Bayesian Networks – Parameter Learning by Expectation Maximization

Consider the following Bayes Net:

```
Pr

Bt Ut
```

All the variables are binary here. Pr = pregnancy, Bt = blood test, Ut = urine test. Use the following incomplete data to compute P(Pr), P(Bt|Pr), and P(Ut|Pr). Missing entry is denoted by ‘*’ in the table.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Pr</th>
<th>Bt</th>
<th>Ut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>*</td>
<td>Pos</td>
<td>Pos</td>
</tr>
<tr>
<td>2.</td>
<td>Yes</td>
<td>Neg</td>
<td>Pos</td>
</tr>
<tr>
<td>3.</td>
<td>Yes</td>
<td>Pos</td>
<td>*</td>
</tr>
<tr>
<td>4.</td>
<td>Yes</td>
<td>Pos</td>
<td>Neg</td>
</tr>
<tr>
<td>5.</td>
<td>*</td>
<td>Neg</td>
<td>*</td>
</tr>
</tbody>
</table>

P1. (70%) Write your own Matlab program of expectation maximization (EM) algorithm to find the above probabilities.

P2. (20%) Use Kevin Murphy’s Bayes Net Matlab toolbox (http://www.cs.ubc.ca/~murphyk/Software/BNT/bnt.html) to compute the same probabilities.

P3. (10%) Compute P(Bt=Pos|Ut=Neg).

Make any reasonable assumptions if you need to.