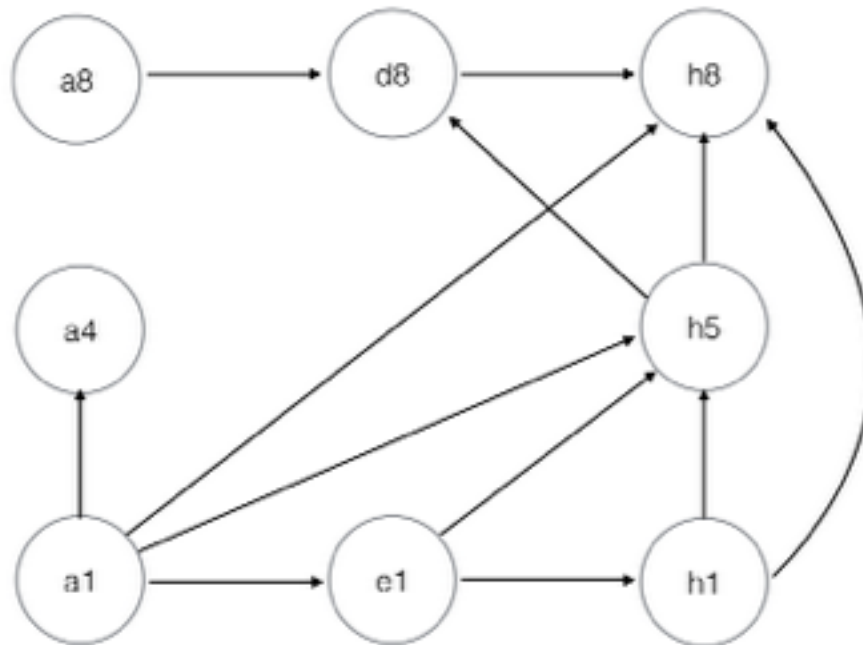


Emily Schultz (ess2183)
COMS 4771 - Machine Learning
Assignment 11 - Problem 4
Due: 4/30/14

[Explain.pdf](#)



This shows the Bayes Net's acyclic dependencies. Because of the relationships of the blocks that are not sensors, some blocks, like h5 and d8, which were not connected in A10, are now connected. This is because when we perform the Bayes Ball Algorithm, they become coupled.

The relationships are generally two-sided, ie. knowledge of d8 affects the outcome of a8, and vice versa. However a Bayes Net is defined to be acyclic, so it is drawn as such. Because there are intermediate blocks, connecting a8 and d8, and the Bayes Ball algorithm passes through them (so they are not conditionally independent), this means they are dependent on each other. The Bayes Ball algorithm has coupled them now that there is knowledge of intermediate nodes (like c7 for example).

The block of observed nodes surrounding City Hall allows a8 and d8 to be independent of a1, e1, etc. (sensor blocks near Machine St.) because the Bayes Ball bounces back on these, making them conditionally independent. Similarly a4 is only dependent on a1.

Also note that h1 is connected to h8, which you wouldn't necessarily expect given h5, but information about h1 can affect h8, even with knowledge of h5, so they are not conditionally independent. This is because there is a path to h8 from h1 that doesn't touch h5, so there is (minimal) dependency there.

Conditional Probability Tables (from output of run_me.m)

Each table shows the probability that the sensor cell is contaminated given that the cells along the left column are observed.

(From contaminated %, not contaminated % = (1- contaminated %))

<u>a1</u>	a1=2
a4=1,e1=1,h5=1	0.0286
a4=2,e1=1,h5=1	0.0298
a4=1,e1=2,h5=1	0.0294
a4=2,e1=2,h5=1	0.0306
a4=1,e1=1,h5=2	0.0289
a4=2,e1=1,h5=2	0.0301
a4=1,e1=2,h5=2	0.0301
a4=2,e1=2,h5=2	0.0313

<u>e1</u>	e1=2
a1=1,h1=1,h5=1,h8=1	0.0494
a1=2,h1=1,h5=1,h8=1	0.0508
a1=1,h1=2,h5=1,h8=1	0.0664
a1=2,h1=2,h5=1,h8=1	0.0681
a1=1,h1=1,h5=2,h8=1	0.1036
a1=2,h1=1,h5=2,h8=1	0.1075
a1=1,h1=2,h5=2,h8=1	0.1420
a1=2,h1=2,h5=2,h8=1	0.1470
a1=1,h1=1,h5=1,h8=2	0.0500
a1=2,h1=1,h5=1,h8=2	0.0514
a1=1,h1=2,h5=1,h8=2	0.0670
a1=2,h1=2,h5=1,h8=2	0.0688
a1=1,h1=1,h5=2,h8=2	0.1078
a1=2,h1=1,h5=2,h8=2	0.1119
a1=1,h1=2,h5=2,h8=2	0.1479
a1=2,h1=2,h5=2,h8=2	0.1532

<u>h1</u>	h1=2
e1=1,h5=1,h8=1	0.0674
e1=2,h5=1,h8=1	0.0900
e1=1,h5=2,h8=1	0.0788
e1=2,h5=2,h8=1	0.1091
e1=1,h5=1,h8=2	0.0674
e1=2,h5=1,h8=2	0.0897
e1=1,h5=2,h8=2	0.0780
e1=2,h5=2,h8=2	0.1084

<u>a4</u>	a4=2
a1=1	0.0186
a1=2	0.0194

<u>h5</u>	h5=2
a1=1,e1=1,h1=1,d8=1,h8=1	0.1700
a1=2,e1=1,h1=1,d8=1,h8=1	0.1717
a1=1,e1=2,h1=1,d8=1,h8=1	0.3128
a1=2,e1=2,h1=1,d8=1,h8=1	0.3180
a1=1,e1=1,h1=2,d8=1,h8=1	0.1950
a1=2,e1=1,h1=2,d8=1,h8=1	0.1967
a1=1,e1=2,h1=2,d8=1,h8=1	0.3606
a1=2,e1=2,h1=2,d8=1,h8=1	0.3659
a1=1,e1=1,h1=1,d8=2,h8=1	0.1699
a1=2,e1=1,h1=1,d8=2,h8=1	0.1716
a1=1,e1=2,h1=1,d8=2,h8=1	0.3126
a1=2,e1=2,h1=1,d8=2,h8=1	0.3178
a1=1,e1=1,h1=2,d8=2,h8=1	0.1949
a1=2,e1=1,h1=2,d8=2,h8=1	0.1965
a1=1,e1=2,h1=2,d8=2,h8=1	0.3604

<u>h5</u>	h5=2
a1=2,e1=2,h1=2,d8=2,h8=1	0.3656
a1=1,e1=1,h1=1,d8=1,h8=2	0.2342
a1=2,e1=1,h1=1,d8=1,h8=2	0.2366
a1=1,e1=2,h1=1,d8=1,h8=2	0.4125
a1=2,e1=2,h1=1,d8=1,h8=2	0.4188
a1=1,e1=1,h1=2,d8=1,h8=2	0.2638
a1=2,e1=1,h1=2,d8=1,h8=2	0.2662
a1=1,e1=2,h1=2,d8=1,h8=2	0.4641
a1=2,e1=2,h1=2,d8=1,h8=2	0.4703
a1=1,e1=1,h1=1,d8=2,h8=2	0.2319
a1=2,e1=1,h1=1,d8=2,h8=2	0.2343
a1=1,e1=2,h1=1,d8=2,h8=2	0.4093
a1=2,e1=2,h1=1,d8=2,h8=2	0.4155
a1=1,e1=1,h1=2,d8=2,h8=2	0.2614
a1=2,e1=1,h1=2,d8=2,h8=2	0.2637
a1=1,e1=2,h1=2,d8=2,h8=2	0.4608
a1=2,e1=2,h1=2,d8=2,h8=2	0.4669

<u>a8</u>	a8=2
d8=1	0.0634
d8=2	0.0989
<u>d8</u>	d8=2
h5=1,a8=1,h8=1	0.0757
h5=2,a8=1,h8=1	0.0757
h5=1,a8=2,h8=1	0.1173
h5=2,a8=2,h8=1	0.1172
h5=1,a8=1,h8=2	0.0798
h5=2,a8=1,h8=2	0.0789

<u>d8</u>	d8=2
h5=1,a8=2,h8=2	0.1233
h5=2,a8=2,h8=2	0.1219

<u>h8</u>	h8=2
a1=1,e1=1,h1=1,h5=1,d8=1	0.1667
a1=2,e1=1,h1=1,h5=1,d8=1	0.1668
a1=1,e1=2,h1=1,h5=1,d8=1	0.1685
a1=2,e1=2,h1=1,h5=1,d8=1	0.1686
a1=1,e1=1,h1=2,h5=1,d8=1	0.1666
a1=2,e1=1,h1=2,h5=1,d8=1	0.1666
a1=1,e1=2,h1=2,h5=1,d8=1	0.1680
a1=2,e1=2,h1=2,h5=1,d8=1	0.1682
a1=1,e1=1,h1=1,h5=2,d8=1	0.2300
a1=2,e1=1,h1=1,h5=2,d8=1	0.2304
a1=1,e1=2,h1=1,h5=2,d8=1	0.2381
a1=2,e1=2,h1=1,h5=2,d8=1	0.2386
a1=1,e1=1,h1=2,h5=2,d8=1	0.2282
a1=2,e1=1,h1=2,h5=2,d8=1	0.2286
a1=1,e1=2,h1=2,h5=2,d8=1	0.2368
a1=2,e1=2,h1=2,h5=2,d8=1	0.2373
a1=1,e1=1,h1=1,h5=1,d8=2	0.1748
a1=2,e1=1,h1=1,h5=1,d8=2	0.1749
a1=1,e1=2,h1=1,h5=1,d8=2	0.1766
a1=2,e1=2,h1=1,h5=1,d8=2	0.1767
a1=1,e1=1,h1=2,h5=1,d8=2	0.1747
a1=2,e1=1,h1=2,h5=1,d8=2	0.1747
a1=1,e1=2,h1=2,h5=1,d8=2	0.1761
a1=2,e1=2,h1=2,h5=1,d8=2	0.1763

<u>h8</u>	h8=2
a1=1,e1=1,h1=1,h5=2,d8=2	0.2381
a1=2,e1=1,h1=1,h5=2,d8=2	0.2385
a1=1,e1=2,h1=1,h5=2,d8=2	0.2462
a1=2,e1=2,h1=1,h5=2,d8=2	0.2467
a1=1,e1=1,h1=2,h5=2,d8=2	0.2363
a1=2,e1=1,h1=2,h5=2,d8=2	0.2367
a1=1,e1=2,h1=2,h5=2,d8=2	0.2449
a1=2,e1=2,h1=2,h5=2,d8=2	0.2454