

# Lab2 oskhi827

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9/17/2020

## Question 1

```
#, out.width='.49\\linewidth', fig.width=5, fig.height=5,fig.show='hold',fig.align='center'
library(HMM)

states = c("1", "2", "3", "4", "5", "6", "7", "8", "9", "10")
symbols = c("1", "2", "3", "4", "5", "6", "7", "8", "9", "10")
#start_prob = rep(0, 10)
#start_prob[1] = 1
start_prob = NULL
sur_state = function(x){
  state = x%%10
  if (state ==0) {
    state=10
  }
  return(state)
}
trans_prob = matrix(data=0, nrow = 10, ncol=10)
for (i in 1:10) {
  trans_prob[i,i] = 0.5
  trans_prob[i,sur_state(i+1)] = 0.5
}
emmis_prob = matrix(data=0, nrow = 10, ncol=10)
for (i in 1:10) {
  for (j in -2:2) {
    emmis_prob[i,sur_state(i+j)] = 0.5
  }
}
HMM = initHMM(states, symbols, start_prob, trans_prob, emmis_prob)
```

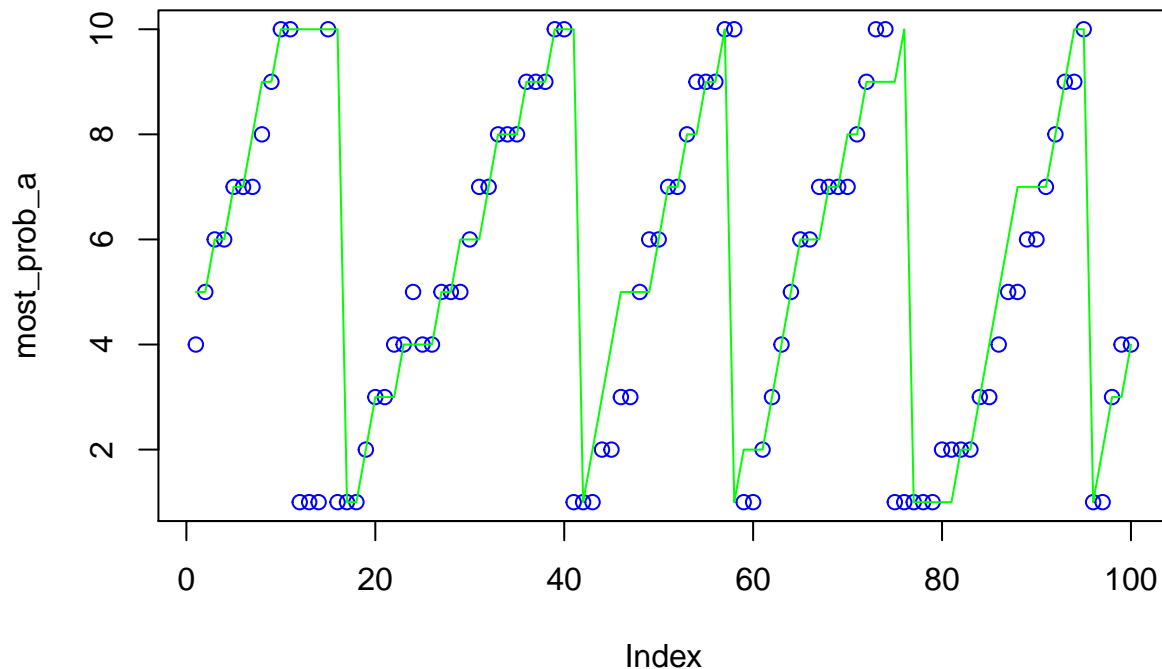
## Question 2

```
N = 100
sim = simHMM(HMM, N)
```

### Question 3 & 4

```
observed = sim$observation

# filtered alpha --Alpha uses all observations up to point t to estimate Zt
alpha_log = forward(HMM, observed)
alpha = exp(alpha_log)
most_prob_a = apply(alpha, MARGIN = 2, which.max)
plot(most_prob_a, col="blue")
lines(sim$states, col="green")
```



```
fi_acc = sum(sim$states==most_prob_a)/100
cat("Filtered accuracy:", fi_acc)
```

```
## Filtered accuracy: 0.61
```

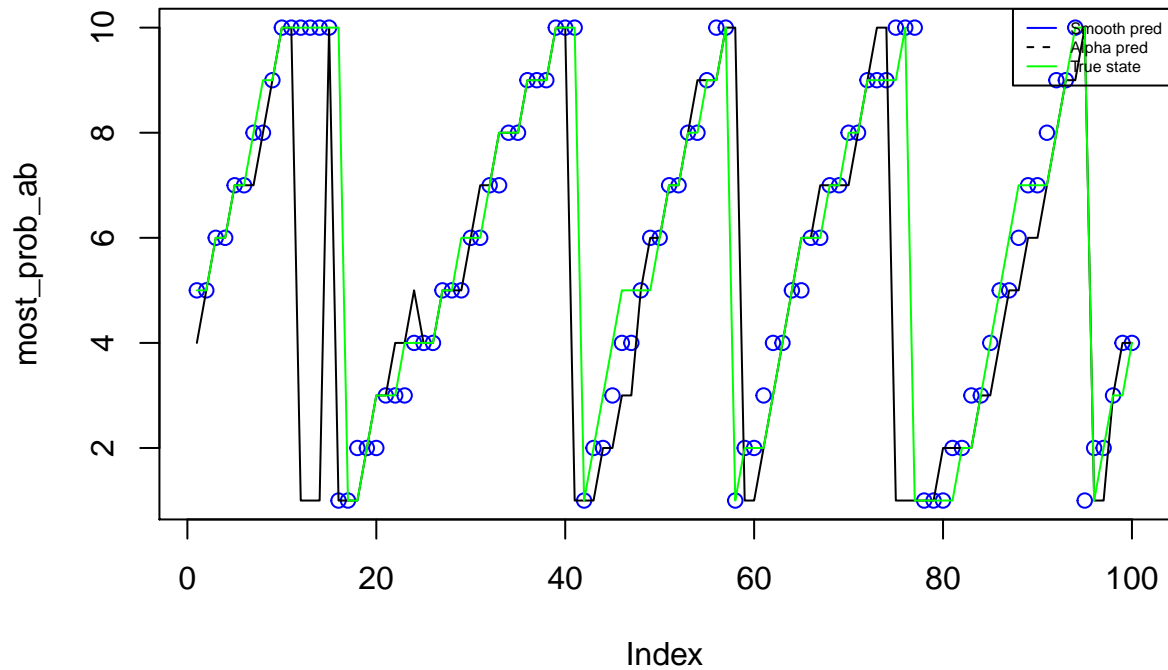
```
# Beta.
beta_log = backward(HMM, observed)
beta = exp(beta_log)

# smoothed alpha*beta -- Alpha beta uses all observations (to T) to estimate Zt. "which is better"
alpha_beta = alpha*beta
most_prob_ab = apply(alpha_beta, MARGIN = 2, which.max)
```

```

plot(most_prob_ab, col="blue",)
lines(most_prob_a)
lines(sim$states, col="green")
legend("topright", c("Smooth pred", "Alpha pred", "True state"),
      col=c("blue", "black", "green"), lty=1:2, cex=0.5)

```



```

sm_acc = sum(sim$states==most_prob_ab)/100
cat("Smoothing accuracy:", sm_acc)

```

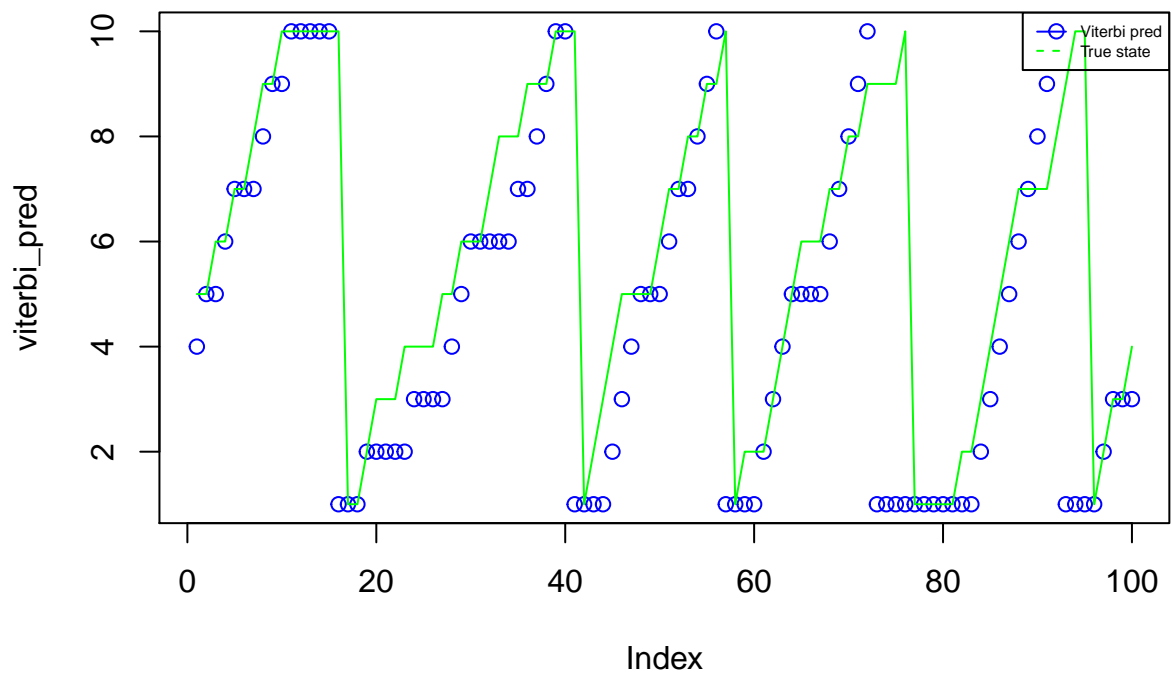
```
## Smoothing accuracy: 0.73
```

```
# Normalize??
```

```

# Most prob path
viterbi_pred = viterbi(HMM, observed)
plot(viterbi_pred, col="blue",)
lines(sim$states, col="green")
legend("topright", c("Viterbi pred", "True state"),
      col=c("blue", "green"), lty=1:2, cex=0.5)

```



```
vi_acc = sum(sim$states==viterbi_pred)/100
cat("Most prob path accuracy:", vi_acc)
```

```
## Most prob path accuracy: 0.41
```