posterior\_probability

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# posterior\_probability

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source('functions.R')

Attaching package: 'dplyr'

The following objects are masked from 'package:stats':  
  
 filter, lag

The following objects are masked from 'package:base':  
  
 intersect, setdiff, setequal, union

Attaching package: 'relations'

The following object is masked from 'package:dplyr':  
  
 sym

# Applying the QCG Algorithm

## Posterior Probability Inference

### Example Bayesian Network

P\_X <- data.frame(X = c(0,1),  
 Weight = c(0.75, 0.25),  
 stringsAsFactors = FALSE)  
P\_Y\_X <- data.frame(X = c(0,0,1,1),  
 Y = c(0,1,0,1),  
 Weight = c(0.2,0.8,0.9,0.1),  
 stringsAsFactors = FALSE)  
P\_Z\_Y <- data.frame(Y = c(0,0,1,1),  
 Z = c(0,1,0,1),  
 Weight = c(1,0,0.25,0.75),  
 stringsAsFactors = FALSE)

### Initialization

#### Incorporate the evidence Z=1

P\_Z\_Y <- cond(P\_Z\_Y, c("Z"), c(1))  
print(P\_Z\_Y)

Y Z Weight  
 0 1 0.00   
 1 1 0.75

#### Create variable-relations association

assoc1 <- assoc(list(P\_X, P\_Y\_X, P\_Z\_Y), c("X", "Y", "Z"))  
print(assoc1)

$X  
$X[[1]]  
 X Weight  
1 0 0.75  
2 1 0.25  
  
  
$Y  
$Y[[1]]  
 X Y Weight  
1 0 0 0.2  
2 0 1 0.8  
3 1 0 0.9  
4 1 1 0.1  
  
  
$Z  
$Z[[1]]  
 Y Z Weight  
 0 1 0.00   
 1 1 0.75

### Step 1 Eliminate Z

Combination query on list of relations associated with Z in the assoc1 dictionary

q\_comb\_Z = comb\_list(assoc1$Z)

print(q\_comb\_Z)

Y Z Weight  
 0 1 0.00   
 1 1 0.75

Elimination query to eliminate Z from the weighted relation factor resulting from the composition query for Z

q\_elim\_Z = elim(q\_comb\_Z, "Z")  
print(q\_elim\_Z)

Y Weight  
1 0 0.00  
2 1 0.75

#### Posterior Probability for Y

The posterior probability for Y corresponds to the normalization of the weighted relation factor resulting from the elimination query for Z

prob\_Y <- q\_elim\_Z  
prob\_Y$Weight <- prob\_Y$Weight/sum(prob\_Y$Weight)  
print(prob\_Y)

Y Weight  
1 0 0  
2 1 1

#### Update Variable-Relations associations dictionary assoc1

Add to dictionary the weighted relation factor resulting from the elimination query for Z, q\_elim\_Z ; and remove the variable Z from dictionary

assoc2 <- add\_relation\_remove\_var(assoc1, q\_elim\_Z, "Z")  
print(assoc2)

$X  
$X[[1]]  
 X Weight  
1 0 0.75  
2 1 0.25  
  
  
$Y  
$Y[[1]]  
 X Y Weight  
1 0 0 0.2  
2 0 1 0.8  
3 1 0 0.9  
4 1 1 0.1  
  
$Y[[2]]  
 Y Weight  
1 0 0.00  
2 1 0.75

#### Step 2 Eliminate Y

Combination query on list of relations associated with Y in the assoc2 dictionary

q\_comb\_Y <- comb\_list(assoc2$Y)  
print(q\_comb\_Y)

Y X Weight  
1 0 0 0.000  
2 0 1 0.000  
3 1 0 0.600  
4 1 1 0.075

Elimination query to eliminate Y from the weighted relation factor resulting from the composition query for Y

q\_elim\_Y <- elim(q\_comb\_Y, "Y")  
print(q\_elim\_Y)

X Weight  
1 0 0.600  
2 1 0.075

#### Update Variable-Relations associations dictionary assoc2

Add to dictionary the weighted relation factor resulting from the elimination query for Y, q\_elim\_Y ; and remove the variable Y from dictionary

assoc3 <- add\_relation\_remove\_var(assoc2, q\_elim\_Y, "Y")  
print(assoc3)

$X  
$X[[1]]  
 X Weight  
1 0 0.75  
2 1 0.25  
  
$X[[2]]  
 X Weight  
1 0 0.600  
2 1 0.075

Combination query on list of relations associated with X in the assoc3 dictionary

q\_comb\_X <- comb\_list(assoc3$X)  
print(q\_comb\_X)

X Weight  
1 0 0.45000  
2 1 0.01875

#### Posterior Probability for X

The posterior probability for X corresponds to the normalization of the weighted relation factor resulting from the combination query for X

prob\_X <- q\_comb\_X  
prob\_X$Weight <- prob\_X$Weight/sum(prob\_X$Weight)  
print(prob\_X)

X Weight  
1 0 0.96  
2 1 0.04