TissueDrawing
Technical details and regression checks

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Contents

1 The VDedgeDrawn object

A `VDedgeDrawn` object encodes a description of an edge. It has two subclasses, representing polygons and circular segments. Edges are unique. If two set boundaries overlap they are described by a common edge on the overlap. The orientation of an edge is important. An edge whose name starts with a '-' is interpreted as the reversal of the edge with the same name without the '-' (and only the latter is stored in the diagram's list of edges). Edge names are unique.

Most edges form the boundaries of both Faces and Sets. The exception is invisible edges which are added between otherwise disjoint sets to ensure the diagram is not disjoint.

Edges have bounding boxes in the `bb` slot, although I am not sure if these are always correctly updated upon the joining or splitting of edges.

1.1 The VDedgeSector object

A `VDedgeSector` object inherits from a `VDedgeDrawn` one. A sector is a segment of a circle, defined by two points, together with the convention that a right-handed sector goes clockwise (Figure 1). Angles are all interpreted in the same way as `atan2`, ie clockwise from the line $y = 0$. The angles of the beginning θ_f and end θ_t of the segment obey $2\pi \geq \theta_f > 0$ and $\theta_f > \theta_t > -2 * \pi$.

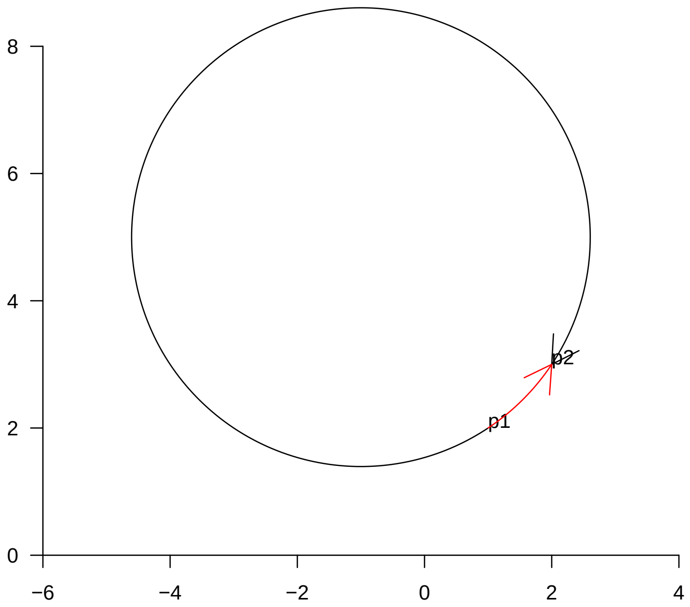


Figure 1: In black, a right-handed edge sector, and in red a left-handed one

1.2 The VDedgeLines object

A `VDedgeSector` object inherits from a `VDedgeDrawn` one and describes polygonal edges.

1.3 Edge methods

Edges can be shown, split at a point, converted to *xy* coordinates, or reversed. It can have a 'midpoint' found on its interior. A point can be tested to see if it lies on an edge. Pairs of edges can be tested for identity, joined together (not much used and barely tested), and crucially can be tested for intersection.

2 Faces

Individual faces within a diagram are stored as a vector of edge names describing an oriented traversal of the face.

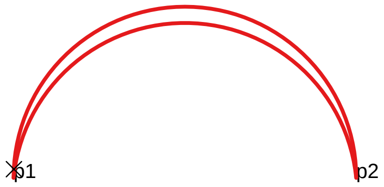


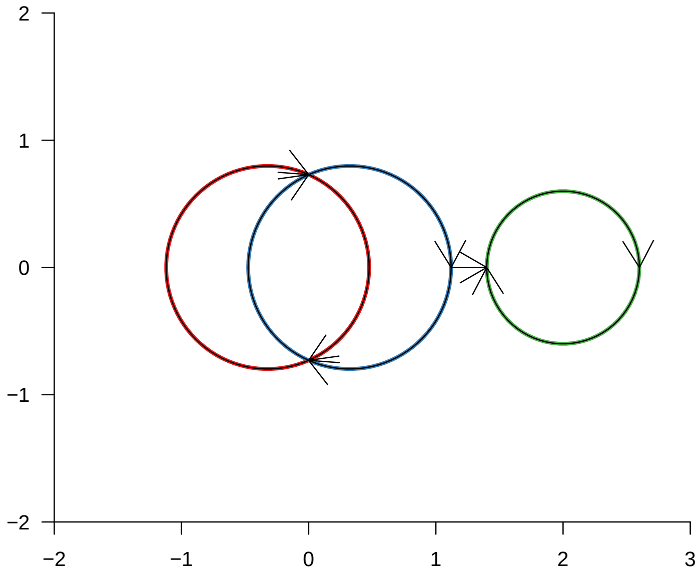
Figure 2: A face which doesn't contain its centroid

.

3 Joining disjoint faces

```
> .PlotArcs <- function(drawing, edgeNames) {
+     if (missing(edgeNames)) {
```

```
+         edgeNames = names(drawing@edgeList)
+     }
+     exy <- lapply(drawing@edgeList[edgeNames], .edge.to.xy)
+     lapply(exy, function(xy) {
+         grid.lines(xy[, 1], xy[, 2], arrow = arrow(), default.units = "native")
+     })
+ }

> VD2 <- compute.Venn(Venn(n = 2))
> VD3 <- newTissueFromCircle(centre.xy = c(2, 0), radius = 0.6,
+     Set = 3)
> VD23 <- VD2
> VD23@faceList <- c(VD2@faceList, VD3@faceList)
> VD23@edgeList <- c(VD2@edgeList, VD3@edgeList)
> VD23@setList <- c(VD2@setList, VD3@setList)
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-2, 3), c(-2, 2))
> grid.xaxis()
> grid.yaxis()
> cejf <- .create.edge.joining.faces(VD23, "DarkMatter", "1")
> VD23 <- cejf$drawing
> PlotSetBoundaries(VD23)
> .PlotArcs(VD23)

$`i24|i23|1`
lines[GRID.lines.2222]

$`i24|i23|2`
lines[GRID.lines.2223]

$`i23|i24|1`
lines[GRID.lines.2224]

$`i23|e25|2`
lines[GRID.lines.2225]

$`e25|i24|2`
lines[GRID.lines.2226]

$`c31|e26|3`
lines[GRID.lines.2227]

$`e26|c31|3`
lines[GRID.lines.2228]

$`e25|e26|invisible`
lines[GRID.lines.2229]
```



4 The TissueDrawing object

First we test constucting them from scratch.

```
> VD.nodeList <- list(p1 = matrix(1:2, ncol = 2), p2 = matrix(2:3,
+     ncol = 2), p3 = matrix(c(-1, 0), ncol = 2))
> sectorfromto <- function(sector, from, to, nodeList) {
+     sector@from <- from
+     sector@to <- to
+     from.point <- nodeList[[from]]
+     sector@fromTheta <- .point.xy.to.theta(from.point, sector@centre)
+     sector@toTheta <- .point.xy.to.theta(nodeList[[to]], sector@centre)
+     sector <- .normalise.sector(sector)
+ }
> centre = c(-1, 5)
> fromTheta <- .point.xy.to.theta(nodeList[["p1"]], centre)
> toTheta <- .point.xy.to.theta(nodeList[["p2"]], centre)
> lh <- newEdgeSector(centre = c(-1, 5), hand = 1, fromTheta = fromTheta,
+     toTheta = toTheta, radius = sqrt(13))
> lh <- sectorfromto(lh, "p1", "p2", VD.nodeList)
> centre = c(4, 0)
> fromTheta <- .point.xy.to.theta(nodeList[["p1"]], centre)
> toTheta <- .point.xy.to.theta(nodeList[["p2"]], centre)
> rh <- newEdgeSector(centre = c(4, 0), hand = 1, fromTheta = fromTheta,
+     toTheta = toTheta, radius = sqrt(13))
```

```
> el <- newEdgeLines(from = "p1", to = "p3", xy = matrix(c(1, 2,
+     -0.5, 0, -1, 0), ncol = 2, byrow = T))
> VD.edgeList <- list(`p1|p2|1` = sectorfromto(lh, "p1", "p2",
+     VD.nodeList), `p2|p1|1` = sectorfromto(lh, "p2", "p1", VD.nodeList),
+     `p1|p2|2` = sectorfromto(rh, "p1", "p2", VD.nodeList), `p2|p1|2` = sectorfromto(rh,
+         "p2", "p1", VD.nodeList), `p1|p3|3` = el, `p3|p1|3` = newEdgeLines(from = "p3",
+         to = "p1", xy = matrix(c(-1, 0, 1, 2), ncol = 2, byrow = T)))
> VD.faceList <- list(`100` = c("p1|p2|1", "-p1|p2|2"), `110` = c("p1|p2|2",
+     "p2|p1|1"), `010` = c("p2|p1|2", "-p2|p1|1"), `001` = c("p1|p3|3",
+     "p3|p1|3"), DarkMatter = c("-p3|p1|3", "-p1|p3|3", "-p2|p1|2",
+     "-p1|p2|1"))
> VD.setList <- list(`1` = c("p1|p2|1", "p2|p1|1"), `2` = c("p1|p2|2",
+     "p2|p1|2"), `3` = c("p1|p3|3", "p3|p1|3"))
> VD.faceSignature <- lapply(names(VD.faceList), function(x) {
+     x
+ })
> names(VD.faceSignature) <- names(VD.faceList)
> VD <- new("TissueDrawing", nodeList = VD.nodeList, edgeList = VD.edgeList,
+     setList = VD.setList, faceList = VD.faceList, faceSignature = VD.faceSignature)
> .validateDrawing(VD)

Validating a drawing on 3 sets......done

> VD

        from to         type npoints centre hand
p1|p2|1   p1 p2 VDedgeSector      NA   -1,5    1
p2|p1|1   p2 p1 VDedgeSector      NA   -1,5    1
p1|p2|2   p1 p2 VDedgeSector      NA    4,0    1
p2|p1|2   p2 p1 VDedgeSector      NA    4,0    1
p1|p3|3   p1 p3  VDedgeLines       3   <NA>   NA
p3|p1|3   p3 p1  VDedgeLines       2   <NA>   NA
   X1 X2
p1  1  2
p2  2  3
p3 -1  0
                                         faces
100                           p1|p2|1;-p1|p2|2
110                            p1|p2|2;p2|p1|1
010                           p2|p1|2;-p2|p1|1
001                            p1|p3|3;p3|p1|3
DarkMatter -p3|p1|3;-p1|p3|3;-p2|p1|2;-p1|p2|1
                  sig
100               100
110               110
010               010
001               001
DarkMatter DarkMatter
  paste.face..collapse.......
1             p1|p2|1;p2|p1|1
```

```
2             p1|p2|2;p2|p1|2
3             p1|p3|3;p3|p1|3
```

```
> .checkPointOnEdge(edge = VD@edgeList[["p1|p2|1"]], point.xy = VD@nodeList[["p1"]])
```

```
[1] TRUE
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-7, 7), c(-5, 10))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VD)
> PlotSetBoundaries(VD)
> PlotNodes(VD)
```

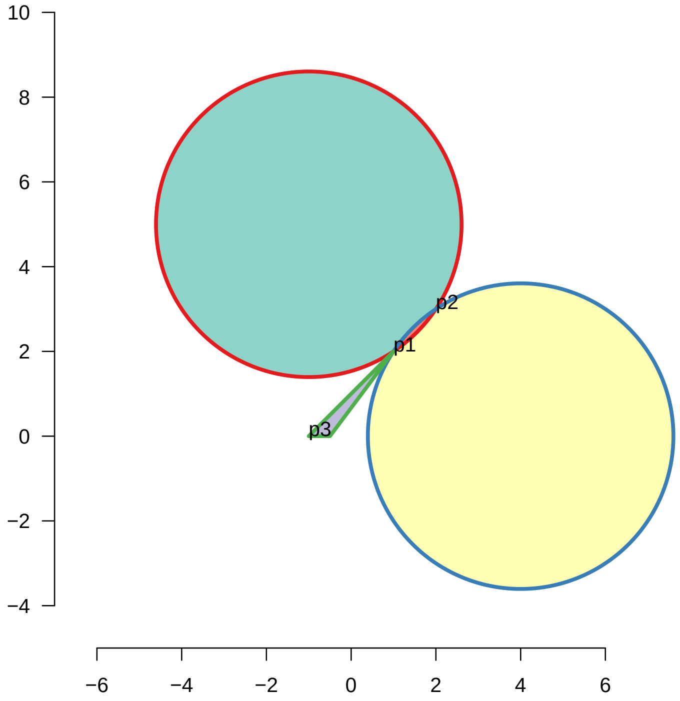


Figure 3: Constructing TissueDrawing objects from scratch

5 Injecting points and edges

We test injecting points

```
> p4 <- matrix(c(7, -2), ncol = 2)
> rownames(p4) <- "p4"
> VD4 <- injectPoint(drawing = VD, edgeName = "p2|p1|2", newPoint = p4)
> .validateDrawing(VD4)
```

```
Validating a drawing on 3 sets......done
```

```
> VD4
```

```
        from to         type npoints centre hand
p1|p2|1   p1 p2 VDedgeSector      NA   -1,5    1
p2|p1|1   p2 p1 VDedgeSector      NA   -1,5    1
p1|p2|2   p1 p2 VDedgeSector      NA    4,0    1
p1|p3|3   p1 p3  VDedgeLines       3   <NA>   NA
p3|p1|3   p3 p1  VDedgeLines       2   <NA>   NA
p2|p4|2   p2 p4 VDedgeSector      NA    4,0    1
p4|p1|2   p4 p1 VDedgeSector      NA    4,0    1
   X1 X2
p1  1  2
p2  2  3
p3 -1  0
p4  7 -2
                                                 faces
100                                p1|p2|1;-p1|p2|2
110                                 p1|p2|2;p2|p1|1
010                         p2|p4|2;p4|p1|2;-p2|p1|1
001                                 p1|p3|3;p3|p1|3
DarkMatter -p3|p1|3;-p1|p3|3;-p4|p1|2;-p2|p4|2;-p1|p2|1
                  sig
100               100
110               110
010               010
001               001
DarkMatter DarkMatter
  paste.face..collapse.......
1             p1|p2|1;p2|p1|1
2     p1|p2|2;p2|p4|2;p4|p1|2
3             p1|p3|3;p3|p1|3
```

```
> p5 <- matrix(c(-3, 2), ncol = 2)
> rownames(p5) <- "p5"
> VD4 <- injectPoint(VD4, edgeName = "p1|p2|1", newPoint = p5)
> .validateDrawing(VD4)
```

```
Validating a drawing on 3 sets......done
```

```
> VD4
```

```
        from to         type npoints centre hand
p2|p1|1   p2 p1 VDedgeSector      NA   -1,5    1
p1|p2|2   p1 p2 VDedgeSector      NA    4,0    1
p1|p3|3   p1 p3  VDedgeLines       3   <NA>   NA
p3|p1|3   p3 p1  VDedgeLines       2   <NA>   NA
p2|p4|2   p2 p4 VDedgeSector      NA    4,0    1
p4|p1|2   p4 p1 VDedgeSector      NA    4,0    1
p1|p5|1   p1 p5 VDedgeSector      NA   -1,5    1
```

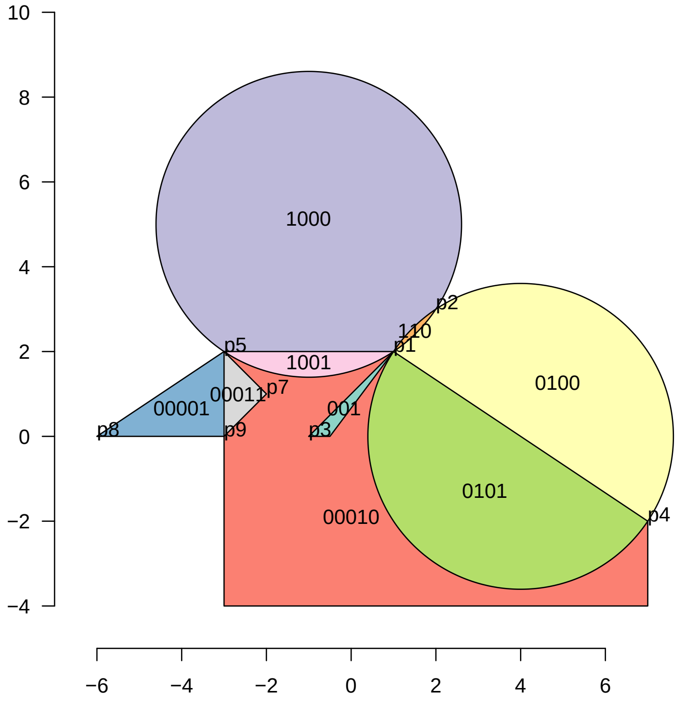
```
p5|p2|1   p5 p2 VDedgeSector      NA   -1,5    1
   X1 X2
p1  1  2
p2  2  3
p3 -1  0
p4  7 -2
p5 -3  2
                                                           faces
100                                     p1|p5|1;p5|p2|1;-p1|p2|2
110                                              p1|p2|2;p2|p1|1
010                                     p2|p4|2;p4|p1|2;-p2|p1|1
001                                              p1|p3|3;p3|p1|3
DarkMatter -p3|p1|3;-p1|p3|3;-p4|p1|2;-p2|p4|2;-p5|p2|1;-p1|p5|1
                  sig
100               100
110               110
010               010
001               001
DarkMatter DarkMatter
  paste.face..collapse.......
1     p1|p5|1;p5|p2|1;p2|p1|1
2     p1|p2|2;p2|p4|2;p4|p1|2
3             p1|p3|3;p3|p1|3
```

Then we try injecting single edges

```
> p1p4.line <- newEdgeLines(from = "p1", to = "p4", xy = matrix(c(1,
+     2, 7, -2), ncol = 2, byrow = T))
> p5p1.line <- newEdgeLines(from = "p5", to = "p1", xy = matrix(c(-3,
+     2, 1, 2), ncol = 2, byrow = T))
> p4p5.line <- newEdgeLines(from = "p4", to = "p5", xy = matrix(c(7,
+     -2, 7, -4, -3, -4, -3, 2), ncol = 2, byrow = T))
> VD6 <- VD4
> VD6@setList[["4"]] <- c("p4|p5|4", "p5|p1|4", "p1|p4|4")
> VD6@edgeList <- c(VD6@edgeList, list(`p1|p4|4` = p1p4.line, `p5|p1|4` = p5p1.line,
+     `p4|p5|4` = p4p5.line))
> VD6 <- injectEdge(drawing = VD6, newEdgeList = VD6@edgeList["p1|p4|4"],
+     set2Name = "4", addToList = FALSE)
> VD6 <- injectEdge(drawing = VD6, newEdgeList = list(`p5|p1|4` = p5p1.line),
+     set2Name = "4", addToList = FALSE)
> VD6 <- injectEdge(drawing = VD6, newEdgeList = list(`p4|p5|4` = p4p5.line),
+     set2Name = "4", addToList = FALSE)
> .is.face.within.set(drawing = VD6, faceName = "0101", setName = "2")

[1] TRUE

> .is.face.within.set(drawing = VD6, faceName = "1000", setName = "2")

[1] FALSE

> .is.face.within.set(drawing = VD6, faceName = "0001", setName = "2")
```

```
[1] FALSE

> VD6

        from to         type npoints centre hand
p2|p1|1   p2 p1 VDedgeSector      NA   -1,5    1
p1|p2|2   p1 p2 VDedgeSector      NA    4,0    1
p1|p3|3   p1 p3  VDedgeLines       3   <NA>   NA
p3|p1|3   p3 p1  VDedgeLines       2   <NA>   NA
p2|p4|2   p2 p4 VDedgeSector      NA    4,0    1
p4|p1|2   p4 p1 VDedgeSector      NA    4,0    1
p1|p5|1   p1 p5 VDedgeSector      NA   -1,5    1
p5|p2|1   p5 p2 VDedgeSector      NA   -1,5    1
p1|p4|4   p1 p4  VDedgeLines       2   <NA>   NA
p5|p1|4   p5 p1  VDedgeLines       2   <NA>   NA
p4|p5|4   p4 p5  VDedgeLines       4   <NA>   NA
   X1 X2
p1  1  2
p2  2  3
p3 -1  0
p4  7 -2
p5 -3  2
                                                 faces
110                                    p1|p2|2;p2|p1|1
001                                    p1|p3|3;p3|p1|3
DarkMatter                  -p2|p4|2;-p5|p2|1;-p4|p5|4
0101                                   p1|p4|4;p4|p1|2
0100                         -p2|p1|1;p2|p4|2;-p1|p4|4
1001                                   p5|p1|4;p1|p5|1
1000                         p5|p2|1;-p1|p2|2;-p5|p1|4
0001       p4|p5|4;-p1|p5|1;-p3|p1|3;-p1|p3|3;-p4|p1|2
                  sig
110               110
001               001
DarkMatter DarkMatter
0101             0101
0100             0100
1001             1001
1000             1000
0001             0001
  paste.face..collapse.......
1     p1|p5|1;p5|p2|1;p2|p1|1
2     p1|p2|2;p2|p4|2;p4|p1|2
3             p1|p3|3;p3|p1|3
4     p4|p5|4;p5|p1|4;p1|p4|4

> VD8 <- VD6
> p7 <- matrix(c(-2, 1), ncol = 2)
> rownames(p7) <- "p7"
> VD8@nodeList[["p7"]] <- p7
> p8 <- matrix(c(-6, 0), ncol = 2)
> rownames(p8) <- "p8"
> VD8@nodeList[["p8"]] <- p8
> p9 <- matrix(c(-3, 0), ncol = 2)
> rownames(p9) <- "p9"
> VD8@nodeList[["p9"]] <- p9
> p5p7.line <- newEdgeLines(from = "p5", to = "p7", xy = matrix(c(-3,
+     2, -2, 1), ncol = 2, byrow = T))
> p7p9.line <- newEdgeLines(from = "p7", to = "p9", xy = matrix(c(-2,
+     1, -3, 0), ncol = 2, byrow = T))
> p9p8.line <- newEdgeLines(from = "p9", to = "p8", xy = matrix(c(-3,
+     0, -6, 0), ncol = 2, byrow = T))
> p8p5.line <- newEdgeLines(from = "p8", to = "p5", xy = matrix(c(-6,
+     0, -3, 2), ncol = 2, byrow = T))
> VD8@edgeList[["p5|p7|5"]] <- p5p7.line
> VD8@edgeList[["p7|p9|5"]] <- p7p9.line
> VD8@edgeList[["p9|p8|5"]] <- p9p8.line
> VD8@edgeList[["p8|p5|5"]] <- p8p5.line
> VD8@setList[["5"]] <- c("p5|p7|5", "p7|p9|5", "p9|p8|5", "p8|p5|5")
> VD8@edgeList[["p4|p5|4"]]@xy

     [,1] [,2]
[1,]    7   -2
[2,]    7   -4
[3,]   -3   -4
[4,]   -3    2

> VD8 <- injectPoint(drawing = VD8, edgeName = "p4|p5|4", newPoint = VD8@nodeList[["p9"]])
> VD8@edgeList[["p9|p5|4"]]@xy

     [,1] [,2]
[1,]   -3    0
[2,]   -3    2

> VD8@edgeList[["p4|p9|4"]]@xy

     [,1] [,2]
[1,]    7   -2
[2,]    7   -4
[3,]   -3   -4
[4,]   -3    0

> VD8 <- injectEdge(drawing = VD8, newEdgeList = VD8@edgeList[c("p5|p7|5",
+     "p7|p9|5")], set2Name = "5", addToList = FALSE)
> VD8 <- injectEdge(drawing = VD8, newEdgeList = VD8@edgeList[c("p9|p8|5",
+     "p8|p5|5")], set2Name = "5", addToList = FALSE)
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-7, 7), c(-5, 10))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VD8)
> PlotSetBoundaries(VD8, gp = gpar(lwd = 2, col = c("red", "blue",
+     "green", "black", "orange")))
> .PlotFaceNames.TissueDrawing(VD8)
> PlotNodes(VD8)
```

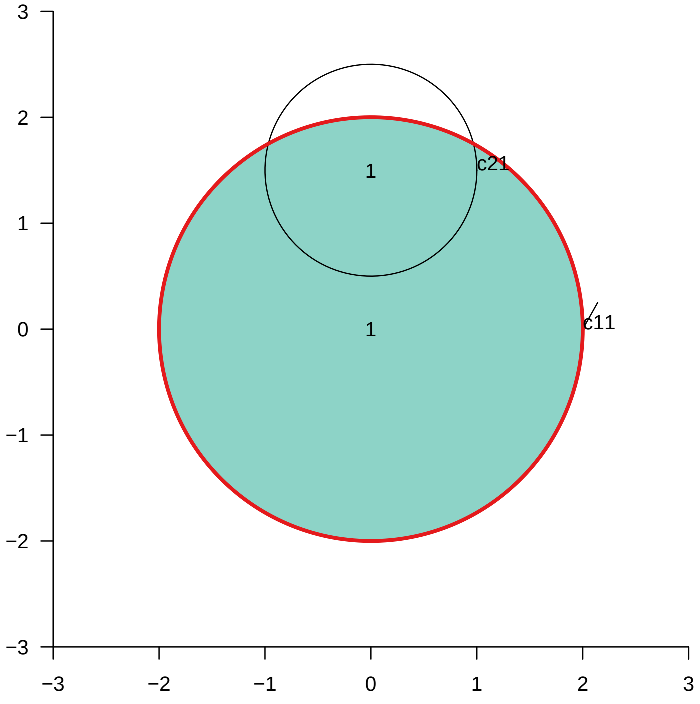


6 Making a simple drawing from a circle

```
> centre.xy <- c(0, 0)
> VDC1 <- newTissueFromCircle(centre.xy, radius = 2, Set = 1)
> VDC2 <- newTissueFromCircle(centre.xy + c(0, 1.5), radius = 1,
+     Set = 2)
> .validateDrawing(VDC2)
```

```
Validating a drawing on 1 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> xy <- .edge.to.xy(VDC1@edgeList[[1]])
> grid.lines(xy[, 1], xy[, 2], default.units = "native", arrow = arrow())
> PlotFaces(VDC1)
> PlotFaces(VDC2, gp = gpar(fill = "red"))
> PlotSetBoundaries(VDC1)
> .PlotFaceNames.TissueDrawing(VDC1)
> PlotNodes(VDC1)
> PlotNodes(VDC2)
> .PlotFaceNames.TissueDrawing(VDC2)
```

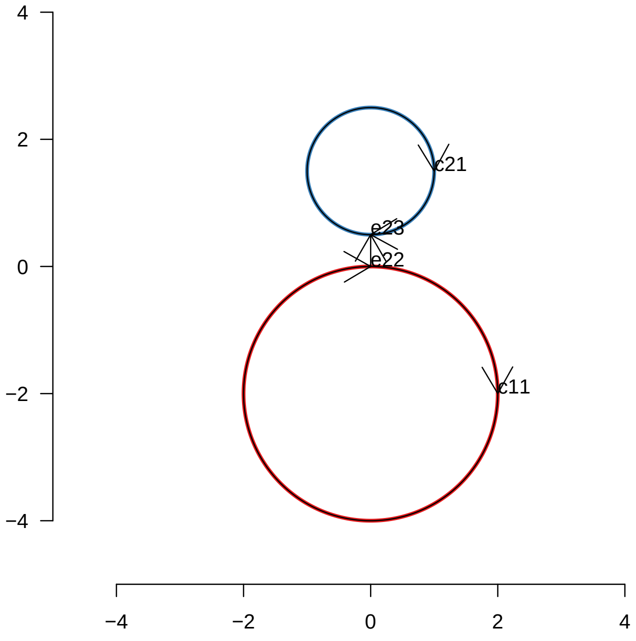


7 Circles

```
> r = 0.6
> d = 0.4
> angles <- pi/2 - c(0, 2 * pi/3, 4 * pi/3)
> x <- d * cos(angles)
> y <- d * sin(angles)
> r <- rep(r, 3)
> centres <- matrix(c(x, y), ncol = 2, byrow = FALSE)
> VDC1 <- newTissueFromCircle(centres[1, ], radius = r[1], Set = 1)
> VDC2 <- newTissueFromCircle(centres[2, ], radius = r[2], Set = 2)
> TM <- addSetToDrawing(drawing1 = VDC1, drawing2 = VDC2, set2Name = "Set2")
> VDC3 <- newTissueFromCircle(centres[3, ], radius = r[3], Set = 3)
> TM <- addSetToDrawing(drawing1 = TM, drawing2 = VDC3, set2Name = "Set3")
> .validateDrawing(TM)
```

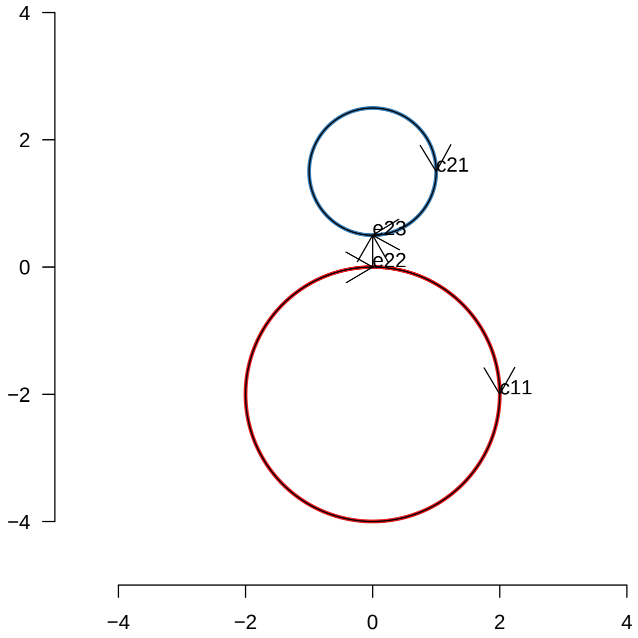
```
Validating a drawing on 3 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-1.5, 1.5), c(-1.5, 1.5))
> grid.xaxis()
> grid.yaxis()
> PlotSetBoundaries(TM)
> PlotNodes(TM)
> shoar(TM)
```



7.1 Non overlapping circles

```
> centre.xy <- c(0, -2)
> VDC1 <- newTissueFromCircle(centre.xy, radius = 2, Set = 1)
> VDC2 <- newTissueFromCircle(centre.xy + c(0, 3.5), radius = 1,
+     Set = 2)
> TN2 <- addSetToDrawing(VDC1, VDC2)
> VDC3 <- newTissueFromCircle(c(0, -0.5), radius = 1, Set = 3)
> .validateDrawing(TN2)

Validating a drawing on 2 sets......done

> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-5, 5), c(-5, 5))
> grid.xaxis()
> grid.yaxis()
> PlotSetBoundaries(TN2)
> PlotNodes(TN2)
> shoar(TN2)
```



7.2 Example of bug 528

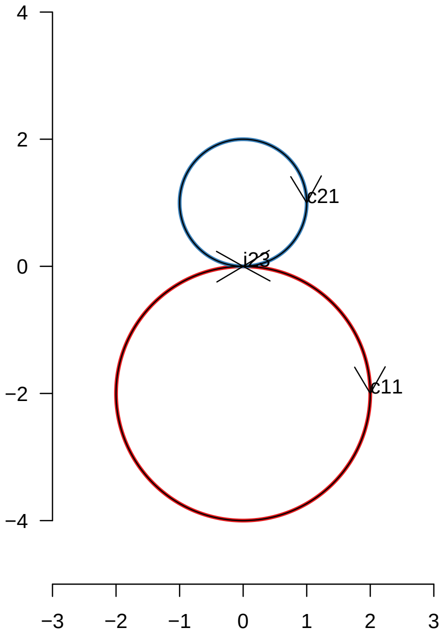
```
> centre.xy <- c(0, -2)
> VDC1b <- newTissueFromCircle(centre.xy, radius = 2, Set = 1)
> VDC2b <- newTissueFromCircle(centre.xy + c(0, 3), radius = 1,
+     Set = 2)
> TN2b <- (addSetToDrawing(VDC1b, VDC2b))
> TN2b

          from  to        type npoints centre hand
c11|i23|1  c11 i23 VDedgeSector      NA   0,-2    1
```

```
i23|c11|1  i23 c11 VDedgeSector      NA   0,-2    1
c21|i23|2  c21 i23 VDedgeSector      NA    0,1    1
i23|c21|2  i23 c21 VDedgeSector      NA    0,1    1
    X1 X2
c11  2 -2
i23  0  0
c21  1  1
                                                 faces
10                                 c11|i23|1;i23|c11|1
DarkMatter -c11|i23|1;-i23|c11|1;-c21|i23|2;-i23|c21|2
01                                 i23|c21|2;c21|i23|2
                  sig
10                 10
DarkMatter DarkMatter
01                 01
     paste.face..collapse.......
Set1         c11|i23|1;i23|c11|1
Set2         c21|i23|2;i23|c21|2
```

```
> (.validateDrawing(TN2b))
```

```
Validating a drawing on 2 sets......done
NULL
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-5, 5))
> grid.xaxis()
> grid.yaxis()
> PlotSetBoundaries(TN2b)
> PlotNodes(TN2b)
> shoar(TN2b)
```

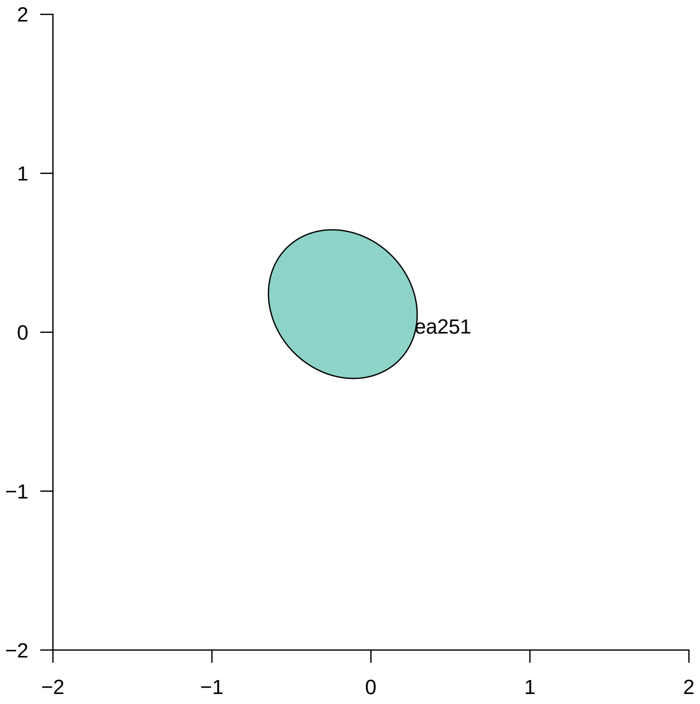


7.3 Ellipses

Ellipses could be coped with specially by finding roots of quartics, but don't bother and just generate them as polygons

```
> VE <- newTissueFromEllipse(f1 = c(0, 0), phi = pi/4, e = 0.5,
+     a = 0.5, Set = 1)
> .validateDrawing(VE)

Validating a drawing on 1 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-2, 2), c(-2, 2))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VE)
> PlotSetBoundaries(VE, gp = gpar(lwd = 2, col = c("red", "blue",
+     "green")))
> PlotNodes(VE)
```



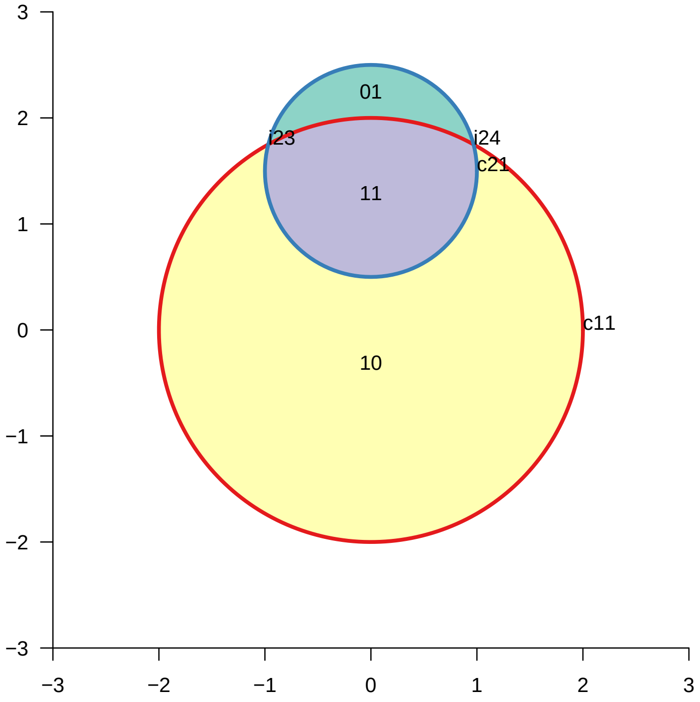
```
> phi <- 0.8
> dex <- 1.7
> dey <- 2.5
> a <- 7.6
> e <- 0.9
> x0 <- c(-0.9, -5)
> VE <- list()
> dx <- 0.2
> VE[[1]] <- newTissueFromEllipse(x0 + c(0, 0), -phi, e, -a, Set = 1,
+     dx = dx)
> VE[[2]] <- newTissueFromEllipse(x0 + c(dex, 0), phi, e, a, Set = 2,
+     dx = dx)
> VE[[3]] <- newTissueFromEllipse(x0 + c(-dey, dey), -phi, e, -a,
+     Set = 3, dx = dx)
> VE[[4]] <- newTissueFromEllipse(x0 + c(dex + dey, dey), phi,
+     e, a, Set = 4, dx = dx)
> TM <- VE[[1]]
> TM2 <- addSetToDrawing(TM, VE[[2]], set2Name = paste("Set", 2,
+     sep = ""))
> TM3 <- addSetToDrawing(TM2, VE[[3]], set2Name = paste("Set",
+     3, sep = ""))
> TM4 <- addSetToDrawing(TM3, VE[[4]], set2Name = paste("Set",
+     4, sep = ""))
> .validateDrawing(TM4)

Validating a drawing on 4 sets......done
sig 0100 duplicated in faces 0100;0100-1
sig 1000 duplicated in faces 1000;1000-1
```

8 Check for the intersection of two edges

```
> centre.xy <- c(0, 0)
> VDC1 <- newTissueFromCircle(centre.xy, radius = 2, Set = 1)
> renameFaces(VDC1, oldName = .faceNames(VDC1, onlyVisible = TRUE),
+     "1")

          from  to         type npoints centre hand
c11|c11|1  c11 c11 VDedgeSector      NA    0,0    1
    X1            X2
c11  2 -4.898425e-16
                faces
1           c11|c11|1
DarkMatter -c11|c11|1
                  sig
1                   1
DarkMatter DarkMatter
     paste.face..collapse.......
Set1                   c11|c11|1

> VDC2 <- newTissueFromCircle(centre.xy + c(0, 1.5), radius = 1,
+     Set = 2)
> edge1 <- VDC1@edgeList[[1]]
> edge2 <- VDC2@edgeList[[1]]
> .findIntersection(edge1, edge2)

           [,1] [,2]
[1,] -0.9682458 1.75
[2,]  0.9682458 1.75

> edge1 <- VD8@edgeList[["p1|p4|4"]]
> edge2 <- VDC2@edgeList[[1]]
> .findIntersection(edge1, edge2)

     [,1] [,2]
```

```
> edge1 <- VD8@edgeList[["p1|p4|4"]]
> edge2 <- VD8@edgeList[["p2|p4|2"]]
> .findIntersection(edge1, edge2)

     [,1] [,2]
[1,]    7   -2

> .find.point.within.face(drawing = VD8, faceName = "1001")

     [,1]     [,2]
[1,]   -1 1.755971
attr(,"names")
[1] "centroid" NA

> .is.point.within.face(VD8, "DarkMatter", p7)

[1] FALSE

> .is.point.within.face(VD8, "DarkMatter", matrix(c(-100, 100),
+     ncol = 2))

[1] TRUE

> edge1 <- VD8@edgeList[["p1|p4|4"]]
> edge2 <- VD8@edgeList[["p1|p3|3"]]
> .findIntersection(edge1, edge2)

    [,1] [,2]
ict    1    2

> drawing1 <- VDC1
> drawing2 <- VDC2
> VM <- addSetToDrawing(drawing1 = VDC1, drawing2 = VDC2, set2Name = "Set2")
> .validateDrawing(VM)

Validating a drawing on 2 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VM)
> PlotSetBoundaries(VM)
> .PlotFaceNames.TissueDrawing(VM)
> PlotNodes(VM)
```



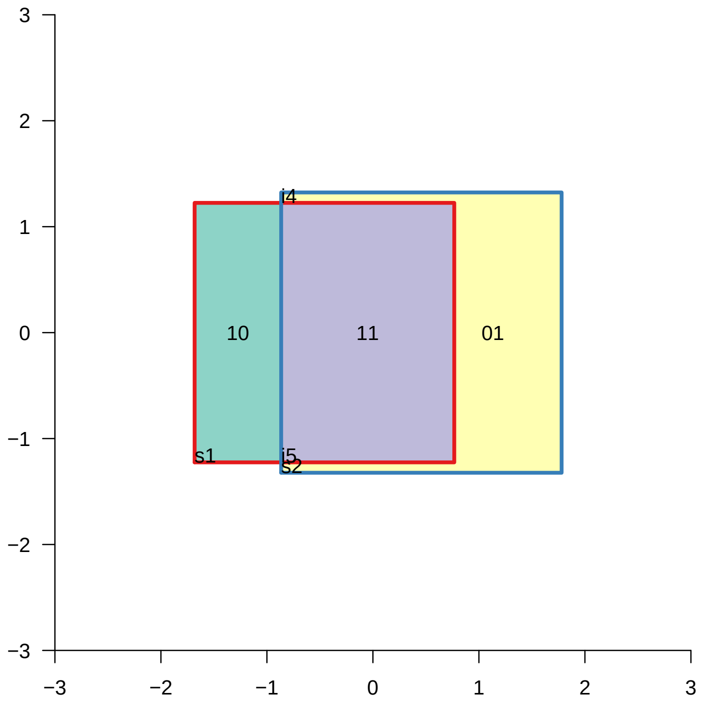
9 addSetToDrawing two polygons

```
> d <- 1
> s1 <- 0.7
> s2 <- 0.6
> d <- 0.9146274
> s1 <- 2.44949
> s2 <- 2.645751
> l1 <- -d/2 - s1/2
> l2 <- d/2 - s2/2
> r1 <- -d/2 + s1/2
> r2 <- d/2 + s2/2
> poly.1 <- matrix(c(l1, -s1/2, l1, s1/2, r1, s1/2, r1, -s1/2),
+     ncol = 2, byrow = TRUE)
```

```
> rownames(poly.1) <- paste("s", 1:4, sep = "")
> poly.2 <- matrix(c(l2, -s2/2, l2, s2/2, r2, s2/2, r2, -s2/2),
+     ncol = 2, byrow = TRUE)
> rownames(poly.2) <- paste("s", 2:5, sep = "")
> VDP1 <- newTissueFromPolygon(points.xy = poly.1, Set = 1)
> VDP2 <- newTissueFromPolygon(points.xy = poly.2, Set = 2)
> TM <- addSetToDrawing(drawing1 = VDP1, drawing2 = VDP2, set2Name = "Set2")
> .validateDrawing(TM)
```

```
Validating a drawing on 2 sets......done
```

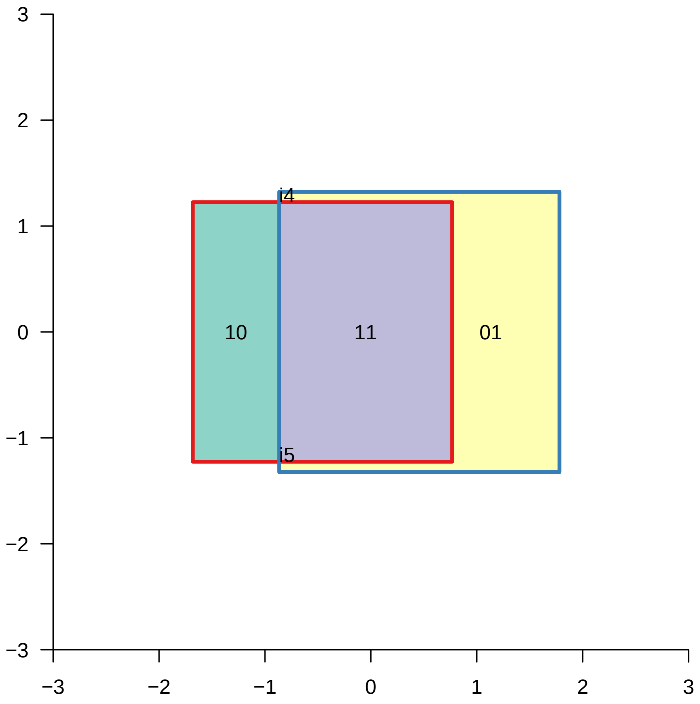
```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM)
> PlotSetBoundaries(TM)
> .PlotFaceNames.TissueDrawing(TM)
> PlotNodes(TM)
```



```
> TMR <- remove.nonintersectionpoints(drawing = TM)
> .validateDrawing(TMR)
```

```
Validating a drawing on 2 sets......done
```

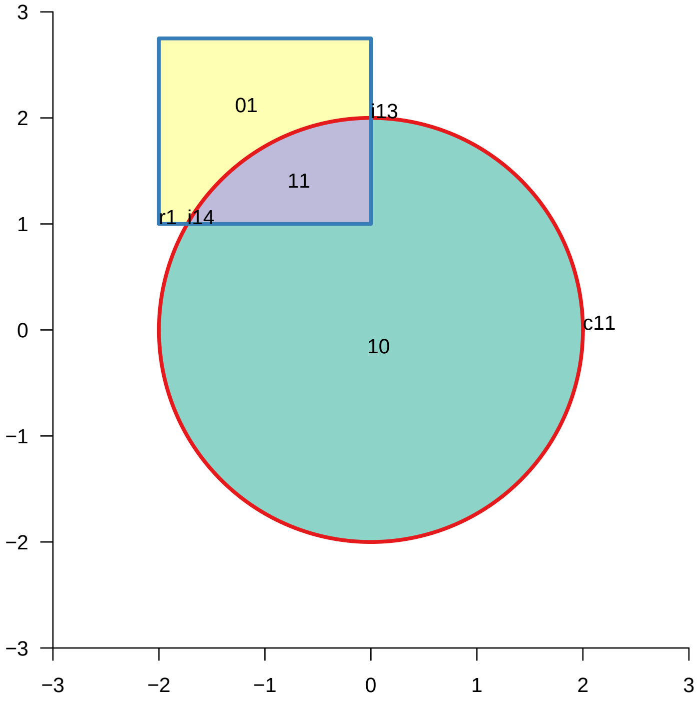
```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TMR)
> PlotSetBoundaries(TMR)
> .PlotFaceNames.TissueDrawing(TMR)
> PlotNodes(TMR)
```



10 addSetToDrawing a polygon and a circle

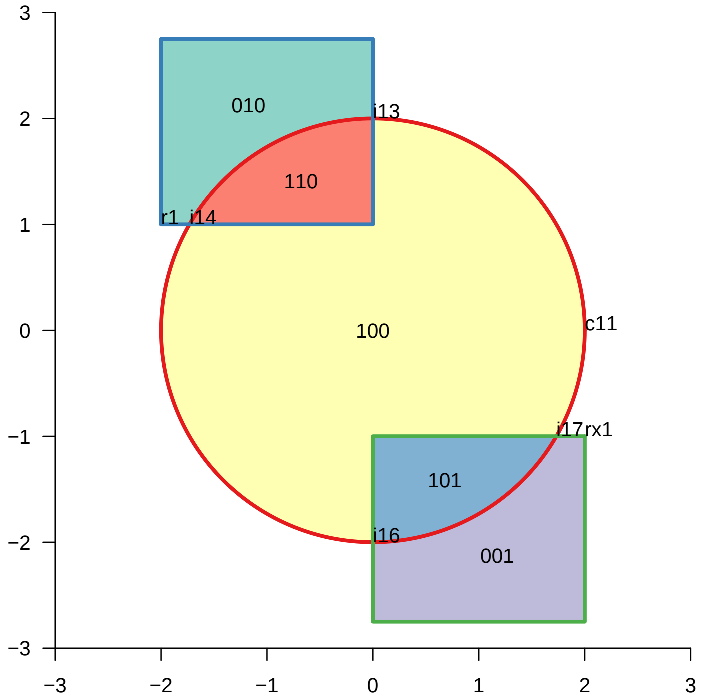
```
> centre.xy <- c(0, 0)
> poly.xy <- matrix(c(-2, 1, -2, 2.75, 0, 2.75, 0, 1), byrow = TRUE,
+     ncol = 2, dimnames = list(paste("r", 1:4, sep = "")))
> VDP1 <- newTissueFromPolygon(points.xy = poly.xy, Set = 2)
> poly2.xy <- -poly.xy
> rownames(poly2.xy) <- sub("r", "rx", rownames(poly2.xy))
> VDP2 <- newTissueFromPolygon(points.xy = poly2.xy, Set = 3)
> drawing1 <- VDC1
> drawing2 <- VDP1
> VDCPM <- addSetToDrawing(drawing1 = VDC1, drawing2 = VDP1, set2Name = "Set2")
> .validateDrawing(VDCPM)

Validating a drawing on 2 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VDCPM)
> PlotSetBoundaries(VDCPM)
> .PlotFaceNames.TissueDrawing(VDCPM)
> PlotNodes(VDCPM)
```



```
> VDCPM2 <- addSetToDrawing(drawing1 = VDCPM, drawing2 = VDP2,
+     set2Name = "Set3")
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VDCPM2)
> PlotSetBoundaries(VDCPM2)
> .PlotFaceNames.TissueDrawing(VDCPM2)
> PlotNodes(VDCPM2)
```

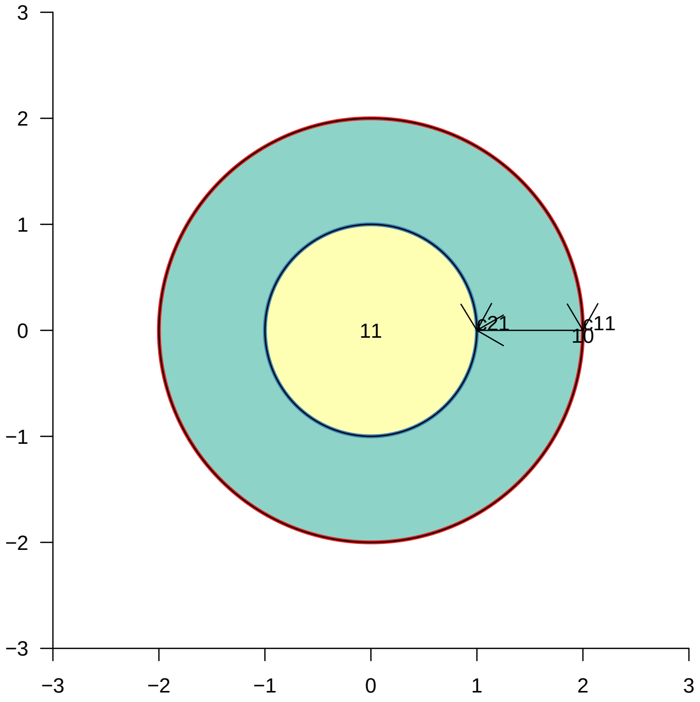


11 Invisible edges

```
> centre.xy <- c(0, 0)
> VDC3 <- newTissueFromCircle(centre.xy, radius = 2, Set = 1)
> VDC4 <- newTissueFromCircle(centre.xy, radius = 1, Set = 2)
> VDI <- addSetToDrawing(drawing1 = VDC3, drawing2 = VDC4, set2Name = "Set2")
> .validateDrawing(VDI)
```

```
Validating a drawing on 2 sets......done
```

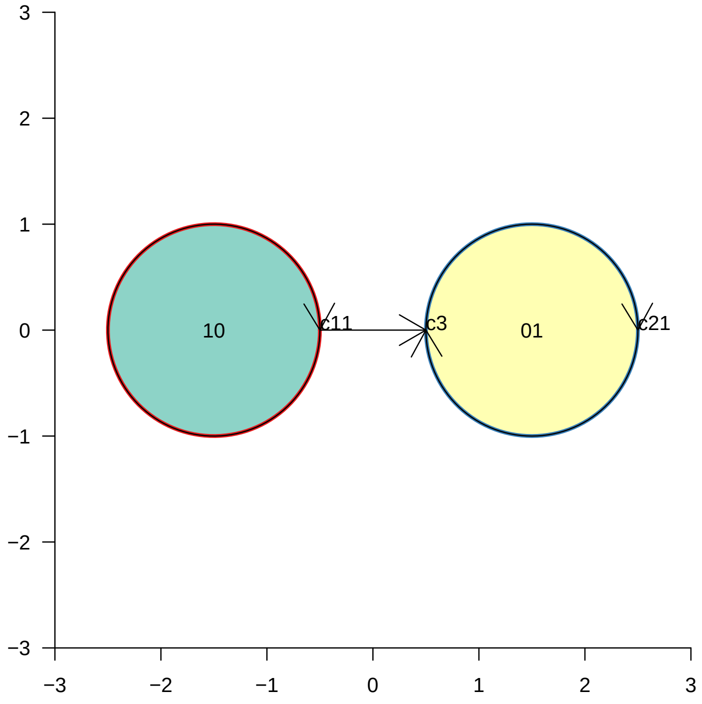
```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VDI)
> PlotSetBoundaries(VDI)
> .PlotFaceNames.TissueDrawing(VDI)
> PlotNodes(VDI)
> shoar(VDI)
```



The code only attemtps to inject invisible edges between known points, so we have to give the algorithm a hint by inserting such known points in the right place

```
> centre.xy <- c(-1.5, 0)
> VDC5 <- newTissueFromCircle(centre.xy, radius = 1, Set = 1)
> VDC6 <- newTissueFromCircle(centre.xy + c(3, 0), radius = 1,
+     Set = 2)
> VDC6 <- injectPoint(VDC6, "c21|c21|2", newPoint = matrix(c(0.5,
+     0), ncol = 2, dimnames = list("c3")))
> VD0 <- addSetToDrawing(drawing1 = VDC5, drawing2 = VDC6, set2Name = "Set2")
> .validateDrawing(VD0)

Validating a drawing on 2 sets......done
```

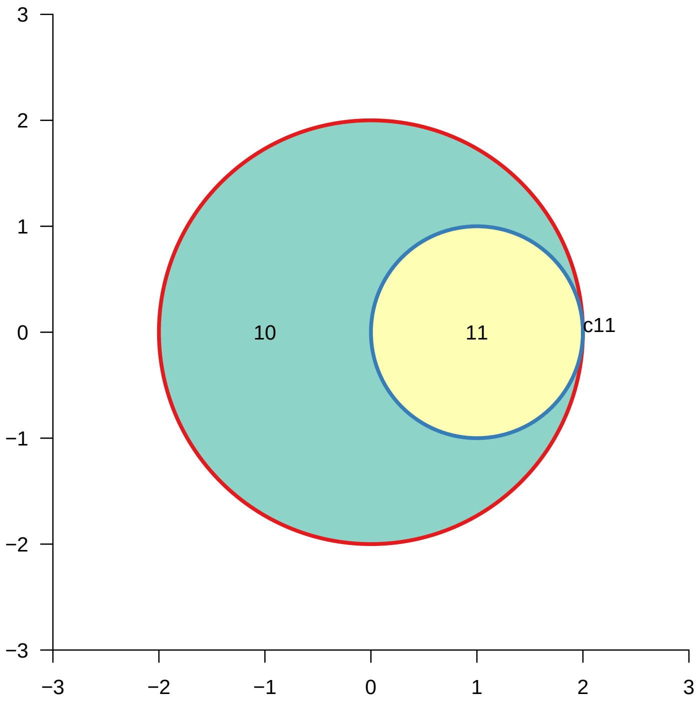
```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VDO)
> PlotSetBoundaries(VDO)
> .PlotFaceNames.TissueDrawing(VDO)
> PlotNodes(VDO)
> shoar(VDO)
```



12 Tangents

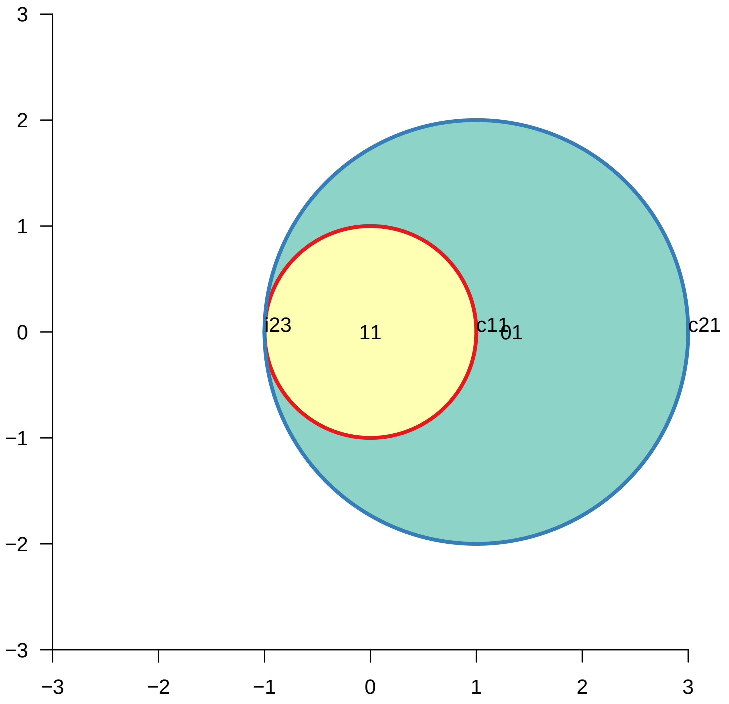
```
> centre.xy <- c(0, 0)
> VDC7 <- newTissueFromCircle(centre.xy, radius = 2, Set = 1)
> VDC8 <- newTissueFromCircle(centre.xy + c(1, 0), radius = 1,
+     Set = 2)
> VDT <- addSetToDrawing(drawing1 = VDC7, drawing2 = VDC8, set2Name = "Set2")
> .validateDrawing(VDT)

Validating a drawing on 2 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VDT)
> PlotSetBoundaries(VDT)
> .PlotFaceNames.TissueDrawing(VDT)
> PlotNodes(VDT)
```



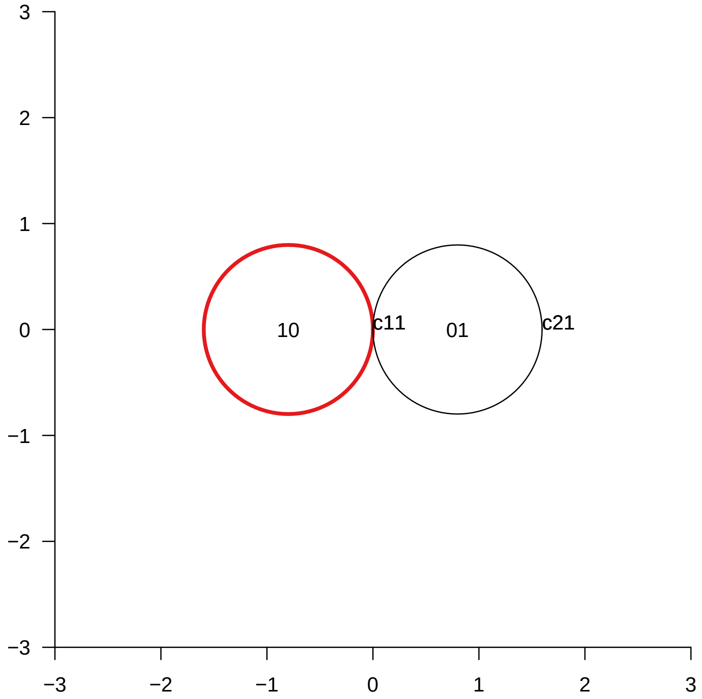
```
> centre.xy <- c(0, 0)
> VDC9 <- newTissueFromCircle(centre.xy, radius = 1, Set = 1)
> VDC10 <- newTissueFromCircle(centre.xy + c(1, 0), radius = 2,
+     Set = 2)
> VDT2 <- addSetToDrawing(drawing1 = VDC9, drawing2 = VDC10, set2Name = "Set2")
> .validateDrawing(VDT2)

Validating a drawing on 2 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(VDT2)
> PlotSetBoundaries(VDT2)
> .PlotFaceNames.TissueDrawing(VDT2)
> PlotNodes(VDT2)
```



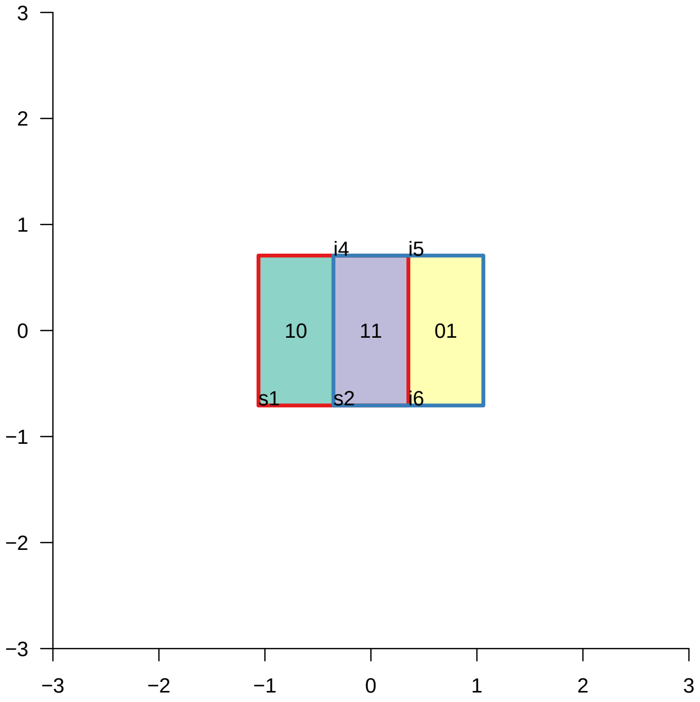
```
> r1 = 0.797884560802865
> r2 = 0.797884560802865
> d = 1.59576912160573
> r = c(r1, r2)
> centres <- matrix(c(-d/2, 0, d/2, 0), ncol = 2, byrow = TRUE)
> VDC1 <- newTissueFromCircle(centres[1, ], radius = r[1], Set = 1)
> VDC2 <- newTissueFromCircle(centres[2, ], radius = r[2], Set = 2)
> VDT <- addSetToDrawing(drawing1 = VDC1, drawing2 = VDC2, set2Name = "Set2")
> .validateDrawing(VDT)

Validating a drawing on 2 sets......done
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotSetBoundaries(VDC1)
> PlotSetBoundaries(VDC2, gp = gpar(col = "red"))
> PlotNodes(VDC1)
> PlotNodes(VDC2)
> .PlotFaceNames.TissueDrawing(VDT)
> PlotNodes(VDT)
```



```
> l1 <- -1.06066
> r1 <- 0.3535534
> l2 <- -0.3535534
> r2 <- 1.06066
> s1 <- 1.414214
> s2 <- 1.414214
> poly.1 <- matrix(c(l1, -s1/2, l1, s1/2, r1, s1/2, r1, -s1/2),
+     ncol = 2, byrow = TRUE)
> rownames(poly.1) <- paste("s", 1:4, sep = "")
> poly.2 <- matrix(c(l2, -s2/2, l2, s2/2, r2, s2/2, r2, -s2/2),
+     ncol = 2, byrow = TRUE)
> rownames(poly.2) <- paste("s", 2:5, sep = "")
> VDP1 <- newTissueFromPolygon(points.xy = poly.1, Set = 1)
> VDP2 <- newTissueFromPolygon(points.xy = poly.2, Set = 2)
> TM <- addSetToDrawing(drawing1 = VDP1, drawing2 = VDP2, set2Name = "Set2")
```

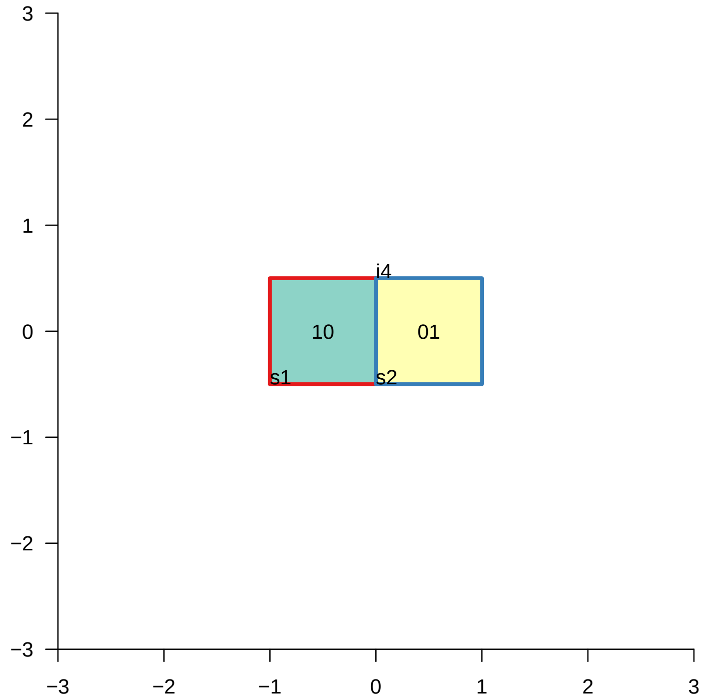
```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM)
> PlotSetBoundaries(TM)
> .PlotFaceNames.TissueDrawing(TM)
> PlotNodes(TM)
```



```
> d <- 1
> s1 <- 1
> s2 <- 1
> l1 <- -d/2 - s1/2
> l2 <- d/2 - s2/2
> r1 <- -d/2 + s1/2
> r2 <- d/2 + s2/2
> poly.1 <- matrix(c(l1, -s1/2, l1, s1/2, r1, s1/2, r1, -s1/2),
+     ncol = 2, byrow = TRUE)
> rownames(poly.1) <- paste("s", 1:4, sep = "")
> poly.2 <- matrix(c(l2, -s2/2, l2, s2/2, r2, s2/2, r2, -s2/2),
+     ncol = 2, byrow = TRUE)
```

```
> rownames(poly.2) <- paste("s", 2:5, sep = "")
> VDP3 <- newTissueFromPolygon(points.xy = poly.1, Set = 1)
> VDP4 <- newTissueFromPolygon(points.xy = poly.2, Set = 2)
> TM3 <- addSetToDrawing(drawing1 = VDP3, drawing2 = VDP4, set2Name = "Set2")
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM3)
> PlotSetBoundaries(TM3)
> .PlotFaceNames.TissueDrawing(TM3)
> PlotNodes(TM3)
```

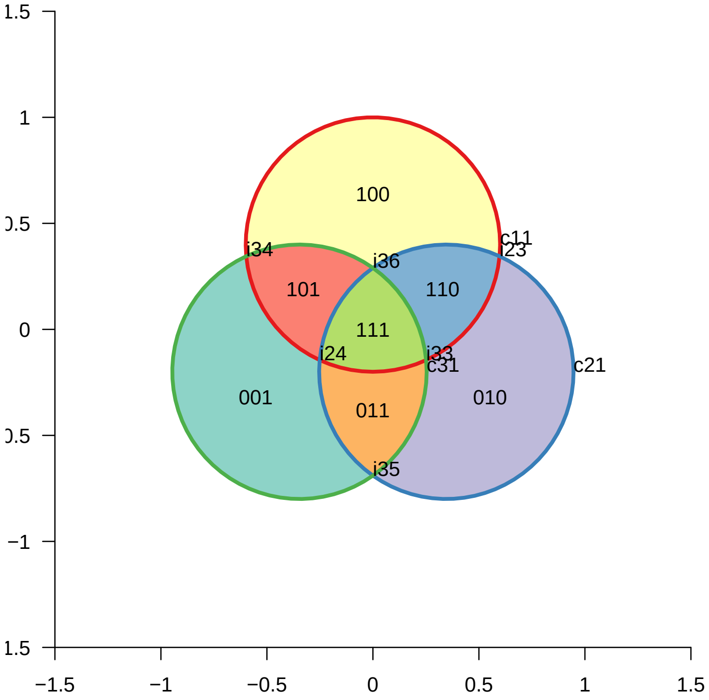


13 Three circles

13.1 Canonical

```
> r <- 0.6
> d <- 0.4
> angles <- pi/2 - c(0, 2 * pi/3, 4 * pi/3)
> x <- d * cos(angles)
> y <- d * sin(angles)
> r <- rep(r, 3)
> centres <- matrix(c(x, y), ncol = 2, byrow = FALSE)
> VDC1 <- newTissueFromCircle(centres[1, ], radius = r[1], Set = 1)
> VDC2 <- newTissueFromCircle(centres[2, ], radius = r[2], Set = 2)
> TM3 <- addSetToDrawing(drawing1 = VDC1, drawing2 = VDC2, set2Name = "Set2")
> VDC3 <- newTissueFromCircle(centres[3, ], radius = r[3], Set = 3)
> TM3 <- addSetToDrawing(drawing1 = TM3, drawing2 = VDC3, set2Name = "Set3")
```

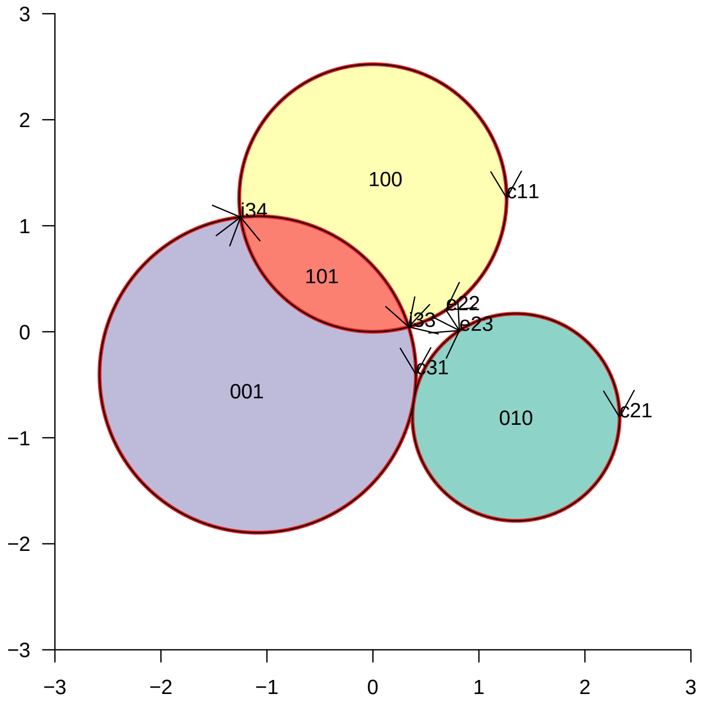
```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-1.5, 1.5), c(-1.5, 1.5))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM3)
> PlotSetBoundaries(TM3)
> .PlotFaceNames.TissueDrawing(TM3)
> PlotNodes(TM3)
```



13.2 One tangent point

```
> r <- c(1.261566, 0.977205, 1.492705)
> x <- c(0, 1.350138, -1.086542)
> y <- c(1.2615663, -0.8066661, -0.4028718)
> centres <- matrix(c(x, y), ncol = 2, byrow = FALSE)
> VDC1 <- newTissueFromCircle(centres[1, ], radius = r[1], Set = 1)
> VDC2 <- newTissueFromCircle(centres[2, ], radius = r[2], Set = 2)
> TM <- addSetToDrawing(drawing1 = VDC1, drawing2 = VDC2, set2Name = "Set2")
> VDC3 <- newTissueFromCircle(centres[3, ], radius = r[3], Set = 3)
> TM <- addSetToDrawing(drawing1 = TM, drawing2 = VDC3, set2Name = "Set3")
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM)
> PlotSetBoundaries(VDC1)
> PlotSetBoundaries(VDC2)
> PlotSetBoundaries(VDC3)
> .PlotFaceNames.TissueDrawing(TM)
> PlotNodes(TM)
> shoar(TM)
```



13.3 Two circles tangent numerics

```
> r <- c(1.492705, 0.977205, 1.128379)
> x <- c(0, 1.384666, -1.028597)
> y <- c(1.49270533, -0.55257134, -0.02662434)
> centres <- matrix(c(x, y), ncol = 2, byrow = FALSE)
> VDC12b <- newTissueFromCircle(centres[1, ], radius = r[1], Set = 1)
> VDC22b <- newTissueFromCircle(centres[2, ], radius = r[2], Set = 2)
> TM2b <- try(addSetToDrawing(drawing1 = VDC12b, drawing2 = VDC22b,
+     set2Name = "Set2"))
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotSetBoundaries(VDC1b)
> PlotSetBoundaries(VDC2b)
```

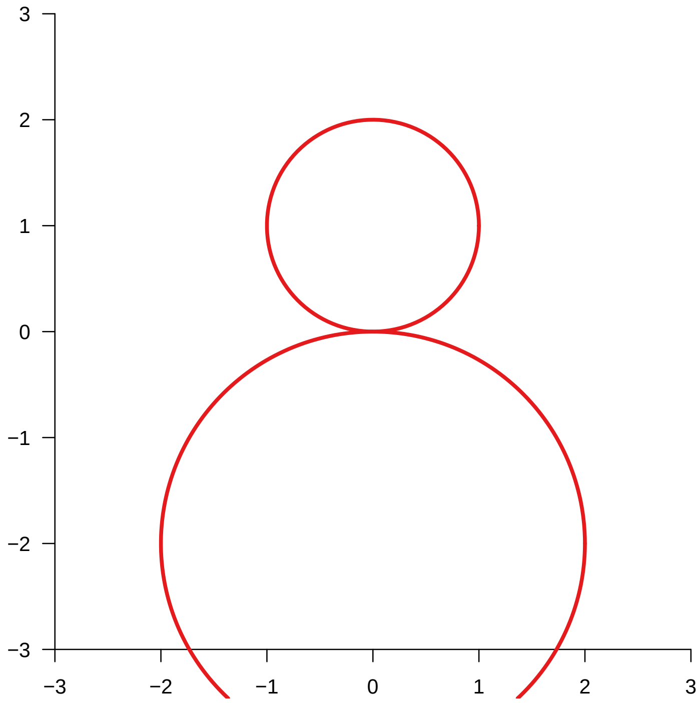
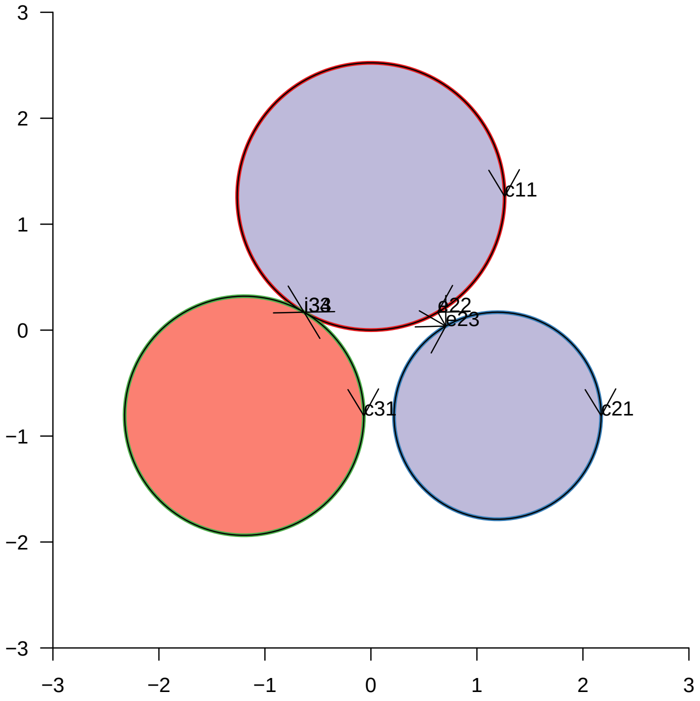


Figure 4: Numerical difficulties cause a bug here

13.4 April May June

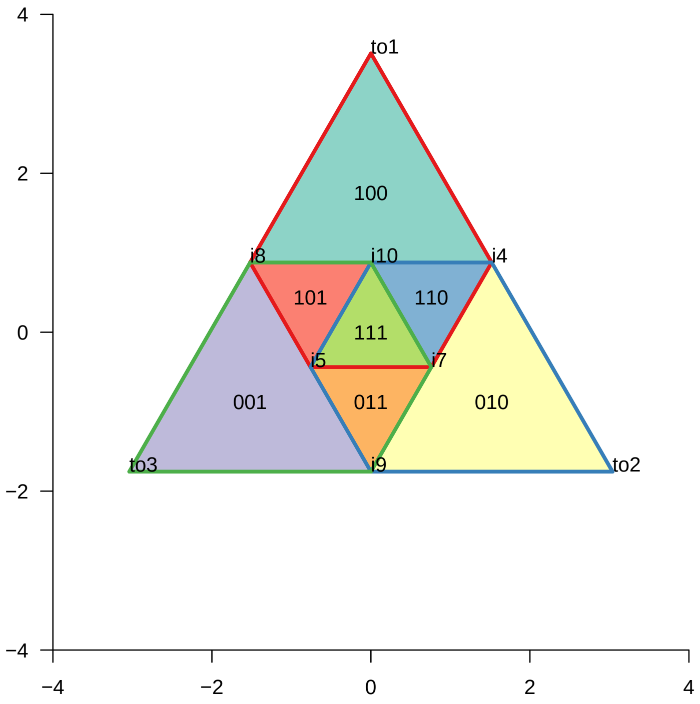
```
> r <- c(1.26156626101008, 0.977205023805844, 1.12837916709551)
> x <- c(0, 1.19497271405280, -1.19497271405280)
> y <- c(1.26156626101008, -0.808187193387839, -0.808187193387839)
> centres <- matrix(c(x, y), ncol = 2, byrow = FALSE)
> VDC1c <- newTissueFromCircle(centres[1, ], radius = r[1], Set = 1)
> VDC2c <- newTissueFromCircle(centres[2, ], radius = r[2], Set = 2)
> TMc <- addSetToDrawing(drawing1 = VDC1c, drawing2 = VDC2c, set2Name = "Set2")
> VDC3c <- newTissueFromCircle(centres[3, ], radius = r[3], Set = 3)
> TM3c <- addSetToDrawing(drawing1 = TMc, drawing2 = VDC3c, set2Name = "Set3")
> TV3c <- .merge.faces.invisibly.split(TM3c)
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-3, 3), c(-3, 3))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TV3c)
> PlotSetBoundaries(TV3c)
> PlotNodes(TV3c)
> shoar(TV3c)
```



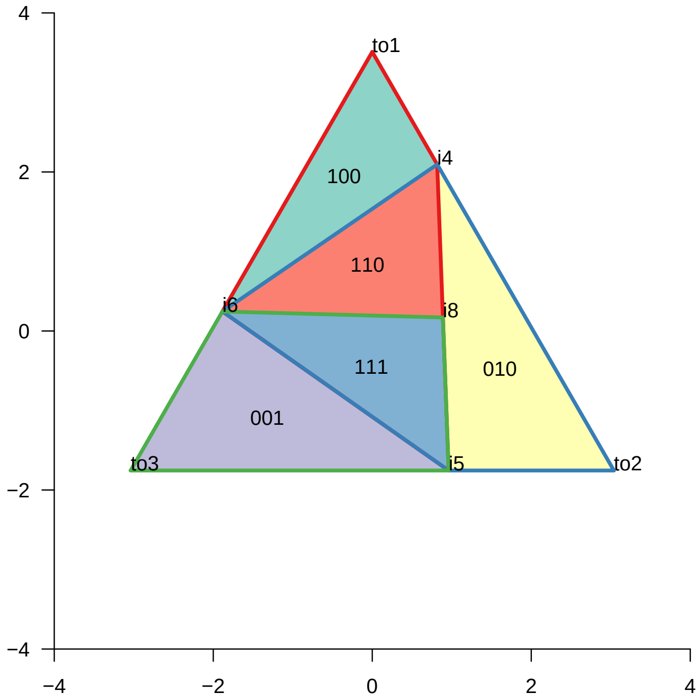
14 Triangles

```
> .inscribetriangle.feasible <- function(wghts) {
+     w0 <- 1 - sum(wghts)
+     stopifnot(all(wghts <= 1) & all(wghts >= 0) & w0 >= 0)
+     wa <- wghts[1]
+     wb <- wghts[2]
+     wc <- wghts[3]
+     Delta <- w0^2 - 4 * wa * wb * wc
+     return(Delta >= 0)
+ }
> .inscribetriangle.compute <- function(wghts) {
+     wa <- wghts[1]
+     wb <- wghts[2]
+     wc <- wghts[3]
+     stopifnot(.inscribetriangle.feasible(wghts))
+     pa <- (1 - wc)
+     pb <- (wb + wc - wa - 1)
+     pc <- wa * (1 - wb)
+     sc <- if (wa > 0) {
+         (-pb - sqrt(pb^2 - 4 * pa * pc))/(2 * pa)
+     }
+     else if (wb + wc < 1) {
+         (1 - wb - wc)/(1 - wc)
+     }
+     else {
+         0
+     }
+     sb <- if (sc > 0) {
+         1 - wa/sc
+     }
+     else {
+         wc/(1 - wb)
+     }
+     sa <- wb/(1 - sc)
+     c(sc, sa, sb)
+ }
> .inscribetriangle.inscribe <- function(xy, wghts) {
+     scalef <- NA
+     isfeasible <- .inscribetriangle.feasible(wghts)
+     if (!isfeasible) {
+         scalef <- 4 * wghts[1] * wghts[2] * wghts[3]/(1 - sum(wghts))^2
+         scalef <- scalef^(1/3)
+         wghts <- wghts/(scalef * 1.001)
+         isfeasible <- .inscribetriangle.feasible(wghts)
+         stopifnot(!isfeasible)
+     }
+     if (!isfeasible)
+         return(list(feasible = FALSE))
+     scab <- .inscribetriangle.compute(wghts)
+     inner.xy <- (1 - scab) * xy + scab * (xy[c(2, 3, 1), ])
+     return(list(feasible = TRUE, inner.xy = inner.xy, scalef = scalef))
+ }

> WeightUniverse <- 18
> WeightVisible <- 16
> WeightInvisible <- WeightUniverse - WeightVisible
> w0ratio <- WeightInvisible/WeightVisible
> wa <- 0.25
> wb <- 0.25
> wc <- 0.25
> outer.weights <- c(wa, wb, wc)
> outer.innerw <- 1 - sum(outer.weights)
> outer.inner.ratios <- outer.weights/outer.innerw
> outer.feasible <- .inscribetriangle.feasible(outer.weights)
> wab <- 0.0625
> wbc <- 0.0625
> wca <- 0.0625
> wabc <- 0.0625
> inner.weights <- c(wab, wbc, wca)
> inner.innerw <- wabc
> sf <- (sum(inner.weights) + inner.innerw)
> Weight.Inner <- sf * WeightVisible
> if (sf > 0) {
+     inner.weights <- inner.weights/sf
+     inner.feasible <- .inscribetriangle.feasible(inner.weights)
+ } else {
+     inner.feasible <- FALSE
+ }
> side <- sqrt(4 * WeightVisible/(3 * sqrt(3)))
> angles <- pi/2 - c(0, 2 * pi/3, 4 * pi/3)
> outer.xy <- t(sapply(angles, function(a) c(x = side * cos(a),
+     y = side * sin(a))))
> inner <- .inscribetriangle.inscribe(outer.xy, wghts = outer.weights)
> inner.xy <- inner$inner.xy
> innest <- .inscribetriangle.inscribe(inner.xy, wghts = inner.weights)
> innest.xy = innest$inner.xy
> outest.xy <- outer.xy * sqrt(1 + wOratio)
> rownames(outer.xy) <- paste("to", 1:3, sep = "")
> rownames(inner.xy) <- paste("ti", 1:3, sep = "")
> rownames(innest.xy) <- paste("tt", 1:3, sep = "")
> outline.a.xy <- do.call(rbind, list(outer.xy[1, , drop = FALSE],
+     inner.xy[1, , drop = FALSE], innest.xy[1, , drop = FALSE],
+     innest.xy[2, , drop = FALSE], inner.xy[3, , drop = FALSE]))
> outline.b.xy <- do.call(rbind, list(outer.xy[2, , drop = FALSE],
+     inner.xy[2, , drop = FALSE], innest.xy[2, , drop = FALSE],
+     innest.xy[3, , drop = FALSE], inner.xy[1, , drop = FALSE]))
> outline.c.xy <- do.call(rbind, list(outer.xy[3, , drop = FALSE],
+     inner.xy[3, , drop = FALSE], innest.xy[3, , drop = FALSE],
+     innest.xy[1, , drop = FALSE], inner.xy[2, , drop = FALSE]))
> VDP1 <- newTissueFromPolygon(points.xy = outline.a.xy, Set = 1)
> VDP2 <- newTissueFromPolygon(points.xy = outline.b.xy, Set = 2)
> VDP3 <- newTissueFromPolygon(points.xy = outline.c.xy, Set = 3)
> TMT <- addSetToDrawing(drawing1 = VDP1, drawing2 = VDP2, set2Name = "Set2")
> TMT <- addSetToDrawing(drawing1 = TMT, drawing2 = VDP3, set2Name = "Set3")
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-4, 4), c(-4, 4))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TMT)
> PlotSetBoundaries(TMT)
> .PlotFaceNames.TissueDrawing(TMT)
> PlotNodes(TMT)
```



```
> WeightUniverse <- 18
> WeightVisible <- 16
> WeightInvisible <- WeightUniverse - WeightVisible
> w0ratio <- WeightInvisible/WeightVisible
> wa <- 0.166666667
> wb <- 0.25
> wc <- 0.25
> outer.weights <- c(wa, wb, wc)
> outer.innerw <- 1 - sum(outer.weights)
> outer.inner.ratios <- outer.weights/outer.innerw
> outer.feasible <- .inscribetriangle.feasible(outer.weights)
> wab <- 0.166666667
> wbc <- 0
> wca <- 0
> wabc <- 0.166666667
> inner.weights <- c(wab, wbc, wca)
> inner.innerw <- wabc
> sf <- (sum(inner.weights) + inner.innerw)
> Weight.Inner <- sf * WeightVisible
> if (sf > 0) {
+     inner.weights <- inner.weights/sf
+     inner.feasible <- .inscribetriangle.feasible(inner.weights)
+ } else {
+     inner.feasible <- FALSE
+ }
> side <- sqrt(4 * WeightVisible/(3 * sqrt(3)))
> angles <- pi/2 - c(0, 2 * pi/3, 4 * pi/3)
> outer.xy <- t(sapply(angles, function(a) c(x = side * cos(a),
+     y = side * sin(a))))
> inner <- .inscribetriangle.inscribe(outer.xy, wghts = outer.weights)
> inner.xy <- inner$inner.xy
> innest <- .inscribetriangle.inscribe(inner.xy, wghts = inner.weights)
> innest.xy = innest$inner.xy
> outest.xy <- outer.xy * sqrt(1 + w0ratio)
> rownames(outer.xy) <- paste("to", 1:3, sep = "")
> rownames(inner.xy) <- paste("ti", 1:3, sep = "")
> rownames(innest.xy) <- paste("tt", 1:3, sep = "")
> outline.a.xy <- do.call(rbind, list(outer.xy[1, , drop = FALSE],
+     inner.xy[1, , drop = FALSE], innest.xy[1, , drop = FALSE],
+     innest.xy[2, , drop = FALSE], inner.xy[3, , drop = FALSE]))
> outline.b.xy <- do.call(rbind, list(outer.xy[2, , drop = FALSE],
+     inner.xy[2, , drop = FALSE], innest.xy[2, , drop = FALSE],
+     innest.xy[3, , drop = FALSE], inner.xy[1, , drop = FALSE]))
> outline.c.xy <- do.call(rbind, list(outer.xy[3, , drop = FALSE],
+     inner.xy[3, , drop = FALSE], innest.xy[3, , drop = FALSE],
+     innest.xy[1, , drop = FALSE], inner.xy[2, , drop = FALSE]))
> VDP1 <- newTissueFromPolygon(points.xy = outline.a.xy, Set = 1)
> VDP2 <- newTissueFromPolygon(points.xy = outline.b.xy, Set = 2)
> VDP3 <- newTissueFromPolygon(points.xy = outline.c.xy, Set = 3)
> TMT <- addSetToDrawing(drawing1 = VDP1, drawing2 = VDP2, set2Name = "Set2")
> TMT <- addSetToDrawing(drawing1 = TMT, drawing2 = VDP3, set2Name = "Set3")
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-4, 4), c(-4, 4))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TMT)
> PlotSetBoundaries(TMT)
> .PlotFaceNames.TissueDrawing(TMT)
> PlotNodes(TMT)
```



15 Three squares

```
> ss1 <- c(-2.04988805276466, 1.4142135623731, 1.41421356237309,
+     -1.77228856812726, -1.77228856812726, -2.04988805276466,
+     -2.04988805276466, -2.04988805276466, 3.8936089116869, 3.8936089116869,
+     1.77228856812726, 1.77228856812726)
> ss2 <- c(-2.25237500351774, 3.88908729652601, 3.88908729652601,
+     -2.25237500351774, -2.16799518941608, -2.16799518941608,
+     1.4142135623731, 1.41421356237309)
> ss3 <- c(-1.4142135623731, 4.56252232622749, 4.56252232622749,
+     2.08764859207457, 2.08764859207457, -1.4142135623731, -1.4142135623731,
+     -1.4142135623731, 2.08764859207457, 2.08764859207457, 3.53553390593274,
+     3.53553390593274)
> SS1 <- matrix(ss1, ncol = 2, byrow = FALSE)
> rownames(SS1) <- paste("sa", 1:6, sep = "")
> SS2 <- matrix(ss2, ncol = 2, byrow = FALSE)
> rownames(SS2) <- paste("sb", 1:4, sep = "")
> SS3 <- matrix(ss3, ncol = 2, byrow = FALSE)
> rownames(SS3) <- paste("sc", 1:6, sep = "")
> VDP1 <- newTissueFromPolygon(points.xy = SS1, Set = 1)
> VDP2 <- newTissueFromPolygon(points.xy = SS2, Set = 2)
> VDP3 <- newTissueFromPolygon(points.xy = SS3, Set = 3)
> TM <- addSetToDrawing(drawing1 = VDP1, drawing2 = VDP2, set2Name = "Set2")
> TM <- addSetToDrawing(drawing1 = TM, drawing2 = VDP3, set2Name = "Set3")
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-7, 7), c(-5, 10))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM)
> PlotSetBoundaries(TM, gp = gpar(lwd = 2, col = c("green", "red")))
> PlotNodes(TM)
> .PlotFaceNames.TissueDrawing(TM)
> PlotSetBoundaries(VDP3, gp = gpar(lwd = 2, col = c("green")))
```

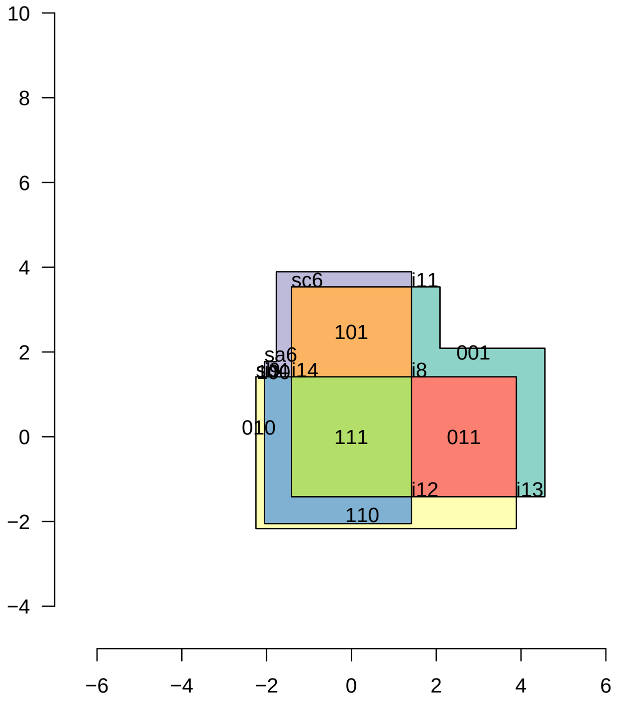


Figure 5: Injecting points

16 Noncontigous subsets

```
> px1 <- matrix(c(-5, -3, -5, 3, 5, 3, 5, -3), ncol = 2, byrow = TRUE)
> rownames(px1) <- paste("pa", 1:nrow(px1), sep = "")
> px2 <- matrix(c(-3, -5, -3, 5, 3, 5, 3, -5), ncol = 2, byrow = TRUE)
> rownames(px2) <- paste("pb", 1:nrow(px2), sep = "")
> VX1 <- newTissueFromPolygon(px1, Set = 1)
> VX2 <- newTissueFromPolygon(px2, Set = 2)
> TM <- addSetToDrawing(VX1, VX2, set2Name = "Set2")
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-10, 10), c(-10, 10))
> grid.xaxis()
> grid.yaxis()
> PlotNodes(TM)
> PlotSetBoundaries(TM, gp = gpar(lwd = 2, col = c("green", "red",
+     "blue")))
> .PlotFaceNames.TissueDrawing(TM)
```

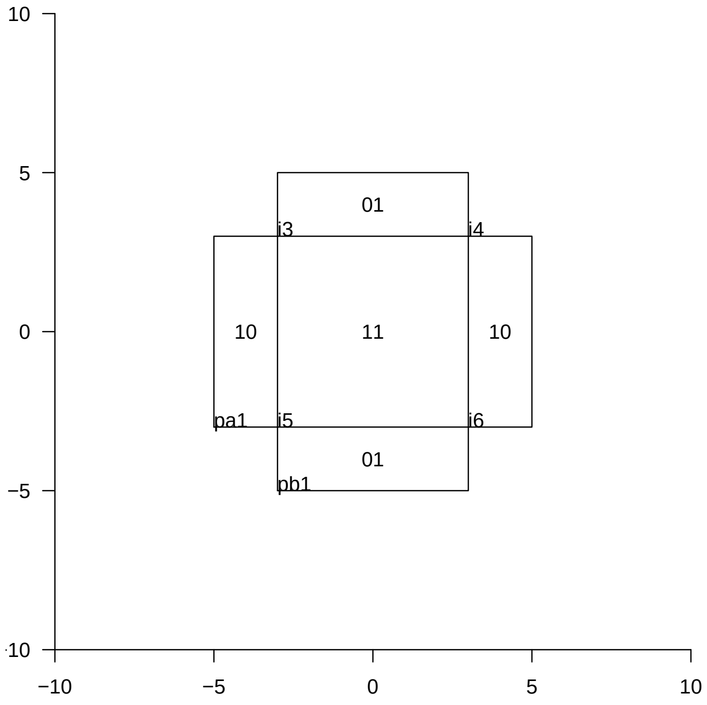


Figure 6: Injecting points

17 Ellipses

```
> phi <- 0.8
> dex <- 1.7
> dey <- 2.5
> a <- 7.6
> e <- 0.9
> x0 <- c(-0.9, -5)
> E <- list()
> E[[1]] <- newTissueFromEllipse(f1 = x0 + c(0, 0), phi = -phi,
+     dx = 0.1, e = e, a = -a, Set = 1)
> E[[2]] <- newTissueFromEllipse(x0 + c(5 + dex, -2), phi, e, a,
+     dx = 0.1, Set = 2)
> TM <- E[[1]]
> TM <- addSetToDrawing(TM, E[[2]], set2Name = "Set2")
```

```
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-10, 10), c(-10, 10))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM)
> PlotSetBoundaries(E[[2]], gp = gpar(lwd = 2, col = c("red", "red",
+     "blue")))
> PlotNodes(TM)
> .PlotFaceNames.TissueDrawing(TM)
> PlotSetBoundaries(TM, gp = gpar(lwd = 2, col = c("green")))
```

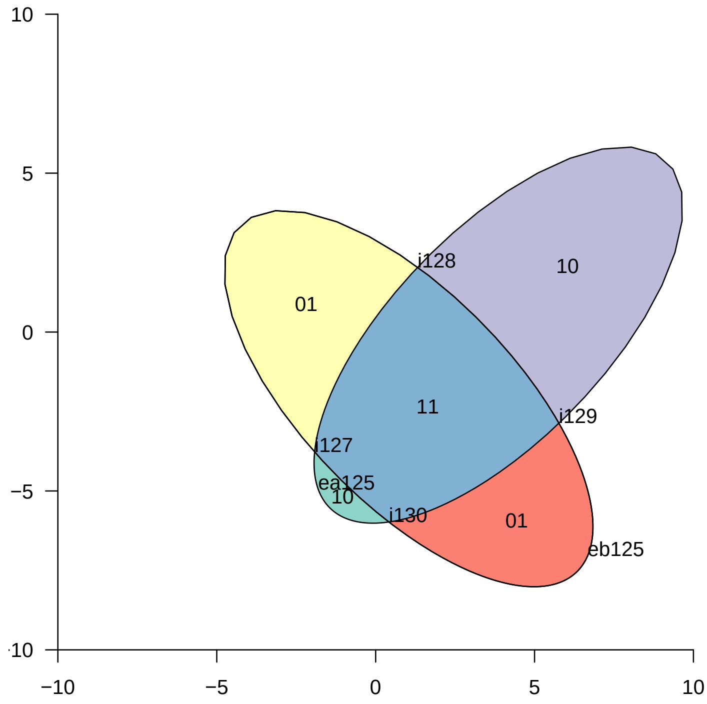


Figure 7: Injecting points

```
> phi <- 0.8
> dex <- 1.7
> dey <- 2.5
> a <- 7.6
> e <- 0.9
> x0 <- c(-0.9, -5)
> dx <- 0.1
> E <- list()
> E[[1]] <- newTissueFromEllipse(f1 = x0 + c(0, 0), dx = dx, phi = -phi,
+     e = e, a = -a, Set = 1)
> E[[2]] <- newTissueFromEllipse(x0 + c(dex, 0), dx = dx, phi,
+     e, a, Set = 2)
> E[[3]] <- newTissueFromEllipse(x0 + c(-dey, dey), dx = dx, -phi,
+     e, -a, Set = 3)
> E[[4]] <- newTissueFromEllipse(x0 + c(dex + dey, dey), dx = dx,
+     phi, e, a, Set = 4)
> TM <- E[[1]]
> TM <- addSetToDrawing(TM, E[[2]], set2Name = "Set2")
> grid.newpage()
> pushViewport(plotViewport(c(1, 1, 1, 1)))
> makevp.eqsc(c(-10, 10), c(-10, 10))
> grid.xaxis()
> grid.yaxis()
> PlotFaces(TM)
> PlotSetBoundaries(TM, gp = gpar(lwd = 2, col = c("green", "red",
+     "blue")))
> PlotNodes(TM)
> .PlotFaceNames.TissueDrawing(TM)
```

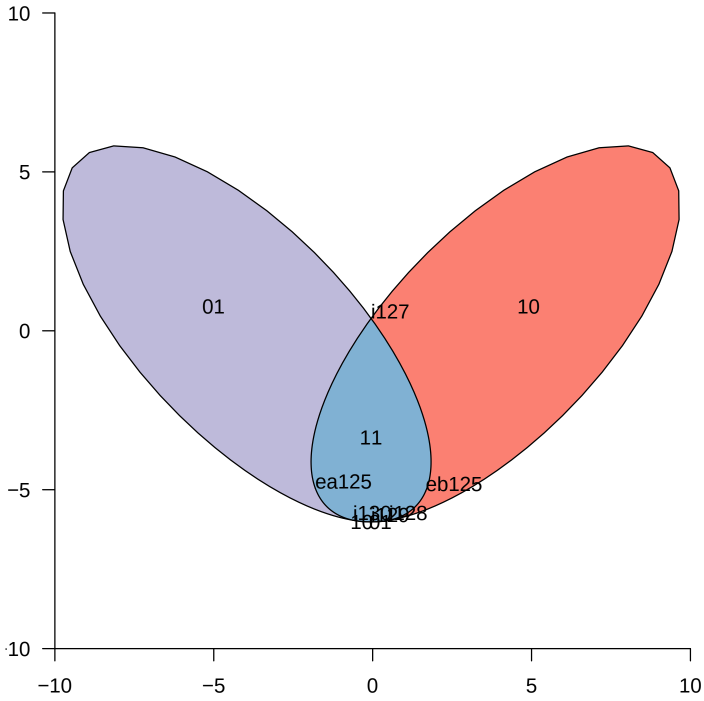


Figure 8: Injecting points

18 Chow Ruskey

18.1 Bug 522

```
Validating a drawing on 4 sets......done
```

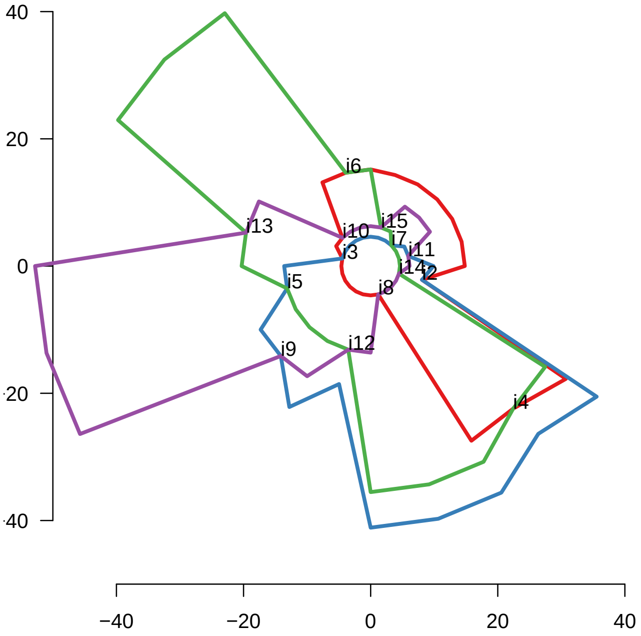


Figure 9: Chow-Ruskey weighted 4-set diagram with smudge warnings

19 This document

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SVN id of this document	Id: TissueDrawingTest.Rnw 58 2009-09-23 22:57:05Z js229 .
Generated on	29th September, 2009
R version	R version 2.9.0 (2009-04-17)

[1]

References

[1] A. W. F. Edwards. *Cogwheels of the Mind: The Story of Venn Diagrams*. The John Hopkins University Press, Baltimore, Maryland, 2004.