mlearn 310 Hw2

(2) ID3 Algo

Information Gain $= -5/11 \log_2(5/11) - 6/11 \log_2(6/11)$

$\simeq 0.994103$

Gain for Age

Senior	$-1/3 \log_2(1/3) - 2/3 \log_2(2/3)$	$= 0.91$
middleAge	$-1/4 \log_2(1/4) - 3/4 \log_2(3/4)$	$= 0.8112$
YoungAdult	$-3/4 \log_2(3/4) - 1/4 \log_2(1/4)$	$= 0.8112$

$E(\text{Age}) = 3/11 \times .91 + 4/11 (.81) + 4/11 (.81)$

$= 0.837$

$\text{Gain}(\text{Age}) = 0.994 - 0.837$

$= 0.157$

Gain for Prior purchase

$E(\text{PriorPur}) = 5/11 (0.72) + 6/11 (0.65)$

$= .672$

YES	$-4/5 \log_2(4/5) - 1/5 \log_2(1/5)$	$= 0.72$
No	$-1/6 \log_2(1/6) - 5/6 \log_2(5/6)$	$= 0.65$

$\text{Gain}(\text{Prior Purchase}) = 0.994 - 0.672$

mlearn310 HW2 (1/2)

Gain for Income

(2.2) ID3 Algo.

Income		
low	$-1/4 \log_2(1/4) - 3/4 \log_2(3/4)$	$= 0.81$
medium	$-1/3 \log_2(1/3) - 2/3 \log(2/3)$	$\simeq 0.91$
High	$-3/4 \log_2(3/4) - 1/4 \log(1/4)$	$\simeq 0.81$

$$E(\text{Income}) = 4/11\,(0.81) + 3/11\,(0.81) + 4/11\,(0.91)$$

$$= 0.846$$

$$G(\text{Incom}) = 0.994 - 0.846$$

$$\simeq 0.148$$

Gain for Education

Edu		
College	$-4/7 \log(4/7) - 3/7 \log(3/7)$	$= 0.98$
High School	$-1/4 \log(1/4) - 3/4 \log(3/4)$	$= 0.81$

$$E(\text{Edu}) = 7/11\,(0.98) + 4/11\,(0.81)$$

$$= 0.928$$

$$G(\text{Edu}) = 0.994 - 0.928$$

$$= 0.066$$

mlearn310 Hw2

(2.3) ID3 Algo

Gain (Age) = 0.157

Gain (Prior Purchase) = 0.322

Gain (Income) = 0.148

Gain (Education) = 0.066

We choose Prior Purchase on root

Decision Tree

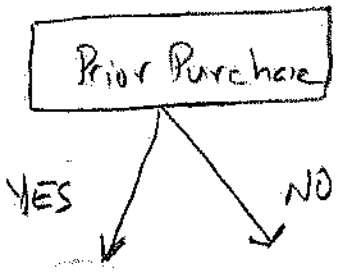

Table for Prior Purchase = YES

Age	Income	Education	Prior Purchase	Buy PC?
YoungAdult	High	College	YES	Yes
MiddleAge	High	High school	YES	NO
YoungAdult	Medium	High school	YES	Yes
Senior	High	College	YES	Yes
MiddleAge	Low	College	YES	Yes

Information Gain $= -4/5 \log_2(4/5) - 1/5 \log_2(1/5)$

$= 0.721928$

mlearn310 Hw2

2.4 ID3 Algo

Gain for Age

	Buy PC?		
	Yes	No	
Young Adult	2	0	0
Midde Age	1	1	1
Senior	1	0	0

$$E(Age) = \frac{2}{5}(0) + \frac{2}{5}(1) + \frac{1}{5}(0)$$

$$= 0.4$$

$$Gain(Age) = 0.721 - 0.4$$

$$\simeq 0.321$$

Gain for Income:

	Buy PC?		
	Yes	No	
low	1	0	0
Medium	1	0	0
High	2	1	1

$$E(Incom) = \frac{1}{5}(0) + \frac{1}{5}(0) + \frac{3}{5}(1)$$

$$= 0.6$$

$$Gain(Incom) = 0.721 - 0.60$$

$$= 0.121$$

Gain for Education:

	Buy PC?		
	Yes	No	
College	3	0	0
HighSchool	1	1	1

$$E(Educatn) = \frac{3}{5}(0) + \frac{2}{5}(1) = 0.4$$

$$Gain(Edu) = 0.721 - 0.4$$

$$\simeq 0.321$$

$Gain(Age) \simeq 0.321$

$Gain(Edu) \simeq 0.321 \Rightarrow$ We choose Education as there

mLearn810 Hw 2

2.3 ID3 Algo