

```

library(HMM)
library(entropy)

# Question 1
States=1:10
Symbols=1:10
transProbs=matrix(c(.5,.5,0,0,0,0,0,0,0,0,
.5,.5,0,0,0,0,0,0,0,0,
0,0,.5,.5,0,0,0,0,0,0,
0,0,0,.5,.5,0,0,0,0,0,
0,0,0,0,.5,.5,0,0,0,0,
0,0,0,0,0,.5,.5,0,0,0,
0,0,0,0,0,0,.5,.5,0,0,
0,0,0,0,0,0,0,.5,.5,0,
0,0,0,0,0,0,0,0,.5,.5,
.5,0,0,0,0,0,0,0,0,.5), nrow=length(States), ncol=length(States), byrow = TRUE)
emissionProbs=matrix(c(.2,.2,.2,0,0,0,0,0,.2,.2,
.2,.2,.2,.2,0,0,0,0,0,.2,
.2,.2,.2,.2,.2,0,0,0,0,0,
0,.2,.2,.2,.2,.2,0,0,0,0,0,
0,0,.2,.2,.2,.2,.2,0,0,0,0,
0,0,0,.2,.2,.2,.2,.2,0,0,0,
0,0,0,0,.2,.2,.2,.2,.2,0,0,0,
.2,0,0,0,0,.2,.2,.2,.2,.2,
.2,.2,0,0,0,0,0,.2,.2,.2), nrow=length(States), ncol=length(States), byrow = TRUE)
startProbs=c(.1,.1,.1,.1,.1,.1,.1,.1,.1,.1)
hmm=initHMM(States,Symbols,startProbs,transProbs,emissionProbs)

# Question 2
sim=simHMM(hmm,100)

# Question 3
logf=forward(hmm,sim$observation[1:100])
expf=exp(logf)
filtered=prop.table(expf,2)
smoothed=posterior(hmm,sim$observation[1:100])
v=viterbi(hmm,sim$observation[1:100])

# Questions 4 and 5
maxfiltered=apply(filtered,2,which.max)
table(maxfiltered==sim$states)
maxsmoothed=apply(smoothed,2,which.max)
table(maxsmoothed==sim$states)
table(v==sim$states)
plot(v,type="b")
plot(maxsmoothed,type="b")
plot(maxfiltered,type="b")

# Question 6
apply(filtered,2,entropy.empirical,unit="log2")
apply(smoothed,2,entropy.empirical,unit="log2")

# Question 7
filtered[,100]~*transProbs

```