

MLTA Tutorial 1: Graphical Models

David Barber
Department of Computer Science, University College London

1 Setting up

To get the MATLAB code for this tutorial, please go to

<http://web4.cs.ucl.ac.uk/staff/D.Barber/pmwiki/pmwiki.php?n=Brml.Software>

and download

<http://web4.cs.ucl.ac.uk/staff/D.Barber/textbook/290313oo.zip>

You'll then need to unzip the file in a local directory. Open matlab and type

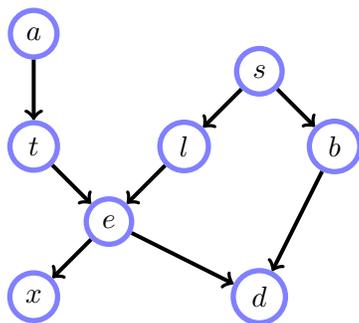
```
>> cd localdir
```

where localdir is the name of the directory where you downloaded the software. Now type

```
>> setup
```

This will initialise the files and paths and enable you to run the demos.

2 Chest Clinic Demo



x = Positive X-ray

d = Dyspnea (Shortness of breath)

e = Either Tuberculosis or Lung Cancer

t = Tuberculosis

l = Lung Cancer

b = Bronchitis

a = Visited Asia

s = Smoker

Figure 1: Belief network structure for the Chest Clinic example.

Consider the Chest Clinic network in Figure (1). The table values are:

$p(a = \text{yes})$	$= 0.01$	$p(s = \text{yes})$	$= 0.5$
$p(t = \text{yes} a = \text{yes})$	$= 0.05$	$p(t = \text{yes} a = \text{no})$	$= 0.01$
$p(l = \text{yes} s = \text{yes})$	$= 0.1$	$p(l = \text{yes} s = \text{no})$	$= 0.01$
$p(b = \text{yes} s = \text{yes})$	$= 0.6$	$p(b = \text{yes} s = \text{no})$	$= 0.3$
$p(x = \text{yes} e = \text{yes})$	$= 0.98$	$p(x = \text{yes} e = \text{no})$	$= 0.05$
$p(d = \text{yes} e = \text{yes}, b = \text{yes})$	$= 0.9$	$p(d = \text{yes} e = \text{yes}, b = \text{no})$	$= 0.7$
$p(d = \text{yes} e = \text{no}, b = \text{yes})$	$= 0.8$	$p(d = \text{yes} e = \text{no}, b = \text{no})$	$= 0.1$

You should now be able to run the demo by typing

```
>> demoChestClinic
```

This will display various probabilities for the Chest Clinic belief network.

2.1

Modify the file `demoChestClinic.m` by typing

```
>> edit demoChestClinic.m
```

By including the additional line:

```
disptable(condpot(setpot(jointpot,[xray dys],[yes yes]),lcancer),variable);
```

at the end of the file `demoChestClinic.m`, compute the probability that a person has lung cancer, given that the person has a positive x-ray and dyspnea.

2.2

What is the probability that a person has lung cancer, given that they have a positive x-ray, dyspnea and have visited asia.

2.3

What is the probability that a person has lung cancer?

2.4

If all that we know about a person is that they are smoker, how will this affect our belief that they have been to asia? Show computationally whether this is the case and explain why you obtain the result you do.

3 Stubby Finger Typist demo

You should now be able to run the HMM demo by typing

```
>> demoHMMbigram
```

from MATLAB.

Modify the file `demoHMMbigram.m` by typing

```
>> edit demoHMMbigram.m
```

to try to find the word that was intended to be typed given the observed string `gtiklksnr`

Note that you will also need to increase the value `Nmax` in the program.

4 Search

From MATLAB type

```
>> load wikiAdjSmall; import brml.*; M=condp(A+0.00001*ones(size(A)));
```

The 1000×1000 matrix `M` contains the elements of a Markov transition matrix. $M(i, j)$ is the probability that if one is at website j , a random jump will take us to website i .

Websites 10, 11, 203, 670, 851 all contain the search term ‘dog biscuits’. If you had to choose a single website to present to the user as a result of the search query ‘dog biscuits’, which would you present?