Probabilistic Reasoning Over Time

Jacob Regan

# Hidden Markov Model

15.13)

Bayesian Network:  
E\_t = Enough Sleep at time t – temporal variable

|  |  |
| --- | --- |
| E\_(t-1) | P(E\_t|E\_(t-1)) |
| T | 0.8 |
| F | 0.3 |

For the evidence, or observation set for Red Eyes (R) and Sleep in class (S)

|  |  |
| --- | --- |
| E\_t | P(R\_t|E\_t) |
| T | 0.2 |
| F | 0.7 |

|  |  |
| --- | --- |
| E\_t | P(S\_t|E\_t) |
| T | 0.1 |
| F | 0.3 |

Hidden Markov Model:

For the HMM version of the above DBN, the hidden variable is E\_t, and the evidence variables are R and S. This table shows the restructured probabilities consistent with a HMM for t.

|  |  |  |
| --- | --- | --- |
| R | S | P(R, S|E) |
| T | T | 0.2 |
| T | F | 0.18 |
| F | T | 0.08 |
| F | F | .72 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Forward Backward | Country Dance | Fixed Lag - 2 | 3 | 4 | 5 |
| 1 | 0.593624947524664 | 0.5947574966698026 | 0.546457398515136 | 0.5456980894514486 | 0.5377066066020413 | 0.5379198406357245 |
| 2 | 0.7553437175637515 | 0.7520046528532773 | 0.05834382223174401 | 0.05989068192549772 | 0.053143019002065535 | 0.05852532913415644 |
| 3 | 0.5624127809363474 | 0.5551742529438575 | 0.28120246421164696 | 0.2843049457393356 | 0.28373482516502496 | 0.28454038888660926 |
| 4 | 0.0448366412185192 | 0.05135295408815745 | 0.5434000325794092 | 0.5450686570480873 | 0.5437108231318739 | 0.5464427633437278 |
| 5 | 0.42264766678257626 | 0.42654638859823013 | 0.05248833208963724 | 0.05506981684912237 | 0.06174714262983428 | 0.05650281382749089 |
| 6 | 0.4235410916797825 | 0.42378014357115623 | 0.2884386366279493 | 0.2855399753983338 | 0.28943740931285156 | 0.29005632586305197 |
| 7 | 0.0383292966720432 | 0.034222869423689566 | 0.5418675065241902 | 0.542255862267691 | 0.5385039773179046 | 0.5410135581398366 |
| 8 | 0.4128815943871122 | 0.4174402957573932 | 0.05553609275038446 | 0.057987404831635385 | 0.05242118485114529 | 0.059174734155136646 |
| 9 | 0.4214331526371143 | 0.4196597054489607 | 0.28994751817385966 | 0.28548991556180914 | 0.28833007424895835 | 0.2831501252205174 |
| 10 | 0.039973420365778944 | 0.0353511791758522 | 0.5468617335932832 | 0.5423606709375691 | 0.5467985092620674 | 0.5456321642518667 |
| 11 | 0.41582675306571576 | 0.41808671782667567 | 0.056151904306221495 | 0.053408961924548706 | 0.05554347440118113 | 0.060353761693632345 |
| 12 | 0.41558728230317277 | 0.42296759494346453 | 0.28936337804353923 | 0.2826812087538345 | 0.28734757050039994 | 0.28852705750285895 |
| 13 | 0.04020236147947699 | 0.040378266633188775 | 0.5390243007251092 | 0.5425457943175885 | 0.5379362420171075 | 0.5411018750631895 |
| 14 | 0.4104205543774531 | 0.4186955673720592 | 0.05410853915866019 | 0.05692827589630713 | 0.05203004440527041 | 0.05946990831526501 |
| 15 | 0.42356655092537004 | 0.4235611015758981 | 0.2901839006342873 | 0.2875380751130453 | 0.2814556927445392 | 0.2826616030973308 |
| 16 | 0.03779271177195501 | 0.03634291312118406 | 0.5465600127249136 | 0.547373404274145 | 0.5466654751627571 | 0.5404453800741115 |
| 17 | 0.41681407688055216 | 0.4105153080273585 | 0.056158230962897376 | 0.05333964926895365 | 0.058282805782269125 | 0.05535744917984945 |
| 18 | 0.4179963021228733 | 0.4174867055126539 | 0.2822873627623143 | 0.2916265928206165 | 0.290545944101611 | 0.3094194032971906 |
| 19 | 0.03549641603705132 | 0.036695956766596226 | 0.5477507194319664 | 0.5592661333625022 | 0.5463610652732549 | 0.590618717445311 |
| 20 | 0.41692095048620276 | 0.4172895082200479 | 0.059830229363489855 | 0.07882912530293928 | 0.06044745850001074 | 0.11964783824912929 |
| 21 | 0.41774024108503643 | 0.41965097990173467 | 0.30134503236704097 | 0.4122546031631492 | 0.3515356967525037 |  |
| 22 | 0.03301955891184451 | 0.04048772290302985 | 0.5912540883667509 | 0.8332476660964632 |  |  |
| 23 | 0.4240840066517773 | 0.4316152744598232 | 0.1249529482716306 |  |  |  |
| 24 | 0.4697595504895554 | 0.4685010636951368 |  |  |  |  |
| 25 | 0.05738345979926287 | 0.06118847223257552 |  |  |  |  |

Dynamic Bayesian Network

See attached file ‘PFText.txt” for particle filtering results.