Nussinov Complexity Report

Nussinov algorithm analysis with graph

```
library(basicTrendline)
library(spatialEco)
```

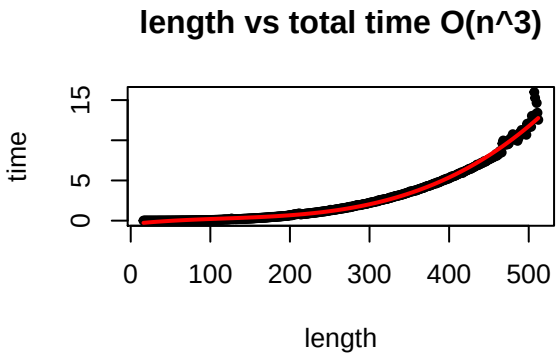
```
genGraph <- function(file){
  data=read.csv(file,sep="\t")
  data=data[order(data$length),]
  attach(data)
  par(mfrow=c(2,2))

  lm1<-lm(total ~ poly(length, 3, raw=TRUE))
  lm2<-lm(nus ~ poly(length, 3, raw=TRUE))
  lm3<-lm(trace ~ poly(length, 2, raw=TRUE))

  plot(length, total, pch=20,xlab="length",ylab="time",
       main="length vs total time O(n^3)")
  lines(length,lm1$fitted.values,col=2,lwd=2)

  plot(length, nus, pch=20,xlab="length",ylab="time",
       main="length vs nussinov time O(n^3)")
  lines(length,lm2$fitted.values,col=2,lwd=2)

  trendline(length, trace, model='line3P',
            main="length vs traceback time O(n^2)",
            xlab="length",ylab="time",pch=20)

  plot(length, total, pch=20,xlab="length",ylab="time",
       main="length vs time")
  lines(length,lm1$fitted.values,col=2,lwd=10)
  lines(length,lm2$fitted.values,col=3,lwd=2)
  lines(length,lm3$fitted.values,col=4,lwd=2)
  legend("topleft", legend=c("total", "nussinov", "traceback"),
         col=c(2,3,4), lty=1,lwd=2,cex=1,bty = "n")
  detach(data)
  print(summary(lm1))
  print(summary(lm2))
  print(summary(lm3))
}
```

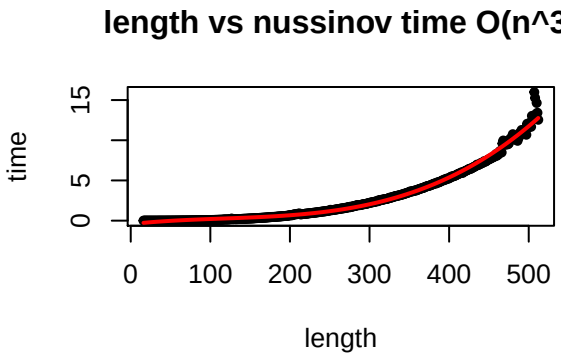
```
genGraph2 <- function(file){
  data=read.csv(file,sep="\t")
  data=data[order(data$length),]
  attach(data)
  par(mfrow=c(2,2))

  len=seq(from=min(length),to=max(length),by=16)

  lm1<-lm(total ~ poly(length, 3, raw=TRUE))
```

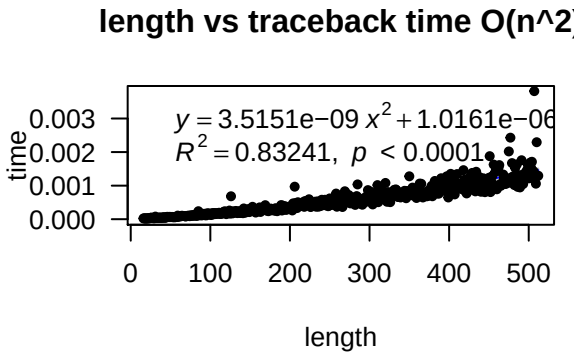
```
  cu1=coef(lm1)
  time1=cu1[1]+cu1[2]*len+cu1[3]*len^2+cu1[4]*len^3
  plot(length, total, pch=20,xlab="length",ylab="time",
       main="length vs total time O(n^3)")
  lines(len, time1, lty=1, lwd=2, col="blue")

  lm2<-lm(nus ~ poly(length, 3, raw=TRUE))
  cu2=coef(lm2)
  time2=cu2[1]+cu2[2]*len+cu1[3]*len^2+cu1[4]*len^3
  plot(length, total, pch=20,xlab="length",ylab="time",
       main="length vs nussinov time O(n^3)")
  lines(len, time2, lty=1, lwd=2, col="blue")

  trendline(length, trace, model='line3P',
            main="length vs traceback time O(n^2)",
            xlab="length",ylab="time",pch=20)

  lm3<-lm(trace ~ poly(length, 2, raw=TRUE))

  plot(length, total, pch=20,xlab="length",ylab="time",
       main="length vs time")
  lines(len,time1,col=2,lwd=10)
  lines(len,time2,col=3,lwd=2)
  lines(length,lm3$fitted.values,col=4,lwd=2)
  legend("topleft", legend=c("total", "nussinov", "traceback"),
         col=c(2,3,4), lty=1,lwd=2,cex=1,bty = "n")
  detach(data)
}
```

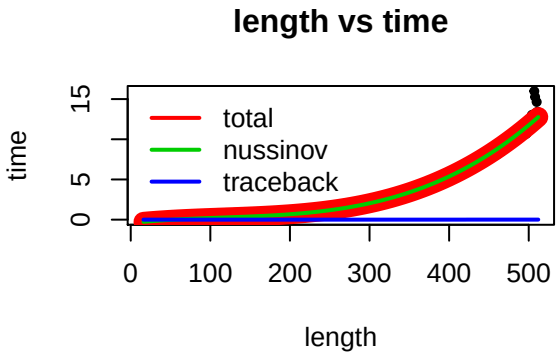
```
genGraph("/Users/linni/Documents/GitHub/Python-R/Algorithm/Nussinov_RNA/testcase/test16-512.txt")
```

```
##
## Call:
## lm(formula = y ~ I(x^2) + x)
##
## Residuals:
##         Min          1Q      Median          3Q         Max
## -4.0994e-04 -6.5594e-05 -1.5741e-05  3.1932e-05  2.3769e-03
##
## Coefficients:
##               Estimate Std. Error t value  Pr(>|t|)
## (Intercept) 1.9311e-05 2.8558e-05  0.6762    0.4992
## I(x^2)      3.5151e-09 4.5738e-10  7.6854 8.287e-14 ***
## x           1.0161e-06 2.4852e-07  4.0884 5.070e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.00018773 on 494 degrees of freedom
## Multiple R-squared:  0.83241,    Adjusted R-squared:  0.83173
## F-statistic: 1226.8 on 2 and 494 DF,  p-value: < 2.22e-16
##
##
## N: 497 , AIC: -7113.6 , BIC:  -7096.8
## Residual Sum of Squares:  1.7409e-05
```










```
##
## Call:
## lm(formula = total ~ poly(length, 3, raw = TRUE))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.8181 -0.1216  0.0096  0.1208  3.6520
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 -4.309e-01  6.931e-02  -6.218 1.08e-09 ***
## poly(length, 3, raw = TRUE)1  1.074e-02  1.100e-03   9.768  < 2e-16 ***
## poly(length, 3, raw = TRUE)2 -6.175e-05  4.763e-06 -12.964  < 2e-16 ***
## poly(length, 3, raw = TRUE)3  1.780e-07  5.939e-09  29.962  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3072 on 493 degrees of freedom
## Multiple R-squared:  0.9924, Adjusted R-squared:  0.9923
## F-statistic: 2.143e+04 on 3 and 493 DF,  p-value: < 2.2e-16
##
##
## Call:
## lm(formula = nus ~ poly(length, 3, raw = TRUE))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.8179 -0.1215  0.0096  0.1207  3.6497
##
```

```
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  -4.309e-01  6.929e-02  -6.219 1.07e-09 ***
## poly(length, 3, raw = TRUE)1  1.074e-02  1.099e-03   9.768  < 2e-16 ***
## poly(length, 3, raw = TRUE)2 -6.174e-05  4.762e-06 -12.966  < 2e-16 ***
## poly(length, 3, raw = TRUE)3  1.779e-07  5.938e-09  29.969  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3071 on 493 degrees of freedom
## Multiple R-squared:  0.9924, Adjusted R-squared:  0.9923
## F-statistic: 2.144e+04 on 3 and 493 DF,  p-value: < 2.2e-16
##
##
## Call:
## lm(formula = trace ~ poly(length, 2, raw = TRUE))
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -4.100e-04 -6.559e-05 -1.574e-05  3.193e-05  2.377e-03
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  1.931e-05  2.856e-05   0.676    0.499
## poly(length, 2, raw = TRUE)1 1.016e-06  2.485e-07   4.088 5.07e-05 ***
## poly(length, 2, raw = TRUE)2 3.515e-09  4.574e-10   7.685 8.29e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0001877 on 494 degrees of freedom
## Multiple R-squared:  0.8324, Adjusted R-squared:  0.8317
## F-statistic:  1227 on 2 and 494 DF,  p-value: < 2.2e-16
```

```
genGraph2("/Users/linni/Documents/GitHub/Python-R/Algorithm/Nussinov_RNA/testcase/test4-12power.txt")
```

```
##
## Call:
## lm(formula = y ~ I(x^2) + x)
##
## Residuals:
##         Min          1Q      Median          3Q         Max
## -0.00210487 -0.00077133 -0.00028396  0.00040041  0.00252166
##
## Coefficients:
##               Estimate  Std. Error t value Pr(>|t|)
## (Intercept)  9.9914e-04  7.5054e-04  1.3312   0.2315
## I(x^2)       4.3153e-09  3.7172e-10 11.6088 2.46e-05 ***
## x           -4.2249e-06  1.5041e-06 -2.8090   0.0308 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0015697 on 6 degrees of freedom
## Multiple R-squared:  0.99455,    Adjusted R-squared:  0.99274
## F-statistic: 547.81 on 2 and 6 DF,  p-value: 1.6157e-07
##
```

```
##
## N: 9 , AIC: -86.332 , BIC:  -85.543
## Residual Sum of Squares:  1.4784e-05
```