106-2: EE4052

通識課程：計算機程式設計之旅

Computer Programming

Unit 15: 影像與動畫

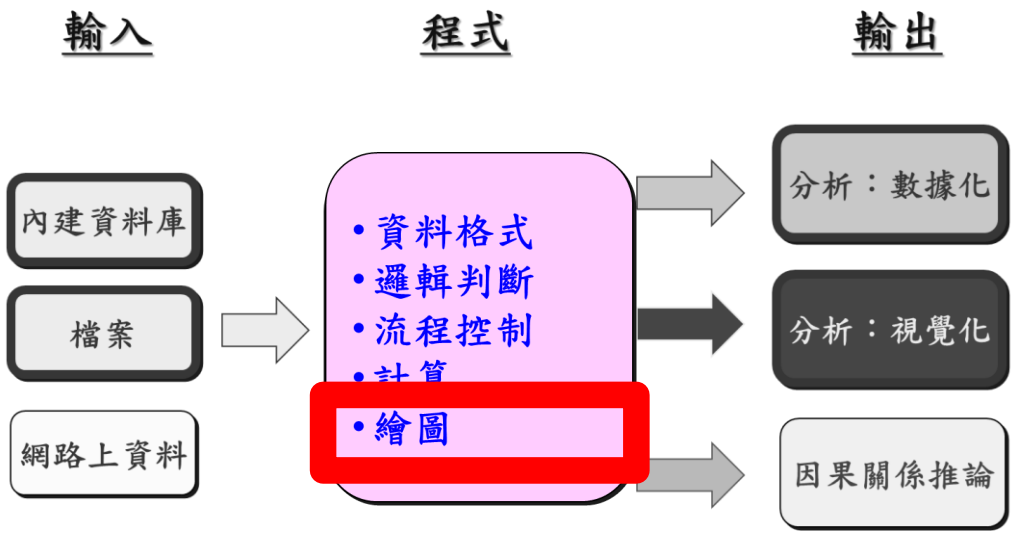
連 豐 力

臺大電機系

Feb 2018 - Jun 2018

課程主題進度

- **U01:** 課程介紹：討論主題，作業，報告，進行方式
- **U02:** 主題，案例，程式，演算法，資源
- **U03:** 設定軟體 R 與 Rstudio
- **U04:** 數據處理與繪圖指令功能
- **U05:** 資料類別與基本運算
- **U06:** 邏輯判斷與流程控制
- **U07:** 函數：計算與排序
- **U08:** 多維度資料格式
- **U09:** 檔案資料輸入與輸出
- **U10:** 繪圖功能與文字
- **U11:** 多重繪圖與顏色
- **U12:** 資料間的相關性
- **U13:** 探索性資料分析
- **U14:** 資料連結分析
- **U15:** 影像與動畫

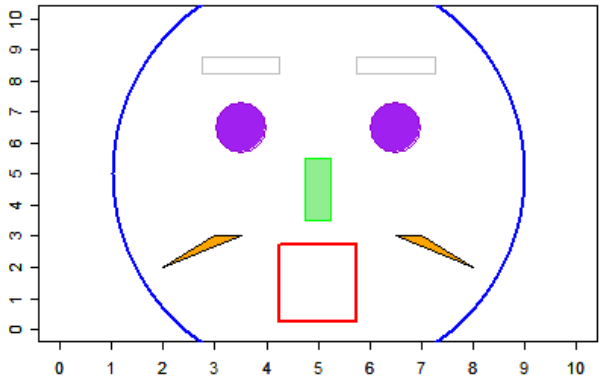


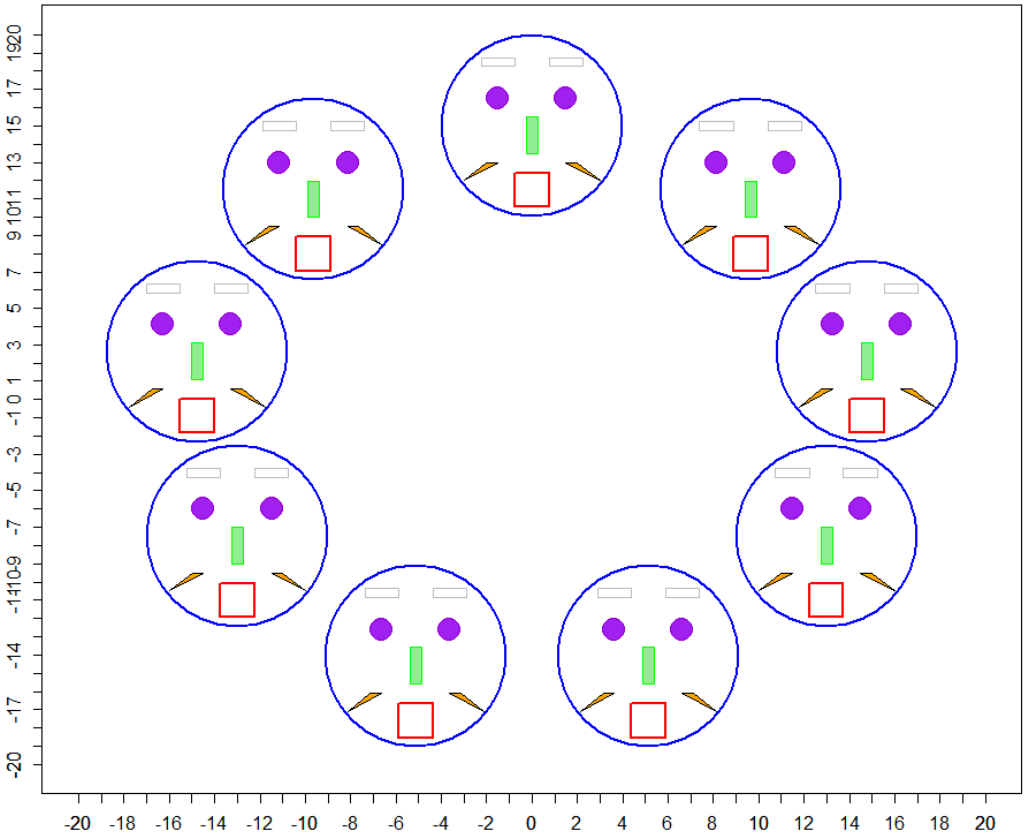
Unit 15: 繪圖+流程->動畫

- for(index in index.set) {

  statement

  }





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- 畫一個臉
- 行走路徑與迴圈控制
- 畫一個動畫
- 數學函數繪圖

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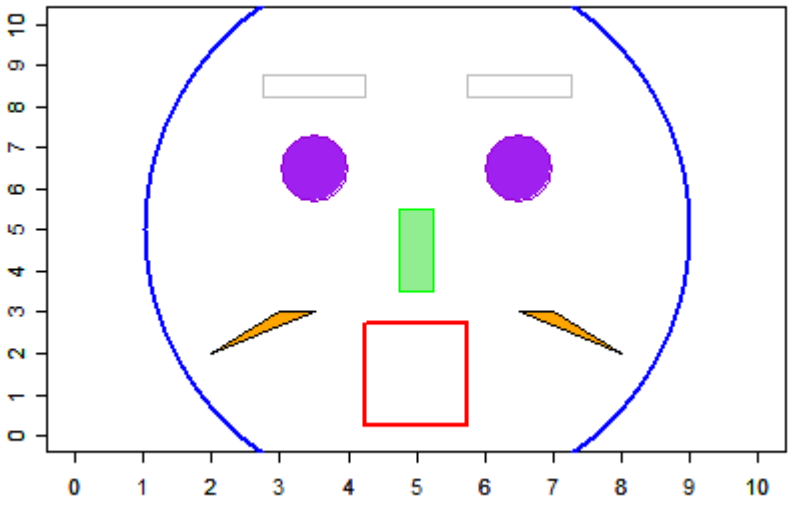
畫一個臉

圖形元件 – 圓形 矩形 多邊形

- symbols( )　　# 圓形 矩形
- polygon( )　　# 多邊形



圖形元件 – 圓形 矩形 多邊形

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 4, 2) + 0.1)

- plot(0:10, 0:10, xlab = "", ylab = "", pch = 1:11, col = 1:8, type = "n")
- axis(side = 1, at = 0:10)
- axis(side = 2, at = 0:10)

- # 臉輪廓
- symbols(5, 5, circles = 4, fg = "blue", lwd = 2, inches = FALSE, add = TRUE)

圖形元件 – 圓形 矩形 多邊形

- # 眼睛
- symbols(3.5, 6.5, circles = 0.5, fg = "dark violet", bg = "purple", inches = FALSE, add = TRUE)
- symbols(6.5, 6.5, circles = 0.5, fg = "dark violet", bg = "purple", inches = FALSE, add = TRUE)

- # 眉毛
- symbols(3.5, 8.5, rectangles = matrix(c(1.5, 0.5), nrow =1), fg = "gray", inches = FALSE, add = TRUE)
- symbols(6.5, 8.5, rectangles = matrix(c(1.5, 0.5), nrow =1), fg = "gray", inches = FALSE, add = TRUE)

圖形元件 – 圓形 矩形 多邊形

- # 鼻子
- symbols(5, 4.5, rectangles = matrix(c(0.5, 2), nrow =1), fg = "green", bg = "lightgreen", inches = FALSE, add = TRUE)

- # 嘴巴
- symbols(5, 1.5, squares = 1.5, fg = "red", lwd = 2, inches = FALSE, add = TRUE)

- # 鬍子
- polygon(c(3.5, 3, 2), c(3, 3, 2), col = "orange")
- polygon(c(6.5, 7, 8), c(3, 3, 2), col = "orange")

- par(old.par)

繪圖函數 – myFace( )

```
# draw face
myFace <- function( cx, cy ) {
# 臉輪廓
symbols( cx+0, cy+0, circles = 4, fg = "blue", lwd = 2, inches = FALSE, add = TRUE )
# 眼睛
symbols( cx-1.5, cy+1.5, circles = 0.5, fg = "dark violet", bg = "purple", inches = FALSE, add = TRUE )
symbols( cx+1.5, cy+1.5, circles = 0.5, fg = "dark violet", bg = "purple", inches = FALSE, add = TRUE )
# 眉毛
symbols( cx-1.5, cy+3.5, rectangles = matrix(c(1.5, 0.5), nrow =1), fg = "gray", inches = FALSE, add = TRUE )
symbols( cx+1.5, cy+3.5, rectangles = matrix(c(1.5, 0.5), nrow =1), fg = "gray", inches = FALSE, add = TRUE )
```

繪圖函數 – myFace( )

```
# 鼻子
symbols( cx+0, cy-0.5, rectangles = matrix(c(0.5, 2), nrow =1), fg = "green", bg = "lightgreen", inches = FALSE, add = TRUE )
# 嘴巴
symbols( cx+0, cy-3.5, squares = 1.5, fg = "red", lwd = 2, inches = FALSE, add = TRUE )
# 鬍子
polygon( c( cx-1.5, cx-2, cx-3), c( cy-2, cy-2, cy-3), col = "orange" )
polygon( c( cx+1.5, cx+2, cx+3), c( cy-2, cy-2, cy-3), col = "orange" )

}
```

繪圖函數 – myFaceOff( )

```
# draw face
myFaceOff <- function( cx, cy ) {
# 臉輪廓
symbols( cx+0, cy+0, circles = 4, fg = "white", lwd = 2, inches = FALSE, add = TRUE )
# 眼睛
symbols( cx-1.5, cy+1.5, circles = 0.5, fg = "white", bg = "white", inches = FALSE, add = TRUE )
symbols( cx+1.5, cy+1.5, circles = 0.5, fg = "white", bg = "white", inches = FALSE, add = TRUE )
# 眉毛
symbols( cx-1.5, cy+3.5, rectangles = matrix(c(1.5, 0.5), nrow =1), fg = "white", inches = FALSE, add = TRUE )
symbols( cx+1.5, cy+3.5, rectangles = matrix(c(1.5, 0.5), nrow =1), fg = "white", inches = FALSE, add = TRUE )
```

繪圖函數 – myFaceOff( )

```
# 鼻子
symbols( cx+0, cy-0.5, rectangles = matrix(c(0.5, 2), nrow =1), fg = "white", bg = "white", inches = FALSE, add = TRUE )
# 嘴巴
symbols( cx+0, cy-3.5, squares = 1.5, fg = "white", lwd = 2, inches = FALSE, add = TRUE )
# 鬍子
polygon( c( cx-1.5, cx-2, cx-3), c( cy-2, cy-2, cy-3), col = "white", border = "white" )
polygon( c( cx+1.5, cx+2, cx+3), c( cy-2, cy-2, cy-3), col = "white", border = "white" )


}
```

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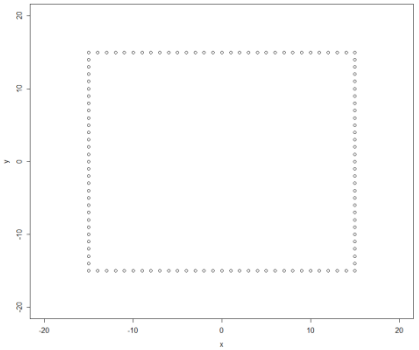
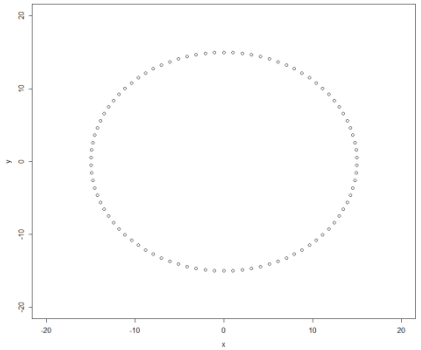
行走路徑與迴圈控制

行走路徑

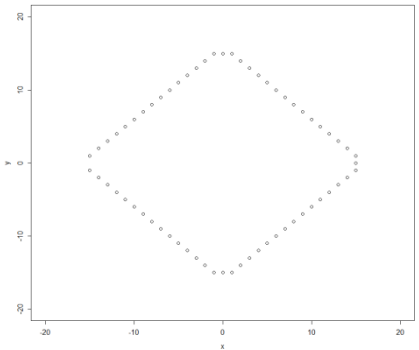
- x <- c(-15:15, rep(15, 31), 15:-15, rep(-15, 31))
- y <- c(rep(15, 31), 15:-15, rep(-15, 31), -15:15)

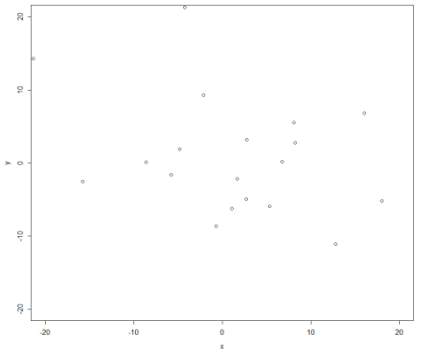
- x <- sin(1:90/45*pi)*15
- y <- cos(1:90/45*pi)*15





- x <- c(-15:15, 15, 15:-15)
- y <- c(1:15, 15, 15:1, 0, -1:-15. -15. -15:-1)



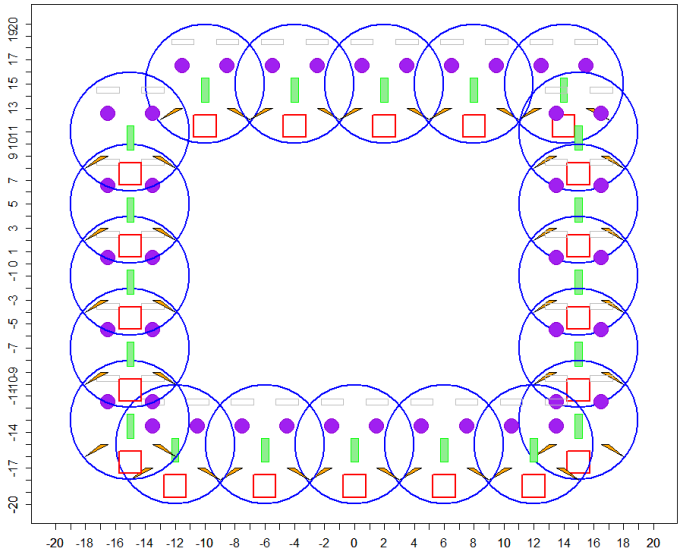


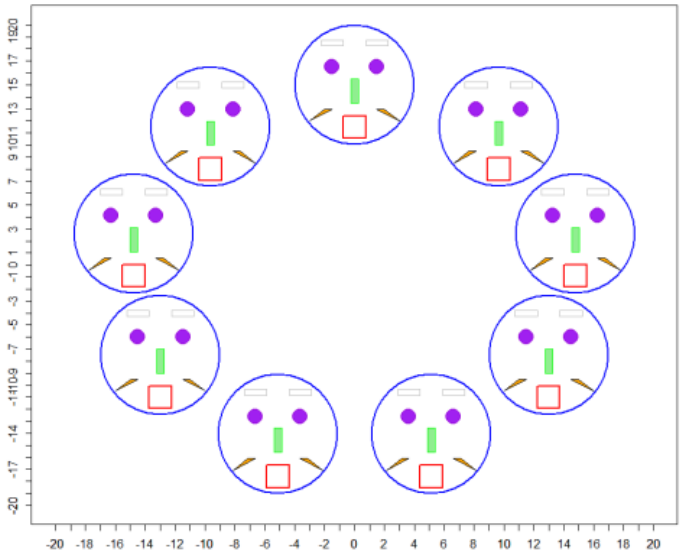
- x <- rnorm(20) * 10
- y <- rnorm(20) * 10

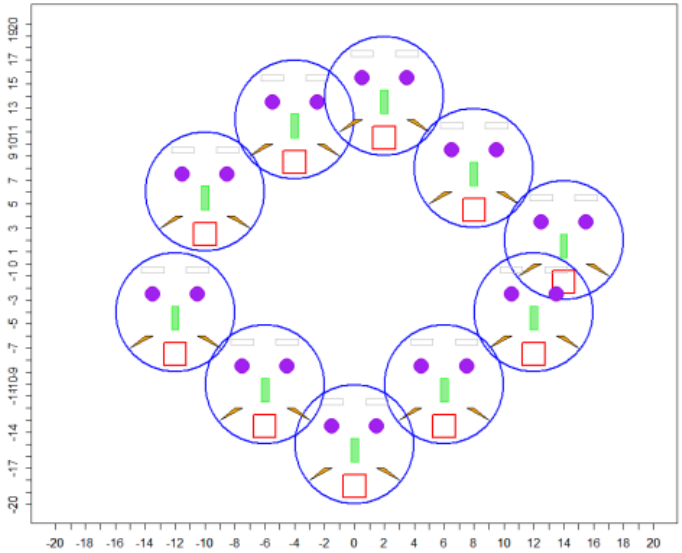
迴圈控制

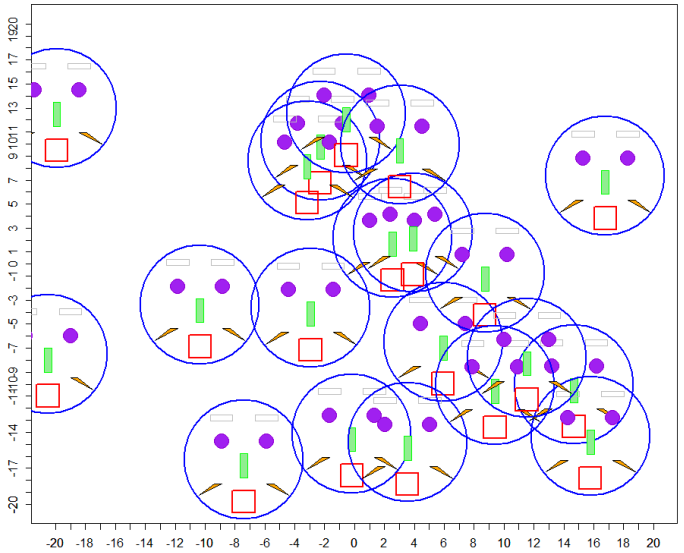
```
Num <- length(x)
for ( i in 1:Num ){
        myFace( x[i], y[i] )
        #line <- readline()
        Sys.sleep( 0.1 )
        myFaceOff( x[i], y[i] )
        #line <- readline()
}
for ( i in 1:Num ){
        myFace( x[i], y[i] )
}
```

行走路徑









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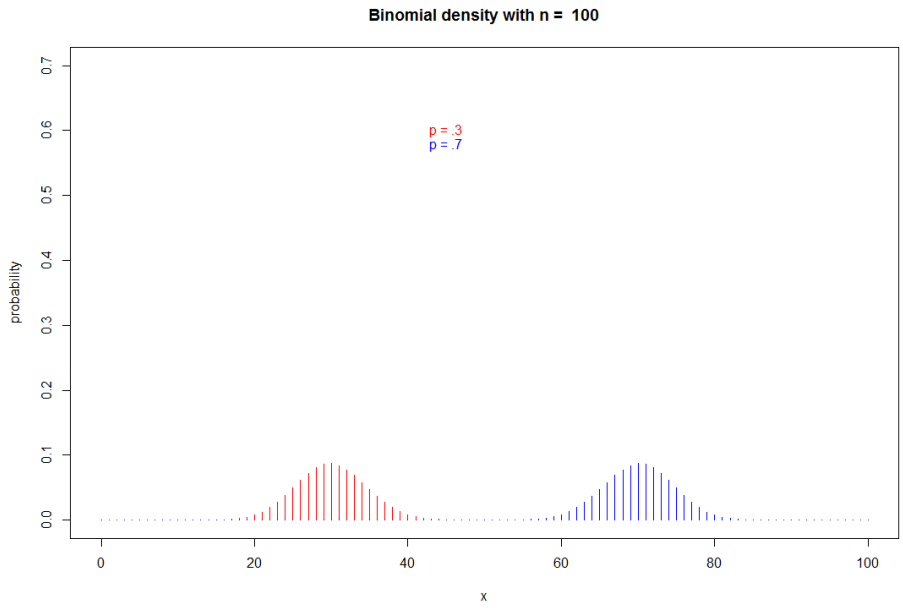
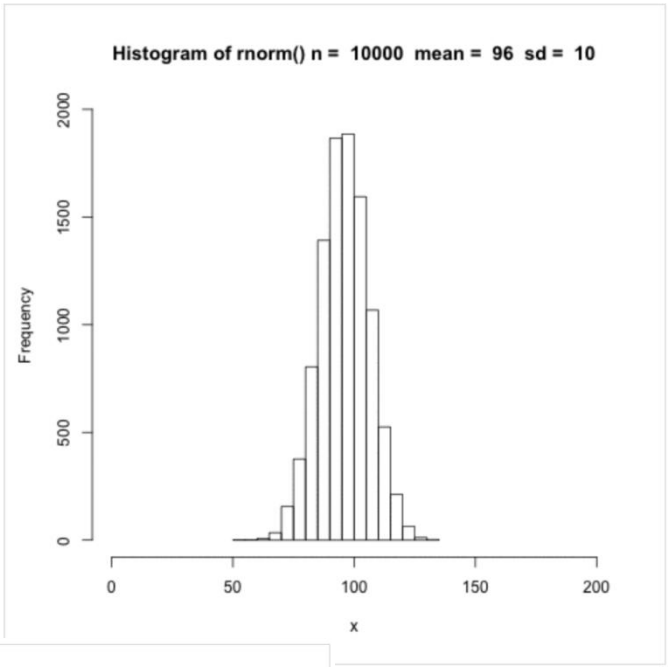
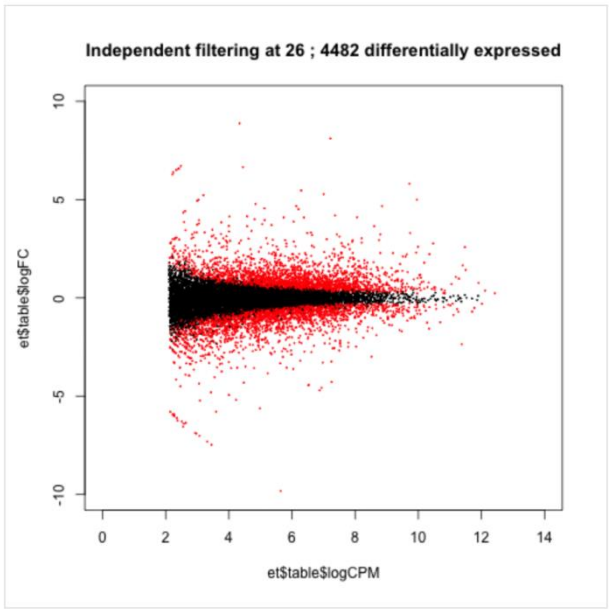
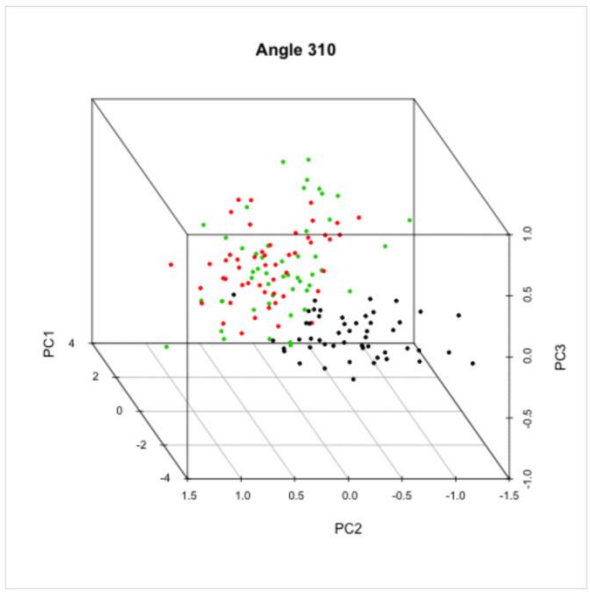
畫一個動畫

機率分布圖

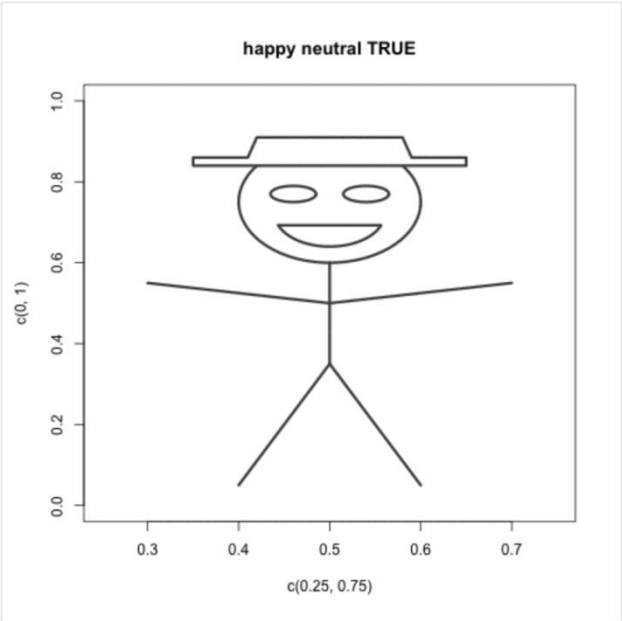

Binomial density with n = 100
p = .3
p = .7
probability
x

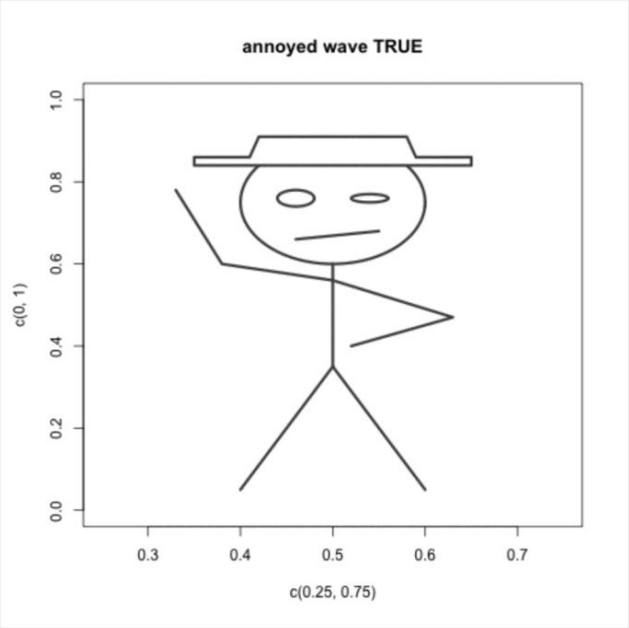

Histogram of rnorm() n = 10000 mean = 96 sd = 10
Frequency
x

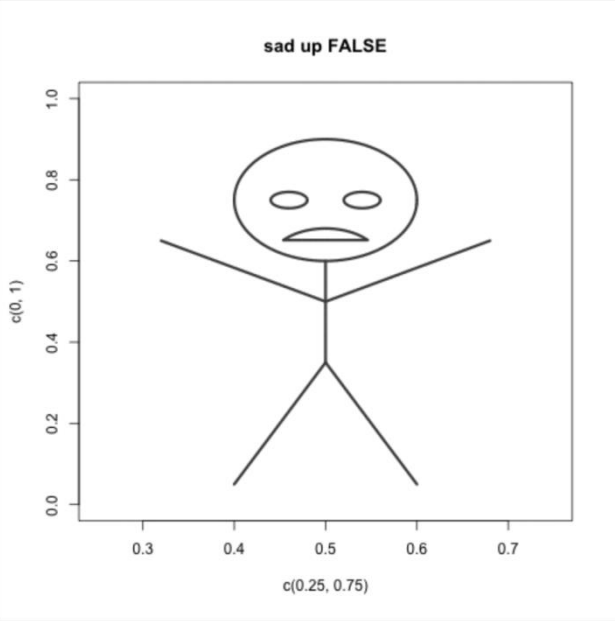

Independent filtering at 26 ; 4482 differentially expressed
et$table$logFC
et$table$logCPM


Angle 310
PC1
PC2
PC3

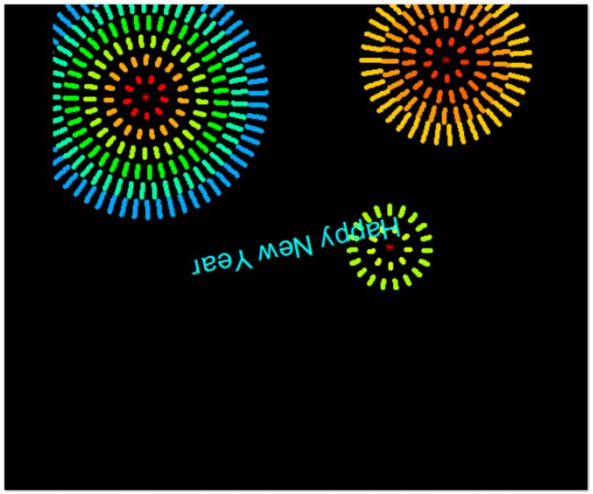
畫一個動畫


happy neutral TRUE
c(0, 1)
c(0.25, 0.75)


annoyed wave TRUE
c(0, 1)
c(0.25, 0.75)


sad up FALSE
c(0, 1)
c(0.25, 0.75)


Happy New Year


Happy New Year

R Animated Plots 機率分布圖

- Distribution shifts according to the mean
- Visualize filtering threshold
- Rotating 3D scatter plot
- Stick figures
- https://davetang.org/muse/2015/02/12/animated-plots-using-r/

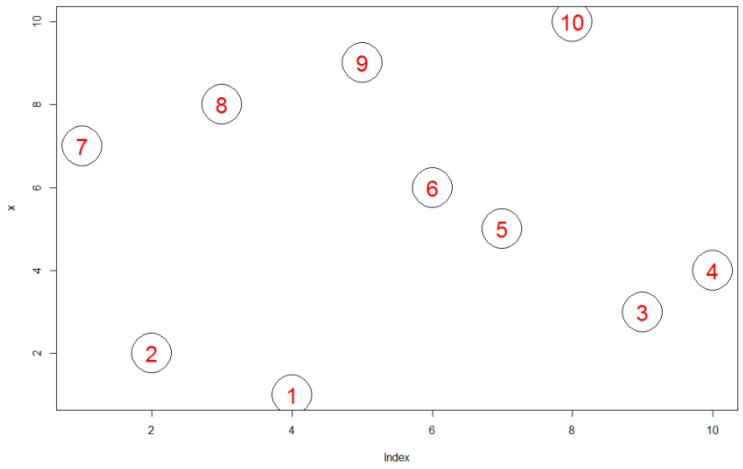
- Binomial Density
- https://www.r-bloggers.com/animated-plots-with-r/

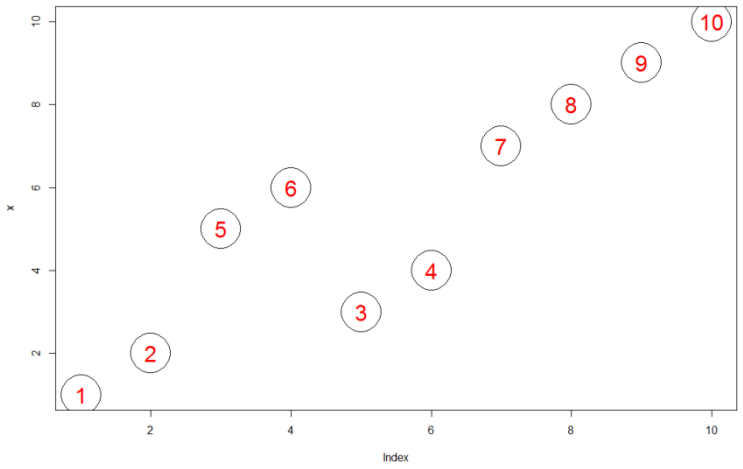
- Happy New Year with R
- http://sixf.org/en/2015/02/happy-new-year-with-r/

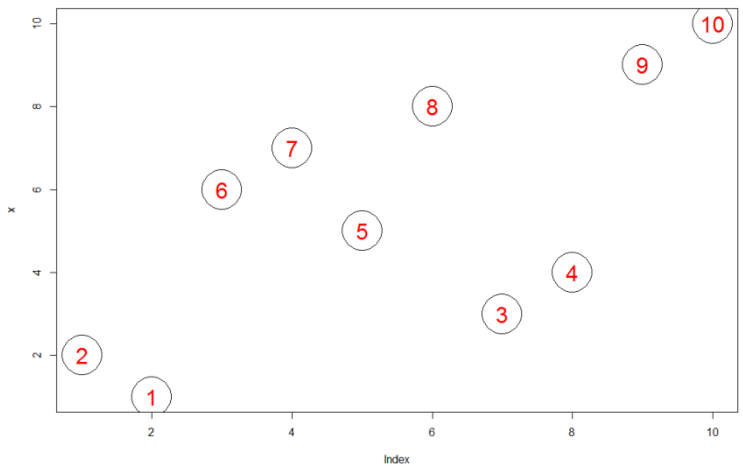
數據排序

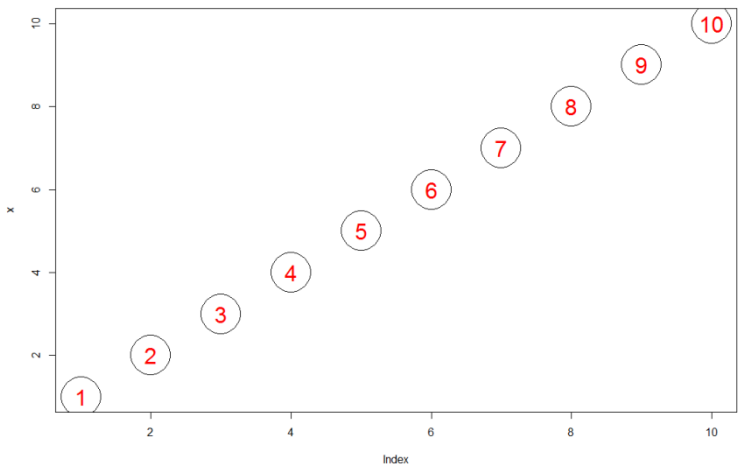
```
mySort <- function( x ) {
        itemCount <- length( x )
        repeat {
                hasChanged <- FALSE
                itemCount <- itemCount - 1
                if ( itemCount >= 1 ){
                for( k in 1 : itemCount ) {
                        if ( x[ k ] > x[ k+1 ] ) {
                                t <- x[ k ]
                                x[ k ] <- x[ k+1 ]
                                x[ k+1 ] <- t
                                hasChanged <- TRUE
                        }
                }
                }
                if ( !hasChanged ) break;
        }
        return( x )
}
```

搜尋演算法的過程


10
9
8
7
6
5
4
3
2
1
x
Index


10
9
8
7
6
5
4
3
2
1
x
Index


10
9
8
7
6
5
4
3
2
1
x
Index


10
9
8
7
6
5
4
3
2
1
x
Index

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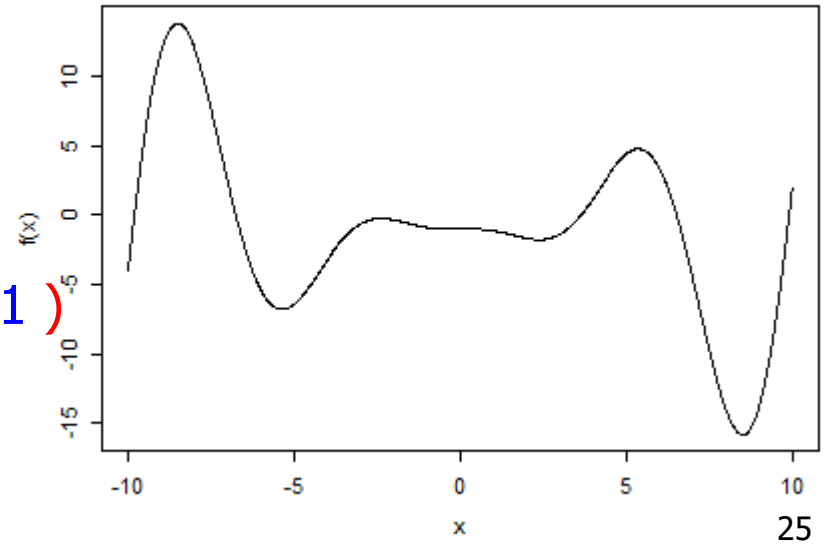
數學函數繪圖

數學函數繪圖

- curve( ) # 數學函數繪圖

- f <- function(x) 0.01 * x^3 * cos(x) - 0.2 * x^2 * sin(x) + 0.05 * x - 1
- win.graph(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 2) + 0.1)

- curve(f, from = -10, to = 10)
- curve(f, from = -10, to = 10, n = 1001)
- par(old.par)

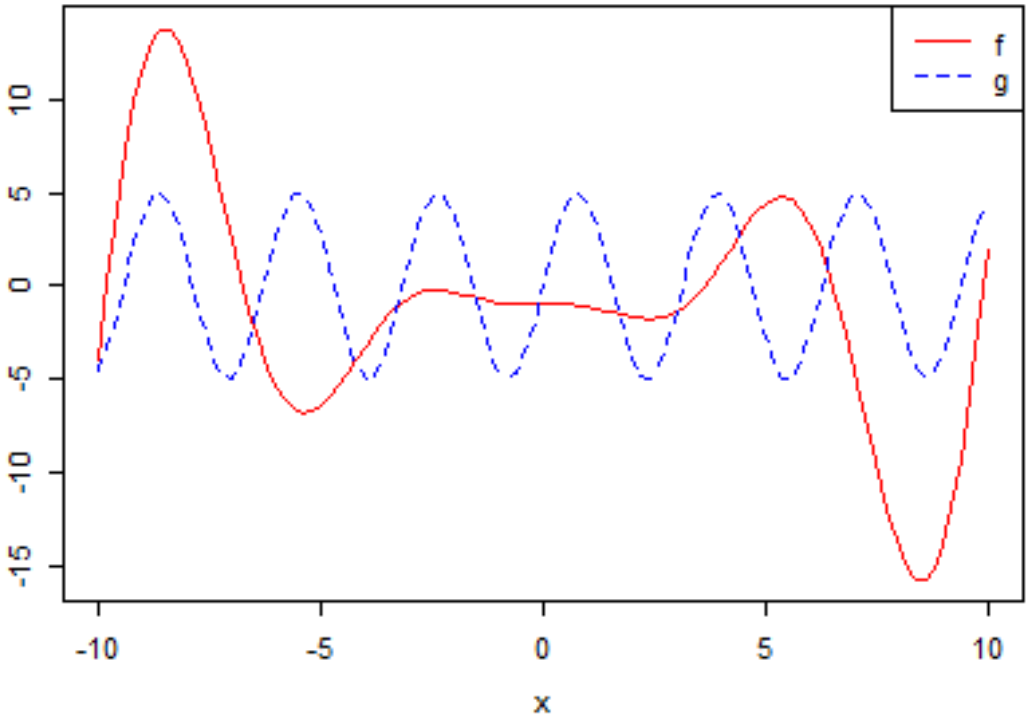


數學函數繪圖

```
f <- function(x)  0.01 * x^3 * cos(x) - 0.2 * x^2 * sin(x) + 0.05 * x - 1
g <- function(x)  10 * cos(x) * sin(x)

win.graph( width = 4.5, height = 3.3, pointsize = 8 )
old.par <- par( mex = 0.8, mar = c(5, 5, 4, 2) + 0.1 )

curve( f, from = -10, to = 10, lty = 1, col = "red", ylab = "" )
curve( g, add = TRUE, lty = 2, col = "blue" )

legend( "topright", legend = c("f", "g"), lty = 1:2, col = c("red", "blue"))
par(old.par)
```

數學函數繪圖

- f <- function(x) 0.01 * x^3 * cos(x) - 0.2 * x^2 * sin(x) + 0.05 * x - 1
- g <- function(x) 10 * cos(x) * sin(x)



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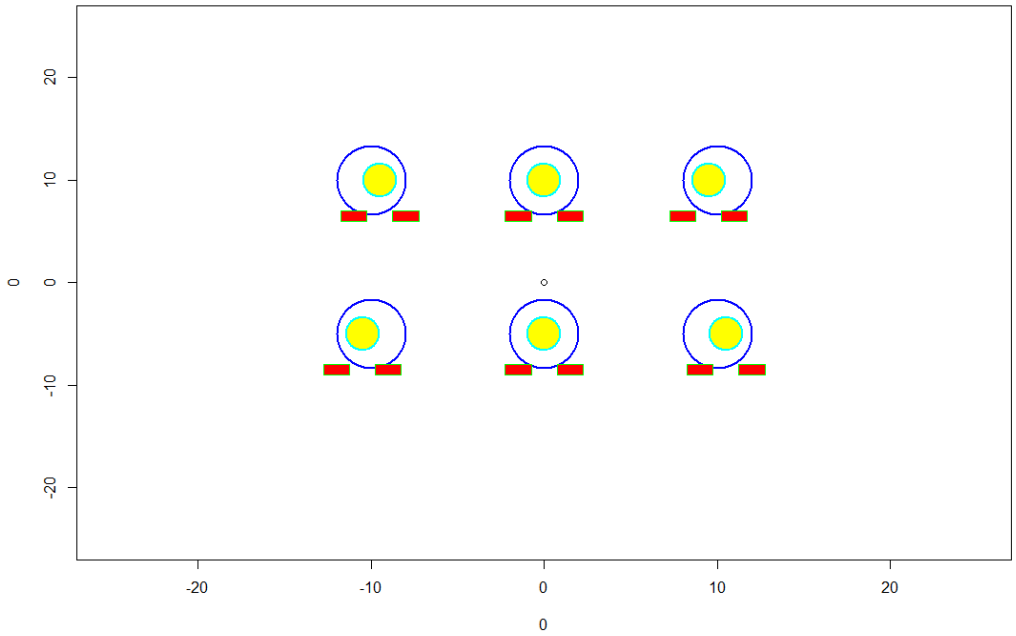
作業

HW10++：動作與動畫

- 參考範例程式， HW10_B01921001_Animation.R
- 使用 Ball_0( ), Ball_1( ), Ball_2( )
  可以繪製下圖的六個不同姿態（腳的站姿）的主角
- 也可以使用 Ball_0_OFF( ), Ball_1_OFF ( ), Ball_2_OFF ( )
  把這這個主角消除掉。
- 請參考範例程式，寫一個動畫程式，
  讓這個主角自由自在地遊走在您的螢幕上！



HW10++：動作與動畫

- 繳交下面檔案，檔案名稱：HW10_學號_關鍵字.xxx
  - 主要指定檔案： HW10_B01921001_Animation.R
    將有進行改變的哪幾行程式碼以及對應的註解解釋，
    報告檔案： HW10_B01921001_Animation.pdf 或者 .pptx
    程式執行之後所產生的過程或完成圖，
    試著解釋您的規劃的動作為何？
    或者是：R Markdown 等整合式的檔案，.Rmd 與 .pdf

- 繳交方式與期限：
  - E-mail 上面兩個檔案到：ntucp2018s@gmail.com
  - E-mail 主旨：HW10_B01921001_Animation
    (就是，作業編號_您的學號_關鍵字)
  - 繳交期限：7/3 (Tue), 2018, 11pm 以前