TDDE15 - Exam

oktober 25, 2024

Graphical Models (5 p)

```
rm(list = ls())
library(bnlearn)
library(gRain)
```

```
## Loading required package: gRbase
```

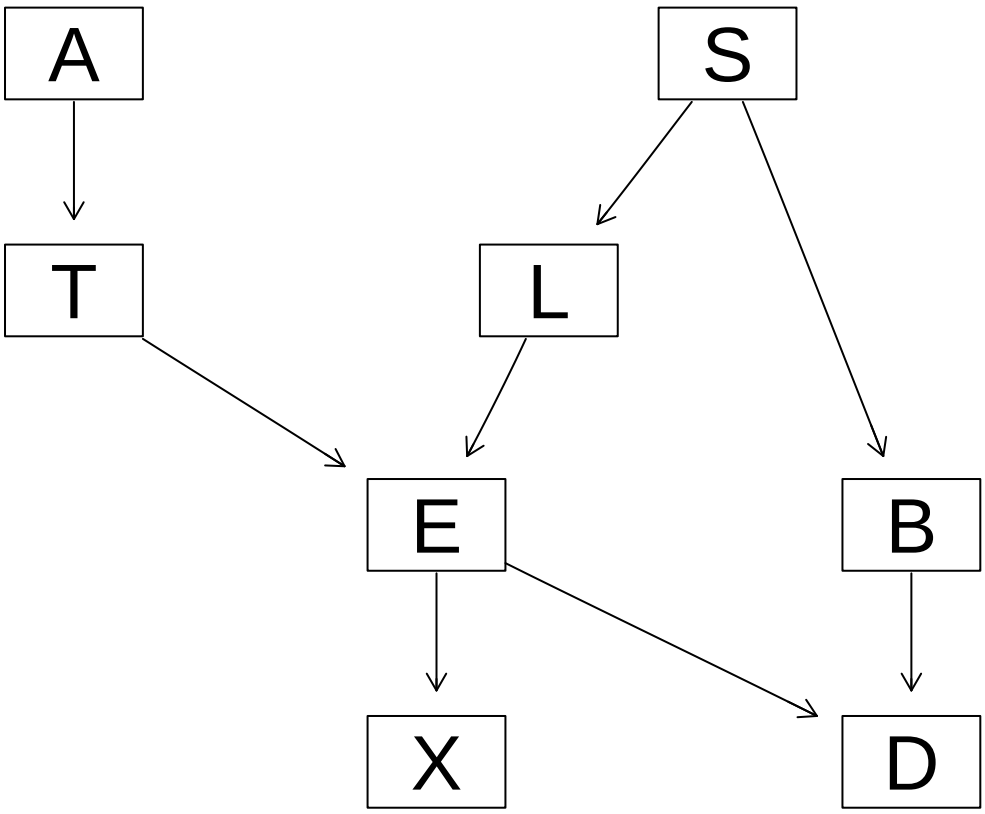
```
##
## Attaching package: 'gRbase'
```

```
## The following objects are masked from 'package:bnlearn':
##
##     ancestors, children, nodes, parents
```

```
data("asia")
```

```
true_dag = model2network("[A][S][T|A][L|S][B|S][D|B:E][E|T:L][X|E]")
net = bn.fit(true_dag, data = asia)
true_dag_grain = as.grain(net)
true_dag_compiled = compile(true_dag_grain)
graphviz.plot(true_dag)
```

```
## Loading required namespace: Rgraphviz
```




```
samples = matrix(nrow = 1000, ncol = 8)
colnames(samples) = c("A", "S", "T", "L","B", "E","X", "D")

for (i in 1:1000) {
   samples[i, "A"] <- sample(c("no", "yes"), size = 1, prob = net$A$prob)
   samples[i, "S"] <- sample(c("no", "yes"), size = 1, prob = net$S$prob)
   samples[i, "T"] <- sample(c("no", "yes"), size = 1, prob = net$L$prob[, samples[i, "A"]])
   samples[i, "L"] <- sample(c("no", "yes"), size = 1, prob = net$prob[, samples[i, "S"]])
   samples[i, "B"] <- sample(c("no", "yes"), size = 1, prob = net$prob[, samples[i, "S"]])
   samples[i, "E"] <- sample(c("no", "yes"), size = 1, prob = net$probs[,samples[i, "L"], samples[i, "T
   samples[i, "D"] <- sample(c("no", "yes"), size = 1, prob = net$D$prob[, samples[i, "B"],samples[i, "
}

foo<-samples[which(samples[,8]=="yes"),2]
table(foo)/length(foo)
```

```
## foo
##        no       yes
## 0.4952229 0.5047771
```

```
net<-as.grain(net)
net<-compile(net)
net<-setEvidence(net,nodes=c("D"),states=c("yes"))
querygrain(net,c("S"))
```

```
## $S
## S
##       no      yes
## 0.334384 0.665616
```

Hidden Markov Models

- p(healthy D2) = 0.9
- p(infected D2) = 0.8
- if infected remains infected for two days
- p(test positive) = 0.6
- p(test negative) = 0.7

hhi = 0.1

hhh = 0.9

ii = 0.8

	H	S1	S2
H	0.9	0.1	0.0
S1	0	0.8	0.2
S2	0.2	0.0	0.8

```
# Load the HMM package
library(HMM)
library(entropy)
```

```
##
## Attaching package: 'entropy'
```

```
## The following object is masked from 'package:bnlearn':
##
##     discretize
```

```
# Define the hidden states and observation symbols
states <- c("H", "S1", "S2")
symbols <- c("H", "S")

start_probs <- c(.5, .5, 0)

trans_probs = matrix(c(.9,.1,0,
                       0,.8,.2,
                       .2,0,.8
                       ), nrow=length(states), ncol=length(states), byrow = TRUE)

colnames(trans_probs) = states
colnames(trans_probs) = states

emission_probs = matrix(c(.7,.3,
                          .4,.6,
                          .4,.6
), nrow=length(states), ncol=length(symbols), byrow = TRUE)

colnames(emission_probs) = symbols
rownames(emission_probs) = states

# Initialize the Hidden Markov Model
hmm_model <- initHMM(
```

```
  States = states,           # vector of states
  Symbols = symbols,         # vector of observation symbols
  startProbs = start_probs,  # Initial state probabilities
  transProbs = trans_probs,  # Transition probabilities matrix
  emissionProbs = emission_probs  # Emission probabilities matrix
)




set.seed(12345)
simHMM(hmm_model, length = 100)
```

```
## $states
##   [1] "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"  "S1" "S1" "S1" "S1" "S1" "S1"
##  [16] "S1" "S1" "S1" "S1" "S2" "S2" "S2" "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"
##  [31] "H"  "H"  "H"  "H"  "H"  "H"  "H"  "S1" "S1" "S1" "S1" "S1" "S2" "S2" "S2"
##  [46] "S2" "S2" "S2" "S2" "S2" "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"
##  [61] "H"  "H"  "S1" "S1" "S2" "S2" "H"  "H"  "H"  "S1" "S1" "S1" "S1" "S1" "S1"
##  [76] "S1" "S2" "S2" "S2" "S2" "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"  "H"
##  [91] "S1" "S2" "S2" "S2" "S2" "S2" "S2" "S2" "S2" "S2"
##
## $observation
##   [1] "H" "H" "S" "H" "H" "S" "H" "S" "H" "S" "H" "S" "H" "S" "H" "H" "H" "S"
##  [19] "S" "S" "S" "S" "H" "H" "S" "S" "S" "H" "H" "S" "H" "H" "S" "H" "S" "S"
##  [37] "H" "S" "S" "H" "S" "H" "S" "H" "S" "H" "H" "S" "H" "S" "S" "H" "S" "H"
##  [55] "H" "S" "H" "H" "S" "H" "S" "H" "H" "H" "S" "S" "S" "H" "S" "S" "H" "S"
##  [73] "H" "S" "S" "H" "H" "H" "H" "H" "H" "H" "H" "H" "S" "S" "H" "S" "H" "H"
##  [91] "H" "H" "S" "S" "H" "S" "S" "H" "S" "S"
```

Reinforcement learning