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Disciplina Aprendizagem de Máquina
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Análise do algoritmo de rede neural Multilayer Perceptron no WEKA

SUMÁRIO

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Introdução

A intenção deste trabalho é utilizar o programa WEKA, um software de código aberto distribuído sob a Licença Pública Geral GNU, que disponibiliza o algoritmo de rede neural **Multilayer Perceptron (MLP)** para treinar o dataset Car Evaluation, baixado através da página UC Irvine Machine Learning Repository, com o objetivo de extrair o melhor resultado das respostas no aprendizado da máquina enquanto estudamos cada passo relevante do processo.

O dataset utilizado para essa análise chama-se Car Evaluation e download foi feito através da página UC Irvine Machine Learning Repository.

As respostas completas retornadas pelo programa WEKA encontram-se na sessão "**Apêndices**" deste documento.

Características do Conjunto de Dados

Nome: Car Evaluation Database

Descrição: Derivado de um modelo hierárquico simples de decisão, este banco de dados pode ser útil para testar métodos de indução construtiva e descoberta de estrutura.

Tipo: Multivariado

Área de Aplicação: Outros

Tarefas Associadas: Classificação

Tipo de Atributo: Categórico

Número de Instâncias: 1728

Número de Atributos: 6

Nota: Não possui dados faltantes.

O Car Evaluation Database foi derivado de um modelo hierárquico simples de decisão desenvolvido originalmente para a demonstração do DEX, conforme descrito no trabalho de M. Bohanec e V. Rajkovic: "Expert system for decision making," publicado na Sistemica 1(1), pp. 145-157, 1990.

O modelo avalia carros de acordo com a seguinte estrutura de conceitos:

- **CAR**: Aceitabilidade do carro
    - **PRICE**: Preço geral
        - **buying**: Preço de compra. Categorizado como:
            - **vhigh** (muito alto);
            - **high** (alto);
            - **med** (médio);
            - **low** (baixo).
        - **maint**: Custo de manutenção. Categorizado como:
            - **vhigh** (muito alto);
            - **high** (alto);
            - **med** (médio);
            - **low** (baixo).
    - **TECH**: Características técnicas
        - **COMFORT**: Conforto
            - **doors**: Número de portas. Categorizado como:
                - **2**;
                - **3**;
                - **4**;
                - **5more** (5 ou mais).
            - **persons**: Capacidade de pessoas. Categorizado como:
                - **2**;
                - **4**;
                - **more** (mais).
            - **lug_boot**: Tamanho do porta-malas. Categorizado como:
                - **small** (pequeno);
                - **med** (médio);
                - **big** (grande).
        - **safety**: Segurança estimada do carro. Categorizado como:

- **low**;
- **med**;
- **high**.

Os **Rótulos de Classe** são escritos da seguinte maneira:

- **unacc**: Inaceitável
- **acc**: Aceitável
- **good**: Bom
- **vgood**: Muito bom

Os atributos de entrada estão escritos em minúsculas. Além do conceito alvo (CAR), o modelo inclui três conceitos intermediários: PRICE, TECH, e COMFORT. Cada conceito no modelo original está relacionado aos seus descendentes de nível inferior por um conjunto de exemplos.

O Car Evaluation Database contém exemplos com a informação estrutural removida, ou seja, relaciona diretamente CAR aos seis atributos de entrada: buying, maint, doors, persons, lug_boot, safety.

Exposição do algoritmo Multilayer Perceptron (MLP)

O algoritmo **Multilayer Perceptron** (MLP) é um tipo de rede neural feedforward, o que quer dizer que as informações fluem de uma única direção, da camada de entrada à camada de saída sem a opção de voltar o processamento em direção à entrada, o que as diferencia das redes neurais recorrentes (RNNs) que são capazes de manter memória de estados passados.

O Multilayer Perceptron é composto por várias camadas de neurônios. Cada neurônio em uma camada está conectado a todos os neurônios da camada seguinte. Quando um conjunto de dados é fornecido, ele passa pela camada de entrada, é processado nas camadas ocultas e, por fim, chega à camada de saída, onde é gerada uma previsão ou classificação. Cada neurônio aplica uma função de ativação a sua saída, o que permite que a rede aprenda padrões complexos e não-lineares.

Sem funções de ativação não-lineares, as camadas ocultas se reduziriam a combinações lineares das entradas, o que, por propriedades da álgebra linear, seria equivalente a um único mapeamento linear de entrada para saída. Isso limitaria a capacidade do modelo de capturar padrões complexos e sofisticados, tornando-o incapaz de ajustar os pesos (configurações globais de valores utilizados para calcular os resultados) de maneira eficaz durante a retropropagação. Como resultado, a rede teria dificuldades para otimizar a função de custo e aprender representações mais úteis dos dados.

Portanto as funções de ativação desempenham um papel crucial nas redes neurais. Alguns exemplos de funções comuns são:

- **Sigmoid**. A função sigmoid é dada por ***S(x) = 1 / (1 + e^(-x))***. Ela produz saídas no intervalo entre 0 e 1, tornando-a útil para problemas de classificação binária, mas pode levar à lentidão no aprendizado caso haja grandes valores de entrada. Ela é suave e diferenciável em todos os pontos, mas pode sofrer de "vanishing gradient" (gradientes que se tornam muito pequenos), dificultando assim o treinamento de redes mais profundas.

- **ReLU (Rectified Linear Unit)**. A função ReLU é definida como ***f(x) = max(0, x)***. Ela produz saídas zero para entradas negativas e linear para entradas positivas. É computacionalmente eficiente e ajuda a mitigar o problema do "vanishing gradient", mas infelizmente pode sofrer de "dying ReLU", onde neurônios ficam inativos e nunca se ativam (onde há uma saída constante de zero) para entradas negativas.

- **Tanh (Tangente Hiperbólica)**. A função tanh é dada por ***tanh(x) = (e^x - e^(-x)) / (e^x + e^(-x))***. Ela produz saídas no intervalo entre -1 e 1. É uma função suave e diferenciável, semelhante à sigmoid onde também pode sofrer de "vanishing gradient", especialmente para entradas grandes, mas geralmente apresenta melhores resultados em termos de convergência.

O método de retropropagação é feito em cima do conjunto de dados durante o processo de treinamento, onde o erro entre a previsão da rede e o valor real é calculado e os pesos são ajustados para minimizar esse erro, usando técnicas como o gradiente descendente. Esse algoritmo otimiza os pesos ajustando-os na direção oposta ao gradiente da função de custo, com passos controlados por uma taxa de aprendizado, daí o termo “descendente”. Esse treinamento continua por várias iterações (chamados de **épocas**) até que o modelo alcance um desempenho satisfatório.

O MLP é uma das formas mais básicas de rede neural, mas sua estrutura permite resolver uma ampla variedade de problemas em aprendizado de máquina.

Definindo os valores para a análise

Por motivos didáticos, utilizaremos apenas duas camadas de neurônios nesta análise. Em cenários reais, o ideal é utilizar quantas camadas forem necessárias para atingir o melhor desempenho de aprendizado. Usaremos também duas

fórmulas matemáticas, propostas pela mentora desta disciplina, que se baseiam no número de atributos e classes do dataset para definir a estrutura das camadas.

- **Primeira fórmula**: (número de atributos + número de classes) / 2

- **Segunda fórmula**: (⅔ * número de atributos) + número de classes

A partir da segunda camada, o número de atributos será substituído pela quantidade de neurônios que resultaram no melhor desempenho de aprendizado da camada anterior.

O nosso dataset possui os seguinte parâmetros:

Qtd. Atributos = 6	Qtd. Classes = 5
● **buying**: vhigh, high, med, low. ● **maint**: vhigh, high, med, low. ● **doors**: 2, 3, 4, 5more. ● **persons**: 2, 4, more. ● **lug_boot**: small, med, big. ● **safety**: low, med, high.	● **unacc**: Inaceitável ● **acc**: Aceitável ● **good**: Bom ● **vgood**: Muito bom

Os cálculos das camadas serão apresentados a seguir. Será exibido uma tabela com os resultados onde o melhor será destacado. As respostas de retorno do programa WEKA serão fixadas na sessão “**Apêndices**” separadas pelo tipo de conteúdo.

Primeira Camada de Neurônios

Primeira fórmula = (6 + 5) / 2 = 5,5. Como não existem “meios” neurônios, o valor será arredondado para 6.

Segunda fórmula = (⅔ * 6) + 5 = 4 + 5 = 9

A quantidade de neurônios varia de 6 a 9.

Qtd. de Neurônios	Acurácia
6	98,78%
7	99,01%

8	99,24%
9	99,13%

As respostas do programa WEKA podem ser encontradas na sessão “**Primeira Camada de Neurônios”** do **Apêndice A**.

Segunda Camada de Neurônios

Primeira fórmula = (8 + 5) / 2 = 6,5. Como não existem “meios” neurônios, o valor será arredondado para 7.

Segunda fórmula = (⅔ * 8) + 5 = 5,3 + 5 = 10,3. Arredondando para o número mais próximo, teremos 10.

A quantidade de neurônios varia de 7 a 10.

Qtd. de Neurônios	Acurácia
7	99,82%
8	99,88%
9	99,76%
10	99,88%

Como a quantidade de 8 neurônios e a de 10 obtiveram o mesmo resultado de acurácia, elegeremos apenas um entre os dois. Além disso, a segunda camada foi a que obteve os melhores resultados, então o valor dela será utilizado para as próximas análises.

As respostas do programa WEKA podem ser encontradas na sessão “**Segunda Camada de Neurônios”** do **Apêndice B**.

Definindo a Taxa de Aprendizado (Learning Rate)

O Learning Rate influencia a velocidade em que os algoritmos ajustam os pesos das conexões neuronais. Seguiremos nesse processo com os 8 neurônios da segunda camada oculta (hiddenLayers: 8, 8).

Learning Rate	Acurácia

0.3	99,88%
0.4	99,71%
0.5	99,76%

Seguiremos com o Learning Rate igual a 0.3.

As respostas do programa WEKA podem ser encontradas na sessão “**Learning Rate”** do **Apêndice C**.

Definindo O Tempo de Treinamento (Training Time)

No Training Time simulamos o tempo de treinamento para testar a quantidade de épocas (iterações).

Training Time	Acurácia
500	99,88%
750	99,94%
1000	99,94%
1250	99,94%

A partir de 750 a quantidade de acurácia se manteve em 99,94%.

As respostas do programa WEKA podem ser encontradas na sessão “**Training Time”** do **Apêndice D**.

Conclusão

As melhores configurações utilizando o Multilayer Perceptron neste dataset foram:

Primeira Camada	**8 Neurônios**
Segunda Camada	**8 Neurônios**
Learning Rate	**0.3**
Training Time	**750**

Acurácia Alcançada	**99,94%**

***

Referências

Página web do WECA: https://waikato.github.io/weka-wiki/

Repositório de datasets: http://archive.ics.uci.edu/

Dataset utilizado na pesquisa:
http://archive.ics.uci.edu/dataset/19/car+evaluation

Trabalho de M. Bohanec e V. Rajkovic: "Expert system for decision making," publicado na Sistemica 1(1), pp. 145-157, 1990. Através do link: https://repositorio.ufscar.br/bitstream/handle/ufscar/366/1698.pdf?sequence=1&isAllowed=y

Apêndices

Apêndice A

Primeira Camada de Neurônios

6 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
6
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -4.51293300708992
    Node 4    0.4483225920641432
    Node 5    10.925532632099078
    Node 6    6.8915407203645875
```

```
    Node 7    6.897452422224797
    Node 8    -2.3954517394457038
    Node 9    7.736090002947923
Sigmoid Node 1
    Inputs    Weights
    Threshold    -3.796450652925747
    Node 4    0.8057570251779642
    Node 5    -11.389840740818372
    Node 6    -6.599951071804719
    Node 7    -6.7786650512486535
    Node 8    9.931914311966853
    Node 9    -8.264784017788127
Sigmoid Node 2
    Inputs    Weights
    Threshold    -6.393051473529833
    Node 4    9.124043425824777
    Node 5    -1.86977867699786
    Node 6    -4.7104931285704605
    Node 7    -4.797932627851334
    Node 8    -8.729403243727605
    Node 9    -5.204529477213726
Sigmoid Node 3
    Inputs    Weights
    Threshold    3.979368224866922
    Node 4    -11.492605901606739
    Node 5    -1.327979047176173
    Node 6    -5.056603837822541
    Node 7    -4.910865166248672
    Node 8    -9.187826013848928
    Node 9    -1.5971297364269044
Sigmoid Node 4
    Inputs    Weights
    Threshold    2.655671691316843
    Attrib buying=vhigh    -0.9024318433140424
    Attrib buying=high    -0.32292582887549565
    Attrib buying=med    -2.5755225599365605
    Attrib buying=low    -1.4823256171306802
    Attrib maint=vhigh    -0.49751105746759594
    Attrib maint=high    -2.59358930917988
    Attrib maint=med    -1.5849049737905003
    Attrib maint=low    -0.6245953742011003
    Attrib doors=2    3.0517281402869383
    Attrib doors=3    -0.5090688810397312
    Attrib doors=4    -3.957532825646319
    Attrib doors=5more    -3.956441376506078
    Attrib persons=2    -0.8504035108849132
    Attrib persons=4    0.7092917421823725
    Attrib persons=more    -2.5084041642218278
    Attrib lug_boot=small    6.407312181996458
    Attrib lug_boot=med    -0.9861847561175909
    Attrib lug_boot=big    -8.009872476258051
    Attrib safety=low    -1.1615738532876039
    Attrib safety=med    6.308300731276318
    Attrib safety=high    -7.836264692580453
Sigmoid Node 5
    Inputs    Weights
    Threshold    -1.145474711698878
    Attrib buying=vhigh    4.623915344378227
    Attrib buying=high    4.980560906186057
```

```
    Attrib buying=med    -3.811773502314909
    Attrib buying=low    -3.5630634994006884
    Attrib maint=vhigh    6.904353170927689
    Attrib maint=high    -1.9182602792446082
    Attrib maint=med    -1.4417574593015547
    Attrib maint=low    -1.3349368390132201
    Attrib doors=2    2.251622744758556
    Attrib doors=3    1.1125031203745228
    Attrib doors=4    -0.6123646590193157
    Attrib doors=5more    -0.607531219578142
    Attrib persons=2    4.436743937614735
    Attrib persons=4    -0.8819578989702153
    Attrib persons=more    -2.4795707417585335
    Attrib lug_boot=small    3.183587402159213
    Attrib lug_boot=med    0.39783450437907136
    Attrib lug_boot=big    -2.505102789366941
    Attrib safety=low    4.61217074835963
    Attrib safety=med    2.3755317802843616
    Attrib safety=high    -5.8806629519943945
Sigmoid Node 6
    Inputs    Weights
    Threshold    0.8592464153405704
    Attrib buying=vhigh    2.693947079947274
    Attrib buying=high    0.07941066781817553
    Attrib buying=med    -2.2421797191017707
    Attrib buying=low    -2.368832073332727
    Attrib maint=vhigh    2.6115230982504687
    Attrib maint=high    0.40533483367559725
    Attrib maint=med    -2.361025340938942
    Attrib maint=low    -2.430227911332559
    Attrib doors=2    -1.313432170209665
    Attrib doors=3    0.03255387912060982
    Attrib doors=4    -0.28269565349327397
    Attrib doors=5more    -0.31563602259769313
    Attrib persons=2    4.9819000718213475
    Attrib persons=4    -2.6329995902368775
    Attrib persons=more    -3.2869686955032047
    Attrib lug_boot=small    -1.2033941995901798
    Attrib lug_boot=med    0.09563018582023088
    Attrib lug_boot=big    0.16880209018780223
    Attrib safety=low    5.030687041300413
    Attrib safety=med    -2.927776115998476
    Attrib safety=high    -2.925178431810377
Sigmoid Node 7
    Inputs    Weights
    Threshold    1.037369895905479
    Attrib buying=vhigh    3.419944787676745
    Attrib buying=high    0.016146469076112738
    Attrib buying=med    -2.922696141695107
    Attrib buying=low    -2.610561458198912
    Attrib maint=vhigh    3.1617351257708455
    Attrib maint=high    0.19864641649524967
    Attrib maint=med    -2.7947791145773566
    Attrib maint=low    -2.798947125383083
    Attrib doors=2    -0.3441378920553404
    Attrib doors=3    -0.6668007245739533
    Attrib doors=4    -0.5514507648046877
    Attrib doors=5more    -0.5269956579833193
    Attrib persons=2    5.378026273953218
```

```
    Attrib persons=4    -4.165923086716655
    Attrib persons=more    -2.292959765933907
    Attrib lug_boot=small    -0.19977396672478107
    Attrib lug_boot=med    -0.5073198670961294
    Attrib lug_boot=big    -0.3749839453091731
    Attrib safety=low    5.747949969886442
    Attrib safety=med    -3.436547281457976
    Attrib safety=high    -3.3821551506661547
Sigmoid Node 8
    Inputs    Weights
    Threshold    4.695629394661685
    Attrib buying=vhigh    8.339159663608896
    Attrib buying=high    8.105340422650604
    Attrib buying=med    -9.95497258053173
    Attrib buying=low    -15.935822148807864
    Attrib maint=vhigh    9.905310840329525
    Attrib maint=high    3.562696185563866
    Attrib maint=med    -8.477332648202667
    Attrib maint=low    -14.328893072851534
    Attrib doors=2    -0.5361664433395092
    Attrib doors=3    -2.0103013325133547
    Attrib doors=4    -3.454238251052077
    Attrib doors=5more    -3.4510735924967832
    Attrib persons=2    -4.576033238555502
    Attrib persons=4    0.5985919726489564
    Attrib persons=more    -0.6476604811848359
    Attrib lug_boot=small    5.341026308849149
    Attrib lug_boot=med    -3.5100726253302215
    Attrib lug_boot=big    -6.42940991791432
    Attrib safety=low    -4.6777089947482695
    Attrib safety=med    5.91003190962526
    Attrib safety=high    -5.90406550802948
Sigmoid Node 9
    Inputs    Weights
    Threshold    -2.25782167567352
    Attrib buying=vhigh    2.6824586257071994
    Attrib buying=high    2.6109532696681725
    Attrib buying=med    2.3812671354305937
    Attrib buying=low    -3.154611751053633
    Attrib maint=vhigh    3.8535406887063473
    Attrib maint=high    4.123517685469784
    Attrib maint=med    -1.5261233649161412
    Attrib maint=low    -1.9851534331719096
    Attrib doors=2    7.623647009140964
    Attrib doors=3    -1.1209176700202341
    Attrib doors=4    -1.0976000075779972
    Attrib doors=5more    -1.0915448264825516
    Attrib persons=2    4.2431501765856146
    Attrib persons=4    -2.5217226443847243
    Attrib persons=more    0.3951440176080681
    Attrib lug_boot=small    8.623272514634145
    Attrib lug_boot=med    -0.2750441721165323
    Attrib lug_boot=big    -6.13612758854051
    Attrib safety=low    4.393053715223411
    Attrib safety=med    1.9189921695911851
    Attrib safety=high    -4.121687312445653
Class unacc
    Input
    Node 0
```

```
Class acc
   Input
   Node 1
Class good
   Input
   Node 2
Class vgood
   Input
   Node 3


Time taken to build model: 2.14 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1707               98.7847 %
Incorrectly Classified Instances        21                1.2153 %
Kappa statistic                          0.9734
Mean absolute error                      0.0113
Root mean squared error                  0.0738
Relative absolute error                  4.913  %
Root relative squared error             21.8209 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,998    0,006    0,998      0,998    0,998      0,993    0,999     1,000     unacc
               0,971    0,003    0,989      0,971    0,980      0,975    0,996     0,982     acc
               0,899    0,005    0,886      0,899    0,892      0,888    0,995     0,881     good
               0,985    0,004    0,914      0,985    0,948      0,947    1,000     0,986     vgood
Weighted Avg.  0,988    0,005    0,988      0,988    0,988      0,983    0,998     0,991

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1208    2    0    0 |    a = unacc
   3  373    7    1 |    b = acc
   0    2   62    5 |    c = good
   0    0    1   64 |    d = vgood
```

7 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
7
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
```

```
            class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -8.433865572148754
    Node 4    8.354611363205516
    Node 5    8.019163108761358
    Node 6    -0.9459952454155448
    Node 7    8.229701578743779
    Node 8    7.8402466323297455
    Node 9    9.779419130540203
    Node 10    -2.950046185509054
Sigmoid Node 1
    Inputs    Weights
    Threshold    -3.9089427858183265
    Node 4    -7.318123054327464
    Node 5    -7.8788832926994905
    Node 6    0.6045074068222127
    Node 7    -7.6303587516994575
    Node 8    -7.3806348851217685
    Node 9    -9.44677951950504
    Node 10    14.9113406253515
Sigmoid Node 2
    Inputs    Weights
    Threshold    -6.394974568864578
    Node 4    -8.451172274683396
    Node 5    0.6492190774651292
    Node 6    9.855601135896782
    Node 7    -7.3782872191012485
    Node 8    -2.816859632695519
    Node 9    -4.762152504278502
    Node 10    -7.977040120222788
Sigmoid Node 3
    Inputs    Weights
    Threshold    3.8085470890731576
    Node 4    -1.2996306764984005
    Node 5    -1.5779892480778948
    Node 6    -11.568564380984741
    Node 7    -2.0260433101688995
    Node 8    -4.333094958674439
    Node 9    -5.7967377095619295
    Node 10    -9.438560839527895
Sigmoid Node 4
    Inputs    Weights
    Threshold    -1.2180568558752647
    Attrib buying=vhigh    1.4038445563159434
    Attrib buying=high    1.2995927592063996
    Attrib buying=med    -0.5658125796254398
    Attrib buying=low    0.28827722641132525
    Attrib maint=vhigh    1.8961964298841822
    Attrib maint=high    0.4597579296445809
    Attrib maint=med    -0.3710751140506061
    Attrib maint=low    0.45637850840684063
    Attrib doors=2    4.306663345625521
    Attrib doors=3    0.12174354710851835
    Attrib doors=4    -1.0413115291392772
```

```
   Attrib doors=5more    -0.9922248589814405
   Attrib persons=2    4.113708003341694
   Attrib persons=4    -4.967170833486123
   Attrib persons=more    1.9539006784707482
   Attrib lug_boot=small    4.427618356491511
   Attrib lug_boot=med    -0.10562570643950546
   Attrib lug_boot=big    -3.1086960676440647
   Attrib safety=low    4.273458331793298
   Attrib safety=med    -0.4564323454107414
   Attrib safety=high    -2.557966576705681
Sigmoid Node 5
   Inputs    Weights
   Threshold    -0.7800164852595873
   Attrib buying=vhigh    2.3124680616288167
   Attrib buying=high    1.594128091297249
   Attrib buying=med    -0.2722788335626195
   Attrib buying=low    -2.240428353429619
   Attrib maint=vhigh    2.4048544016177997
   Attrib maint=high    0.87017517450848
   Attrib maint=med    -0.6734172708218948
   Attrib maint=low    -1.1183414745368192
   Attrib doors=2    4.99429558196138
   Attrib doors=3    -2.165269867773898
   Attrib doors=4    -0.7226563100715611
   Attrib doors=5more    -0.7230957651086426
   Attrib persons=2    2.8241760758866294
   Attrib persons=4    -0.9589194652710062
   Attrib persons=more    -1.1212623997619036
   Attrib lug_boot=small    6.067121624455045
   Attrib lug_boot=med    -0.36280855738815976
   Attrib lug_boot=big    -4.945313655988903
   Attrib safety=low    2.9466381636787613
   Attrib safety=med    0.6675867378061634
   Attrib safety=high    -2.926471070222945
Sigmoid Node 6
   Inputs    Weights
   Threshold    1.6326644351595128
   Attrib buying=vhigh    -0.9825294037752325
   Attrib buying=high    -3.6244851050108364
   Attrib buying=med    0.1513049279020215
   Attrib buying=low    1.1666064904473479
   Attrib maint=vhigh    -1.8109610751634242
   Attrib maint=high    -1.6819092235455824
   Attrib maint=med    -0.42657900073006305
   Attrib maint=low    0.5004002070174312
   Attrib doors=2    3.748647184358678
   Attrib doors=3    -0.07718587100005307
   Attrib doors=4    -3.54920432320521
   Attrib doors=5more    -3.49268229067114
   Attrib persons=2    0.13304545169624318
   Attrib persons=4    0.7770603568552605
   Attrib persons=more    -2.5737457991913217
   Attrib lug_boot=small    6.695198253831367
   Attrib lug_boot=med    -0.5554835388313646
   Attrib lug_boot=big    -7.76774978848189
   Attrib safety=low    -0.5469431003486679
   Attrib safety=med    6.5521651126400435
   Attrib safety=high    -7.749381693776854
Sigmoid Node 7
```

```
    Inputs    Weights
    Threshold    -0.11951486905462234
    Attrib buying=vhigh    1.2399609677015968
    Attrib buying=high    0.9325939869201456
    Attrib buying=med    -1.3028834315492568
    Attrib buying=low    -0.7146150643291836
    Attrib maint=vhigh    1.8623058503227272
    Attrib maint=high    0.35739256903268835
    Attrib maint=med    -1.450801257250999
    Attrib maint=low    -0.5679923386413364
    Attrib doors=2    -0.24079895271191873
    Attrib doors=3    2.932041989517924
    Attrib doors=4    -1.1768582005800907
    Attrib doors=5more    -1.265060157718277
    Attrib persons=2    6.068871195733773
    Attrib persons=4    -0.802857819174378
    Attrib persons=more    -5.164720973720129
    Attrib lug_boot=small    1.8432008403280633
    Attrib lug_boot=med    1.2508490465231437
    Attrib lug_boot=big    -2.9704556053924143
    Attrib safety=low    5.314664416790923
    Attrib safety=med    -0.9128483699676346
    Attrib safety=high    -4.270780836400498
Sigmoid Node 8
    Inputs    Weights
    Threshold    1.6645669527370335
    Attrib buying=vhigh    1.9743719268062379
    Attrib buying=high    0.7709672536494625
    Attrib buying=med    -1.7065134935780308
    Attrib buying=low    -4.313312705925456
    Attrib maint=vhigh    1.850671238655596
    Attrib maint=high    -0.059393675139424305
    Attrib maint=med    -2.2405938688917892
    Attrib maint=low    -2.8557382668507
    Attrib doors=2    -1.0419284766243653
    Attrib doors=3    -0.8693886806265814
    Attrib doors=4    -0.7006911786516201
    Attrib doors=5more    -0.6879372113175763
    Attrib persons=2    4.792115086329465
    Attrib persons=4    -3.2131328560748558
    Attrib persons=more    -3.2585070823240185
    Attrib lug_boot=small    -0.8430541428109913
    Attrib lug_boot=med    -0.3814075568375576
    Attrib lug_boot=big    -0.4107680929816631
    Attrib safety=low    3.4503147168276316
    Attrib safety=med    -0.23682175652531293
    Attrib safety=high    -4.792414952092146
Sigmoid Node 9
    Inputs    Weights
    Threshold    0.9535972377683506
    Attrib buying=vhigh    3.1365996063972563
    Attrib buying=high    -0.04305881638667713
    Attrib buying=med    -2.788020966389162
    Attrib buying=low    -2.4081406180889307
    Attrib maint=vhigh    3.157134798251852
    Attrib maint=high    0.16289713660440402
    Attrib maint=med    -2.6085459168988456
    Attrib maint=low    -2.696379367772104
    Attrib doors=2    -0.6814172963769446
```

```
    Attrib doors=3    -0.40785699986249063
    Attrib doors=4    -0.5062779319299194
    Attrib doors=5more    -0.49877780418761186
    Attrib persons=2    5.568996258059934
    Attrib persons=4    -3.278977146692252
    Attrib persons=more    -3.303633315734378
    Attrib lug_boot=small    -1.1655112475418925
    Attrib lug_boot=med    0.08160959000931878
    Attrib lug_boot=big    0.08890719933020405
    Attrib safety=low    5.274092745153978
    Attrib safety=med    -3.6987315092819686
    Attrib safety=high    -2.61339234114854
Sigmoid Node 10
    Inputs    Weights
    Threshold    4.760726208431785
    Attrib buying=vhigh    8.247641239233616
    Attrib buying=high    8.49878974762882
    Attrib buying=med    -9.817453679490836
    Attrib buying=low    -16.275716289782654
    Attrib maint=vhigh    9.975806088048474
    Attrib maint=high    3.519902001148252
    Attrib maint=med    -8.406354750281459
    Attrib maint=low    -14.5708630848374
    Attrib doors=2    -0.4310842925551401
    Attrib doors=3    -1.8996249715687867
    Attrib doors=4    -3.5184677875364714
    Attrib doors=5more    -3.5095174844732298
    Attrib persons=2    -4.808446533383259
    Attrib persons=4    0.7633014824984306
    Attrib persons=more    -0.6750280976083222
    Attrib lug_boot=small    5.682274927974556
    Attrib lug_boot=med    -3.6774686356247064
    Attrib lug_boot=big    -6.7777708306597475
    Attrib safety=low    -4.867617477995301
    Attrib safety=med    6.019499542421997
    Attrib safety=high    -5.8338605403138395
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 2.28 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1711               99.0162 %
Incorrectly Classified Instances        17                0.9838 %
Kappa statistic                          0.9785
Mean absolute error                      0.0092
```

```
Root mean squared error                  0.067
Relative absolute error                4.0053 %
Root relative squared error           19.8113 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,006    0,998      0,999    0,998      0,994    1,000     1,000     unacc
               0,974    0,003    0,989      0,974    0,982      0,976    0,997     0,992     acc
               0,928    0,005    0,889      0,928    0,908      0,904    0,996     0,894     good
               0,985    0,001    0,970      0,985    0,977      0,976    1,000     0,998     vgood
Weighted Avg.  0,990    0,005    0,990      0,990    0,990      0,986    0,999     0,994

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1209    1    0    0 |    a = unacc
   3  374    7    0 |    b = acc
   0    3   64    2 |    c = good
   0    0    1   64 |    d = vgood
```

8 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
8
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.307973132276034
    Node 4    -1.9877843976018912
    Node 5    0.7802675895276521
    Node 6    10.567695140767457
    Node 7    9.743492040627913
    Node 8    8.657089734018882
    Node 9    -1.2065890756368305
    Node 10    7.189612069613431
    Node 11    3.8411057758175216
Sigmoid Node 1
    Inputs    Weights
    Threshold    -5.008268199023723
    Node 4    1.5681194964840428
```

```
    Node 5    5.624702116079719
    Node 6    -11.204202278005758
    Node 7    -9.734876491233017
    Node 8    -12.396899681873775
    Node 9    11.708584627765084
    Node 10    -6.9752680060552965
    Node 11    -4.217436753970877
Sigmoid Node 2
    Inputs    Weights
    Threshold    -5.0772744760410475
    Node 4    9.619978076397793
    Node 5    -7.645716959926852
    Node 6    -2.4391967569290705
    Node 7    -4.55883545966336
    Node 8    -3.3971547636461272
    Node 9    -9.99045815169587
    Node 10    -4.246849015997567
    Node 11    -2.626807321848224
Sigmoid Node 3
    Inputs    Weights
    Threshold    4.4932520829501525
    Node 4    -9.60424689931587
    Node 5    -1.338239682402281
    Node 6    -1.3961551334142646
    Node 7    -4.535451126064645
    Node 8    -1.5691295348792489
    Node 9    -9.085144600647839
    Node 10    -6.392205921599801 5
    Node 11    -4.040573219741283
Sigmoid Node 4
    Inputs    Weights
    Threshold    1.9040164361895082
    Attrib buying=vhigh    -0.6062856195552492
    Attrib buying=high    0.03178128606891315
    Attrib buying=med    -2.0876712965465987
    Attrib buying=low    -1.2734059553446817
    Attrib maint=vhigh    -0.12039213999089703
    Attrib maint=high    -1.7554824730362044
    Attrib maint=med    -1.4016855495511928
    Attrib maint=low    -0.5978330109776748
    Attrib doors=2    1.9984016984916528
    Attrib doors=3    -0.20585202905642694
    Attrib doors=4    -2.7900869806584896
    Attrib doors=5more    -2.7684172409567487
    Attrib persons=2    -0.4494398612775049
    Attrib persons=4    0.3696806694772
    Attrib persons=more    -1.7733028836484923
    Attrib lug_boot=small    4.58128005338128
    Attrib lug_boot=med    -0.8429381061000923
    Attrib lug_boot=big    -5.543775554089725
    Attrib safety=low    -0.9840492659210233
    Attrib safety=med    4.508386243319784
    Attrib safety=high    -5.43853081199694
Sigmoid Node 5
    Inputs    Weights
    Threshold    -0.7251445512845666
    Attrib buying=vhigh    1.2459584600758802
    Attrib buying=high    -0.025850045022032593
    Attrib buying=med    -0.7246537267067202
```

```
    Attrib buying=low    0.8645847752886512
    Attrib maint=vhigh    0.2557858413724357
    Attrib maint=high    0.4712413984790321
    Attrib maint=med    -0.32976036880623444
    Attrib maint=low    1.0062718475675188
    Attrib doors=2    3.880898348507998
    Attrib doors=3    -1.416158021500275
    Attrib doors=4    -0.5171657488479043
    Attrib doors=5more    -0.5440887624383113
    Attrib persons=2    3.8863268616213933
    Attrib persons=4    -2.7308179029509163
    Attrib persons=more    -0.47554826026836683
    Attrib lug_boot=small    2.9254939784912297
    Attrib lug_boot=med    1.081977008272933
    Attrib lug_boot=big    -3.3351190347235513
    Attrib safety=low    4.137399404049361
    Attrib safety=med    0.5439730646207533
    Attrib safety=high    -3.9549747421321553
Sigmoid Node 6
    Inputs    Weights
    Threshold    -0.12362611442994512
    Attrib buying=vhigh    3.567650747022554
    Attrib buying=high    4.068764097958359
    Attrib buying=med    -4.066413328534805
    Attrib buying=low    -3.4262167388446545
    Attrib maint=vhigh    5.889017855104637
    Attrib maint=high    -2.1405477568794264
    Attrib maint=med    -1.9985610273350622
    Attrib maint=low    -1.594462643827926
    Attrib doors=2    1.0627521548143062
    Attrib doors=3    0.4776372319468633
    Attrib doors=4    -0.6854214715123933
    Attrib doors=5more    -0.6922966491341397
    Attrib persons=2    4.672601260787525
    Attrib persons=4    -1.676110811081827
    Attrib persons=more    -2.8370747514607872
    Attrib lug_boot=small    1.6305712252261662
    Attrib lug_boot=med    0.14138928991074665
    Attrib lug_boot=big    -1.6454542500095324
    Attrib safety=low    4.299551356081711
    Attrib safety=med    0.047225720942974066
    Attrib safety=high    -4.23115993808704
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.9187012250119962
    Attrib buying=vhigh    2.931971744579471
    Attrib buying=high    -1.7634378997251112
    Attrib buying=med    -0.3091382651890106
    Attrib buying=low    -2.772268699637389
    Attrib maint=vhigh    0.2602299304122799
    Attrib maint=high    1.8831840849189938
    Attrib maint=med    -2.0378151573707988
    Attrib maint=low    -2.047941173695699
    Attrib doors=2    -0.2036864233752945
    Attrib doors=3    -0.24845207479647682
    Attrib doors=4    -0.785720069970307
    Attrib doors=5more    -0.766700661710063
    Attrib persons=2    6.012064541513469
    Attrib persons=4    -3.170595316159551
```

```
    Attrib persons=more    -3.789494866778644
    Attrib lug_boot=small    0.29504818784526854
    Attrib lug_boot=med    -0.30139948960298
    Attrib lug_boot=big    -0.9975871141500916
    Attrib safety=low    5.467380299291352
    Attrib safety=med    -2.0769213394498385
    Attrib safety=high    -4.341683707940882
Sigmoid Node 8
    Inputs    Weights
    Threshold    -1.54623552267953
    Attrib buying=vhigh    2.2097886712977055
    Attrib buying=high    1.4128627051697342
    Attrib buying=med    0.19794878274470204
    Attrib buying=low    -0.717070016199879
    Attrib maint=vhigh    2.108258756396506
    Attrib maint=high    1.1500463628840438
    Attrib maint=med    -0.1612421430076796
    Attrib maint=low    -0.023703413735646887
    Attrib doors=2    4.792955776260776
    Attrib doors=3    -1.2527998899868178
    Attrib doors=4    -0.19940932699300623
    Attrib doors=5more    -0.20268388766586215
    Attrib persons=2    3.1524015988590293
    Attrib persons=4    -3.8001899294440173
    Attrib persons=more    2.230330034874909
    Attrib lug_boot=small    4.611769899479292
    Attrib lug_boot=med    -0.6363201433989013
    Attrib lug_boot=big    -2.4768962668383074
    Attrib safety=low    3.3168797502036247
    Attrib safety=med    0.27970875477608653
    Attrib safety=high    -2.091184644974612
Sigmoid Node 9
    Inputs    Weights
    Threshold    4.430875252247275
    Attrib buying=vhigh    7.486257155609298
    Attrib buying=high    7.653201583397602
    Attrib buying=med    -9.113394231398106
    Attrib buying=low    -14.930570977543562
    Attrib maint=vhigh    8.990128877556497
    Attrib maint=high    3.262668528576599
    Attrib maint=med    -7.712550007633919
    Attrib maint=low    -13.485608137997815
    Attrib doors=2    -0.8803691914010817
    Attrib doors=3    -1.698748827757645
    Attrib doors=4    -3.2450797575946266
    Attrib doors=5more    -3.2580602492527873
    Attrib persons=2    -3.870548332980969
    Attrib persons=4    0.3806107390199415
    Attrib persons=more    -0.9821218693884146
    Attrib lug_boot=small    4.540768004565396
    Attrib lug_boot=med    -3.2020719150309103
    Attrib lug_boot=big    -5.736004268992389
    Attrib safety=low    -3.9722464354541875
    Attrib safety=med    5.027899804248917
    Attrib safety=high    -5.555925262902579
Sigmoid Node 10
    Inputs    Weights
    Threshold    0.6573166572489012
    Attrib buying=vhigh    2.1013389106481024
```

```
    Attrib buying=high    -0.05541131067297807
    Attrib buying=med    -1.6898772031218467
    Attrib buying=low    -1.4955484454872778
    Attrib maint=vhigh    1.8616274700779547
    Attrib maint=high    0.5486931902621834
    Attrib maint=med    -1.7845448740339032
    Attrib maint=low    -1.8738713569654906
    Attrib doors=2    -1.005991466821858
    Attrib doors=3    -0.1706144479031213
    Attrib doors=4    -0.03222674755734277
    Attrib doors=5more    -0.042008195856787924
    Attrib persons=2    4.261302135965536
    Attrib persons=4    -2.4820269232933425
    Attrib persons=more    -2.477195013365814
    Attrib lug_boot=small    -1.0318666984976081
    Attrib lug_boot=med    -0.22813117387061607
    Attrib lug_boot=big    0.6118938510876855
    Attrib safety=low    4.208476368133109
    Attrib safety=med    -2.3674509814111606
    Attrib safety=high    -2.332244368129584
Sigmoid Node 11
    Inputs    Weights
    Threshold    -0.22048174554155744
    Attrib buying=vhigh    0.39678355126217885
    Attrib buying=high    1.2925385020178124
    Attrib buying=med    0.6296649446115121
    Attrib buying=low    -1.903350027774561
    Attrib maint=vhigh    1.482323734853872
    Attrib maint=high    0.09193629034699619
    Attrib maint=med    0.6831087035557236
    Attrib maint=low    -1.7552576770909827
    Attrib doors=2    3.4190177324236934
    Attrib doors=3    1.518386891891087
    Attrib doors=4    -2.268484937393592
    Attrib doors=5more    -2.2568347401728253
    Attrib persons=2    1.9500818390854358
    Attrib persons=4    0.21910851621770908
    Attrib persons=more    -1.981806024111765
    Attrib lug_boot=small    4.443594880395522
    Attrib lug_boot=med    0.1566036515945699
    Attrib lug_boot=big    -4.3970999647794144
    Attrib safety=low    1.9441080831350004
    Attrib safety=med    -0.23876882631358423
    Attrib safety=high    -1.4049377028858152
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 2.53 seconds
```

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1715               99.2477 %
Incorrectly Classified Instances        13                0.7523 %
Kappa statistic                          0.9835
Mean absolute error                      0.0076
Root mean squared error                  0.0604
Relative absolute error                  3.3182 %
Root relative squared error             17.8667 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,006    0,998      0,999    0,998      0,994    1,000     1,000     unacc
               0,974    0,002    0,992      0,974    0,983      0,978    0,997     0,992     acc
               0,971    0,004    0,905      0,971    0,937      0,935    0,996     0,864     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.  0,992    0,005    0,993      0,992    0,993      0,989    0,999     0,993

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1209    1    0    0 |    a = unacc
   3  374    7    0 |    b = acc
   0    2   67    0 |    c = good
   0    0    0   65 |    d = vgood
```

9 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
9
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -7.205296997295838
    Node 4    2.659420191866606
    Node 5    5.016769832128479
    Node 6    5.165661856298759
    Node 7    8.425087664855651
```

```
    Node 8    5.8451278385409395
    Node 9    -1.1904314220021226
    Node 10    9.731354774025494
    Node 11    -1.4583590448455985
    Node 12    9.80114424217251
Sigmoid Node 1
    Inputs    Weights
    Threshold    -3.727101048192931
    Node 4    -0.3191485174555008
    Node 5    -5.563724452406792
    Node 6    -7.98169468765684
    Node 7    -8.290576895613246
    Node 8    -8.627345621692792
    Node 9    6.854303383749526
    Node 10    -10.35895953553582
    Node 11    10.01664344843119
    Node 12    -7.82435180502254
Sigmoid Node 2
    Inputs    Weights
    Threshold    -5.360529659141679
    Node 4    9.43520807577472
    Node 5    -3.0901086038092562
    Node 6    -1.8880994401304083
    Node 7    -3.9536094082619226
    Node 8    -1.3177381831220938
    Node 9    -7.194933460370556
    Node 10    -7.645921229359603
    Node 11    -8.77530534432918
    Node 12    -4.656464278690825
Sigmoid Node 3
    Inputs    Weights
    Threshold    3.960122836905287
    Node 4    -10.7653295222285
    Node 5    -1.4750025289579327
    Node 6    -1.3521156392014217
    Node 7    -2.3049394296740098
    Node 8    -1.5274149677793838
    Node 9    -4.8640555152541385
    Node 10    -1.8493739404914975
    Node 11    -9.741133666107654
    Node 12    -5.4678330664855155
Sigmoid Node 4
    Inputs    Weights
    Threshold    -0.03342232913643931
    Attrib buying=vhigh    -4.142787809089899
    Attrib buying=high    -3.86714983349233
    Attrib buying=med    3.65397357301084
    Attrib buying=low    4.4655169514628055
    Attrib maint=vhigh    -4.687671773075851
    Attrib maint=high    -3.65459021587112
    Attrib maint=med    3.810894142428828
    Attrib maint=low    4.551125964809783
    Attrib doors=2    3.2619751702063615
    Attrib doors=3    0.6108959777985716
    Attrib doors=4    -1.8728820329029126
    Attrib doors=5more    -1.8369718691483825
    Attrib persons=2    4.81354172805517
    Attrib persons=4    -1.3215522167115068
    Attrib persons=more    -3.5316277361056465
```

```
    Attrib lug_boot=small    6.0855870079896475
    Attrib lug_boot=med    -0.5336552083487958
    Attrib lug_boot=big    -5.4889557332251915
    Attrib safety=low    2.251630482432054
    Attrib safety=med    3.896115892228646
    Attrib safety=high    -6.033403016408758
Sigmoid Node 5
    Inputs    Weights
    Threshold    -0.24069799899012087
    Attrib buying=vhigh    1.489888339195244
    Attrib buying=high    1.9231707998858665
    Attrib buying=med    -1.595126894431637
    Attrib buying=low    -1.5363407024240474
    Attrib maint=vhigh    2.6592308630653285
    Attrib maint=high    -0.8944824484974876
    Attrib maint=med    -0.5600822181501881
    Attrib maint=low    -0.7907776155323812
    Attrib doors=2    1.885389189424655
    Attrib doors=3    -1.4370303707995815
    Attrib doors=4    -0.03183759128683793
    Attrib doors=5more    -0.03269634317789385
    Attrib persons=2    3.2370822535727046
    Attrib persons=4    -2.2198190812803933
    Attrib persons=more    -0.8219158298577389
    Attrib lug_boot=small    2.504118438330886
    Attrib lug_boot=med    -0.16925423351682226
    Attrib lug_boot=big    -2.1666603270139415
    Attrib safety=low    3.2822866505456307
    Attrib safety=med    0.44332776868555257
    Attrib safety=high    -3.602462869932379
Sigmoid Node 6
    Inputs    Weights
    Threshold    -1.0209085309821975
    Attrib buying=vhigh    2.4189918101583614
    Attrib buying=high    1.7806842354315136
    Attrib buying=med    0.11529855377545893
    Attrib buying=low    -2.2426944358434433
    Attrib maint=vhigh    2.8254392392757537
    Attrib maint=high    1.2880552439140571
    Attrib maint=med    -1.0370667253162964
    Attrib maint=low    -1.1146618971102535
    Attrib doors=2    1.320283940176483
    Attrib doors=3    1.046792640682516
    Attrib doors=4    -0.2744686276035258
    Attrib doors=5more    -0.26287772431605894
    Attrib persons=2    2.503384105914501
    Attrib persons=4    0.7356463211254003
    Attrib persons=more    -2.227435378225641 3
    Attrib lug_boot=small    2.0772763538267838
    Attrib lug_boot=med    1.3575920966061386
    Attrib lug_boot=big    -2.4193511097898805
    Attrib safety=low    2.5304170242155894
    Attrib safety=med    1.6191621209202507
    Attrib safety=high    -3.1083620857577334
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.9889375754966971
    Attrib buying=vhigh    1.238813815224582
    Attrib buying=high    1.8555452177475746
```

```
    Attrib buying=med    -2.779195859022968
    Attrib buying=low    -2.2772147462813166
    Attrib maint=vhigh    2.767675775249326
    Attrib maint=high    -1.851849375449967
    Attrib maint=med    -1.4510186036172394
    Attrib maint=low    -1.542358172910229
    Attrib doors=2    0.11929068280594038
    Attrib doors=3    0.04269283480778907
    Attrib doors=4    -1.1135875119830918
    Attrib doors=5more    -1.1081401861017735
    Attrib persons=2    5.20474782196741
    Attrib persons=4    -2.730987268361587
    Attrib persons=more    -3.5299172807296793
    Attrib lug_boot=small    0.20174083678123458
    Attrib lug_boot=med    -0.15811237026428385
    Attrib lug_boot=big    -1.130206920932107
    Attrib safety=low    4.9127516371840025
    Attrib safety=med    -2.1221228739047837
    Attrib safety=high    -3.7800985461267755
Sigmoid Node 8
    Inputs    Weights
    Threshold    -0.6084968581734667
    Attrib buying=vhigh    4.361900753799252
    Attrib buying=high    -0.7682007562823663
    Attrib buying=med    0.5279205210484798
    Attrib buying=low    -2.8856134790685073
    Attrib maint=vhigh    1.6308768891611676
    Attrib maint=high    3.1215121204655616
    Attrib maint=med    -1.5776417024398237
    Attrib maint=low    -1.9463117248168817
    Attrib doors=2    1.186204091508233
    Attrib doors=3    0.7611045088056262
    Attrib doors=4    -0.34370523197193226
    Attrib doors=5more    -0.3571942880399295
    Attrib persons=2    2.358207721923653
    Attrib persons=4    -0.7721688122606402
    Attrib persons=more    -0.9527112946210055
    Attrib lug_boot=small    1.2711469596260534
    Attrib lug_boot=med    0.36007970167346887
    Attrib lug_boot=big    -1.047302766451481
    Attrib safety=low    2.469864869960268
    Attrib safety=med    0.3471634841076444
    Attrib safety=high    -2.138454405833611
Sigmoid Node 9
    Inputs    Weights
    Threshold    0.37446875954145176
    Attrib buying=vhigh    1.7225269499924334
    Attrib buying=high    -1.034620285317577
    Attrib buying=med    0.3009653191050093
    Attrib buying=low    -1.7996779324376935
    Attrib maint=vhigh    0.18538216641077682
    Attrib maint=high    2.1278052580855706
    Attrib maint=med    -0.564841424327652
    Attrib maint=low    -2.7576182226899335
    Attrib doors=2    3.588814266684602
    Attrib doors=3    -1.2034892474550012
    Attrib doors=4    -1.6286570940071563
    Attrib doors=5more    -1.6274494386469973
    Attrib persons=2    4.864167283777245
```

```
   Attrib persons=4    -2.477845999098108
   Attrib persons=more    -2.7561993163409535
   Attrib lug_boot=small    -0.8583482976752534
   Attrib lug_boot=med    2.7524962366423615
   Attrib lug_boot=big    -2.2180542041906337
   Attrib safety=low    3.860598453115451
   Attrib safety=med    0.11185716304584524
   Attrib safety=high    -4.420801534621068
Sigmoid Node 10
   Inputs    Weights
   Threshold    -1.2483108839823531
   Attrib buying=vhigh    1.5077470457731947
   Attrib buying=high    1.5120357874194612
   Attrib buying=med    0.219796441301503
   Attrib buying=low    -0.718096815807774
   Attrib maint=vhigh    1.9697491788513213
   Attrib maint=high    0.9816196674487543
   Attrib maint=med    -0.10533096707793195
   Attrib maint=low    -0.3109559800359625
   Attrib doors=2    4.560496424283349
   Attrib doors=3    -0.715681240439213
   Attrib doors=4    -0.6185141516859278
   Attrib doors=5more    -0.6148225752204581
   Attrib persons=2    3.774366903038706
   Attrib persons=4    -4.322572511410742
   Attrib persons=more    1.8342790980574002
   Attrib lug_boot=small    4.257242051536871
   Attrib lug_boot=med    -0.46963761691777883
   Attrib lug_boot=big    -2.4928868557417156
   Attrib safety=low    3.7884903662929177
   Attrib safety=med    -0.24508517528174387
   Attrib safety=high    -2.1580324922728646
Sigmoid Node 11
   Inputs    Weights
   Threshold    4.546818982864981
   Attrib buying=vhigh    7.062296135939963
   Attrib buying=high    7.01103603025993
   Attrib buying=med    -8.915148818381347
   Attrib buying=low    -14.224103368764842
   Attrib maint=vhigh    8.577166897456813
   Attrib maint=high    2.8797481206549302
   Attrib maint=med    -7.679189373075305
   Attrib maint=low    -12.8870049288755
   Attrib doors=2    -1.244464451231092
   Attrib doors=3    -1.5112598961647512
   Attrib doors=4    -3.1442850208216986
   Attrib doors=5more    -3.1488805255431256
   Attrib persons=2    -3.0943980601311205
   Attrib persons=4    -0.002131934448634264
   Attrib persons=more    -1.4222316398887467
   Attrib lug_boot=small    4.9682284288702
   Attrib lug_boot=med    -3.7258868603838047
   Attrib lug_boot=big    -5.731717424238796
   Attrib safety=low    -3.6617333647183443
   Attrib safety=med    4.7466579972476755
   Attrib safety=high    -5.7047993512055895
Sigmoid Node 12
   Inputs    Weights
   Threshold    0.6933852622688731
```

```
   Attrib buying=vhigh    2.167400010658634
   Attrib buying=high    -0.340927100723446
   Attrib buying=med    -1.7215802271830645
   Attrib buying=low    -1.5969900118820473
   Attrib maint=vhigh    1.8705124477628257
   Attrib maint=high    0.7857580883675511
   Attrib maint=med    -1.9940753347862112
   Attrib maint=low    -2.0954575827103024
   Attrib doors=2    -0.6271980371636737
   Attrib doors=3    -0.30361956254246514
   Attrib doors=4    -0.30547654780368316
   Attrib doors=5more    -0.30459775104200604
   Attrib persons=2    4.349181149501086
   Attrib persons=4    -2.607510149676766
   Attrib persons=more    -2.500494508446114
   Attrib lug_boot=small    -0.9328026711117667
   Attrib lug_boot=med    8.30785120148464E-4
   Attrib lug_boot=big    0.2372578188901655
   Attrib safety=low    4.50045503352989
   Attrib safety=med    -3.093676779802672
   Attrib safety=high    -2.043996629759842
Class unacc
   Input
   Node 0
Class acc
   Input
   Node 1
Class good
   Input
   Node 2
Class vgood
   Input
   Node 3


Time taken to build model: 2.81 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1713               99.1319 %
Incorrectly Classified Instances        15                0.8681 %
Kappa statistic                          0.981
Mean absolute error                      0.0077
Root mean squared error                  0.0605
Relative absolute error                  3.354  %
Root relative squared error             17.8901 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
               0,998    0,008    0,997      0,998    0,998      0,992    1,000     1,000     unacc
               0,974    0,004    0,987      0,974    0,980      0,975    0,999     0,997     acc
               0,957    0,004    0,917      0,957    0,936      0,934    0,996     0,936     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.  0,991    0,006    0,991      0,991    0,991      0,986    1,000     0,997

=== Confusion Matrix ===
```

```
   a    b    c    d   <-- classified as
 1208    2    0    0 |    a = unacc
   4  374    6    0 |    b = acc
   0    3   66    0 |    c = good
   0    0    0   65 |    d = vgood
```

Apêndice B

Segunda Camada de Neurônios

7 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 7"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -7.069603374334023
    Node 12    2.620571393411695
    Node 13    3.22162798105037
    Node 14    2.308259494070336
    Node 15    5.6312122434878065
    Node 16    -0.36396400700509346
    Node 17    -1.2753980104214593
    Node 18    5.455462207092009
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.139273402870785
    Node 12    -0.778543222245248
    Node 13    -1.784044051418028
    Node 14    -0.6462392096001806
    Node 15    -6.578891001903564
    Node 16    1.5829656963313703
    Node 17    11.887537447982066
    Node 18    -6.17022985970887
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.6709349897438575
    Node 12    -0.14376272345291097
    Node 13    -0.8728587878621918
```

```
   Node 14    -0.4428174721208883
   Node 15    -1.7495862024796776
   Node 16    10.020449646238388
   Node 17    -10.384734662470702
   Node 18    -1.714516061321154
Sigmoid Node 3
   Inputs    Weights
   Threshold    5.149313646275574
   Node 12    -2.71513178864791
   Node 13    -2.3513295752347214
   Node 14    -2.658428730756662
   Node 15    -1.6235540571447207
   Node 16    -8.959666917755724
   Node 17    -4.662031561913494
   Node 18    -1.654588441194373
Sigmoid Node 4
   Inputs    Weights
   Threshold    -0.3262857970301871
   Attrib buying=vhigh    0.2741741250852519
   Attrib buying=high    0.07770952069842162
   Attrib buying=med    0.11740370537853646
   Attrib buying=low    0.13007249234708565
   Attrib maint=vhigh    0.25628312173558043
   Attrib maint=high    0.1063421765522794
   Attrib maint=med    0.05874024936241553
   Attrib maint=low    0.14590091513566955
   Attrib doors=2    2.1128234927675447
   Attrib doors=3    -1.716002796822269
   Attrib doors=4    0.10957012157008961
   Attrib doors=5more    0.08369284358482779
   Attrib persons=2    2.927680491324462
   Attrib persons=4    -3.165628845068428
   Attrib persons=more    0.6690612689224715
   Attrib lug_boot=small    2.0473146299775937
   Attrib lug_boot=med    0.10675063375148952
   Attrib lug_boot=big    -1.7850067336187747
   Attrib safety=low    2.8712155112057514
   Attrib safety=med    -1.3178512292849291
   Attrib safety=high    -1.1645326930045063
Sigmoid Node 5
   Inputs    Weights
   Threshold    0.3693661953548433
   Attrib buying=vhigh    -3.1173952087214998
   Attrib buying=high    1.0165188227055135
   Attrib buying=med    -0.7199257912796715
   Attrib buying=low    2.0649762296611347
   Attrib maint=vhigh    -0.7257423737842786
   Attrib maint=high    -2.5749875545345082
   Attrib maint=med    1.273987978367337
   Attrib maint=low    1.3042822815410666
   Attrib doors=2    -0.36485523306770246
   Attrib doors=3    -0.22816283673441237
   Attrib doors=4    -0.0701770920094362
   Attrib doors=5more    -0.07010775436998315
   Attrib persons=2    -2.519272069672712
   Attrib persons=4    1.041270650776095
   Attrib persons=more    1.0708037202542908
   Attrib lug_boot=small    -0.5668352085801838
   Attrib lug_boot=med    -0.23484194874856182
```

```
    Attrib lug_boot=big    0.356869949842629
    Attrib safety=low    -2.239917177932901
    Attrib safety=med    -0.053377986874639224
    Attrib safety=high    1.85648381096126
Sigmoid Node 6
    Inputs    Weights
    Threshold    0.34009334408596226
    Attrib buying=vhigh    1.5019800269666257
    Attrib buying=high    0.6612728971409604
    Attrib buying=med    -1.385343726382099
    Attrib buying=low    -1.4878380193988006
    Attrib maint=vhigh    1.7647411541041742
    Attrib maint=high    -0.2582945506227588
    Attrib maint=med    -1.223587009689588
    Attrib maint=low    -1.033490653348562
    Attrib doors=2    -0.7201452570161894
    Attrib doors=3    -0.25746559597885776
    Attrib doors=4    0.12190980336685965
    Attrib doors=5more    0.12561569158528899
    Attrib persons=2    2.8789318018914183
    Attrib persons=4    -1.7399629958916125
    Attrib persons=more    -1.5141689804430292
    Attrib lug_boot=small    -1.3647655578703077
    Attrib lug_boot=med    0.024105818219132925
    Attrib lug_boot=big    0.9362807289391964
    Attrib safety=low    2.874267006020447
    Attrib safety=med    -2.42879614320196
    Attrib safety=high    -0.8356306893005968
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.8849615563412385
    Attrib buying=vhigh    0.15123793615595058
    Attrib buying=high    1.0246768152404289
    Attrib buying=med    -1.5661584865415732
    Attrib buying=low    -1.4559408151072821
    Attrib maint=vhigh    1.3121797981472914
    Attrib maint=high    -1.1929258812607544
    Attrib maint=med    -1.040696843443236
    Attrib maint=low    -0.7984284766407358
    Attrib doors=2    -0.6210104444926579
    Attrib doors=3    -0.4780855965909959
    Attrib doors=4    -0.36674913961386624
    Attrib doors=5more    -0.364901577085116
    Attrib persons=2    2.788024302896482
    Attrib persons=4    -1.849408668128981
    Attrib persons=more    -1.8523442436870288
    Attrib lug_boot=small    -0.705406732262401
    Attrib lug_boot=med    -0.37527706636395325
    Attrib lug_boot=big    0.1613718804012862
    Attrib safety=low    2.0664287399851564
    Attrib safety=med    0.3803620279255208
    Attrib safety=high    -3.4075246143517823
Sigmoid Node 8
    Inputs    Weights
    Threshold    0.4140951560284129
    Attrib buying=vhigh    1.6714518523672497
    Attrib buying=high    0.26728078382839476
    Attrib buying=med    -1.7232346471237485
    Attrib buying=low    -1.1426527401356685
```

```
    Attrib maint=vhigh    1.7933397010676777
    Attrib maint=high    -0.015969155739517314
    Attrib maint=med    -1.3794649068125169
    Attrib maint=low    -1.2380674481523937
    Attrib doors=2    -0.49336694711939805
    Attrib doors=3    -0.1778409018419091
    Attrib doors=4    -0.10944778325909216
    Attrib doors=5more    -0.1135183795523547
    Attrib persons=2    2.930314344074663
    Attrib persons=4    -1.614968081898039
    Attrib persons=more    -1.678609932471591
    Attrib lug_boot=small    -0.8818022850743618
    Attrib lug_boot=med    0.041934497463591215
    Attrib lug_boot=big    0.3987588290313597
    Attrib safety=low    2.9712378536390855
    Attrib safety=med    -1.922909540576791
    Attrib safety=high    -1.403866434687578
Sigmoid Node 9
    Inputs    Weights
    Threshold    -0.30186657455022176
    Attrib buying=vhigh    0.42753664499496297
    Attrib buying=high    -0.03892460512299276
    Attrib buying=med    0.11438164124410634
    Attrib buying=low    0.04729471803141424
    Attrib maint=vhigh    0.2335080608215191
    Attrib maint=high    0.20054251222359218
    Attrib maint=med    0.0580527135951326
    Attrib maint=low    0.022161381286855436
    Attrib doors=2    -2.07013807562946
    Attrib doors=3    -1.0327341007608324
    Attrib doors=4    1.7839611056739453
    Attrib doors=5more    1.7609885212447294
    Attrib persons=2    -1.8023879139634937
    Attrib persons=4    -0.17581719243885444
    Attrib persons=more    2.291753774471577
    Attrib lug_boot=small    -3.8262341092402283
    Attrib lug_boot=med    0.12632942493244104
    Attrib lug_boot=big    3.953326833628739
    Attrib safety=low    -1.6313188309842144
    Attrib safety=med    0.8169936960535571
    Attrib safety=high    1.0399217413821007
Sigmoid Node 10
    Inputs    Weights
    Threshold    0.9293384356827706
    Attrib buying=vhigh    1.2179704949810146
    Attrib buying=high    2.0226008210988233
    Attrib buying=med    -1.2453493902704384
    Attrib buying=low    -3.8828817405104443
    Attrib maint=vhigh    1.40996547341063
    Attrib maint=high    1.6445380453662695
    Attrib maint=med    -0.9210002404506651
    Attrib maint=low    -3.842009258171572
    Attrib doors=2    -0.1793478633139243
    Attrib doors=3    -0.4720726732036644
    Attrib doors=4    -0.5566401456288804
    Attrib doors=5more    -0.5564075963018132
    Attrib persons=2    -0.41157040073886925
    Attrib persons=4    -0.250412812533545
    Attrib persons=more    -0.2211278420711473
```

```
   Attrib lug_boot=small    0.2016232286491155
   Attrib lug_boot=med    -0.3711414351610498
   Attrib lug_boot=big    -0.691219947211081
   Attrib safety=low    -0.4738506589079558
   Attrib safety=med    0.11219610926354905
   Attrib safety=high    -0.5270823582212704
Sigmoid Node 11
   Inputs    Weights
   Threshold    -1.2432034810589474
   Attrib buying=vhigh    -1.0879315367935016
   Attrib buying=high    -1.3941721176498314
   Attrib buying=med    1.3621541198669247
   Attrib buying=low    3.5753346043081953
   Attrib maint=vhigh    -1.9582567728688927
   Attrib maint=high    -0.3696931665632023
   Attrib maint=med    2.319861096143102
   Attrib maint=low    2.3849799875771462
   Attrib doors=2    0.5652768505431283
   Attrib doors=3    0.5966493519139122
   Attrib doors=4    0.6916211288433499
   Attrib doors=5more    0.6958331949961665
   Attrib persons=2    1.2016747851103742
   Attrib persons=4    -0.01029642937434593
   Attrib persons=more    0.0716209891003529
   Attrib lug_boot=small    0.03048230600788321
   Attrib lug_boot=med    0.3947642842430139
   Attrib lug_boot=big    0.7590410127438749
   Attrib safety=low    0.8804524806075769
   Attrib safety=med    -2.378446369962563
   Attrib safety=high    2.738843322313063
Sigmoid Node 12
   Inputs    Weights
   Threshold    0.06943498433835964
   Node 4    1.9538302505715435
   Node 5    -1.3435508113059231
   Node 6    1.4110680973530396
   Node 7    1.9900746378767278
   Node 8    1.4727941167436127
   Node 9    -1.9038071400471956
   Node 10    -0.2381751271191817
   Node 11    0.06485077080772898
Sigmoid Node 13
   Inputs    Weights
   Threshold    -0.22179494624255874
   Node 4    2.257947010513713
   Node 5    -2.157273198384049
   Node 6    1.7623915051591272
   Node 7    2.290887854172579
   Node 8    1.77915820058048
   Node 9    -2.3452837278114784
   Node 10    0.5202128026610527
   Node 11    0.24663170546554375
Sigmoid Node 14
   Inputs    Weights
   Threshold    0.07041388977935605
   Node 4    1.8459532222217487
   Node 5    -1.2547716763736536
   Node 6    1.400419090029388
   Node 7    1.9520706172911364
```

```
    Node 8    1.3626688463406749
    Node 9    -1.6369769965900691
    Node 10    -0.1238616962200252
    Node 11    -0.2805853478948164
Sigmoid Node 15
    Inputs    Weights
    Threshold    -0.3248868142496795
    Node 4    4.340029886608692
    Node 5    -4.1001299443501615
    Node 6    3.142516970022265
    Node 7    4.189383734708608
    Node 8    3.3278815737628
    Node 9    -4.80904472452516
    Node 10    1.7039285225809708
    Node 11    0.9155593517328126
Sigmoid Node 16
    Inputs    Weights
    Threshold    4.296087811619755
    Node 4    4.939424754596958
    Node 5    3.0276496224557805
    Node 6    1.4142461577932377
    Node 7    4.38003686869293
    Node 8    1.3885093805578974
    Node 9    -6.263750710566837
    Node 10    -0.2422000751023386
    Node 11    -4.4860241333871365
Sigmoid Node 17
    Inputs    Weights
    Threshold    1.3607148678436427
    Node 4    4.460081320177664
    Node 5    -0.006230131480443758
    Node 6    4.491293322844271
    Node 7    2.0954287161677554
    Node 8    3.4849954484209213
    Node 9    -5.777654591405788
    Node 10    7.358156897931905
    Node 11    -5.041712751082895
Sigmoid Node 18
    Inputs    Weights
    Threshold    -0.3283356617054141
    Node 4    4.1902652918871786
    Node 5    -3.9643087035331486
    Node 6    3.0205451896391
    Node 7    4.0537353842981885
    Node 8    3.21914692396924
    Node 9    -4.639406961777496
    Node 10    1.6447209798196658
    Node 11    0.8521946370645849
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
```

```
   Node 3


Time taken to build model: 3.84 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1725               99.8264 %
Incorrectly Classified Instances         3                0.1736 %
Kappa statistic                          0.9962
Mean absolute error                      0.0026
Root mean squared error                  0.0241
Relative absolute error                  1.1307 %
Root relative squared error              7.1317 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     unacc
               0,992    0,000    1,000      0,992    0,996      0,995    1,000     1,000     acc
               1,000    0,001    0,986      1,000    0,993      0,993    1,000     1,000     good
               1,000    0,001    0,970      1,000    0,985      0,984    1,000     1,000     vgood
Weighted Avg.  0,998    0,000    0,998      0,998    0,998      0,998    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1210    0    0    0 |    a = unacc
   0  381    1    2 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

8 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.676497497419739
```

```
    Node 12    -0.243157420469325
    Node 13    4.161917465285917
    Node 14    5.036339181190744
    Node 15    3.913158581512514
    Node 16    4.1804960255091705
    Node 17    -1.3006973971874518
    Node 18    3.349680424943593
    Node 19    -2.2012266047405973
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.665259297376204
    Node 12    1.3695193962730925
    Node 13    -3.8978056362650952
    Node 14    -5.264292181445521
    Node 15    -3.654091176175842
    Node 16    -3.836978453389413
    Node 17    6.665311580757991
    Node 18    -2.469675888561184
    Node 19    7.469775550765375
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.735580584263445
    Node 12    10.526608340139346
    Node 13    -1.745469440250562
    Node 14    -1.9623923669012502
    Node 15    -1.6352062113887067
    Node 16    -1.7091034985951417
    Node 17    -4.947165718705198
    Node 18    -1.0724247529826152
    Node 19    -6.309887798480004
Sigmoid Node 3
    Inputs    Weights
    Threshold    4.936311356509575
    Node 12    -9.290504449883892
    Node 13    -1.6703695901410283
    Node 14    -1.4142917327634006
    Node 15    -1.6429782041150895
    Node 16    -1.6594962080428923
    Node 17    -4.064774098408571
    Node 18    -1.9849145039004674
    Node 19    -3.5345942339154774
Sigmoid Node 4
    Inputs    Weights
    Threshold    -0.23576674559442648
    Attrib buying=vhigh    0.3174591257718334
    Attrib buying=high    1.0787099337314376
    Attrib buying=med    1.77402982012317
    Attrib buying=low    -2.6050596656459
    Attrib maint=vhigh    0.6769348548331313
    Attrib maint=high    -0.09610664479940455
    Attrib maint=med    0.3623977053108407
    Attrib maint=low    -0.3995391645263544
    Attrib doors=2    1.3150835463692618
    Attrib doors=3    0.27059496545238587
    Attrib doors=4    -0.5459906875956234
    Attrib doors=5more    -0.547633851641303
    Attrib persons=2    2.213212273201942
    Attrib persons=4    -1.123940747156066
    Attrib persons=more    -0.8776644094040311
```

```
    Attrib lug_boot=small    1.910627856989203
    Attrib lug_boot=med    0.6153919980397834
    Attrib lug_boot=big    -2.2877784657568294
    Attrib safety=low    2.1339089342035726
    Attrib safety=med    0.909257520985048
    Attrib safety=high    -2.8596482185638954
Sigmoid Node 5
    Inputs    Weights
    Threshold    0.9433909873281792
    Attrib buying=vhigh    1.3618136114475834
    Attrib buying=high    0.27889145696379053
    Attrib buying=med    -1.0111069305175484
    Attrib buying=low    -2.592049439656475
    Attrib maint=vhigh    1.4057084940853748
    Attrib maint=high    0.20240601641609945
    Attrib maint=med    -1.788698947922419
    Attrib maint=low    -1.7840591062086644
    Attrib doors=2    -0.8414099025519123
    Attrib doors=3    -0.5394513199058975
    Attrib doors=4    -0.28287740940885586
    Attrib doors=5more    -0.2821234441972961
    Attrib persons=2    2.1469583871762135
    Attrib persons=4    -1.603203727523077
    Attrib persons=more    -1.5653078540036778
    Attrib lug_boot=small    -1.3408934762735716
    Attrib lug_boot=med    -0.6815737444756933
    Attrib lug_boot=big    0.9839473989443677
    Attrib safety=low    1.3122277375241316
    Attrib safety=med    0.3579355978362084
    Attrib safety=high    -2.5968301016049264
Sigmoid Node 6
    Inputs    Weights
    Threshold    -0.26497746849898846
    Attrib buying=vhigh    0.9849277626527232
    Attrib buying=high    -0.1876665745230164
    Attrib buying=med    -1.1531421168567155
    Attrib buying=low    0.8466686580353444
    Attrib maint=vhigh    0.5586656835766007
    Attrib maint=high    2.282203125674473
    Attrib maint=med    -1.5106743324418508
    Attrib maint=low    -0.8172676608631535
    Attrib doors=2    1.2625652540253156
    Attrib doors=3    0.16191310563918232
    Attrib doors=4    -0.46120234209623
    Attrib doors=5more    -0.4493495919324071
    Attrib persons=2    1.1892587515207964
    Attrib persons=4    -0.31327316876924555
    Attrib persons=more    -0.622447463915718
    Attrib lug_boot=small    2.0129619652342225
    Attrib lug_boot=med    0.21421922067003835
    Attrib lug_boot=big    -2.085387248497509
    Attrib safety=low    1.2593599621171343
    Attrib safety=med    1.3776641723666914
    Attrib safety=high    -2.4368138104548427
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.7323104966824062
    Attrib buying=vhigh    0.1521977619183333
    Attrib buying=high    1.1426305971820874
```

```
   Attrib buying=med    -2.4544177788124957
   Attrib buying=low    -0.40691509082012384
   Attrib maint=vhigh    1.2106341630996087
   Attrib maint=high    -2.978491493244966
   Attrib maint=med    -0.11673973421049823
   Attrib maint=low    0.3021009047865043
   Attrib doors=2    -0.7560980697539174
   Attrib doors=3    -0.5565864231786959
   Attrib doors=4    -0.11601880232144628
   Attrib doors=5more    -0.1182684365691757
   Attrib persons=2    2.855283045964008
   Attrib persons=4    -1.888467366905546
   Attrib persons=more    -1.6882381809990477
   Attrib lug_boot=small    -0.8683642170294024
   Attrib lug_boot=med    -0.21174792482663177
   Attrib lug_boot=big    0.2881778028912309
   Attrib safety=low    2.2538946849489343
   Attrib safety=med    0.25072925026724135
   Attrib safety=high    -3.276909620600982
Sigmoid Node 8
   Inputs    Weights
   Threshold    -0.7068318070239685
   Attrib buying=vhigh    0.8019464373524392
   Attrib buying=high    0.247453432304408
   Attrib buying=med    0.18922876474026545
   Attrib buying=low    0.2152099442900912
   Attrib maint=vhigh    0.5219709943155256
   Attrib maint=high    0.4483177722394602
   Attrib maint=med    0.3574539621591026
   Attrib maint=low    0.09794394625880215
   Attrib doors=2    2.037277346206886
   Attrib doors=3    -1.8401476265627945
   Attrib doors=4    0.5653010052709673
   Attrib doors=5more    0.5648720222770193
   Attrib persons=2    2.9729162485057095
   Attrib persons=4    -3.1000378017289494
   Attrib persons=more    0.8915229703235515
   Attrib lug_boot=small    2.4221795065125926
   Attrib lug_boot=med    -0.37065733585393335
   Attrib lug_boot=big    -1.3666339648473587
   Attrib safety=low    2.1077150581864714
   Attrib safety=med    -1.1390369358700554
   Attrib safety=high    -0.24608848796307425
Sigmoid Node 9
   Inputs    Weights
   Threshold    -0.7717242992029351
   Attrib buying=vhigh    -2.7994023798558967
   Attrib buying=high    -0.07442044957345614
   Attrib buying=med    2.3838464042376697
   Attrib buying=low    1.8522181624064835
   Attrib maint=vhigh    -2.5677620208479413
   Attrib maint=high    -0.43332958249742265
   Attrib maint=med    2.2904194898250623
   Attrib maint=low    2.2386821522685763
   Attrib doors=2    0.6406882285318479
   Attrib doors=3    0.20533440457999688
   Attrib doors=4    0.29595796911160166
   Attrib doors=5more    0.295894228080605
   Attrib persons=2    -4.488159303419957
```

```
   Attrib persons=4    2.5382719409698704
   Attrib persons=more    2.6889503493779476
   Attrib lug_boot=small    1.225369185607533
   Attrib lug_boot=med    0.031192931370402605
   Attrib lug_boot=big    -0.556595203778578
   Attrib safety=low    -4.602448691637061
   Attrib safety=med    3.1845669991425845
   Attrib safety=high    2.12237342817993
Sigmoid Node 10
   Inputs    Weights
   Threshold    -0.05233158015281267
   Attrib buying=vhigh    0.24040471575878725
   Attrib buying=high    0.12343815957439279
   Attrib buying=med    -0.09230060754609261
   Attrib buying=low    -0.07982823495859563
   Attrib maint=vhigh    0.2525033723438698
   Attrib maint=high    0.14652619627306884
   Attrib maint=med    -0.06705251636382761
   Attrib maint=low    -0.26241196201008676
   Attrib doors=2    -3.260589406136598
   Attrib doors=3    -0.6446913278075728
   Attrib doors=4    2.1260388901800518
   Attrib doors=5more    2.126162791076957
   Attrib persons=2    -1.7585331989309505
   Attrib persons=4    -0.5445980998444994
   Attrib persons=more    2.3735856461468137
   Attrib lug_boot=small    -4.566781780152633
   Attrib lug_boot=med    -0.40090071210290423
   Attrib lug_boot=big    4.99190010967213
   Attrib safety=low    -1.5718717142755896
   Attrib safety=med    0.6479231126489251
   Attrib safety=high    1.0549548095596513
Sigmoid Node 11
   Inputs    Weights
   Threshold    1.9488976748656675
   Attrib buying=vhigh    2.0490711384367444
   Attrib buying=high    2.2908522248685945
   Attrib buying=med    -2.695008546962134
   Attrib buying=low    -5.646540420299475
   Attrib maint=vhigh    2.7032561280817613
   Attrib maint=high    0.5019452524065041
   Attrib maint=med    -2.197495253733043
   Attrib maint=low    -4.952934204653578
   Attrib doors=2    -0.4813302767432615
   Attrib doors=3    -0.7661227360900414
   Attrib doors=4    -1.2676333559429567
   Attrib doors=5more    -1.2692815755117424
   Attrib persons=2    0.434264564960236
   Attrib persons=4    -0.9541199140100688
   Attrib persons=more    -1.3245158034340299
   Attrib lug_boot=small    0.33441750390758845
   Attrib lug_boot=med    -0.6865611487611855
   Attrib lug_boot=big    -1.5786175973226397
   Attrib safety=low    0.21104220551730732
   Attrib safety=med    0.005170836345401767
   Attrib safety=high    -2.145824822407726
Sigmoid Node 12
   Inputs    Weights
   Threshold    2.1198552561569572
```

```
    Node 4    2.657286554180374
    Node 5    4.282683444306119
    Node 6    1.9265523145492256
    Node 7    5.758217207313993
    Node 8    5.022387924674813
    Node 9    1.0059439026103645
    Node 10    -6.69258956912532
    Node 11    2.1903919682984676
Sigmoid Node 13
    Inputs    Weights
    Threshold    0.7910860725595108
    Node 4    1.0209543436103214
    Node 5    2.343919708655611
    Node 6    0.8347469170714531
    Node 7    1.220735096106226
    Node 8    3.803684467182193
    Node 9    -4.47029713276755
    Node 10    -2.84256106669356
    Node 11    0.6744518750242655
Sigmoid Node 14
    Inputs    Weights
    Threshold    1.0567765829836762
    Node 4    1.267494145068228
    Node 5    2.8309814159869275
    Node 6    1.0625180669671757
    Node 7    1.419478712920068
    Node 8    4.703395919129004
    Node 9    -5.419511286690068
    Node 10    -3.467386759107209
    Node 11    0.7771314074960927
Sigmoid Node 15
    Inputs    Weights
    Threshold    0.6691622055648652
    Node 4    0.9975512458239899
    Node 5    2.2299776197657395
    Node 6    0.8269147533385263
    Node 7    1.1658852638971529
    Node 8    3.5610526736763672
    Node 9    -4.287478127792949
    Node 10    -2.638405291607427
    Node 11    0.689417789372883
Sigmoid Node 16
    Inputs    Weights
    Threshold    0.8251435159866786
    Node 4    0.9876685597728129
    Node 5    2.3422423748399193
    Node 6    0.8362348088164034
    Node 7    1.1489525809415553
    Node 8    3.805924973271349
    Node 9    -4.427055945171063
    Node 10    -2.833740762476332 4
    Node 11    0.6291434811003543
Sigmoid Node 17
    Inputs    Weights
    Threshold    -0.29878797754396635
    Node 4    1.3709012362587285
    Node 5    1.6205131937222095
    Node 6    3.3771953871283804
    Node 7    1.969797419644337
```

```
    Node 8    2.354561544856084
    Node 9    -2.2835135801481727
    Node 10    -3.1149489964271746
    Node 11    6.873144741082383
Sigmoid Node 18
    Inputs    Weights
    Threshold    0.6509426597839091
    Node 4    0.7393860375660125
    Node 5    1.7563000173490946
    Node 6    0.4822438306435522
    Node 7    1.0557173789874033
    Node 8    2.8702491160499948
    Node 9    -3.3462519942011233
    Node 10    -2.037835221376477
    Node 11    0.3027320640817577
Sigmoid Node 19
    Inputs    Weights
    Threshold    -0.5858029597813753
    Node 4    1.3596283026994755
    Node 5    1.7414103307972961
    Node 6    3.9877691633366803
    Node 7    1.9528143083289817
    Node 8    2.115554348727707
    Node 9    -2.301443094838674
    Node 10    -3.2632642812206636
    Node 11    7.697222280431426
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 4.05 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1726               99.8843 %
Incorrectly Classified Instances         2                0.1157 %
Kappa statistic                          0.9975
Mean absolute error                      0.0022
Root mean squared error                  0.0187
Relative absolute error                  0.9599 %
Root relative squared error              5.5362 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
               0,998    0,000    1,000      0,998    0,999      0,997    1,000     1,000     unacc
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
```

```
               1,000    0,001    0,986      1,000    0,993      0,993    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.    0,999    0,000    0,999      0,999    0,999      0,997    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1208    1    1    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

9 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 9"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.962149253860956
    Node 12    4.178678804335834
    Node 13    3.612853929274541
    Node 14    3.748933468021331
    Node 15    2.2622458892554493
    Node 16    1.3984246485376706
    Node 17    2.8994751243606207
    Node 18    -3.22160118510327
    Node 19    3.627060233956007
    Node 20    -0.8902496787808486
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.782059931926739
    Node 12    -5.4707846232328885
    Node 13    -3.3039004193752812
    Node 14    -4.066483336925986
    Node 15    -0.560451182690437
    Node 16    0.9312695175381901
    Node 17    -1.463150840992409
    Node 18    11.985037252305304
    Node 19    -2.977688748991298
    Node 20    2.067160312275603
Sigmoid Node 2
```

```
    Inputs    Weights
    Threshold    -4.039376340621841
    Node 12    -1.5742746840231983
    Node 13    -1.9616464122901838
    Node 14    -1.787031237908874
    Node 15    -1.8710139129476788
    Node 16    -2.612969300578378
    Node 17    -1.8999071608461247
    Node 18    -8.806057953644943
    Node 19    -2.003055404796897
    Node 20    9.702400658316163
Sigmoid Node 3
    Inputs    Weights
    Threshold    5.31097804006149
    Node 12    -1.2268042866031326
    Node 13    -1.367607296427026
    Node 14    -1.3007666034038305
    Node 15    -1.5642030426976594
    Node 16    -1.6340309451814432
    Node 17    -1.38161662325521
    Node 18    -2.5164808051737246
    Node 19    -1.2427941238281321
    Node 20    -9.675092168678026
Sigmoid Node 4
    Inputs    Weights
    Threshold    0.06612759806204618
    Attrib buying=vhigh    -0.27697350009026184
    Attrib buying=high    -0.41335222001447547
    Attrib buying=med    0.26400124297781014
    Attrib buying=low    0.24683479250885978
    Attrib maint=vhigh    -0.5516623485005313
    Attrib maint=high    0.055590831843468344
    Attrib maint=med    0.21499642723844228
    Attrib maint=low    0.10771160882630036
    Attrib doors=2    2.9055594570812264
    Attrib doors=3    0.7081765394095655
    Attrib doors=4    -1.844597451975179
    Attrib doors=5more    -1.846992852269645
    Attrib persons=2    1.1856633798311993
    Attrib persons=4    0.5008265653514815
    Attrib persons=more    -1.8495470263888445
    Attrib lug_boot=small    4.683222484827516
    Attrib lug_boot=med    0.00741425469987959
    Attrib lug_boot=big    -4.788145577711898
    Attrib safety=low    1.3083830755626427
    Attrib safety=med    -0.3463908512396751
    Attrib safety=high    -1.0211041340549205
Sigmoid Node 5
    Inputs    Weights
    Threshold    0.1851708254845377
    Attrib buying=vhigh    1.5746929331940043
    Attrib buying=high    0.48172787358825664
    Attrib buying=med    -0.3938766265901107
    Attrib buying=low    -2.1082570151308544
    Attrib maint=vhigh    1.3284057308406738
    Attrib maint=high    0.6820055147969653
    Attrib maint=med    -1.1354650746768273
    Attrib maint=low    -1.2514580473348875
    Attrib doors=2    -0.4154862900058818
```

```
    Attrib doors=3    -0.21149938893095996
    Attrib doors=4    0.07779056685898057
    Attrib doors=5more    0.07829659455775695
    Attrib persons=2    0.45491860734056794
    Attrib persons=4    -0.38467195262501375
    Attrib persons=more    -0.25418189532316
    Attrib lug_boot=small    -0.6213221998305544
    Attrib lug_boot=med    -0.11140932180018151
    Attrib lug_boot=big    0.4097037386448441
    Attrib safety=low    0.17137733720867868
    Attrib safety=med    0.9503563186696684
    Attrib safety=high    -1.3285124780485196
Sigmoid Node 6
    Inputs    Weights
    Threshold    -0.5217871682651244
    Attrib buying=vhigh    0.628289475034284
    Attrib buying=high    0.44962217076297856
    Attrib buying=med    0.3198478636570246
    Attrib buying=low    -0.4392253644872534
    Attrib maint=vhigh    0.6212426732138674
    Attrib maint=high    0.48588304109257596
    Attrib maint=med    -0.24379594734448623
    Attrib maint=low    0.050452987903008686
    Attrib doors=2    1.0702933502153005
    Attrib doors=3    0.9146337483072731
    Attrib doors=4    -0.4793125103134894
    Attrib doors=5more    -0.4874314637635223
    Attrib persons=2    1.846946425637568
    Attrib persons=4    -0.05173808898300951
    Attrib persons=more    -1.3574333254843545
    Attrib lug_boot=small    2.006338879046427
    Attrib lug_boot=med    0.2946628766915648
    Attrib lug_boot=big    -1.7833055756644036
    Attrib safety=low    1.8982110097270963
    Attrib safety=med    1.497237424496959
    Attrib safety=high    -2.945929220770645
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.6055373942195766
    Attrib buying=vhigh    -0.7784789420244018
    Attrib buying=high    1.3439248053883885
    Attrib buying=med    -2.369686413156483
    Attrib buying=low    0.5156057708813225
    Attrib maint=vhigh    1.2645628575968217
    Attrib maint=high    -3.0259768277153567
    Attrib maint=med    0.15782842528908336
    Attrib maint=low    0.3031131399399178
    Attrib doors=2    0.04406798047357852
    Attrib doors=3    -0.5040633457446123
    Attrib doors=4    -0.41734146872955813
    Attrib doors=5more    -0.40923788515031195
    Attrib persons=2    3.0488804939881926
    Attrib persons=4    -1.9526969420738283
    Attrib persons=more    -1.6625649469914063
    Attrib lug_boot=small    0.3032699640730371 3
    Attrib lug_boot=med    -0.469843692196388 1
    Attrib lug_boot=big    -0.548209127620934
    Attrib safety=low    2.307890372256939
    Attrib safety=med    -0.3450134500697255
```

```
   Attrib safety=high    -2.6162796379424305
Sigmoid Node 8
   Inputs    Weights
   Threshold    -0.5890190772461964
   Attrib buying=vhigh    0.5864968408507445
   Attrib buying=high    0.5159709249473837
   Attrib buying=med    0.1561790854291505
   Attrib buying=low    -0.15195573210020558
   Attrib maint=vhigh    0.7815076067114617
   Attrib maint=high    0.30207682663525215
   Attrib maint=med    -0.013565737748231185
   Attrib maint=low    0.20614906529477073
   Attrib doors=2    2.9773388428062977
   Attrib doors=3    -1.2665306929262183
   Attrib doors=4    -0.30077660805012446
   Attrib doors=5more    -0.29546521468029896
   Attrib persons=2    3.536622196817613
   Attrib persons=4    -3.5591100387712644
   Attrib persons=more    0.6619407803648769
   Attrib lug_boot=small    2.6618102006046276
   Attrib lug_boot=med    -0.6252006596285496
   Attrib lug_boot=big    -1.4748840985797933
   Attrib safety=low    3.2690256674769143
   Attrib safety=med    -0.945333544265496
   Attrib safety=high    -1.7404258698256119
Sigmoid Node 9
   Inputs    Weights
   Threshold    -2.1277677095597647
   Attrib buying=vhigh    -1.1340158132123168
   Attrib buying=high    -1.356244080776927
   Attrib buying=med    2.1959940797255593
   Attrib buying=low    4.423369909621292
   Attrib maint=vhigh    -1.6507007284724924
   Attrib maint=high    -0.348462997488448
   Attrib maint=med    1.9030081630692568
   Attrib maint=low    4.201351023175069
   Attrib doors=2    1.342686354411333
   Attrib doors=3    1.1862955760194718
   Attrib doors=4    0.8794905574141659
   Attrib doors=5more    0.878984720841582
   Attrib persons=2    -1.6023388364118478
   Attrib persons=4    1.9354501299319677
   Attrib persons=more    1.6934295371603614
   Attrib lug_boot=small    1.352453398794687
   Attrib lug_boot=med    0.6147003609477752
   Attrib lug_boot=big    0.05336760543012601
   Attrib safety=low    -1.5072109103380515
   Attrib safety=med    2.4267843668951508
   Attrib safety=high    1.1665119743007588
Sigmoid Node 10
   Inputs    Weights
   Threshold    -0.6115096279810293
   Attrib buying=vhigh    -2.270706647770679
   Attrib buying=high    -0.09568410925457584
   Attrib buying=med    1.6996237874842155
   Attrib buying=low    1.873006183630564
   Attrib maint=vhigh    -2.0176975552185734
   Attrib maint=high    -0.3462918875600932
   Attrib maint=med    1.8858013125038307
```

```
   Attrib maint=low    1.7990838758095318
   Attrib doors=2    0.7139826395185488
   Attrib doors=3    0.22587759831190038
   Attrib doors=4    0.24307461217085813
   Attrib doors=5more    0.24273361138412886
   Attrib persons=2    -3.9334028336344207
   Attrib persons=4    2.2756101688396346
   Attrib persons=more    2.3755196979482665
   Attrib lug_boot=small    0.8292542453650558
   Attrib lug_boot=med    0.10481056356219634
   Attrib lug_boot=big    -0.19656471696832561
   Attrib safety=low    -3.8012482597494315
   Attrib safety=med    2.3361391138440557
   Attrib safety=high    2.1049033247703823
Sigmoid Node 11
   Inputs    Weights
   Threshold    -1.2897456931814608
   Attrib buying=vhigh    -1.12906237368927
   Attrib buying=high    -0.9953587518173417
   Attrib buying=med    1.5060383750673527
   Attrib buying=low    3.2983822390716058
   Attrib maint=vhigh    -1.824892520704626
   Attrib maint=high    0.10131061347944834
   Attrib maint=med    2.1327021775967125
   Attrib maint=low    2.2957583042150236
   Attrib doors=2    0.4509175618098291
   Attrib doors=3    0.6145036574658109
   Attrib doors=4    0.7658164920242734
   Attrib doors=5more    0.76786250332688
   Attrib persons=2    0.2856138754776138
   Attrib persons=4    0.45925305758218393
   Attrib persons=more    0.5150611842719651
   Attrib lug_boot=small    -0.13452914665801236
   Attrib lug_boot=med    0.5587145281195186
   Attrib lug_boot=big    0.8437385895101708
   Attrib safety=low    0.41377541508246524
   Attrib safety=med    -1.322808189949169
   Attrib safety=high    2.198426793741462
Sigmoid Node 12
   Inputs    Weights
   Threshold    -0.05462483522499737
   Node 4    2.418331460461961
   Node 5    1.9937095101928068
   Node 6    2.684892028115682
   Node 7    1.3003806874367585
   Node 8    3.9251318389227503
   Node 9    -2.8730745736520427
   Node 10    -5.372082673989618
   Node 11    0.35039392391604063
Sigmoid Node 13
   Inputs    Weights
   Threshold    0.04290171379972097
   Node 4    1.9047027768154714
   Node 5    1.3798129810590363
   Node 6    1.7793579451235637
   Node 7    0.8572639711476273
   Node 8    3.8179244395383134
   Node 9    -1.6756154043491975
   Node 10    -4.169482409013619
```

```
   Node 11    0.657623987828817
Sigmoid Node 14
   Inputs    Weights
   Threshold    -0.004252159655655573
   Node 4    2.128044874975647
   Node 5    1.5936251235018337
   Node 6    2.090285148750663
   Node 7    1.0025294872552049
   Node 8    3.8383400708234627
   Node 9    -2.0941077598695976
   Node 10    -4.561631612261604
   Node 11    0.5777797972846018
Sigmoid Node 15
   Inputs    Weights
   Threshold    0.012732864205521206
   Node 4    1.0067061525294017
   Node 5    0.5822305992278212
   Node 6    0.8831109836133623
   Node 7    0.6799104028190353
   Node 8    2.615805128204062
   Node 9    -0.7359089103089208
   Node 10    -2.3689399457842737
   Node 11    -0.048902546998366776
Sigmoid Node 16
   Inputs    Weights
   Threshold    0.7697650823715932
   Node 4    1.1467342379389038
   Node 5    1.0279017394965526
   Node 6    0.8617408981873717
   Node 7    0.7852758329812446
   Node 8    2.3359080940575656
   Node 9    -1.5319637070818926
   Node 10    -1.417636690723459
   Node 11    -0.9947957556661114
Sigmoid Node 17
   Inputs    Weights
   Threshold    0.08089491468754957
   Node 4    1.2098898725555498
   Node 5    0.8450883319893219
   Node 6    1.110570596145189
   Node 7    0.6973942268923865
   Node 8    3.0530709637551032
   Node 9    -0.8971496672835008
   Node 10    -3.0617943547680517
   Node 11    0.3361046570559607
Sigmoid Node 18
   Inputs    Weights
   Threshold    1.2638569723029196
   Node 4    5.398788734943413
   Node 5    2.9567872231903736
   Node 6    2.993097353940329
   Node 7    2.7831686756987186
   Node 8    1.5382621020081821
   Node 9    -7.642636994899803
   Node 10    0.5479957987931326
   Node 11    -4.435895104312839
Sigmoid Node 19
   Inputs    Weights
   Threshold    0.04707941599308544
```

```
    Node 4    1.7715502710482722
    Node 5    1.3125147620993
    Node 6    1.6654890524051293
    Node 7    0.7793048549427635
    Node 8    3.8234898546428795
    Node 9    -1.5363060773200752
    Node 10    -3.984521606259641
    Node 11    0.7115971099637333
Sigmoid Node 20
    Inputs    Weights
    Threshold    0.9213271483201246
    Node 4    7.179612342119095
    Node 5    2.624670740456953
    Node 6    1.6208580052877852
    Node 7    4.513151448579451
    Node 8    0.8510764657993868
    Node 9    0.9641537826571285
    Node 10    -0.30571916172939734
    Node 11    -5.440950988254605
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 4.23 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1724               99.7685 %
Incorrectly Classified Instances         4                0.2315 %
Kappa statistic                          0.9949
Mean absolute error                      0.0029
Root mean squared error                  0.0326
Relative absolute error                  1.2747 %
Root relative squared error              9.6342 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,004    0,998      0,999    0,999      0,996    1,000     1,000     unacc
               0,995    0,001    0,995      0,995    0,995      0,993    0,999     0,998     acc
               0,986    0,000    1,000      0,986    0,993      0,992    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.    0,998    0,003    0,998      0,998    0,998      0,995    1,000     0,999

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
```

```
 1209    1    0    0 |    a = unacc
   2  382    0    0 |    b = acc
   0    1   68    0 |    c = good
   0    0    0   65 |    d = vgood
```

10 Neurônios

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 10"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.853737314672267
    Node 12    -1.8771957456199106
    Node 13    3.6262066077004174
    Node 14    4.135001892530346
    Node 15    2.909917233233729
    Node 16    -2.2571877221543297
    Node 17    -0.6599274184833009
    Node 18    3.773047446169409
    Node 19    2.4332736960080075
    Node 20    3.643079210934538
    Node 21    3.2020140837555524
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.343517352933694
    Node 12    6.90442395412766
    Node 13    -3.704543244322542
    Node 14    -5.208388466353113
    Node 15    -1.4803689738071577
    Node 16    7.483844620487316
    Node 17    1.419642843778734
    Node 18    -3.742967831929689
    Node 19    -0.9169299600644226
    Node 20    -3.1014957324084893
    Node 21    -2.188627982092832
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.03277447819935
    Node 12    -4.773725990208869
    Node 13    -1.8167561155610483
    Node 14    -1.3632875709935146
```

```
    Node 15    -2.10701416572151
    Node 16    -5.772755327703621
    Node 17    9.714486143925273
    Node 18    -1.7206076778680688
    Node 19    -2.3394044896791244
    Node 20    -1.9234116991697288
    Node 21    -1.9702758828193367
Sigmoid Node 3
    Inputs    Weights
    Threshold    5.52297827198447
    Node 12    -3.3875130579595796
    Node 13    -1.6010323338958523
    Node 14    -1.3928458629361946
    Node 15    -1.3837516343114915
    Node 16    -2.66226972863659
    Node 17    -9.992235958289022
    Node 18    -1.543414384499066
    Node 19    -1.0041987072073089
    Node 20    -1.545950101220354
    Node 21    -1.3329525091145102
Sigmoid Node 4
    Inputs    Weights
    Threshold    0.6070312234681017
    Attrib buying=vhigh    -0.726547021243429
    Attrib buying=high    1.7658565875107723
    Attrib buying=med    -2.09442146487098
    Attrib buying=low    -0.16446459153782766
    Attrib maint=vhigh    2.145165128270877
    Attrib maint=high    -3.3493427784859664
    Attrib maint=med    -0.32837072265835454
    Attrib maint=low    0.3573083032640579
    Attrib doors=2    -0.22662517275722693
    Attrib doors=3    -0.4364043196934983
    Attrib doors=4    -0.3516273072366837
    Attrib doors=5more    -0.25013396196682647
    Attrib persons=2    3.6974426423316067
    Attrib persons=4    -2.330416452582423
    Attrib persons=more    -1.9915121757998002
    Attrib lug_boot=small    -0.3692973392081814
    Attrib lug_boot=med    -0.13607099448317164
    Attrib lug_boot=big    -0.1605395805752775
    Attrib safety=low    2.9257144110074886
    Attrib safety=med    -0.18813513742072885
    Attrib safety=high    -3.3934682585372262
Sigmoid Node 5
    Inputs    Weights
    Threshold    -2.223154408222821
    Attrib buying=vhigh    -1.5117941699269837
    Attrib buying=high    -0.9907549785612273
    Attrib buying=med    2.0918085239475133
    Attrib buying=low    4.801501303368985
    Attrib maint=vhigh    -1.6614651258787019
    Attrib maint=high    -0.3191191454581898
    Attrib maint=med    2.198914312212784
    Attrib maint=low    4.095505274738521
    Attrib doors=2    1.5033175096655114
    Attrib doors=3    1.1467577881711435
    Attrib doors=4    0.8570935690527924
    Attrib doors=5more    0.852571946142309
```

```
   Attrib persons=2    -2.06706355529449
   Attrib persons=4    2.2484625279636816
   Attrib persons=more    1.9679551233312427
   Attrib lug_boot=small    1.5869172250097536
   Attrib lug_boot=med    0.7227450825970284
   Attrib lug_boot=big    -0.0747373746524251
   Attrib safety=low    -1.9706636882452435
   Attrib safety=med    2.7632917739435636
   Attrib safety=high    1.3547068423214057
Sigmoid Node 6
   Inputs    Weights
   Threshold    0.2193492736325992
   Attrib buying=vhigh    -0.2108783102795057
   Attrib buying=high    -0.24955717592415877
   Attrib buying=med    0.025482295321244425
   Attrib buying=low    -0.015197763322995444
   Attrib maint=vhigh    -0.08147383446367018
   Attrib maint=high    -0.13544349281489046
   Attrib maint=med    -0.14980691968927526
   Attrib maint=low    -0.2286533923397955
   Attrib doors=2    2.8330310909493477
   Attrib doors=3    0.5879468577896183
   Attrib doors=4    -1.938238886314393
   Attrib doors=5more    -1.945939576954885
   Attrib persons=2    1.412959502867598
   Attrib persons=4    0.32361239304898765
   Attrib persons=more    -1.9931033396725544
   Attrib lug_boot=small    4.667998157769695
   Attrib lug_boot=med    -0.09787975769200329
   Attrib lug_boot=big    -4.854475386703109
   Attrib safety=low    1.1559218373959614
   Attrib safety=med    -0.4977774075194646
   Attrib safety=high    -0.9602305933817141
Sigmoid Node 7
   Inputs    Weights
   Threshold    -1.5628978593806078
   Attrib buying=vhigh    1.6769088328751347
   Attrib buying=high    1.1910535751683975
   Attrib buying=med    0.39241595812512686
   Attrib buying=low    -0.21856017430353938
   Attrib maint=vhigh    1.6805939463807729
   Attrib maint=high    0.785095945504977
   Attrib maint=med    0.23602833328648015
   Attrib maint=low    0.4218609166363557
   Attrib doors=2    4.940583677913598
   Attrib doors=3    -0.9214248011961238
   Attrib doors=4    -0.5276416029389029
   Attrib doors=5more    -0.4488372768459722
   Attrib persons=2    3.313552947191693
   Attrib persons=4    -3.718106428937879
   Attrib persons=more    1.9557113516932165
   Attrib lug_boot=small    4.329208169123498
   Attrib lug_boot=med    -0.9694828629938764
   Attrib lug_boot=big    -1.8365661903250543
   Attrib safety=low    3.28945836936078
   Attrib safety=med    -0.22501746995136424
   Attrib safety=high    -1.600843152654921
Sigmoid Node 8
   Inputs    Weights
```

```
    Threshold    -0.6232681512913779
    Attrib buying=vhigh    0.7131646784026443
    Attrib buying=high    0.03265994605131039
    Attrib buying=med    0.26667852550701243
    Attrib buying=low    0.17450351161331823
    Attrib maint=vhigh    0.05739129739978069
    Attrib maint=high    1.062625793214396
    Attrib maint=med    0.02794862824449573
    Attrib maint=low    0.10504031960260957
    Attrib doors=2    1.5065437529023362
    Attrib doors=3    0.8808196234526067
    Attrib doors=4    -0.509461295516976
    Attrib doors=5more    -0.5719192926311034
    Attrib persons=2    2.0289406338265237
    Attrib persons=4    -0.06352146250921163
    Attrib persons=more    -1.3999038247000781
    Attrib lug_boot=small    2.4654293659720703
    Attrib lug_boot=med    0.1386526270490106
    Attrib lug_boot=big    -1.9820048164407713
    Attrib safety=low    1.933433495240668
    Attrib safety=med    2.3649960625489617
    Attrib safety=high    -3.703773781149299
Sigmoid Node 9
    Inputs    Weights
    Threshold    -1.0138890543666306
    Attrib buying=vhigh    -2.8790636943788135
    Attrib buying=high    -0.2637598412659793
    Attrib buying=med    2.3933136213476796
    Attrib buying=low    2.6273476577657617
    Attrib maint=vhigh    -2.3187231906597923
    Attrib maint=high    -0.3909414061514316
    Attrib maint=med    2.299769373083504
    Attrib maint=low    2.3105501655107887
    Attrib doors=2    0.9424360700682737
    Attrib doors=3    0.3738707772066083
    Attrib doors=4    0.3804607686129914
    Attrib doors=5more    0.3893239727373912
    Attrib persons=2    -5.272572840980953
    Attrib persons=4    3.0514883582909254
    Attrib persons=more    3.2083963265073745
    Attrib lug_boot=small    0.7432598197821284
    Attrib lug_boot=med    0.3652713328906502
    Attrib lug_boot=big    -0.05456558561490316
    Attrib safety=low    -4.6998543859666295
    Attrib safety=med    2.7187913714445076
    Attrib safety=high    2.951765977571797
Sigmoid Node 10
    Inputs    Weights
    Threshold    -1.8009769118483858
    Attrib buying=vhigh    -1.7667825389074967
    Attrib buying=high    -1.3725472412238549
    Attrib buying=med    2.183691836099768
    Attrib buying=low    4.759925711335873
    Attrib maint=vhigh    -2.177605839262389
    Attrib maint=high    -0.4588525207447828
    Attrib maint=med    2.2312091957719757
    Attrib maint=low    4.198693683767769
    Attrib doors=2    0.6608871410899868
    Attrib doors=3    0.9283303590920615
```

```
    Attrib doors=4    1.036831267125258
    Attrib doors=5more    1.0439692806149123
    Attrib persons=2    -1.1638505712875975
    Attrib persons=4    1.495945799345551
    Attrib persons=more    1.534800999560189
    Attrib lug_boot=small    -0.2559916534697816
    Attrib lug_boot=med    0.8826741888234219
    Attrib lug_boot=big    1.1854905396166582
    Attrib safety=low    -0.5108523249341907
    Attrib safety=med    -0.12226710622732648
    Attrib safety=high    2.446241817845793
Sigmoid Node 11
    Inputs    Weights
    Threshold    -0.7272003927798835
    Attrib buying=vhigh    -0.4806356873469725
    Attrib buying=high    -0.5992769874562646
    Attrib buying=med    1.1555081224203796
    Attrib buying=low    1.3825466857746782
    Attrib maint=vhigh    -0.8425718515573446
    Attrib maint=high    0.6800856305963052
    Attrib maint=med    0.8671747705770957
    Attrib maint=low    0.7739992852897465
    Attrib doors=2    0.23198092741801804
    Attrib doors=3    0.19306368211202854
    Attrib doors=4    0.4980628713704748
    Attrib doors=5more    0.5089688325068906
    Attrib persons=2    0.4181525659573561
    Attrib persons=4    0.03828421929018899
    Attrib persons=more    0.2212582093371555
    Attrib lug_boot=small    -0.20995856996813292
    Attrib lug_boot=med    0.35632481084653916
    Attrib lug_boot=big    0.6431818092662727
    Attrib safety=low    0.4949609705312523
    Attrib safety=med    -1.9486436279294148
    Attrib safety=high    2.186102234245903
Sigmoid Node 12
    Inputs    Weights
    Threshold    2.4914510713689473
    Node 4    2.376135889234255
    Node 5    -4.154975970706364
    Node 6    3.780610110538203
    Node 7    1.5673721580063809
    Node 8    2.747828009973552
    Node 9    1.1043746583569054
    Node 10    -4.732470920864183
    Node 11    -1.589075995976384
Sigmoid Node 13
    Inputs    Weights
    Threshold    0.7615104113241791
    Node 4    1.2207991978788237
    Node 5    -2.336388466597343
    Node 6    1.7855179425780399
    Node 7    3.7973521871746705
    Node 8    2.335671151203676
    Node 9    -3.9439319158434136
    Node 10    -0.65480596481867
    Node 11    0.3599450814680827
Sigmoid Node 14
    Inputs    Weights
```

```
    Threshold    0.8637696971259613
    Node 4    1.6331514445026338
    Node 5    -3.6973667783459203
    Node 6    1.9761616284028543
    Node 7    3.1357353064948827
    Node 8    3.383949480972841
    Node 9    -4.671756850224696
    Node 10    -1.4769826178899503
    Node 11    -0.22289905210168412
Sigmoid Node 15
    Inputs    Weights
    Threshold    0.49655920243578916
    Node 4    0.9669033171757415
    Node 5    -0.8994397108983793
    Node 6    0.9311401491337148
    Node 7    3.1346662161387253
    Node 8    1.265197936429234
    Node 9    -2.8006327415340015
    Node 10    -0.38702648980980886
    Node 11    0.3404838992411448
Sigmoid Node 16
    Inputs    Weights
    Threshold    2.542116396706326
    Node 4    2.418896340544845
    Node 5    -4.585111549642353
    Node 6    3.860622860797182
    Node 7    1.595558663205198
    Node 8    2.9821110157552186
    Node 9    1.4254880726815249
    Node 10    -4.950542094759533
    Node 11    -1.5840860673959323
Sigmoid Node 17
    Inputs    Weights
    Threshold    3.3037767247857834
    Node 4    3.062398617350055
    Node 5    0.7520993492442698
    Node 6    7.0727857599434465
    Node 7    0.8200678525251502
    Node 8    1.748603810758544
    Node 9    1.7029769657508962
    Node 10    -3.680125647618109
    Node 11    -5.561524039472079
Sigmoid Node 18
    Inputs    Weights
    Threshold    0.8029141754482362
    Node 4    1.2135066931126495
    Node 5    -2.3378961242335126
    Node 6    1.8172968414814687
    Node 7    3.911998455997711
    Node 8    2.3523559173193216
    Node 9    -4.047924471432307
    Node 10    -0.5720007478865167
    Node 11    0.36385016493279837
Sigmoid Node 19
    Inputs    Weights
    Threshold    0.5856198123360777
    Node 4    0.800975938782716
    Node 5    -0.46074891117046896
    Node 6    0.24822595725883206
```

```
    Node 7    2.711741708864742
    Node 8    0.9518729995538209
    Node 9    -2.261851976719389
    Node 10    -0.4571524302128945
    Node 11    0.535190418597942
Sigmoid Node 20
    Inputs    Weights
    Threshold    0.7241197473361582
    Node 4    1.1100016363006806
    Node 5    -1.8505498650869374
    Node 6    1.6409926173333917
    Node 7    3.9383246212961365
    Node 8    2.0190635579101532
    Node 9    -3.7639953004076645
    Node 10    -0.49228244928106557
    Node 11    0.43155028924190436
Sigmoid Node 21
    Inputs    Weights
    Threshold    0.600603554656845
    Node 4    1.0229898354560745
    Node 5    -1.3355304735176934
    Node 6    1.2681529491466808
    Node 7    3.4253611787495553
    Node 8    1.6035833029908086
    Node 9    -3.211258452976888
    Node 10    -0.38709996923097695
    Node 11    0.35064368044034183
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 4.45 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1726               99.8843 %
Incorrectly Classified Instances         2                0.1157 %
Kappa statistic                          0.9975
Mean absolute error                      0.0024
Root mean squared error                  0.0242
Relative absolute error                  1.055  %
Root relative squared error              7.1615 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,000    1,000      0,999    1,000      0,999    1,000     1,000     unacc
```

```
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
               0,986    0,000    1,000      0,986    0,993      0,992    1,000     0,999     good
               1,000    0,001    0,985      1,000    0,992      0,992    1,000     0,999     vgood
Weighted Avg.    0,999    0,000    0,999      0,999    0,999      0,998    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1209    1    0    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   68    1 |    c = good
   0    0    0   65 |    d = vgood
```

Apêndice C

Learning Rate

0,3

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.676497497419739
    Node 12    -0.243157420469325
    Node 13    4.161917465285917
    Node 14    5.036339181190744
    Node 15    3.913158581512514
    Node 16    4.1804960255091705
    Node 17    -1.3006973971874518
    Node 18    3.349680424943593
    Node 19    -2.2012266047405973
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.665259297376204
    Node 12    1.3695193962730925
    Node 13    -3.8978056362650952
    Node 14    -5.264292181445521
    Node 15    -3.654091176175842
    Node 16    -3.836978453389413
    Node 17    6.665311580757991
```

```
    Node 18    -2.469675888561184
    Node 19    7.469775550765375
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.735580584263445
    Node 12    10.526608340139346
    Node 13    -1.745469440250562
    Node 14    -1.9623923669012502
    Node 15    -1.6352062113887067
    Node 16    -1.7091034985951417
    Node 17    -4.947165718705198
    Node 18    -1.0724247529826152
    Node 19    -6.309887798480004
Sigmoid Node 3
    Inputs    Weights
    Threshold    4.936311356509575
    Node 12    -9.290504449883892
    Node 13    -1.6703695901410283
    Node 14    -1.4142917327634006
    Node 15    -1.6429782041150895
    Node 16    -1.6594962080428923
    Node 17    -4.064774098408571
    Node 18    -1.9849145039004674
    Node 19    -3.5345942339154774
Sigmoid Node 4
    Inputs    Weights
    Threshold    -0.23576674559442648
    Attrib buying=vhigh    0.3174591257718334
    Attrib buying=high    1.0787099337314376
    Attrib buying=med    1.77402982012317
    Attrib buying=low    -2.6050596656459
    Attrib maint=vhigh    0.6769348548331313
    Attrib maint=high    -0.09610664479940455
    Attrib maint=med    0.3623977053108407
    Attrib maint=low    -0.3995391645263544
    Attrib doors=2    1.3150835463692618
    Attrib doors=3    0.27059496545238587
    Attrib doors=4    -0.5459906875956234
    Attrib doors=5more    -0.547633851641303
    Attrib persons=2    2.213212273201942
    Attrib persons=4    -1.123940747156066
    Attrib persons=more    -0.8776644094040311
    Attrib lug_boot=small    1.910627856989203
    Attrib lug_boot=med    0.6153919980397834
    Attrib lug_boot=big    -2.2877784657568294
    Attrib safety=low    2.1339089342035726
    Attrib safety=med    0.909257520985048
    Attrib safety=high    -2.8596482185638954
Sigmoid Node 5
    Inputs    Weights
    Threshold    0.9433909873281792
    Attrib buying=vhigh    1.3618136114475834
    Attrib buying=high    0.27889145696379053
    Attrib buying=med    -1.0111069305175484
    Attrib buying=low    -2.592049439656475
    Attrib maint=vhigh    1.4057084940853748
    Attrib maint=high    0.20240601641609945
    Attrib maint=med    -1.788698947922419
    Attrib maint=low    -1.7840591062086644
```

```
    Attrib doors=2    -0.8414099025519123
    Attrib doors=3    -0.5394513199058975
    Attrib doors=4    -0.28287740940885586
    Attrib doors=5more    -0.2821234441972961
    Attrib persons=2    2.1469583871762135
    Attrib persons=4    -1.603203727523077
    Attrib persons=more    -1.5653078540036778
    Attrib lug_boot=small    -1.3408934762735716
    Attrib lug_boot=med    -0.6815737444756933
    Attrib lug_boot=big    0.9839473989443677
    Attrib safety=low    1.3122277375241316
    Attrib safety=med    0.3579355978362084
    Attrib safety=high    -2.5968301016049264
Sigmoid Node 6
    Inputs    Weights
    Threshold    -0.26497746849898846
    Attrib buying=vhigh    0.9849277626527232
    Attrib buying=high    -0.1876665745230164
    Attrib buying=med    -1.1531421168567155
    Attrib buying=low    0.8466686580353444
    Attrib maint=vhigh    0.5586656835766007
    Attrib maint=high    2.282203125674473
    Attrib maint=med    -1.5106743324418508
    Attrib maint=low    -0.8172676608631535
    Attrib doors=2    1.2625652540253156
    Attrib doors=3    0.16191310563918232
    Attrib doors=4    -0.46120234209623
    Attrib doors=5more    -0.4493495919324071
    Attrib persons=2    1.1892587515207964
    Attrib persons=4    -0.31327316876924555
    Attrib persons=more    -0.622447463915718
    Attrib lug_boot=small    2.0129619652342225
    Attrib lug_boot=med    0.21421922067003835
    Attrib lug_boot=big    -2.085387248497509
    Attrib safety=low    1.2593599621171343
    Attrib safety=med    1.3776641723666914
    Attrib safety=high    -2.4368138104548427
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.7323104966824062
    Attrib buying=vhigh    0.1521977619183333
    Attrib buying=high    1.1426305971820874
    Attrib buying=med    -2.4544177788124957
    Attrib buying=low    -0.40691509082012384
    Attrib maint=vhigh    1.2106341630996087
    Attrib maint=high    -2.978491493244966
    Attrib maint=med    -0.11673973421049823
    Attrib maint=low    0.3021009047865043
    Attrib doors=2    -0.7560980697539174
    Attrib doors=3    -0.5565864231786959
    Attrib doors=4    -0.11601880232144628
    Attrib doors=5more    -0.1182684365691757
    Attrib persons=2    2.855283045964008
    Attrib persons=4    -1.888467366905546
    Attrib persons=more    -1.6882381809990477
    Attrib lug_boot=small    -0.8683642170294024
    Attrib lug_boot=med    -0.21174792482663177
    Attrib lug_boot=big    0.2881778028912309
    Attrib safety=low    2.2538946849489343
```

```
   Attrib safety=med    0.25072925026724135
   Attrib safety=high    -3.276909620600982
Sigmoid Node 8
   Inputs    Weights
   Threshold    -0.7068318070239685
   Attrib buying=vhigh    0.8019464373524392
   Attrib buying=high    0.247453432304408
   Attrib buying=med    0.18922876474026545
   Attrib buying=low    0.2152099442900912
   Attrib maint=vhigh    0.5219709943155256
   Attrib maint=high    0.4483177722394602
   Attrib maint=med    0.3574539621591026
   Attrib maint=low    0.09794394625880215
   Attrib doors=2    2.037277346206886
   Attrib doors=3    -1.8401476265627945
   Attrib doors=4    0.5653010052709673
   Attrib doors=5more    0.5648720222770193
   Attrib persons=2    2.9729162485057095
   Attrib persons=4    -3.1000378017289494
   Attrib persons=more    0.8915229703235515
   Attrib lug_boot=small    2.4221795065125926
   Attrib lug_boot=med    -0.37065733585393335
   Attrib lug_boot=big    -1.3666339648473587
   Attrib safety=low    2.1077150581864714
   Attrib safety=med    -1.1390369358700554
   Attrib safety=high    -0.24608848796307425
Sigmoid Node 9
   Inputs    Weights
   Threshold    -0.7717242992029351
   Attrib buying=vhigh    -2.7994023798558967
   Attrib buying=high    -0.07442044957345614
   Attrib buying=med    2.3838464042376697
   Attrib buying=low    1.8522181624064835
   Attrib maint=vhigh    -2.5677620208479413
   Attrib maint=high    -0.43332958249742265
   Attrib maint=med    2.2904194898250623
   Attrib maint=low    2.2386821522685763
   Attrib doors=2    0.6406882285318479
   Attrib doors=3    0.20533440457999688
   Attrib doors=4    0.29595796911160166
   Attrib doors=5more    0.295894228080605
   Attrib persons=2    -4.488159303419957
   Attrib persons=4    2.5382719409698704
   Attrib persons=more    2.6889503493779476
   Attrib lug_boot=small    1.225369185607533
   Attrib lug_boot=med    0.031192931370402605
   Attrib lug_boot=big    -0.556595203778578
   Attrib safety=low    -4.602448691637061
   Attrib safety=med    3.1845669991425845
   Attrib safety=high    2.12237342817993
Sigmoid Node 10
   Inputs    Weights
   Threshold    -0.05233158015281267
   Attrib buying=vhigh    0.24040471575878725
   Attrib buying=high    0.12343815957439279
   Attrib buying=med    -0.09230060754609261
   Attrib buying=low    -0.07982823495859563
   Attrib maint=vhigh    0.2525033723438698
   Attrib maint=high    0.14652619627306884
```

```
   Attrib maint=med    -0.06705251636382761
   Attrib maint=low    -0.26241196201008676
   Attrib doors=2    -3.260589406136598
   Attrib doors=3    -0.6446913278075728
   Attrib doors=4    2.1260388901800518
   Attrib doors=5more    2.126162791076957
   Attrib persons=2    -1.7585331989309505
   Attrib persons=4    -0.5445980998444994
   Attrib persons=more    2.3735856461468137
   Attrib lug_boot=small    -4.566781780152633
   Attrib lug_boot=med    -0.40090071210290423
   Attrib lug_boot=big    4.99190010967213
   Attrib safety=low    -1.5718717142755896
   Attrib safety=med    0.6479231126489251
   Attrib safety=high    1.0549548095596513
Sigmoid Node 11
   Inputs    Weights
   Threshold    1.9488976748656675
   Attrib buying=vhigh    2.0490711384367444
   Attrib buying=high    2.2908522248685945
   Attrib buying=med    -2.695008546962134
   Attrib buying=low    -5.646540420299475
   Attrib maint=vhigh    2.7032561280817613
   Attrib maint=high    0.5019452524065041
   Attrib maint=med    -2.197495253733043
   Attrib maint=low    -4.952934204653578
   Attrib doors=2    -0.4813302767432615
   Attrib doors=3    -0.7661227360900414
   Attrib doors=4    -1.2676333559429567
   Attrib doors=5more    -1.2692815755117424
   Attrib persons=2    0.434264564960236
   Attrib persons=4    -0.9541199140100688
   Attrib persons=more    -1.3245158034340299
   Attrib lug_boot=small    0.33441750390758845
   Attrib lug_boot=med    -0.6865611487611855
   Attrib lug_boot=big    -1.5786175973226397
   Attrib safety=low    0.21104220551730732
   Attrib safety=med    0.005170836345401767
   Attrib safety=high    -2.145824822407726
Sigmoid Node 12
   Inputs    Weights
   Threshold    2.1198552561569572
   Node 4    2.657286554180374
   Node 5    4.282683444306119
   Node 6    1.9265523145492256
   Node 7    5.758217207313993
   Node 8    5.022387924674813
   Node 9    1.0059439026103645
   Node 10    -6.69258956912532
   Node 11    2.1903919682984676
Sigmoid Node 13
   Inputs    Weights
   Threshold    0.7910860725595108
   Node 4    1.0209543436103214
   Node 5    2.343919708655611
   Node 6    0.8347469170714531
   Node 7    1.220735096106226
   Node 8    3.803684467182193
   Node 9    -4.47029713276755
```

```
    Node 10    -2.84256106669356
    Node 11    0.6744518750242655
Sigmoid Node 14
    Inputs    Weights
    Threshold    1.0567765829836762
    Node 4    1.267494145068228
    Node 5    2.8309814159869275
    Node 6    1.0625180669671757
    Node 7    1.419478712920068
    Node 8    4.703395919129004
    Node 9    -5.419511286690068
    Node 10    -3.467386759107209
    Node 11    0.7771314074960927
Sigmoid Node 15
    Inputs    Weights
    Threshold    0.6691622055648652
    Node 4    0.9975512458239899
    Node 5    2.2299776197657395
    Node 6    0.8269147533385263
    Node 7    1.1658852638971529
    Node 8    3.5610526736763672
    Node 9    -4.287478127792949
    Node 10    -2.638405291607427
    Node 11    0.689417789372883
Sigmoid Node 16
    Inputs    Weights
    Threshold    0.8251435159866786
    Node 4    0.9876685597728129
    Node 5    2.3422423748399193
    Node 6    0.8362348088164034
    Node 7    1.1489525809415553
    Node 8    3.805924973271349
    Node 9    -4.427055945171063
    Node 10    -2.8337407624763324
    Node 11    0.6291434811003543
Sigmoid Node 17
    Inputs    Weights
    Threshold    -0.29878797754396635
    Node 4    1.3709012362587285
    Node 5    1.6205131937222095
    Node 6    3.3771953871283804
    Node 7    1.969797419644337
    Node 8    2.354561544856084
    Node 9    -2.2835135801481727
    Node 10    -3.1149489964271746
    Node 11    6.873144741082383
Sigmoid Node 18
    Inputs    Weights
    Threshold    0.6509426597839091
    Node 4    0.7393860375660125
    Node 5    1.7563000173490946
    Node 6    0.4822438306435522
    Node 7    1.0557173789874033
    Node 8    2.8702491160499948
    Node 9    -3.3462519942011233
    Node 10    -2.037835221376477
    Node 11    0.3027320640817577
Sigmoid Node 19
    Inputs    Weights
```

```
   Threshold    -0.5858029597813753
   Node 4    1.3596283026994755
   Node 5    1.7414103307972961
   Node 6    3.9877691633366803
   Node 7    1.9528143083289817
   Node 8    2.115554348727707
   Node 9    -2.301443094838674
   Node 10    -3.2632642812206636
   Node 11    7.697222280431426
Class unacc
   Input
   Node 0
Class acc
   Input
   Node 1
Class good
   Input
   Node 2
Class vgood
   Input
   Node 3


Time taken to build model: 4.06 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1726               99.8843 %
Incorrectly Classified Instances         2                0.1157 %
Kappa statistic                          0.9975
Mean absolute error                      0.0022
Root mean squared error                  0.0187
Relative absolute error                  0.9599 %
Root relative squared error              5.5362 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,998    0,000    1,000      0,998    0,999      0,997    1,000     1,000     unacc
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
               1,000    0,001    0,986      1,000    0,993      0,993    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.  0,999    0,000    0,999      0,999    0,999      0,997    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1208    1    1    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

0,4

```
=== Run information ===
```

```
Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.4 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -6.6404539796576305
    Node 12    -0.2797276638609682
    Node 13    3.6887873087796046
    Node 14    4.617114719534349
    Node 15    3.847803950293258
    Node 16    3.8792139480999834
    Node 17    3.549581505218972
    Node 18    3.5539020658756972
    Node 19    -2.1853917959191618
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.541540373406745
    Node 12    1.8853445495499648
    Node 13    -3.517306650546743
    Node 14    -5.354958163909497
    Node 15    -2.2118898712806967
    Node 16    -3.922590522039981
    Node 17    -1.5257794744880084
    Node 18    -3.143709371623541
    Node 19    12.640754286562318
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.200562817366857
    Node 12    9.62223578306707
    Node 13    -1.8667123316127154
    Node 14    -1.559381381857948
    Node 15    -2.493456932209829
    Node 16    -1.8698489599095822
    Node 17    -2.6586542800158584
    Node 18    -1.8534764249232525
    Node 19    -10.126250076724707
Sigmoid Node 3
    Inputs    Weights
    Threshold    5.265244726427304
    Node 12    -10.097713950247073
    Node 13    -1.6368338211942512
    Node 14    -1.4375373287811395
    Node 15    -1.4644567263322696
    Node 16    -1.5714518590416204
    Node 17    -1.4471901151557967
```

```
    Node 18    -1.6145055395659593
    Node 19    -3.8266512953795826
Sigmoid Node 4
    Inputs    Weights
    Threshold    0.32884587834567847
    Attrib buying=vhigh    0.5884944490663742
    Attrib buying=high    1.440967731187997
    Attrib buying=med    -2.2232186808390266
    Attrib buying=low    -0.37032953331513424
    Attrib maint=vhigh    1.798455017016037
    Attrib maint=high    -2.288198822122368
    Attrib maint=med    -0.4604375080713203
    Attrib maint=low    0.3646428161155971
    Attrib doors=2    0.3748836070737812
    Attrib doors=3    0.4856056987953282
    Attrib doors=4    -0.8111570585477612
    Attrib doors=5more    -0.686503522616953
    Attrib persons=2    1.368042607201713
    Attrib persons=4    -0.3779856972868163
    Attrib persons=more    -1.3430624172132226
    Attrib lug_boot=small    -0.1156360188993202
    Attrib lug_boot=med    0.3176353274024579
    Attrib lug_boot=big    -0.5283705431711503
    Attrib safety=low    1.7444370451964386
    Attrib safety=med    -0.6952784802455985
    Attrib safety=high    -1.4302529522663803
Sigmoid Node 5
    Inputs    Weights
    Threshold    0.3946733393952593
    Attrib buying=vhigh    0.4541807241735387
    Attrib buying=high    -0.10547294794894062
    Attrib buying=med    -0.5525475835287476
    Attrib buying=low    -0.6611761985928718
    Attrib maint=vhigh    0.4714339691493974
    Attrib maint=high    -0.2834124693632687
    Attrib maint=med    -0.46716750807950225
    Attrib maint=low    -0.588062239470542
    Attrib doors=2    -0.7147405346528243
    Attrib doors=3    -1.6764610759794172
    Attrib doors=4    0.7973474422766358
    Attrib doors=5more    0.745427388157486
    Attrib persons=2    1.359088202643392
    Attrib persons=4    -2.094558670248888
    Attrib persons=more    0.2626349211880935
    Attrib lug_boot=small    1.0105795977281764
    Attrib lug_boot=med    -1.8213275062550467
    Attrib lug_boot=big    0.32094573465496445
    Attrib safety=low    1.063225106305495
    Attrib safety=med    -0.8001663405775157
    Attrib safety=high    -0.6410078840400282
Sigmoid Node 6
    Inputs    Weights
    Threshold    -0.9022448447598302
    Attrib buying=vhigh    -1.2770084895652345
    Attrib buying=high    -1.055753021661553
    Attrib buying=med    -0.6560852023075069
    Attrib buying=low    4.754169195364176
    Attrib maint=vhigh    -1.6458879817433094
    Attrib maint=high    -4.1265341923015155
```

```
   Attrib maint=med    1.2257166995866513
   Attrib maint=low    6.334167042925367
   Attrib doors=2    -0.6662034672621812
   Attrib doors=3    0.2690927473562764
   Attrib doors=4    1.0984030777703744
   Attrib doors=5more    1.0871688202931604
   Attrib persons=2    -0.28016129893432606
   Attrib persons=4    0.134960825706465
   Attrib persons=more    1.036005968324533
   Attrib lug_boot=small    -1.5586589707219047
   Attrib lug_boot=med    0.2268241853935664
   Attrib lug_boot=big    2.1108960989961982
   Attrib safety=low    -0.1857418942515325
   Attrib safety=med    -1.5901647621373358
   Attrib safety=high    2.6133843566790196
Sigmoid Node 7
   Inputs    Weights
   Threshold    -0.9633611726732378
   Attrib buying=vhigh    0.5502751923338989
   Attrib buying=high    0.45131784607845
   Attrib buying=med    0.5462178406041194
   Attrib buying=low    0.27702794916256474
   Attrib maint=vhigh    0.4125728675787513
   Attrib maint=high    0.6740274643846078
   Attrib maint=med    0.2714680342603489
   Attrib maint=low    0.45077881291824057
   Attrib doors=2    3.490034019684252
   Attrib doors=3    1.2267610327325034
   Attrib doors=4    -1.4169337414983427
   Attrib doors=5more    -1.4554897040304793
   Attrib persons=2    3.566776435266815
   Attrib persons=4    -0.04156555136913367
   Attrib persons=more    -2.5509617164829246
   Attrib lug_boot=small    5.171441486336084
   Attrib lug_boot=med    0.4615685426222378
   Attrib lug_boot=big    -4.729272698567618
   Attrib safety=low    3.771304132775788
   Attrib safety=med    3.5993013240314085
   Attrib safety=high    -6.4472194728361885
Sigmoid Node 8
   Inputs    Weights
   Threshold    -1.591891468796464
   Attrib buying=vhigh    0.009216573297005837
   Attrib buying=high    0.2771723240356519
   Attrib buying=med    1.4760158502196166
   Attrib buying=low    1.4615531546797196
   Attrib maint=vhigh    -0.05479757388785708
   Attrib maint=high    1.4275225896275976
   Attrib maint=med    0.979268995942472
   Attrib maint=low    0.8438119868355255
   Attrib doors=2    -2.008284583356286
   Attrib doors=3    0.289668290767039
   Attrib doors=4    2.409551468827539
   Attrib doors=5more    2.4064868944986855
   Attrib persons=2    0.9416516258139644
   Attrib persons=4    -0.5895130160433072
   Attrib persons=more    1.2973224691016723
   Attrib lug_boot=small    -3.6472870760396425
   Attrib lug_boot=med    0.45329354117681575
```

```
    Attrib lug_boot=big    4.763941402446889
    Attrib safety=low    0.9734029411736755
    Attrib safety=med    -3.915654866556662
    Attrib safety=high    4.549901221509199
Sigmoid Node 9
    Inputs    Weights
    Threshold    -1.0420669190613698
    Attrib buying=vhigh    -2.8481820700719833
    Attrib buying=high    -0.267464850378076
    Attrib buying=med    2.7140323433493787
    Attrib buying=low    2.304541554032381
    Attrib maint=vhigh    -2.613330754450199
    Attrib maint=high    -0.37275796101210923
    Attrib maint=med    2.6435788576817294
    Attrib maint=low    2.4112051362458384
    Attrib doors=2    0.5832207626444635
    Attrib doors=3    0.37561904496270276
    Attrib doors=4    0.5060188770341327
    Attrib doors=5more    0.5137013853796695
    Attrib persons=2    -5.439710251440021
    Attrib persons=4    3.130488940890312
    Attrib persons=more    3.318626917335566
    Attrib lug_boot=small    0.5207035487813682
    Attrib lug_boot=med    0.2194875111134599
    Attrib lug_boot=big    0.23011847316293826
    Attrib safety=low    -5.515314568246983
    Attrib safety=med    3.326726286114781
    Attrib safety=high    3.163422637675274
Sigmoid Node 10
    Inputs    Weights
    Threshold    -2.5682414056427043
    Attrib buying=vhigh    -2.246073618682082
    Attrib buying=high    -1.3274332283300307
    Attrib buying=med    2.8442860924326525
    Attrib buying=low    5.952754438387151
    Attrib maint=vhigh    -2.901122236388568
    Attrib maint=high    0.3880889953290674
    Attrib maint=med    3.558617016910829
    Attrib maint=low    4.055800965371721
    Attrib doors=2    0.9031738315344883
    Attrib doors=3    1.143343072307235
    Attrib doors=4    1.6560911879474987
    Attrib doors=5more    1.6761325065031938
    Attrib persons=2    -3.132626633090832
    Attrib persons=4    2.784816733543438
    Attrib persons=more    2.9341740724087546
    Attrib lug_boot=small    0.567547355314938
    Attrib lug_boot=med    0.7414266701533119
    Attrib lug_boot=big    1.2311534174381373
    Attrib safety=low    -3.0699088583235405
    Attrib safety=med    3.2604850748832446
    Attrib safety=high    2.456339816863134
Sigmoid Node 11
    Inputs    Weights
    Threshold    -1.263757116889095
    Attrib buying=vhigh    0.4876318988121569
    Attrib buying=high    0.5299932766484734
    Attrib buying=med    0.719178618834641
    Attrib buying=low    0.6868801852579928
```

```
   Attrib maint=vhigh    0.5382129091204567
   Attrib maint=high    0.6361514121539352
   Attrib maint=med    0.6602993198850019
   Attrib maint=low    0.6454178644522247
   Attrib doors=2    4.0088408377580524
   Attrib doors=3    -0.6700682889473855
   Attrib doors=4    -0.5211187366669074
   Attrib doors=5more    -0.17671217292220356
   Attrib persons=2    3.0881872254700453
   Attrib persons=4    -2.857640432121566
   Attrib persons=more    1.137736845922725
   Attrib lug_boot=small    2.9101940730618283
   Attrib lug_boot=med    -0.31703571801796937
   Attrib lug_boot=big    -1.311264805465187
   Attrib safety=low    3.313716578279427
   Attrib safety=med    -1.1843557888975227
   Attrib safety=high    -0.8463177781725972
Sigmoid Node 12
   Inputs    Weights
   Threshold    4.943276484640599
   Node 4    2.821073456563751
   Node 5    1.7652176623575047
   Node 6    -0.18145148861839067
   Node 7    2.69764211601576
   Node 8    -7.4669880975859595
   Node 9    2.399130178290498
   Node 10    -4.434920118127664
   Node 11    2.797487951134847
Sigmoid Node 13
   Inputs    Weights
   Threshold    1.1608310992397448
   Node 4    0.49658325300977224
   Node 5    0.7131877357639879
   Node 6    -0.554799253802792
   Node 7    3.03317744748445
   Node 8    -0.4740345255808211
   Node 9    -3.538180098195632
   Node 10    -2.5942205352269663
   Node 11    4.257394073430958
Sigmoid Node 14
   Inputs    Weights
   Threshold    1.2565149076997324
   Node 4    0.9353864075741258
   Node 5    0.4873966511343436
   Node 6    -1.1731118895029735
   Node 7    4.953214785725454
   Node 8    -0.4261842143557626
   Node 9    -4.5335172209995624
   Node 10    -4.624774495310608
   Node 11    3.0910717939703782
Sigmoid Node 15
   Inputs    Weights
   Threshold    0.8323790150931486
   Node 4    0.1314865179818287
   Node 5    0.25234453926464595
   Node 6    -0.014875056039317215
   Node 7    1.4153940701596983
   Node 8    0.08157942155038754
   Node 9    -2.847191406310849
```

```
    Node 10    -0.9890838226370741
    Node 11    4.30325601342908
Sigmoid Node 16
    Inputs    Weights
    Threshold    1.2566646554461887
    Node 4    0.4663126105128203
    Node 5    0.7843370103192095
    Node 6    -0.4776299233016783
    Node 7    2.950803347809986
    Node 8    -0.5169766637580585
    Node 9    -3.7215165826691052
    Node 10    -2.4585256173605194
    Node 11    4.869523576949673
Sigmoid Node 17
    Inputs    Weights
    Threshold    0.9948192051071717
    Node 4    0.08719951605570767
    Node 5    0.05201962671200827
    Node 6    -0.08504776637350603
    Node 7    1.380996502772174
    Node 8    0.39845217629197877
    Node 9    -2.4978722079546567
    Node 10    -0.9931069242275234
    Node 11    3.8438077677734137
Sigmoid Node 18
    Inputs    Weights
    Threshold    1.0683547763447756
    Node 4    0.3812475302409321
    Node 5    0.6350766937859265
    Node 6    -0.2737614759693823
    Node 7    2.310265806649392
    Node 8    -0.5041969869566443
    Node 9    -3.324652482828844
    Node 10    -1.8400042820612776
    Node 11    4.4819165522982845
Sigmoid Node 19
    Inputs    Weights
    Threshold    5.3204481713244824
    Node 4    2.490149111496702
    Node 5    1.9815766062662172
    Node 6    -6.755136290458212
    Node 7    5.731009338056091
    Node 8    -0.5669831399264621
    Node 9    2.6547293621209627
    Node 10    -6.1785329107148605
    Node 11    2.0534183659293914
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3
```

```
Time taken to build model: 4.15 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1723               99.7106 %
Incorrectly Classified Instances         5                0.2894 %
Kappa statistic                          0.9937
Mean absolute error                      0.003
Root mean squared error                  0.0324
Relative absolute error                  1.2961 %
Root relative squared error              9.5814 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,997    0,000    1,000      0,997    0,998      0,995    1,000     1,000     unacc
               1,000    0,003    0,990      1,000    0,995      0,993    1,000     1,000     acc
               1,000    0,001    0,986      1,000    0,993      0,993    1,000     1,000     good
               0,985    0,000    1,000      0,985    0,992      0,992    1,000     1,000     vgood
Weighted Avg.  0,997    0,001    0,997      0,997    0,997      0,994    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1206    3    1    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    1    0   64 |    d = vgood
```

0,5

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.5 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -6.815153061005734
    Node 12    -1.9163770024381175
    Node 13    3.6744182153569342
```

```
    Node 14    4.211223390754928
    Node 15    0.30875666070890767
    Node 16    3.9004092695568104
    Node 17    3.852906633007805
    Node 18    3.7879467507483158
    Node 19    3.1665642141882566
Sigmoid Node 1
    Inputs    Weights
    Threshold    -5.127811476409132
    Node 12    12.851946089358002
    Node 13    -3.2595146533035377
    Node 14    -4.457703437964852
    Node 15    -0.11005707437509213
    Node 16    -3.6581795680831615
    Node 17    -3.9163768164802564
    Node 18    -3.680942556673998
    Node 19    -1.4547785637830686
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.791488606358973
    Node 12    -10.35142664411636
    Node 13    -2.249297786962044
    Node 14    -2.2590290267329656
    Node 15    9.938039843676881
    Node 16    -2.237628948090719
    Node 17    -2.166320687584319
    Node 18    -2.0946739928141676
    Node 19    -2.132753075266137
Sigmoid Node 3
    Inputs    Weights
    Threshold    5.045822846969881
    Node 12    -8.683984998019296
    Node 13    -1.9629161460999958
    Node 14    -1.8422652679833724
    Node 15    -9.98896284285909
    Node 16    -1.861705783694827
    Node 17    -1.880726967357894
    Node 18    -1.853643932612839
    Node 19    -2.0423045862813916
Sigmoid Node 4
    Inputs    Weights
    Threshold    -1.9265461177659673
    Attrib buying=vhigh    -1.7073590388092603
    Attrib buying=high    -1.6770673221542631
    Attrib buying=med    2.065180731850855
    Attrib buying=low    5.265943587436518
    Attrib maint=vhigh    -3.095815787741312
    Attrib maint=high    0.038280366946518415
    Attrib maint=med    3.2114035903626283
    Attrib maint=low    3.771377325593544
    Attrib doors=2    1.2822016479570733
    Attrib doors=3    0.4902149790835867
    Attrib doors=4    1.0550510125117116
    Attrib doors=5more    1.0461450773754013
    Attrib persons=2    0.8494008948582594
    Attrib persons=4    0.26186330989051576
    Attrib persons=more    0.7911222840645683
    Attrib lug_boot=small    0.4954765825484288
    Attrib lug_boot=med    0.4651594364971661
```

```
    Attrib lug_boot=big    0.9683847423981781
    Attrib safety=low    0.9871869320380018
    Attrib safety=med    -2.4923631028447564
    Attrib safety=high    3.379473779602942
Sigmoid Node 5
    Inputs    Weights
    Threshold    -2.2066953263744447
    Attrib buying=vhigh    -2.9746588440447814
    Attrib buying=high    -4.016515193250991
    Attrib buying=med    2.9208950519267955
    Attrib buying=low    8.408000311012211
    Attrib maint=vhigh    -4.147099457204048
    Attrib maint=high    -2.100049602539436
    Attrib maint=med    2.823707341443534
    Attrib maint=low    7.758970802074964
    Attrib doors=2    0.5273770803364862
    Attrib doors=3    1.3250072249621356
    Attrib doors=4    1.2112216511120522
    Attrib doors=5more    1.2907045949309297
    Attrib persons=2    0.4585713099650837
    Attrib persons=4    0.5722591109562678
    Attrib persons=more    1.0977026984310654
    Attrib lug_boot=small    -0.05956582785089425
    Attrib lug_boot=med    0.7392553741905286
    Attrib lug_boot=big    1.4318769455582263
    Attrib safety=low    0.6787501421137169
    Attrib safety=med    0.465327714447931
    Attrib safety=high    1.0793416908961617
Sigmoid Node 6
    Inputs    Weights
    Threshold    -1.2037908226101173
    Attrib buying=vhigh    -1.0710169319069578
    Attrib buying=high    -0.9512607096718207
    Attrib buying=med    -0.7034082921982282
    Attrib buying=low    5.0941003713076976
    Attrib maint=vhigh    -3.709686533566428
    Attrib maint=high    2.1914738587610945
    Attrib maint=med    1.6532059914663553
    Attrib maint=low    2.255560207506619
    Attrib doors=2    -1.2197953845037697
    Attrib doors=3    0.8620878532567487
    Attrib doors=4    1.4746853380584852
    Attrib doors=5more    1.2745753270467586
    Attrib persons=2    -3.0171670684501373
    Attrib persons=4    2.793866081135408
    Attrib persons=more    1.415652460261795
    Attrib lug_boot=small    -1.4258727917967975
    Attrib lug_boot=med    0.5670046076091909
    Attrib lug_boot=big    1.9394754757055668
    Attrib safety=low    -2.67085298735087
    Attrib safety=med    -0.8834078982538761
    Attrib safety=high    4.693284563745217
Sigmoid Node 7
    Inputs    Weights
    Threshold    -0.6386043191614436
    Attrib buying=vhigh    0.4885314647735435
    Attrib buying=high    0.344134793504117
    Attrib buying=med    0.292090752927331
    Attrib buying=low    0.05056810995036642
```

```
    Attrib maint=vhigh    0.22982774832778227
    Attrib maint=high    0.0810618764586875
    Attrib maint=med    0.43004248432875186
    Attrib maint=low    0.41840136300298203
    Attrib doors=2    5.20689130858834
    Attrib doors=3    0.8220129919856518
    Attrib doors=4    -2.415380250116021
    Attrib doors=5more    -2.418666150593329
    Attrib persons=2    2.691115285456541
    Attrib persons=4    1.0749892775012244
    Attrib persons=more    -3.1166122490546844
    Attrib lug_boot=small    7.799884707149986
    Attrib lug_boot=med    0.6611372683856812
    Attrib lug_boot=big    -7.882041498656979
    Attrib safety=low    2.8710855488113087
    Attrib safety=med    1.6106687892503648
    Attrib safety=high    -3.883125207602545
Sigmoid Node 8
    Inputs    Weights
    Threshold    -2.809672756189849
    Attrib buying=vhigh    -0.5123988233454453
    Attrib buying=high    0.20196291282605433
    Attrib buying=med    2.708646432549331
    Attrib buying=low    3.2613099549885067
    Attrib maint=vhigh    -0.1605488192988946
    Attrib maint=high    0.6648332016816235
    Attrib maint=med    2.7595328280801144
    Attrib maint=low    2.3675513628412785
    Attrib doors=2    1.9731444912446652
    Attrib doors=3    1.1806244719699086
    Attrib doors=4    1.3930088299238566
    Attrib doors=5more    0.9862068523848476
    Attrib persons=2    -0.9903715959476198
    Attrib persons=4    5.661298862337472
    Attrib persons=more    -1.8036849001242634
    Attrib lug_boot=small    1.7840371444545389
    Attrib lug_boot=med    0.766385278724981
    Attrib lug_boot=big    0.23730673179757308
    Attrib safety=low    -1.1902990181375357
    Attrib safety=med    0.30647959666253677
    Attrib safety=high    3.7092500049940793
Sigmoid Node 9
    Inputs    Weights
    Threshold    -1.7299624844341508
    Attrib buying=vhigh    -4.170638869362519
    Attrib buying=high    -0.009046234591236883
    Attrib buying=med    3.876709210417723
    Attrib buying=low    3.5816940012129637
    Attrib maint=vhigh    -4.014711092575256
    Attrib maint=high    -0.33517660769447927
    Attrib maint=med    3.492197351256273
    Attrib maint=low    4.302176758224061
    Attrib doors=2    1.7275047558777954
    Attrib doors=3    0.7146837121555868
    Attrib doors=4    0.37782095880089733
    Attrib doors=5more    0.5343417739324722
    Attrib persons=2    -7.513545313698478
    Attrib persons=4    4.5566198102033075
    Attrib persons=more    4.65422667565464
```

```
   Attrib lug_boot=small    1.3964586992338364
   Attrib lug_boot=med    0.2997053875179997
   Attrib lug_boot=big    -0.0379589883213373
   Attrib safety=low    -7.717339483640623
   Attrib safety=med    5.22180582798123
   Attrib safety=high    4.158263576575219
Sigmoid Node 10
   Inputs    Weights
   Threshold    -2.543911656325959
   Attrib buying=vhigh    -0.6373471233255007
   Attrib buying=high    -1.4371607671042557
   Attrib buying=med    4.509623972774769
   Attrib buying=low    2.7397581028291182
   Attrib maint=vhigh    -0.6796819011364044
   Attrib maint=high    -2.0750668073048786
   Attrib maint=med    3.8879405593102803
   Attrib maint=low    3.919533391720108
   Attrib doors=2    -1.1294460548043925
   Attrib doors=3    1.6207219978888414
   Attrib doors=4    2.3776488452360223
   Attrib doors=5more    2.461156311338493
   Attrib persons=2    -3.2654351696546255
   Attrib persons=4    2.4691075585158324
   Attrib persons=more    3.358362034683543
   Attrib lug_boot=small    -0.9319916191184997
   Attrib lug_boot=med    2.0312116633209594
   Attrib lug_boot=big    1.4165776493871254
   Attrib safety=low    -2.65708907874604
   Attrib safety=med    1.9553664488086169
   Attrib safety=high    3.324308914043605
Sigmoid Node 11
   Inputs    Weights
   Threshold    -1.6509026743873483
   Attrib buying=vhigh    0.3099436190618902
   Attrib buying=high    0.49859237646153953
   Attrib buying=med    1.300167939610759
   Attrib buying=low    1.0892711594156372
   Attrib maint=vhigh    0.09734924560073491
   Attrib maint=high    1.1042878759317343
   Attrib maint=med    1.0274460490617798
   Attrib maint=low    1.0252894500139427
   Attrib doors=2    -2.343133840901647
   Attrib doors=3    0.2549974382470945
   Attrib doors=4    2.7739968607373306
   Attrib doors=5more    2.729372296135061
   Attrib persons=2    0.8305233973394149
   Attrib persons=4    -0.6700295847164432
   Attrib persons=more    1.5949353841460845
   Attrib lug_boot=small    -4.611020001826716
   Attrib lug_boot=med    0.8169160428798037
   Attrib lug_boot=big    5.4631430660240206
   Attrib safety=low    1.009073122214376
   Attrib safety=med    -3.9138739595853607
   Attrib safety=high    4.5749894060781955
Sigmoid Node 12
   Inputs    Weights
   Threshold    6.421602178366384
   Node 4    -5.33187759145723
   Node 5    -9.698457110132766
```

Node 6 0.3232475728653608
Node 7 5.917577702665973
Node 8 -1.46660082153259
Node 9 1.20726667030413
Node 10 -1.019039141836841
Node 11 -3.989516753790341
Sigmoid Node 13
Inputs Weights
Threshold 2.3954005610998568
Node 4 1.7035707608058577
Node 5 -0.09507038864245565
Node 6 -2.107905700658649
Node 7 2.6785051371031923
Node 8 -2.8785039160666206
Node 9 -4.414837043400072
Node 10 -2.4278598846342874
Node 11 0.20015201568862964
Sigmoid Node 14
Inputs Weights
Threshold 2.895518350862731
Node 4 2.274752073254963
Node 5 -0.19075337021899177
Node 6 -2.5938288283134523
Node 7 3.1719921025129354
Node 8 -3.3750625601420854
Node 9 -5.057607536429277
Node 10 -2.9905756727504422
Node 11 0.24486696609311812
Sigmoid Node 15
Inputs Weights
Threshold 4.102476747099273
Node 4 -4.502763737109684
Node 5 1.780430928242871
Node 6 1.0172043667548942
Node 7 2.979380498920235
Node 8 -0.29566397652793247
Node 9 -0.2425556295849284
Node 10 0.925287951991601
Node 11 -6.475838528366562
Sigmoid Node 16
Inputs Weights
Threshold 2.6301553298103575
Node 4 1.8610140284524233
Node 5 -0.10624736187979102
Node 6 -2.242914583699271
Node 7 2.814612641768815
Node 8 -2.9754013534797954
Node 9 -4.703300815381249
Node 10 -2.591702900760374
Node 11 0.23431775133107835
Sigmoid Node 17
Inputs Weights
Threshold 2.646716206404089
Node 4 1.983302870012132
Node 5 -0.16792665866565967
Node 6 -2.36538806078799
Node 7 2.914364112954909
Node 8 -3.108030442372721
Node 9 -4.713965596551852

```
    Node 10    -2.72519281770443
    Node 11    0.19097293149474182
Sigmoid Node 18
    Inputs    Weights
    Threshold    2.52680502951296
    Node 4    1.9327003872169695
    Node 5    -0.16645854114567282
    Node 6    -2.2624746308061767
    Node 7    2.833213175738929
    Node 8    -2.990050264515672
    Node 9    -4.603164043656706
    Node 10    -2.5622922815690137
    Node 11    0.18180498149152544
Sigmoid Node 19
    Inputs    Weights
    Threshold    1.9300862663611946
    Node 4    0.6436220925133478
    Node 5    0.12879417815075767
    Node 6    -1.2769161373876938
    Node 7    1.768878828734868
    Node 8    -1.9440798896722975
    Node 9    -3.723415552206003
    Node 10    -1.5411477510929483
    Node 11    0.2260055415453373
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 4.11 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1724               99.7685 %
Incorrectly Classified Instances         4                0.2315 %
Kappa statistic                          0.9949
Mean absolute error                      0.0028
Root mean squared error                  0.0319
Relative absolute error                  1.2404 %
Root relative squared error              9.4244 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
               1,000    0,006    0,998      1,000    0,999      0,996    1,000     1,000     unacc
               0,990    0,000    1,000      0,990    0,995      0,993    1,000     0,999     acc
               1,000    0,001    0,986      1,000    0,993      0,993    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
```

```
Weighted Avg.    0,998    0,004    0,998      0,998    0,998      0,995    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1210    0    0    0 |    a = unacc
   3  380    1    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

Apêndice D

Training Time

500

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H
"8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.676497497419739
    Node 12    -0.243157420469325
    Node 13    4.161917465285917
    Node 14    5.036339181190744
    Node 15    3.913158581512514
    Node 16    4.1804960255091705
    Node 17    -1.3006973971874518
    Node 18    3.349680424943593
    Node 19    -2.2012266047405973
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.665259297376204
    Node 12    1.3695193962730925
    Node 13    -3.8978056362650952
    Node 14    -5.264292181445521
    Node 15    -3.654091176175842
    Node 16    -3.836978453389413
    Node 17    6.665311580757991
    Node 18    -2.469675888561184
    Node 19    7.469775550765375
Sigmoid Node 2
```

```
    Inputs    Weights
    Threshold    -4.735580584263445
    Node 12    10.526608340139346
    Node 13    -1.745469440250562
    Node 14    -1.9623923669012502
    Node 15    -1.6352062113887067
    Node 16    -1.7091034985951417
    Node 17    -4.947165718705198
    Node 18    -1.0724247529826152
    Node 19    -6.309887798480004
Sigmoid Node 3
    Inputs    Weights
    Threshold    4.936311356509575
    Node 12    -9.290504449883892
    Node 13    -1.6703695901410283
    Node 14    -1.4142917327634006
    Node 15    -1.6429782041150895
    Node 16    -1.6594962080428923
    Node 17    -4.064774098408571
    Node 18    -1.9849145039004674
    Node 19    -3.5345942339154774
Sigmoid Node 4
    Inputs    Weights
    Threshold    -0.23576674559442648
    Attrib buying=vhigh    0.3174591257718334
    Attrib buying=high    1.0787099337314376
    Attrib buying=med    1.77402982012317
    Attrib buying=low    -2.6050596656459
    Attrib maint=vhigh    0.6769348548331313
    Attrib maint=high    -0.09610664479940455
    Attrib maint=med    0.3623977053108407
    Attrib maint=low    -0.3995391645263544
    Attrib doors=2    1.3150835463692618
    Attrib doors=3    0.27059496545238587
    Attrib doors=4    -0.5459906875956234
    Attrib doors=5more    -0.547633851641303
    Attrib persons=2    2.213212273201942
    Attrib persons=4    -1.123940747156066
    Attrib persons=more    -0.8776644094040311
    Attrib lug_boot=small    1.910627856989203
    Attrib lug_boot=med    0.6153919980397834
    Attrib lug_boot=big    -2.2877784657568294
    Attrib safety=low    2.1339089342035726
    Attrib safety=med    0.909257520985048
    Attrib safety=high    -2.8596482185638954
Sigmoid Node 5
    Inputs    Weights
    Threshold    0.9433909873281792
    Attrib buying=vhigh    1.3618136114475834
    Attrib buying=high    0.27889145696379053
    Attrib buying=med    -1.0111069305175484
    Attrib buying=low    -2.592049439656475
    Attrib maint=vhigh    1.4057084940853748
    Attrib maint=high    0.20240601641609945
    Attrib maint=med    -1.788698947922419
    Attrib maint=low    -1.7840591062086644
    Attrib doors=2    -0.8414099025519123
    Attrib doors=3    -0.5394513199058975
    Attrib doors=4    -0.28287740940885586
```

```
   Attrib doors=5more    -0.2821234441972961
   Attrib persons=2    2.1469583871762135
   Attrib persons=4    -1.603203727523077
   Attrib persons=more    -1.5653078540036778
   Attrib lug_boot=small    -1.3408934762735716
   Attrib lug_boot=med    -0.6815737444756933
   Attrib lug_boot=big    0.9839473989443677
   Attrib safety=low    1.3122277375241316
   Attrib safety=med    0.3579355978362084
   Attrib safety=high    -2.5968301016049264
Sigmoid Node 6
   Inputs    Weights
   Threshold    -0.26497746849898846
   Attrib buying=vhigh    0.9849277626527232
   Attrib buying=high    -0.1876665745230164
   Attrib buying=med    -1.1531421168567155
   Attrib buying=low    0.8466686580353444
   Attrib maint=vhigh    0.5586656835766007
   Attrib maint=high    2.282203125674473
   Attrib maint=med    -1.5106743324418508
   Attrib maint=low    -0.8172676608631535
   Attrib doors=2    1.2625652540253156
   Attrib doors=3    0.16191310563918232
   Attrib doors=4    -0.46120234209623
   Attrib doors=5more    -0.4493495919324071
   Attrib persons=2    1.1892587515207964
   Attrib persons=4    -0.31327316876924555
   Attrib persons=more    -0.622447463915718
   Attrib lug_boot=small    2.0129619652342225
   Attrib lug_boot=med    0.21421922067003835
   Attrib lug_boot=big    -2.085387248497509
   Attrib safety=low    1.2593599621171343
   Attrib safety=med    1.3776641723666914
   Attrib safety=high    -2.4368138104548427
Sigmoid Node 7
   Inputs    Weights
   Threshold    0.7323104966824062
   Attrib buying=vhigh    0.1521977619183333
   Attrib buying=high    1.1426305971820874
   Attrib buying=med    -2.4544177788124957
   Attrib buying=low    -0.40691509082012384
   Attrib maint=vhigh    1.2106341630996087
   Attrib maint=high    -2.978491493244966
   Attrib maint=med    -0.11673973421049823
   Attrib maint=low    0.3021009047865043
   Attrib doors=2    -0.7560980697539174
   Attrib doors=3    -0.5565864231786959
   Attrib doors=4    -0.11601880232144628
   Attrib doors=5more    -0.1182684365691757
   Attrib persons=2    2.855283045964008
   Attrib persons=4    -1.888467366905546
   Attrib persons=more    -1.6882381809990477
   Attrib lug_boot=small    -0.8683642170294024
   Attrib lug_boot=med    -0.21174792482663177
   Attrib lug_boot=big    0.2881778028912309
   Attrib safety=low    2.2538946849489343
   Attrib safety=med    0.25072925026724135
   Attrib safety=high    -3.276909620600982
Sigmoid Node 8
```

```
    Inputs    Weights
    Threshold    -0.7068318070239685
    Attrib buying=vhigh    0.8019464373524392
    Attrib buying=high    0.247453432304408
    Attrib buying=med    0.18922876474026545
    Attrib buying=low    0.2152099442900912
    Attrib maint=vhigh    0.5219709943155256
    Attrib maint=high    0.4483177722394602
    Attrib maint=med    0.3574539621591026
    Attrib maint=low    0.09794394625880215
    Attrib doors=2    2.037277346206886
    Attrib doors=3    -1.8401476265627945
    Attrib doors=4    0.5653010052709673
    Attrib doors=5more    0.5648720222770193
    Attrib persons=2    2.9729162485057095
    Attrib persons=4    -3.1000378017289494
    Attrib persons=more    0.8915229703235515
    Attrib lug_boot=small    2.4221795065125926
    Attrib lug_boot=med    -0.37065733585393335
    Attrib lug_boot=big    -1.3666339648473587
    Attrib safety=low    2.1077150581864714
    Attrib safety=med    -1.1390369358700554
    Attrib safety=high    -0.24608848796307425
Sigmoid Node 9
    Inputs    Weights
    Threshold    -0.7717242992029351
    Attrib buying=vhigh    -2.7994023798558967
    Attrib buying=high    -0.07442044957345614
    Attrib buying=med    2.3838464042376697
    Attrib buying=low    1.8522181624064835
    Attrib maint=vhigh    -2.5677620208479413
    Attrib maint=high    -0.43332958249742265
    Attrib maint=med    2.2904194898250623
    Attrib maint=low    2.2386821522685763
    Attrib doors=2    0.6406882285318479
    Attrib doors=3    0.20533440457999688
    Attrib doors=4    0.29595796911160166
    Attrib doors=5more    0.295894228080605
    Attrib persons=2    -4.488159303419957
    Attrib persons=4    2.5382719409698704
    Attrib persons=more    2.6889503493779476
    Attrib lug_boot=small    1.225369185607533
    Attrib lug_boot=med    0.031192931370402605
    Attrib lug_boot=big    -0.556595203778578
    Attrib safety=low    -4.602448691637061
    Attrib safety=med    3.1845669991425845
    Attrib safety=high    2.12237342817993
Sigmoid Node 10
    Inputs    Weights
    Threshold    -0.05233158015281267
    Attrib buying=vhigh    0.24040471575878725
    Attrib buying=high    0.12343815957439279
    Attrib buying=med    -0.09230060754609261
    Attrib buying=low    -0.07982823495859563
    Attrib maint=vhigh    0.2525033723438698
    Attrib maint=high    0.14652619627306884
    Attrib maint=med    -0.06705251636382761
    Attrib maint=low    -0.26241196201008676
    Attrib doors=2    -3.260589406136598
```

```
   Attrib doors=3    -0.6446913278075728
   Attrib doors=4    2.1260388901800518
   Attrib doors=5more    2.126162791076957
   Attrib persons=2    -1.7585331989309505
   Attrib persons=4    -0.5445980998444994
   Attrib persons=more    2.3735856461468137
   Attrib lug_boot=small    -4.566781780152633
   Attrib lug_boot=med    -0.40090071210290423
   Attrib lug_boot=big    4.99190010967213
   Attrib safety=low    -1.5718717142755896
   Attrib safety=med    0.6479231126489251
   Attrib safety=high    1.0549548095596513
Sigmoid Node 11
   Inputs    Weights
   Threshold    1.9488976748656675
   Attrib buying=vhigh    2.0490711384367444
   Attrib buying=high    2.2908522248685945
   Attrib buying=med    -2.695008546962134
   Attrib buying=low    -5.646540420299475
   Attrib maint=vhigh    2.7032561280817613
   Attrib maint=high    0.5019452524065041
   Attrib maint=med    -2.197495253733043
   Attrib maint=low    -4.952934204653578
   Attrib doors=2    -0.4813302767432615
   Attrib doors=3    -0.7661227360900414
   Attrib doors=4    -1.2676333559429567
   Attrib doors=5more    -1.2692815755117424
   Attrib persons=2    0.434264564960236
   Attrib persons=4    -0.9541199140100688
   Attrib persons=more    -1.3245158034340299
   Attrib lug_boot=small    0.33441750390758845
   Attrib lug_boot=med    -0.6865611487611855
   Attrib lug_boot=big    -1.5786175973226397
   Attrib safety=low    0.21104220551730732
   Attrib safety=med    0.005170836345401767
   Attrib safety=high    -2.145824822407726
Sigmoid Node 12
   Inputs    Weights
   Threshold    2.1198552561569572
   Node 4    2.657286554180374
   Node 5    4.282683444306119
   Node 6    1.9265523145492256
   Node 7    5.758217207313993
   Node 8    5.022387924674813
   Node 9    1.0059439026103645
   Node 10    -6.69258956912532
   Node 11    2.1903919682984676
Sigmoid Node 13
   Inputs    Weights
   Threshold    0.7910860725595108
   Node 4    1.0209543436103214
   Node 5    2.343919708655611
   Node 6    0.8347469170714531
   Node 7    1.220735096106226
   Node 8    3.803684467182193
   Node 9    -4.47029713276755
   Node 10    -2.84256106669356
   Node 11    0.6744518750242655
Sigmoid Node 14
```

```
   Inputs    Weights
   Threshold    1.0567765829836762
   Node 4    1.267494145068228
   Node 5    2.8309814159869275
   Node 6    1.0625180669671757
   Node 7    1.419478712920068
   Node 8    4.703395919129004
   Node 9    -5.419511286690068
   Node 10    -3.467386759107209
   Node 11    0.7771314074960927
Sigmoid Node 15
   Inputs    Weights
   Threshold    0.6691622055648652
   Node 4    0.9975512458239899
   Node 5    2.2299776197657395
   Node 6    0.8269147533385263
   Node 7    1.1658852638971529
   Node 8    3.5610526736763672
   Node 9    -4.287478127792949
   Node 10    -2.638405291607427
   Node 11    0.689417789372883
Sigmoid Node 16
   Inputs    Weights
   Threshold    0.8251435159866786
   Node 4    0.9876685597728129
   Node 5    2.3422423748399193
   Node 6    0.8362348088164034
   Node 7    1.1489525809415553
   Node 8    3.805924973271349
   Node 9    -4.427055945171063
   Node 10    -2.8337407624763324
   Node 11    0.6291434811003543
Sigmoid Node 17
   Inputs    Weights
   Threshold    -0.29878797754396635
   Node 4    1.3709012362587285
   Node 5    1.6205131937222095
   Node 6    3.3771953871283804
   Node 7    1.969797419644337
   Node 8    2.354561544856084
   Node 9    -2.2835135801481727
   Node 10    -3.1149489964271746
   Node 11    6.873144741082383
Sigmoid Node 18
   Inputs    Weights
   Threshold    0.6509426597839091
   Node 4    0.7393860375660125
   Node 5    1.7563000173490946
   Node 6    0.4822438306435522
   Node 7    1.0557173789874033
   Node 8    2.8702491160499948
   Node 9    -3.3462519942011233
   Node 10    -2.037835221376477
   Node 11    0.3027320640817577
Sigmoid Node 19
   Inputs    Weights
   Threshold    -0.5858029597813753
   Node 4    1.3596283026994755
   Node 5    1.7414103307972961
```

```
    Node 6    3.9877691633366803
    Node 7    1.9528143083289817
    Node 8    2.115554348727707
    Node 9    -2.301443094838674
    Node 10    -3.2632642812206636
    Node 11    7.697222280431426
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 4.05 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1726               99.8843 %
Incorrectly Classified Instances         2                0.1157 %
Kappa statistic                          0.9975
Mean absolute error                      0.0022
Root mean squared error                  0.0187
Relative absolute error                  0.9599 %
Root relative squared error              5.5362 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,998    0,000    1,000      0,998    0,999      0,997    1,000     1,000     unacc
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
               1,000    0,001    0,986      1,000    0,993      0,993    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.  0,999    0,000    0,999      0,999    0,999      0,997    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1208    1    1    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

750

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 750 -V 0 -S 0 -E 20 -H
"8, 8"
```

```
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.815099989560518
    Node 12    -0.3181323572933891
    Node 13    4.242313736519464
    Node 14    5.132554107801463
    Node 15    3.9874866321510365
    Node 16    4.261821332817216
    Node 17    -1.3157230230994987
    Node 18    3.410650846206406
    Node 19    -2.2240387830232953
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.783698767148245
    Node 12    1.2700113100425132
    Node 13    -3.9712278986519927
    Node 14    -5.358715306271543
    Node 15    -3.7236567012825676
    Node 16    -3.9095337259635192
    Node 17    6.872081768791868
    Node 18    -2.514697323921331
    Node 19    7.686889319763052
Sigmoid Node 2
    Inputs    Weights
    Threshold    -4.959065320681605
    Node 12    10.962620629855143
    Node 13    -1.8002721411047526
    Node 14    -2.0264085106336154
    Node 15    -1.6862966499008254
    Node 16    -1.763902615518851
    Node 17    -5.154677732858321
    Node 18    -1.109948925960182
    Node 19    -6.526019978374257
Sigmoid Node 3
    Inputs    Weights
    Threshold    5.145142001001633
    Node 12    -9.720859408034347
    Node 13    -1.6781830051135476
    Node 14    -1.418553239858299
    Node 15    -1.651355238024015
    Node 16    -1.6677116870940467
    Node 17    -4.164946319652649
    Node 18    -2.0042344437709554
    Node 19    -3.634902433080955
Sigmoid Node 4
```

```
   Inputs    Weights
   Threshold    -0.23788058215743202
   Attrib buying=vhigh    0.3013747499402361
   Attrib buying=high    1.1071943158545072
   Attrib buying=med    1.7498402701995455
   Attrib buying=low    -2.5890424488878665
   Attrib maint=vhigh    0.6893222948513412
   Attrib maint=high    -0.09381226202042091
   Attrib maint=med    0.35410410819991317
   Attrib maint=low    -0.401699717086607
   Attrib doors=2    1.31674333343311
   Attrib doors=3    0.2767202510172531
   Attrib doors=4    -0.5479126774223211
   Attrib doors=5more    -0.5492692613173921
   Attrib persons=2    2.2157182442859926
   Attrib persons=4    -1.1152871375150086
   Attrib persons=more    -0.8867101535661487
   Attrib lug_boot=small    1.9205355167647662
   Attrib lug_boot=med    0.5990858419386037
   Attrib lug_boot=big    -2.279266132868097
   Attrib safety=low    2.137788021426773
   Attrib safety=med    0.9210966616710737
   Attrib safety=high    -2.8732526099103772
Sigmoid Node 5
   Inputs    Weights
   Threshold    0.9631607166805908
   Attrib buying=vhigh    1.3842819366600538
   Attrib buying=high    0.2864960384099311
   Attrib buying=med    -1.0223889648806392
   Attrib buying=low    -2.650379770656743
   Attrib maint=vhigh    1.438610231074709
   Attrib maint=high    0.19984140641433795
   Attrib maint=med    -1.815996221663867
   Attrib maint=low    -1.82663841815953
   Attrib doors=2    -0.8550895943637601
   Attrib doors=3    -0.5504778497651792
   Attrib doors=4    -0.29014119475430994
   Attrib doors=5more    -0.28969289588551295
   Attrib persons=2    2.179900296299446
   Attrib persons=4    -1.6307453384790664
   Attrib persons=more    -1.5904778815233738
   Attrib lug_boot=small    -1.349006962491353
   Attrib lug_boot=med    -0.7058075207321753
   Attrib lug_boot=big    0.9965249320663628
   Attrib safety=low    1.3233407066381209
   Attrib safety=med    0.3399425407142372
   Attrib safety=high    -2.6097197429493137
Sigmoid Node 6
   Inputs    Weights
   Threshold    -0.27156238413879735
   Attrib buying=vhigh    1.000195524520795
   Attrib buying=high    -0.16194077060991882
   Attrib buying=med    -1.1628477284627399
   Attrib buying=low    0.8285505351398371
   Attrib maint=vhigh    0.5413264771041734
   Attrib maint=high    2.2964008570876864
   Attrib maint=med    -1.518161361963825
   Attrib maint=low    -0.7934693250022681
   Attrib doors=2    1.2527704272077753
```

Attrib doors=3 0.1894046115336886
Attrib doors=4 -0.46176297591579313
Attrib doors=5more -0.45331580591021226
Attrib persons=2 1.1965736018724291
Attrib persons=4 -0.2951181394803906
Attrib persons=more -0.641332427916377
Attrib lug_boot=small 2.013069429416406
Attrib lug_boot=med 0.22160219581823468
Attrib lug_boot=big -2.0862927721879956
Attrib safety=low 1.2691604758117017
Attrib safety=med 1.3756529044317798
Attrib safety=high -2.4380181405746506
Sigmoid Node 7
Inputs Weights
Threshold 0.7249231449828539
Attrib buying=vhigh 0.16848556589896516
Attrib buying=high 1.1274217683396215
Attrib buying=med -2.446144394696392
Attrib buying=low -0.4014927466752152
Attrib maint=vhigh 1.2253191853130583
Attrib maint=high -3.0130307498203748
Attrib maint=med -0.10823343081972471
Attrib maint=low 0.3282235391565201
Attrib doors=2 -0.7590911761245321
Attrib doors=3 -0.55614736553768
Attrib doors=4 -0.10778677347106685
Attrib doors=5more -0.10917171329083622
Attrib persons=2 2.865418705270397
Attrib persons=4 -1.8900519256772748
Attrib persons=more -1.6894019298341119
Attrib lug_boot=small -0.882573318553871
Attrib lug_boot=med -0.19375142985936758
Attrib lug_boot=big 0.29177776114798726
Attrib safety=low 2.263141674323006
Attrib safety=med 0.26514063615833705
Attrib safety=high -3.293180644166453
Sigmoid Node 8
Inputs Weights
Threshold -0.7212210255691593
Attrib buying=vhigh 0.7885855682641053
Attrib buying=high 0.2551962809300553
Attrib buying=med 0.19337752372096711
Attrib buying=low 0.24545764286250177
Attrib maint=vhigh 0.5307560140863677
Attrib maint=high 0.44541296622079235
Attrib maint=med 0.36827866453885527
Attrib maint=low 0.11001746721732905
Attrib doors=2 2.129769870924218
Attrib doors=3 -1.8228680732503328
Attrib doors=4 0.5245956968236164
Attrib doors=5more 0.5245836897850082
Attrib persons=2 2.991685418069115
Attrib persons=4 -3.091407998175749
Attrib persons=more 0.8785132157519622
Attrib lug_boot=small 2.3912660525459204
Attrib lug_boot=med -0.3325240177001965
Attrib lug_boot=big -1.3594646104894181
Attrib safety=low 2.1268721180570163
Attrib safety=med -1.0909811271608656

```
   Attrib safety=high    -0.2989121379974851
Sigmoid Node 9
   Inputs    Weights
   Threshold    -0.7742226342984425
   Attrib buying=vhigh    -2.8027117958670846
   Attrib buying=high    -0.07171061978193781
   Attrib buying=med    2.3925460696983314
   Attrib buying=low    1.849114753356491
   Attrib maint=vhigh    -2.5714282372454997
   Attrib maint=high    -0.43362761408362505
   Attrib maint=med    2.2988183641689313
   Attrib maint=low    2.2392441960995075
   Attrib doors=2    0.6358701633980076
   Attrib doors=3    0.21485892895424902
   Attrib doors=4    0.2959745839597696
   Attrib doors=5more    0.2961678241830678
   Attrib persons=2    -4.49412051884501
   Attrib persons=4    2.5522537002108536
   Attrib persons=more    2.683428140657646
   Attrib lug_boot=small    1.2153411880272345
   Attrib lug_boot=med    0.031141637574704457
   Attrib lug_boot=big    -0.5440175773071207
   Attrib safety=low    -4.626596159052015
   Attrib safety=med    3.1926967338480683
   Attrib safety=high    2.1408894959851787
Sigmoid Node 10
   Inputs    Weights
   Threshold    -0.0577074215431961
   Attrib buying=vhigh    0.2871565010314529
   Attrib buying=high    0.10828526208338841
   Attrib buying=med    -0.11211950058744277
   Attrib buying=low    -0.08085654691814748
   Attrib maint=vhigh    0.2801476370008999
   Attrib maint=high    0.14151822516000237
   Attrib maint=med    -0.07292180786761002
   Attrib maint=low    -0.2684272812695198
   Attrib doors=2    -3.241937351287547
   Attrib doors=3    -0.6537877390099822
   Attrib doors=4    2.126604148173095
   Attrib doors=5more    2.1267935722181277
   Attrib persons=2    -1.7545708549948575
   Attrib persons=4    -0.5422362252371085
   Attrib persons=more    2.3726372689937976
   Attrib lug_boot=small    -4.6511314916920234
   Attrib lug_boot=med    -0.3525126757110967
   Attrib lug_boot=big    5.033237626209941
   Attrib safety=low    -1.5682178015307437
   Attrib safety=med    0.6580274206521958
   Attrib safety=high    1.0465724302018669
Sigmoid Node 11
   Inputs    Weights
   Threshold    1.9609451905017197
   Attrib buying=vhigh    2.065348463623998
   Attrib buying=high    2.3182702350936277
   Attrib buying=med    -2.7265102091698457
   Attrib buying=low    -5.6828291247761
   Attrib maint=vhigh    2.7248883090524534
   Attrib maint=high    0.49813807475815625
   Attrib maint=med    -2.2114238498284795
```

```
   Attrib maint=low    -4.980925643152154
   Attrib doors=2    -0.4708508007681277
   Attrib doors=3    -0.7730265393271816
   Attrib doors=4    -1.2817670031318267
   Attrib doors=5more    -1.2828186323328645
   Attrib persons=2    0.4259522168345295
   Attrib persons=4    -0.9529061249571622
   Attrib persons=more    -1.3294647599972562
   Attrib lug_boot=small    0.3353841904724578
   Attrib lug_boot=med    -0.6811611363794706
   Attrib lug_boot=big    -1.5970318119051992
   Attrib safety=low    0.20322370251641528
   Attrib safety=med    0.01775330536589921
   Attrib safety=high    -2.162636304063322
Sigmoid Node 12
   Inputs    Weights
   Threshold    2.16083952896354
   Node 4    2.7082011461031974
   Node 5    4.336090942724291
   Node 6    1.9340369577315986
   Node 7    5.93729368434173
   Node 8    5.102110832598171
   Node 9    1.0522181398247816
   Node 10    -6.8546612040720944
   Node 11    2.30003614590734
Sigmoid Node 13
   Inputs    Weights
   Threshold    0.8182801155259487
   Node 4    1.0018591934184384
   Node 5    2.427296378359486
   Node 6    0.8327359752568534
   Node 7    1.2018861588228735
   Node 8    3.882054306774047
   Node 9    -4.503104058086077
   Node 10    -2.886472993602956
   Node 11    0.666991895278834
Sigmoid Node 14
   Inputs    Weights
   Threshold    1.0883281829404763
   Node 4    1.243388151897632
   Node 5    2.926692620608957
   Node 6    1.0572638240171897
   Node 7    1.3985220400611338
   Node 8    4.796329903589621
   Node 9    -5.4560834863257215
   Node 10    -3.515756984124737
   Node 11    0.7645669580430943
Sigmoid Node 15
   Inputs    Weights
   Threshold    0.6962206058406526
   Node 4    0.9793910665374179
   Node 5    2.308173168730558
   Node 6    0.8250320309671889
   Node 7    1.1485317395300418
   Node 8    3.636123905621063
   Node 9    -4.3171789804230345
   Node 10    -2.6815771657933065
   Node 11    0.6818684716853382
Sigmoid Node 16
```

```
    Inputs    Weights
    Threshold    0.8512979537129157
    Node 4    0.9700481878187064
    Node 5    2.427002190638033
    Node 6    0.8344114427723218
    Node 7    1.1329706307972338
    Node 8    3.8815970589439597
    Node 9    -4.46063030567779
    Node 10    -2.8772196898304774
    Node 11    0.6228417387980696
Sigmoid Node 17
    Inputs    Weights
    Threshold    -0.2981086669600685
    Node 4    1.361005424754591
    Node 5    1.6466171913852357
    Node 6    3.4249251499342215
    Node 7    2.0011959829948585
    Node 8    2.4174527997949746
    Node 9    -2.3260466389620116
    Node 10    -3.1600999432807573
    Node 11    7.018338169529743
Sigmoid Node 18
    Inputs    Weights
    Threshold    0.6736038243621721
    Node 4    0.7263999439501547
    Node 5    1.8236417716828266
    Node 6    0.48326683544886656
    Node 7    1.0467289654503196
    Node 8    2.920944078156541
    Node 9    -3.368227623168392
    Node 10    -2.0715222013665913
    Node 11    0.2997661144185878
Sigmoid Node 19
    Inputs    Weights
    Threshold    -0.5783448582138113
    Node 4    1.356072726847474
    Node 5    1.76946234389799
    Node 6    4.038170265446551
    Node 7    1.9885829422510302
    Node 8    2.187098862741874
    Node 9    -2.3446814326886325
    Node 10    -3.3169265197063034
    Node 11    7.827839309065271
Class unacc
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 6.15 seconds
```

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1727               99.9421 %
Incorrectly Classified Instances         1                0.0579 %
Kappa statistic                          0.9987
Mean absolute error                      0.0018
Root mean squared error                  0.0172
Relative absolute error                  0.7988 %
Root relative squared error              5.0913 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate   FP Rate   Precision   Recall  F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,000    1,000      0,999    1,000      0,999    1,000     1,000     unacc
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.    0,999    0,000    0,999      0,999    0,999      0,999    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1209    1    0    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

1000

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 1000 -V 0 -S 0 -E 20
-H "8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.915472097439935
    Node 12    -0.36871964120718226
    Node 13    4.297972282123601
    Node 14    5.198806256118473
    Node 15    4.039143119028586
    Node 16    4.318027586838591
```

```
    Node 17    -1.3238016968361466
    Node 18    3.45289485467984
    Node 19    -2.2369267791075127
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.866132291611533
    Node 12    1.202395675296325
    Node 13    -4.023976436810909
    Node 14    -5.426155371187751
    Node 15    -3.7735804474402554
    Node 16    -3.9617326441898335
    Node 17    7.0156652234174635
    Node 18    -2.5473706435791255
    Node 19    7.8373535707331525
Sigmoid Node 2
    Inputs    Weights
    Threshold    -5.113023703846573
    Node 12    11.262479244416644
    Node 13    -1.8376829785669486
    Node 14    -2.0699980866993126
    Node 15    -1.7212273962075533
    Node 16    -1.801321888073199
    Node 17    -5.299071935546725
    Node 18    -1.1357462247700834
    Node 19    -6.676095532344457
Sigmoid Node 3
    Inputs    Weights
    Threshold    5.290871017671381
    Node 12    -10.023061745093326
    Node 13    -1.683392702982358
    Node 14    -1.4213691022936137
    Node 15    -1.6569598921568576
    Node 16    -1.6731860836907977
    Node 17    -4.232797464552192
    Node 18    -2.017332575741033
    Node 19    -3.7027077735194887
Sigmoid Node 4
    Inputs    Weights
    Threshold    -0.2394683872180754
    Attrib buying=vhigh    0.29084219117442206
    Attrib buying=high    1.124807262540836
    Attrib buying=med    1.7347763812499128
    Attrib buying=low    -2.5778833377373522
    Attrib maint=vhigh    0.6977338551863104
    Attrib maint=high    -0.09226665538483483
    Attrib maint=med    0.3487570121810324
    Attrib maint=low    -0.4031341779169957
    Attrib doors=2    1.3173920803129802
    Attrib doors=3    0.2810480493726609
    Attrib doors=4    -0.5488884030923186
    Attrib doors=5more    -0.5500944707614174
    Attrib persons=2    2.2175878062902235
    Attrib persons=4    -1.109039025035162
    Attrib persons=more    -0.8932400229894824
    Attrib lug_boot=small    1.928193248212064
    Attrib lug_boot=med    0.5873400339165915
    Attrib lug_boot=big    -2.273590251232781
    Attrib safety=low    2.1406182235508564
    Attrib safety=med    0.9282040461835975
```

```
   Attrib safety=high    -2.8816023914862803
Sigmoid Node 5
   Inputs    Weights
   Threshold    0.9775104675955039
   Attrib buying=vhigh    1.396486095764925
   Attrib buying=high    0.29594258828794695
   Attrib buying=med    -1.0317538814795562
   Attrib buying=low    -2.691365064870527
   Attrib maint=vhigh    1.4604553663531008
   Attrib maint=high    0.19763856941145883
   Attrib maint=med    -1.835291303002903
   Attrib maint=low    -1.855685136925793
   Attrib doors=2    -0.8651110879207233
   Attrib doors=3    -0.5579925202556153
   Attrib doors=4    -0.2956429786668052
   Attrib doors=5more    -0.2953544497554541
   Attrib persons=2    2.2004509810625805
   Attrib persons=4    -1.6491580484284434
   Attrib persons=more    -1.606965607252131
   Attrib lug_boot=small    -1.3544911883070505
   Attrib lug_boot=med    -0.7225558939021582
   Attrib lug_boot=big    1.0044077801373015
   Attrib safety=low    1.3315637557995947
   Attrib safety=med    0.32605764769023654
   Attrib safety=high    -2.618407650001755
Sigmoid Node 6
   Inputs    Weights
   Threshold    -0.27567913732144683
   Attrib buying=vhigh    1.0091680502059848
   Attrib buying=high    -0.1432729952770673
   Attrib buying=med    -1.1699845217007885
   Attrib buying=low    0.8162805337251162
   Attrib maint=vhigh    0.5282813909624602
   Attrib maint=high    2.3081556236302525
   Attrib maint=med    -1.5243858061634277
   Attrib maint=low    -0.7777210548380669
   Attrib doors=2    1.244686196510019
   Attrib doors=3    0.20771648056641587
   Attrib doors=4    -0.4619092749059313
   Attrib doors=5more    -0.4551636388897489
   Attrib persons=2    1.2011653716146662
   Attrib persons=4    -0.2831948293456226
   Attrib persons=more    -0.6537307546107501
   Attrib lug_boot=small    2.0129149815504284
   Attrib lug_boot=med    0.22595008742764136
   Attrib lug_boot=big    -2.086369462748741
   Attrib safety=low    1.2757203417855536
   Attrib safety=med    1.3745356908823176
   Attrib safety=high    -2.4393440398163437
Sigmoid Node 7
   Inputs    Weights
   Threshold    0.7205206960402203
   Attrib buying=vhigh    0.17905397810505463
   Attrib buying=high    1.116774494918712
   Attrib buying=med    -2.441183326103191
   Attrib buying=low    -0.3975700561682178
   Attrib maint=vhigh    1.2340407932353665
   Attrib maint=high    -3.0364577327380413
   Attrib maint=med    -0.10266385725631152
```

```
   Attrib maint=low    0.34616423847372
   Attrib doors=2    -0.7607449674994814
   Attrib doors=3    -0.5558779587278927
   Attrib doors=4    -0.10290189707091857
   Attrib doors=5more    -0.10386730724056215
   Attrib persons=2    2.8718055711165063
   Attrib persons=4    -1.890669986033914
   Attrib persons=more    -1.6907682863809423
   Attrib lug_boot=small    -0.8924280429774398
   Attrib lug_boot=med    -0.1815017556115013
   Attrib lug_boot=big    0.2937852602663208
   Attrib safety=low    2.26880338503586
   Attrib safety=med    0.27509756682848263
   Attrib safety=high    -3.3043968366067413
Sigmoid Node 8
   Inputs    Weights
   Threshold    -0.7320295129399176
   Attrib buying=vhigh    0.7817478471586914
   Attrib buying=high    0.25844167528758616
   Attrib buying=med    0.19645214052517285
   Attrib buying=low    0.26759232754769596
   Attrib maint=vhigh    0.538326343538473
   Attrib maint=high    0.4414258372838961
   Attrib maint=med    0.37586703775916974
   Attrib maint=low    0.12046286822326656
   Attrib doors=2    2.1944229242429167
   Attrib doors=3    -1.8103577018062726
   Attrib doors=4    0.49673089404980225
   Attrib doors=5more    0.4969020425376304
   Attrib persons=2    3.0055957599993075
   Attrib persons=4    -3.0845762747039895
   Attrib persons=more    0.8685796377206697
   Attrib lug_boot=small    2.3724476238122634
   Attrib lug_boot=med    -0.30916422185938347
   Attrib lug_boot=big    -1.3531974902257222
   Attrib safety=low    2.141275519039577
   Attrib safety=med    -1.0626870203538306
   Attrib safety=high    -0.3308011584163498
Sigmoid Node 9
   Inputs    Weights
   Threshold    -0.7756128350623801
   Attrib buying=vhigh    -2.8055998232929396
   Attrib buying=high    -0.06987383510199588
   Attrib buying=med    2.3984558650374668
   Attrib buying=low    1.8470366022909914
   Attrib maint=vhigh    -2.5740334820322794
   Attrib maint=high    -0.4327638522691355
   Attrib maint=med    2.3030043036673424
   Attrib maint=low    2.239580141101237
   Attrib doors=2    0.6337807492315556
   Attrib doors=3    0.22234523013390067
   Attrib doors=4    0.29463113405723235
   Attrib doors=5more    0.2948947886002921
   Attrib persons=2    -4.4988034765728875
   Attrib persons=4    2.5627407916385603
   Attrib persons=more    2.6790142077218118
   Attrib lug_boot=small    1.2071379420291777
   Attrib lug_boot=med    0.033050434286995674
   Attrib lug_boot=big    -0.536332927257405
```

```
   Attrib safety=low    -4.644215521557068
   Attrib safety=med    3.1965851228978366
   Attrib safety=high    2.1560106702044854
Sigmoid Node 10
   Inputs    Weights
   Threshold    -0.06296164978042561
   Attrib buying=vhigh    0.31671364345411285
   Attrib buying=high    0.0980877497159963
   Attrib buying=med    -0.12353235066421797
   Attrib buying=low    -0.07829487042218002
   Attrib maint=vhigh    0.2959521621949666
   Attrib maint=high    0.1367964564500258
   Attrib maint=med    -0.07412596203954172
   Attrib maint=low    -0.2677974271072216
   Attrib doors=2    -3.2252662599622726
   Attrib doors=3    -0.6609301216784508
   Attrib doors=4    2.127055967213063
   Attrib doors=5more    2.127321500995831
   Attrib persons=2    -1.7503347181572555
   Attrib persons=4    -0.5407235745549029
   Attrib persons=more    2.372142709711202
   Attrib lug_boot=small    -4.711849821866663
   Attrib lug_boot=med    -0.3158894877855862
   Attrib lug_boot=big    5.062586996696034
   Attrib safety=low    -1.5642188789809395
   Attrib safety=med    0.6661004387239886
   Attrib safety=high    1.0397547178175899
Sigmoid Node 11
   Inputs    Weights
   Threshold    1.969306018885212
   Attrib buying=vhigh    2.0777566153532216
   Attrib buying=high    2.336203702260736
   Attrib buying=med    -2.7477477343637693
   Attrib buying=low    -5.708654875245762
   Attrib maint=vhigh    2.741350460274281
   Attrib maint=high    0.49500859781445616
   Attrib maint=med    -2.220982787229969
   Attrib maint=low    -5.001421036795766
   Attrib doors=2    -0.4641637994721475
   Attrib doors=3    -0.7781198393798688
   Attrib doors=4    -1.2910642884990227
   Attrib doors=5more    -1.2918367049759392
   Attrib persons=2    0.41988216682748486
   Attrib persons=4    -0.9521492401656164
   Attrib persons=more    -1.3325124231652512
   Attrib lug_boot=small    0.3355746594483485
   Attrib lug_boot=med    -0.6775981590086336
   Attrib lug_boot=big    -1.6091460866354328
   Attrib safety=low    0.19768960643696393
   Attrib safety=med    0.026201798295678504
   Attrib safety=high    -2.173911529297205
Sigmoid Node 12
   Inputs    Weights
   Threshold    2.187622730919422
   Node 4    2.7423330285730434
   Node 5    4.372041296209772
   Node 6    1.9384510182193866
   Node 7    6.060140047506859
   Node 8    5.148869705895584
```

```
    Node 9    1.0822208176361525
    Node 10    -6.967295640471306
    Node 11    2.378857486285837
Sigmoid Node 13
    Inputs    Weights
    Threshold    0.8349521878180343
    Node 4    0.9893246591099134
    Node 5    2.4830801646974443
    Node 6    0.8320986128171846
    Node 7    1.187943691591785
    Node 8    3.938132729518632
    Node 9    -4.526476193767114
    Node 10    -2.9148415323148287
    Node 11    0.662971642052871
Sigmoid Node 14
    Inputs    Weights
    Threshold    1.1075548748039055
    Node 4    1.2276448093188053
    Node 5    2.9907078756009486
    Node 6    1.0545767380535283
    Node 7    1.3832861280810607
    Node 8    4.8616882603601095
    Node 9    -5.481997788693526
    Node 10    -3.546786325619339
    Node 11    0.7575011300398493
Sigmoid Node 15
    Inputs    Weights
    Threshold    0.7129238384157286
    Node 4    0.9674072418089581
    Node 5    2.360444784524177
    Node 6    0.8244064600023736
    Node 7    1.1355606682238617
    Node 8    3.690057977803092
    Node 9    -4.33843611807127
    Node 10    -2.7097238423127195
    Node 11    0.6776237787359412
Sigmoid Node 16
    Inputs    Weights
    Threshold    0.8672622730676316
    Node 4    0.9584756585741222
    Node 5    2.4836544532298257
    Node 6    0.8338150750879985
    Node 7    1.1209768205540638
    Node 8    3.935983942203705
    Node 9    -4.484502329008196
    Node 10    -2.905149640913754
    Node 11    0.6196046844836719
Sigmoid Node 17
    Inputs    Weights
    Threshold    -0.29838272426594137
    Node 4    1.3544168727584176
    Node 5    1.6651730532651878
    Node 6    3.457620673871705
    Node 7    2.022846538707572
    Node 8    2.461003225043397
    Node 9    -2.356121762392554
    Node 10    -3.19215882808508
    Node 11    7.115611022409102
Sigmoid Node 18
```

```
   Inputs    Weights
   Threshold    0.6874133908163664
   Node 4    0.717837744913848
   Node 5    1.868386011974654
   Node 6    0.48457620776536736
   Node 7    1.0392332326239209
   Node 8    2.958565034057015
   Node 9    -3.384294988374428
   Node 10    -2.093013882642529
   Node 11    0.29863617545499316
Sigmoid Node 19
   Inputs    Weights
   Threshold    -0.5738604412075589
   Node 4    1.3535055560529703
   Node 5    1.7893826117909006
   Node 6    4.071978535514925
   Node 7    2.012553510589629
   Node 8    2.236338847136916
   Node 9    -2.375059862851642
   Node 10    -3.3542760496141653
   Node 11    7.915572460957545
Class unacc
   Input
   Node 0
Class acc
   Input
   Node 1
Class good
   Input
   Node 2
Class vgood
   Input
   Node 3


Time taken to build model: 8.05 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1727               99.9421 %
Incorrectly Classified Instances         1                0.0579 %
Kappa statistic                          0.9987
Mean absolute error                      0.0016
Root mean squared error                  0.0162
Relative absolute error                  0.703  %
Root relative squared error              4.7786 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,000    1,000      0,999    1,000      0,999    1,000     1,000     unacc
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.  0,999    0,000    0,999      0,999    0,999      0,999    1,000     1,000

=== Confusion Matrix ===
```

```
   a    b    c    d   <-- classified as
 1209    1    0    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```

1250

```
=== Run information ===

Scheme:       weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 1250 -V 0 -S 0 -E 20
-H "8, 8"
Relation:     car
Instances:    1728
Attributes:   7
              buying
              maint
              doors
              persons
              lug_boot
              safety
              class
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

Sigmoid Node 0
    Inputs    Weights
    Threshold    -5.994746890297046
    Node 12    -0.40656346352317535
    Node 13    4.340597186219229
    Node 14    5.249336167640901
    Node 15    4.078817623651682
    Node 16    4.361020768603899
    Node 17    -1.3286810275910228
    Node 18    3.4852760354565606
    Node 19    -2.2451832162789787
Sigmoid Node 1
    Inputs    Weights
    Threshold    -6.929513950052969
    Node 12    1.1513182851198127
    Node 13    -4.065253328433663
    Node 14    -5.478724074216856
    Node 15    -3.812620770663189
    Node 16    -4.0026125119019484
    Node 17    7.125743176853671
    Node 18    -2.5730982484373692
    Node 19    7.952539136030043
Sigmoid Node 2
    Inputs    Weights
    Threshold    -5.23032427762571
    Node 12    11.490648230329567
    Node 13    -1.8659315208228995
    Node 14    -2.102837790669119
    Node 15    -1.7476381889703625
    Node 16    -1.8295788776177628
```

```
   Node 17    -5.409958918842425
   Node 18    -1.1553250712466088
   Node 19    -6.791185941030182
Sigmoid Node 3
   Inputs    Weights
   Threshold    5.402747697920602
   Node 12    -10.256032175530963
   Node 13    -1.6872551275470558
   Node 14    -1.4234428196729478
   Node 15    -1.661125178095049
   Node 16    -1.6772433667494755
   Node 17    -4.283604149097359
   Node 18    -2.0271592151126883
   Node 19    -3.753413076538779
Sigmoid Node 4
   Inputs    Weights
   Threshold    -0.2407837076859249
   Attrib buying=vhigh    0.28329337635543084
   Attrib buying=high    1.1371897382312033
   Attrib buying=med    1.723947510697112
   Attrib buying=low    -2.569257487120232
   Attrib maint=vhigh    0.7040870482860584
   Attrib maint=high    -0.09118397040284701
   Attrib maint=med    0.3449730940381129
   Attrib maint=low    -0.4041554969201061
   Attrib doors=2    1.317636270405361
   Attrib doors=3    0.28453195440918566
   Attrib doors=4    -0.5494860089407562
   Attrib doors=5more    -0.5505943191062219
   Attrib persons=2    2.219126621846939
   Attrib persons=4    -1.1039916699571
   Attrib persons=more    -0.8985108731564373
   Attrib lug_boot=small    1.9343696958228436
   Attrib lug_boot=med    0.5782262821917951
   Attrib lug_boot=big    -2.269337626651118
   Attrib safety=low    2.1428945098010757
   Attrib safety=med    0.9331647251932987
   Attrib safety=high    -2.887524036278148
Sigmoid Node 5
   Inputs    Weights
   Threshold    0.9884997102775008
   Attrib buying=vhigh    1.404619102075373
   Attrib buying=high    0.3038258149011945
   Attrib buying=med    -1.0388952958971216
   Attrib buying=low    -2.7222183687406045
   Attrib maint=vhigh    1.4769228722586851
   Attrib maint=high    0.1954118517941036
   Attrib maint=med    -1.8499811662672163
   Attrib maint=low    -1.8772145473137372
   Attrib doors=2    -0.8725176757835459
   Attrib doors=3    -0.563566111229567
   Attrib doors=4    -0.3000935028000742
   Attrib doors=5more    -0.29990223214945666
   Attrib persons=2    2.2153973423857756
   Attrib persons=4    -1.6629670948508768
   Attrib persons=more    -1.619092164835032
   Attrib lug_boot=small    -1.3588189791176037
   Attrib lug_boot=med    -0.735085716438845
   Attrib lug_boot=big    1.0102761508026243
```

```
    Attrib safety=low    1.338409332910375
    Attrib safety=med    0.3153993018920657
    Attrib safety=high    -2.6255841239963575
Sigmoid Node 6
    Inputs    Weights
    Threshold    -0.27866026206313715
    Attrib buying=vhigh    1.0154200013925647
    Attrib buying=high    -0.12905821238599902
    Attrib buying=med    -1.1755451557536962
    Attrib buying=low    0.8073366831838059
    Attrib maint=vhigh    0.5179327172013468
    Attrib maint=high    2.317801759232668
    Attrib maint=med    -1.5293736388179857
    Attrib maint=low    -0.7660684345415794
    Attrib doors=2    1.2380425896819
    Attrib doors=3    0.2212990592323109
    Attrib doors=4    -0.4618791954047629
    Attrib doors=5more    -0.4561704407452929
    Attrib persons=2    1.2044943791581504
    Attrib persons=4    -0.27446534719339566
    Attrib persons=more    -0.662808119564833
    Attrib lug_boot=small    2.012665078365071
    Attrib lug_boot=med    0.22887669891299264
    Attrib lug_boot=big    -2.086065046306911
    Attrib safety=low    1.2807203762725632
    Attrib safety=med    1.3738976517819186
    Attrib safety=high    -2.440724910461404
Sigmoid Node 7
    Inputs    Weights
    Threshold    0.7174664768577745
    Attrib buying=vhigh    0.18680883492030942
    Attrib buying=high    1.1086353451700433
    Attrib buying=med    -2.4378534087435795
    Attrib buying=low    -0.394407242229412
    Attrib maint=vhigh    1.2400736084792165
    Attrib maint=high    -3.0540411757909705
    Attrib maint=med    -0.09853464556018134
    Attrib maint=low    0.3596940929515448
    Attrib doors=2    -0.761676821752678
    Attrib doors=3    -0.5557798767483254
    Attrib doors=4    -0.0995566025217727
    Attrib doors=5more    -0.10027039115121497
    Attrib persons=2    2.876430614718447
    Attrib persons=4    -1.891019150458997
    Attrib persons=more    -1.6919899463753976
    Attrib lug_boot=small    -0.8996417303272795
    Attrib lug_boot=med    -0.17236634905201415
    Attrib lug_boot=big    0.2949177602390681
    Attrib safety=low    2.272793498044926
    Attrib safety=med    0.2826710294594304
    Attrib safety=high    -3.3129061930642556
Sigmoid Node 8
    Inputs    Weights
    Threshold    -0.740254857073358
    Attrib buying=vhigh    0.7778301708093108
    Attrib buying=high    0.26068411071560205
    Attrib buying=med    0.19827504870601195
    Attrib buying=low    0.28389534855513415
    Attrib maint=vhigh    0.5443093486849954
```

```
    Attrib maint=high    0.43740725076249737
    Attrib maint=med    0.38147486633337546
    Attrib maint=low    0.12934130929086576
    Attrib doors=2    2.242842895660691
    Attrib doors=3    -1.8009801671736585
    Attrib doors=4    0.476009086642166
    Attrib doors=5more    0.4762770321616578
    Attrib persons=2    3.0162387783146714
    Attrib persons=4    -3.0794505959554885
    Attrib persons=more    0.8610362847902322
    Attrib lug_boot=small    2.3601885566026093
    Attrib lug_boot=med    -0.29366001752298276
    Attrib lug_boot=big    -1.3482172832189123
    Attrib safety=low    2.152474024414071
    Attrib safety=med    -1.0448440429143298
    Attrib safety=high    -0.35161729709699036
Sigmoid Node 9
    Inputs    Weights
    Threshold    -0.77650558990993
    Attrib buying=vhigh    -2.8083455829813113
    Attrib buying=high    -0.06841596282137184
    Attrib buying=med    2.4029705690160554
    Attrib buying=low    1.845595295415324
    Attrib maint=vhigh    -2.576347945929459
    Attrib maint=high    -0.4312959870970001
    Attrib maint=med    2.305358953755463
    Attrib maint=low    2.2398575994336163
    Attrib doors=2    0.6329282127852911
    Attrib doors=3    0.22847330555067993
    Attrib doors=4    0.2928757635632754
    Attrib doors=5more    0.29316012981884143
    Attrib persons=2    -4.502716912190891
    Attrib persons=4    2.5710899738564
    Attrib persons=more    2.6754712159696727
    Attrib lug_boot=small    1.200233457636588
    Attrib lug_boot=med    0.035666036897517184
    Attrib lug_boot=big    -0.5311512906278033
    Attrib safety=low    -4.6580168518252085
    Attrib safety=med    3.1983998316686297
    Attrib safety=high    2.1688900465491723
Sigmoid Node 10
    Inputs    Weights
    Threshold    -0.06744831103568352
    Attrib buying=vhigh    0.3369483071337383
    Attrib buying=high    0.09060327285488491
    Attrib buying=med    -0.13060312044625502
    Attrib buying=low    -0.07500096494814995
    Attrib maint=vhigh    0.3062124381981315
    Attrib maint=high    0.132733692190161
    Attrib maint=med    -0.07418771526672158
    Attrib maint=low    -0.2649598631128311
    Attrib doors=2    -3.211512436007448
    Attrib doors=3    -0.6671848366828027
    Attrib doors=4    2.1277636176943906
    Attrib doors=5more    2.1280880640746043
    Attrib persons=2    -1.746676370990275
    Attrib persons=4    -0.5401677923443952
    Attrib persons=more    2.3724152415889677
    Attrib lug_boot=small    -4.758333955211022
```

```
   Attrib lug_boot=med    -0.2872960823775095
   Attrib lug_boot=big    5.084964385887502
   Attrib safety=low    -1.5607347119884611
   Attrib safety=med    0.6716950779729333
   Attrib safety=high    1.035162572831404
Sigmoid Node 11
   Inputs    Weights
   Threshold    1.9757280574984881
   Attrib buying=vhigh    2.087797494845806
   Attrib buying=high    2.34922254553604
   Attrib buying=med    -2.7635141053399126
   Attrib buying=low    -5.72879230426375
   Attrib maint=vhigh    2.7546228402910877
   Attrib maint=high    0.49253305139949277
   Attrib maint=med    -2.2283837540386444
   Attrib maint=low    -5.0176609808154895
   Attrib doors=2    -0.4594728334675133
   Attrib doors=3    -0.7821642675583501
   Attrib doors=4    -1.2978893978953043
   Attrib doors=5more    -1.2985022106323882
   Attrib persons=2    0.4150744226780211
   Attrib persons=4    -0.951667691593402
   Attrib persons=more    -1.3346082662013519
   Attrib lug_boot=small    0.3357211522946029
   Attrib lug_boot=med    -0.675078397327661
   Attrib lug_boot=big    -1.6182343797759784
   Attrib safety=low    0.19336997028338113
   Attrib safety=med    0.03240167347138281
   Attrib safety=high    -2.1822138069324435
Sigmoid Node 12
   Inputs    Weights
   Threshold    2.2075287156854997
   Node 4    2.7676903558230115
   Node 5    4.398911739746434
   Node 6    1.9414598376939716
   Node 7    6.153345376920935
   Node 8    5.180197155959526
   Node 9    1.1043914943166477
   Node 10    -7.053274874816003
   Node 11    2.4402437800323042
Sigmoid Node 13
   Inputs    Weights
   Threshold    0.8464965917719857
   Node 4    0.980322504503718
   Node 5    2.524770185486281
   Node 6    0.8322264827616438
   Node 7    1.1769635182572125
   Node 8    3.9814204397966693
   Node 9    -4.544851601531572
   Node 10    -2.9357023427603117
   Node 11    0.6603774235486759
Sigmoid Node 14
   Inputs    Weights
   Threshold    1.1207982860687473
   Node 4    1.2163414874353942
   Node 5    3.038525139584916
   Node 6    1.0532498805384423
   Node 7    1.371416408941562
   Node 8    4.911583236859071
```

```
    Node 9    -5.502304271874653
    Node 10    -3.569483680467121
    Node 11    0.7528023226257912
Sigmoid Node 15
    Inputs    Weights
    Threshold    0.7245681510485439
    Node 4    0.9587731539971098
    Node 5    2.3995032398492473
    Node 6    0.824500189289968
    Node 7    1.125284152931618
    Node 8    3.7318051981790172
    Node 9    -4.355202650315504
    Node 10    -2.73054450351511
    Node 11    0.6747987215742169
Sigmoid Node 16
    Inputs    Weights
    Threshold    0.8782636356193392
    Node 4    0.9501740847034212
    Node 5    2.5259539519952052
    Node 6    0.8339266656307035
    Node 7    1.1114589375184953
    Node 8    3.9780648858080587
    Node 9    -4.503250403326351
    Node 10    -2.925624742284261
    Node 11    0.6175864906850285
Sigmoid Node 17
    Inputs    Weights
    Threshold    -0.2989633908712731
    Node 4    1.3495786400980985
    Node 5    1.6795986441305304
    Node 6    3.4824160495074397
    Node 7    2.039271117912985
    Node 8    2.4942052072662246
    Node 9    -2.3794639113082177
    Node 10    -3.216860525015563
    Node 11    7.1883080949952625
Sigmoid Node 18
    Inputs    Weights
    Threshold    0.6969232032438699
    Node 4    0.7116997752524592
    Node 5    1.9016464539942992
    Node 6    0.4860943953635505
    Node 7    1.0329099083010578
    Node 8    2.988222830721892
    Node 9    -3.3971618273056903
    Node 10    -2.1087673345731686
    Node 11    0.2981644592029017
Sigmoid Node 19
    Inputs    Weights
    Threshold    -0.570798636288938
    Node 4    1.3515409498105426
    Node 5    1.804865078610246
    Node 6    4.0972676837057715
    Node 7    2.0304540350294573
    Node 8    2.2737164850315272
    Node 9    -2.3985749753125347
    Node 10    -3.3826631530583238
    Node 11    7.981250798622278
Class unacc
```

```
    Input
    Node 0
Class acc
    Input
    Node 1
Class good
    Input
    Node 2
Class vgood
    Input
    Node 3


Time taken to build model: 10.05 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1727               99.9421 %
Incorrectly Classified Instances         1                0.0579 %
Kappa statistic                          0.9987
Mean absolute error                      0.0015
Root mean squared error                  0.0153
Relative absolute error                  0.6368 %
Root relative squared error              4.5222 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

               TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
               0,999    0,000    1,000      0,999    1,000      0,999    1,000     1,000     unacc
               1,000    0,001    0,997      1,000    0,999      0,998    1,000     1,000     acc
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     good
               1,000    0,000    1,000      1,000    1,000      1,000    1,000     1,000     vgood
Weighted Avg.  0,999    0,000    0,999      0,999    0,999      0,999    1,000     1,000

=== Confusion Matrix ===

   a    b    c    d   <-- classified as
 1209    1    0    0 |    a = unacc
   0  384    0    0 |    b = acc
   0    0   69    0 |    c = good
   0    0    0   65 |    d = vgood
```