

## CSC384 Spring 2015 assignment 3

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### Question 1. Implement Variable Elimination

1.

$$(a) P(b|a) = 0.5$$

$$(b) P(c|a) = 0.5$$

$$(c) P(c|a, -e) = 0.5714285714285714$$

$$(d) P(c|a, -f) = 0.5$$

### Question 2. Car Diagnosis Network

1.

The probability of Car Starts is independent of Air Filter given Air System.

$$P(st | asys) = P(st | asys, af)$$

$$P(st = 'true' | asys = 'okay') = P(st | asys = 'okay', af = 'clean') = 0.289$$

$$P(st = 'true' | asys = 'okay') = P(st | asys = 'okay', af = 'dirty') = 0.289$$

$$P(st = 'true' | asys = 'faulty') = P(st | asys = 'faulty', af = 'clean') = 0.236$$

$$P(st = 'true' | asys = 'faulty') = P(st | asys = 'faulty', af = 'dirty') = 0.236$$

$$P(st = 'false' | asys = 'okay') = P(st | asys = 'okay', af = 'clean') = 0.711$$

$$P(st = 'false' | asys = 'okay') = P(st | asys = 'okay', af = 'dirty') = 0.711$$

$$P(st = 'false' | asys = 'faulty') = P(st | asys = 'faulty', af = 'clean') = 0.764$$

$$P(st = 'false' | asys = 'faulty') = P(st | asys = 'faulty', af = 'dirty') = 0.764$$

2.

Voltage at Plug = 'weak' explains away Spark Quality = 'bad' which decreases the probability of Spark Plugs = 'too wide' and Spark Plugs = 'fouled'.

$$P(sp = 'okay' | sq = 'bad') = 0.533$$

$$P(sp = 'too wide' | sq = 'bad') = 0.156$$

$$P(sp = 'fouled' | sq = 'bad') = 0.311$$

$$P(sp = 'okay' | sq = 'bad', pv = 'weak') = 0.0$$

$$P(sp = 'too wide' | sq = 'bad', pv = 'weak') = 0.0$$

$$P(sp = 'fouled' | sq = 'bad', pv = 'weak') = 0.0$$

3.

Each of the accumulated evidence items asys = 'okay', fs = 'okay', cc = 'true', sq = 'good' increases the probability of st = 'true' as shown below.

$$P(st = 'true') = 0.28$$

$$P(st = 'true' | asys = 'okay') = 0.289$$

$$P(st = 'true' | asys = 'okay', fs = 'okay') = 0.318$$

$$P(st = 'true' | asys = 'okay', fs = 'okay', cc = 'true') = 0.64$$

$$P(st = 'true' | asys = 'okay', fs = 'okay', cc = 'true', sq = 'good') = 0.986$$

4.

Evidence items hl = 'off', cs = 'faulty' decrease the probability of cc = 'true', while evidence items bv = 'strong', ss = 'okay' increase the probability of cc = 'true' as shown below.

$$P(cc = 'true') = 0.497$$

$$P(cc = 'true' | hl = 'off') = 0.166$$

$$P(cc = 'true' | hl = 'off', cs = 'faulty') = 0.132$$

$$P(cc = 'true' | hl = 'off', cs = 'faulty', bv = 'strong') = 0.774$$

$$P(cc = 'true' | hl = 'off', cs = 'faulty', bv = 'strong', ss = 'okay') = 0.8$$