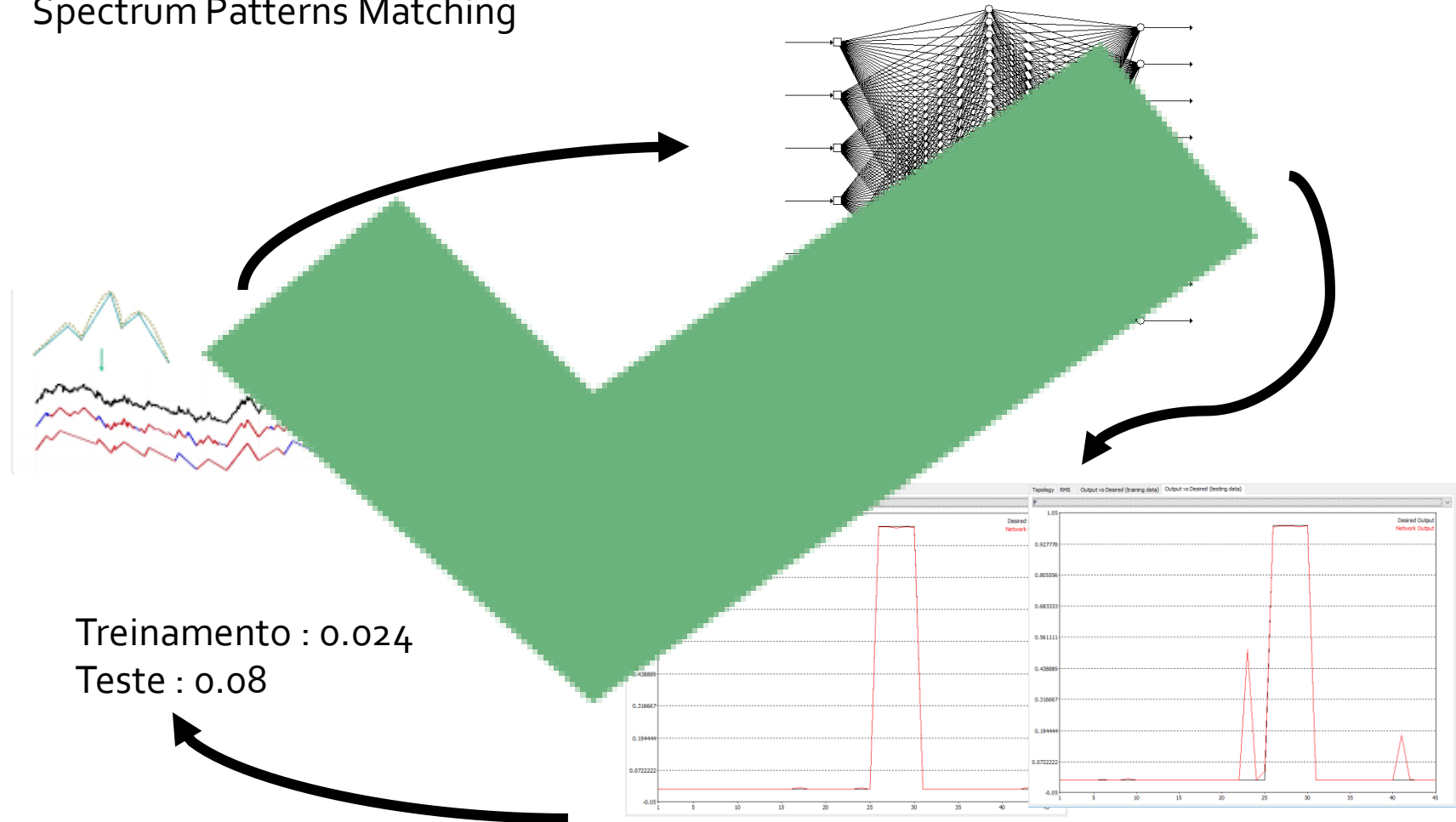
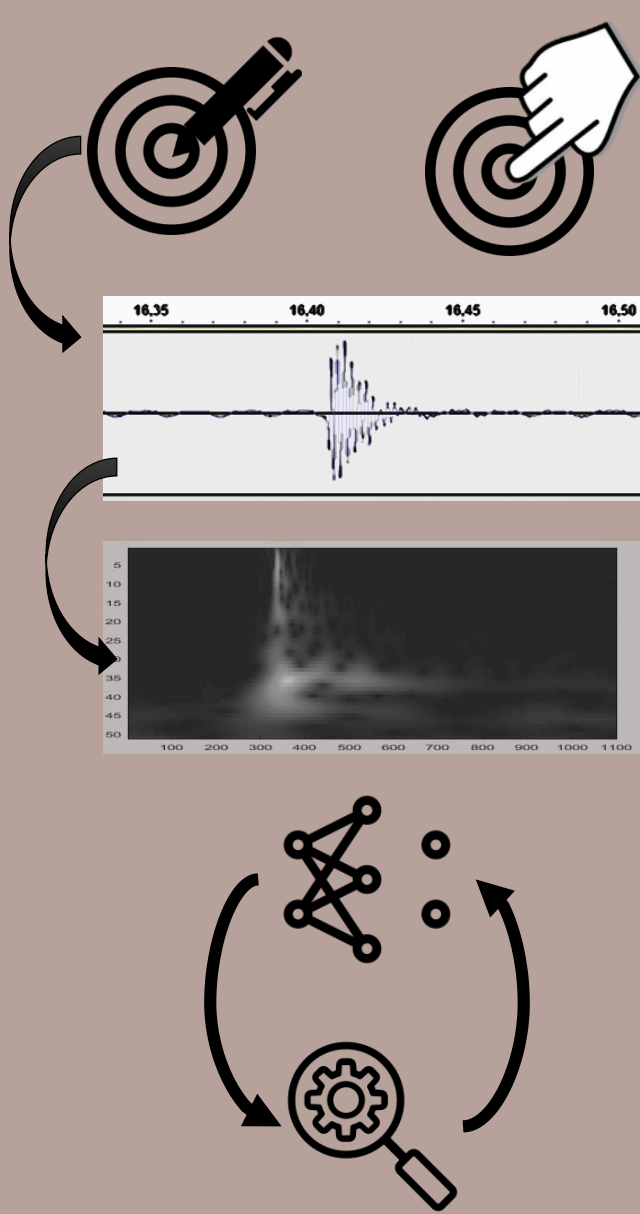


Treinamento : 0.024
Teste : 0.08



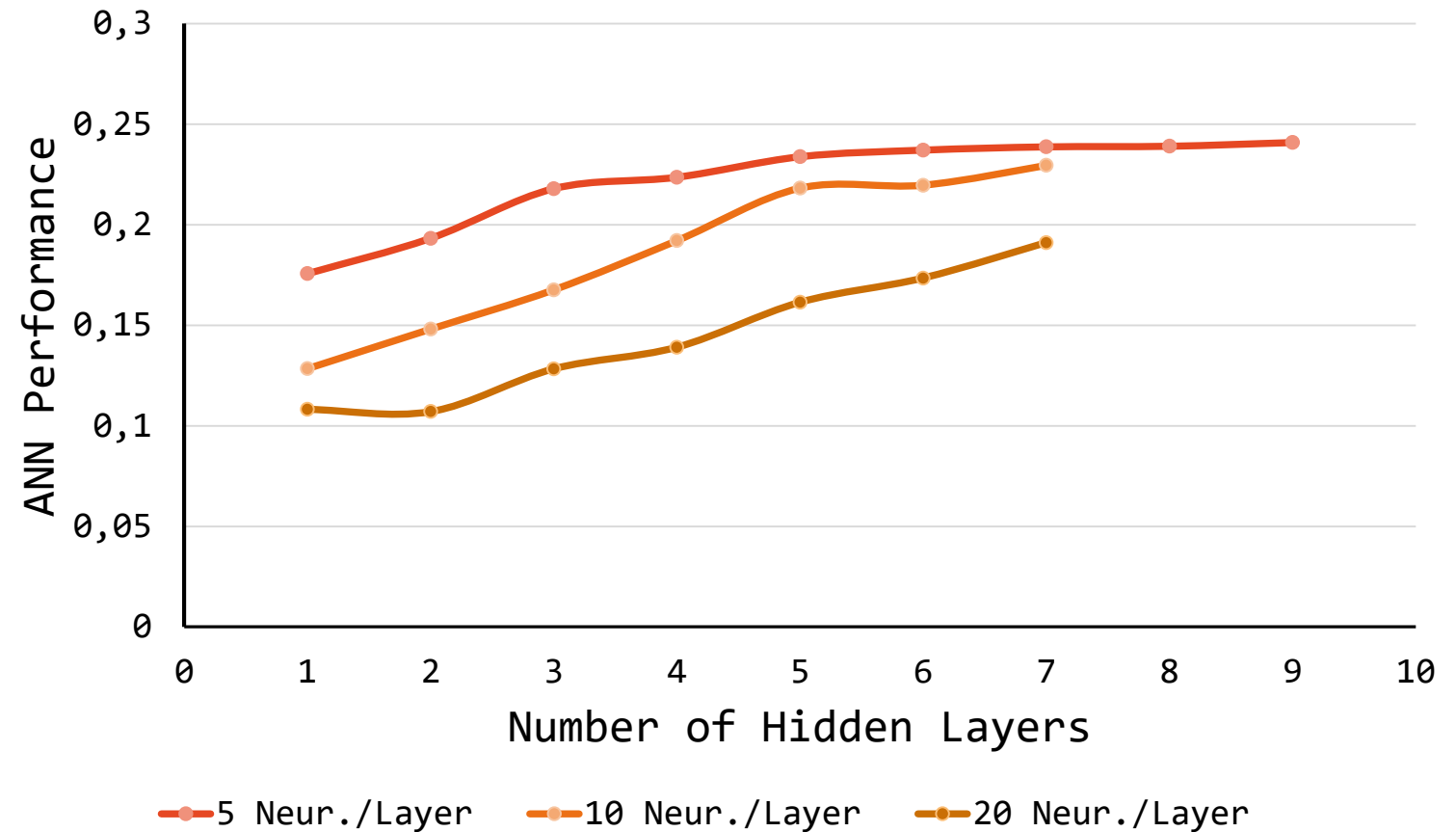
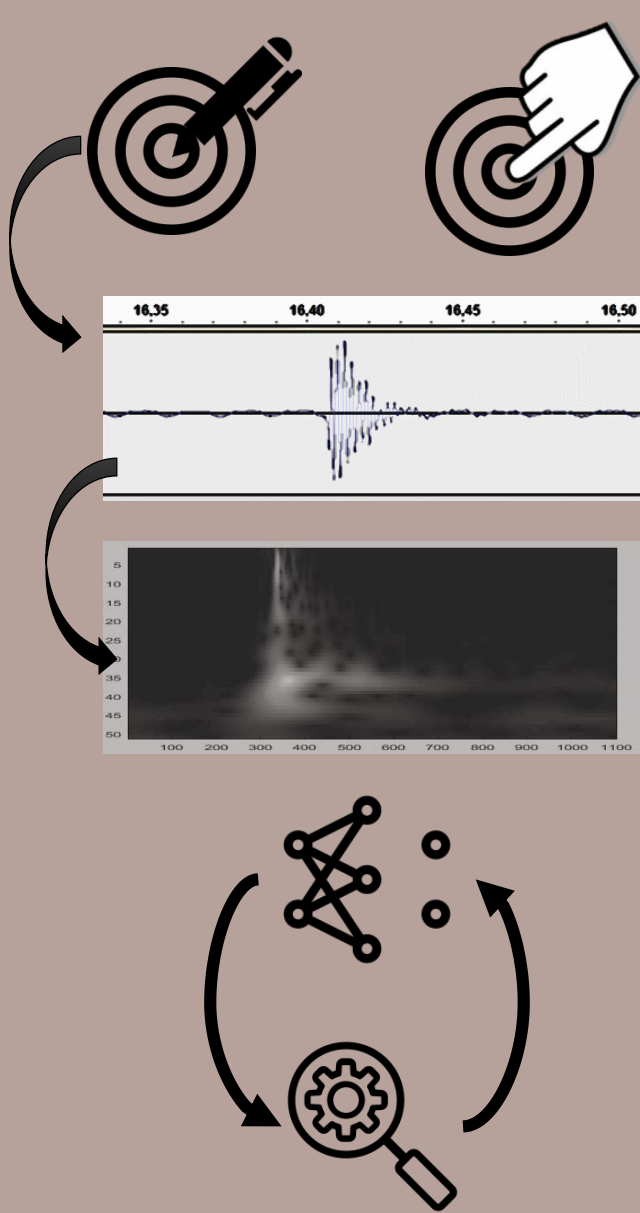
Otimização da RNA

Important : Neural Network Output
Spectrum Patterns Matching



Otimização da RNA

First Exploration of the performance in function of basic topology aspects

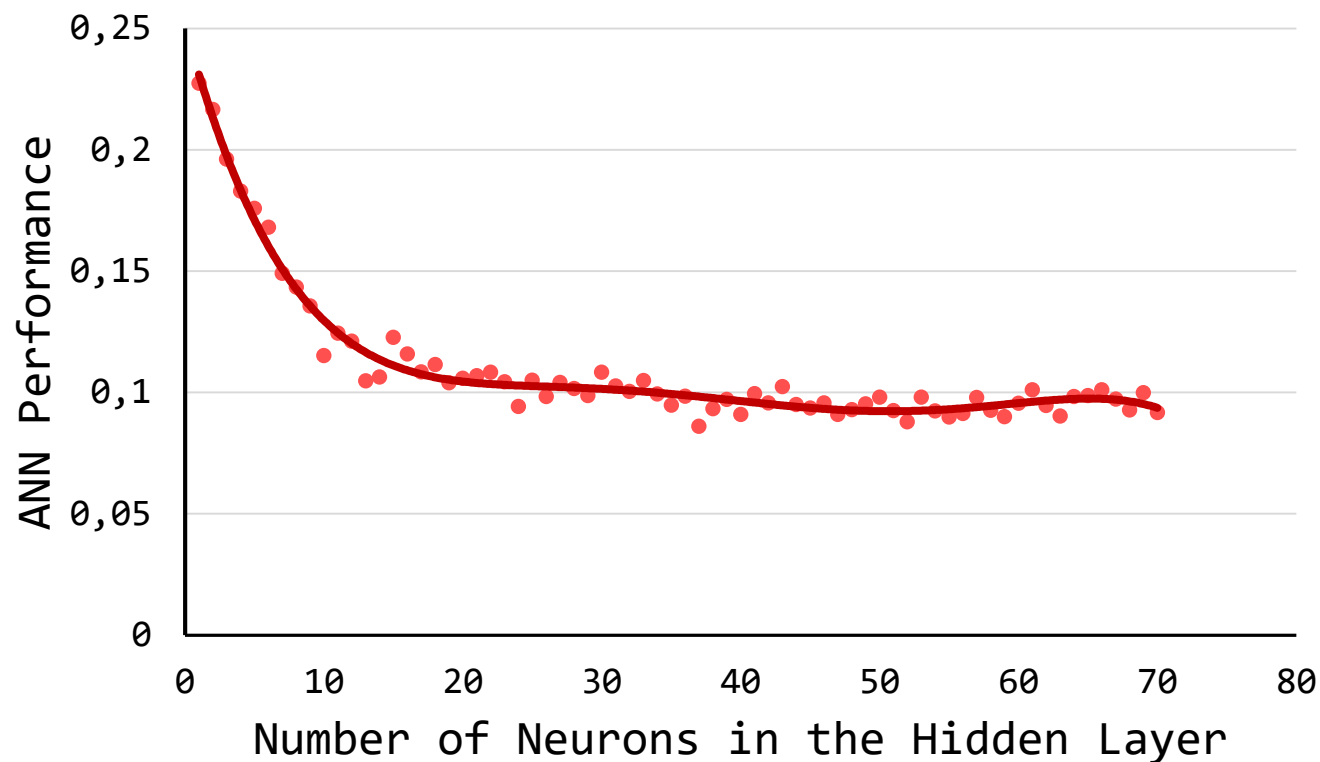
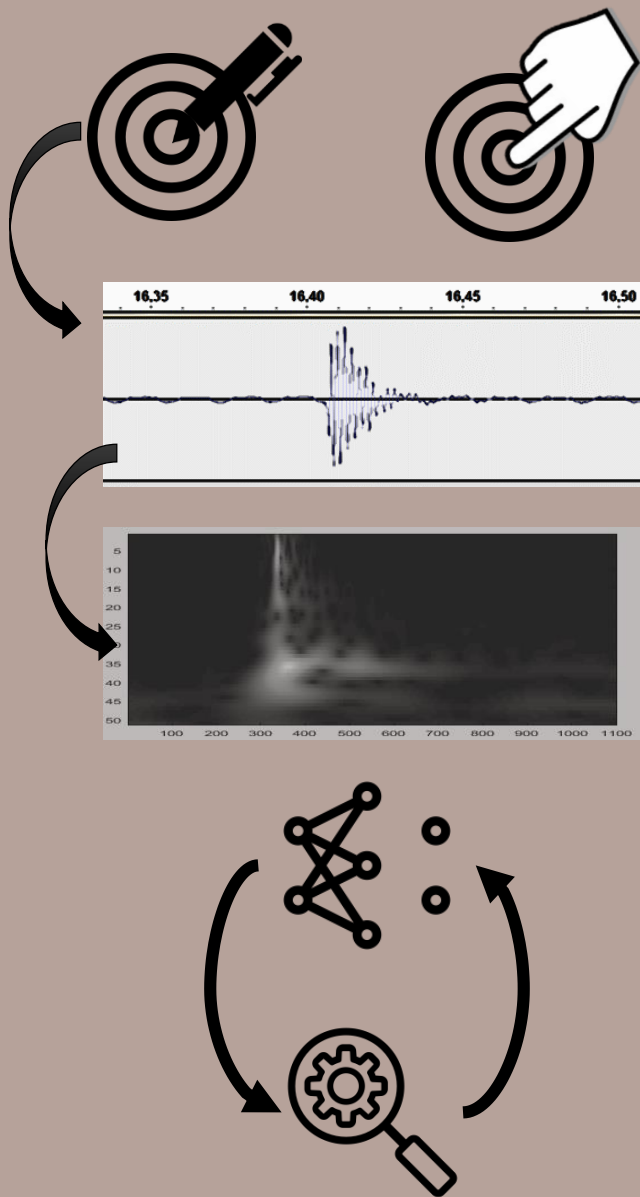


**implementation & iteration realized through Matlab*

** transfer function: tan-sigmoid*

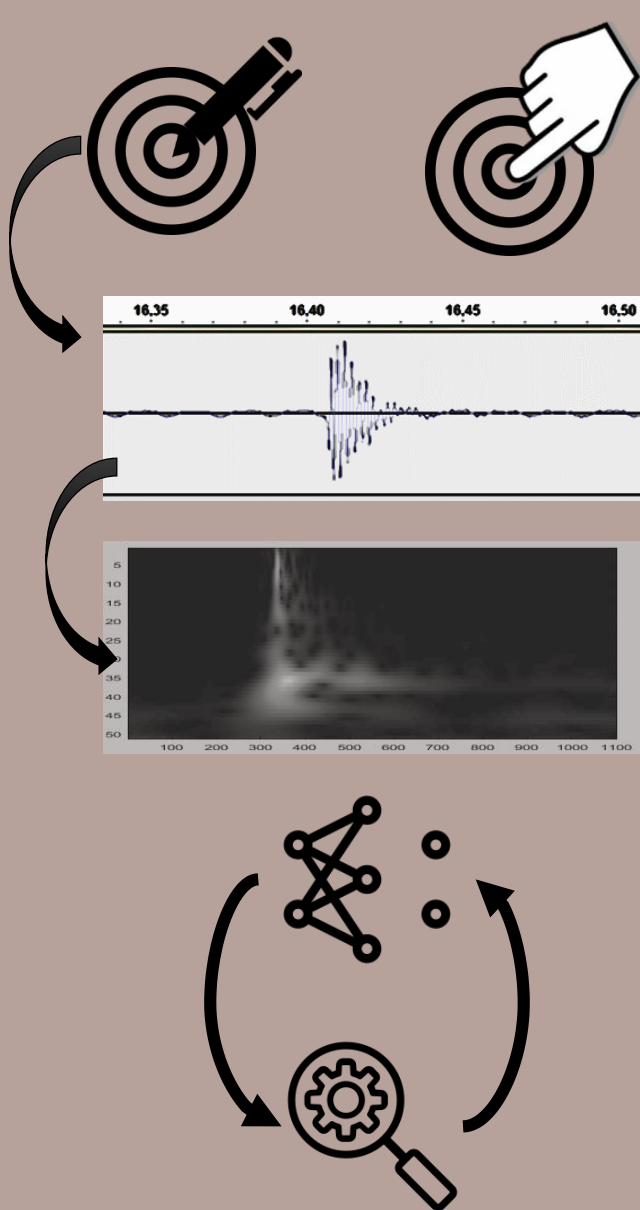
Otimização da RNA

Second step on exploration: One hidden layer (*most efficient result from 1st step*)



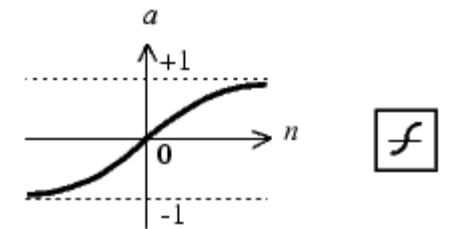
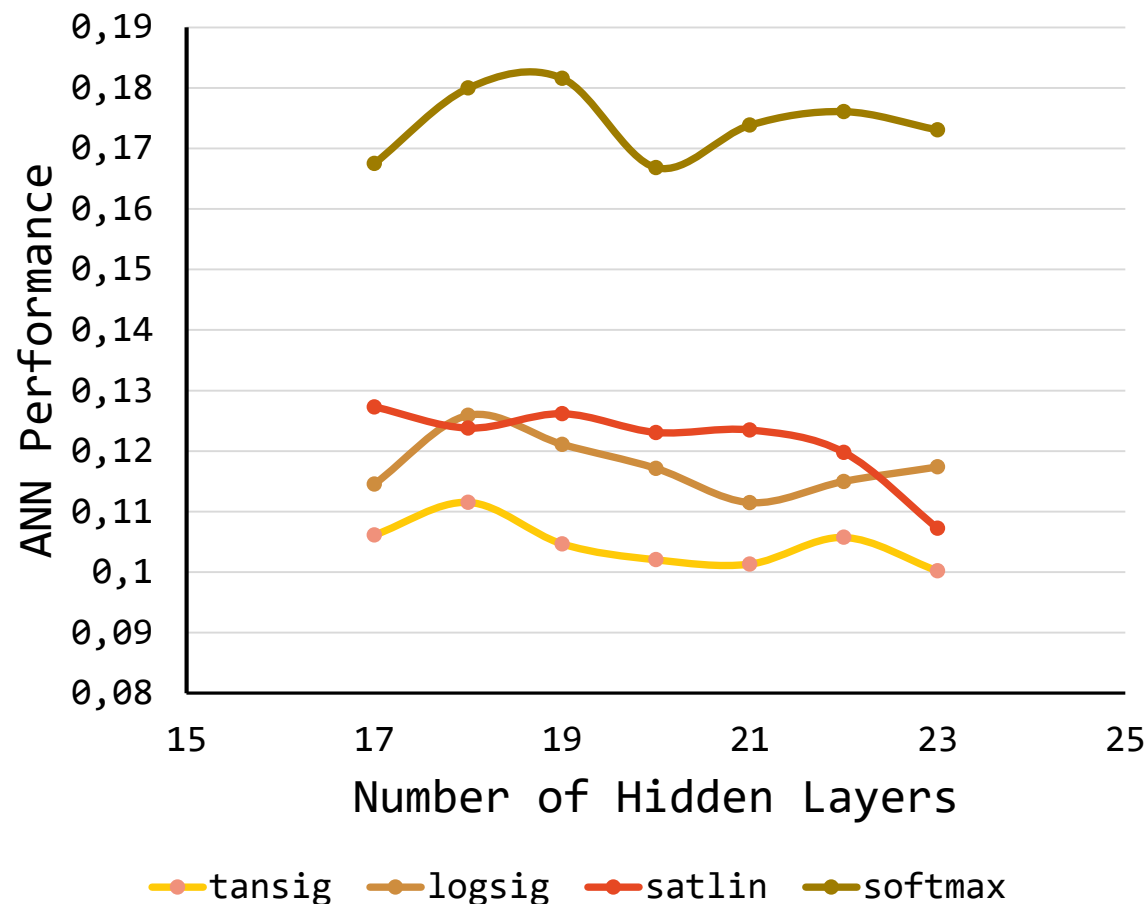
*implementation & iteration realized through Matlab

* transfer function: tan-sigmoid



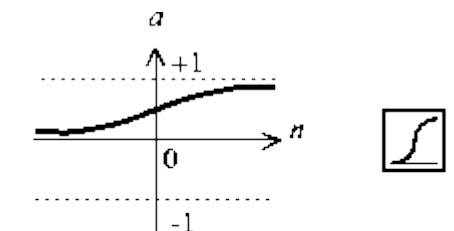
Otimização da RNA

Last step: choice of the transfer function



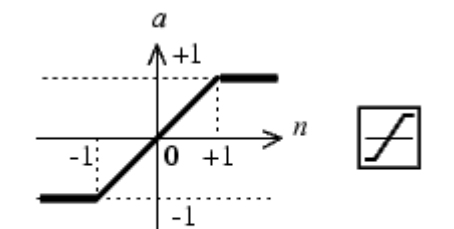
$$a = \text{tansig}(n)$$

Tan-Sigmoid Transfer Function



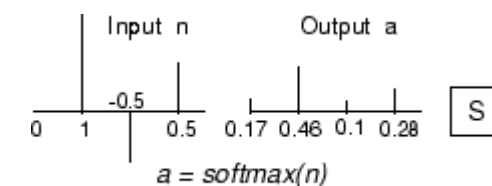
$$a = \text{logsig}(n)$$

Log-Sigmoid Transfer Function



$$a = \text{satlins}(n)$$

Satlins Transfer Function

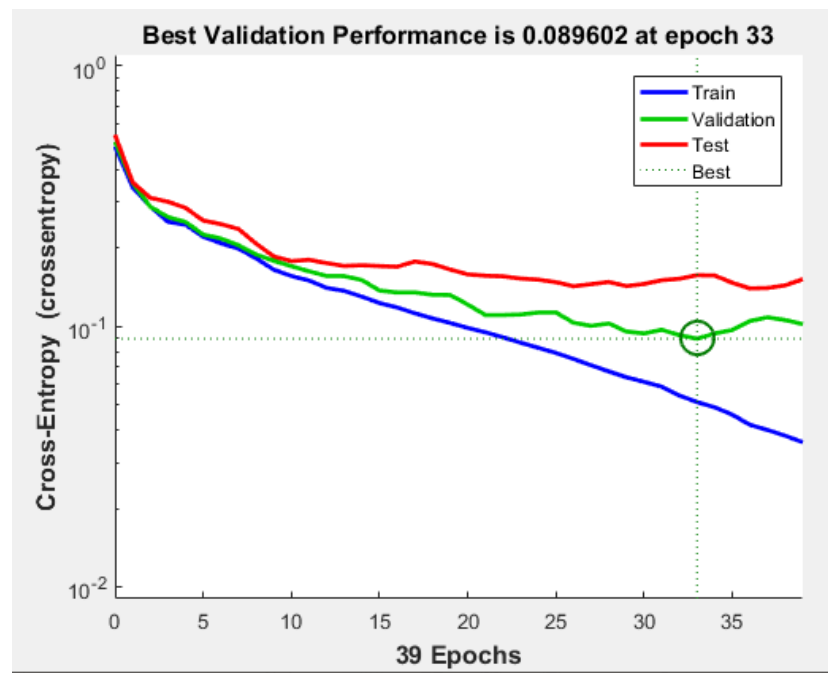
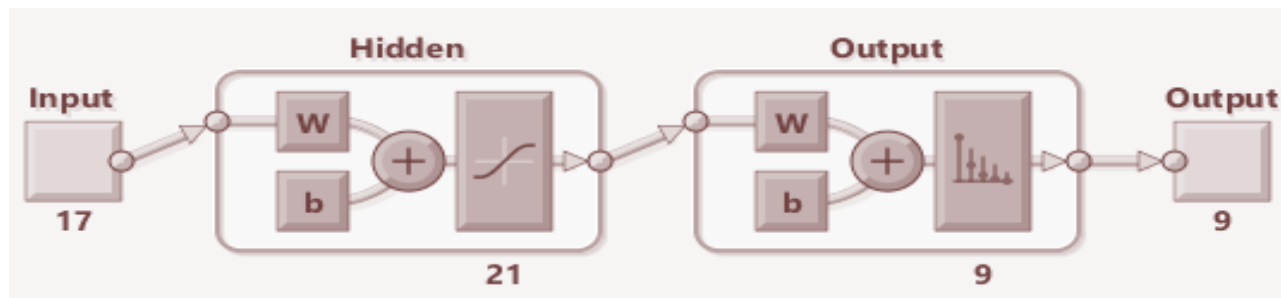


Softmax Transfer Function

Analise

Análise da RNA escolhida como ótima por método semi-manual.

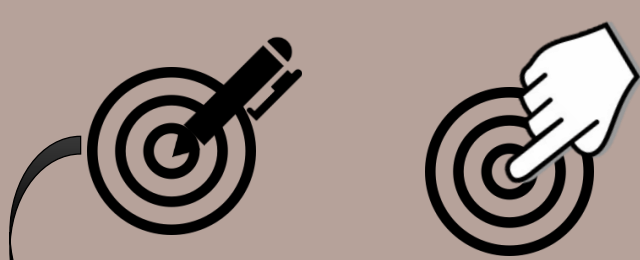
Transfer Function = *TanSigmoid*



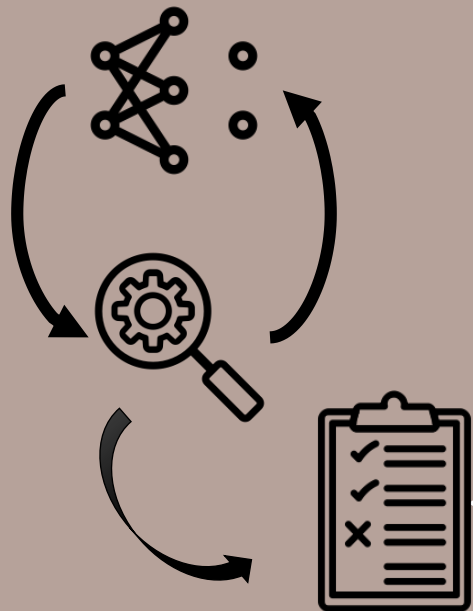
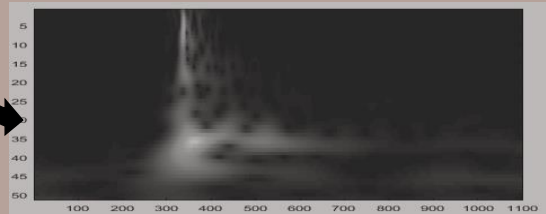
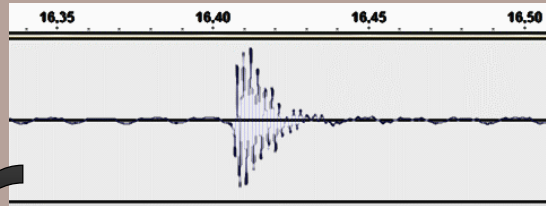
Confusion Matrix

	1	2	3	4	5	6	7	8	9	
1	19 10.6%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	100%
2	0 0.0%	9 5.0%	0 0.0%	0 0.0%	0 0.0%	2 1.1%	1 0.6%	0 0.0%	1 0.6%	69.2%
3	0 0.0%	2 1.1%	20 11.1%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 0.6%	0 0.0%	87.0%
4	1 0.6%	1 0.6%	0 0.0%	18 10.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 0.6%	85.7%
5	0 0.0%	1 0.6%	0 0.0%	0 0.0%	17 9.4%	1 0.6%	0 0.0%	2 1.1%	1 0.6%	77.3%
6	0 0.0%	1 0.6%	0 0.0%	0 0.0%	1 0.6%	14 7.8%	0 0.0%	0 0.0%	0 0.0%	87.5%
7	0 0.0%	4 2.2%	0 0.0%	0 0.0%	1 0.6%	0 0.0%	19 10.6%	0 0.0%	0 0.0%	79.2%
8	0 0.0%	0 0.0%	0 0.0%	1 0.6%	1 0.6%	3 1.7%	0 0.0%	14 7.8%	0 0.0%	73.7%
9	0 0.0%	2 1.1%	0 0.0%	1 0.6%	0 0.0%	0 0.0%	0 0.0%	3 1.7%	17 9.4%	73.9%
	95.0%	45.0%	100%	90.0%	85.0%	70.0%	95.0%	70.0%	85.0%	81.7%
	5.0%	55.0%	0.0%	10.0%	15.0%	30.0%	5.0%	30.0%	15.0%	18.3%
	1	2	3	4	5	6	7	8	9	

Target Class



Analyse



Average Error Distance by Touch (cm)								
1	2	3	4	5	6	7	8	9
0,3	4,8	0,0	0,9	0,9	2,0	0,6	1,8	1,5

mic



conclusão.

obrigado pela
atenção.



Referências

Matlab Online Documentation

PSI2672 Course Material

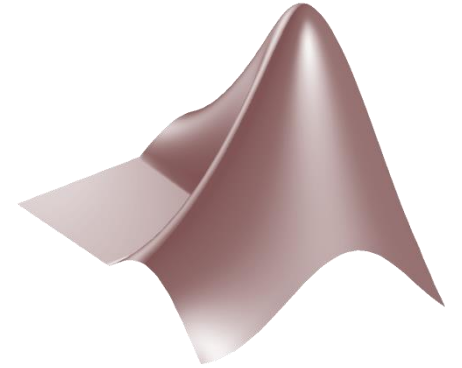
L. Garrido, H. Mojica, Predicción del tipo de cambio peso-dólar utilizando Redes Neuronales Artificiales (rna), 2007

Andy Khong, W.S. Gan, et al., "*Localization of acoustic source on solids: A linear predictive coding based algorithm for location template matching*", Acoustics, Speech, and Signal Processing, 1988. ICASSP-88., 1988 International Conference,

Mais referêncis no relatorio final.



Softwares





Casos de aplicações de RNA - Classificação & Regressão

Escola Politécnica – PSI2672

São Paulo, Junho 2017

Grupo V – 28 junho 2017

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