Lucas Roberts: The Alias Table Method in R

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The alias method is a technique that breaks any discrete distribution into a finite mixture of (at most) two point distributions. The algorithm is known to run in linear time, i.e the algorithm is $\mathcal{O}(n)$. The code that follows beneath contains a subroutine that takes in a probability vector and sets up the alias table. The next routine takes the table and uses the table to generate random variates. This code is implemented in the R software available free at, `www.r-project.org`. The intermediate c++ programmer should readily be able to translate this to c++, by adding a header file, and the correct data structure. The most readable paper on this subject is [1].

```
 ##This code sets up an alias table for a general vector
## of probabilities and then simulates draws from the
## alias table and returns the random variates and the
## table.
##-------------------------------------------------------

##-------first set up the alias table----------------
prob<-c(0.10, 0.05. 0.40. 0.35. 0.10)
SimAlias<-function(p=prob){
l<-length(prob)
great<-c()
small<-c()
for(i in 1:l){
if(l*p[i]< 1){small<-c(small,i)}
else{great<-c(great,i)}
}
Atable<-matrix(NA,4,l)
Atable[1,]<-1:l  #standard index
Atable[2,]<-p #probability masses
s<-length(small)
g<-length(great)
while(s!=0 && g!=0){
```

```
Atable[4,small[s]]<-l*Atable[2,small[s]]
Atable[3,small[s]]<-great[g]
Atable[4,great[g]]<-Atable[2,great[g]]+(Atable[2,small[s]]-(1/l))
if(Atable[2,great[g]] > 1/l){great<-c(great,g)}
else{small<-c(small,g)}
s <- s - 1
g <- g - 1
}
for(i in 1:l){
if(is.na(Atable[3,i])==1){Atable[3,i]<-Atable[1,i]}
if(is.na(Atable[4,i])==1){Atable[4,i]<-1}
}
return(Atable)
}


#now to use the alias table to generate random variates
#seeds that give different output are 120000 (4), 11500 (1), 59000 (3) etc.
aliasGen<-function(p=prob,iseed=120000,k=7){
work<-SimAlias(p=prob)
u<-u16807d(iseed,1)
iseed<-u[1,]
u<-u[2,]
n<-ceiling(u*k)
u<-u16807d(iseed,1)
iseed<-u[1,]
u<-u[2,]
if(u < work[4,n]){return(c(iseed,work[1,n]))}
else(return(c(iseed,work[3,n])))
}
```

References

[1] Michael D. Vose. A linear algorithm for generating random numbers with a given distribution. *IEEE Transactions on software engineering*, 17(9), September 1991.