TrabalhoMNIST

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```
#install.packages("h2o")
library(h2o)
```

```
##
## ----------------------------------------------------------------------
##
## Your next step is to start H2O:
##     > h2o.init()
##
## For H2O package documentation, ask for help:
##     > ??h2o
##
## After starting H2O, you can use the Web UI at http://localhost:54321
## For more information visit https://docs.h2o.ai
##
## ----------------------------------------------------------------------
```

```
##
## Attaching package: 'h2o'
```

```
## The following objects are masked from 'package:stats':
##
##     cor, sd, var
```

```
## The following objects are masked from 'package:base':
##
##     &&, %*%, %in%, ||, apply, as.factor, as.numeric, colnames,
##     colnames<-, ifelse, is.character, is.factor, is.numeric, log,
##     log10, log1p, log2, round, signif, trunc
```

Importamos o arquivo para visualização

```
#uso interno
options(warn=-1)
digitos <- read.csv(gzfile("test.csv.gz"), header=F)
dim(digitos)
```

```
## [1] 10000   785
```

```
head(digitos)
```

```
##   V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11 V12 V13 V14 V15 V16 V17 V18 V19 V20 V21
## 1  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 2  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 3  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 4  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
```

```
## 5  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 6  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
##   V22 V23 V24 V25 V26 V27 V28 V29 V30 V31 V32 V33 V34 V35 V36 V37 V38 V39 V40
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   V41 V42 V43 V44 V45 V46 V47 V48 V49 V50 V51 V52 V53 V54 V55 V56 V57 V58 V59
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   V60 V61 V62 V63 V64 V65 V66 V67 V68 V69 V70 V71 V72 V73 V74 V75 V76 V77 V78
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   V79 V80 V81 V82 V83 V84 V85 V86 V87 V88 V89 V90 V91 V92 V93 V94 V95 V96 V97
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   V98 V99 V100 V101 V102 V103 V104 V105 V106 V107 V108 V109 V110 V111 V112 V113
## 1   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V114 V115 V116 V117 V118 V119 V120 V121 V122 V123 V124 V125 V126 V127 V128
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0   14  104  156  246  216
## 4    0    0    0    0    0    0    0    0    0    0   12  136  155  254  254
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V129 V130 V131 V132 V133 V134 V135 V136 V137 V138 V139 V140 V141 V142 V143
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3   97    9    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4  255  254  133    8    0    0    0    0    0    0    0    0    0    0    0
## 5    0   93  253    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V144 V145 V146 V147 V148 V149 V150 V151 V152 V153 V154 V155 V156 V157 V158
## 1    0    0    0    0    0    0    0    0    5  127  231  194   83    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

```
## 3    0    0    0    0    0    0    0   46  224  245  253  245  253  254  122
## 4    0    0    0    0    0    0    0   15  198  253  253  228  127  100  223
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0  166
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V159 V160 V161 V162 V163 V164 V165 V166 V167 V168 V169 V170 V171 V172 V173
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4  253  165   13    0    0    0    0    0    0    0    0    0    0    0    0
## 5  252    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V174 V175 V176 V177 V178 V179 V180 V181 V182 V183 V184 V185 V186 V187 V188
## 1    0    0    0    0    0   35  203  253  253  237  237  199    6    0   53
## 2    0    0    0  214  213  152  193  254  253  254  213   82    0    0    0
## 3    0    0    0   25  130  205  254  177  131   63  100  155  209   24    0
## 4    0    0    0    0   19  193  253  248  126   25    0    0   37   82   58
## 5    0    0    0    0    0    0    0    0    0    0    0   83  240  252    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V189 V190 V191 V192 V193 V194 V195 V196 V197 V198 V199 V200 V201 V202 V203
## 1   53    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4   70    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V204 V205 V206 V207 V208 V209 V210 V211 V212 V213 V214 V215 V216 V217 V218
## 1    0    0    0  224  253  228  123   18   89  247   54   13  213  236   27
## 2    0  253  252  253  252  253  252  253  252  223   20    0    0    0    0
## 3  117  210  253  253  254  253  247  123    0    5  217  129    0    0    0
## 4    0   20  190  253  252  111    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0  184  252  210    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V219 V220 V221 V222 V223 V224 V225 V226 V227 V228 V229 V230 V231 V232 V233
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0  234
## 3    0    0    0    0    0    0    0    0    0    0    0    0   83  244  253
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0   72
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0   18   19   19   19    0    0    0    0    0    0    0    0    0    0
##   V234 V235 V236 V237 V238 V239 V240 V241 V242 V243 V244 V245 V246 V247 V248
## 1   91  254  242   43    0    0   50  159    0  182  253  244   33    0    0
## 2  253  234  253  142  102  193  253  244   40    0    0    0    0    0    0
## 3  253  139   58   58   58   87    0    0  214  174    0    0    0    0    0
## 4  253  253  206    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0   22  215  252   85    0    0    0    0    0
## 6    0   15  102  131   25   50  149  149  149  149  149  149  149  149  245
##   V249 V250 V251 V252 V253 V254 V255 V256 V257 V258 V259 V260 V261 V262 V263
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0   98  254
## 2    0    0    0    0    0    0    0    0    0    0    0    0   30   50   30
## 3    0    0    0    0    0    0    0    0    0    0  156  254  254  154    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0  122  253  253
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6  254  254  193    0    0    0    0    0    0    0    0    0    2   41  214
##   V264 V265 V266 V267 V268 V269 V270 V271 V272 V273 V274 V275 V276 V277 V278
```

```
##   V1  V2  V3  V4  V5  V6  V7  V8  V9 V10 V11 V12 V13 V14 V15 V16
## 1 233   0   0   0   0   0  99 248 253 120   0   0   0   0   0   0
## 2  50   0  41 193 252 203   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0  59 239 175   0   0   0   0   0   0   0   0
## 4 129   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   3 118 253 245  21   0   0   0   0   0   0   0   0
## 6 254 254 254 254 254 254 254 254 254 254 254 254 254 255 254 254
##   V17 V18 V19 V20 V21 V22 V23 V24 V25 V26 V27 V28 V29 V30 V31 V32
## 1   0   0   0   0   0   0   0   0   0   0   0  38 255 246  48   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0  11   0
## 3   0   0   0   0   0   0   0   0 156 253 253  34   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   2 191 253 251  16   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6 239   0   0   0   0   0   0   0   0   0  25 200 254 254 254 254
##   V33 V34 V35 V36 V37 V38 V39 V40 V41 V42 V43 V44 V45 V46 V47 V48
## 1   0   0   0   0   0   0 133   0   0   0   0   0   0   0   0   0
## 2 173 254 253 123   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0  16 201 253 211 132 214 215 131  88   9   0   0   0   0
## 4   0   0   0   0   0   0  29 243 157  29   0   0   0   0   0   0
## 5   0  45 252 252 160   0   0   0   0   0   0   0   0   0   0   0
## 6 254 254 254 254 254 254 254 254 254 254 239 235 217  50   0   0
##   V49 V50 V51 V52 V53 V54 V55 V56 V57 V58 V59 V60 V61 V62 V63 V64
## 1   0   0   0   0   0   0   0   0   0  46 254 253 226  72  95   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0 132 252 253 183
## 3   0   0   0   0   0   0 156 253 253  19   0  49  79  79 130   0
## 4   0   0   0   0   0   0   0  54 253 253 147   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0 170 253
## 6   0   0   0   0   0   0   0   2 157 254 254 254 248 189 180 253
##   V65 V66 V67 V68 V69 V70 V71 V72 V73 V74 V75 V76 V77 V78 V79 V80
## 1 140 232 253 253  58   0   0   0   0   0   0   0   0   0   0   0
## 2 171   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3 235 254 253 198 174 174 175 241 253 196  18   0   0   0   0   0
## 4   0   0   0   0  30 253 253 170   0   0   0   0   0   0   0   0
## 5 252 252 128   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6 245 211 211 211 211 211 211 211  62  43   0   0   0   0   0   0
##   V81 V82 V83 V84 V85 V86 V87 V88 V89 V90 V91 V92 V93 V94 V95 V96
## 1   0   0   0   0   0   0  68 254 253 253 253 253 254 253 253 253
## 2   0   0   0   0   0   0   0  31 132 254 253 254 112   0   0   0
## 3   0   0   0   0 156 253 253 198 234 246 253 253 253 253 244 253
## 4   0   0   0   0   0  54 253 253 128   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0  95 253 252 227 253
## 6   0   0   0   0   0 128 254 254 254 239 119  17  16  63   0   0
##   V97 V98 V99 V100 V101 V102 V103 V104 V105 V106 V107 V108 V109 V110
## 1 253 210  40    0    0    0    0    0    0    0    0    0    0    0
## 2   0   0   0    0    0    0    0    0    0    0    0    0    0    0
## 3  86   6   0    0    0   62  211  253   73    0    0    0    0    0
## 4   0   0  50  253  253  170    0    0    0    0    0    0    0    0
## 5  29   0   0    0    0    0    0    0    0    0    0    0    0    0
## 6   0   0   0    0    0    0    0    0    0    0    0    0    0    0
##   V111 V112 V113 V114 V115 V116 V117 V118 V119 V120 V121 V122 V123 V124
## 1    0    0    0    0    0   19  102  211  253  253  254  227   49    9
## 2    0    0    0    0    0  193  252  253  252  253  232  203  162   82
## 3    0  119  253  253  253  253  254  253  253  253  215   83    0    0
## 4    0    0   54  253  253   29    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0  168  253  252   79    0    0
```

```
## 6    0    0    0   67  229  254  254  254  254  124   46    0    0    0    0
##    V384 V385 V386 V387 V388 V389 V390 V391 V392 V393 V394 V395 V396 V397 V398
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0  175  253  155    0    0    0    0    0    0    0    0
## 4  148  253  253  170    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##    V399 V400 V401 V402 V403 V404 V405 V406 V407 V408 V409 V410 V411 V412 V413
## 1    0    0    0    0    0    0  175  253  253  208   31    0    0    0    0
## 2    0    0    0    0  193  253  254  253  254  253  254  253  254   50    0
## 3    0  193  254  254  254  255  254  254  184   23    0    0    0    0    0
## 4    0  144  253  253   65    0    0    0    0    0    0    0   10  229  253
## 5    0    0    0    0    0    0   62  243  255  196    0    0    0    0    0
## 6    0    0  104  227  254  254  254  254  217   49    0    0    0    0    0
##    V414 V415 V416 V417 V418 V419 V420 V421 V422 V423 V424 V425 V426 V427 V428
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0  176  254  155    0    0    0    0    0    0    0    0    0  118
## 4  253  134    0    0    0    0    0    0    0    0    0    0    0    0  117
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##    V429 V430 V431 V432 V433 V434 V435 V436 V437 V438 V439 V440 V441 V442 V443
## 1    0    0    0   96  224  254  254  196    0    0    0    0    0    0    0
## 2    0    0   71  252  253  171  151  151  172  252  253  131    0    0    0
## 3  253  250  233  234  188   68    3    0    0    0    0    0    0    0    0
## 4  253  253  147    0    0    0    0    0    0    0  112  253  253  253   53
## 5    0    0    0    0  207  252  239   33    0    0    0    0    0    0    0
## 6    0   35  134  228  254  254  254  241   52    0    0    0    0    0    0
##    V444 V445 V446 V447 V448 V449 V450 V451 V452 V453 V454 V455 V456 V457 V458
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3  175  253  155    0    0    0    0    0    0    0    0    0  118  253  213
## 4    0    0    0    0    0    0    0    0    0    0    0    0  171  253  253
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0   39   72    0
##    V459 V460 V461 V462 V463 V464 V465 V466 V467 V468 V469 V470 V471 V472 V473
## 1    5  217  253  234  248  245   78    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0  203  254  151    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0   44  229  253
## 4  147    0    0    0    0    0    0    0  130  253  253  194    5    0    0
## 5    0   51  240  252  230    0    0    0    0    0    0    0    0    0    0
## 6    0   50  191  254  254  254  214   49    0    0    0    0    0    0    0
##    V474 V475 V476 V477 V478 V479 V480 V481 V482 V483 V484 V485 V486 V487 V488
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0  127  253
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3   88    0    0    0    0    0    0    0    0    0  118  253  219    9    0
## 4    0    0    0    0    0    0    0    0    0    0  171  253  253  251   11
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0   17  188
## 6    0    0    0    0    0    0    0    0    0    0  131  252  206  132   82
##    V489 V490 V491 V492 V493 V494 V495 V496 V497 V498 V499 V500 V501 V502 V503
## 1  198    6  128  254  203    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0   21  223  253  151    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0   47  228  253  164    5    0
```

```
## 4    0    0    0    0    0   58  249  253  253   73    0    0    0    0    0
## 5  252  252   94    0    0    0    0    0    0    0    0    0    0    0    0
## 6   37   71  189  254  254  217   85    0    0    0    0    0    0    0    0
##   V504 V505 V506 V507 V508 V509 V510 V511 V512 V513 V514 V515 V516 V517 V518
## 1    0    0    0    0    0    0    0    0    0    0   16  246  253   85    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0  118  253  253   96    0    0    0
## 4    0    0    0    0    0    0    0    0  103  253  253  253   25    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0   99  252  252  147
## 6    0    0    0    0    0    0    0    0  192  254  254  254  254  227  151
##   V519 V520 V521 V522 V523 V524 V525 V526 V527 V528 V529 V530 V531 V532 V533
## 1   45  254  236   12    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0   51  253  254   50    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0   76  231  253  185   34    0    0    0    0
## 4    0    0    0  181  253  253  212   30    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6  220  254  254  254  119    0    0    0    0    0    0    0    0    0    0
##   V534 V535 V536 V537 V538 V539 V540 V541 V542 V543 V544 V545 V546 V547 V548
## 1    0    0    0    0    0    0    0    0  135  254  200   18    0    0  178
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    8  206  254  254    0    0    0    0    0
## 4    0    0    0    0    0    0   54  253  253  253  129    0    0    0    0
## 5    0    0    0    0    0    0    0    0   87  253  253  245   73    0    0
## 6    0    0    0    0    0    0  238  254  254  254  254  254  254  254  254
##   V549 V550 V551 V552 V553 V554 V555 V556 V557 V558 V559 V560 V561 V562 V563
## 1  253  115    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2   92  252  233   30    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0   70  231  255  249  135    0    0    0    0    0    0    0
## 4   85  246  253  248   72    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6  254  229   53    0    0    0    0    0    0    0    0    0    0    0    0
##   V564 V565 V566 V567 V568 V569 V570 V571 V572 V573 V574 V575 V576 V577 V578
## 1    0    0    0    0    0   25  231  255   76    0    0    0  156  254  175
## 2    0    0    0    0    0    0    0    0    0    0    0    0   21  214  253
## 3    0    0    0    0    0  130  253  253   16    0    0    0    0    8   25
## 4    0    0    0    0   15  176  253  253  216   29    0    0   87  242  253
## 5    0    0    0    0    0    0  159  252  252   87    0    0    0    0    0
## 6    0    0    0    0   97  254  254  254  254  254  254  254  254  254   76
##   V579 V580 V581 V582 V583 V584 V585 V586 V587 V588 V589 V590 V591 V592 V593
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2  142    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3  147  250  253  219   88    0    0    0    0    0    0    0    0    0    0
## 4  250  112    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V594 V595 V596 V597 V598 V599 V600 V601 V602 V603 V604 V605 V606 V607 V608
## 1    0    0    0   40  253  254   39    0    0   53  239  251   86    0    0
## 2    0    0    0    0    0    0    0    0    0   21  203  253  252   20    0
## 3    0    0    0   55  247  253  236  130   79   79  116  206  241  253  210
## 4    0    0    0   72  253  253  253  213   84  166  241  253  253  109    0
## 5    0    0    0    0  253  252  252   45    0    0    0    0    0    0    0
## 6    0    0    1   24   33  148  213  254  254  255  231   57    6    0    0
##   V609 V610 V611 V612 V613 V614 V615 V616 V617 V618 V619 V620 V621 V622 V623
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

```
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3  137   30    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V624 V625 V626 V627 V628 V629 V630 V631 V632 V633 V634 V635 V636 V637 V638
## 1    0   12  182  254  179   79  168  235  254  233    0    0    0    0    0
## 2    0    0    0    0    0    0    0  173  253  255  172    0    0    0    0
## 3    0    0   86  244  254  253  253  253  253  254  227   87    9    0    0
## 4    0   10   76  242  253  253  253  253  253  253  110    1    0    0    0
## 5    0   53  253  252  153    9    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0   11   18   18   18   14    0    0    0    0    0    0
##   V639 V640 V641 V642 V643 V644 V645 V646 V647 V648 V649 V650 V651 V652 V653
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V654 V655 V656 V657 V658 V659 V660 V661 V662 V663 V664 V665 V666 V667 V668
## 1   83  254  253  253  253  253  207   70    0    0    0    0    0    0    0
## 2    0    0    0    0  163  253  252  172   10    0    0    0    0    0    0
## 3    0   45  178  253  253  253  215  133   31    0    0    0    0    0    0
## 4    0   65  193  253  253  226  100   17    2    0    0    0    0    0    0
## 5  253  210    6    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V669 V670 V671 V672 V673 V674 V675 V676 V677 V678 V679 V680 V681 V682 V683
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0   81
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V684 V685 V686 V687 V688 V689 V690 V691 V692 V693 V694 V695 V696 V697 V698
## 1  238  253  200  118   23    0    0    0    0    0    0    0    0    0    0
## 2   21  255  253  255  131    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V699 V700 V701 V702 V703 V704 V705 V706 V707 V708 V709 V710 V711 V712 V713
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0  102  253
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V714 V715 V716 V717 V718 V719 V720 V721 V722 V723 V724 V725 V726 V727 V728
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2  212   91   10    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

```
##   V729 V730 V731 V732 V733 V734 V735 V736 V737 V738 V739 V740 V741 V742 V743
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V744 V745 V746 V747 V748 V749 V750 V751 V752 V753 V754 V755 V756 V757 V758
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V759 V760 V761 V762 V763 V764 V765 V766 V767 V768 V769 V770 V771 V772 V773
## 1    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   V774 V775 V776 V777 V778 V779 V780 V781 V782 V783 V784 V785
## 1    0    0    0    0    0    0    0    0    0    0    0    8
## 2    0    0    0    0    0    0    0    0    0    0    0    3
## 3    0    0    0    0    0    0    0    0    0    0    0    8
## 4    0    0    0    0    0    0    0    0    0    0    0    0
## 5    0    0    0    0    0    0    0    0    0    0    0    1
## 6    0    0    0    0    0    0    0    0    0    0    0    5
```

Visualizamos alguns digitos

```
dig1 = t(matrix(unlist(digitos[20,-785]), nrow = 28, byrow = F))
dig1 = t(apply(dig1, 2, rev))
dig1
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13]
##  [1,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [2,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [3,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [4,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [5,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [6,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [7,]    0    0    0    0    0    0    0    0    0     0     0     0     0
##  [8,]    0    0    0    0    0    0    0    0    0     0     0     0     4
##  [9,]    0    0    0    0    0    0    0    0    0     0     0    30   141
## [10,]    0    0    0    0    0    0    0    0    0     0     0    96   253
## [11,]    0    0    0    0    0    0    0    0    0     0     0   199   253
## [12,]    0    0    0    0    0    0    0    0    0     0    23   222   253
## [13,]    0    0    0    0    0    0    0    0    0     0     0   199   253
## [14,]    0   32   55   31    0    0    0    0    0     0     0   176   253
## [15,]    0  231  253  230  136   64    0    0    0     0     0    92   253
## [16,]    0  188  253  253  253  249  188  110   15     0     0     6   238
## [17,]    0   13   86  180  229  253  253  253  224   168   100    13   165
## [18,]    0    0    0    0   47  156  201  253  253   253   253   216   230
## [19,]    0    0    0    0    0    0    9  138  226   251   253   253   253
```

```
## [20,]    0    0    0    0    0    0    0    0    0   80  188  240  253
## [21,]    0    0    0    0    0    0    0    0    0    0    0   34   43
## [22,]    0    0    0    0    0    0    0    0    0    0    0    0    0
## [23,]    0    0    0    0    0    0    0    0    0    0    0    0    0
## [24,]    0    0    0    0    0    0    0    0    0    0    0    0    0
## [25,]    0    0    0    0    0    0    0    0    0    0    0    0    0
## [26,]    0    0    0    0    0    0    0    0    0    0    0    0    0
## [27,]    0    0    0    0    0    0    0    0    0    0    0    0    0
## [28,]    0    0    0    0    0    0    0    0    0    0    0    0    0
##       [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25]
##  [1,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [2,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [3,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [4,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [5,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [6,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [7,]    0    0    0    0    0    0    0    0    0    0    0    0
##  [8,]  115  151  140   14    0    0    0    0    0    0    0    0
##  [9,]  253  253  253  183   14    0    0    0    0    0    0    0
## [10,]  251  243  253  253  188    8    0    0    0    0    0    0
## [11,]  174    0  175  253  253  187   15    0    0    0    0    0
## [12,]   87    0   43  226  253  253  159    0    0    0    0    0
## [13,]  186    0    0   42  225  253  248   42    0    0    0    0
## [14,]  207   11    0    0   37  227  253  216    0    0    0    0
## [15,]  253   49    0    0    0  101  253  255    0    0    0    0
## [16,]  253  150    0    0    0   16  214  254    0    0    0    0
## [17,]  253  221    8    0    0    0  177  255    0    0    0    0
## [18,]  253  253   11    0    0  110  239  255    0    0    0    0
## [19,]  253  253  198  244  244  253  253  185    0    0    0    0
## [20,]  253  160  144  253  253  245  159   13    0    0    0    0
## [21,]   43    9    5   43   43   38    0    0    0    0    0    0
## [22,]    0    0    0    0    0    0    0    0    0    0    0    0
## [23,]    0    0    0    0    0    0    0    0    0    0    0    0
## [24,]    0    0    0    0    0    0    0    0    0    0    0    0
## [25,]    0    0    0    0    0    0    0    0    0    0    0    0
## [26,]    0    0    0    0    0    0    0    0    0    0    0    0
## [27,]    0    0    0    0    0    0    0    0    0    0    0    0
## [28,]    0    0    0    0    0    0    0    0    0    0    0    0
##       [,26] [,27] [,28]
##  [1,]    0    0    0
##  [2,]    0    0    0
##  [3,]    0    0    0
##  [4,]    0    0    0
##  [5,]    0    0    0
##  [6,]    0    0    0
##  [7,]    0    0    0
##  [8,]    0    0    0
##  [9,]    0    0    0
## [10,]    0    0    0
## [11,]    0    0    0
## [12,]    0    0    0
## [13,]    0    0    0
## [14,]    0    0    0
## [15,]    0    0    0
```

```
## [16,]     0     0     0
## [17,]     0     0     0
## [18,]     0     0     0
## [19,]     0     0     0
## [20,]     0     0     0
## [21,]     0     0     0
## [22,]     0     0     0
## [23,]     0     0     0
## [24,]     0     0     0
## [25,]     0     0     0
## [26,]     0     0     0
## [27,]     0     0     0
## [28,]     0     0     0
```

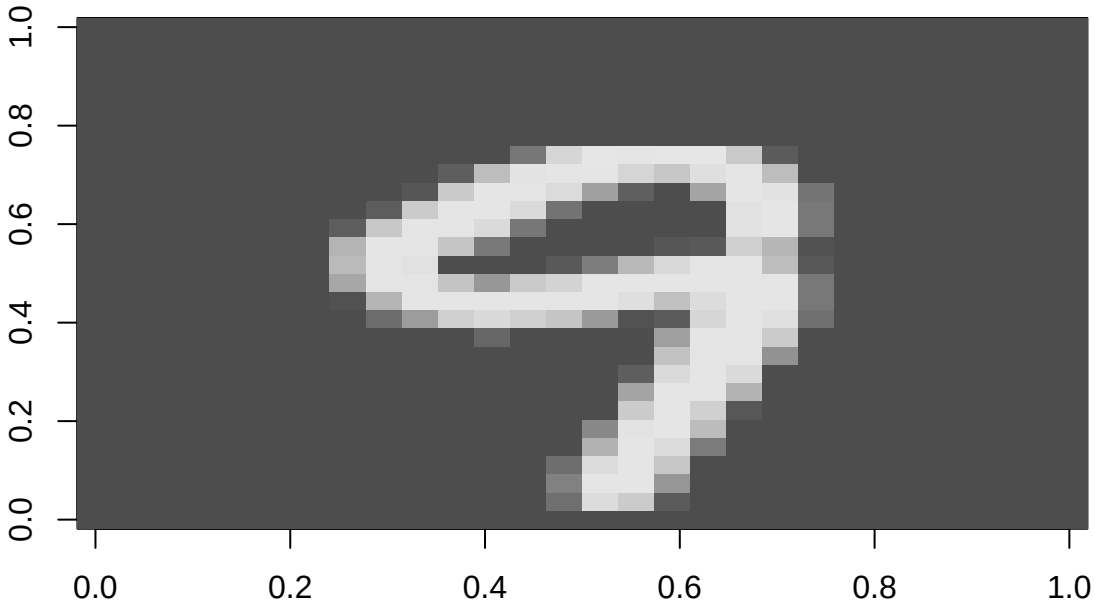
```
digitos[20,785]
```

```
## [1] 9
```

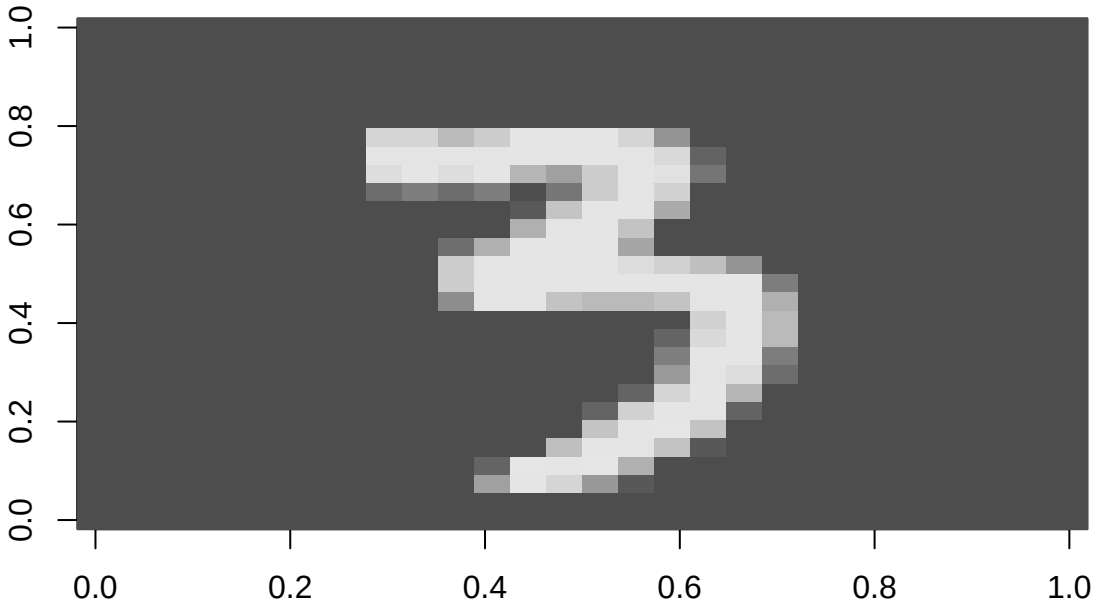
```
dig2 = t(matrix(unlist(digitos[2,-785]), nrow = 28, byrow = F))
dig2 = t(apply(dig2, 2, rev))

dig3 = t(matrix(unlist(digitos[4,-785]), nrow = 28, byrow = F))
dig3 = t(apply(dig3, 2, rev))

dig4 = t(matrix(unlist(digitos[5,-785]), nrow = 28, byrow = F))
dig4 = t(apply(dig4, 2, rev))
```

Visualizamos as imagens

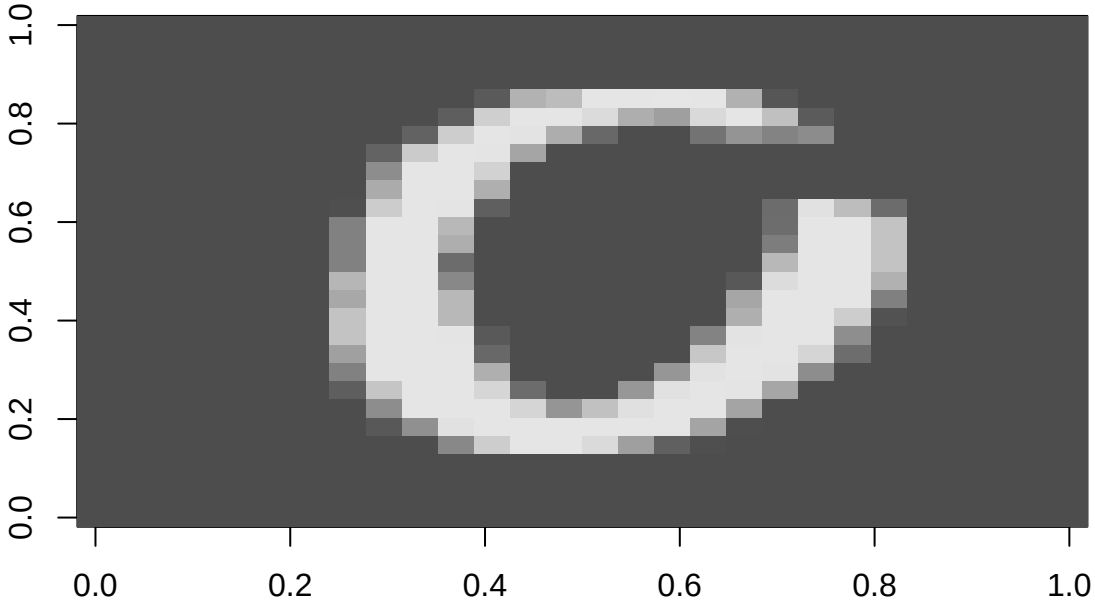
```
#Executar com ctrl + shift + enter
image(dig1, col = grey.colors(255))
```



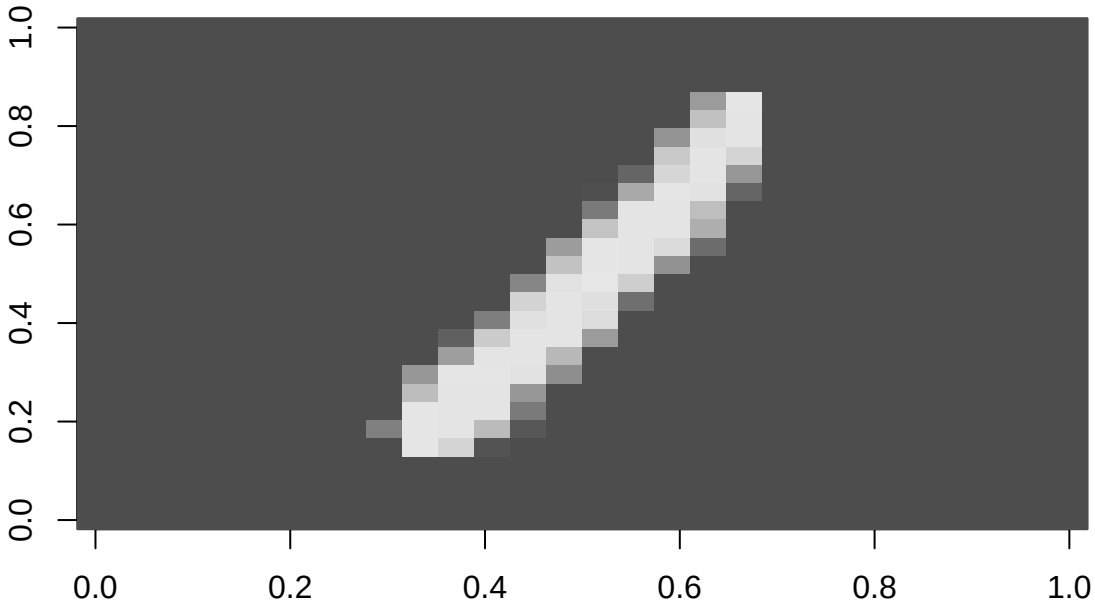

```
image(dig2,col=grey.colors(255))
```




```
image(dig3,col=grey.colors(255))
```




```
image(dig4,col=grey.colors(255))
```



Inicialização

```
h2o.init()
```

```
##  Connection successful!
##
## R is connected to the H2O cluster:
##     H2O cluster uptime:         1 minutes 57 seconds
##     H2O cluster timezone:       America/Sao_Paulo
##     H2O data parsing timezone:  UTC
##     H2O cluster version:        3.40.0.1
##     H2O cluster version age:    1 month and 27 days
##     H2O cluster name:           H2O_started_from_R_afonsolelis_bnm936
##     H2O cluster total nodes:    1
##     H2O cluster total memory:   3.69 GB
##     H2O cluster total cores:    8
##     H2O cluster allowed cores:  8
##     H2O cluster healthy:        TRUE
##     H2O Connection ip:          localhost
##     H2O Connection port:        54321
##     H2O Connection proxy:       NA
##     H2O Internal Security:      FALSE
##     R Version:                  R version 4.1.2 (2021-11-01)
```

```
treino <- h2o.importFile('train.csv.gz')
```

```
##   |                                                                      |
```

```
teste <- h2o.importFile('test.csv.gz')
```

```
##   |                                                                      |
```

```
dim(treino)
```

```
## [1] 60000   785
```

```
head(treino)
```

```
##   C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21
## 1  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
```

```
## 2  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 3  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 4  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 5  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
## 6  0  0  0  0  0  0  0  0  0   0   0   0   0   0   0   0   0   0   0   0   0
##   C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97
## 1   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 2   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 3   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 4   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 5   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
## 6   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
##   C98 C99 C100 C101 C102 C103 C104 C105 C106 C107 C108 C109 C110 C111 C112 C113
## 1   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 2   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 4   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5  77 133  151  254  254  220   93    2    0    0    0    0    0    0    0    0
## 6   0   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   C114 C115 C116 C117 C118 C119 C120 C121 C122 C123 C124 C125 C126 C127 C128
## 1    0    0    0    0    0   25  105  105  105  123  253  253  253  253  255
## 2    0    0    0    0    0    0    0    0    0    7  210  253  205   78    0
## 3    0    0    0    0    0    0    0    0    0    0    0   56   91  202  254
## 4    0    0    0    0    0    0    0    0    0    0    0    0   10  216  163
## 5    0    0    0    0    0    0    0    0    0    0   11   83  254  253  253
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   C129 C130 C131 C132 C133 C134 C135 C136 C137 C138 C139 C140 C141 C142 C143
## 1  253  156   55    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3  254  254  107    0    0    0    0    0    0    0    0    0    0    0    0
## 4    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5  253  253  253  253   47    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
```

```
##   C144 C145 C146 C147 C148 C149 C150 C151 C152 C153 C154 C155 C156 C157 C158
## 1    0    0    0  183  252  252  252  252  252  252  252  252  253  252  252
## 2    0    0    0    0    0    0    0   89  252  252  252  229   49    0    0
## 3    0    0    0    0    0    0    4   17   60  225  253  253  253  253  253
## 4    0    0    0    0    0    0    0    0    0    0  174  254  162   40  148
## 5    0    0    0    0    0    0    0    0  110  253  254  253  253  253  253
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   C159 C160 C161 C162 C163 C164 C165 C166 C167 C168 C169 C170 C171 C172 C173
## 1  231  164   18    0    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
## 3  241   96    3    0    0    0    0    0    0    0    0    0    0    0    0
## 4  185   40    0    0    0    0    0    0    0    0    0    0    0    0    0
## 5  253  253  170    4    0    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   C174 C175 C176 C177 C178 C179 C180 C181 C182 C183 C184 C185 C186 C187 C188
## 1    0  208  252  252  252  252  252  252  252  252  253  252  252  252  252
## 2    0    0    0    0    0  213  252  252  252  253  212   17    0    0    0
## 3    0    0    0   53  135  253  253  253  253  253  253  253  253  253  253
## 4    0    0    0    0    0    0    2  127  252  181  133  233  254  254  226
## 5    0    0    0    0    0    0  110  253  254  253  206   84  170  242  253
## 6    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
##   C189 C190 C191 C192 C193 C194 C195 C196 C197 C198 C199 C200
## 1   74    0    0    0    0    0    0    0    0    0    0    0
## 2    0    0    0    0    0    0    0    0    0    0    0    0
## 3   32    0    0    0    0    0    0    0    0    0    0    0
## 4   39    0    0    0    0    0    0    0    0    0    0    0
## 5  253   24    0    0    0    0    0    0    0    0    0    0
## 6    0    0    0    0    0    0    0    0    0    0    0    0
```

```
colnames(treino)
```

```
##   [1] "C1"   "C2"   "C3"   "C4"   "C5"   "C6"   "C7"   "C8"   "C9"   "C10"
##  [11] "C11"  "C12"  "C13"  "C14"  "C15"  "C16"  "C17"  "C18"  "C19"  "C20"
##  [21] "C21"  "C22"  "C23"  "C24"  "C25"  "C26"  "C27"  "C28"  "C29"  "C30"
##  [31] "C31"  "C32"  "C33"  "C34"  "C35"  "C36"  "C37"  "C38"  "C39"  "C40"
##  [41] "C41"  "C42"  "C43"  "C44"  "C45"  "C46"  "C47"  "C48"  "C49"  "C50"
##  [51] "C51"  "C52"  "C53"  "C54"  "C55"  "C56"  "C57"  "C58"  "C59"  "C60"
##  [61] "C61"  "C62"  "C63"  "C64"  "C65"  "C66"  "C67"  "C68"  "C69"  "C70"
##  [71] "C71"  "C72"  "C73"  "C74"  "C75"  "C76"  "C77"  "C78"  "C79"  "C80"
##  [81] "C81"  "C82"  "C83"  "C84"  "C85"  "C86"  "C87"  "C88"  "C89"  "C90"
##  [91] "C91"  "C92"  "C93"  "C94"  "C95"  "C96"  "C97"  "C98"  "C99"  "C100"
## [101] "C101" "C102" "C103" "C104" "C105" "C106" "C107" "C108" "C109" "C110"
## [111] "C111" "C112" "C113" "C114" "C115" "C116" "C117" "C118" "C119" "C120"
## [121] "C121" "C122" "C123" "C124" "C125" "C126" "C127" "C128" "C129" "C130"
## [131] "C131" "C132" "C133" "C134" "C135" "C136" "C137" "C138" "C139" "C140"
## [141] "C141" "C142" "C143" "C144" "C145" "C146" "C147" "C148" "C149" "C150"
## [151] "C151" "C152" "C153" "C154" "C155" "C156" "C157" "C158" "C159" "C160"
## [161] "C161" "C162" "C163" "C164" "C165" "C166" "C167" "C168" "C169" "C170"
## [171] "C171" "C172" "C173" "C174" "C175" "C176" "C177" "C178" "C179" "C180"
## [181] "C181" "C182" "C183" "C184" "C185" "C186" "C187" "C188" "C189" "C190"
## [191] "C191" "C192" "C193" "C194" "C195" "C196" "C197" "C198" "C199" "C200"
## [201] "C201" "C202" "C203" "C204" "C205" "C206" "C207" "C208" "C209" "C210"
## [211] "C211" "C212" "C213" "C214" "C215" "C216" "C217" "C218" "C219" "C220"
## [221] "C221" "C222" "C223" "C224" "C225" "C226" "C227" "C228" "C229" "C230"
## [231] "C231" "C232" "C233" "C234" "C235" "C236" "C237" "C238" "C239" "C240"
```

```
## [241] "C241" "C242" "C243" "C244" "C245" "C246" "C247" "C248" "C249" "C250"
## [251] "C251" "C252" "C253" "C254" "C255" "C256" "C257" "C258" "C259" "C260"
## [261] "C261" "C262" "C263" "C264" "C265" "C266" "C267" "C268" "C269" "C270"
## [271] "C271" "C272" "C273" "C274" "C275" "C276" "C277" "C278" "C279" "C280"
## [281] "C281" "C282" "C283" "C284" "C285" "C286" "C287" "C288" "C289" "C290"
## [291] "C291" "C292" "C293" "C294" "C295" "C296" "C297" "C298" "C299" "C300"
## [301] "C301" "C302" "C303" "C304" "C305" "C306" "C307" "C308" "C309" "C310"
## [311] "C311" "C312" "C313" "C314" "C315" "C316" "C317" "C318" "C319" "C320"
## [321] "C321" "C322" "C323" "C324" "C325" "C326" "C327" "C328" "C329" "C330"
## [331] "C331" "C332" "C333" "C334" "C335" "C336" "C337" "C338" "C339" "C340"
## [341] "C341" "C342" "C343" "C344" "C345" "C346" "C347" "C348" "C349" "C350"
## [351] "C351" "C352" "C353" "C354" "C355" "C356" "C357" "C358" "C359" "C360"
## [361] "C361" "C362" "C363" "C364" "C365" "C366" "C367" "C368" "C369" "C370"
## [371] "C371" "C372" "C373" "C374" "C375" "C376" "C377" "C378" "C379" "C380"
## [381] "C381" "C382" "C383" "C384" "C385" "C386" "C387" "C388" "C389" "C390"
## [391] "C391" "C392" "C393" "C394" "C395" "C396" "C397" "C398" "C399" "C400"
## [401] "C401" "C402" "C403" "C404" "C405" "C406" "C407" "C408" "C409" "C410"
## [411] "C411" "C412" "C413" "C414" "C415" "C416" "C417" "C418" "C419" "C420"
## [421] "C421" "C422" "C423" "C424" "C425" "C426" "C427" "C428" "C429" "C430"
## [431] "C431" "C432" "C433" "C434" "C435" "C436" "C437" "C438" "C439" "C440"
## [441] "C441" "C442" "C443" "C444" "C445" "C446" "C447" "C448" "C449" "C450"
## [451] "C451" "C452" "C453" "C454" "C455" "C456" "C457" "C458" "C459" "C460"
## [461] "C461" "C462" "C463" "C464" "C465" "C466" "C467" "C468" "C469" "C470"
## [471] "C471" "C472" "C473" "C474" "C475" "C476" "C477" "C478" "C479" "C480"
## [481] "C481" "C482" "C483" "C484" "C485" "C486" "C487" "C488" "C489" "C490"
## [491] "C491" "C492" "C493" "C494" "C495" "C496" "C497" "C498" "C499" "C500"
## [501] "C501" "C502" "C503" "C504" "C505" "C506" "C507" "C508" "C509" "C510"
## [511] "C511" "C512" "C513" "C514" "C515" "C516" "C517" "C518" "C519" "C520"
## [521] "C521" "C522" "C523" "C524" "C525" "C526" "C527" "C528" "C529" "C530"
## [531] "C531" "C532" "C533" "C534" "C535" "C536" "C537" "C538" "C539" "C540"
## [541] "C541" "C542" "C543" "C544" "C545" "C546" "C547" "C548" "C549" "C550"
## [551] "C551" "C552" "C553" "C554" "C555" "C556" "C557" "C558" "C559" "C560"
## [561] "C561" "C562" "C563" "C564" "C565" "C566" "C567" "C568" "C569" "C570"
## [571] "C571" "C572" "C573" "C574" "C575" "C576" "C577" "C578" "C579" "C580"
## [581] "C581" "C582" "C583" "C584" "C585" "C586" "C587" "C588" "C589" "C590"
## [591] "C591" "C592" "C593" "C594" "C595" "C596" "C597" "C598" "C599" "C600"
## [601] "C601" "C602" "C603" "C604" "C605" "C606" "C607" "C608" "C609" "C610"
## [611] "C611" "C612" "C613" "C614" "C615" "C616" "C617" "C618" "C619" "C620"
## [621] "C621" "C622" "C623" "C624" "C625" "C626" "C627" "C628" "C629" "C630"
## [631] "C631" "C632" "C633" "C634" "C635" "C636" "C637" "C638" "C639" "C640"
## [641] "C641" "C642" "C643" "C644" "C645" "C646" "C647" "C648" "C649" "C650"
## [651] "C651" "C652" "C653" "C654" "C655" "C656" "C657" "C658" "C659" "C660"
## [661] "C661" "C662" "C663" "C664" "C665" "C666" "C667" "C668" "C669" "C670"
## [671] "C671" "C672" "C673" "C674" "C675" "C676" "C677" "C678" "C679" "C680"
## [681] "C681" "C682" "C683" "C684" "C685" "C686" "C687" "C688" "C689" "C690"
## [691] "C691" "C692" "C693" "C694" "C695" "C696" "C697" "C698" "C699" "C700"
## [701] "C701" "C702" "C703" "C704" "C705" "C706" "C707" "C708" "C709" "C710"
## [711] "C711" "C712" "C713" "C714" "C715" "C716" "C717" "C718" "C719" "C720"
## [721] "C721" "C722" "C723" "C724" "C725" "C726" "C727" "C728" "C729" "C730"
## [731] "C731" "C732" "C733" "C734" "C735" "C736" "C737" "C738" "C739" "C740"
## [741] "C741" "C742" "C743" "C744" "C745" "C746" "C747" "C748" "C749" "C750"
## [751] "C751" "C752" "C753" "C754" "C755" "C756" "C757" "C758" "C759" "C760"
## [761] "C761" "C762" "C763" "C764" "C765" "C766" "C767" "C768" "C769" "C770"
## [771] "C771" "C772" "C773" "C774" "C775" "C776" "C777" "C778" "C779" "C780"
```

```
## [781] "C781" "C782" "C783" "C784" "C785"
```

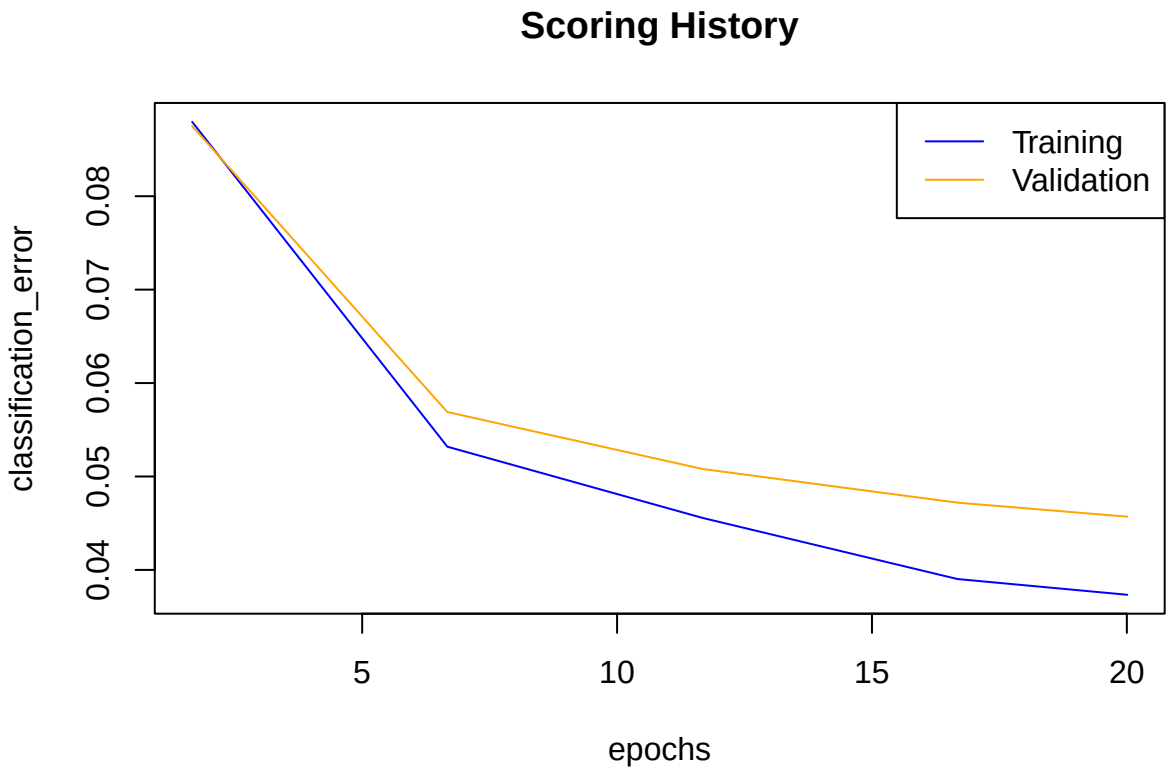
```
#transforma a classe em fator
treino[,785] <- as.factor(treino[,785])
teste[,785] <- as.factor(teste[,785])
```

Modelo

```
modelo <- h2o.deeplearning(x = colnames(treino[,1:784]),  y = "C785",  training_frame = treino,  valida
```

```
##   |                                                                      |
```

```
plot(modelo)
```



Perfor-

mance do modelo

```
h2o.performance(modelo)
```

```
## H2OMultinomialMetrics: deeplearning
## ** Reported on training data. **
## ** Metrics reported on temporary training frame with 10096 samples **
##
## Training Set Metrics:
## =====================
##
## MSE: (Extract with `h2o.mse`) 0.03538105
## RMSE: (Extract with `h2o.rmse`) 0.1880985
## Logloss: (Extract with `h2o.logloss`) 0.134883
## Mean Per-Class Error: 0.03760181
## AUC: (Extract with `h2o.auc`) NaN
## AUCPR: (Extract with `h2o.aucpr`) NaN
## Confusion Matrix: Extract with `h2o.confusionMatrix(<model>,train = TRUE)`)
## ========================================================================
```

```
## Confusion Matrix: Row labels: Actual class; Column labels: Predicted class
##           0    1    2    3    4   5   6   7   8   9  Error           Rate
## 0      1043    0    0    2    1   2   1   1  10   0 0.0160 =   17 / 1.060
## 1         1 1054    8    3    0   0   0   3   7   0 0.0204 =   22 / 1.076
## 2         4    0  977    7    6   1   2  10  10   1 0.0403 =   41 / 1.018
## 3         3    0   12  979    0  19   0   7   9   1 0.0495 =   51 / 1.030
## 4         0    0    0    1  982   0   5   0   5  22 0.0325 =   33 / 1.015
## 5         4    0    7   13    0 909   9   0   8   5 0.0482 =     46 / 955
## 6        11    0    0    0    2  11 959   0   4   0 0.0284 =     28 / 987
## 7         2    2    8    1    2   0   1 960   0  14 0.0303 =     30 / 990
## 8         0    2    6   16    1   9   2   0 920   5 0.0427 =     41 / 961
## 9         3    2    0   14   12   8   2  15  12 936 0.0677 =   68 / 1.004
## Totals 1071 1060 1018 1036 1006 959 981 996 985 984 0.0373 = 377 / 10.096
##
## Hit Ratio Table: Extract with `h2o.hit_ratio_table(<model>,train = TRUE)`
## =======================================================================
## Top-10 Hit Ratios:
##     k hit_ratio
## 1   1  0.962658
## 2   2  0.985737
## 3   3  0.992175
## 4   4  0.995840
## 5   5  0.998019
## 6   6  0.998811
## 7   7  0.999604
## 8   8  0.999901
## 9   9  1.000000
## 10 10  1.000000
```

Fazemos um teste, prevendo um novo valor

```
treino[20,785]
```

```
## [1] 4
## attr(,"types")
## attr(,"types")[[1]]
## [1] enum
##
## Levels: 0 1 2 3 4 5 6 7 8 9
```

```
pred <- h2o.predict(modelo, newdata = treino[20,1:784])
```

```
##   |                                                                              |
```

```
pred$predict
```

```
##   predict
## 1       4
##
## [1 row x 1 column]
```