Zastosowanie SOM dla danych giełdowych

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Dokument przedstawia zastosowanie map samoorganizujących na danych giełdowych. Wykorzystano dane giełdowe od początku stycznia do końcówki maja 2020, czyli obserwacje z czasów pandemii koronawirusa. Do pobrania danych wykorzystano bibliotekę quantmod. Analizie poddano dane 20. wielkich amerykańskich spółek technologicznych, w tym Amazon (AMZN), Apple (AAPL), Uber (UBER), Netflix (NFLX), Spotify (SPOT).

Mapy samoorganizujące to sieci neuronów, z którymi są stowarzyszone współrzędne na prostej, płaszczyźnie lub w dowolnej n-wymiarowej przestrzeni. Uczenietego tego rodzaju sieci polega na zmianach współrzędnych neuronów, tak, by dążyły one do wzorca zgodnego ze strukturą analizowanych danych. Sieci zatem „rozpinają się" wokół zbiorów danych, dopasowując do nich swoją strukturę. Sieci te klasyfikują wielowymiarowe dane wejściowe w taki sposób, by możliwa była ich reprezentacji w mniejszej ilości wymiarów - przeważnie dwóch - przy jednoczesnym jak najwierniejszym odwzorowaniu struktury wewnętrznej wektora wejściowego.

```
if (!require("quantmod")) {
    install.packages("quantmod")
    library(quantmod)
}
```

```
## Loading required package: quantmod
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
## Loading required package: TTR
```

```
## Version 0.4-0 included new data defaults. See ?getSymbols.
```

```
if (!require("kohonen")) {
    install.packages("kohonen")
    library(kohonen)
}
```

```
## Loading required package: kohonen
```

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:xts':
##
##     first, last
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

Pobierzmy dane z 4. miesięcy.

```
start <- as.Date("2020-01-01")
end <- as.Date("2020-05-01")

companies <- c("AMZN", "AAPL", "UBER", "NFLX", "SPOT", "MSFT", "GOOG", "FB", "BABA", "INTC", "NVDA", "P
fullnames <- c("Amazon.com", "Apple", "Uber Technologies", "Netflix", "Spotify Technology", "Microsoft

getSymbols(companies, from = start)
```

```
## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
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## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
```

```
##  [1] "AMZN" "AAPL" "UBER" "NFLX" "SPOT" "MSFT" "GOOG" "FB"   "BABA" "INTC"
## [11] "NVDA" "PYPL" "TSLA" "ATVI" "YELP" "MU"   "ISRG" "EA"   "CRM"  "AMD"
```

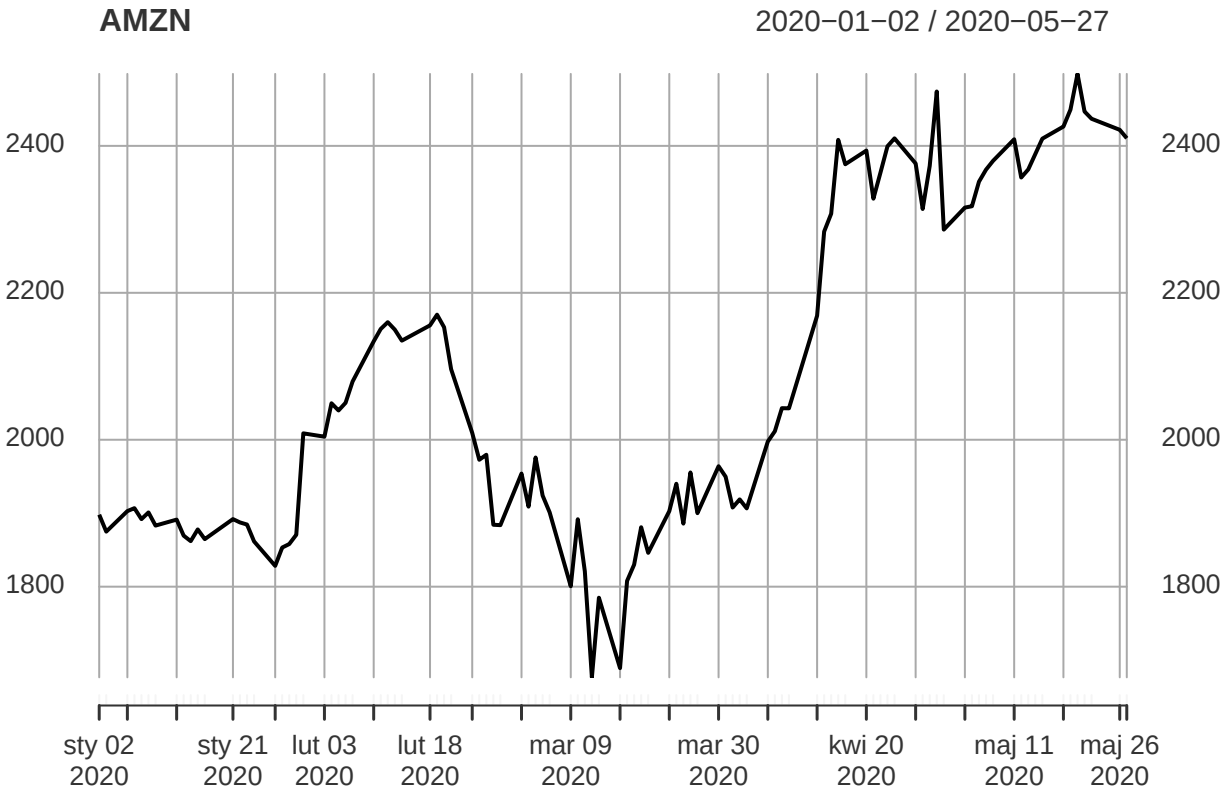
```
head(AMZN)
```

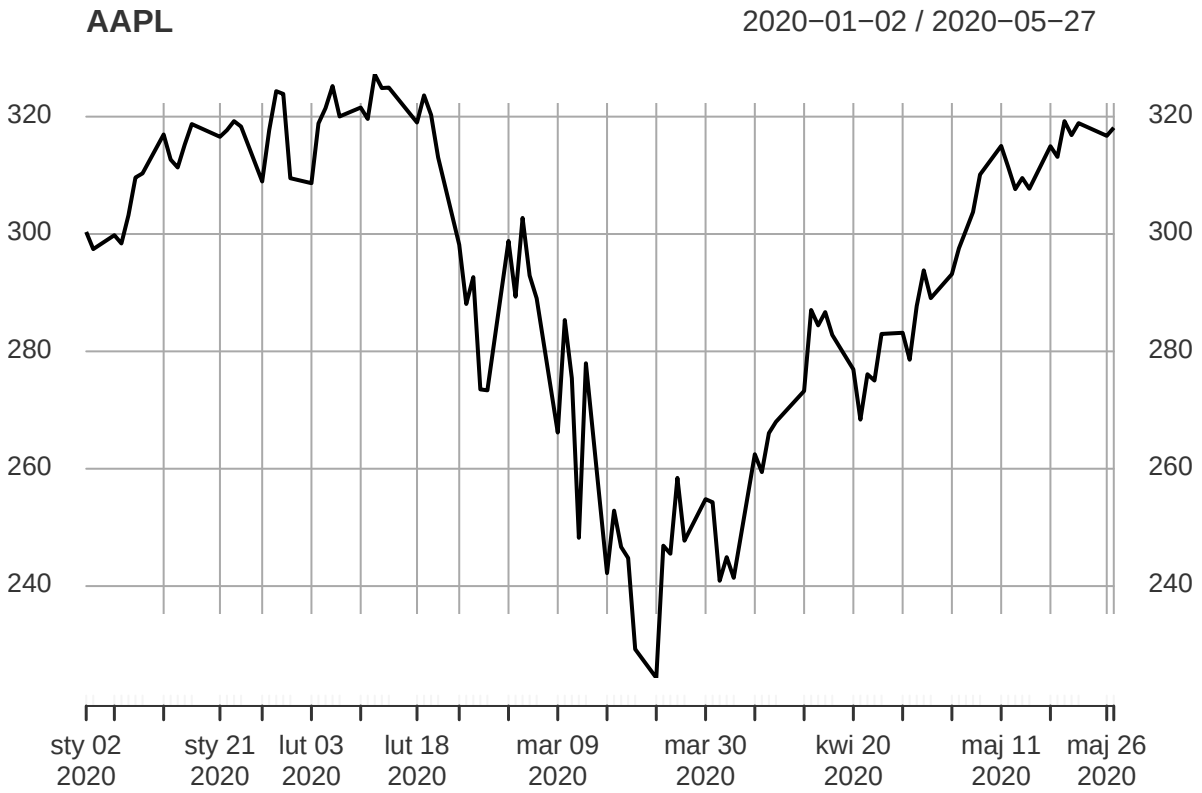
```
##            AMZN.Open AMZN.High AMZN.Low AMZN.Close AMZN.Volume AMZN.Adjusted
## 2020-01-02   1875.00   1898.01  1864.15    1898.01     4029000       1898.01
## 2020-01-03   1864.50   1886.20  1864.50    1874.97     3764400       1874.97
## 2020-01-06   1860.00   1903.69  1860.00    1902.88     4061800       1902.88
## 2020-01-07   1904.50   1913.89  1892.04    1906.86     4044900       1906.86
## 2020-01-08   1898.04   1911.00  1886.44    1891.97     3508000       1891.97
## 2020-01-09   1909.89   1917.82  1895.80    1901.05     3167300       1901.05
```

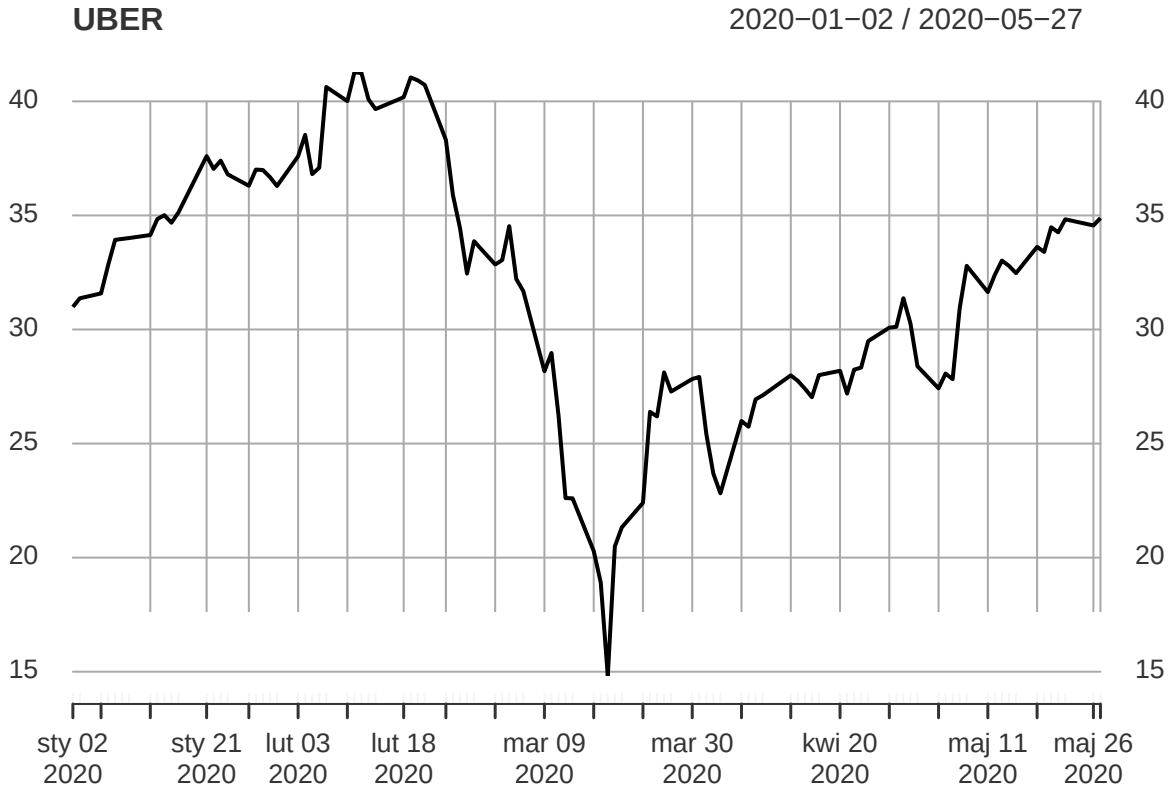
```
companies <- as.list(companies)
```

Sprawdźmy, jak prezentowały się przez wybrane 4 miesiące kursy wybranych spółek.

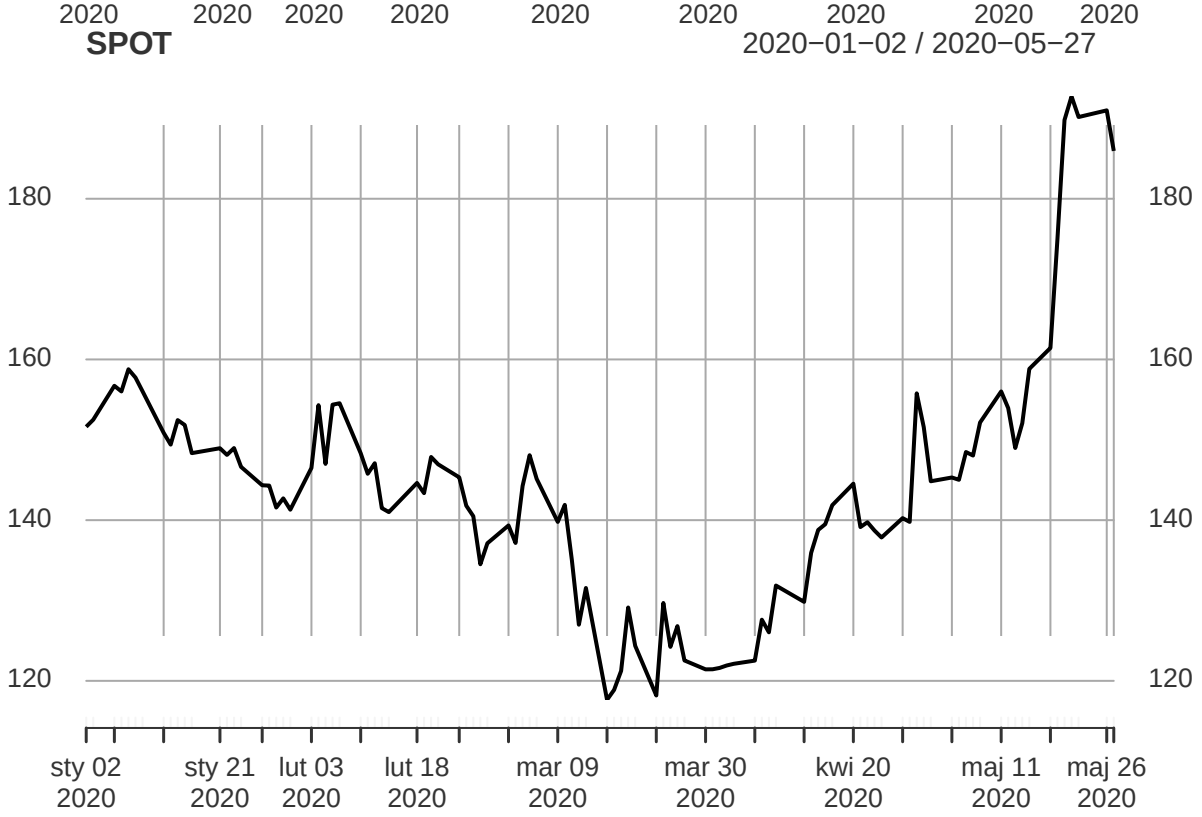
```
for (company in companies) {
  col <- paste(company, "Close", sep=".")
  print(plot(get(company)[, col], main = company))
}
```

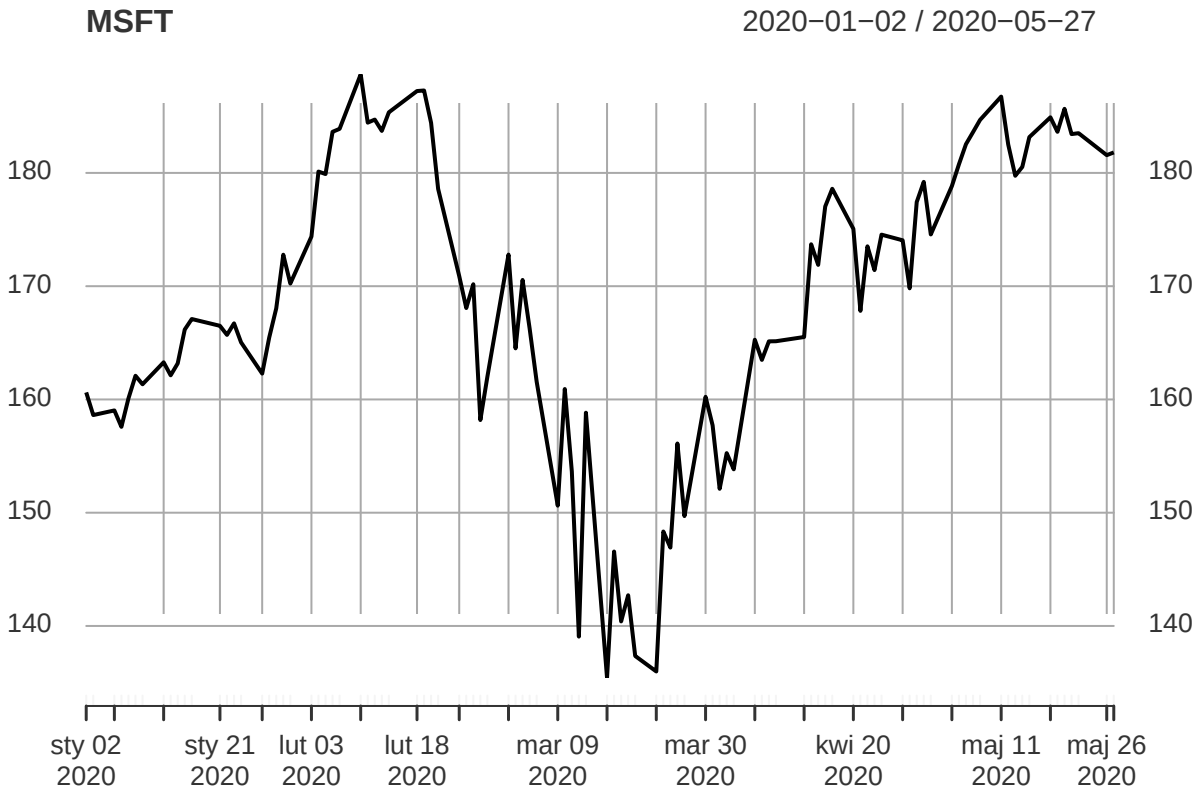


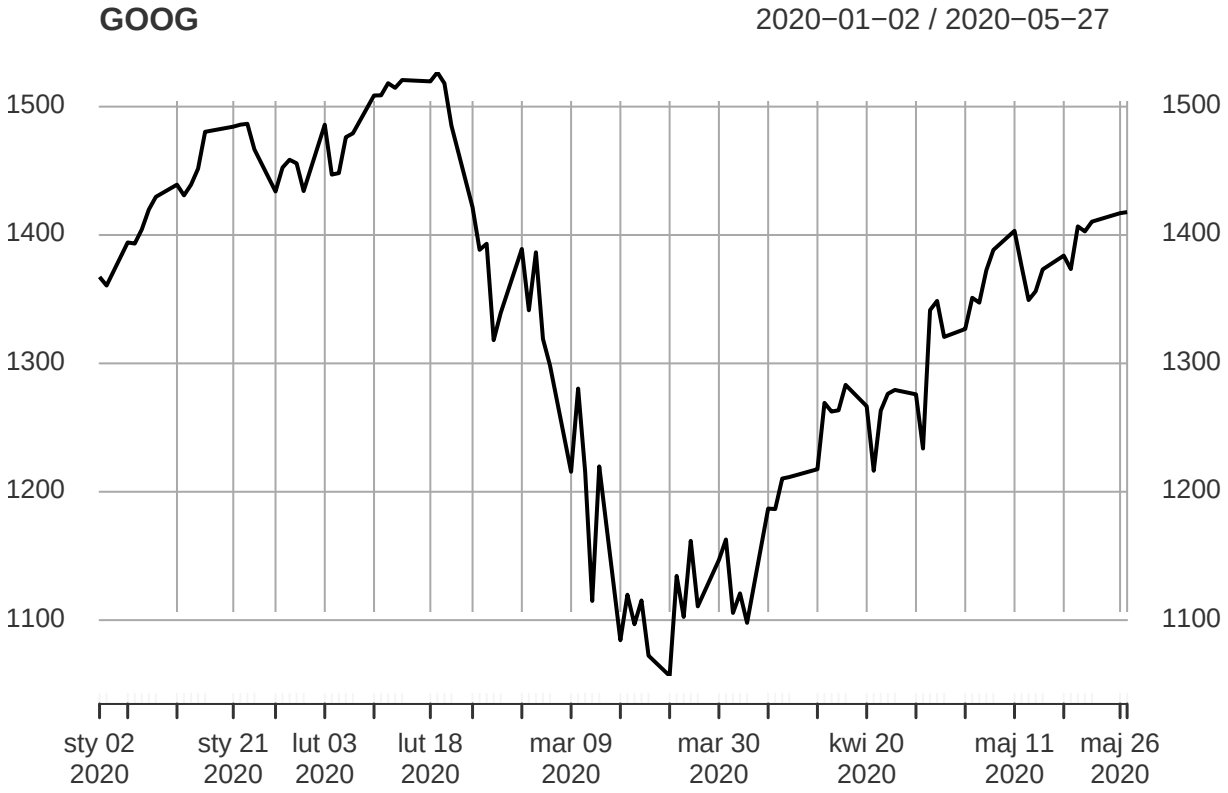

AAPL
2020−01−02 / 2020−05−27
320
300
280
260
240
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

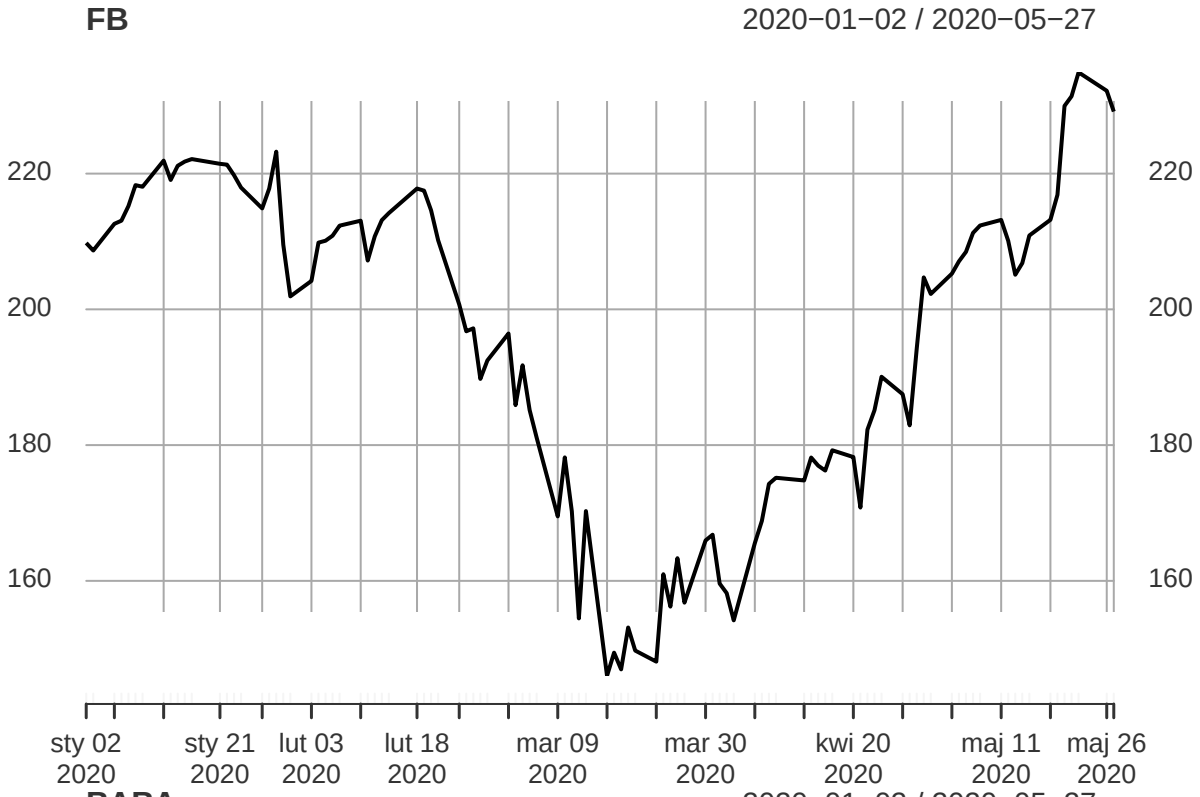

UBER
2020−01−02 / 2020−05−27
40
35
30
25
20
15
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

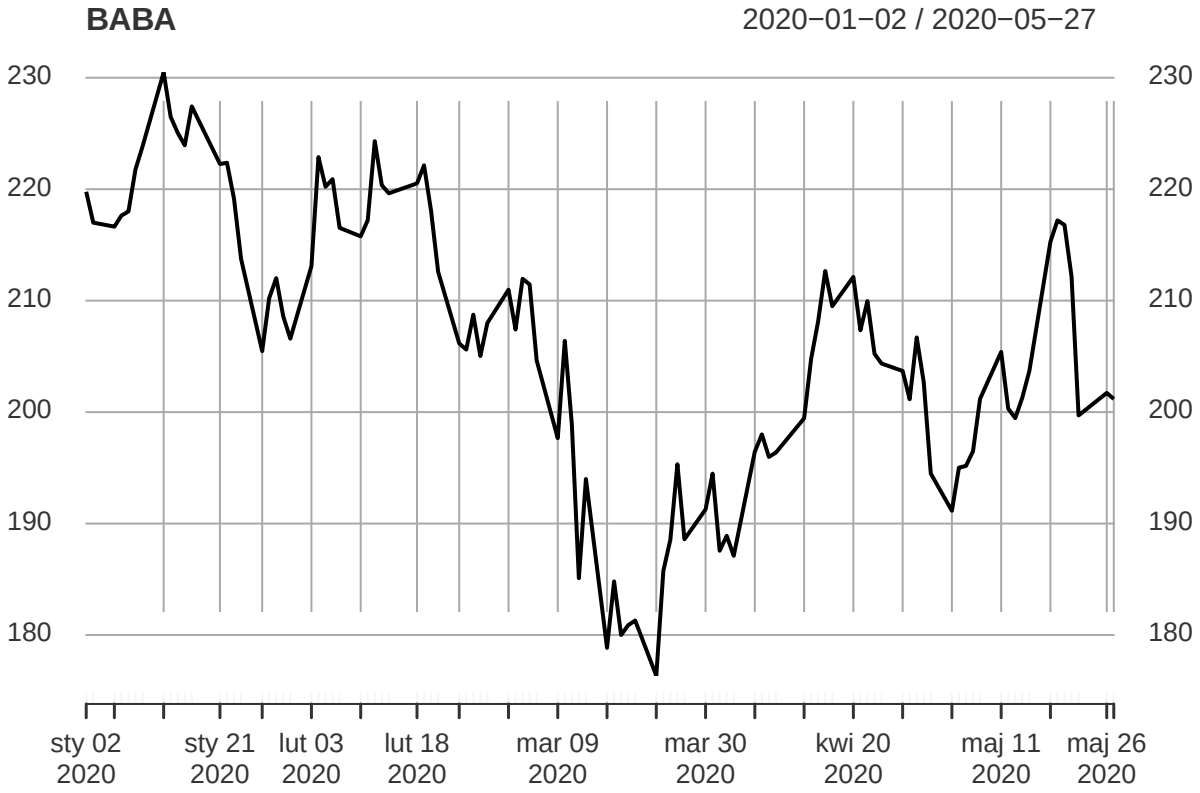

NFLX
2020−01−02 / 2020−05−27
450
400
350
300
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

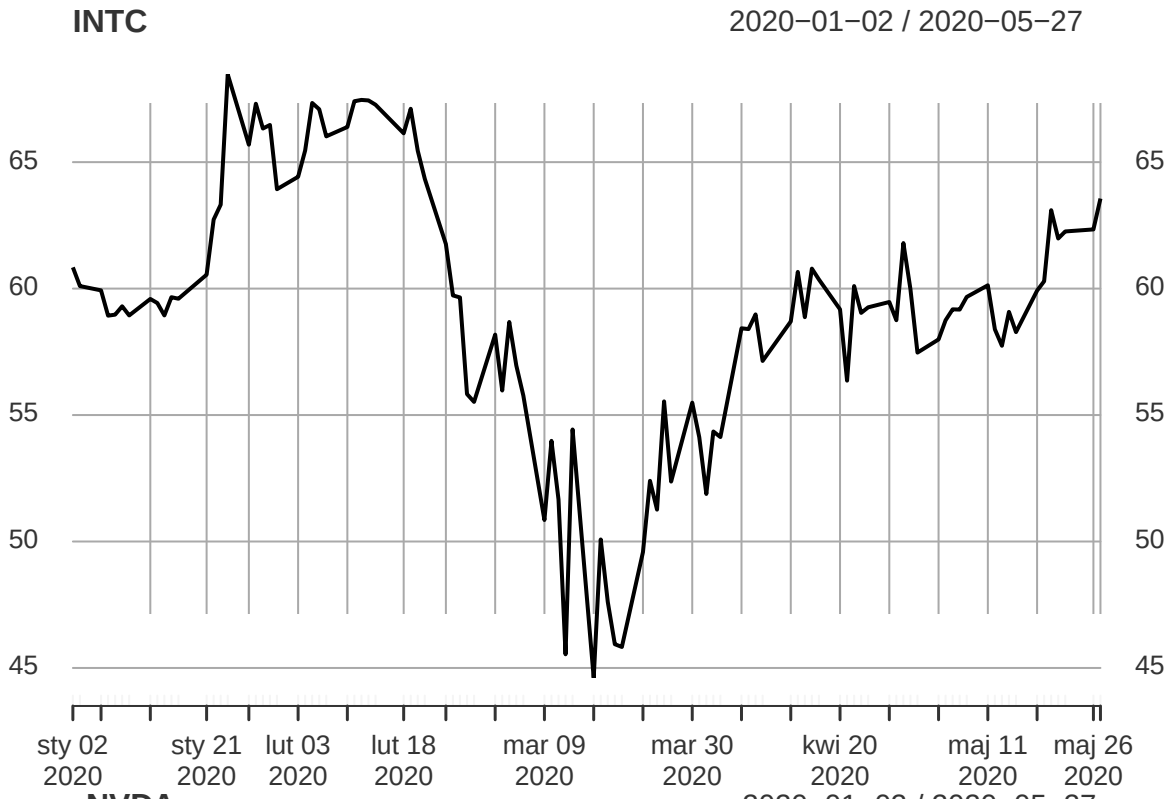

SPOT
2020−01−02 / 2020−05−27
180
160
140
120
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

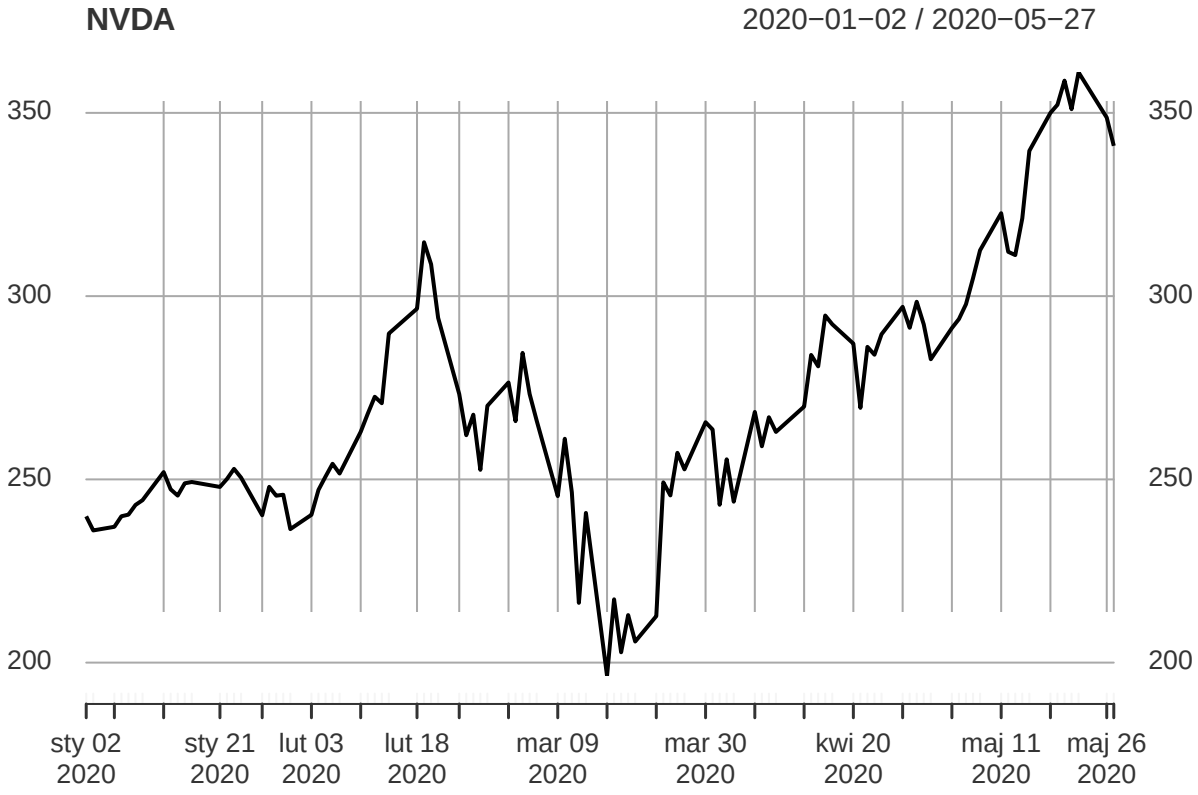

MSFT
2020−01−02 / 2020−05−27
180
170
160
150
140
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

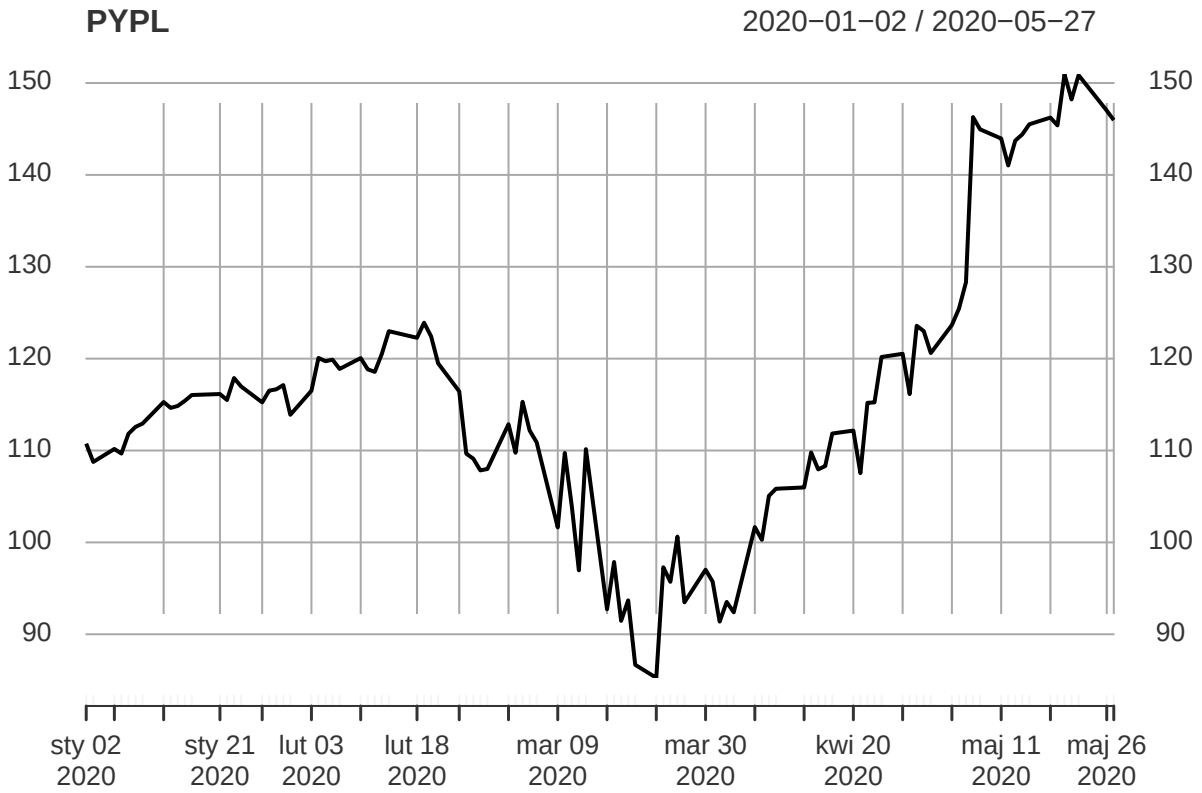

GOOG
2020−01−02 / 2020−05−27
1500
1400
1300
1200
1100
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

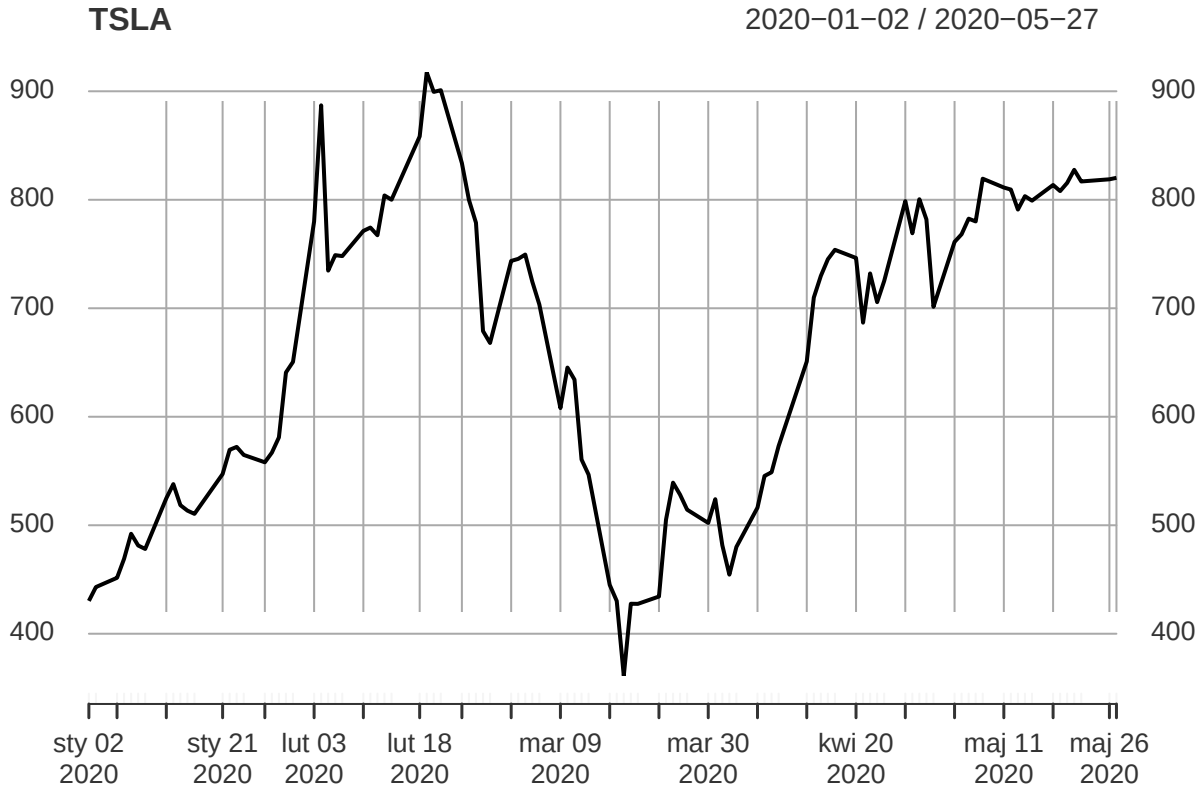

FB
2020−01−02 / 2020−05−27
220
200
180
160
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

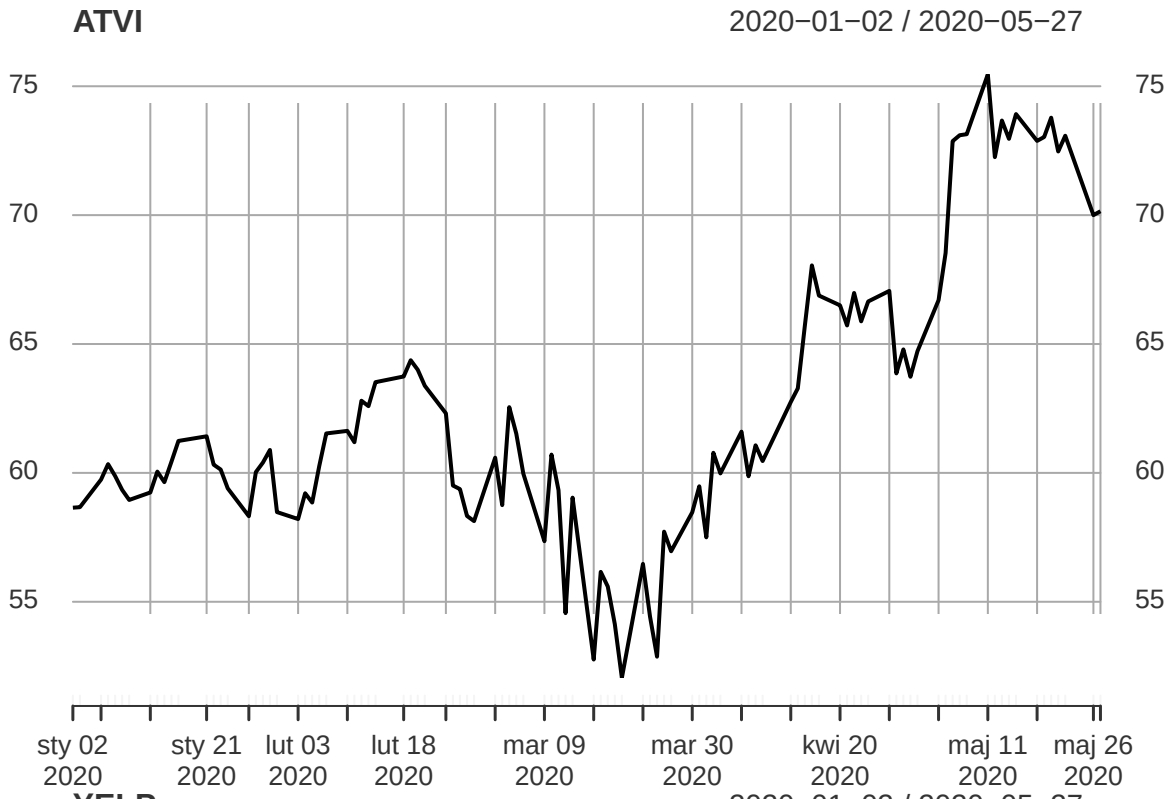

BABA
2020−01−02 / 2020−05−27
230
220
210
200
190
180
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

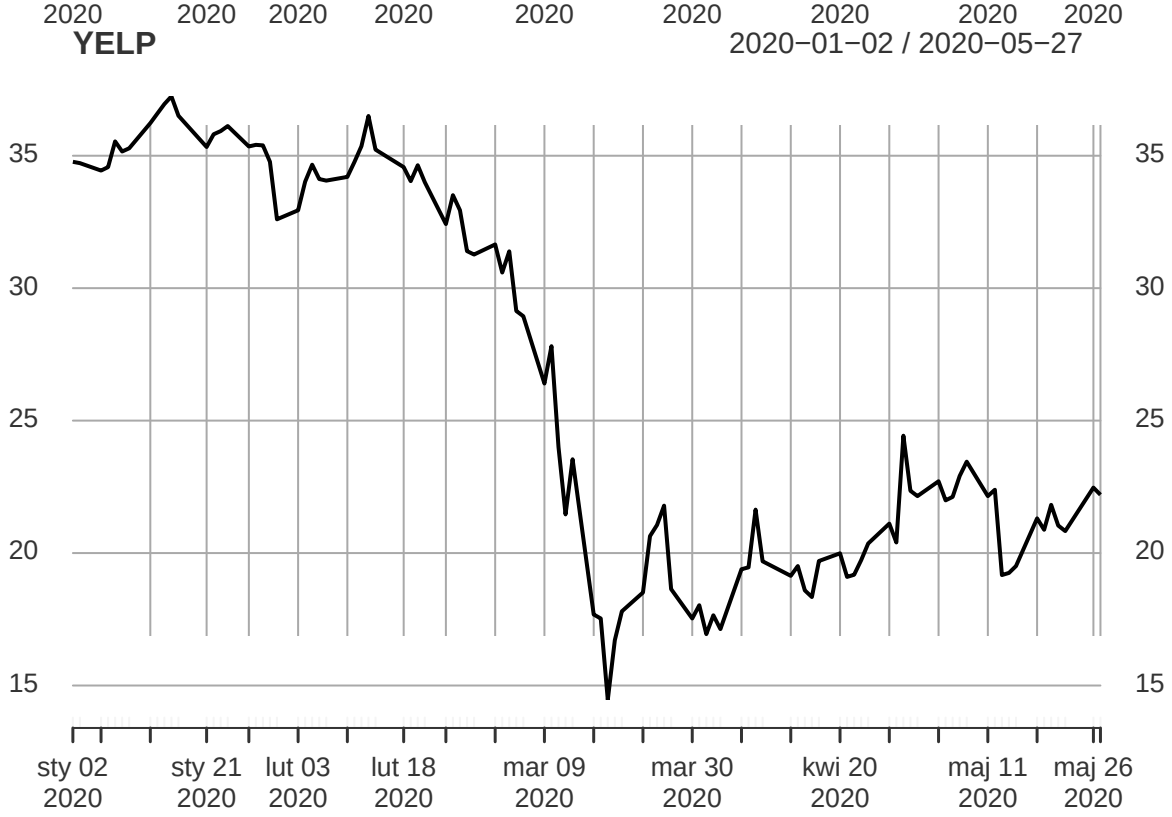

INTC
2020−01−02 / 2020−05−27
65
60
55
50
45
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

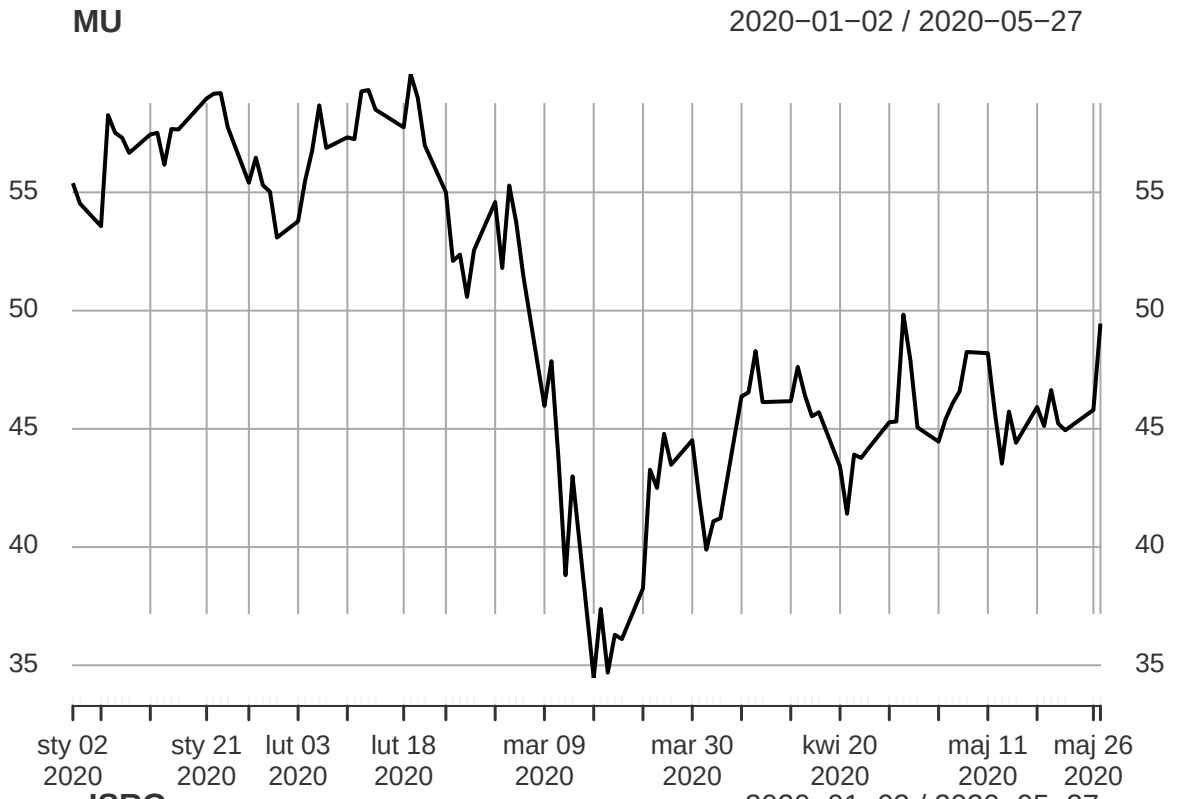

NVDA
2020−01−02 / 2020−05−27
350
300
250
200
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

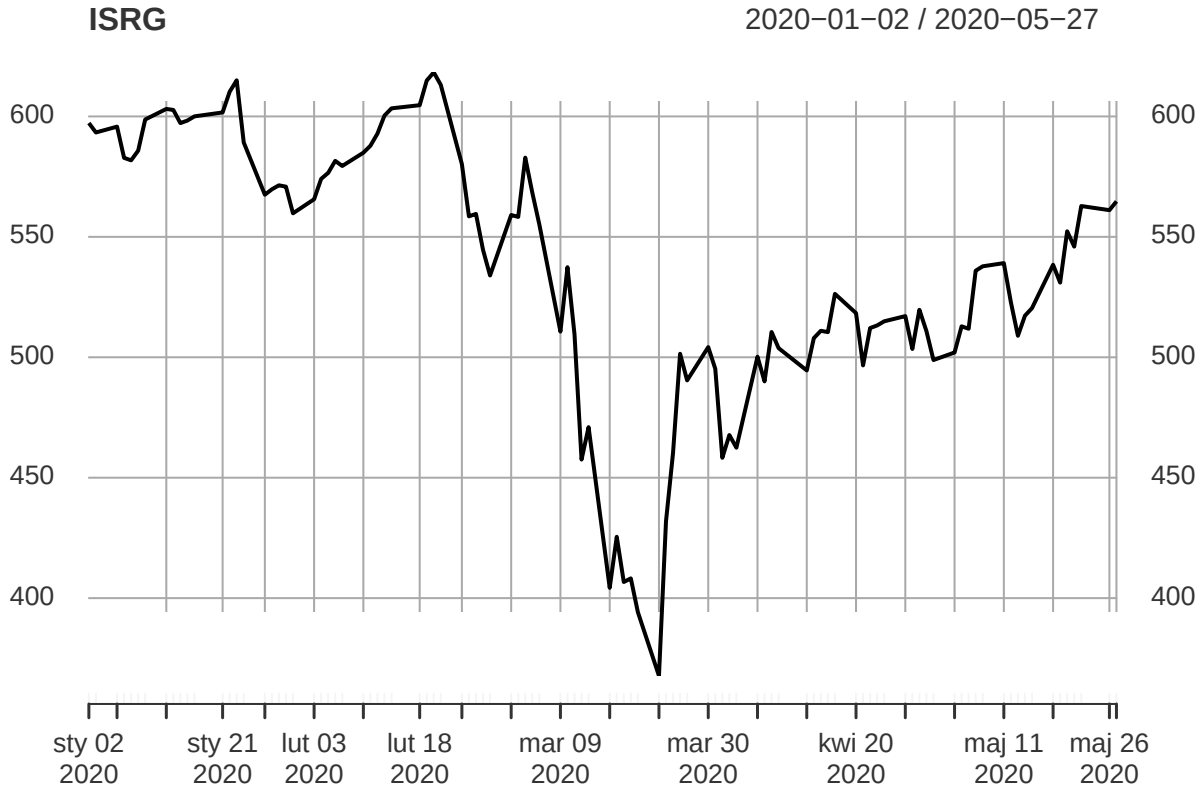

PYPL
2020−01−02 / 2020−05−27
150
140
130
120
110
100
90
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

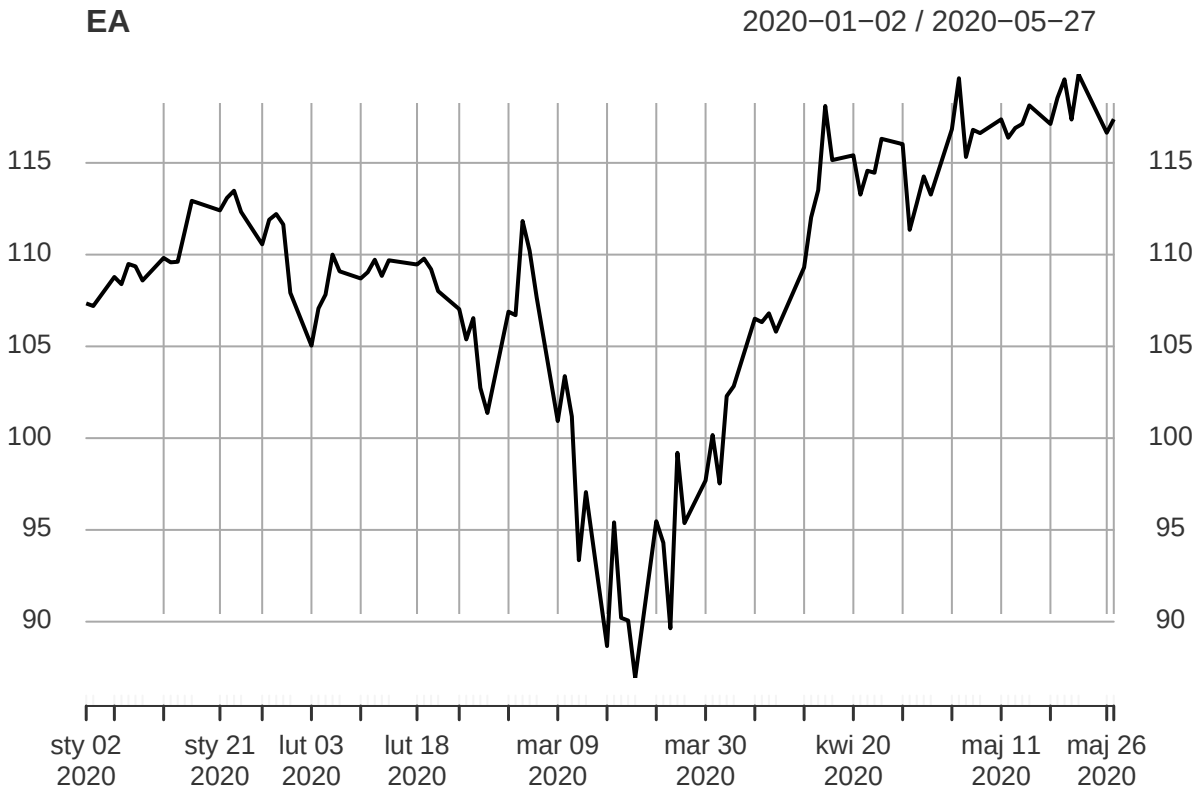

TSLA
2020−01−02 / 2020−05−27
900
800
700
600
500
400
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

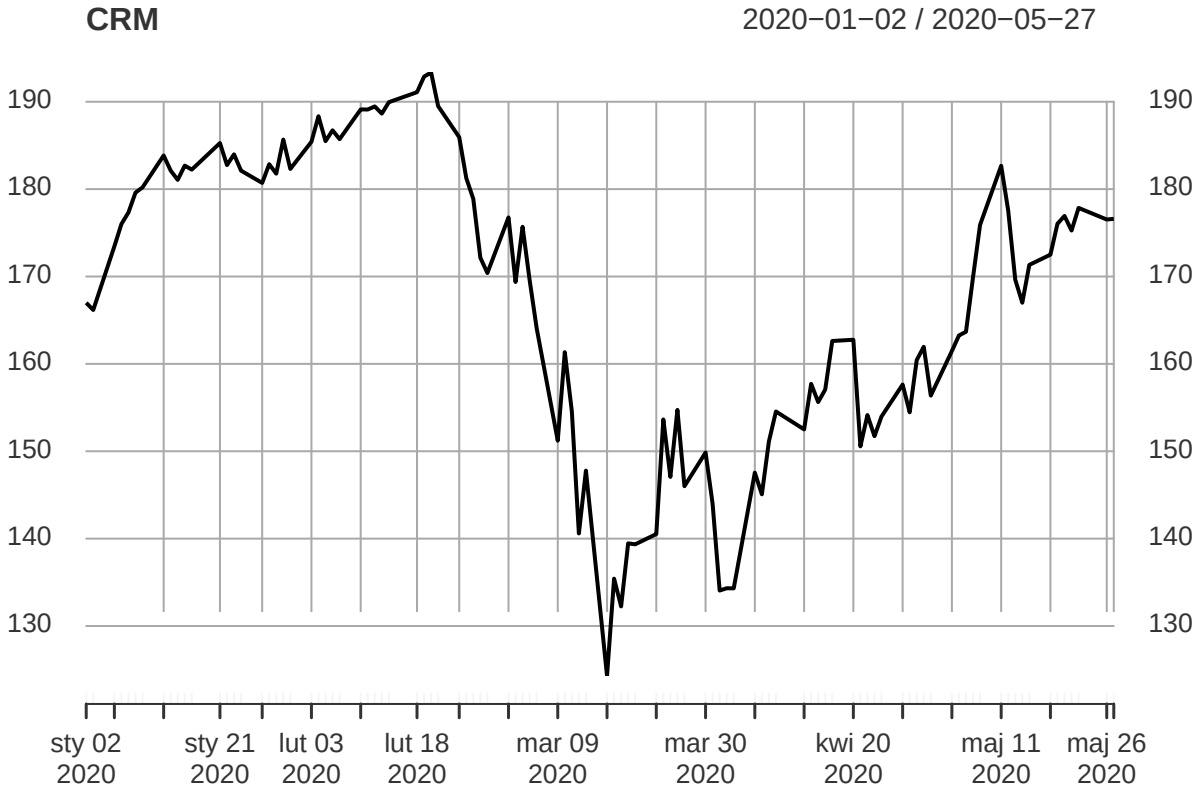

ATVI
2020−01−02 / 2020−05−27
75
70
65
60
55
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020

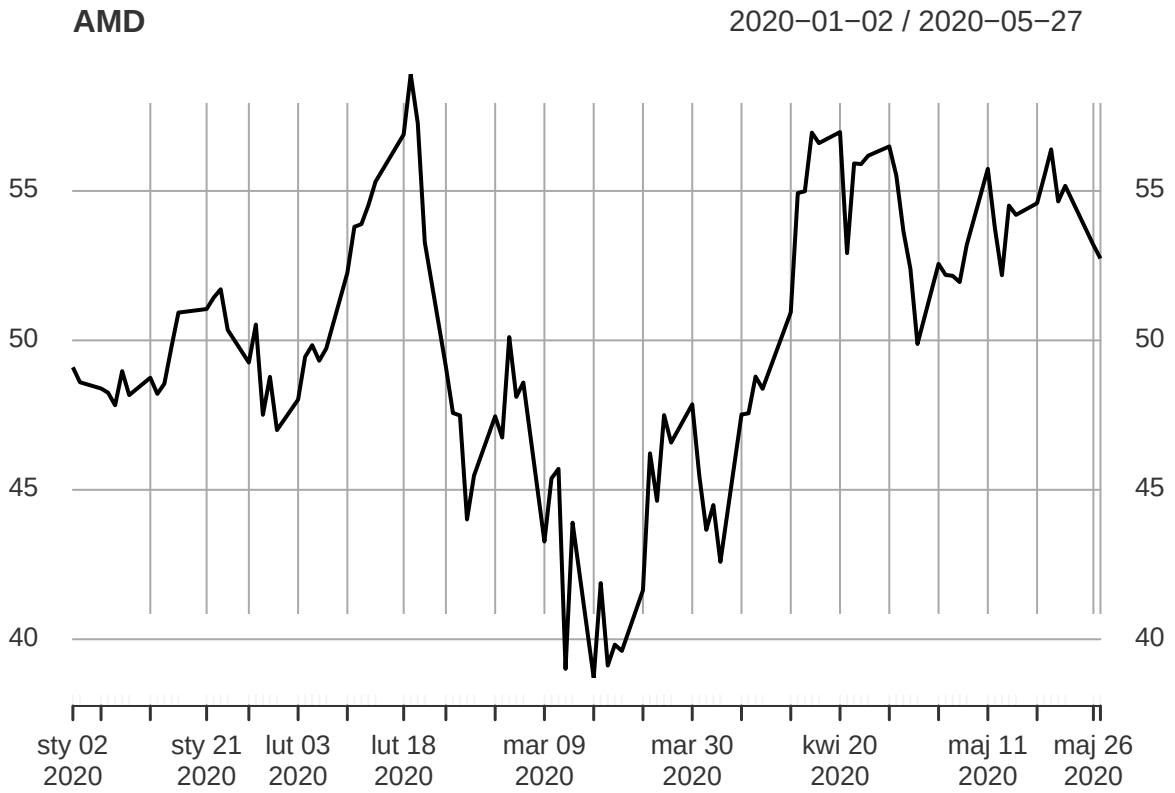

YELP
2020−01−02 / 2020−05−27
35
30
25
20
15
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020


MU
2020−01−02 / 2020−05−27
55
50
45
40
35
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020


ISRG
2020−01−02 / 2020−05−27
600
550
500
450
400
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020


EA
2020−01−02 / 2020−05−27
115
110
105
100
95
90
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020


CRM
2020−01−02 / 2020−05−27
190
180
170
160
150
140
130
sty 02 2020
sty 21 2020
lut 03 2020
lut 18 2020
mar 09 2020
mar 30 2020
kwi 20 2020
maj 11 2020
maj 26 2020



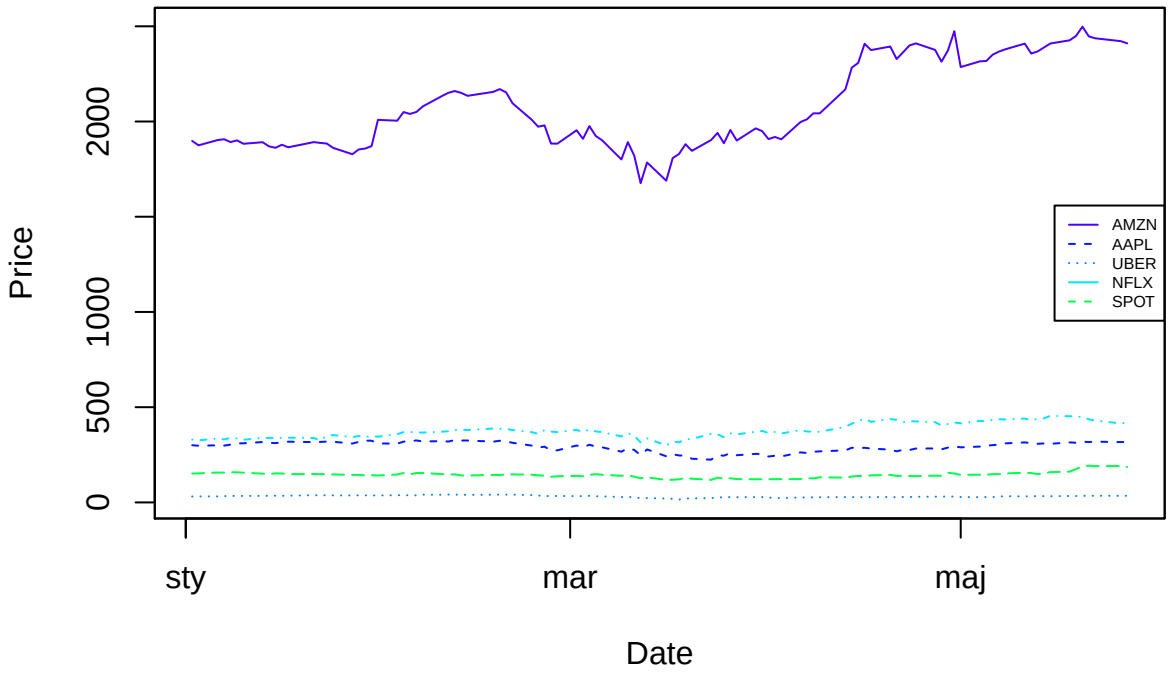
Możemy zaobserwować, że wszystkie wybrane spółki znacznie odczuły marcowe załamanie giełdowe. Niektóre z nich (Netflix, Amazon) zanotowały wkrótce wzrost wartości do poziomu wyższego niż przed załamaniem, podczas gdy inne nie wróciły na dawny poziom.

Sprawdźmy jeszcze na wspólnym wykresie jak prezentowały się ceny akcji wybranych spółek.

```
stocks <- as.xts(data.frame(AMZN = AMZN[, "AMZN.Close"], AAPL = AAPL[, "AAPL.Close"], UBER = UBER[, "UB
head(stocks)
```

```
##            AMZN.Close AAPL.Close UBER.Close NFLX.Close SPOT.Close
## 2020-01-02    1898.01     300.35      30.99     329.81     151.62
## 2020-01-03    1874.97     297.43      31.37     325.90     152.50
## 2020-01-06    1902.88     299.80      31.58     335.83     156.72
## 2020-01-07    1906.86     298.39      32.81     330.75     156.02
## 2020-01-08    1891.97     303.19      33.93     339.26     158.78
## 2020-01-09    1901.05     309.63      33.97     335.66     157.74
```

```
plot(as.zoo(stocks), screens = 1, lty = 1:5, xlab = "Date", ylab = "Price", col = topo.colors(10))
legend("right", c("AMZN", "AAPL", "UBER", "NFLX", "SPOT"), lty = 1:3, cex = 0.5, col = topo.colors(10))
```



Przeskalowano dane przed wykorzystaniem ich do analizy map samoorganizujących. Do wykonania analizy wykorzystano bibliotekę kohonen.

```
CORPS <- data.frame(AMZN[, 4], SPOT[, 4], AAPL[, 4], UBER[, 4], NFLX[, 4], ATVI[, 4], BABA[, 4], CRM[, 4

CORPS <- as.data.frame(t(as.matrix(CORPS)))

CORPS.sc = scale(CORPS)
head(CORPS.sc)
```

```
##              2020-01-02   2020-01-03   2020-01-06   2020-01-07   2020-01-08
## AMZN.Close  3.292997458  3.279845953  3.268879377  3.274227279  3.246755673
## SPOT.Close -0.372231494 -0.369529843 -0.364989276 -0.367335375 -0.367175162
## AAPL.Close -0.060084988 -0.062468462 -0.067230836 -0.071220755 -0.066061163
## UBER.Close -0.625403206 -0.626166472 -0.625413479 -0.623599197 -0.627503959
## NFLX.Close  0.001744051 -0.002149424  0.007749855 -0.003915397  0.009149585
## ATVI.Close -0.567351890 -0.568326307 -0.566810746 -0.566339700 -0.573394767
##              2020-01-09  2020-01-10   2020-01-13   2020-01-14  2020-01-15
## AMZN.Close  3.241247094  3.21456662  3.199757236  3.186144734  3.17861767
## SPOT.Close -0.370542433 -0.37465713 -0.394421478 -0.397017678 -0.38881902
## AAPL.Close -0.055856751 -0.05401855 -0.051427443 -0.056875139 -0.05725611
## UBER.Close -0.626969112 -0.62825441 -0.635481707 -0.635667406 -0.63388635
## NFLX.Close -0.001927802 -0.01511548 -0.006077592 -0.002691463  0.00060935
## ATVI.Close -0.574407551 -0.57642521 -0.583647451 -0.583150299 -0.58248982
##              2020-01-16   2020-01-17  2020-01-21  2020-01-22   2020-01-23
## AMZN.Close  3.182225779  3.144590036  3.15685726  3.14456930  3.137317195
## SPOT.Close -0.391275753 -0.399999785 -0.40072931 -0.40394683 -0.406109575
## AAPL.Close -0.052992833 -0.048118080 -0.05861480 -0.05797800 -0.058506201
## UBER.Close -0.633829162 -0.633795915 -0.62799604 -0.63056679 -0.633891238
## NFLX.Close -0.004589794 -0.004873741 -0.01465144 -0.04104477  0.003497277
## ATVI.Close -0.580519581 -0.579874730 -0.57937912 -0.58307208 -0.587485600
##             2020-01-24 2020-01-27  2020-01-28   2020-01-29   2020-01-30
## AMZN.Close  3.14368040  3.1527345  3.15415039  3.148038515  3.144408504
```

```
## SPOT.Close -0.40743359 -0.4041392 -0.40937186 -0.416141455 -0.417645718
## AAPL.Close -0.05195157 -0.0564569 -0.04781703 -0.036618179 -0.044200761
## UBER.Close -0.63484851 -0.6323368 -0.63309421 -0.633302633 -0.636217003
## NFLX.Close  0.02020915  0.0152086  0.01647001  0.002461711  0.005005079
## ATVI.Close -0.58805276 -0.5858270 -0.58509264 -0.584691589 -0.586310276
##              2020-01-31   2020-02-03    2020-02-04  2020-02-05   2020-02-06
## AMZN.Close  3.276068027  3.185256569  3.2078139931  3.25579691  3.236088788
## SPOT.Close -0.407738399 -0.411730850 -0.4095166671 -0.41454327 -0.404066976
## AAPL.Close -0.075915288 -0.097747155 -0.0954889153 -0.07627868 -0.076044759
## UBER.Close -0.614888653 -0.622608769 -0.6304850093 -0.62820548 -0.629251037
## NFLX.Close -0.005727658 -0.002212166  0.0002424115  0.01722156  0.004098385
## ATVI.Close -0.571115071 -0.582683119 -0.5910168338 -0.58546917 -0.584763362
##              2020-02-07  2020-02-10    2020-02-11   2020-02-12   2020-02-13
## AMZN.Close  3.257045732  3.26482042  3.2750485387  3.274899573  3.256581404
## SPOT.Close -0.401363860 -0.41549987 -0.4196673733 -0.420517757 -0.432913078
## AAPL.Close -0.086829564 -0.09443244 -0.0993283612 -0.089844602 -0.096051571
## UBER.Close -0.617896061 -0.61627361 -0.6122319828 -0.614805669 -0.619209235
## NFLX.Close  0.002010962 -0.00264589  0.0003261551  0.007106584  0.007797375
## ATVI.Close -0.578170618 -0.57620041 -0.5755249332 -0.575243123 -0.577875407
##              2020-02-14   2020-02-18   2020-02-19    2020-02-20   2020-02-21
## AMZN.Close  3.241312585  3.236139791  3.217214388  3.2170362487  3.199152970
## SPOT.Close -0.436875045 -0.434543912 -0.443261513 -0.4330339880 -0.430293575
## AAPL.Close -0.097533654 -0.116272209 -0.117714917 -0.1191473541 -0.120983744
## UBER.Close -0.623821793 -0.625193003 -0.628031701 -0.6276932324 -0.628114068
## NFLX.Close  0.004757581  0.009269616 -0.004714509  0.0004441395  0.003820301
## ATVI.Close -0.579806109 -0.582189721 -0.585916155 -0.5856814910 -0.585916830
##              2020-02-24  2020-02-25  2020-02-26 2020-02-27  2020-02-28
## AMZN.Close  3.21538349  3.23135810  3.23824095  3.2654477  3.25357444
## SPOT.Close -0.42032323 -0.41759118 -0.42172158 -0.4186049 -0.41495274
## AAPL.Close -0.12218500 -0.12606429 -0.11891049 -0.1259297 -0.12880164
## UBER.Close -0.62906876 -0.62866322 -0.63275004 -0.6334846 -0.63181345
## NFLX.Close  0.01536629  0.01744717  0.05341083  0.0808020  0.07213848
## ATVI.Close -0.58225609 -0.58159003 -0.58315716 -0.5789962 -0.58085905
##              2020-03-02  2020-03-03  2020-03-04  2020-03-05  2020-03-06
## AMZN.Close  3.23362314  3.23686167  3.24539156  3.27331934  3.28363810
## SPOT.Close -0.42508850 -0.42264314 -0.41968780 -0.40351028 -0.40204238
## AAPL.Close -0.10355673 -0.10837469 -0.10254172 -0.10364146 -0.10002206
## UBER.Close -0.63979922 -0.63769066 -0.63924278 -0.64340119 -0.64019114
## NFLX.Close  0.06225984  0.05571983  0.05964325  0.06169628  0.06776934
## ATVI.Close -0.58386837 -0.58458970 -0.58317342 -0.58271937 -0.58081137
##              2020-03-09  2020-03-10  2020-03-11  2020-03-12  2020-03-13
## AMZN.Close  3.32284984  3.31690171  3.32866622  3.34663066  3.33840211
## SPOT.Close -0.38645363 -0.39853134 -0.40023042 -0.38641701 -0.39546308
## AAPL.Close -0.10417373 -0.09397928 -0.08973973 -0.09434883 -0.06483408
## UBER.Close -0.63572379 -0.63830450 -0.64093425 -0.63786930 -0.64152096
## NFLX.Close  0.07521318  0.07330780  0.07502809  0.06710293  0.06688906
## ATVI.Close -0.57055308 -0.57091408 -0.56774099 -0.56090148 -0.55923067
##              2020-03-16  2020-03-17  2020-03-18  2020-03-19 2020-03-20
## AMZN.Close  3.44294217  3.49462252  3.54984843  3.55039902  3.5693735
## SPOT.Close -0.37668880 -0.38423028 -0.35962105 -0.35462171 -0.3580379
## AAPL.Close -0.07391539 -0.07651168 -0.07264994 -0.09682081 -0.1187977
## UBER.Close -0.61330267 -0.61379632 -0.60309921 -0.59679631 -0.5930580
## NFLX.Close  0.06372654  0.07710648  0.08475748  0.09767231  0.1174998
## ATVI.Close -0.53438278 -0.52824875 -0.50982159 -0.52180778 -0.5229831
```

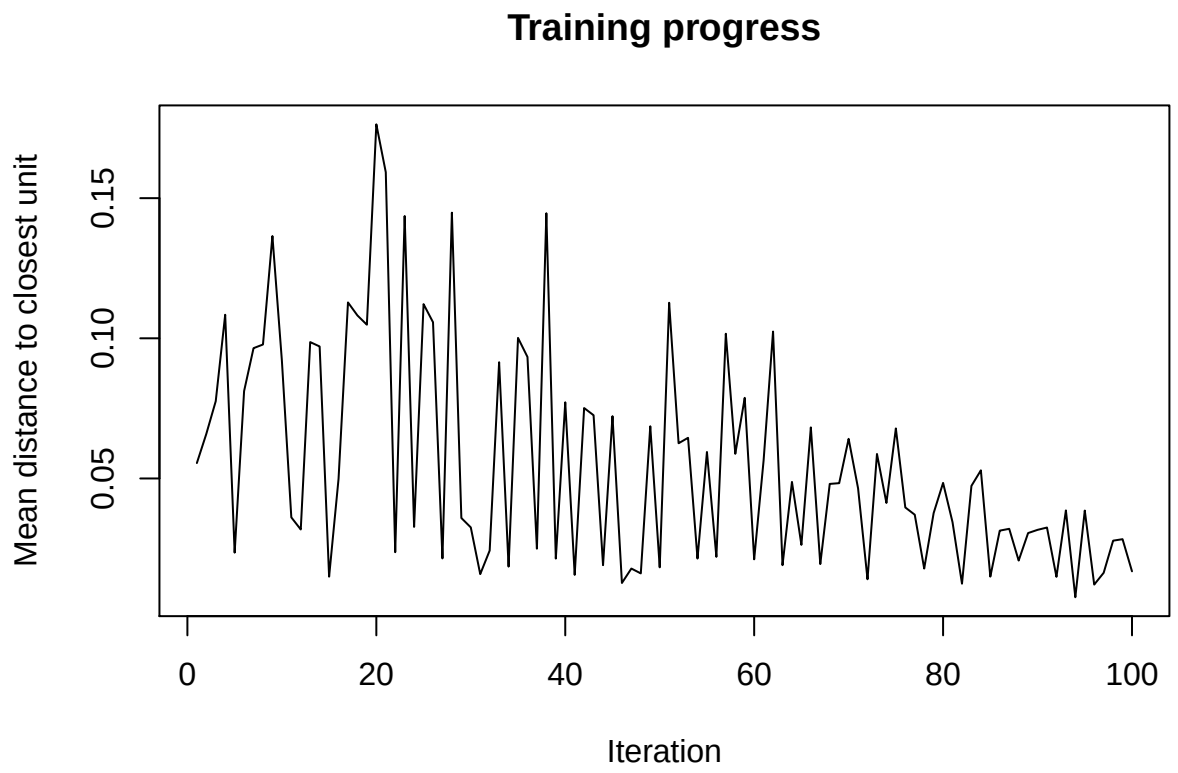
```
##            2020-03-23 2020-03-24  2020-03-25 2020-03-26 2020-03-27 2020-03-30
## AMZN.Close  3.6184937  3.5447470  3.52039016  3.5084761  3.5207979  3.5298645
## SPOT.Close -0.3713298 -0.3774390 -0.39120874 -0.3997544 -0.3991668 -0.4076400
## AAPL.Close -0.1339279 -0.1235512 -0.12188815 -0.1184365 -0.1230695 -0.1226041
## UBER.Close -0.5854588 -0.6012346 -0.60890345 -0.6106733 -0.6092390 -0.6076652
## NFLX.Close  0.1698947  0.1157130  0.09320863  0.1050064  0.1181408  0.1256109
## ATVI.Close -0.5092908 -0.5404870 -0.54966136 -0.5474126 -0.5437872 -0.5421869
##            2020-03-31 2020-04-01 2020-04-02 2020-04-03 2020-04-06 2020-04-07
## AMZN.Close  3.5027247  3.5462059  3.5443385  3.5523188  3.5155462  3.5208798
## SPOT.Close -0.4090638 -0.3910788 -0.3934173 -0.3906916 -0.4111039 -0.3994491
## AAPL.Close -0.1248179 -0.1280920 -0.1238323 -0.1271054 -0.1180296 -0.1251495
## UBER.Close -0.6091592 -0.6031215 -0.6086777 -0.6101074 -0.6132507 -0.6114268
## NFLX.Close  0.1345231  0.1434259  0.1504204  0.1388231  0.1280103  0.1096762
## ATVI.Close -0.5416334 -0.5324039 -0.5273771 -0.5279978 -0.5386786 -0.5404069
##             2020-04-08  2020-04-09 2020-04-13 2020-04-14 2020-04-15 2020-04-16
## AMZN.Close  3.51634236  3.50981307  3.5537460  3.5564901  3.5649310  3.6073322
## SPOT.Close -0.40801016 -0.39762684 -0.4056581 -0.4041216 -0.3996059 -0.3994675
## AAPL.Close -0.12134424 -0.11926599 -0.1271655 -0.1253983 -0.1333720 -0.1394945
## UBER.Close -0.61088520 -0.61182137 -0.6034108 -0.6036470 -0.6031794 -0.5980856
## NFLX.Close  0.09371146  0.09079804  0.1125883  0.1079163  0.1267751  0.1298038
## ATVI.Close -0.54101512 -0.54362674 -0.5359139 -0.5381161 -0.5331707 -0.5256393
##            2020-04-17 2020-04-20 2020-04-21 2020-04-22 2020-04-23 2020-04-24
## AMZN.Close  3.5762438  3.5979875  3.6201716  3.5930837  3.6089323  3.6065894
## SPOT.Close -0.3982632 -0.3911032 -0.3877898 -0.3968432 -0.3950141 -0.4006332
## AAPL.Close -0.1474204 -0.1562880 -0.1511733 -0.1521815 -0.1535808 -0.1447041
## UBER.Close -0.6009094 -0.5974688 -0.5927671 -0.5969002 -0.5905057 -0.5917027
## NFLX.Close  0.1020341  0.1284912  0.1517793  0.1085565  0.1150386  0.1057407
## ATVI.Close -0.5317114 -0.5295198 -0.5222198 -0.5273916 -0.5240017 -0.5261730
##             2020-04-27  2020-04-28  2020-04-29  2020-04-30 2020-05-01
## AMZN.Close  3.56873394  3.57846547  3.52668417  3.57809426  3.5277457
## SPOT.Close -0.40363497 -0.39755038 -0.38204005 -0.38420819 -0.3908361
## AAPL.Close -0.14970183 -0.14373493 -0.14939571 -0.14154934 -0.1268826
## UBER.Close -0.59937952 -0.59807923 -0.60139040 -0.59115838 -0.6039497
## NFLX.Close  0.09586278  0.08530245  0.06951387  0.07350485  0.1040743
## ATVI.Close -0.53367531 -0.53638085 -0.54246677 -0.53407220 -0.5374626
##            2020-05-04 2020-05-05 2020-05-06 2020-05-07  2020-05-08  2020-05-11
## AMZN.Close  3.5189773  3.5002620  3.5154021  3.5050825  3.48852076  3.49638821
## SPOT.Close -0.3975501 -0.4019987 -0.3977752 -0.4049539 -0.40351090 -0.39935239
## AAPL.Close -0.1307864 -0.1280405 -0.1274850 -0.1306699 -0.12747309 -0.12443481
## UBER.Close -0.6102573 -0.6120381 -0.6121243 -0.6112571 -0.61206811 -0.61442409
## NFLX.Close  0.1127742  0.1002639  0.1099050  0.1032555  0.09167272  0.09259078
## ATVI.Close -0.5393850 -0.5393729 -0.5320943 -0.5369696 -0.54156473 -0.53865274
##            2020-05-12 2020-05-13 2020-05-14 2020-05-15 2020-05-18 2020-05-19
## AMZN.Close  3.4900512  3.5200945  3.5207955  3.5195479  3.5137525  3.5358672
## SPOT.Close -0.3977986 -0.4009043 -0.3986847 -0.3910502 -0.3923754 -0.3690203
## AAPL.Close -0.1198972 -0.1205249 -0.1227521 -0.1323995 -0.1275839 -0.1318906
## UBER.Close -0.6122912 -0.6058125 -0.6076975 -0.6105767 -0.6128079 -0.6121936
## NFLX.Close  0.0926012  0.1102884  0.1092682  0.1220817  0.1097678  0.1048785
## ATVI.Close -0.5419643 -0.5339815 -0.5373081 -0.5385652 -0.5450966 -0.5441504
##             2020-05-20  2020-05-21  2020-05-22  2020-05-26  2020-05-27
## AMZN.Close  3.53496358  3.50974763  3.50054198  3.48983323  3.48230506
## SPOT.Close -0.35085389 -0.34386575 -0.34966238 -0.34500780 -0.35389918
## AAPL.Close -0.13295489 -0.13167766 -0.12907387 -0.12887833 -0.12597991
## UBER.Close -0.61233941 -0.61481548 -0.61586975 -0.61392763 -0.61443009
```

```
## NFLX.Close  0.08327741  0.07245784  0.06017087  0.03965206  0.04954696
## ATVI.Close -0.54617678 -0.54948869 -0.55032042 -0.55300639 -0.55360448
```

```
CORPS.grid = somgrid(xdim = 4, ydim=5, topo="hexagonal")
CORPS.som = som(CORPS.sc, grid=CORPS.grid, rlen=100, alpha=c(0.05,0.01))
```

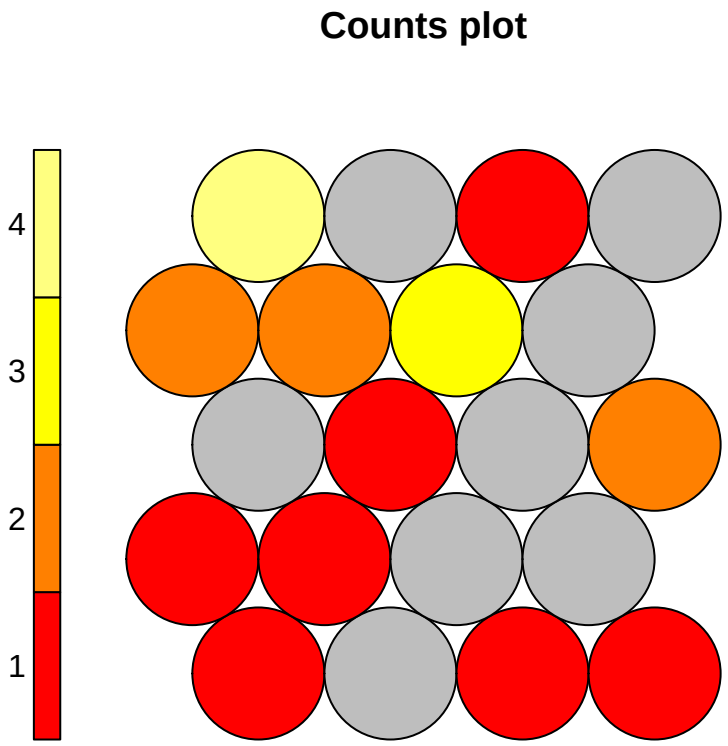
Sprawdźmy jak przebiegał proces treningowy. Wraz z następowaniem kolejnych iteracji procesu uczenia, dystans między neuronami zmniejszał się. Możliwe że model jest nieco niedotrenowany, gdyż widzimy, że odległość maleje wciąż przy setnej oteracji.

```
plot(CORPS.som, type="changes")
```



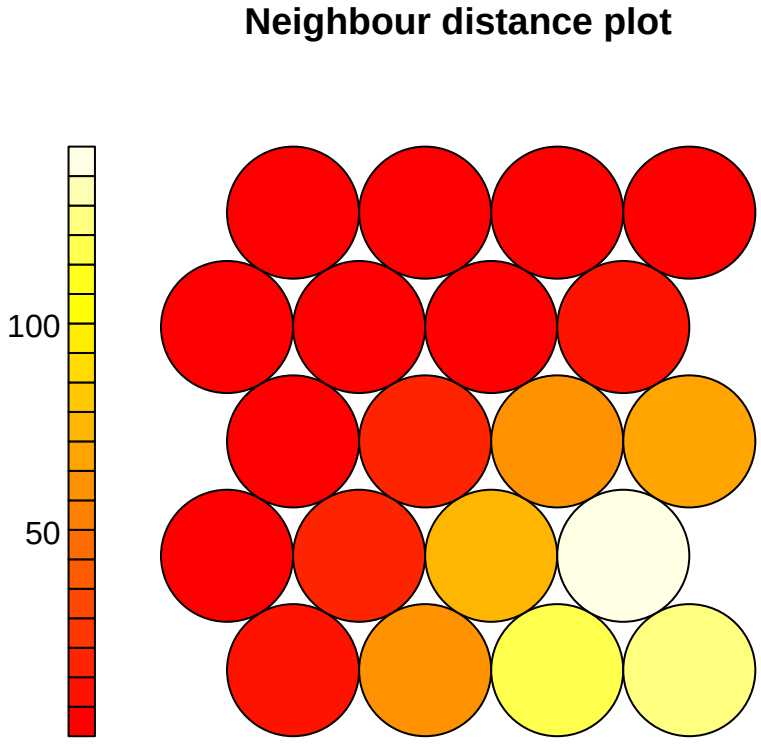
Pakiet kohonen umożliwia przedstawienie wykresu na którym widać, ile obserwacji trafiło do której komórki. Wydaje się, że dość dobrze dobrano wielkość macierzy, gdyż większość z węzłów zawiera po 5-10 przypadków. Puste węzły świadzyłyby o zbyt dużej mapie, natomiast zbyt duża liczba przypisań w węzłach o za małej mapie.

```
plot(CORPS.som, type="count")
```

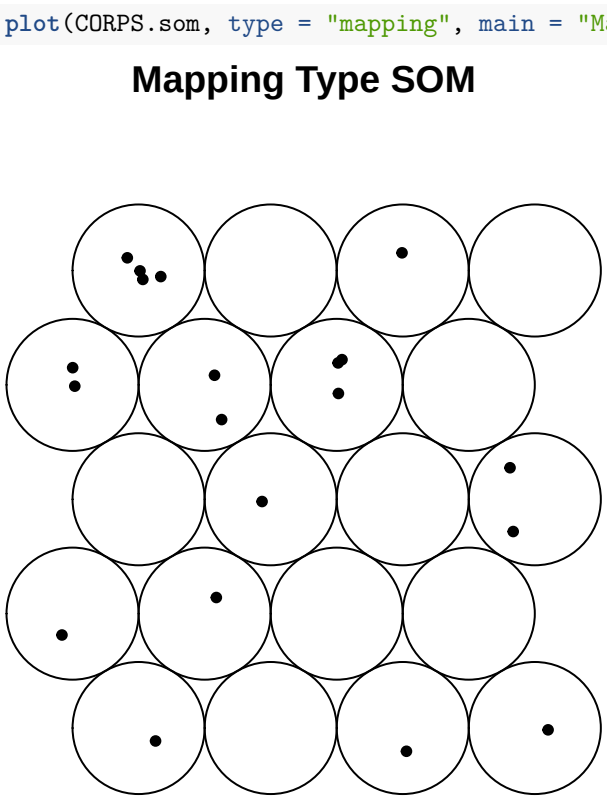


Poniższy wykres przedstawia odległości komórek od najbliższych sąsiadów. Taka wizualizaca nosi także nazwę U-macierzy. Obszary z wyższymi wartościami charakteryzują węzły, które są bardziej niepodobne, a obszary z mniejszymi wartościami charakteryzują podobne węzły. Widzimy powstałe granice. U-macierze mogą służyć do dokonywania klasteryzacji.

```
plot(CORPS.som, type="dist.neighbours")
```

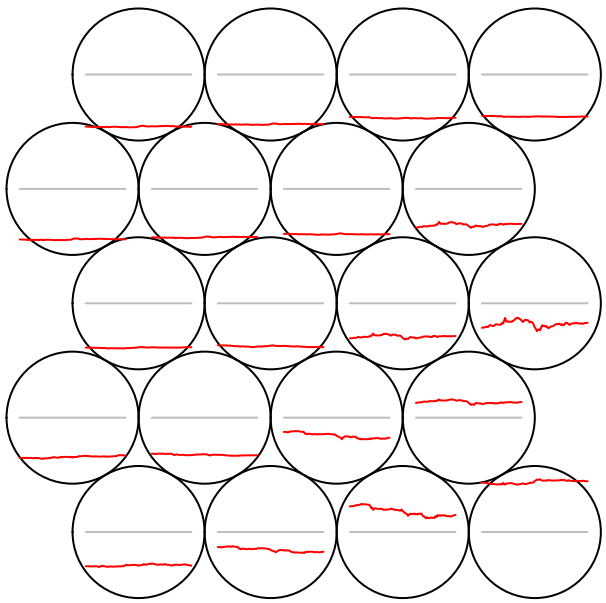


```
plot(CORPS.som, type = "mapping", main = "Mapping Type SOM", pchs = 20)
```



Poniższy wykres przedstawia charakterystykę obserwacji znajdujących się w danych komórkach.

```
plot(CORPS.som, type="codes")
```



```r
for (i in 1:length(companies)) {
  print(paste(companies[i], CORPS.som$unit.classif[i], fullnames[i]))
}
```

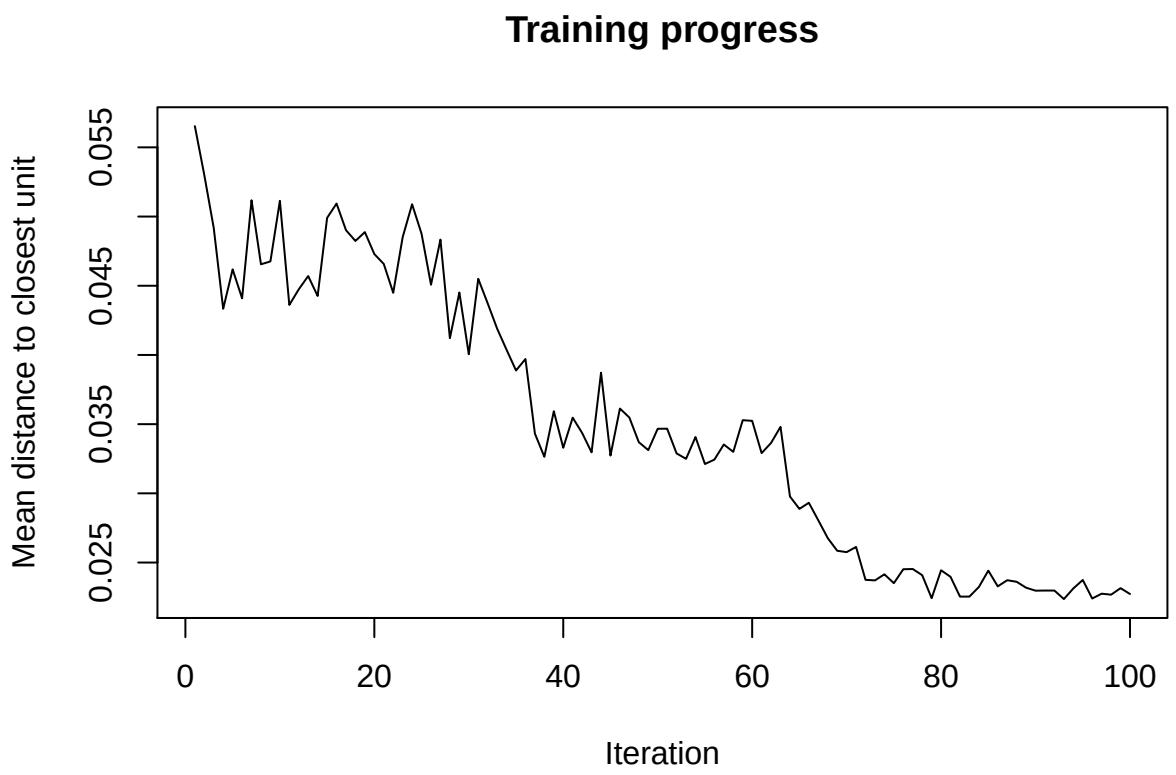
```
## [1] "AMZN 4 Amazon.com"
## [1] "AAPL 15 Apple"
## [1] "UBER 6 Uber Technologies"
## [1] "NFLX 17 Netflix"
## [1] "SPOT 1 Spotify Technology"
## [1] "MSFT 13 Microsoft Corporation"
## [1] "GOOG 10 Alphabet"
## [1] "FB 15 Facebook"
## [1] "BABA 14 Alibaba Group"
## [1] "INTC 19 Intel"
## [1] "NVDA 3 Nvidia"
## [1] "PYPL 13 PayPal"
## [1] "TSLA 12 Tesla"
## [1] "ATVI 15 Activision Blizzard"
## [1] "YELP 17 Yelp,"
## [1] "MU 5 Micron Technology"
## [1] "ISRG 14 Intuitive Surgical"
## [1] "EA 12 Electronic Arts"
## [1] "CRM 17 Salesforce.com "
## [1] "AMD 17 Advanced Micro Devices"
```

```r
CORPS <- data.frame(AMZN[, 4], SPOT[, 4], AAPL[, 4], UBER[, 4], NFLX[, 4], ATVI[, 4], BABA[, 4], CRM[, 4

CORPS.sc = scale(CORPS)
head(CORPS.sc)
```

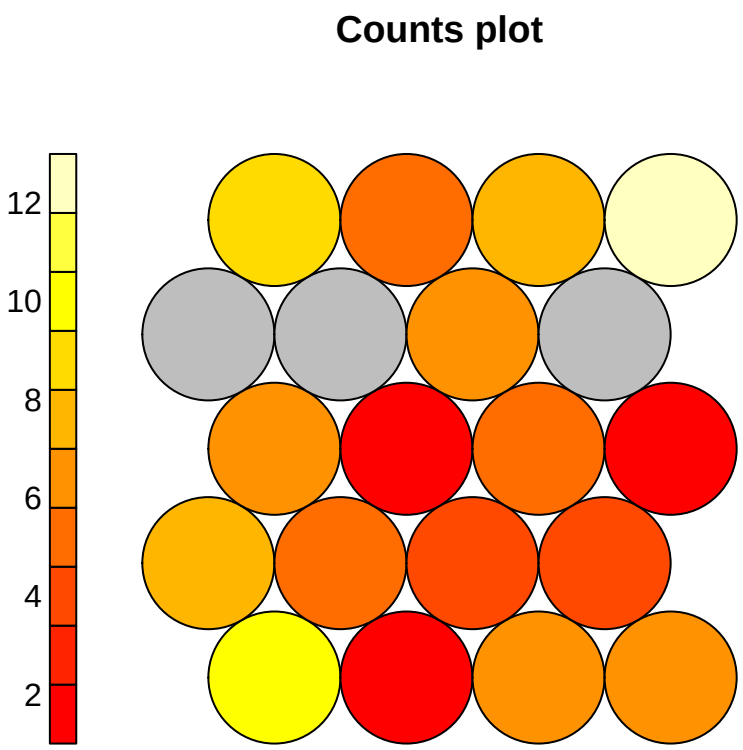
```
##            AMZN.Close SPOT.Close AAPL.Close  UBER.Close NFLX.Close ATVI.Close
## 2020-01-02 -0.7964111  0.4814920  0.3006642 -0.11913352  -1.250131 -0.7056294
## 2020-01-03 -0.8984577  0.5385204  0.1916727 -0.05104184  -1.349935 -0.7019575
## 2020-01-06 -0.7748414  0.8119962  0.2801344 -0.01341252  -1.096470 -0.5054728
## 2020-01-07 -0.7572137  0.7666331  0.2275062  0.20698907  -1.226138 -0.3952952
## 2020-01-08 -0.8231630  0.9454937  0.4066691  0.40767960  -1.008918 -0.4797648
## 2020-01-09 -0.7829465  0.8780972  0.6470467  0.41484731  -1.100809 -0.5789251
##            BABA.Close   CRM.Close    EA.Close  FB.Close GOOG.Close  INTC.Close
## 2020-01-02  1.0791024 -0.02830413 -0.15440735 0.5982807  0.2499119  0.31991776
## 2020-01-03  0.8587497 -0.07647908 -0.17279301 0.5520780  0.1982488  0.18025236
## 2020-01-06  0.8301117  0.35121673  0.03470402 0.7156606  0.4565651  0.14816753
## 2020-01-07  0.9088663  0.50102796 -0.01651353 0.7348073  0.4498666 -0.04056898
## 2020-01-08  0.9382993  0.57916483  0.12794611 0.8247152  0.5344065 -0.03301933
## 2020-01-09  1.2389967  0.71252627  0.11087399 0.9529171  0.6538252  0.02926334
##            ISRG.Close MSFT.Close  MU.Close NVDA.Close PYPL.Close TSLA.Close
## 2020-01-02  1.0993065 -0.6063421 0.8758426 -0.8651951 -0.3156847  -1.625231
## 2020-01-03  1.0284571 -0.7584453 0.7486555 -0.9739472 -0.4453625  -1.535717
## 2020-01-06  1.0721956 -0.7272638 0.6066793 -0.9459098 -0.3534804  -1.475830
## 2020-01-07  0.8379575 -0.8375384 1.3017717 -0.8646289 -0.3860628  -1.352827
## 2020-01-08  0.8195229 -0.6466494 1.1908527 -0.8518842 -0.2459584  -1.190789
## 2020-01-09  0.8919983 -0.4945463 1.1597956 -0.7771170 -0.1970848  -1.266613
##            YELP.Close  AMD.Close
## 2020-01-02   1.128586 -0.1819294
## 2020-01-03   1.121678 -0.2895230
## 2020-01-06   1.082988 -0.3347121
```

```
## 2020-01-07   1.100951 -0.3648381
## 2020-01-08   1.234982 -0.4552162
## 2020-01-09   1.182475 -0.2099031
```

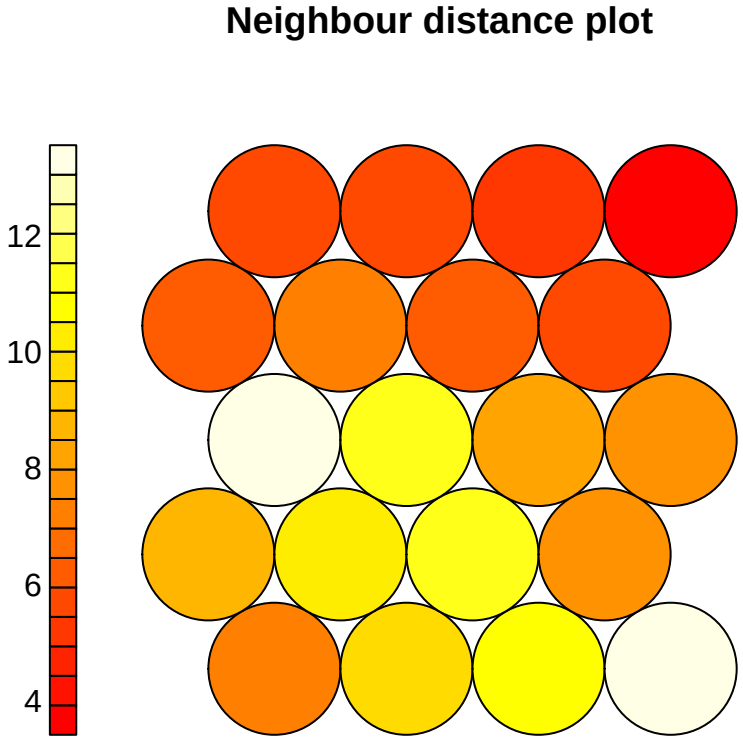
```
CORPS.grid = somgrid(xdim = 4, ydim=5, topo="hexagonal")
CORPS.som = som(CORPS.sc, grid=CORPS.grid, rlen=100, alpha=c(0.05,0.01))

plot(CORPS.som, type="changes")
```




```
plot(CORPS.som, type="count")
```

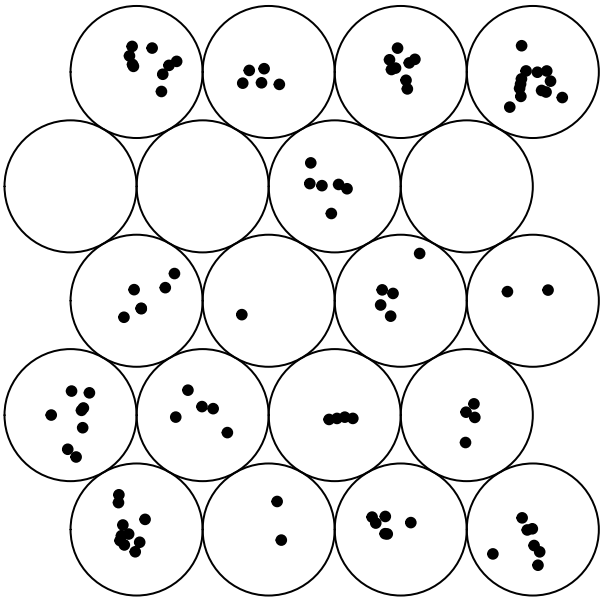



```
plot(CORPS.som, type="dist.neighbours")
```




```
plot(CORPS.som, type = "mapping", main = "Mapping Type SOM", pchs = 20)
```

Mapping Type SOM



```
plot(CORPS.som, type="codes")
```

Codes plot