Apple Bread Challenge 1

Aanchal Saraf

```
library(viridis)
```

```
## Loading required package: viridisLite
```

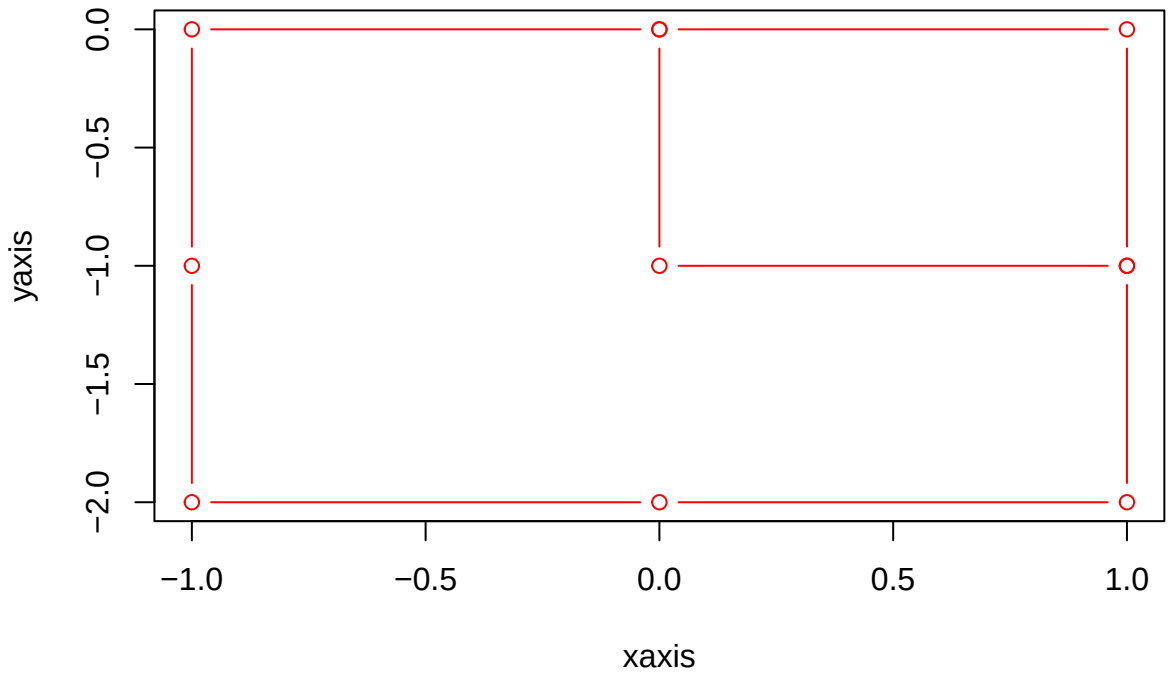
A random walk on Z^2 can be thought of as a position of particle, at time n, denoted by S_n which is defined inductively below. Let $x \in Z^2, n \geq 1$.

Let $S_0 = x$. Suppose we have defined $S_1, S_2, ..., S_{n-1}$. At time n, the particle chooses one of the four neighbours of the vertex S_{n-1} at random and moves to that neighbour which we denote by S_n.

Simulate and plot the range of the random walk on Z^2 for:

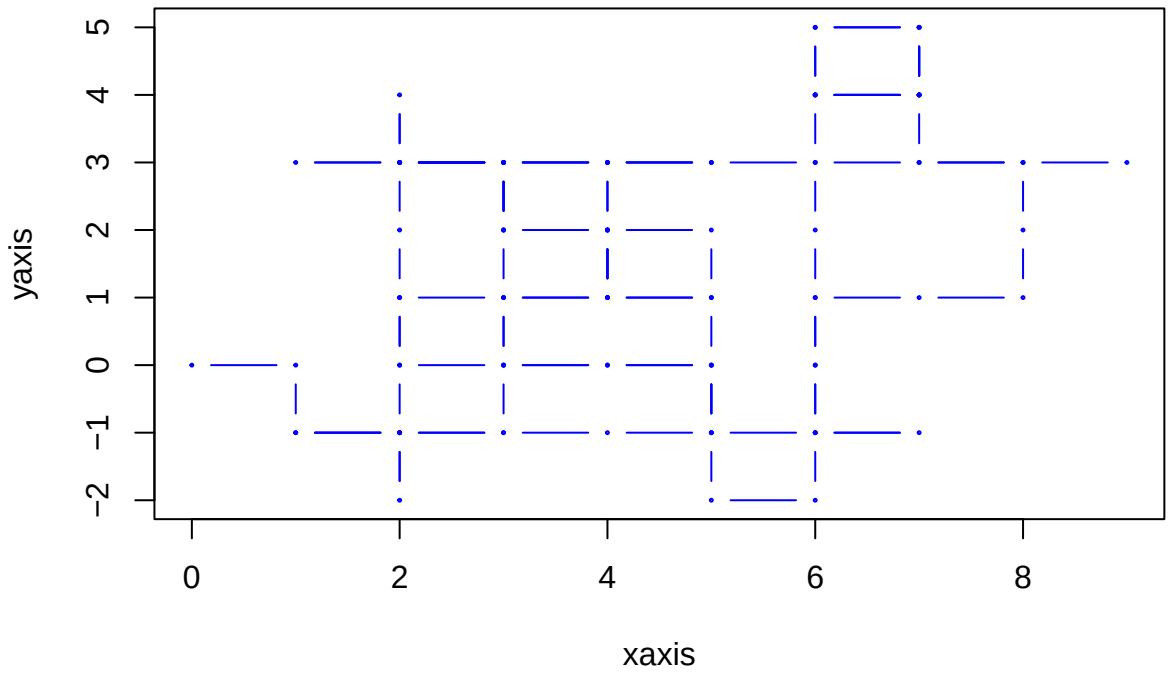
(a) $n = 10$ amd $x = 0$ (origin)

```
xaxis <- c(0)
yaxis<-c(0)
choice<-c(1,2,3,4)
for (i in 2:11) {
    si=sample(choice,1)
    if (si==1) {
      xaxis[i]=xaxis[i-1]+1
      yaxis[i]=yaxis[i-1]
    }
    if (si==2) {
      xaxis[i]=xaxis[i-1]-1
      yaxis[i]=yaxis[i-1]
    }
    if (si==3) {
      yaxis[i]=yaxis[i-1]+1
      xaxis[i]=xaxis[i-1]
    }
    if (si==4) {
      yaxis[i]=yaxis[i-1]-1
      xaxis[i]=xaxis[i-1]
    }
}
walk <- data.frame(xaxis,yaxis)
plot(walk,type="b",col="red")
```



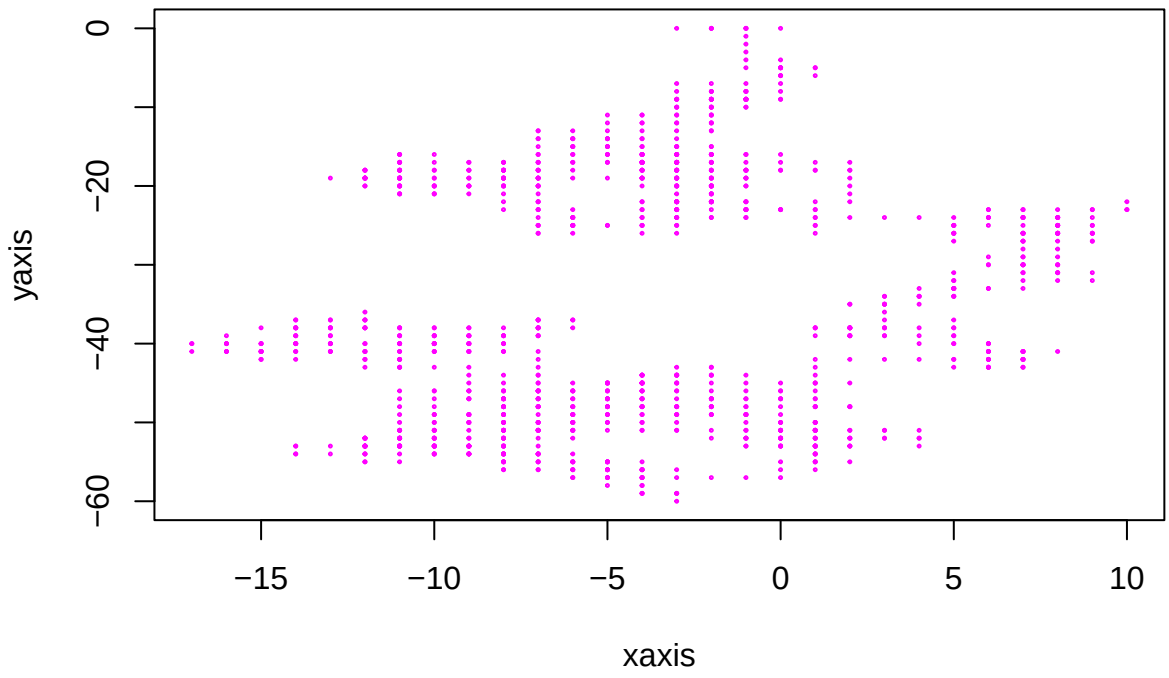
(b) $n = 100$ amd $x = 0$ (origin)

```
xaxis <- c(0)
yaxis<-c(0)
choice<-c(1,2,3,4)
for (i in 2:101) {
    si=sample(choice,1)
    if (si==1) {
      xaxis[i]=xaxis[i-1]+1
      yaxis[i]=yaxis[i-1]
    }
    if (si==2) {
      xaxis[i]=xaxis[i-1]-1
      yaxis[i]=yaxis[i-1]
    }
    if (si==3) {
      yaxis[i]=yaxis[i-1]+1
      xaxis[i]=xaxis[i-1]
    }
    if (si==4) {
      yaxis[i]=yaxis[i-1]-1
      xaxis[i]=xaxis[i-1]
    }
}
walk <- data.frame(xaxis,yaxis)
plot(walk,type="b",col="blue",cex=0.2)
```



(c) $x = 0$ and till the first time the walk hits a point at a distance 55 from the origin.

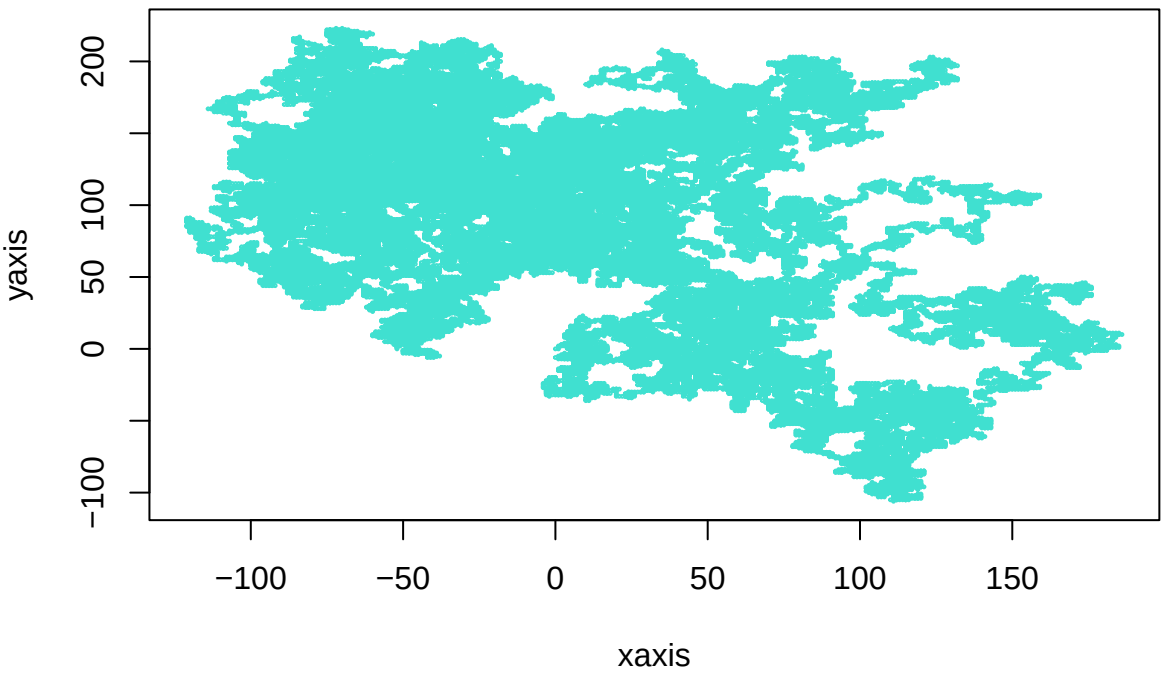
```
xaxis <- c(0)
yaxis<-c(0)
choice<-c(1,2,3,4)
i=2
while (i>0) {
  si=sample(choice,1)
  if (si==1) {
    xaxis[i]=xaxis[i-1]+1
    yaxis[i]=yaxis[i-1]
  }
  if (si==2) {
    xaxis[i]=xaxis[i-1]-1
    yaxis[i]=yaxis[i-1]
  }
  if (si==3) {
    yaxis[i]=yaxis[i-1]+1
    xaxis[i]=xaxis[i-1]
  }
  if (si==4) {
    yaxis[i]=yaxis[i-1]-1
    xaxis[i]=xaxis[i-1]
  }
  a=xaxis[i]
  b=yaxis[i]
  d=sqrt((a^2)+(b^2))
  if (d==55) {
    break
  }
  i=i+1
}
walk <- data.frame(xaxis,yaxis)
plot(walk,type="b",col="magenta",cex=0.2)
```


yaxis
0
−20
−40
−60
−15
−10
−5
0
5
10
xaxis

(d) $x = (55, 0)$ and till the first time the walk hits the origin.

```
xaxis <- c(55)
yaxis<-c(0)
choice<-c(1,2,3,4)
i=2
while (i>0) {
  si=sample(choice,1)
  if (si==1) {
    xaxis[i]=xaxis[i-1]+1
    yaxis[i]=yaxis[i-1]
  }
  if (si==2) {
    xaxis[i]=xaxis[i-1]-1
    yaxis[i]=yaxis[i-1]
  }
  if (si==3) {
    yaxis[i]=yaxis[i-1]+1
    xaxis[i]=xaxis[i-1]
  }
  if (si==4) {
    yaxis[i]=yaxis[i-1]-1
    xaxis[i]=xaxis[i-1]
  }
  a=xaxis[i]
  b=yaxis[i]

  if (a==0 & b==0) {
    break
  }
  i=i+1
}
walk <- data.frame(xaxis,yaxis)
plot(walk,type="b",col="turquoise",cex=0.2)
```


yaxis
200
100
50
0
−100
−100
−50
0
50
100
150
xaxis