**EXAM 3** **AI Fall 2017**

[3 questions, 40 points for Undergrad, 50 points for Grad, 45 min]

WRITE YOUR NAME and LAST 4 DIGITS OF ID:

*Symbols used below:* ~ is NOT, ^ is AND, || is OR

**Q1a.** Convert each of the following sentences over propositions *A, B, C, D,* and *E* to *clausal* form or *conjunctive normal form*. [15]

S1. A <=> (B || E).

S2. E < => D.

S3. C ^ F => ~B.

S4. E => B

S5. B => F

S6. B => C

**Grad Q1b.** Use resolution (DPLL algorithm) to prove the sentence *~A ^ ~B* by drawing the resolution tree (that indicate steps of the proof). [**grad 5**]

**ANS-1a***:*

*7.20*

S1: (￢A ∨ B ∨ E) ∧ (￢B ∨ A) ∧ (￢E ∨ A).

S2: (￢E ∨ D).

S3: (￢C ∨ ￢F ∨ ￢B).

S4: (￢E ∨ B).

S5: (￢B ∨ F).

S6: (￢B ∨ C).

**KEY-1b**. I am expecting here to see that you knew how the resolution tree is done, more than actual result. If not a sample is in p255, Fig 7.13

**Q2a.** Consider a Bayesian network, *a -> b -> c*, where *a, b,* and *c* are three Propositional variables with each having values {*T, F*}. Complete the middle expression of the following equation for computing the conditional probability P(c|b). [5]

P(c|b) = / = ∑a P(a,b,c) / ∑a,c′ P(a,b,c′)

**Q2b.** Use the above equationto express P(c=T | b) [2]

**Q2c**. Expand the expression in Q1a further in terms of P(a), P(b|a) and P(c|b). **[ug 3, grad 5]**

**ANS-2.**

**a.** P(c|b) = P(b,c) / P(b) = ∑a P(a,b,c) / ∑a,c′ P(a,b,c’)

**b.** Use *c=T* only on numerator, not denominator, because denominator sums over *c’=T and c’=F* both**.**

**c**. By Equation (14.1), this can be written as

P(c|b)=[∑a P(a)P(b|a)P(c|b)]**/**[∑a,c′P(a)P(b|a)P(c’|b)

**Q3.** Explain in a line or two, for each of below. Figures are welcome.

**Undergrad students answer any five of them. [ug 3x5]**

**Graduate students answer all of them. [grad 3x6]**

**a.** k-nearest neighbor lookup:

**b.** Decision boundary:

**c.** Batch gradient descent:

**d.** Perceptron learning rule for univariate linear regression (with the formula explaining each term):

**e.** Overfitting:

**f.** Can a decision-learning-tree have less number of attributes than that in a given problem?

**ANS-3.**

**a.** p 738

**b.** p723, This is not only for Decision tree!

**c.** p 720. Ordering of iteration is important

**d.** p 724 Formula was needed.

**e.** E.g., p 705, This is not only for Decision tree!

**f.** Yes, redundant attributes should not appear in a decision.

[Not in syllabus: Further pruning may eliminate low-significant attributes from Decision tree as post-processing.]