aMI Handin assignments

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1 Water tank

1.1 Baysian network

Indsæt figur fra Genie image.

1.2 Suitable conditional probability distribution

Hvis ventil er åben fanger den stortset altid der er flow, hvis den er lukket laver den oftere fejl.

1.3 Simulation

We assume that only the controller has access to the water level sensor, and thus we can not manually read the water level through the sensor.

2 Matlab

2.1 Forward-backward algorithm

The changes we did to the given code was as follows:

- In the HMM class we added a backwardMessages
- We initialised it to NaN when a HMM object was created

```
backwardMessages;

function obj = HMM(priorModel, transModel, sensorModel)
  ...
  obj.backwardMessages = NaN;
end
```

The code below is our implementation of the backward part of the algorithm. The linebreak in the code is not present in the actual code but was done to fit on the page.

```
function obj = backward(obj, data)
  totalTime = length(data);

  obj.backwardMessages=zeros(obj.noHidden,totalTime+1);

  obj.backwardMessages(:,totalTime+1) = 1;
    for t=totalTime:-1:1,
      obj.backwardMessages(:,t)
```

```
      = obj.transModel*obj.sensorModel{data(t)}*obj.backwardMessages(:,t+1);
      obj.backwardMessages(:,t)
      = obj.backwardMessages(:,t)./sum(obj.backwardMessages(:,t));
    end
end
```

The result of running the our function on the given demo that forward was run on gives the following result:

0.6469	0.5923	0.3763	0.6533	0.6273	1.0000
0.3531	0.4077	0.6237	0.3467	0.3727	1.0000

2.2 HMM for exercise 1

```
Trans = [ 0.8, 0.2;
  0.2, 0.8 ];
Prio = [ 0.6, 0.4 ]';
Sens = [ 0.02, 0.21;
 0.18, 0.49;
 0.08, 0.09;
 0.72, 0.21 ]';

% 1=yes+red, 2=yes+not red,  3=no+red, 4=no+not red
Dat = [ 4, 2, 1 ];

newhmm = HMM(Prio, Trans, Sens);
newhmm = newhmm.forward(Dat);
newhmm = newhmm.backward(Dat);

disp('Forward:');
disp(newhmm.forwardMessages);
disp('Backward:');
disp(newhmm.backwardMessages);
```

2.3 Implementation of HMM

- Forward:

0.8372	0.4643	0.0804
0.1628	0.5357	0.9196

- Backward:

0.5325	0.2661	0.2522	1.0000
0.4675	0.7339	0.7478	1.0000