CS 264A	HW #4	Jason Chapman

(1) $f(X,Y,Z) = -6X + 5Y - 4Z + 3$; X, Y, Z are binary features

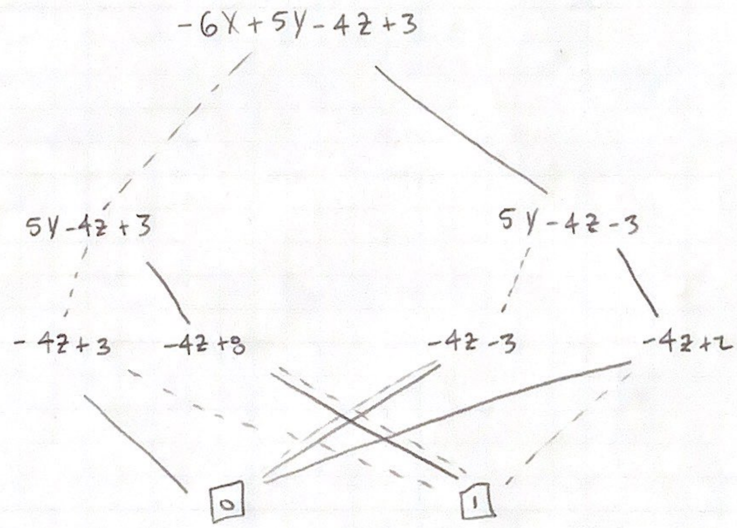
Classifier labels instance positive iff $f(X,Y,Z) \geq 0$.

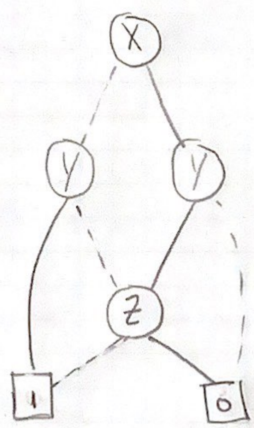
a) $X = 1$, $Y = 1$

$f(1,1,Z) = -6 + 5 - 4Z + 3 = -4Z + 2 \Rightarrow f(1,1,Z) = -4Z + 2$

In general, when the values of X & Y are known, $f(X,Y,Z)$ will simply become a function of only Z & a constant.

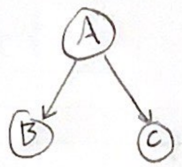
b)





c) If an instance has $X=0$ & $Y=1$, the value of the feature Z does not impact the instance classification, as is evident in the above OBDD

2)



A	θ_A
a_0	0.8
a_1	0.2

A	B	$\theta_{B\mid A}$
a_0	b_0	0.3
a_0	b_1	0.7
a_1	b_0	0.7
a_1	b_1	0.3

A	C	$\theta_{C\mid A}$
a_0	c_0	0.1
a_0	c_1	0.9
a_1	c_0	0.9
a_1	c_1	0.1

a) Indicator clauses:

$(I_{a_0} \vee I_{a_1})^W$ $\quad(\neg I_{a_0} \vee \neg I_{a_1})^W$ $\quad(I_{b_0} \vee I_{b_1})^W$ $\quad(\neg I_{b_0} \vee \neg I_{b_1})^W$

$(I_{c_0} \vee I_{c_1})^W$ $\quad(\neg I_{c_0} \vee \neg I_{c_1})^W$

Parameter Clauses:

$(\neg I_{a_0})^{-\log .8}$ $\quad(\neg I_{a_1})^{-\log .2}$

$(\neg I_{a_0} \vee \neg I_{b_0})^{-\log .3}$ $\quad(\neg I_{a_0} \vee \neg I_{b_1})^{-\log .7}$ $\quad(\neg I_{a_1} \vee \neg I_{b_0})^{-\log .7}$ $\quad(\neg I_{a_1} \vee \neg I_{b_1})^{-\log .3}$

$(\neg I_{a_0} \vee \neg I_{c_0})^{-\log .1}$ $\quad(\neg I_{a_0} \vee \neg I_{c_1})^{-\log .9}$ $\quad(\neg I_{a_1} \vee \neg I_{c_0})^{-\log .9}$ $\quad(\neg I_{a_1} \vee \neg I_{c_1})^{-\log .1}$

b.) $B = b_0$

- Add $(I_{b_0})^W$ to the parameter clauses

c)

$I_{a_0}\ \neg I_{a_1}\ I_{b_0}\ \neg I_{b_1}\ I_{c_0}\ \neg I_{c_1} = -\log .8 - \log .3 - \log .1 = -\log(.8 \times .3 \times .1)$
$= -\log(0.024)$

$I_{a_0}\ \neg I_{a_1}\ I_{b_0}\ \neg I_{b_1}\ \neg I_{c_0}\ I_{c_1} = -\log .8 - \log .3 - \log .9 = -\log(.8 \times .3 \times .9)$
$= -\log(0.216)$

$\neg I_{a_0}\ I_{a_1}\ I_{b_0}\ \neg I_{b_1}\ I_{c_0}\ \neg I_{c_1} = -\log .2 - \log .7 - \log .9 = -\log(.2 \times .7 \times .9)$
$= -\log(0.126)$

$\neg I_{a_0}\ I_{a_1}\ I_{b_0}\ \neg I_{b_1}\ \neg I_{c_0}\ I_{c_1} = -\log .2 - \log .7 - \log .1 = -\log(.2 \times .7 \times .1)$
$= -\log(0.014)$

$\Gamma = I_{a_0}\ \neg I_{a_1}\ I_{b_0}\ \neg I_{b_1}\ \neg I_{c_0}\ I_{c_1}$

$\text{Penalty}(\Gamma) = -\log .8 - \log .3 - \log .9 = -\log(.8 \times .3 \times .9) = -\log(0.216)$

$\text{Weight}(\Gamma) = 7W - \log .2 - \log .7 - \log .7 - \log .3 - \log .1 - \log .9 - \log .1$

$= 7W - \log(.2 \times .7 \times .7 \times .3 \times .1 \times .9 \times .1)$

$= 7W - \log(0.0002646)$

③ $\Delta = \bar{w}\bar{x}\bar{y}\bar{z} + \bar{w}\bar{x}\bar{y}z + \bar{w}\bar{x}y\bar{z} + w\bar{x}\bar{y}\bar{z} + w\bar{x}y\bar{z} + w\bar{x}yz + wxy\bar{z} + wxyz$

a)

- apply consensus method on all possible combinations

$\bar{w}\bar{x}\bar{y} + \bar{w}\bar{x}\bar{z} + \bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z} + w\bar{x}\bar{z} + w\bar{x}y + wy\bar{z} + wyz + wxy$

- apply consensus method on all possible combinations

$\bar{x}\bar{z} + \bar{x}\bar{z} + wy + wy$

// The only term not subsumed by $\bar{x}\bar{z}$ or wy is $\bar{w}\bar{x}\bar{y}$

$\Rightarrow$ Prime Implicants: $\bar{w}\bar{x}\bar{y}$, $\bar{x}\bar{z}$, wy

b.) Sufficient Reasons for instance $wxyz$:

- wy

④ $\Delta = [E \wedge [(F \wedge (G \vee W)) \vee (\neg F \wedge R)]] \vee [G \wedge R \wedge W]$

a.) Instance: $E, \neg F, G, W, R$

$[T \wedge [(\neg T \wedge (T \vee T)) \vee (T \wedge T)]] \vee [T \wedge T \wedge T] \Rightarrow$ Yes

b) $[E \wedge [(F \wedge G) \vee (F \wedge W) \vee (\neg F \wedge R)]] \vee [G \wedge R \wedge W]$

$(E \wedge F \wedge G) \vee (E \wedge F \wedge W) \vee (E \wedge \neg F \wedge R) \vee (G \wedge R \wedge W)$

consensus on c1 & c3: $E \wedge G \wedge R$

consensus on c2 & c3: $E \wedge W \wedge R$ $\Rightarrow$ Sufficient Reason for decision: (E, G, R)

c.) The decision <u>is</u> biased because each of its sufficient reasons, (E, G, R) & (E, W, R), contains at least one protected feature, R.

⑤

a) False

b.) False

c.) True