

Advanced Methods - Breast Cancer

V2 Maestros

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Problem Statement

The dataset contains diagnosis data about breast cancer patients and whether they are Benign (healthy) or Malignant (possible disease). We need to predict whether new patients are benign or malignant based on model built on this data.

Techniques Used

1. Principal Component Analysis
2. Training and Testing
3. Confusion Matrix
4. Neural Networks
5. Support Vector Machines
6. Bagging
7. Boosting

Data Engineering & Analysis

```
setwd("C:/Personal/V2Maestros/Modules/Machine Learning Algorithms/Advanced Methods")
cancer_data <- read.csv("breast_cancer.csv")
str(cancer_data)
```

Loading and understanding the dataset

```

## 'data.frame': 569 obs. of 32 variables:
## $ id          : int 87139402 8910251 905520 868871 9012568 ...
## $ diagnosis   : Factor w/ 2 levels "B","M": 1 1 1 1 1 1 1 2 1 1 ...
## $ radius_mean : num 12.3 10.6 11.1 11.3 15.2 ...
## $ texture_mean: num 12.4 18.9 16.8 13.4 13.2 ...
## $ perimeter_mean: num 78.8 69.3 70.9 73 97.7 ...
## $ area_mean   : num 464 346 373 385 712 ...
## $ smoothness_mean: num 0.1028 0.0969 0.1077 0.1164 0.0796 ...
## $ compactness_mean: num 0.0698 0.1147 0.078 0.1136 0.0693 ...
## $ concavity_mean: num 0.0399 0.0639 0.0305 0.0464 0.0339 ...
## $ points_mean : num 0.037 0.0264 0.0248 0.048 0.0266 ...
## $ symmetry_mean: num 0.196 0.192 0.171 0.177 0.172 ...
## $ dimension_mean: num 0.0595 0.0649 0.0634 0.0607 0.0554 ...
## $ radius_se    : num 0.236 0.451 0.197 0.338 0.178 ...
## $ texture_se   : num 0.666 1.197 1.387 1.343 0.412 ...
## $ perimeter_se : num 1.67 3.43 1.34 1.85 1.34 ...
## $ area_se      : num 17.4 27.1 13.5 26.3 17.7 ...
## $ smoothness_se: num 0.00805 0.00747 0.00516 0.01127 0.00501 ...
## $ compactness_se: num 0.0118 0.03581 0.00936 0.03498 0.01485 ...
## $ concavity_se : num 0.0168 0.0335 0.0106 0.0219 0.0155 ...
## $ points_se    : num 0.01241 0.01365 0.00748 0.01965 0.00915 ...
## $ symmetry_se  : num 0.0192 0.035 0.0172 0.0158 0.0165 ...
## $ dimension_se : num 0.00225 0.00332 0.0022 0.00344 0.00177 ...
## $ radius_worst : num 13.5 11.9 12.4 11.9 16.2 ...
## $ texture_worst: num 15.6 22.9 26.4 15.8 15.7 ...
## $ perimeter_worst: num 87 78.3 79.9 76.5 104.5 ...
## $ area_worst   : num 549 425 471 434 819 ...
## $ smoothness_worst: num 0.139 0.121 0.137 0.137 0.113 ...
## $ compactness_worst: num 0.127 0.252 0.148 0.182 0.174 ...
## $ concavity_worst: num 0.1242 0.1916 0.1067 0.0867 0.1362 ...
## $ points_worst : num 0.0939 0.0793 0.0743 0.0861 0.0818 ...
## $ symmetry_worst: num 0.283 0.294 0.3 0.21 0.249 ...
## $ dimension_worst: num 0.0677 0.0759 0.0788 0.0678 0.0677 ...

```

```
summary(cancer_data)
```

```

##      id      diagnosis  radius_mean   texture_mean
## Min. :8.67e+03 B:357     Min. : 6.98  Min. : 9.71
## 1st Qu.:8.69e+05 M:212     1st Qu.:11.70 1st Qu.:16.17
## Median :9.06e+05                         Median :18.84
## Mean   :3.04e+07                          Mean   :14.13  Mean   :19.29
## 3rd Qu.:8.81e+06                         3rd Qu.:15.78 3rd Qu.:21.80
## Max.  :9.11e+08                         Max.  :28.11  Max.  :39.28
## 
##      perimeter_mean  area_mean  smoothness_mean  compactness_mean
## Min.   : 43.8      Min.   :144      Min.   :0.0526  Min.   :0.0194
## 1st Qu.: 75.2      1st Qu.:420      1st Qu.:0.0864  1st Qu.:0.0649
## Median : 86.2      Median :551      Median :0.0959  Median :0.0926
## Mean   : 92.0      Mean   :655      Mean   :0.0964  Mean   :0.1043
## 3rd Qu.:104.1      3rd Qu.:783      3rd Qu.:0.1053  3rd Qu.:0.1304
## Max.  :188.5      Max.  :2501     Max.  :0.1634  Max.  :0.3454
## 
##      concavity_mean  points_mean  symmetry_mean  dimension_mean
## Min.   :0.0000  Min.   :0.0000  Min.   :0.106  Min.   :0.0500
## 1st Qu.:0.0296  1st Qu.:0.0203  1st Qu.:0.162  1st Qu.:0.0577
## Median :0.0615  Median :0.0335  Median :0.179  Median :0.0615

```

```

##   Mean    :0.0888  Mean    :0.0489  Mean    :0.181  Mean    :0.0628
## 3rd Qu.:0.1307  3rd Qu.:0.0740  3rd Qu.:0.196  3rd Qu.:0.0661
## Max.    :0.4268  Max.    :0.2012  Max.    :0.304  Max.    :0.0974
##   radius_se      texture_se      perimeter_se      area_se
## Min.    :0.112  Min.    :0.360  Min.    :0.757  Min.    : 6.8
## 1st Qu.:0.232  1st Qu.:0.834  1st Qu.:1.606  1st Qu.:17.9
## Median  :0.324  Median  :1.108  Median  :2.287  Median  :24.5
## Mean    :0.405  Mean    :1.217  Mean    :2.866  Mean    :40.3
## 3rd Qu.:0.479  3rd Qu.:1.474  3rd Qu.:3.357  3rd Qu.:45.2
## Max.    :2.873  Max.    :4.885  Max.    :21.980  Max.    :542.2
##   smoothness_se    compactness_se    concavity_se    points_se
## Min.    :0.00171  Min.    :0.00225  Min.    :0.0000  Min.    :0.00000
## 1st Qu.:0.00517  1st Qu.:0.01308  1st Qu.:0.0151  1st Qu.:0.00764
## Median  :0.00638  Median  :0.02045  Median  :0.0259  Median  :0.01093
## Mean    :0.00704  Mean    :0.02548  Mean    :0.0319  Mean    :0.01180
## 3rd Qu.:0.00815  3rd Qu.:0.03245  3rd Qu.:0.0420  3rd Qu.:0.01471
## Max.    :0.03113  Max.    :0.13540  Max.    :0.3960  Max.    :0.05279
##   symmetry_se      dimension_se      radius_worst    texture_worst
## Min.    :0.00788  Min.    :0.000895  Min.    : 7.93  Min.    :12.0
## 1st Qu.:0.01516  1st Qu.:0.002248  1st Qu.:13.01  1st Qu.:21.1
## Median  :0.01873  Median  :0.003187  Median  :14.97  Median  :25.4
## Mean    :0.02054  Mean    :0.003795  Mean    :16.27  Mean    :25.7
## 3rd Qu.:0.02348  3rd Qu.:0.004558  3rd Qu.:18.79  3rd Qu.:29.7
## Max.    :0.07895  Max.    :0.029840  Max.    :36.04  Max.    :49.5
##   perimeter_worst    area_worst    smoothness_worst    compactness_worst
## Min.    : 50.4  Min.    : 185  Min.    :0.0712  Min.    :0.0273
## 1st Qu.: 84.1  1st Qu.: 515  1st Qu.:0.1166  1st Qu.:0.1472
## Median  : 97.7  Median  : 686  Median  :0.1313  Median  :0.2119
## Mean    :107.3  Mean    : 881  Mean    :0.1324  Mean    :0.2543
## 3rd Qu.:125.4  3rd Qu.:1084  3rd Qu.:0.1460  3rd Qu.:0.3391
## Max.    :251.2  Max.    :4254   Max.    :0.2226  Max.    :1.0580
##   concavity_worst    points_worst    symmetry_worst    dimension_worst
## Min.    :0.000  Min.    :0.0000  Min.    :0.156  Min.    :0.0550
## 1st Qu.:0.114  1st Qu.:0.0649  1st Qu.:0.250  1st Qu.:0.0715
## Median  :0.227  Median  :0.0999  Median  :0.282  Median  :0.0800
## Mean    :0.272  Mean    :0.1146  Mean    :0.290  Mean    :0.0839
## 3rd Qu.:0.383  3rd Qu.:0.1614  3rd Qu.:0.318  3rd Qu.:0.0921
## Max.    :1.252  Max.    :0.2910  Max.    :0.664  Max.    :0.2075

```

```
head(cancer_data)
```

		id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean
## 1	87139402		B	12.32	12.39	78.85	464.1
## 2	8910251		B	10.60	18.95	69.28	346.4
## 3	905520		B	11.04	16.83	70.92	373.2
## 4	868871		B	11.28	13.39	73.00	384.8
## 5	9012568		B	15.19	13.21	97.65	711.8
## 6	906539		B	11.57	19.04	74.20	409.7
				smoothness_mean	compactness_mean	concavity_mean	points_mean
## 1				0.10280	0.06981	0.03987	0.03700
## 2				0.09688	0.11470	0.06387	0.02642
## 3				0.10770	0.07804	0.03046	0.02480
## 4				0.11640	0.11360	0.04635	0.04796
## 5				0.07963	0.06934	0.03393	0.02657

```

## 6      0.08546      0.07722      0.05485      0.01428
##   symmetry_mean dimension_mean radius_se texture_se perimeter_se area_se
## 1      0.1959      0.05955      0.2360      0.6656      1.670     17.43
## 2      0.1922      0.06491      0.4505      1.1970      3.430     27.10
## 3      0.1714      0.06340      0.1967      1.3870      1.342     13.54
## 4      0.1771      0.06072      0.3384      1.3430      1.851     26.33
## 5      0.1721      0.05544      0.1783      0.4125      1.338     17.72
## 6      0.2031      0.06267      0.2864      1.4400      2.206     20.30
##   smoothness_se compactness_se concavity_se points_se symmetry_se
## 1      0.008045      0.011800      0.01683     0.012410     0.01924
## 2      0.007470      0.035810      0.03354     0.013650     0.03504
## 3      0.005158      0.009355      0.01056     0.007483     0.01718
## 4      0.011270      0.034980      0.02187     0.019650     0.01580
## 5      0.005012      0.014850      0.01551     0.009155     0.01647
## 6      0.007278      0.020470      0.04447     0.008799     0.01868
##   dimension_se radius_worst texture_worst perimeter_worst area_worst
## 1      0.002248      13.50      15.64      86.97     549.1
## 2      0.003318      11.88      22.94      78.28     424.8
## 3      0.002198      12.41      26.44      79.93     471.4
## 4      0.003442      11.92      15.77      76.53     434.0
## 5      0.001767      16.20      15.73      104.50    819.1
## 6      0.003339      13.07      26.98      86.43     520.5
##   smoothness_worst compactness_worst concavity_worst points_worst
## 1      0.1385      0.1266      0.12420     0.09391
## 2      0.1213      0.2515      0.19160     0.07926
## 3      0.1369      0.1482      0.10670     0.07431
## 4      0.1367      0.1822      0.08669     0.08611
## 5      0.1126      0.1737      0.13620     0.08178
## 6      0.1249      0.1937      0.25600     0.06664
##   symmetry_worst dimension_worst
## 1      0.2827      0.06771
## 2      0.2940      0.07587
## 3      0.2998      0.07881
## 4      0.2102      0.06784
## 5      0.2487      0.06766
## 6      0.3035      0.08284

```

Exploratory Data Analysis

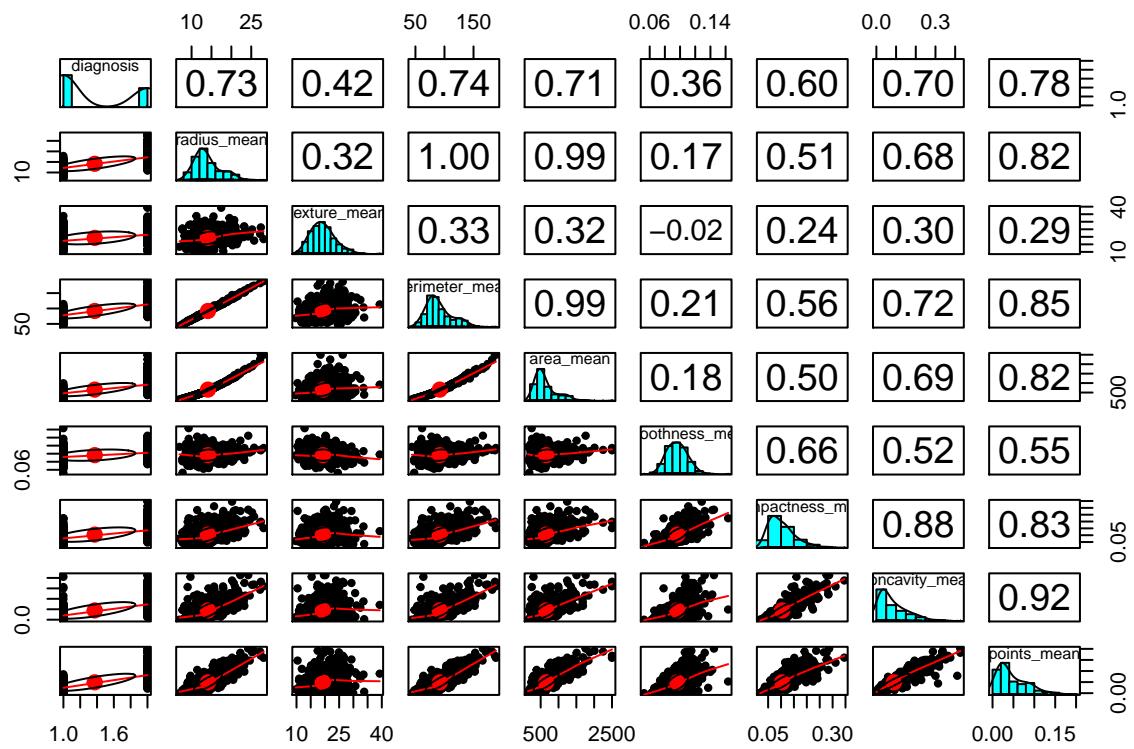
```
library(psych)
```

Correlations

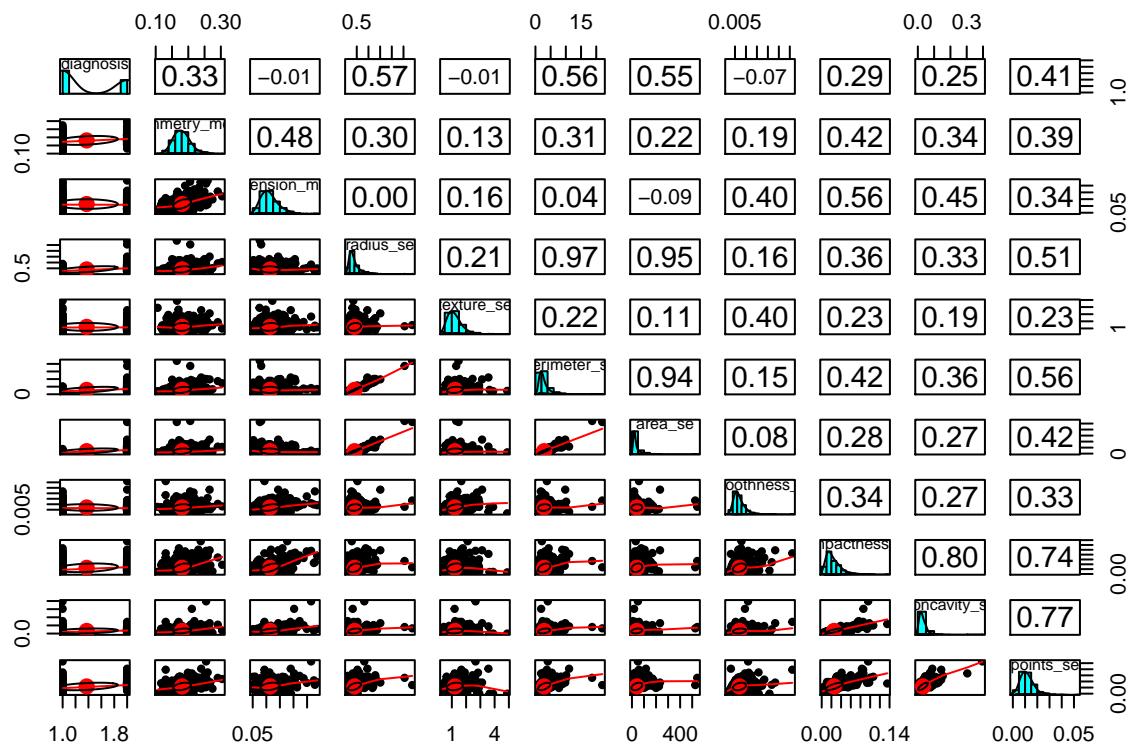
```
## Warning: package 'psych' was built under R version 3.1.1
```

#given the large number of variables, split into 3 sets and see correlation to diagnosis.

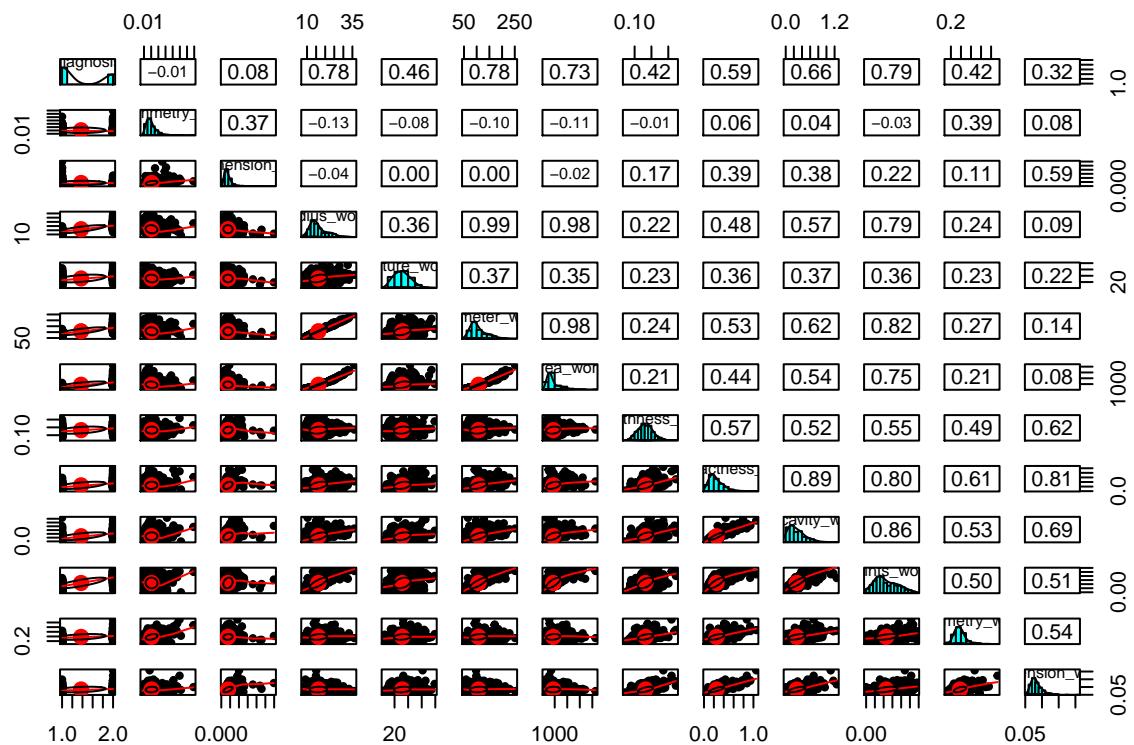
```
pairs.panels(cancer_data[, c(2,3:10)])
```



```
pairs.panels(cancer_data[, c(2,11:20)])
```



```
pairs.panels(cancer_data[, c(2,21:32)])
```

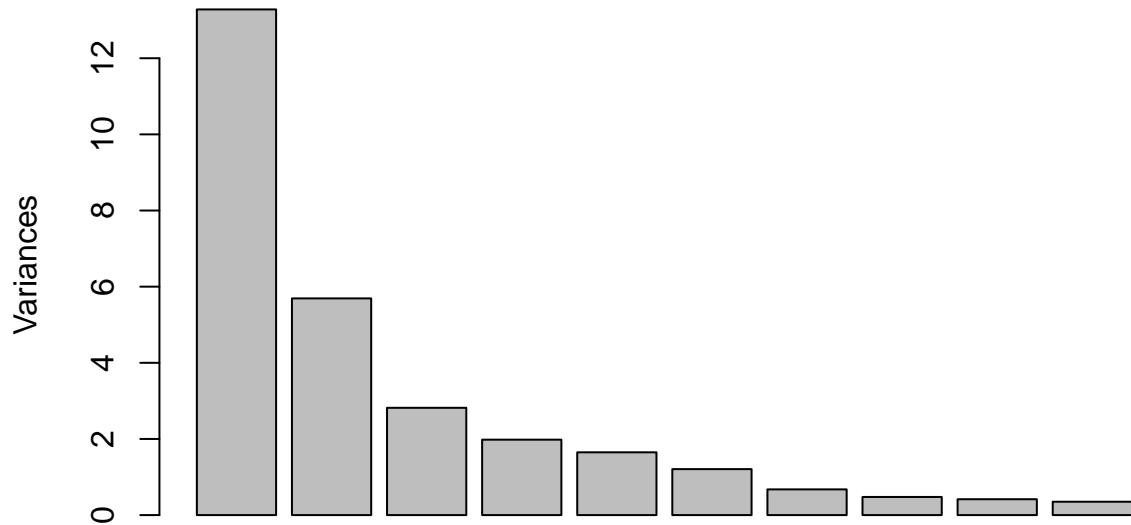


Principal Component Analysis In this section, we first scale the data and discover the principal components of the data. Then we only pick the top components that have the heaviest influence on the target.

```
#scale the data first
scaled_data <- scale(cancer_data[, 3:32])
#convert into principal components
pca_data <- prcomp(scaled_data)

plot(pca_data)
```

pca_data



```
summary(pca_data)
```

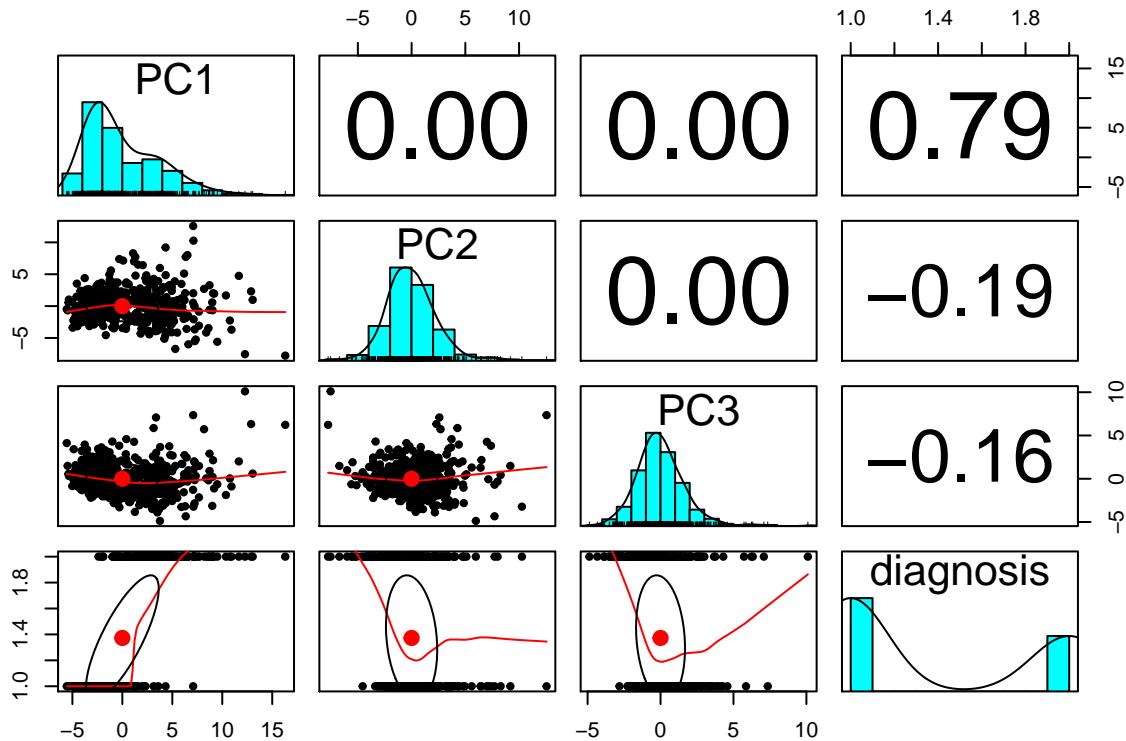
```
## Importance of components:  
##          PC1    PC2    PC3    PC4    PC5    PC6    PC7    PC8  
## Standard deviation 3.644 2.386 1.6787 1.407 1.284 1.0988 0.8217 0.6904  
## Proportion of Variance 0.443 0.190 0.0939 0.066 0.055 0.0403 0.0225 0.0159  
## Cumulative Proportion 0.443 0.632 0.7264 0.792 0.847 0.8876 0.9101 0.9260  
##          PC9    PC10   PC11   PC12   PC13   PC14  
## Standard deviation 0.6457 0.5922 0.5421 0.51104 0.49128 0.39624  
## Proportion of Variance 0.0139 0.0117 0.0098 0.00871 0.00805 0.00523  
## Cumulative Proportion 0.9399 0.9516 0.9614 0.97007 0.97812 0.98335  
##          PC15   PC16   PC17   PC18   PC19   PC20  
## Standard deviation 0.30681 0.28260 0.24372 0.22939 0.22244 0.17652  
## Proportion of Variance 0.00314 0.00266 0.00198 0.00175 0.00165 0.00104  
## Cumulative Proportion 0.98649 0.98915 0.99113 0.99288 0.99453 0.99557  
##          PC21   PC22   PC23   PC24   PC25   PC26  
## Standard deviation 0.173 0.16565 0.15602 0.1344 0.12442 0.09043  
## Proportion of Variance 0.001 0.00091 0.00081 0.0006 0.00052 0.00027  
## Cumulative Proportion 0.997 0.99749 0.99830 0.9989 0.99942 0.99969  
##          PC27   PC28   PC29   PC30  
## Standard deviation 0.08307 0.03987 0.02736 0.0115  
## Proportion of Variance 0.00023 0.00005 0.00002 0.0000  
## Cumulative Proportion 0.99992 0.99997 1.00000 1.0000
```

```

#Get only the first 3 components
final_data <- data.frame(pca_data$x[,1:3])
#add diagnosis to the data frame
final_data$diagnosis <- cancer_data$diagnosis

pairs.panels(final_data)

```



The first 3 principal components influences 75% of the target, so we only pick the top 3. A correlation analysis shows that these 3 have very good correlation to the target. Also the 3 PCs dont have any correlation amongst them.

Modeling & Prediction

Split Training and Testing Split training and testing datasets in the ratio of 70-30

```

library(caret)

## Warning: package 'caret' was built under R version 3.1.1

## Loading required package: lattice
## Loading required package: ggplot2

## Warning: package 'ggplot2' was built under R version 3.1.1

```

```

## 
## Attaching package: 'ggplot2'
## 
## The following object is masked from 'package:psych':
## 
##     %+%
## 

inTrain <- createDataPartition(y=final_data$diagnosis ,p=0.7,list=FALSE)
training <- final_data[inTrain,]
testing <- final_data[-inTrain,]
dim(training);dim(testing)

## [1] 399    4

## [1] 170    4

table(training$diagnosis); table(testing$diagnosis)

## 
##     B      M
## 250 149

## 
##     B      M
## 107  63

```

Model Building and Testing We will build different models based on 4 different algorithms. Then we predict on the test data and measure accuracy. Finally, we compare the algorithms for their accuracy and speed. The “caret” package in R provides a convenient unified interface for using any of the algorithms for modeling and prediction. It has an extensive library of algorithms <http://topepo.github.io/caret/modelList.html> . This can be used to compare performance of different algorithms for a given dataset.

```

predlist <- c("bagFDA",      #Bagging
            "LogitBoost",   #Boosting
            "nnet",         #Neural Networks
            "svmRadialCost") #Support vector machines

#Create a result data set
results <- data.frame( Algorithm=character(), Duration=numeric(), Accuracy=numeric(),
                      stringsAsFactors=FALSE)

#loop through algorithm list and perform model building and prediction

for (i in 1:length(predlist)) {
  pred <- predlist[i]
  print(paste("Algorithm = ",pred ))
  #Measure Time
  startTime <- as.integer(Sys.time())
  #Build model
  model <- train( diagnosis ~ ., data=training, method=pred)
  #Predict

```

```

predicted <- predict(model, testing)
#Compare results
matrix<- confusionMatrix(predicted, testing$diagnosis)
#Measure end time
endTime <- as.integer(Sys.time())
#Store result
thisresult <- c( as.character(pred), endTime-startTime, as.numeric(matrix$overall[1]))
results[i,1] <- pred
results[i,2] <- endTime-startTime
results[i,3] <- round(as.numeric(matrix$overall[1]) * 100, 2)

}

## [1] "Algorithm = bagFDA"
## [1] "Algorithm = LogitBoost"
## [1] "Algorithm = nnet"
## # weights: 6
## initial value 306.819169
## iter 10 value 65.465918
## iter 20 value 48.967964
## iter 30 value 43.675371
## iter 40 value 42.857608
## iter 50 value 42.725234
## iter 60 value 42.718955
## iter 70 value 42.680659
## iter 80 value 42.653250
## iter 90 value 42.649080
## iter 100 value 42.639493
## final value 42.639493
## stopped after 100 iterations
## # weights: 16
## initial value 231.403768
## iter 10 value 50.757209
## iter 20 value 40.520288
## iter 30 value 35.985616
## iter 40 value 32.247430
## iter 50 value 30.366560
## iter 60 value 29.991607
## iter 70 value 29.667205
## iter 80 value 29.548323
## iter 90 value 29.464303
## iter 100 value 29.435523
## final value 29.435523
## stopped after 100 iterations
## # weights: 26
## initial value 250.652001
## iter 10 value 50.766970
## iter 20 value 32.807238
## iter 30 value 29.921568
## iter 40 value 27.936043
## iter 50 value 23.998731
## iter 60 value 23.732881
## iter 70 value 23.577478

```

```

## iter  80 value 23.527590
## iter  90 value 23.390799
## iter 100 value 23.227097
## final  value 23.227097
## stopped after 100 iterations
## # weights:  6
## initial  value 247.714334
## iter   10 value 62.622953
## iter   20 value 56.296849
## final  value 56.233964
## converged
## # weights: 16
## initial  value 270.307042
## iter   10 value 49.319175
## iter   20 value 46.688593
## iter   30 value 45.599968
## iter   40 value 44.958540
## iter   50 value 44.856664
## final  value 44.856643
## converged
## # weights: 26
## initial  value 261.835215
## iter   10 value 51.265030
## iter   20 value 44.826855
## iter   30 value 43.495978
## iter   40 value 42.936575
## iter   50 value 42.840981
## iter   60 value 42.780444
## iter   70 value 42.752401
## final  value 42.752363
## converged
## # weights:  6
## initial  value 297.345796
## iter   10 value 68.120916
## iter   20 value 44.599371
## iter   30 value 43.062570
## iter   40 value 42.945413
## iter   50 value 42.920181
## iter   60 value 42.888967
## iter   70 value 42.873519
## iter   80 value 42.855553
## iter   90 value 42.850698
## iter 100 value 42.842920
## final  value 42.842920
## stopped after 100 iterations
## # weights: 16
## initial  value 266.970777
## iter   10 value 74.664949
## iter   20 value 68.314029
## iter   30 value 67.960146
## iter   40 value 67.790512
## iter   50 value 67.733906
## iter   60 value 67.694322
## iter   70 value 67.646076

```

```

## iter  80 value 67.619561
## iter  90 value 67.596651
## iter 100 value 67.548733
## final  value 67.548733
## stopped after 100 iterations
## # weights:  26
## initial  value 221.392644
## iter   10 value 36.540013
## iter   20 value 30.266561
## iter   30 value 22.331704
## iter   40 value 20.270588
## iter   50 value 20.094915
## iter   60 value 19.918335
## iter   70 value 19.475633
## iter   80 value 19.214732
## iter   90 value 19.128362
## iter 100 value 19.047213
## final  value 19.047213
## stopped after 100 iterations
## # weights:  6
## initial  value 304.468092
## iter   10 value 68.405280
## iter   20 value 54.700502
## iter   30 value 39.990404
## iter   40 value 38.147999
## iter   50 value 37.935525
## iter   60 value 37.873338
## iter   70 value 37.819287
## iter   80 value 37.796151
## iter   90 value 37.785860
## iter 100 value 37.777357
## final  value 37.777357
## stopped after 100 iterations
## # weights:  16
## initial  value 354.814596
## iter   10 value 60.630784
## iter   20 value 30.111450
## iter   30 value 25.536434
## iter   40 value 22.485517
## iter   50 value 21.320871
## iter   60 value 20.798418
## iter   70 value 20.767067
## iter   80 value 20.743537
## iter   90 value 20.727041
## iter 100 value 20.651680
## final  value 20.651680
## stopped after 100 iterations
## # weights:  26
## initial  value 295.868516
## iter   10 value 60.641356
## iter   20 value 26.795614
## iter   30 value 23.533605
## iter   40 value 19.927906
## iter   50 value 15.723600

```

```

## iter  60 value 13.675360
## iter  70 value 13.173185
## iter  80 value 12.980632
## iter  90 value 12.899467
## iter 100 value 10.130554
## final  value 10.130554
## stopped after 100 iterations
## # weights:  6
## initial  value 292.266046
## iter   10 value 52.308325
## iter   20 value 50.203884
## final  value 50.197986
## converged
## # weights: 16
## initial  value 327.107685
## iter   10 value 50.111337
## iter   20 value 41.800717
## iter   30 value 40.940376
## iter   40 value 40.467735
## final  value 40.461804
## converged
## # weights: 26
## initial  value 274.301291
## iter   10 value 60.873676
## iter   20 value 41.245416
## iter   30 value 38.755636
## iter   40 value 38.152533
## iter   50 value 37.503060
## iter   60 value 37.438656
## iter   70 value 37.434200
## final  value 37.434192
## converged
## # weights:  6
## initial  value 256.321691
## iter   10 value 51.607362
## iter   20 value 39.419158
## iter   30 value 38.198746
## iter   40 value 37.943536
## iter   50 value 37.928588
## iter   60 value 37.902140
## iter   70 value 37.894646
## iter   80 value 37.891995
## iter   90 value 37.891375
## iter 100 value 37.890441
## final  value 37.890441
## stopped after 100 iterations
## # weights: 16
## initial  value 289.638899
## iter   10 value 32.869680
## iter   20 value 27.114993
## iter   30 value 24.530943
## iter   40 value 23.858483
## iter   50 value 23.660078
## iter   60 value 23.486235

```

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## iter  70 value 23.275305
## iter  80 value 23.171847
## iter  90 value 22.459542
## iter 100 value 21.668587
## final  value 21.668587
## stopped after 100 iterations
## # weights:  26
## initial  value 278.266898
## iter   10 value 37.818506
## iter   20 value 24.520803
## iter   30 value 20.186025
## iter   40 value 20.083145
## iter   50 value 19.451415
## iter   60 value 19.360572
## iter   70 value 19.246795
## iter   80 value 18.978681
## iter   90 value 18.650244
## iter 100 value 18.322316
## final  value 18.322316
## stopped after 100 iterations
## # weights:  6
## initial  value 283.352237
## iter   10 value 83.818702
## iter   20 value 82.837064
## iter   30 value 81.962113
## iter   40 value 76.606206
## iter   50 value 53.265329
## iter   60 value 45.532621
## iter   70 value 44.705323
## iter   80 value 44.504241
## iter   90 value 44.294062
## iter 100 value 44.259216
## final  value 44.259216
## stopped after 100 iterations
## # weights:  16
## initial  value 238.256048
## iter   10 value 47.499520
## iter   20 value 27.842828
## iter   30 value 27.040033
## iter   40 value 26.303297
## iter   50 value 26.132230
## iter   60 value 25.925436
## iter   70 value 25.007739
## iter   80 value 24.985947
## iter   90 value 24.954607
## iter 100 value 24.917277
## final  value 24.917277
## stopped after 100 iterations
## # weights:  26
## initial  value 257.304834
## iter   10 value 54.279503
## iter   20 value 42.765904
## iter   30 value 30.906856
## iter   40 value 20.236698

```

```

## iter 50 value 15.142787
## iter 60 value 11.668474
## iter 70 value 11.064093
## iter 80 value 10.775959
## iter 90 value 10.108340
## iter 100 value 9.640947
## final value 9.640947
## stopped after 100 iterations
## # weights: 6
## initial value 281.532496
## iter 10 value 67.579846
## iter 20 value 57.064114
## final value 57.057361
## converged
## # weights: 16
## initial value 263.634038
## iter 10 value 72.165706
## iter 20 value 49.638397
## iter 30 value 45.716253
## iter 40 value 44.432372
## iter 50 value 44.291461
## iter 60 value 43.633531
## iter 70 value 43.575816
## iter 70 value 43.575816
## iter 70 value 43.575816
## final value 43.575816
## converged
## # weights: 26
## initial value 266.534453
## iter 10 value 67.609966
## iter 20 value 44.047385
## iter 30 value 41.794145
## iter 40 value 39.918478
## iter 50 value 38.815650
## iter 60 value 38.736556
## iter 70 value 38.693832
## final value 38.692178
## converged
## # weights: 6
## initial value 283.574218
## iter 10 value 59.187313
## iter 20 value 47.435202
## iter 30 value 45.146351
## iter 40 value 44.553808
## iter 50 value 44.521484
## iter 60 value 44.469106
## iter 70 value 44.454237
## final value 44.453590
## converged
## # weights: 16
## initial value 316.073833
## iter 10 value 68.338609
## iter 20 value 31.127886
## iter 30 value 29.425745

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## iter 40 value 29.059730
## iter 50 value 28.855372
## iter 60 value 27.605564
## iter 70 value 27.020451
## iter 80 value 26.661029
## iter 90 value 24.997384
## iter 100 value 24.382382
## final value 24.382382
## stopped after 100 iterations
## # weights: 26
## initial value 263.068891
## iter 10 value 32.373620
## iter 20 value 23.667893
## iter 30 value 20.794314
## iter 40 value 19.968629
## iter 50 value 19.698596
## iter 60 value 18.260036
## iter 70 value 16.792808
## iter 80 value 16.365202
## iter 90 value 15.926402
## iter 100 value 15.830831
## final value 15.830831
## stopped after 100 iterations
## # weights: 6
## initial value 282.677230
## iter 10 value 77.879488
## iter 20 value 75.637484
## iter 30 value 65.843949
## iter 40 value 64.709636
## iter 50 value 64.644036
## iter 60 value 64.569358
## iter 70 value 64.533937
## iter 80 value 64.520406
## iter 90 value 64.512876
## iter 100 value 64.504668
## final value 64.504668
## stopped after 100 iterations
## # weights: 16
## initial value 248.754897
## iter 10 value 80.854768
## iter 20 value 50.223837
## iter 30 value 30.691912
## iter 40 value 25.838466
## iter 50 value 22.832468
## iter 60 value 18.561913
## iter 70 value 18.246644
## iter 80 value 18.240082
## iter 90 value 18.235995
## iter 100 value 18.133913
## final value 18.133913
## stopped after 100 iterations
## # weights: 26
## initial value 223.780771
## iter 10 value 56.395052

```

```

## iter 20 value 28.551103
## iter 30 value 15.910800
## iter 40 value 14.395399
## iter 50 value 14.027196
## iter 60 value 14.006996
## iter 70 value 14.006199
## iter 80 value 14.003767
## iter 80 value 14.003767
## iter 90 value 14.003600
## iter 100 value 14.001829
## final value 14.001829
## stopped after 100 iterations
## # weights: 6
## initial value 265.488682
## iter 10 value 87.295235
## iter 20 value 75.274928
## final value 74.915961
## converged
## # weights: 16
## initial value 285.533611
## iter 10 value 99.629228
## iter 20 value 69.506008
## iter 30 value 60.384674
## iter 40 value 56.506119
## iter 50 value 49.402141
## iter 60 value 49.220914
## final value 49.220900
## converged
## # weights: 26
## initial value 257.679817
## iter 10 value 62.935973
## iter 20 value 56.739582
## iter 30 value 54.756169
## iter 40 value 51.649145
## iter 50 value 46.106850
## iter 60 value 45.530603
## iter 70 value 45.151390
## final value 45.147622
## converged
## # weights: 6
## initial value 330.903151
## iter 10 value 81.303577
## iter 20 value 76.070972
## iter 30 value 71.562369
## iter 40 value 65.624697
## iter 50 value 64.721875
## iter 60 value 64.678752
## iter 70 value 64.629701
## iter 80 value 64.605103
## iter 90 value 64.601214
## iter 100 value 64.600229
## final value 64.600229
## stopped after 100 iterations
## # weights: 16

```

```

## initial value 357.274133
## iter 10 value 61.851231
## iter 20 value 49.160297
## iter 30 value 40.416448
## iter 40 value 36.181258
## iter 50 value 35.076601
## iter 60 value 34.714405
## iter 70 value 33.770283
## iter 80 value 33.675330
## iter 90 value 33.530716
## iter 100 value 33.506091
## final value 33.506091
## stopped after 100 iterations
## # weights: 26
## initial value 219.603523
## iter 10 value 56.804420
## iter 20 value 41.536637
## iter 30 value 30.523705
## iter 40 value 24.578485
## iter 50 value 24.147625
## iter 60 value 23.825424
## iter 70 value 23.646892
## iter 80 value 23.545529
## iter 90 value 23.523880
## iter 100 value 23.493359
## final value 23.493359
## stopped after 100 iterations
## # weights: 6
## initial value 335.484059
## iter 10 value 74.950134
## iter 20 value 61.854387
## iter 30 value 53.336936
## iter 40 value 51.053618
## iter 50 value 50.714929
## iter 60 value 50.533633
## iter 70 value 50.440667
## iter 80 value 50.431721
## iter 90 value 50.397300
## iter 100 value 50.380972
## final value 50.380972
## stopped after 100 iterations
## # weights: 16
## initial value 340.503798
## iter 10 value 50.865612
## iter 20 value 38.928881
## iter 30 value 36.628241
## iter 40 value 35.730077
## iter 50 value 33.185446
## iter 60 value 31.115304
## iter 70 value 30.855846
## iter 80 value 30.850961
## iter 90 value 30.849093
## iter 100 value 30.837374
## final value 30.837374

```

```

## stopped after 100 iterations
## # weights: 26
## initial value 251.411465
## iter 10 value 53.506603
## iter 20 value 35.994389
## iter 30 value 28.909453
## iter 40 value 25.630786
## iter 50 value 21.226360
## iter 60 value 18.499905
## iter 70 value 14.780646
## iter 80 value 9.394375
## iter 90 value 8.566308
## iter 100 value 8.430832
## final value 8.430832
## stopped after 100 iterations
## # weights: 6
## initial value 299.847687
## iter 10 value 87.727162
## iter 20 value 67.998881
## iter 30 value 63.188877
## final value 63.183205
## converged
## # weights: 16
## initial value 296.666885
## iter 10 value 68.650626
## iter 20 value 56.573201
## iter 30 value 52.530195
## iter 40 value 51.478717
## iter 50 value 51.283706
## final value 51.283704
## converged
## # weights: 26
## initial value 237.739056
## iter 10 value 80.958943
## iter 20 value 56.928732
## iter 30 value 53.595035
## iter 40 value 52.612259
## iter 50 value 51.317686
## iter 60 value 50.761211
## iter 70 value 50.577489
## iter 80 value 50.573036
## iter 80 value 50.573036
## iter 80 value 50.573036
## final value 50.573036
## converged
## # weights: 6
## initial value 340.761635
## iter 10 value 55.892916
## iter 20 value 51.935163
## iter 30 value 50.895871
## iter 40 value 50.647658
## iter 50 value 50.626803
## iter 60 value 50.581102
## iter 70 value 50.562143

```

```

## iter  80 value 50.556782
## iter  90 value 50.554859
## iter 100 value 50.551628
## final  value 50.551628
## stopped after 100 iterations
## # weights: 16
## initial  value 265.812151
## iter   10 value 54.158967
## iter   20 value 51.072766
## iter   30 value 40.278807
## iter   40 value 38.041732
## iter   50 value 37.647343
## iter   60 value 37.569334
## iter   70 value 37.552717
## iter   80 value 37.544865
## iter   90 value 37.544543
## iter 100 value 37.542485
## final  value 37.542485
## stopped after 100 iterations
## # weights: 26
## initial  value 289.932758
## iter   10 value 61.186663
## iter   20 value 39.789403
## iter   30 value 30.803318
## iter   40 value 29.250784
## iter   50 value 28.887091
## iter   60 value 28.743776
## iter   70 value 28.649476
## iter   80 value 28.588770
## iter   90 value 28.571690
## iter 100 value 28.517015
## final  value 28.517015
## stopped after 100 iterations
## # weights: 6
## initial  value 261.241066
## iter   10 value 75.160600
## iter   20 value 52.414015
## iter   30 value 47.608013
## iter   40 value 46.933398
## iter   50 value 46.767251
## iter   60 value 46.749336
## iter   70 value 46.745696
## iter   80 value 46.740048
## iter   90 value 46.737718
## iter 100 value 46.734451
## final  value 46.734451
## stopped after 100 iterations
## # weights: 16
## initial  value 224.227169
## iter   10 value 39.725352
## iter   20 value 32.428989
## iter   30 value 30.896452
## iter   40 value 29.627578
## iter   50 value 24.162294

```

```

## iter 60 value 23.888359
## final value 23.887092
## converged
## # weights: 26
## initial value 330.708988
## iter 10 value 41.550798
## iter 20 value 31.015334
## iter 30 value 22.283898
## iter 40 value 14.100047
## iter 50 value 9.798034
## iter 60 value 8.925476
## iter 70 value 8.312542
## iter 80 value 7.935404
## iter 90 value 7.750196
## iter 100 value 7.275658
## final value 7.275658
## stopped after 100 iterations
## # weights: 6
## initial value 313.883540
## iter 10 value 79.177025
## iter 20 value 59.406888
## iter 30 value 58.672073
## final value 58.671954
## converged
## # weights: 16
## initial value 306.188784
## iter 10 value 72.708435
## iter 20 value 51.640912
## iter 30 value 47.980605
## iter 40 value 45.810106
## iter 50 value 45.532424
## final value 45.532087
## converged
## # weights: 26
## initial value 257.879167
## iter 10 value 48.579570
## iter 20 value 44.657963
## iter 30 value 43.279705
## iter 40 value 42.996334
## iter 50 value 42.981849
## iter 60 value 42.981572
## final value 42.981565
## converged
## # weights: 6
## initial value 270.006101
## iter 10 value 57.111945
## iter 20 value 52.137006
## iter 30 value 47.310514
## iter 40 value 46.901321
## iter 50 value 46.811968
## iter 60 value 46.805375
## iter 70 value 46.803366
## iter 80 value 46.801332
## iter 90 value 46.798882

```

```

## iter 100 value 46.798343
## final value 46.798343
## stopped after 100 iterations
## # weights: 16
## initial value 259.115697
## iter 10 value 45.280354
## iter 20 value 38.061186
## iter 30 value 35.128908
## iter 40 value 34.092680
## iter 50 value 34.000792
## iter 60 value 33.579214
## iter 70 value 33.556048
## iter 80 value 33.554661
## iter 90 value 33.551494
## iter 100 value 33.547256
## final value 33.547256
## stopped after 100 iterations
## # weights: 26
## initial value 371.013302
## iter 10 value 51.064326
## iter 20 value 32.774667
## iter 30 value 26.200756
## iter 40 value 19.254993
## iter 50 value 16.585159
## iter 60 value 15.271376
## iter 70 value 14.861437
## iter 80 value 14.640060
## iter 90 value 14.505187
## iter 100 value 14.478194
## final value 14.478194
## stopped after 100 iterations
## # weights: 6
## initial value 308.297260
## iter 10 value 66.405808
## iter 20 value 57.062356
## iter 30 value 56.083904
## iter 40 value 55.775842
## iter 50 value 55.627068
## iter 60 value 55.609205
## iter 70 value 55.546101
## iter 80 value 55.485130
## iter 90 value 55.481169
## iter 100 value 55.452220
## final value 55.452220
## stopped after 100 iterations
## # weights: 16
## initial value 322.169178
## iter 10 value 61.302991
## iter 20 value 48.928707
## iter 30 value 46.370229
## iter 40 value 42.585838
## iter 50 value 41.775813
## iter 60 value 40.717144
## iter 70 value 40.616354

```

```

## iter  80 value 40.605474
## iter  90 value 40.601200
## iter 100 value 40.600271
## final  value 40.600271
## stopped after 100 iterations
## # weights:  26
## initial  value 270.567344
## iter   10 value 53.377015
## iter   20 value 39.266423
## iter   30 value 28.706522
## iter   40 value 27.915161
## iter   50 value 27.575763
## iter   60 value 27.513735
## iter   70 value 27.446485
## iter   80 value 27.145836
## iter   90 value 27.091532
## iter 100 value 27.078008
## final  value 27.078008
## stopped after 100 iterations
## # weights:  6
## initial  value 282.464682
## iter   10 value 90.518290
## iter   20 value 68.662756
## final  value 68.343775
## converged
## # weights:  16
## initial  value 253.048626
## iter   10 value 71.114596
## iter   20 value 62.147578
## iter   30 value 61.415831
## iter   40 value 61.342326
## final  value 61.339505
## converged
## # weights:  26
## initial  value 291.273743
## iter   10 value 74.038416
## iter   20 value 59.276829
## iter   30 value 56.045114
## iter   40 value 55.548556
## iter   50 value 55.502766
## iter   60 value 55.496118
## iter   70 value 55.495696
## final  value 55.495693
## converged
## # weights:  6
## initial  value 247.496369
## iter   10 value 72.548315
## iter   20 value 67.566877
## iter   30 value 67.406012
## iter   40 value 67.113338
## iter   50 value 67.041544
## iter   60 value 67.039406
## iter   70 value 67.029028
## iter   80 value 67.028474

```

```

## iter  90 value 67.025556
## iter 100 value 67.025216
## final  value 67.025216
## stopped after 100 iterations
## # weights:  16
## initial  value 278.264247
## iter   10 value 61.696246
## iter   20 value 46.925074
## iter   30 value 40.408889
## iter   40 value 40.063035
## iter   50 value 39.837605
## iter   60 value 38.342700
## iter   70 value 37.781594
## iter   80 value 37.607118
## iter   90 value 37.561133
## iter 100 value 37.527495
## final  value 37.527495
## stopped after 100 iterations
## # weights:  26
## initial  value 234.485954
## iter   10 value 53.449358
## iter   20 value 37.406016
## iter   30 value 31.379338
## iter   40 value 26.778265
## iter   50 value 26.386042
## iter   60 value 26.154521
## iter   70 value 25.911170
## iter   80 value 25.749858
## iter   90 value 25.403339
## iter 100 value 22.602271
## final  value 22.602271
## stopped after 100 iterations
## # weights:  6
## initial  value 334.814375
## iter   10 value 67.899770
## iter   20 value 54.697476
## iter   30 value 53.036646
## iter   40 value 52.685300
## iter   50 value 52.658298
## iter   60 value 52.570109
## iter   70 value 52.522938
## iter   80 value 52.503812
## iter   90 value 52.489713
## iter 100 value 52.469487
## final  value 52.469487
## stopped after 100 iterations
## # weights:  16
## initial  value 336.661275
## iter   10 value 57.736038
## iter   20 value 37.595276
## iter   30 value 30.878586
## iter   40 value 30.650765
## iter   50 value 30.584173
## iter   60 value 30.125700

```

```

## iter 70 value 29.983218
## iter 80 value 29.943813
## iter 90 value 29.916858
## iter 100 value 29.916675
## final value 29.916675
## stopped after 100 iterations
## # weights: 26
## initial value 260.072588
## iter 10 value 41.272256
## iter 20 value 33.400109
## iter 30 value 23.278136
## iter 40 value 21.474237
## iter 50 value 21.418995
## final value 21.418896
## converged
## # weights: 6
## initial value 252.566497
## iter 10 value 70.902725
## iter 20 value 63.948565
## final value 63.826695
## converged
## # weights: 16
## initial value 281.374427
## iter 10 value 57.055400
## iter 20 value 52.103702
## iter 30 value 52.051104
## iter 40 value 52.044195
## final value 52.043752
## converged
## # weights: 26
## initial value 234.673641
## iter 10 value 84.539419
## iter 20 value 60.282628
## iter 30 value 55.211796
## iter 40 value 52.831358
## iter 50 value 52.452850
## iter 60 value 52.309748
## iter 70 value 51.825825
## iter 80 value 51.678209
## final value 51.676768
## converged
## # weights: 6
## initial value 264.096294
## iter 10 value 72.116463
## iter 20 value 59.202757
## iter 30 value 53.206056
## iter 40 value 52.866888
## iter 50 value 52.660762
## iter 60 value 52.621175
## iter 70 value 52.619414
## iter 80 value 52.612951
## iter 90 value 52.612654
## final value 52.612602
## converged

```

```

## # weights: 16
## initial value 280.154007
## iter 10 value 61.029522
## iter 20 value 49.042497
## iter 30 value 40.582791
## iter 40 value 39.006280
## iter 50 value 38.722189
## iter 60 value 38.294115
## iter 70 value 36.624566
## iter 80 value 35.151127
## iter 90 value 34.768691
## iter 100 value 34.686291
## final value 34.686291
## stopped after 100 iterations
## # weights: 26
## initial value 286.732003
## iter 10 value 50.740088
## iter 20 value 41.348180
## iter 30 value 28.202677
## iter 40 value 22.877349
## iter 50 value 20.091944
## iter 60 value 18.886858
## iter 70 value 15.405860
## iter 80 value 13.323849
## iter 90 value 13.050009
## iter 100 value 12.983714
## final value 12.983714
## stopped after 100 iterations
## # weights: 6
## initial value 307.394700
## iter 10 value 47.286787
## iter 20 value 45.409652
## iter 30 value 45.073410
## iter 40 value 45.042123
## iter 50 value 45.036719
## iter 60 value 45.032282
## iter 70 value 45.027012
## iter 80 value 45.024035
## iter 90 value 45.023261
## iter 100 value 45.021031
## final value 45.021031
## stopped after 100 iterations
## # weights: 16
## initial value 238.259354
## iter 10 value 42.607335
## iter 20 value 30.228970
## iter 30 value 27.834854
## iter 40 value 26.605583
## iter 50 value 26.491511
## iter 60 value 26.475773
## iter 70 value 26.190312
## iter 80 value 26.088412
## iter 90 value 26.071553
## iter 100 value 26.058054

```

```

## final value 26.058054
## stopped after 100 iterations
## # weights: 26
## initial value 389.217670
## iter 10 value 65.535123
## iter 20 value 46.831193
## iter 30 value 39.451250
## iter 40 value 34.596232
## iter 50 value 22.868440
## iter 60 value 18.885548
## iter 70 value 15.634274
## iter 80 value 14.289104
## iter 90 value 13.712742
## iter 100 value 13.490110
## final value 13.490110
## stopped after 100 iterations
## # weights: 6
## initial value 262.293218
## iter 10 value 146.909155
## iter 20 value 68.429974
## iter 30 value 56.340014
## final value 56.040257
## converged
## # weights: 16
## initial value 278.474610
## iter 10 value 65.034585
## iter 20 value 48.570215
## iter 30 value 44.787174
## iter 40 value 44.115302
## iter 50 value 44.087418
## iter 50 value 44.087418
## iter 50 value 44.087418
## final value 44.087418
## converged
## # weights: 26
## initial value 283.623403
## iter 10 value 45.826028
## iter 20 value 43.500678
## iter 30 value 43.257002
## iter 40 value 43.186413
## iter 50 value 43.175225
## final value 43.175179
## converged
## # weights: 6
## initial value 289.030650
## iter 10 value 64.694282
## iter 20 value 46.927297
## iter 30 value 45.335936
## iter 40 value 45.089673
## iter 50 value 45.083321
## iter 60 value 45.076704
## iter 70 value 45.075837
## final value 45.075651
## converged

```

```

## # weights: 16
## initial value 272.952440
## iter 10 value 65.471979
## iter 20 value 39.379206
## iter 30 value 34.947765
## iter 40 value 33.521271
## iter 50 value 32.990198
## iter 60 value 32.958753
## iter 70 value 32.884761
## iter 80 value 32.869905
## iter 90 value 32.805211
## iter 100 value 32.694502
## final value 32.694502
## stopped after 100 iterations
## # weights: 26
## initial value 326.899888
## iter 10 value 52.392352
## iter 20 value 39.174149
## iter 30 value 27.101174
## iter 40 value 22.601454
## iter 50 value 19.665456
## iter 60 value 18.923065
## iter 70 value 17.636446
## iter 80 value 17.113972
## iter 90 value 14.958411
## iter 100 value 12.847214
## final value 12.847214
## stopped after 100 iterations
## # weights: 6
## initial value 250.946039
## iter 10 value 65.457704
## iter 20 value 59.858028
## iter 30 value 59.154413
## iter 40 value 57.763535
## iter 50 value 56.692250
## iter 60 value 55.383441
## iter 70 value 55.335096
## iter 80 value 55.184215
## iter 90 value 55.160164
## iter 100 value 55.137762
## final value 55.137762
## stopped after 100 iterations
## # weights: 16
## initial value 397.688987
## iter 10 value 64.307387
## iter 20 value 40.249576
## iter 30 value 25.099824
## iter 40 value 24.215923
## iter 50 value 24.152967
## iter 60 value 24.117282
## iter 70 value 23.951798
## iter 80 value 23.950186
## iter 90 value 23.948399
## iter 100 value 23.947789

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## final value 23.947789
## stopped after 100 iterations
## # weights: 26
## initial value 311.664156
## iter 10 value 48.694853
## iter 20 value 34.295929
## iter 30 value 21.952606
## iter 40 value 17.986472
## iter 50 value 17.661897
## iter 60 value 17.646079
## iter 70 value 17.645715
## final value 17.645701
## converged
## # weights: 6
## initial value 240.721288
## iter 10 value 79.032789
## iter 20 value 61.282853
## iter 30 value 59.811360
## final value 59.811354
## converged
## # weights: 16
## initial value 307.394648
## iter 10 value 58.574619
## iter 20 value 56.226230
## iter 30 value 51.914221
## iter 40 value 49.131543
## final value 49.113012
## converged
## # weights: 26
## initial value 293.103844
## iter 10 value 49.919474
## iter 20 value 42.448265
## iter 30 value 41.784785
## iter 40 value 41.737112
## iter 50 value 41.734375
## iter 60 value 41.734082
## final value 41.734023
## converged
## # weights: 6
## initial value 298.703384
## iter 10 value 70.048151
## iter 20 value 59.652925
## iter 30 value 58.990462
## iter 40 value 56.744008
## iter 50 value 56.735425
## final value 56.735104
## converged
## # weights: 16
## initial value 249.443546
## iter 10 value 51.967668
## iter 20 value 34.300505
## iter 30 value 28.576735
## iter 40 value 28.161221
## iter 50 value 28.129953

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## iter 60 value 28.045441
## iter 70 value 28.044346
## iter 80 value 28.042703
## iter 90 value 28.035697
## iter 100 value 28.035560
## final value 28.035560
## stopped after 100 iterations
## # weights: 26
## initial value 379.542277
## iter 10 value 47.017345
## iter 20 value 25.113294
## iter 30 value 15.271285
## iter 40 value 11.244596
## iter 50 value 9.511017
## iter 60 value 9.161703
## iter 70 value 8.834968
## iter 80 value 8.316252
## iter 90 value 8.013179
## iter 100 value 7.840538
## final value 7.840538
## stopped after 100 iterations
## # weights: 6
## initial value 297.668809
## iter 10 value 89.724371
## iter 20 value 73.869595
## iter 30 value 67.507374
## iter 40 value 57.282067
## iter 50 value 55.513047
## iter 60 value 55.404544
## iter 70 value 55.345057
## iter 80 value 55.315824
## iter 90 value 55.302615
## iter 100 value 55.291236
## final value 55.291236
## stopped after 100 iterations
## # weights: 16
## initial value 303.048633
## iter 10 value 66.734387
## iter 20 value 42.952762
## iter 30 value 34.028018
## iter 40 value 33.310212
## iter 50 value 32.914667
## iter 60 value 32.895984
## iter 70 value 32.890895
## iter 80 value 32.888314
## iter 90 value 32.882902
## iter 100 value 32.880992
## final value 32.880992
## stopped after 100 iterations
## # weights: 26
## initial value 226.320536
## iter 10 value 54.410465
## iter 20 value 42.181739
## iter 30 value 32.586486

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## iter 40 value 29.766069
## iter 50 value 27.080581
## iter 60 value 24.333015
## iter 70 value 23.427955
## iter 80 value 22.931336
## iter 90 value 22.881181
## iter 100 value 22.802484
## final value 22.802484
## stopped after 100 iterations
## # weights: 6
## initial value 330.302003
## iter 10 value 87.776629
## iter 20 value 72.102197
## iter 30 value 67.198910
## final value 67.198785
## converged
## # weights: 16
## initial value 315.618279
## iter 10 value 98.187021
## iter 20 value 53.852700
## iter 30 value 49.798664
## iter 40 value 48.043063
## iter 50 value 47.676015
## final value 47.674520
## converged
## # weights: 26
## initial value 260.160420
## iter 10 value 59.356145
## iter 20 value 49.835753
## iter 30 value 47.418031
## iter 40 value 46.829938
## iter 50 value 46.776721
## iter 60 value 46.775586
## final value 46.775552
## converged
## # weights: 6
## initial value 298.416879
## iter 10 value 85.143662
## iter 20 value 78.726251
## iter 30 value 65.241101
## iter 40 value 56.320509
## iter 50 value 55.521228
## iter 60 value 55.451300
## iter 70 value 55.395462
## iter 80 value 55.384655
## iter 90 value 55.379226
## iter 100 value 55.377850
## final value 55.377850
## stopped after 100 iterations
## # weights: 16
## initial value 261.594145
## iter 10 value 56.933498
## iter 20 value 36.575174
## iter 30 value 34.668915

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## iter 40 value 33.797329
## iter 50 value 32.791917
## iter 60 value 32.662657
## iter 70 value 32.579266
## iter 80 value 32.564617
## iter 90 value 32.560422
## iter 100 value 32.541614
## final value 32.541614
## stopped after 100 iterations
## # weights: 26
## initial value 342.797697
## iter 10 value 56.559832
## iter 20 value 34.985087
## iter 30 value 28.466625
## iter 40 value 18.961453
## iter 50 value 17.890822
## iter 60 value 17.824527
## iter 70 value 17.794957
## iter 80 value 17.683837
## iter 90 value 17.617893
## iter 100 value 17.571962
## final value 17.571962
## stopped after 100 iterations
## # weights: 6
## initial value 263.869562
## iter 10 value 50.940389
## iter 20 value 40.860379
## iter 30 value 38.536553
## iter 40 value 38.000348
## iter 50 value 37.955740
## iter 60 value 37.894869
## final value 37.885777
## converged
## # weights: 16
## initial value 238.897720
## iter 10 value 39.632154
## iter 20 value 25.802300
## iter 30 value 7.508980
## iter 40 value 4.831918
## iter 50 value 3.993528
## iter 60 value 3.374637
## iter 70 value 3.303751
## iter 80 value 3.261186
## iter 90 value 3.252817
## iter 100 value 3.251042
## final value 3.251042
## stopped after 100 iterations
## # weights: 26
## initial value 301.408622
## iter 10 value 38.115840
## iter 20 value 12.950219
## iter 30 value 6.918055
## iter 40 value 4.116306
## iter 50 value 3.722342

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## iter 60 value 3.207401
## iter 70 value 2.727529
## iter 80 value 2.715034
## iter 90 value 2.707341
## iter 100 value 2.700781
## final value 2.700781
## stopped after 100 iterations
## # weights: 6
## initial value 281.882127
## iter 10 value 124.742121
## iter 20 value 63.858845
## iter 30 value 51.874131
## final value 51.677938
## converged
## # weights: 16
## initial value 316.978704
## iter 10 value 77.356636
## iter 20 value 44.739978
## iter 30 value 43.441094
## iter 40 value 37.924030
## iter 50 value 32.270437
## iter 60 value 31.918112
## final value 31.916642
## converged
## # weights: 26
## initial value 307.733864
## iter 10 value 50.841125
## iter 20 value 33.084015
## iter 30 value 29.777515
## iter 40 value 29.575952
## iter 50 value 29.435532
## final value 29.432909
## converged
## # weights: 6
## initial value 284.068406
## iter 10 value 80.674950
## iter 20 value 61.288199
## iter 30 value 56.762554
## iter 40 value 56.411153
## iter 50 value 56.401160
## iter 60 value 56.372533
## iter 70 value 56.367110
## final value 56.367088
## converged
## # weights: 16
## initial value 263.938177
## iter 10 value 38.448092
## iter 20 value 12.817871
## iter 30 value 8.897863
## iter 40 value 8.553645
## iter 50 value 7.399107
## iter 60 value 6.844026
## iter 70 value 6.715154
## iter 80 value 6.700710

```

```

## iter  90 value 6.671042
## iter 100 value 6.582748
## final  value 6.582748
## stopped after 100 iterations
## # weights:  26
## initial  value 285.576357
## iter   10 value 33.872003
## iter   20 value 10.654807
## iter   30 value 4.150199
## iter   40 value 3.559893
## iter   50 value 3.484891
## iter   60 value 3.436324
## iter   70 value 3.402288
## iter   80 value 3.379523
## iter   90 value 3.373431
## iter 100 value 3.358546
## final  value 3.358546
## stopped after 100 iterations
## # weights:  6
## initial  value 306.589340
## iter   10 value 95.733893
## iter   20 value 58.240411
## iter   30 value 53.130864
## iter   40 value 52.333275
## iter   50 value 52.288734
## iter   60 value 52.232297
## iter   70 value 52.217781
## iter   80 value 52.203178
## iter   90 value 52.190381
## iter 100 value 52.182264
## final  value 52.182264
## stopped after 100 iterations
## # weights:  16
## initial  value 282.447707
## iter   10 value 57.400445
## iter   20 value 46.251408
## iter   30 value 43.915761
## iter   40 value 38.687314
## iter   50 value 37.368385
## iter   60 value 36.895495
## iter   70 value 36.769579
## iter   80 value 36.331772
## iter   90 value 36.262659
## iter 100 value 35.971718
## final  value 35.971718
## stopped after 100 iterations
## # weights:  26
## initial  value 354.123169
## iter   10 value 53.462834
## iter   20 value 42.208165
## iter   30 value 33.338950
## iter   40 value 26.290173
## iter   50 value 23.659122
## iter   60 value 20.578613

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## iter 70 value 15.914363
## iter 80 value 14.252200
## iter 90 value 12.267162
## iter 100 value 11.347197
## final value 11.347197
## stopped after 100 iterations
## # weights: 6
## initial value 296.804657
## iter 10 value 83.384563
## iter 20 value 64.922265
## final value 64.638134
## converged
## # weights: 16
## initial value 266.814452
## iter 10 value 59.928319
## iter 20 value 55.344527
## iter 30 value 48.569813
## iter 40 value 47.222928
## iter 50 value 46.646869
## iter 60 value 46.528976
## final value 46.528919
## converged
## # weights: 26
## initial value 288.224442
## iter 10 value 56.650716
## iter 20 value 48.795277
## iter 30 value 46.007718
## iter 40 value 43.941449
## iter 50 value 42.889589
## iter 60 value 42.793697
## iter 70 value 42.751278
## final value 42.751020
## converged
## # weights: 6
## initial value 254.607092
## iter 10 value 66.959113
## iter 20 value 53.942842
## iter 30 value 52.498599
## iter 40 value 52.305512
## iter 50 value 52.290409
## iter 60 value 52.284838
## iter 70 value 52.270274
## iter 80 value 52.268504
## final value 52.268311
## converged
## # weights: 16
## initial value 291.422727
## iter 10 value 96.011952
## iter 20 value 47.010020
## iter 30 value 42.506716
## iter 40 value 42.289467
## iter 50 value 41.573933
## iter 60 value 41.398529
## iter 70 value 41.287325

```

```

## iter  80 value 41.219334
## iter  90 value 41.056967
## iter 100 value 40.959891
## final  value 40.959891
## stopped after 100 iterations
## # weights:  26
## initial  value 302.084760
## iter   10 value 66.201330
## iter   20 value 39.969195
## iter   30 value 30.411689
## iter   40 value 25.782411
## iter   50 value 23.440307
## iter   60 value 20.790096
## iter   70 value 20.275722
## iter   80 value 20.203572
## iter   90 value 20.145587
## iter 100 value 20.086796
## final  value 20.086796
## stopped after 100 iterations
## # weights:  6
## initial  value 376.169062
## iter   10 value 79.427834
## iter   20 value 76.356805
## iter   30 value 73.476283
## iter   40 value 73.427913
## iter   50 value 73.396961
## iter   60 value 73.392926
## iter   70 value 73.347501
## iter   80 value 73.342782
## iter   90 value 73.338099
## iter 100 value 73.313375
## final  value 73.313375
## stopped after 100 iterations
## # weights:  16
## initial  value 240.920580
## iter   10 value 56.970317
## iter   20 value 44.428104
## iter   30 value 40.429241
## iter   40 value 37.924157
## iter   50 value 37.152923
## iter   60 value 36.153317
## iter   70 value 36.016621
## iter   80 value 36.003451
## iter   90 value 36.003222
## final  value 36.001237
## converged
## # weights:  26
## initial  value 242.532912
## iter   10 value 43.505906
## iter   20 value 34.908408
## iter   30 value 31.985780
## iter   40 value 31.002311
## iter   50 value 30.669470
## iter   60 value 30.470554

```

```

## iter 70 value 28.670855
## iter 80 value 27.386704
## iter 90 value 27.322494
## iter 100 value 27.235326
## final value 27.235326
## stopped after 100 iterations
## # weights: 6
## initial value 277.620593
## iter 10 value 89.572618
## iter 20 value 72.460105
## iter 30 value 70.434051
## final value 70.432765
## converged
## # weights: 16
## initial value 282.142547
## iter 10 value 63.751707
## iter 20 value 59.278153
## iter 30 value 57.882567
## iter 40 value 57.734315
## final value 57.725605
## converged
## # weights: 26
## initial value 362.958574
## iter 10 value 59.667359
## iter 20 value 56.241871
## iter 30 value 55.093743
## iter 40 value 54.525246
## iter 50 value 54.494882
## iter 60 value 54.491859
## iter 70 value 54.491783
## final value 54.491775
## converged
## # weights: 6
## initial value 271.761497
## iter 10 value 71.238089
## iter 20 value 62.852561
## iter 30 value 58.621790
## iter 40 value 57.784460
## iter 50 value 57.693503
## iter 60 value 57.651151
## iter 70 value 57.624559
## iter 80 value 57.597937
## iter 90 value 57.591674
## iter 100 value 57.581521
## final value 57.581521
## stopped after 100 iterations
## # weights: 16
## initial value 273.844937
## iter 10 value 54.399727
## iter 20 value 42.731714
## iter 30 value 35.478498
## iter 40 value 33.688454
## iter 50 value 32.370068
## iter 60 value 31.646408

```

```

## iter  70 value 31.439916
## iter  80 value 31.302227
## iter  90 value 31.228425
## iter 100 value 31.169512
## final  value 31.169512
## stopped after 100 iterations
## # weights:  26
## initial  value 282.331741
## iter   10 value 60.225830
## iter   20 value 41.671838
## iter   30 value 26.932186
## iter   40 value 21.415999
## iter   50 value 21.083981
## iter   60 value 20.874562
## iter   70 value 20.770571
## iter   80 value 20.740863
## iter   90 value 20.722234
## iter 100 value 20.634785
## final  value 20.634785
## stopped after 100 iterations
## # weights:  6
## initial  value 315.284295
## iter   10 value 93.701230
## iter   20 value 58.059886
## iter   30 value 53.019640
## iter   40 value 51.927664
## iter   50 value 51.880415
## iter   60 value 51.808938
## iter   70 value 51.748638
## iter   80 value 51.712120
## iter   90 value 51.708797
## iter 100 value 51.695802
## final  value 51.695802
## stopped after 100 iterations
## # weights:  16
## initial  value 287.072494
## iter   10 value 55.465888
## iter   20 value 35.367298
## iter   30 value 30.326016
## iter   40 value 27.070075
## iter   50 value 23.354571
## iter   60 value 21.915110
## iter   70 value 21.007679
## iter   80 value 20.765968
## iter   90 value 20.657751
## iter 100 value 20.511873
## final  value 20.511873
## stopped after 100 iterations
## # weights:  26
## initial  value 279.334723
## iter   10 value 48.377771
## iter   20 value 32.997630
## iter   30 value 29.699067
## iter   40 value 28.313335

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```

## iter 50 value 26.372597
## iter 60 value 25.454886
## iter 70 value 25.227341
## iter 80 value 25.101788
## iter 90 value 24.477187
## iter 100 value 24.424635
## final value 24.424635
## stopped after 100 iterations
## # weights: 6
## initial value 250.272204
## iter 10 value 66.230083
## iter 20 value 63.090294
## final value 62.890712
## converged
## # weights: 16
## initial value 301.538031
## iter 10 value 86.849877
## iter 20 value 63.104812
## iter 30 value 56.952609
## iter 40 value 54.893490
## iter 50 value 54.349645
## final value 54.349520
## converged
## # weights: 26
## initial value 321.496531
## iter 10 value 58.527226
## iter 20 value 49.576085
## iter 30 value 48.421772
## iter 40 value 47.634602
## iter 50 value 46.957192
## iter 60 value 46.953642
## iter 70 value 46.912761
## iter 80 value 46.906459
## iter 80 value 46.906459
## final value 46.906459
## converged
## # weights: 6
## initial value 266.312891
## iter 10 value 56.145885
## iter 20 value 52.448066
## iter 30 value 52.012802
## iter 40 value 51.873017
## iter 50 value 51.857872
## iter 60 value 51.834281
## iter 70 value 51.831312
## iter 80 value 51.829519
## iter 90 value 51.829034
## final value 51.828803
## converged
## # weights: 16
## initial value 290.615779
## iter 10 value 51.937973
## iter 20 value 42.471105

```

```

## iter 30 value 38.685733
## iter 40 value 36.783944
## iter 50 value 35.876195
## iter 60 value 34.786412
## iter 70 value 34.746700
## iter 80 value 34.742886
## iter 90 value 34.734664
## iter 100 value 34.726956
## final value 34.726956
## stopped after 100 iterations
## # weights: 26
## initial value 200.414547
## iter 10 value 49.938295
## iter 20 value 33.367758
## iter 30 value 27.539390
## iter 40 value 24.973410
## iter 50 value 24.705734
## iter 60 value 24.483345
## iter 70 value 24.390044
## iter 80 value 24.210133
## iter 90 value 23.930054
## iter 100 value 23.879719
## final value 23.879719
## stopped after 100 iterations
## # weights: 6
## initial value 303.541826
## iter 10 value 56.816458
## iter 20 value 52.013358
## iter 30 value 51.921191
## iter 40 value 51.765996
## iter 50 value 51.744166
## iter 60 value 51.740238
## iter 70 value 51.739108
## iter 80 value 51.738915
## iter 90 value 51.738818
## final value 51.738810
## converged
## # weights: 16
## initial value 286.227642
## iter 10 value 61.790718
## iter 20 value 37.242357
## iter 30 value 28.454840
## iter 40 value 27.713137
## iter 50 value 25.626842
## iter 60 value 23.262515
## iter 70 value 23.154050
## iter 80 value 22.965024
## iter 90 value 22.502747
## iter 100 value 22.383091
## final value 22.383091
## stopped after 100 iterations
## # weights: 26
## initial value 256.343958
## iter 10 value 35.922659

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```

## iter 20 value 23.709094
## iter 30 value 18.287095
## iter 40 value 12.543096
## iter 50 value 11.009103
## iter 60 value 10.180739
## iter 70 value 9.492202
## iter 80 value 9.161039
## iter 90 value 9.066779
## iter 100 value 8.931184
## final value 8.931184
## stopped after 100 iterations
## # weights: 6
## initial value 272.276975
## iter 10 value 59.998475
## iter 20 value 51.314017
## final value 51.312332
## converged
## # weights: 16
## initial value 252.665180
## iter 10 value 45.775087
## iter 20 value 42.021600
## iter 30 value 39.436587
## iter 40 value 38.134387
## iter 50 value 37.509819
## final value 37.509513
## converged
## # weights: 26
## initial value 335.684582
## iter 10 value 98.136077
## iter 20 value 48.429676
## iter 30 value 40.944732
## iter 40 value 37.310809
## iter 50 value 36.543380
## iter 60 value 36.359708
## iter 70 value 36.248496
## iter 80 value 36.244721
## final value 36.244721
## converged
## # weights: 6
## initial value 318.276521
## iter 10 value 43.894471
## iter 20 value 39.187692
## iter 30 value 38.321083
## iter 40 value 38.061342
## iter 50 value 38.012555
## iter 60 value 37.980238
## iter 70 value 37.961705
## iter 80 value 37.949939
## iter 90 value 37.941224
## iter 100 value 37.928964
## final value 37.928964
## stopped after 100 iterations
## # weights: 16
## initial value 267.854193

```

```

## iter 10 value 38.656006
## iter 20 value 24.795829
## iter 30 value 22.898721
## iter 40 value 22.324178
## iter 50 value 22.070041
## iter 60 value 21.317657
## iter 70 value 20.925885
## iter 80 value 20.914740
## iter 90 value 20.912309
## iter 100 value 20.909159
## final value 20.909159
## stopped after 100 iterations
## # weights: 26
## initial value 287.582804
## iter 10 value 31.668893
## iter 20 value 21.561475
## iter 30 value 18.543340
## iter 40 value 17.961111
## iter 50 value 17.618971
## iter 60 value 17.216579
## iter 70 value 16.890352
## iter 80 value 16.725469
## iter 90 value 16.672675
## iter 100 value 16.591825
## final value 16.591825
## stopped after 100 iterations
## # weights: 6
## initial value 306.123780
## iter 10 value 73.611025
## iter 20 value 59.974411
## iter 30 value 47.610223
## iter 40 value 46.039868
## iter 50 value 45.972706
## iter 60 value 45.921529
## iter 70 value 45.856003
## iter 80 value 45.848443
## iter 90 value 45.835226
## iter 100 value 45.828177
## final value 45.828177
## stopped after 100 iterations
## # weights: 16
## initial value 266.473555
## iter 10 value 47.601798
## iter 20 value 42.884793
## iter 30 value 36.170073
## iter 40 value 31.309647
## iter 50 value 28.739703
## iter 60 value 28.678170
## iter 70 value 28.677800
## final value 28.677799
## converged
## # weights: 26
## initial value 317.738488
## iter 10 value 62.960725

```

```

## iter 20 value 39.272133
## iter 30 value 28.598682
## iter 40 value 17.827194
## iter 50 value 11.273238
## iter 60 value 9.830066
## iter 70 value 9.738945
## iter 80 value 9.544723
## iter 90 value 9.357750
## iter 100 value 9.192589
## final value 9.192589
## stopped after 100 iterations
## # weights: 6
## initial value 291.110345
## iter 10 value 78.029823
## iter 20 value 58.455986
## final value 58.373971
## converged
## # weights: 16
## initial value 295.883678
## iter 10 value 57.801103
## iter 20 value 50.930339
## iter 30 value 48.341995
## iter 40 value 46.861091
## iter 50 value 46.802511
## final value 46.802509
## converged
## # weights: 26
## initial value 297.606904
## iter 10 value 52.167897
## iter 20 value 49.074463
## iter 30 value 48.508768
## iter 40 value 46.707794
## iter 50 value 46.398175
## iter 60 value 46.344561
## iter 70 value 46.337660
## final value 46.337210
## converged
## # weights: 6
## initial value 309.272146
## iter 10 value 77.805483
## iter 20 value 49.286044
## iter 30 value 46.236768
## iter 40 value 46.026542
## iter 50 value 45.945981
## iter 60 value 45.935477
## iter 70 value 45.928307
## iter 80 value 45.926736
## iter 90 value 45.923289
## iter 100 value 45.921858
## final value 45.921858
## stopped after 100 iterations
## # weights: 16
## initial value 276.628856
## iter 10 value 63.057518

```

```

## iter 20 value 44.860294
## iter 30 value 40.528849
## iter 40 value 37.607778
## iter 50 value 35.849326
## iter 60 value 35.431388
## iter 70 value 35.334498
## iter 80 value 35.254043
## iter 90 value 35.145653
## iter 100 value 35.139315
## final value 35.139315
## stopped after 100 iterations
## # weights: 26
## initial value 450.181565
## iter 10 value 49.048943
## iter 20 value 40.238571
## iter 30 value 30.955877
## iter 40 value 29.452410
## iter 50 value 27.318988
## iter 60 value 26.734543
## iter 70 value 25.046528
## iter 80 value 24.936492
## iter 90 value 24.816891
## iter 100 value 24.748782
## final value 24.748782
## stopped after 100 iterations
## # weights: 6
## initial value 295.832829
## iter 10 value 86.081034
## iter 20 value 77.835054
## iter 30 value 73.765814
## iter 40 value 63.421692
## iter 50 value 62.243818
## iter 60 value 62.172037
## iter 70 value 62.101067
## iter 80 value 62.042851
## iter 90 value 62.033591
## iter 100 value 62.029600
## final value 62.029600
## stopped after 100 iterations
## # weights: 16
## initial value 307.436206
## iter 10 value 104.073421
## iter 20 value 59.464032
## iter 30 value 56.893545
## iter 40 value 56.128494
## iter 50 value 53.109848
## iter 60 value 52.189710
## final value 52.042960
## converged
## # weights: 26
## initial value 307.219107
## iter 10 value 64.555234
## iter 20 value 44.137101
## iter 30 value 37.364215

```

```

## iter 40 value 27.061193
## iter 50 value 18.012196
## iter 60 value 13.802502
## iter 70 value 12.985722
## iter 80 value 11.747562
## iter 90 value 11.342608
## iter 100 value 10.805066
## final value 10.805066
## stopped after 100 iterations
## # weights: 6
## initial value 280.247852
## iter 10 value 115.302801
## iter 20 value 74.394776
## final value 73.200625
## converged
## # weights: 16
## initial value 292.280656
## iter 10 value 72.678967
## iter 20 value 62.764073
## iter 30 value 58.737251
## iter 40 value 52.385860
## iter 50 value 51.145320
## final value 51.144742
## converged
## # weights: 26
## initial value 291.204172
## iter 10 value 69.631225
## iter 20 value 56.311521
## iter 30 value 52.418561
## iter 40 value 49.369738
## iter 50 value 46.072245
## iter 60 value 45.253588
## iter 70 value 45.027876
## iter 80 value 45.016880
## iter 80 value 45.016880
## iter 80 value 45.016880
## final value 45.016880
## converged
## # weights: 6
## initial value 289.777444
## iter 10 value 135.441584
## iter 20 value 74.607238
## final value 74.601900
## converged
## # weights: 16
## initial value 273.219843
## iter 10 value 76.079403
## iter 20 value 54.558126
## iter 30 value 50.248699
## iter 40 value 48.381261
## iter 50 value 46.923774
## iter 60 value 45.509849
## iter 70 value 45.324461
## iter 80 value 44.961701

```

```

## iter  90 value 44.953029
## iter 100 value 44.951137
## final  value 44.951137
## stopped after 100 iterations
## # weights:  26
## initial  value 268.164790
## iter   10 value 66.373622
## iter   20 value 41.466522
## iter   30 value 36.344907
## iter   40 value 32.186484
## iter   50 value 30.576457
## iter   60 value 29.662168
## iter   70 value 28.224332
## iter   80 value 27.865194
## iter   90 value 27.159705
## iter 100 value 26.680773
## final  value 26.680773
## stopped after 100 iterations
## # weights:  6
## initial  value 352.074590
## iter   10 value 114.240707
## iter   20 value 84.559283
## iter   30 value 80.709039
## iter   40 value 80.026939
## iter   50 value 79.713578
## iter   60 value 79.672680
## iter   70 value 79.107198
## iter   80 value 79.098094
## iter   90 value 79.088190
## iter 100 value 79.027607
## final  value 79.027607
## stopped after 100 iterations
## # weights:  16
## initial  value 313.469594
## iter   10 value 28.667446
## iter   20 value 23.514658
## iter   30 value 21.486347
## iter   40 value 20.011530
## iter   50 value 17.963437
## iter   60 value 16.624277
## iter   70 value 16.475608
## iter   80 value 16.418382
## iter   90 value 16.176661
## iter 100 value 16.129100
## final  value 16.129100
## stopped after 100 iterations
## # weights:  26
## initial  value 316.641523
## iter   10 value 35.275222
## iter   20 value 17.886585
## iter   30 value 4.124230
## iter   40 value 0.861611
## iter   50 value 0.162714
## iter   60 value 0.043981

```

```

## iter  70 value 0.026543
## iter  80 value 0.009345
## iter  90 value 0.003781
## iter 100 value 0.003043
## final  value 0.003043
## stopped after 100 iterations
## # weights:  6
## initial  value 338.419063
## iter   10 value 58.817604
## iter   20 value 54.186336
## final  value 54.169078
## converged
## # weights: 16
## initial  value 295.825131
## iter   10 value 53.708296
## iter   20 value 46.361228
## iter   30 value 38.937475
## iter   40 value 36.824836
## iter   50 value 36.203048
## final  value 36.202984
## converged
## # weights: 26
## initial  value 216.075112
## iter   10 value 67.453935
## iter   20 value 38.868787
## iter   30 value 34.782035
## iter   40 value 33.931437
## iter   50 value 33.709771
## iter   60 value 33.687619
## iter   70 value 33.685990
## final  value 33.685987
## converged
## # weights:  6
## initial  value 273.555563
## iter   10 value 51.306532
## iter   20 value 43.011515
## iter   30 value 41.092107
## iter   40 value 40.743572
## iter   50 value 40.724433
## iter   60 value 40.722543
## iter   70 value 40.712534
## iter   80 value 40.712248
## iter   80 value 40.712248
## final  value 40.712247
## converged
## # weights: 16
## initial  value 356.807123
## iter   10 value 52.298069
## iter   20 value 49.443575
## iter   30 value 44.218411
## iter   40 value 30.383089
## iter   50 value 27.188344
## iter   60 value 26.645932
## iter   70 value 26.434769

```

```

## iter  80 value 26.374207
## iter  90 value 26.292896
## iter 100 value 26.282992
## final  value 26.282992
## stopped after 100 iterations
## # weights:  26
## initial  value 313.704560
## iter   10 value 26.818892
## iter   20 value 13.452882
## iter   30 value 0.796472
## iter   40 value 0.601382
## iter   50 value 0.569483
## iter   60 value 0.542754
## iter   70 value 0.514416
## iter   80 value 0.479583
## iter   90 value 0.440185
## iter 100 value 0.423433
## final  value 0.423433
## stopped after 100 iterations
## # weights:  6
## initial  value 249.866077
## iter   10 value 92.934186
## iter   20 value 88.766256
## iter   30 value 84.814908
## iter   40 value 83.871387
## iter   50 value 83.090418
## iter   60 value 83.050389
## iter   70 value 83.049175
## iter   80 value 83.044818
## iter   90 value 83.043514
## iter 100 value 83.040998
## final  value 83.040998
## stopped after 100 iterations
## # weights:  16
## initial  value 331.982852
## iter   10 value 73.051817
## iter   20 value 51.205926
## iter   30 value 47.034641
## iter   40 value 46.720519
## iter   50 value 46.044818
## iter   60 value 42.928083
## iter   70 value 42.714446
## iter   80 value 42.452445
## iter   90 value 41.688065
## iter 100 value 41.601097
## final  value 41.601097
## stopped after 100 iterations
## # weights:  26
## initial  value 322.944818
## iter   10 value 46.444992
## iter   20 value 32.019952
## iter   30 value 15.005848
## iter   40 value 11.842518
## iter   50 value 11.793866

```

```

## iter 60 value 10.665597
## iter 70 value 10.636536
## iter 80 value 10.634253
## iter 90 value 10.628436
## iter 100 value 10.627664
## final value 10.627664
## stopped after 100 iterations
## # weights: 6
## initial value 299.981815
## iter 10 value 117.905513
## iter 20 value 72.529458
## iter 30 value 66.488260
## final value 66.472221
## converged
## # weights: 16
## initial value 243.102663
## iter 10 value 65.617772
## iter 20 value 58.744869
## iter 30 value 53.014870
## iter 40 value 52.309147
## iter 50 value 52.213126
## final value 52.212945
## converged
## # weights: 26
## initial value 258.292732
## iter 10 value 60.117606
## iter 20 value 51.277564
## iter 30 value 49.030733
## iter 40 value 48.501419
## iter 50 value 48.436190
## iter 60 value 48.435832
## final value 48.435821
## converged
## # weights: 6
## initial value 263.288236
## iter 10 value 86.132452
## iter 20 value 84.110883
## iter 30 value 72.556614
## iter 40 value 55.608494
## iter 50 value 54.845645
## iter 60 value 54.483839
## iter 70 value 54.411759
## iter 80 value 54.404902
## final value 54.400287
## converged
## # weights: 16
## initial value 321.858751
## iter 10 value 57.437458
## iter 20 value 39.120481
## iter 30 value 37.214133
## iter 40 value 36.724754
## iter 50 value 36.186667
## iter 60 value 35.784762
## iter 70 value 35.747885

```

```

## iter  80 value 35.737898
## iter  90 value 35.725804
## iter 100 value 35.701318
## final  value 35.701318
## stopped after 100 iterations
## # weights:  26
## initial  value 365.040381
## iter   10 value 64.354963
## iter   20 value 39.890903
## iter   30 value 33.179633
## iter   40 value 28.604523
## iter   50 value 28.038485
## iter   60 value 27.732707
## iter   70 value 27.666124
## iter   80 value 27.623938
## iter   90 value 27.601670
## iter 100 value 27.356617
## final  value 27.356617
## stopped after 100 iterations
## # weights:  6
## initial  value 293.244474
## iter   10 value 77.661644
## iter   20 value 59.677012
## iter   30 value 57.467094
## iter   40 value 57.085777
## iter   50 value 57.016532
## iter   60 value 57.012102
## iter   70 value 56.993811
## iter   80 value 56.966153
## final  value 56.966151
## converged
## # weights:  16
## initial  value 301.852472
## iter   10 value 66.748379
## iter   20 value 44.516024
## iter   30 value 43.201336
## iter   40 value 42.097594
## iter   50 value 37.493097
## iter   60 value 37.048961
## iter   70 value 37.018331
## iter   80 value 37.017840
## final  value 37.017839
## converged
## # weights:  26
## initial  value 333.363848
## iter   10 value 102.749226
## iter   20 value 47.179702
## iter   30 value 35.567596
## iter   40 value 29.588583
## iter   50 value 27.553058
## iter   60 value 27.396758
## iter   70 value 27.386664
## iter   80 value 27.377400
## iter   90 value 27.355929

```

```

## iter 100 value 27.354348
## final value 27.354348
## stopped after 100 iterations
## # weights: 6
## initial value 285.786397
## iter 10 value 73.667181
## iter 20 value 68.853864
## final value 68.814365
## converged
## # weights: 16
## initial value 270.364366
## iter 10 value 62.512181
## iter 20 value 54.517597
## iter 30 value 53.479213
## iter 40 value 53.337351
## final value 53.317202
## converged
## # weights: 26
## initial value 339.283606
## iter 10 value 59.731693
## iter 20 value 49.347905
## iter 30 value 47.974124
## iter 40 value 44.395313
## iter 50 value 43.669103
## iter 60 value 43.588910
## iter 70 value 43.575178
## final value 43.575025
## converged
## # weights: 6
## initial value 346.717491
## iter 10 value 76.733249
## iter 20 value 70.225031
## iter 30 value 61.142357
## iter 40 value 57.437588
## iter 50 value 57.142181
## iter 60 value 57.089742
## iter 70 value 57.078662
## iter 80 value 57.072273
## iter 90 value 57.067905
## iter 100 value 57.062488
## final value 57.062488
## stopped after 100 iterations
## # weights: 16
## initial value 440.380720
## iter 10 value 49.968699
## iter 20 value 36.175584
## iter 30 value 33.060953
## iter 40 value 32.722726
## iter 50 value 32.430083
## iter 60 value 32.182252
## iter 70 value 32.120426
## iter 80 value 32.102296
## iter 90 value 32.088790
## iter 100 value 32.071769

```

```

## final value 32.071769
## stopped after 100 iterations
## # weights: 26
## initial value 311.153316
## iter 10 value 45.738588
## iter 20 value 27.389007
## iter 30 value 21.767548
## iter 40 value 17.451734
## iter 50 value 14.901905
## iter 60 value 14.334698
## iter 70 value 13.372851
## iter 80 value 12.254659
## iter 90 value 9.220397
## iter 100 value 5.538819
## final value 5.538819
## stopped after 100 iterations
## # weights: 6
## initial value 330.796291
## iter 10 value 45.299233
## iter 20 value 43.997137
## iter 30 value 43.730614
## iter 40 value 41.182002
## iter 50 value 40.160417
## iter 60 value 39.942844
## iter 70 value 39.926280
## iter 80 value 39.903911
## iter 90 value 39.881639
## iter 100 value 39.861699
## final value 39.861699
## stopped after 100 iterations
## # weights: 16
## initial value 280.600122
## iter 10 value 37.537086
## iter 20 value 25.237693
## iter 30 value 21.836695
## iter 40 value 20.558185
## iter 50 value 19.928662
## iter 60 value 19.162631
## iter 70 value 19.088981
## iter 80 value 19.065871
## iter 90 value 19.065671
## final value 19.065670
## converged
## # weights: 26
## initial value 331.367083
## iter 10 value 38.274676
## iter 20 value 24.223602
## iter 30 value 18.760538
## iter 40 value 16.817922
## iter 50 value 15.122635
## iter 60 value 14.833157
## iter 70 value 14.761131
## iter 80 value 14.741688
## iter 90 value 14.720474

```

```

## iter 100 value 14.680446
## final value 14.680446
## stopped after 100 iterations
## # weights: 6
## initial value 291.652181
## iter 10 value 57.683470
## iter 20 value 53.397244
## final value 53.162981
## converged
## # weights: 16
## initial value 275.824607
## iter 10 value 47.895415
## iter 20 value 41.444670
## iter 30 value 39.231364
## iter 40 value 38.933421
## iter 50 value 38.856996
## final value 38.856988
## converged
## # weights: 26
## initial value 348.512803
## iter 10 value 46.410514
## iter 20 value 40.448995
## iter 30 value 39.448257
## iter 40 value 38.478760
## iter 50 value 37.808978
## iter 60 value 37.759616
## iter 70 value 37.752820
## final value 37.752655
## converged
## # weights: 6
## initial value 275.053464
## iter 10 value 49.093125
## iter 20 value 44.391209
## iter 30 value 43.411159
## iter 40 value 40.784857
## iter 50 value 40.178764
## iter 60 value 40.033940
## iter 70 value 40.022675
## iter 80 value 40.011153
## iter 90 value 40.000853
## iter 100 value 39.996632
## final value 39.996632
## stopped after 100 iterations
## # weights: 16
## initial value 324.929407
## iter 10 value 50.962221
## iter 20 value 34.237504
## iter 30 value 32.001334
## iter 40 value 31.508814
## iter 50 value 31.320841
## iter 60 value 30.766659
## iter 70 value 30.387738
## iter 80 value 30.362039
## iter 90 value 30.352500

```

```

## iter 100 value 30.345498
## final value 30.345498
## stopped after 100 iterations
## # weights: 26
## initial value 269.774291
## iter 10 value 37.688401
## iter 20 value 23.422325
## iter 30 value 18.417543
## iter 40 value 15.461269
## iter 50 value 15.290505
## iter 60 value 14.615464
## iter 70 value 14.221535
## iter 80 value 13.813216
## iter 90 value 13.745292
## iter 100 value 13.668574
## final value 13.668574
## stopped after 100 iterations
## # weights: 6
## initial value 302.174852
## iter 10 value 59.028150
## iter 20 value 56.471205
## iter 30 value 55.774897
## iter 40 value 55.725108
## iter 50 value 55.607003
## iter 60 value 55.562247
## iter 70 value 55.544332
## iter 80 value 55.534730
## iter 90 value 55.526726
## iter 100 value 55.511336
## final value 55.511336
## stopped after 100 iterations
## # weights: 16
## initial value 280.098605
## iter 10 value 55.457924
## iter 20 value 45.480579
## iter 30 value 42.325705
## iter 40 value 36.900711
## iter 50 value 36.201820
## iter 60 value 34.395601
## iter 70 value 32.706595
## iter 80 value 32.268629
## iter 90 value 32.258021
## iter 100 value 32.251993
## final value 32.251993
## stopped after 100 iterations
## # weights: 26
## initial value 380.604645
## iter 10 value 56.123556
## iter 20 value 41.816939
## iter 30 value 36.674982
## iter 40 value 33.047657
## iter 50 value 31.848178
## iter 60 value 31.497036
## iter 70 value 31.134329

```

```

## iter  80 value 30.818976
## iter  90 value 30.562915
## iter 100 value 30.260614
## final  value 30.260614
## stopped after 100 iterations
## # weights:  6
## initial  value 257.691904
## iter   10 value 79.618112
## iter   20 value 67.862654
## final  value 67.567922
## converged
## # weights: 16
## initial  value 280.101338
## iter   10 value 76.818102
## iter   20 value 62.808292
## iter   30 value 59.136277
## iter   40 value 55.550377
## iter   50 value 55.266403
## final  value 55.266391
## converged
## # weights: 26
## initial  value 231.447346
## iter   10 value 58.695188
## iter   20 value 55.107774
## iter   30 value 54.615475
## iter   40 value 54.503543
## iter   50 value 54.502299
## final  value 54.502292
## converged
## # weights:  6
## initial  value 272.141754
## iter   10 value 62.119289
## iter   20 value 57.932233
## iter   30 value 56.018044
## iter   40 value 55.759525
## iter   50 value 55.744572
## iter   60 value 55.719562
## iter   70 value 55.716067
## iter   80 value 55.714323
## final  value 55.714170
## converged
## # weights: 16
## initial  value 237.188400
## iter   10 value 66.012425
## iter   20 value 43.261803
## iter   30 value 38.728352
## iter   40 value 36.315086
## iter   50 value 35.384825
## iter   60 value 35.034530
## iter   70 value 34.849516
## iter   80 value 34.739094
## iter   90 value 34.733849
## iter 100 value 34.696503
## final  value 34.696503

```

```

## stopped after 100 iterations
## # weights: 26
## initial value 293.388067
## iter 10 value 55.916917
## iter 20 value 41.744449
## iter 30 value 32.351394
## iter 40 value 30.875740
## iter 50 value 30.497988
## iter 60 value 29.957285
## iter 70 value 29.740859
## iter 80 value 29.371472
## iter 90 value 29.270441
## iter 100 value 29.227112
## final value 29.227112
## stopped after 100 iterations
## # weights: 6
## initial value 244.782010
## iter 10 value 67.749992
## iter 20 value 61.127030
## iter 30 value 60.751040
## iter 40 value 60.743407
## iter 40 value 60.743406
## final value 60.743406
## converged
## # weights: 16
## initial value 359.958531
## iter 10 value 60.550445
## iter 20 value 39.082423
## iter 30 value 32.491931
## iter 40 value 31.061367
## iter 50 value 30.043959
## iter 60 value 29.410078
## iter 70 value 29.185596
## iter 80 value 29.164703
## iter 90 value 29.158068
## iter 100 value 29.156516
## final value 29.156516
## stopped after 100 iterations
## # weights: 26
## initial value 300.175125
## iter 10 value 57.242495
## iter 20 value 40.603529
## iter 30 value 32.767666
## iter 40 value 30.603819
## iter 50 value 28.830739
## iter 60 value 26.703773
## iter 70 value 24.702594
## iter 80 value 22.881138
## iter 90 value 21.872714
## iter 100 value 21.415038
## final value 21.415038
## stopped after 100 iterations
## # weights: 6
## initial value 259.875690

```

```

## iter 10 value 84.693747
## iter 20 value 71.868886
## iter 30 value 69.759800
## final value 69.759794
## converged
## # weights: 16
## initial value 290.249854
## iter 10 value 77.020635
## iter 20 value 59.697735
## iter 30 value 53.762120
## iter 40 value 53.736374
## iter 40 value 53.736374
## iter 40 value 53.736374
## final value 53.736374
## converged
## # weights: 26
## initial value 199.673335
## iter 10 value 56.914338
## iter 20 value 49.077995
## iter 30 value 48.527155
## iter 40 value 48.302163
## iter 50 value 48.285802
## final value 48.285764
## converged
## # weights: 6
## initial value 302.940123
## iter 10 value 177.070621
## iter 20 value 126.632236
## iter 30 value 124.358633
## iter 40 value 124.241502
## final value 124.207472
## converged
## # weights: 16
## initial value 252.514248
## iter 10 value 86.477175
## iter 20 value 50.558640
## iter 30 value 46.216314
## iter 40 value 44.097105
## iter 50 value 41.506766
## iter 60 value 41.187746
## iter 70 value 40.771920
## iter 80 value 40.691320
## iter 90 value 40.606435
## iter 100 value 40.228388
## final value 40.228388
## stopped after 100 iterations
## # weights: 26
## initial value 315.688893
## iter 10 value 53.348555
## iter 20 value 33.423971
## iter 30 value 21.500992
## iter 40 value 20.875399
## iter 50 value 20.651362
## iter 60 value 20.427038

```

```

## iter 70 value 19.723160
## iter 80 value 17.540103
## iter 90 value 15.270920
## iter 100 value 14.668563
## final value 14.668563
## stopped after 100 iterations
## # weights: 6
## initial value 288.156050
## iter 10 value 59.911864
## iter 20 value 55.528195
## iter 30 value 54.533160
## iter 40 value 54.356532
## iter 50 value 54.315879
## iter 60 value 54.233999
## iter 70 value 54.205885
## iter 80 value 54.171231
## iter 90 value 54.124154
## iter 100 value 54.115943
## final value 54.115943
## stopped after 100 iterations
## # weights: 16
## initial value 267.657403
## iter 10 value 79.697990
## iter 20 value 34.160664
## iter 30 value 24.905741
## iter 40 value 23.750399
## iter 50 value 23.565678
## iter 60 value 23.397360
## iter 70 value 23.229961
## iter 80 value 23.191202
## iter 90 value 23.149394
## iter 100 value 22.926134
## final value 22.926134
## stopped after 100 iterations
## # weights: 26
## initial value 262.437212
## iter 10 value 31.210649
## iter 20 value 18.512499
## iter 30 value 11.370042
## iter 40 value 6.704360
## iter 50 value 6.193875
## iter 60 value 6.048044
## iter 70 value 5.957635
## iter 80 value 5.687354
## iter 90 value 5.622151
## iter 100 value 5.596268
## final value 5.596268
## stopped after 100 iterations
## # weights: 6
## initial value 235.549592
## iter 10 value 70.427479
## iter 20 value 67.526076
## final value 67.526007
## converged

```

```

## # weights: 16
## initial value 310.491142
## iter 10 value 64.912423
## iter 20 value 48.193735
## iter 30 value 43.871847
## iter 40 value 43.616013
## iter 50 value 43.604145
## final value 43.604144
## converged
## # weights: 26
## initial value 448.732018
## iter 10 value 102.217788
## iter 20 value 52.200855
## iter 30 value 44.537189
## iter 40 value 42.780572
## iter 50 value 42.320061
## iter 60 value 41.811877
## iter 70 value 41.792532
## final value 41.792526
## converged
## # weights: 6
## initial value 261.414249
## iter 10 value 96.309634
## iter 20 value 94.110843
## iter 30 value 94.053317
## iter 40 value 93.375413
## final value 93.339975
## converged
## # weights: 16
## initial value 288.789805
## iter 10 value 68.761595
## iter 20 value 37.469443
## iter 30 value 31.593051
## iter 40 value 29.364329
## iter 50 value 27.517691
## iter 60 value 26.528990
## iter 70 value 25.351812
## iter 80 value 25.129377
## iter 90 value 24.767864
## iter 100 value 24.495130
## final value 24.495130
## stopped after 100 iterations
## # weights: 26
## initial value 300.262345
## iter 10 value 56.188596
## iter 20 value 25.972473
## iter 30 value 20.826653
## iter 40 value 17.257225
## iter 50 value 15.911603
## iter 60 value 15.472777
## iter 70 value 14.158468
## iter 80 value 12.666118
## iter 90 value 11.424247
## iter 100 value 9.988219

```


#Print results

results

	Algorithm	Duration	Accuracy
## 1	bagFDA	69	96.47
## 2	LogitBoost	2	97.65
## 3	nnet	8	97.06
## 4	svmRadialCost	3	94.12

Conclusions

Given that there is one main principal component PC1, most algorithms will perform with excellent accuracy. This example shows how large predictors can be easily compressed using PCA and then used for prediction.