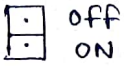
06.05.18.

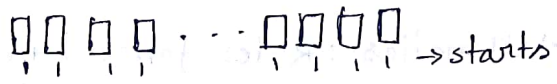
Artificial Intelligence

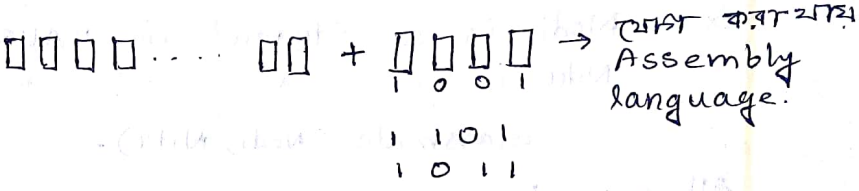
① Algorithm
② Data Structure
③ Discreate Mathmatics

Computere Program : Program a language.

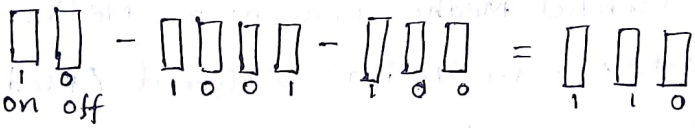
computer : million no of switch







2+4 = 6



Machine language : 3 types → 1. Low level : Machine Code 1001
2. Mid " : 1001 → ADD } Assembly
3. High " : GUI SUB MUL } language
(Graphical User Interface)

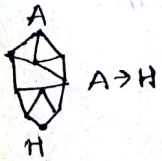
ADD translator 1001
↳ replace করল + − × / → Mid level language.

Comand prompt : keyboard দিয়ে যখন যা কাজ করা হত।

+ compilers bytecode

computer think করে কিনা → Artificial Intelligence.

Data Structure : BFS → Queue → FIFO
DFS → Stack → LIFO.
⇓ অসুবিধা overcome করার জন্য
Advanced Algorithm use হয়।
↳ A* Search
LISP language.



① Bag, pendrive
② Lunch
③ Industrial attachment
④ Certificate
⑤ 4500

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Artificial Intelligence

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Academic | Robotics | Biometrices | Brain image processing
computer interfacing | Data mining.
(Bioinformatics) | Genetic Engg

09.05.18.

AI

Definition :- Artificial Intelligence is a branch of computer science which concerned with the design of Intelligence in an artificial device.

Discrete Mathmatics : Rules for Inference.

Ex: Nodi is a student of BAUST.
Nitu is " " " " .

classmate (Nodi, Nitu).

All man is mortal, Medha is a man, Medha is mortal.

$\forall$ man(Mortal) $\wedge$ man (Medha) $\rightarrow$ Mortal (Medha).

There are idea in the term of Artificial Intelligence.

① Artificial → Artificial device.
② Intelligence.

Intelligence :- The ability to acquire, understand and apply knowledge.

Ability to exercise thought and vesón. (reasoning)

Properties of Intelligence System :-

- An intelligence system expected as behave as likely human.
- An intelligence system expected as possible best manner.

Types of AI Problem : Two types of AI Problem.

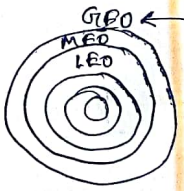
① Common place task
② Expert System tasks.

(i) Common place task :- (Image processing)
- (a) Human recognition, recognizing object.
- (b) Communicating (through Natural language)
- (c) Navigating around obstacle .street.

(ii) Expert System task :
- (a) Medicle diagnosis.
- (b) Solving Mathmatical Problem.
- (c) Playing Game chess board.

AI are not ?
- (i) Read Human mind, body language.
- (ii) Read newspaper and summerize above that paper.

Application of AI :
- (i) Game Playing.
- (ii) Speach Recognition → Speech Signal Processing (SSP)
- (iii) Worker. ex : Chemical Industry.
- (iv) Aviation. ex : (a) Auto Pilot.
  (b) Aircraft control using speech command.
- (v) Telecommunication System. ex :
  (i) Sattellite.



Bangho bondhu-1 satellite

Sub Area of AI :-
- (i) Machine Learning.
- (ii) Natural language processing.
- (iii) Signal processing.
- (iv) Robotics.
- (v) Perception : Vision & Speech Understanding.
- (vi) Reasoning and decision Making.
  - (i) knowledge Representation.
  - (ii) Reasoning. (logic / Probability)

10.05.18.

Artificial Intelligence.

(i) What is AI
(ii) Application
(iii) Sub Area of AI.

Knowledge :- knowledge is a familiarity with someone or something which include fact, Information, Description or skills. acquired through experience or education.

ii) It can refer to theoritical or Practical skills in a subject (implicit, explicit).

iii) act, fact, state of knowing.

Belief :- Belief represent any meaningful expression that is justified true.

Hypothesis : A justified belief that is not know either true or (অজানা) false.

If p then q
if (x > y)
    printf ("x is large number");
else
    " ("y" " " ");

Knowledge	Expression
i) Apu is tall	i) An attribute possessed by a student.
ii) x loves y	ii) a complex relationship between two person.
iii) Bangladesh is a developing country. (developing → financial → Economies)	iii) an economic states of a country.

Types of knowledge :

(i) Declarative knowledge
(ii) Procedural "
(iii) Heuristic "
(iv) Epistomology "
(v) Meta "

C procedural ↓ নির্দিষ্ট process follow করে শুরু শেষ থাকে। int main { } create table ৫1 ↳ non-procedural

(i) Declarative knowledge :- knowledge express statement fact about the word.

I am a boy.
We are student

(ii) Procedural knowledge : knowledge represent step to solve a problem.

(iii) Heuristic knowledge : A special kind of knowledge to solve a problem.
Ex. $a^2+2ab+b^2$.

(iv) Epistomology knowledge : Epistomology is one kind of way to express nature of existing knowledge.
Ex. (a) What type of knowledge
(b) How efficient of this "
(c) What necessary of " ".

(v) Meta knowledge : knowledge about knowledge.
Ex. What knowledge we know?
We are expert about computer science.

Lab

=0=

(i) Uniformed Search
(i) BFS (ii) DFS
(iii) Game playing
(iv) 8 Queen Problem
3x3 4x4 Puzzle game

1	4	7
2	5	8
3	6	

4	7	8
3		5
1	2	6

(iv) Informed Search
(i) A* Algorithm
(ii) Best first Search
(iii) Heuristic Function.

AI Programming Language : ① Prolog. (reasoning, logic)

C=R

② C++
③ Java
④ Python
⑤ LISP (List Processing Language)

i.

Hypot.
(অনুমান) ;

If p then
if (x > y)
printf ("x
else
" ("y "

Knowledge

i) Apu is tall

ii) x loves y

iii) Bangladesh is a developing country.
↓
financial
↓
Economies

ii) a con
two peri

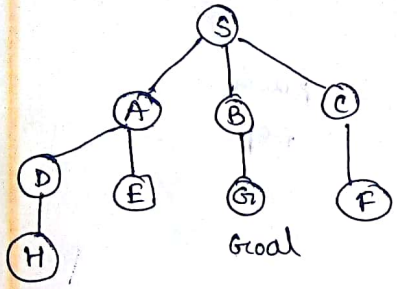
iii) an economic country.

⑩ Informed Search
⑪ A* Algorithm
⑫ Best First Search
⑬ Heuristic Function.

16.05.18.

informed search → কোথায় যেতে হবে তা জানা আছে।
Uninformed " / Blind " " " নেই

Blind search : → BFS
→ DFS

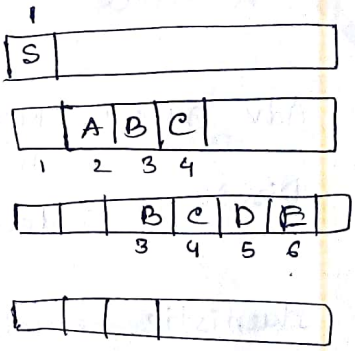


QUEUE

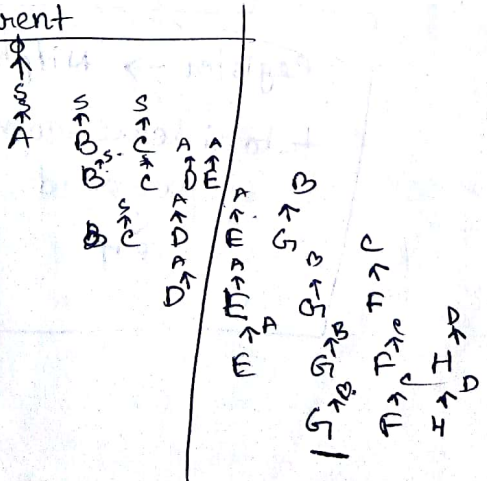
Nadi	Medina	Nabila	Omaiya

Front = 1 (↓ Delete → Front বাড়বে)
Rare = 4 (↓ insert করলে → Rare বাড়বে)

Expanded Node	Queue
S not Goal	A B C
A " "	B C D E
B " "	C D E G F
C " "	D E G F H
D " "	E G F H
E " "	G F H
G Goal	G F H not Expand



Parent



GBS

2	8	3
1	6	4
7		5

1	2	3
8		4
7	6	5

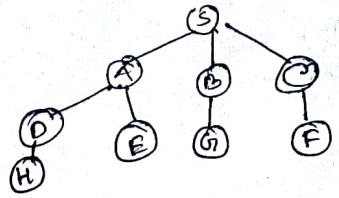
20.05

Adv of BFS : a. BFS is a systematic search strategy

b.

c.

insert delete nare



Stack

DFS : Depth

Expanded Node	Stack	push pop
	S	
S not Goal	A B C	
C " "	A B F	
F " "	A B ~~G~~	G → B → S.
B " "	A ~~G~~	
G Goal	not Expand.	

Adv DFS : Memory কম লাগে
time " "

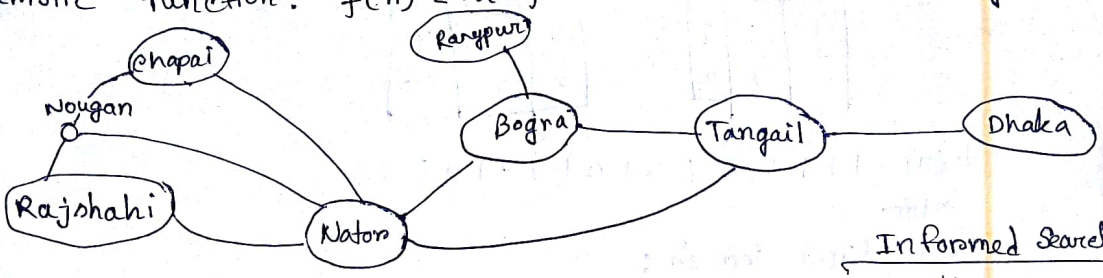
Disadv : deeper and deeper যেতে।

Heuristic search / Informed search :-

=0=

20.05.18.

heuristic function : $f(n) = h(n)$. # previous knowledge লাগে।



Informed Search

Start	Cost
Rangpur	500
Chapai	600
Nougan	550
Rajshahi	450
Nator	300
Bogra	250
Tangail	100
Dhaka	0

Heuristic value

Adv: দ্রুত সমাধান খুঁজে পাওয়া যায়।
অনেকগুলো n থেকে optimal way খুঁজে বের করা সহজ।

Blind search — difference — Heuristic

Algorithm : প্রথমে অনুমান করব then discover করব।

total cost ← $f(n) = h(n)$ → estimated cost (অনুমান করে বলেছি cost)

h(Rangpur) = 500
h(Chapai) = 600
h(Nougan) = 450

Euclidian distance ⟶ $\frac{(x_2 - x_1)^2 + (y_2 - y_1)^2}{2}$

Manhattan " ⟶ $\frac{|x_2 - x_1| + |y_2 - y_1|}{2}$

Ex-1 :

$f(n) = h(n)$ ← starting notation

h(n) = euclidian distance (between two points)

h(kolkata) = 200 " " (kolkata, Guxahati)

h(Rangpur) = euclidian distance (Rangpur, Dhaka)
h(Rangpur) = 380 km.
h(Rangpur) = 500 taka.

2	8	3
1	6	4
	7	5

1	2	3
8		4
7	6	5

$h(n) = 1+1+0+0+0+1+1+2 = 6$

~~Infom~~

Best First Search :-

Informed Search :

① heuristic value
" function
$f(n) = h(n)$

- (i) Best first Search
- (ii) A* Search
- (iii) ID A*
- (iv) SM A* (Shortest Memory of A*)

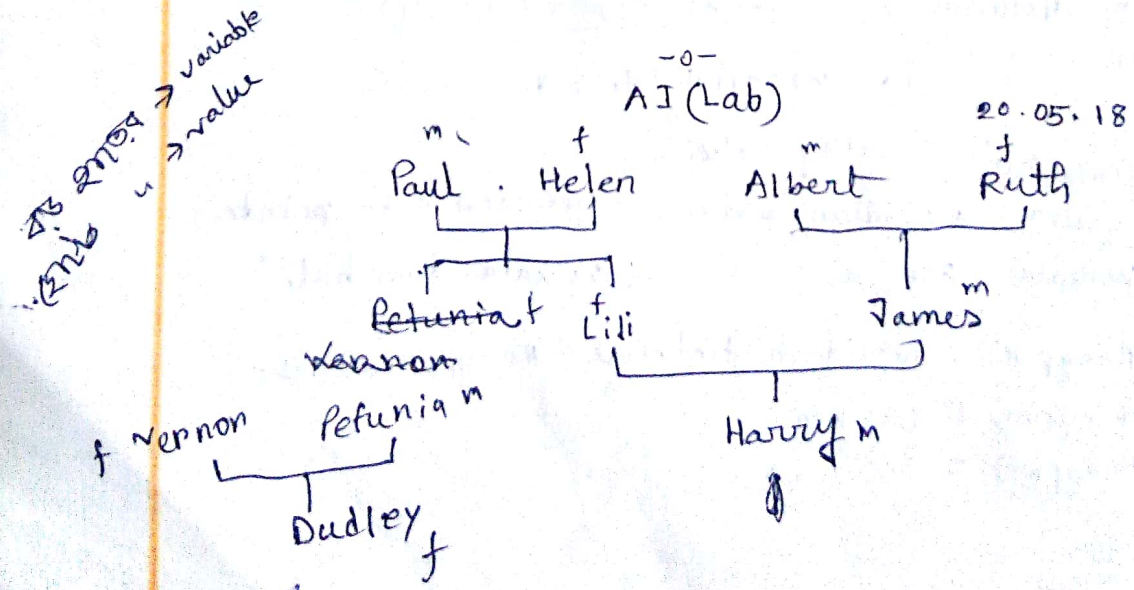
Best First Search : priority queue.

Algorithm : fringe be " "

-o-

AI (Lab)

20.05.18



23.05.18.

Uninformed { BFS, DFS }

Algo

Assignment + Presentation

- i) A* ✓ BFS → Informed
- ii) IDA* ✓
- iii) SMA* ✓
- Local search:
  - iv) Hillclimbing search
  - v) Simulated Annelina
  - vi) Constant Satisfaction Problem

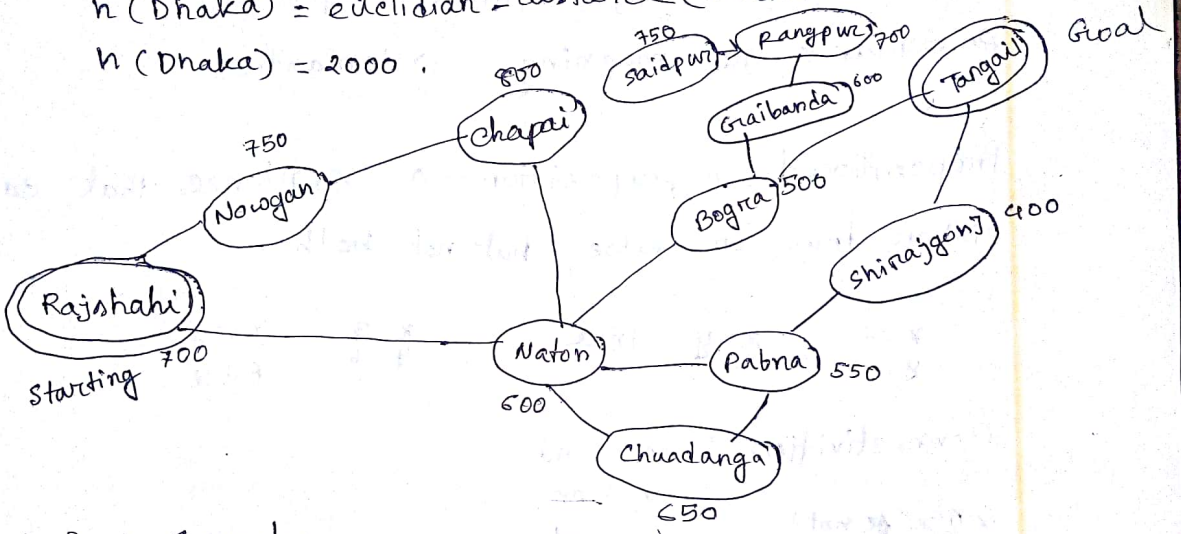
Searching Strategy

- Uniformed search
  - BFS
  - DFS
- Informed search
  - Heuristic function
  - Best first search
  - A* search.

We want to calculate distance from dhaka to kolkata.

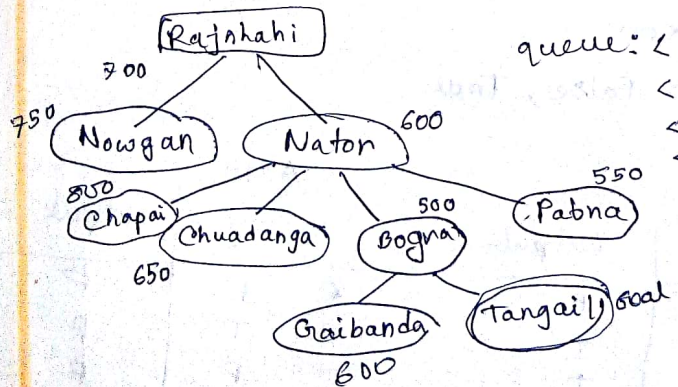
h(Dhaka) = eiclidian-distance(Dhaka, kolkata).

h(Dhaka) = 2000.



Best first search:

fringe = Priority queue



queue: < ~~Rajshahi Goal~~ >

< Nator, Nowgan >

< Nowgan >.

< Nowgan, Chapai, Chuadanga, Bogra, Pabna >

Tangail-Tangail → 0

Shirajgonj → 400

Bogra → 500

Nator → 600

Rajshahi → 700

Nowgan → 750

Chapai → 800

Saidpur → 750

Rangpur → 700

Gaibanda → 600

CT ⇒ ① First lecture
② BFS, DFS

Proposition Logic

Propositional Logic

24.05.18

① Proposition
② Logical connectivity..

x greater than y
$x > y$

Symbol मुलतत्व specific form → Syntax.
Sentance का meaning → Semantics.

Propositional : A proposition – a sentence that can be either true or false but not both.

$x=5$, $y=2$ $x>y$ true.

$x=3$, $y=6$ $x>y$ False

Connectivities :
- $\wedge$ and
- $\vee$ or
- $\neg$ not
- $\rightarrow$ implies
- $\leftrightarrow$ equivalent to
- ⊕ xor
- $\perp$, $\top$ False, True

x	x' (not)
0	1
1	0

Not

x	x'
True	False
False	True

OR

x	y	output
F	F	F
F	T	T
T	F	T
T	T	T

AND

x	y	output
F	F	F
F	T	F
T	F	F
T	T	T

$x \to y$ if x then y

x	y	$x \to y$
F	F	T
F	T	T
T	F	F
T	T	T

p → true, q → false

$x \Leftrightarrow y$

x	y	output
F	F	T
F	T	F
T	F	F
T	T	T

$\neg x \vee y$

T	F	T
T	T	T
F	F	F
F	T	T

XOR gate

x	y	$x \oplus y$
F	F	F
F	T	T
T	F	T
T	T	F

And → conjunction
Or → disjunction
If ... then → .

$x \to y :=$
$x \Leftrightarrow y = (x \to y) \wedge (y \to x)$
$= \neg(x \oplus y)$

well form formula ⇒ wff.

$x \to y$
x = study hard y = rewarded.

(i) S is a sentence · S = it is hot.

(ii) If S is a " · $\neg S$ = it is not hot

$\neg S$ is also a "

(iii) if S and T are " then

$S \vee T$, $S \wedge T$, $S \to T$, $S \Leftrightarrow T$

Lab

30.05.18

carget (&state ('atdoon, onfloon, atwindow, hasnot)).

1. Series sum functions. 1+2+ ... +... n
2. Fibonacci Series (0, 1, 2, 3, ... n).
3. Power calculation $m^{*}n$

30.05.18

AI

A proposition - a sentence that can be either true or false but not both.

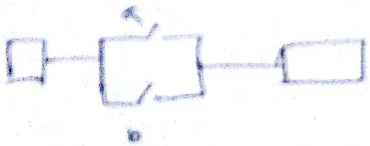
Truth Table - যখন relation বের করি,

The value of a proposition is called Truth Table.

Negation :
AND :
OR :

Propositional logic :-
→ symbol এর সাহায্যে knowledge represent করা।

AND gate



OR

XOR :
Implication : p q = p→q
1 0 = 0

p q	p→q
0 0 →	T
0 1 →	T
1 0 →	F
1 1 →	T

a, b → variable → value রাখা যায়।

30.05.18.

If ---- then .... → use করা।

If -1 is a positive no, then 2+2=5

p	q	p→q
0	0	T
-0	①	T
1	0	F
-1	①	T

Let, p = -1 is a +ve number
q = 2+2 = 5
p→q = true

Bidirectional :

p	q	p⇔q
0	0	1
0	1	0
1	0	0
1	1	1

p if and only if q
necessary and sufficient
if p and q, conversly

Semantics : meaning of a ~~semant~~ sentence.

True Statement	False Statement
T	F
-f	-t
T & -F	t ∝ a ↳ A = any rules 0 or 1
T ∨ A	a ⊗ & f
a → f t	t → f

(P & ¬Q) → R ∨ Q

P = true
Q = false
R = false

(1 & 1) → f ∨ f
1

(¬P ∨ Q) & R → S ∨ (¬R & Q)

a) I_1 : P = true, Q = true, R = false, S = true

b) I_2 : P = u Q = false, R = true, S = true

a) ~~¬F~~ ~~F⊗~~ ~~1&0~~ 0⇒ 1 ∨ (¬T⊗) 1 = 1 True

b) 0 1→0 1 ·T ∨ 0 0&0
1 u

$\sim(P \vee \sim Q) \;\&\; (R \to S)$.

$P = 1$
$Q = 0$
$R = 1$
$S = 0$

To find truth value

$0 \;\&\; (1 \to 0)$
$\quad\quad 0$
$0 \;\&\; 0$
$= 0$ false

$P \leftrightarrow Q$ and $(P \to Q) \;\&\; (Q \to P)$

P	Q	$P \leftrightarrow Q$
0	0	1
0	1	0
1	0	0
1	1	1

P	Q	$P \to Q$
0	0	1
0	1	1
1	0	0
1	1	1

Q	P	$Q \to P$
0	0	1
0	1	1
1	0	0
1	1	1

$(P \to Q)$ $(Q \to P)$

1	1
1	1
0	0
1	1

$(P \to Q) \;\&\; (Q \to P)$

1
1
0
1

=0= 03.05.18.

① Proposition
② Logical connectivity.

$(P \vee q) \wedge S$
↙ or ↘ and
if then $\to$
if and only if $\leftrightarrow$

P = -1 is a pasitive no
q = (2+2 = 5)

if p then q
$p \to q$

03.05.18.

p	q	out	p
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

→ contingency

→ Tautology

→ Contradiction

$\neg(p \vee q) = \neg p \wedge \neg q$

$p \to q \Rightarrow \neg p \vee q$

$p \Leftrightarrow \Rightarrow (p \to q) \,\&\, (q \to p)$

$\neg(p \vee q)$

p	q	$p \vee q$	$\neg(p \vee q)$	$\neg p$	$\neg q$	$\neg p \wedge \neg q$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

Logical equivalence.

Universal set U

$S = \{ S_1, S_2, S_3, S_4, S_5, S_6 \}$

↳ logical consequence

Logical Equivalence: $(p \to r) \vee (q \to r) \equiv (p \wedge q) \to r$

p	q	r	$p \to r$	$q \to r$	$(p \to r) \vee (q \to r)$	$p \wedge q$	$(p \wedge q) \to r$
0	0	0	1	1	1	0	1
0	0	1	1	1	1	0	1
0	1	0	1	0	1	0	1
0	1	1	1	1	1	0	1
1	0	0	0	1	1	0	1
1	0	1	1	1	1	0	1
1	1	0	0	0	0	1	0
1	1	1	1	1	1	1	1

$A \to B$
$\neg A \vee B$

Proposition → Conclusion
↙
Inference.

Rules of Inference :

① Modus Ponens Rule
② Modus Tonens
③ Chain Rule / Syll

Modus Ponens Rules

$$\frac{P \quad P \to Q}{Q}$$

$$\frac{P \to Q \quad P}{Q}$$

Conversion :

$$\frac{\neg P \quad \neg Q \to \neg P}{\neg Q}$$

$Q \to P \equiv \neg Q \vee P$

$P \to Q \equiv \neg P \vee Q \Rightarrow Q \vee \neg P$
$\Rightarrow \neg Q \to \neg P$

$\neg P$
$Q \to P$

$$\frac{\neg Q \to \neg P \quad \neg Q}{\neg P}$$

$(P \wedge P \to Q) \to Q$

$(\neg Q \to \neg P) \wedge \neg Q)$

$(\neg(\neg Q) \vee \neg P)$
$Q \vee \neg P$ ..

Rules of Inference :

① Modus Ponens

$$\frac{P \quad P \to Q}{Q}$$

$$\frac{\neg Q \to \neg P \quad \neg P}{\neg Q}$$

$$\frac{\neg Q \to \neg P \quad \neg Q}{\neg P}$$

② Modus Tones Rules :

$$\frac{\neg Q \quad P \to Q}{\neg P}$$

③ Chain Rules :

$$\frac{P \to Q \quad Q \to R}{P \to R}$$

=0=

03.06.18.

AI Lab

Fibonacci Series :-

sum(5,5)

Output :- go.

Enter ..... : 10

1 2 3 4 5

$\frac{n(n+1)}{2}$

SumN(5, X).

X = 15

Graph :- path বের করে

Travelling by car, train and plane

Finding maze

=০=

06.06.18.

Propositional logic

- Proposition
- Logical connectivity.

Rules of Inference :-

① Modus Ponens.

① MP

$$\frac{P \quad P \to Q}{Q} \qquad \frac{\neg P \quad \neg Q \to \neg P}{\neg Q}$$

④ MT

$$\frac{\neg Q \quad P \to Q}{\neg P}$$

③ Chain Rule

$$\frac{P \to Q \quad Q \to R}{P \to R}$$

④ Simplification :- $\frac{P \wedge Q}{P}$

$U = \{1, 2, 3, 4, 5, 6\}$

$S = \{S_1, S_2, S_3, S_4, S_5\}$

$S_1 S_2 S_3 S_4 S_5 = t$

① Logical compound from sentence

② Proof conclusion by using rule of Inference.

p = It's sunny this afternoon.
q = It's colder than yesterday.
r = We will go swimming.
s = We will take a canoe trip
t = We will be home by sunset.

a. It's not sunny and it's colder than yesterday.

$= \neg p \wedge q$

b. We will go swimming only if it's sunny.

$= r \rightarrow p$

c. If we don't go swimming then we will take canoe trip.

$= \neg r \rightarrow s$

d. If we take a canoe trip, then we will be home by sunset.

$= s \rightarrow t$.

Conclusion : We will be home by sunset. $= t$.

Proof : $\neg p \wedge q$

$= \neg p$ ↳ using simplifies Rule.

$r \rightarrow p$, $\neg r$ → MT rule

$\neg p \rightarrow s$, $\neg p$ → MP rule

s, $s \rightarrow t$ → MP rule

t

27.06.18.

(c) Propositional Logic :- And $\wedge$ Problem :-
OR $\vee$
~~XOR~~
NOT $\neg$ if then $\rightarrow$
iff if and only if $\leftrightarrow$

(c+f) FOPL : First Order Periodic Logic :.

Obj

If attend the class then you can pass. $\rightarrow$

Attend (class) $\longrightarrow$ Pass (Exam)
$\forall x$ Student $(x) \rightarrow$ smart (x)
All student are smart. student $\rightarrow$ smart

Some student are failed.
$\exists x$ Student $(x) \rightarrow$ failed (x).
All, some $\rightarrow$ generalization.

Quantifiers

① Existential quantifier : $\exists$
② Universal " $\forall$

Predicate : relation.

all Student are smart
$\forall x$ Student $(x) \longrightarrow$ smart (x)

Some Student are smart
$\exists x$ Student $(x) \wedge$ smart (x)

Everyone likes Someone
$\forall x \exists x$ likes (x, x)
$\forall x \exists y$ likes (x, y)

Predicate : Capital letter x father of y. ~~Father~~ FATHER (x, y)
K Married to z MARRIED (K, Z)
Mr. M friend of Mr. L FRIEND (L, M).

$$\frac{p \vee q \quad \neg p}{q}$$ disjunctive syllogism

"Students who pass the course either do the homework or attend lecture."
"Bod didn't attend every lecture," "Bob passed the course".

$P(x)$ = x pass the course
$H(x)$ = x Done Home Work
$L(x)$ = x attend class lecture.

① $\forall x\,(P(x) \rightarrow H(x) \vee L(x))$.

② $\neg L(b)$, $P(bob)$

$P(bob) \rightarrow H(bob) \vee L(bob)$ —— ①

$P(bob)$ —— ②

$H(b) \vee L(b)$ from ① and ② using Modus Ponens rule

$\neg L(b)$

$H(b)$

=0=

Quantifier :-

28.06.18.

Some people $\exists x$ people (x)
All " $\forall x$ " (x)

Translating Eng to FOL :

1. Every gardener likes the sun
= $\forall x$ gardener $(x) \rightarrow$ like (x, Sun) ;

2. You can fool some of the people all of the time,
= ~~$\exists x \forall t$~~ $\exists x$ People $(x) \wedge \forall t$ time $(t) \rightarrow$ can-fool (x, t)
$\exists x \forall t$ People $(x) \wedge$ time $(t) \rightarrow$ can-fool (x, t)

3. You can fool all of the people some of the time.
$= \forall x \exists t \; People(x) \wedge time(t) \rightarrow can\_fool(x, t)$.

4. All purple mushrooms are poisonous.
$= \forall x \; Purple\text{-}mushroom(x) \rightarrow Poisonous(x)$.

5. No purple mushroom is poisonous.
$= \forall x \; Purple\text{-}mushroom(x) \rightarrow \neg Poisonous(x)$.

6. Clinton is not tall.
$= \neg tall(Clinton)$.

Translating bet^n Eng and Logic Notation.

Assume: $E(x) = x$ is an Employee
$i(x)$ = income of x
$i(x) = 1400$
$T(x) = x$ pay tax per year.
$GE(x, y) = x$ is greater than or equal y.

E1: All employees earning 1400$ or more pay tax
$= \forall x \; Employee(x) \; \&\& \; \cancel{if(x)} \; i(GE(1400 \text{ or more})) \rightarrow T(x)$
$= \forall x \; E(x) \; \cancel{\&\&}, \; GE(i(x), 1400) \rightarrow T(x)$

E2: Some Employees are Sick today.
$= \exists x \; E(x) \; \cancel{\&\&} \rightarrow S(x)$

E3. No Employees earnings more than the President
$\forall x y \; E(x) \wedge P(y) \rightarrow \neg GE(I(x), I(y))$
(em ↑ presi)

S(x) = x is sick

P(x) = x is President.

Disjunction / Disjunctive (OR ∨) Normal form (DNF)
Conjunctive " " (CNF)

AND, OR, NOT → DNF/CNF এ convert করতে পারা

$a \wedge b \vee c \wedge k \vee \neg p$

$(a \wedge b) \vee (c \wedge k) \vee \neg p$ (DNF)

$a \wedge (b \vee c) \wedge (k \vee \neg p)$ (CNF)

Convert FOPL to CNF :- FOPL → ¬ ∃ ∀ ∧ ∨ ↔

Steps:-

① Eliminate →, ↔ from the expressions.

$a \rightarrow b \Rightarrow \neg a \vee b$

② Move ¬ into preceed the single atom.

$\neg(a \vee b)$ $\neg(a \rightarrow b)$ $\neg(\exists x\, P(x))$

$\neg a \vee \neg b$ $\forall x\, P(x)$

③ ~~Eliminate~~ Rename variable name.

$\forall x\, P(x)\ \exists(x)$ Student(x)

$\forall x\, P(x)\ \exists(y)$ Student(y)

④ Remove ∃x quantifier.

$\exists x\, P(x) = P(c)$.

$\forall x\, \exists y\, P(x, y)$

$\forall x\, P(x, f(x))$.

(v) Remove $\forall x$ quantifier.

(vi) If need applied distributivity.

=o=

01.07.18

FOPL — PL:

Quantifier
$\forall$ Universal
$\exists$ Existential

$\wedge$
$\vee$
$\neg$
$\rightarrow$
$\leftrightarrow$

All people
some student.

1. $\forall x$ gardener $(x) \rightarrow$ like (x, sun);
2. $\exists x \forall t$ People $(x) \wedge$ time $(t) \rightarrow$ can-fool (x, t)
3. $\forall x \exists t$ People $(x) \wedge$ time $(t) \rightarrow$ can-fool (x, t)
4. $\forall x$ Purple-mushroom $(x) \rightarrow$ poisoinus (x)
5. $\forall x$ Purple-mushroom $(x) \rightarrow \neg$ poisoinus (x)
6. $\neg$ tall (Clinton).

Disjunctive Normal Form (DNF):
Conjunctive " " (CNF):

$\vee \wedge \neg$

$a \vee b \wedge c \vee K \wedge L \vee M$

$a \vee (b \wedge c) \vee (K \wedge L) \vee M$ DNF

clause $(a \vee b) \wedge (c \vee k) \wedge (L \vee M)$ CNF

FOPL to CNF: step সমূহ sequentially perform করতে হবে।

$a \rightarrow b$
$\neg a \vee b$

$\exists x \forall y \forall z \; P(f(x), y, z) \rightarrow (\exists u Q(x, u) \;\&\; \exists v R(y, v))$
(a) (b)

$\neg (\exists x \forall y \forall z \; P(f(x), y, z)) \vee (\exists u Q(x, u) \;\&\; \exists v R(y, v))$

$\forall x \exists y \exists z \; P(f(x), y, z) \vee (\exists u Q(x, u) \wedge \exists v R(y, v))$

$\forall x \; P(f(x), f(x), f(x)) \vee (Q(c) \wedge R(c))$

Not
$\neg \forall x \exists x$
$\exists x \forall x$
$\exists x P(x) \Rightarrow P(c)$
$\exists x P(y, z)$
$\exists y \forall y P(y, f(y))$

Distributivity law:

$a \vee (b \wedge c)$

$(a \vee b) \wedge (a \vee c) \ldots$

$P(f(x), f(x), f(x)) \vee (Q(c) \wedge R(c))$

$(P(f(x), f(x), f(x) \vee Q(c)) \wedge (P(f(x), f(x), f(x) \vee R(c))$.

2. $\exists x \forall y (\sim \forall z\, P(f(x), y, z) \vee (\exists u\, Q(x,u) \,\&\, \exists v\, R(y,v)))$

3. $\forall y (\exists z \sim P(f(c), y, z) \vee (\exists u\, Q(x,u) \,\&\, \exists v\, R(y,v)))$

4. $\forall y (\sim P(f(c), y, g(y)) \vee (Q(c, h(y)) \,\&\, R(y, i(y))))$

c

=o=

[ ] → list বোঝায়।

Lab

```
path(Node, Node, _, [Node]).
path(Start, Finish, Visited, [Start | Path]) :-
        edge(Start, X),
        not(member(X, Visited)),
        path(X, finish, [X | Visited], Path).
```

```
edge(1,5).      1, 7
 "  (2,1).      2, 7
    3, 1        3, 6
    4, 3        4, 5
    5, 8        6, 5
    6, 4        8, 7
    7, 5
    8  6
```

Consult :

path(1, 6, [1], path).

capital P ~~ছোট হবে~~ P

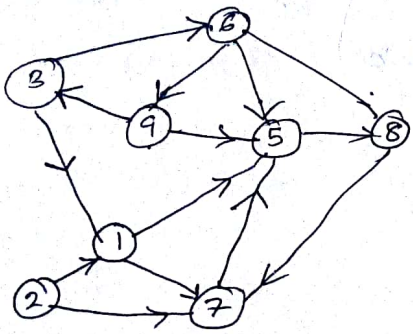
Lab Report :

1.

Lab, next → next

copy paste

Lab Report:
1. Introduction to AI.
2. Areas and Scope of AI
3. AI programming tools and languages
   a. Compilers. b. terms of Languages (fact, Rules, Backtracking, Recursive ...)
4. Problems and Solution
5. Future AI trends
6. Conclusion.



04.07.18.

—o—

পরিসংখ্যান: avg light →

Random variable: a, b, c, d, e

Probability: $\frac{1}{\text{Total Number}}$

Mean: $\frac{a+b+c+d+e}{5}$

Medium = 55

Mode: 40

weight
a = 45
b = 40
c = 55
d = 40
e = 46

বিজোড় → $\frac{5+1}{2}$

জোড় → $\frac{6}{2}$

যার frequency বেশি → 40 2 বার এসেছে

$b = \frac{1}{6}$ $a = \frac{1}{50}$ unconditional or prior probability.

if a an event
then Probability of a = P(a).

P(cavity) = $\frac{1}{30}$

Conditional Probabity :

Two event : a, b → 50x

P(a|b)
a → even b

Any given person .

P(caugh) = 2%.

P(caugh | cold)

$P(a \wedge b) = P(a|b)\ P(b)$ } conditional probability
$P(a \wedge b) = P(b|a)\ P(a)$ }

↓
product rule .

① $0 \leq x \leq 1$ [0 ... 1] kolmogorov's Axiom

P(x) = 0
P(x) = 100

② True, 1 or False, 0

③ Sume Rules:

$P(a \vee b) = P(a) + P(b) - P(a \wedge b)$

(i) Probability — 0/1 logic দিয়ে সব define করা যায় না।

(ii) Unconditional Probability (যে probability গুলো স্বাধীন)

(iii) Conditional " (দুটো element a, b)

(iv) Kolmogorov Axiom.

—o—

08.07.18.

(i) Product Rule:

$$P(A \wedge B) = P(A/B)\,P(B)$$

(ii) Sum " :

$$P(A \vee B) = P(A) + P(B) - P(A \wedge B)$$

$$P(A \backslash B) = P(A \wedge B) / P(B)$$

$$P(A \wedge B) = P(A \backslash B)\,P(B)$$

$$P(A, B) = P(A \backslash B)\,P(B) \quad \text{—— (i)}$$

$$P(A \backslash B) = P(B \backslash A)\,P(A) \quad \text{—— (ii)}$$

Monogrov Axiom

(i) $0 \leq x \leq 1$ (Probability range)

(ii) . an event can either true or false.

(iii) $P(B) = \sum_{i=1}^{n}$ ~~P(A∤B~~ $P(B/A_i)\,P(A_i)$ / $B = \sum_{i=1}^{n} D_i$

Weather

(i) sunny	→ 70 %	40
(ii) cloudy	→ 20%	20%
(iii) rainy	→ 10%	10%
(iv) Others		→ 30%
		100%

Thomas ~~Bios~~ : Bayes:

~~P(A)~~.

$$P(A, B) = P(A/B)\,P(B) \quad \text{—— (i)}$$

$$P(A, B) = P(B/A)\,P(A) \quad \text{—— (ii)}$$

$$P(A/B)\,P(B) = P(B/A)\,P(A)$$

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365 — 5 দিন
1 — $\frac{5}{365}$

11.07

$$P(A/B) = \frac{P(B/A)\,P(A)}{P(B)}$$ — Baysian rule

$$P(A_i/B) = \frac{P(B/A_i)\,P(A_i)}{\sum_{i=1}^{n} P(B/A_i)\,P(A_i)}$$ — ① Bayesian Rule এর extend version

Example :-

rainy day = 5

not rainy = 360

WM → weather map.

$P(WM) = 90\%$

$\neg P(WM) = 10\%$

$P(y/WM) = ?$

$P(B/A_1) = 90\%$

$P(B/A_2) = 10\%$

$P(A_1) = \frac{5}{365}$; বৃষ্টি হবার সম্ভাবনা

$P(A_2) = \frac{360}{365}$; " না " "

$$P(A/B) = \frac{P(B/A)\,P(A)}{\sum_{i=1}^{n} P(B/A_i)\,P(A_i)}$$

$$P(A_i/B) = \frac{P(B/A_1)\,P(A_1)}{P(B/A_1)\,P(A_1) + P(B/A_2)\,P(A_2)}$$

~~P(WM~~

$$P(A_1/B) = \frac{90 \times \frac{5}{365}}{\frac{5}{365} \times 90 + 10 \times \frac{360}{365}}$$

11.07.18

Probability

Conditional Probability :-

$P(A/B)$

$P(a,b) = P(a/b)\,P(b)$.

Kolmogorov's Axioms :- 1.

2. true = 1 false = 0

3. $P(a \vee b) = P(a) + P(b) - P(a \wedge b)$.

First = 70%

$\neg$ First = 100 − 70%.

Conditional Probability : $P(A, B) = P(A \mid B)\,P(B) = P(B \mid A)\,P(A)$ ..

Bayes Rule :-

Ex- 50,000 এর মধ্যে 1 জন এর মেনিঞ্জাইটিস রোগ হয়। ~~stiff neck → 50%~~ 50% stiff

~~stiff neck → 50% 20%.~~ 20 জনে 1 জনের stiff neck হয়।

50,000 " 1 " " " "

$P(\text{stiff neck} / \text{meningitis}) = 50\%$

$P(\text{meningities}) = \frac{1}{50,000}$

$P(\text{stiff\_neck}) = \frac{1}{20}$

$P(\text{meningitis} / \text{stiff\_neck}) = ?$

$$P(A/B) = \frac{P(B/A)\,P(A)}{P(B)} \quad ; \quad P(B) = \sum_{i=1}^{n} P(B/A_i)\,P(A_i)$$

12.07.18

$$P(\text{meningitis}/\text{stiff\_neck}) = \frac{P(\text{stiffneck}/\text{meningitis}) \times P(\text{meningitis})}{P(\text{stiff\_neck})}$$

Ex-2 | বছরে 5 দিন বৃষ্টি হয়। 365 - 5 = 360

A1 : It rains on tomorrow.
A2 : It not " "
B : Weatherman Predict.

$$P(A_1) = \frac{5}{365}$$

$$P(A_2) = \frac{360}{365}$$

$$P(B/A_1) = \frac{90}{100}$$

$$P(B/A_2) = \frac{10}{100}$$

$$P(A/B) = \frac{P(B/A)\,P(A)}{P(B)}$$

$P(A_1/B) = ?$

$$P(A_1/B) = \frac{P(B/A_1)\,P(A_1)}{P(B)}$$

$$= \frac{P(B/A_1)\,P(A_1)}{\sum_{i=1}^{n} P(B/A_i)\,P(A_i)}$$

$$\Rightarrow P(A_1/B) = \frac{P(B/A_1)\,P(A_1)}{P(B/A_1)P(A_1) + P(B/A_2)\,P(A_2)}$$

$$= \frac{\frac{90}{100} \times \frac{5}{365}}{\left(\frac{90}{100} \times \frac{5}{365}\right) + \left(\frac{360}{365} \times \frac{10}{100}\right)}$$

Joint Probability Mass Function :-

x y

x(0,1) (0,1)

x	y	Probability
1	1	
1	0	
0	1	
0	0	

Bayesian Network : A graphical model that efficiently encodes the joint probability distribution for a large set of variables.

Parent (A1) → known

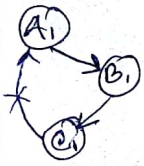
child (B1) → Unknown

P(child / Parent)

P(B1 / A1)

4 condition

1. A set of random variable (set of event)
2. ~~Must have~~ It must be a directed graph (direction indicate parent and child)



3. Not have cycle.
4. It ~~expects~~ express with conditional probability.

P(A1 / Bi)

1) P(F) = 0.1

P(F) = 0.1 F = Flu

C = cough

P(C|F) = 0.8

P(C|¬F) = 0.3

$P(\neg a) = 1 - P(a)$

$P(P) = 0.1 \quad P(\neg P) = 0.9$

$P(C|F) = 80$

$P(\neg C|F) = 20$

a)

F	C	
T	T	$0.1 \times 0.8 = 0.08$
T	F	$0.1 \times 0.2 = 0.02$
F	T	$0.9 \times 0.3 = 0.27$
F	F	$0.9 \times 0.7 = 0.63$

—o—

15.07.18.

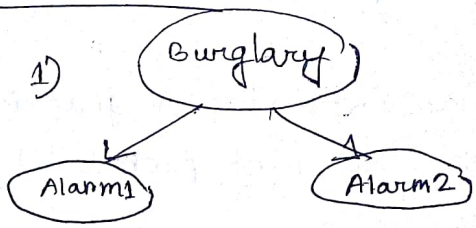
Bayesian Network

$P(Burglary)$

$P(alarm1 \mid Burglary)$

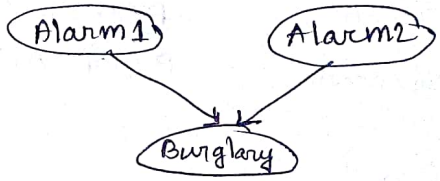
$P(alarm2 \mid Burglary)$

1)



a	b	c
F	F	F
F	F	T
F	T	F

2)



$P(alarm1) = 0.1$

$P(alarm2) = 0.2$

$P(Burglary \mid Alarm1 . Alarm2) = 0.8$

$P(\quad " \quad \mid " \quad . \neg \quad " \quad 2) = 0.7$

$P(Alarm2 \mid Buglary \wedge Alarm1) = P(Alarm1 \wedge Alarm2 \wedge Burlary)$

$P(Alarm1 \wedge Alarm2 \wedge Buglary) = P(Buglary \wedge Alarm1) -$

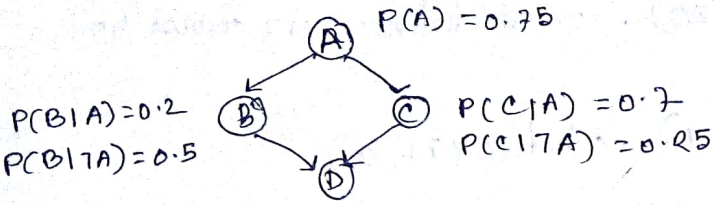
$P(Alarm2 / Buglary \wedge Alarm1)$

$P(B, A) = P(B/A) P(A)$

Conditional Probability : $P(A,B) = P(A/B)\,P(B)$
$= P(B/A)\,P(A)$

$P(A,B,C) = P(A,B) - P(C/A \wedge B)$

$\therefore P(C/A,B) = \frac{P(A \wedge B \wedge C)}{P(A)\cdot P(B)\,P(C)} - P(A,B)$



$P(D \mid B \wedge C) = 0.5$
$P(D \mid B \wedge \neg C) = 0.25$
$P(D \mid \neg B \wedge C) = 0.1$
$P(D \mid \neg B \wedge \neg C) = 0.35$

$P(D \mid A) = ?$

AI (LAB)

14.07.18.

Facts :- Obj এর properties declare করে / দুইটা obj এর relation

pen (yellow).
↑ functor / fact name ↑ properties.

>> pen (X).. = yellow
>> pen (yellow) = true
>> pen (green) = false.

facts → predicate.
rules → cross.

lectures (X, Y) : person X lectures in course Y

, → AND (এবং)
; → OR (অথবা)

>> Lectures (X, 05), lectures (Y, 06). দুইটা true = true

and

value fix? fno

>> " (X, C) , " (Y, C)

name courseno unknown

lectures (turing, 9020)

studies (fred, 9020). কোন student কোন course পড়ে।

>> lectures (codd, C), studies (N, C).

Variable → Capital letter

" → '_' underscore দিতে।

; → next line.

Conjunction , and

Disjunction ; or

Rules :- indirectly recursion

function name

head ← teacher (X, Y) :- neck

formal parameter →

X, Y is teacher & Fred

lectures (X, C), studies (Y, C)

more_advanced (S1, S2) :-

year (S1, Year1)

" (S2, " 2)

Year1 > Year2

?- trace ;

true. more advanced (henry, fred).

[6] [] a[10]

[1,6,9] — [] (tail)

List :- array ক list বলতে পারি। size নির্ধারণ নেই।

An ordered sequence of elements that can have any length. elements of list = constants, variables, structures

[1,6,9] প্রত্যেক list ও empty list থাকে।

head tail

[6] → head 6
tail []

[X|Y]
head → tail

[a, b, c] Head a Tail [b, c]

concat([], L, L). → dominative condition → prog প্রথম exit করবে,
concat([X|M], N, [X|Q]) :-
concat(M, N, Q).

concat([3, 1, 4], [7, 8], k).

k = [3, 1, 4, 7, 8].

[], L, L → List same = true

trace.
true
concat([2,1], [4,6], 0).
call(8) : ([2,1], [4,6], ...)?

18.07.18.

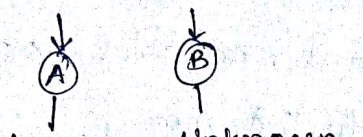
$P(a)$

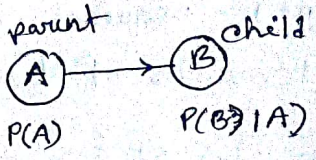
$P(\neg a) = 1 - P(A)$

$P(A)\,P(B) = P(AB)$

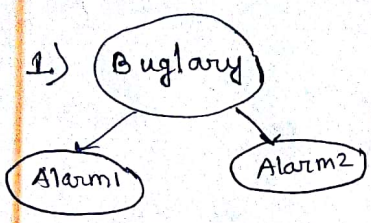
$\# P(A,B) = P(A,B,C) + P(A,B,\neg C)$

Conditional Probability : यदि बायस graph प्रकार represent करें, bayesian network.

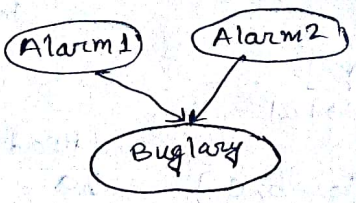




1)



2)



A, B $\quad P(A,B) = P(A/\overrightarrow{B}) \times P(B)$ ← known

$= P(B/A) \times P(A)$

$P(A,\overrightarrow{B,C}) = P(\overrightarrow{A}/B,C) \times P(B) \times P(C) = P(A|BC) = \frac{P(A,B,C)}{P(B) \times P(C)}$

↑ unknown

↓ unknown

$= P(B/A\,C) \times P(A) \times P(C)$

$= P(C/AB) \times P(A) \times P(B)$

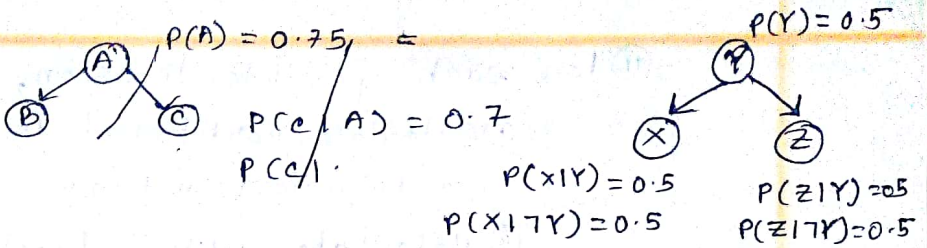
$P(\underset{A}{\text{Alarm2}} \mid \underset{B}{\text{Buglary}}, \underset{C}{\text{Alarm1}}) = \frac{P(\text{Alarm1}, \text{Alarm2}, \text{Buglary})}{P(\text{Buglary}) \times P(\text{Alarm1})}$ ①

$P(\text{Alarm 1}, \text{Alarm 2}, \text{Burglary}) = P(\text{Burglary}/\text{Alarm 1}, \text{Alarm 2}) \times P(\text{Alarm 1}) \times P(\text{Alarm 2})$.

$P(\text{Alarm 1}, \neg\text{Alarm 2}, \text{Burglary}) = P(\text{Burglary}/\neg\text{Alarm 2}, \text{Alarm 1}) \times P(\text{Alarm 1}) \times P(\neg\text{Alarm 2})$

$P(\text{Burglary}, \text{Alarm 1}) = P(\text{Burglary}, \text{Alarm 1}, \text{Alarm 2}) + P(\text{Burglary}, \text{Alarm 1}, \neg\text{Alarm 2})$

"joint probability distribution"



$P(x) = P(x|y) \times P(Y) + P(x|\neg y) \times P(\neg y)$.

$P(z) = P(z|Y) \times P(y) + P(z|\neg y) \times P(\neg y)$.

$P(x, z) = (x, z, Y) + P(x, z, \neg y)$

$= P(x|Y) \times P(Y) \times P(z|Y) \times P(Y) + P(x|\neg y)\, P(\neg y) \times P(z|\neg y) \times P(\neg y)$.

AI

(i) Multiple event (Random variable)

(ii) Action (Decision)

(iii) Utility function

(i) Decision BN network

(ii) " Tree

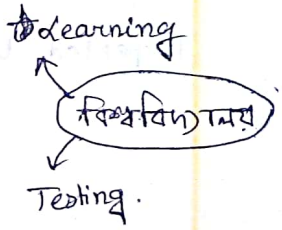
ANN

Support vector Machin.

LDA

HL

first



Utility Node :-

Evaluation the Decision network :

(i) Initial all random variable of Bayesian Network.

(ii) For each possible decesion,.

(i) Calculate Conditional Probability according to Bayesian network.

(ii) Calculate utility function for each possible decesion.

(iii) Return the Highest utility result decision.

Umbrella

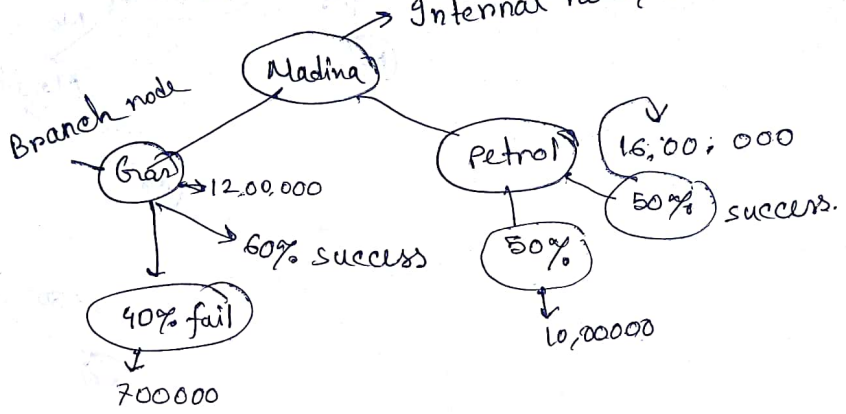
Expected Utility :

$$EU[A] = \sum_{i=1,\dots n}$$

25.07.18.

Decision Tree

Decision Tree is a one type of classification Method that takes input as a situation or attribute and returns a decision.



Petrol = 50% × 1600000 + 50% × 10,00000 = 13,00000.

Gas = 60% × 1200000 + 40% × 700000 = 10,50000.

(i) Internal node / Root node
(ii) Branch node
(iii) Leaf node (Decision point)

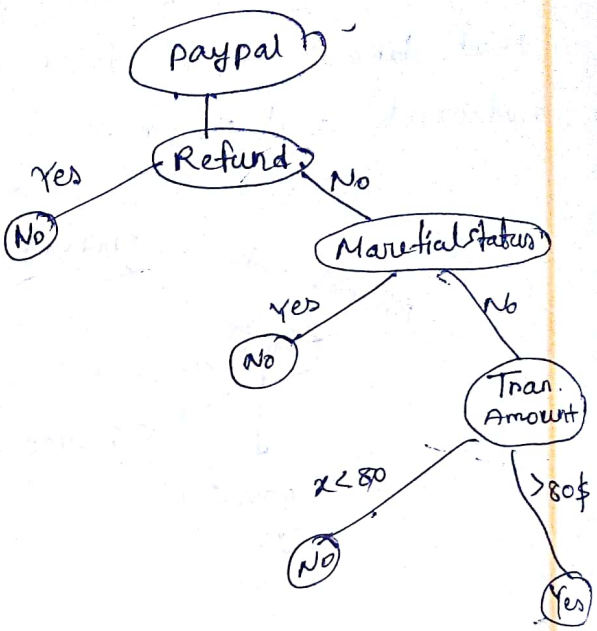
Data set

No	Refund	Marietial-status	Tx	Cheat
Amrita	No	Single / divorsed	780 $	Yes
Madina	No	Married	95 $	No
Shuvo	Yes	Married	100 $	No.

Cheat or not ?

class 1 class 2

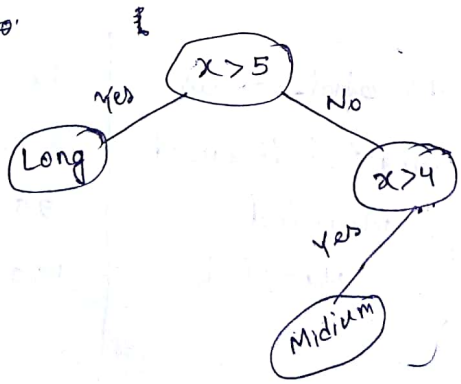
Yes No

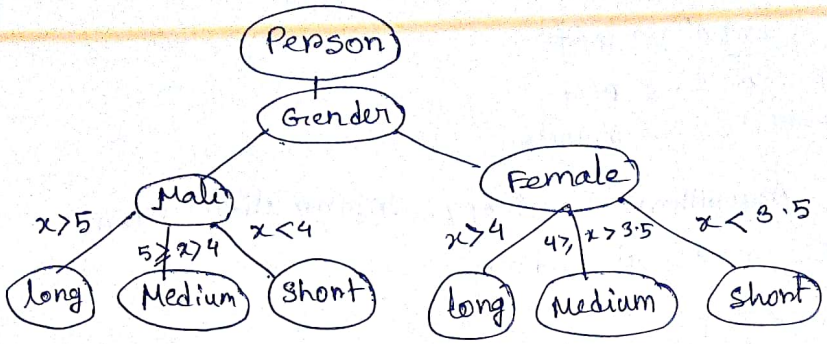


Long Short Medium

Male : $x > 5$ ft $x < 4$ ft $x \geq 4$ $x < 5$

Female : $x > 4$ ft $x < 3.5$ f $x > 3.5$ $x \leq 4$





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AI

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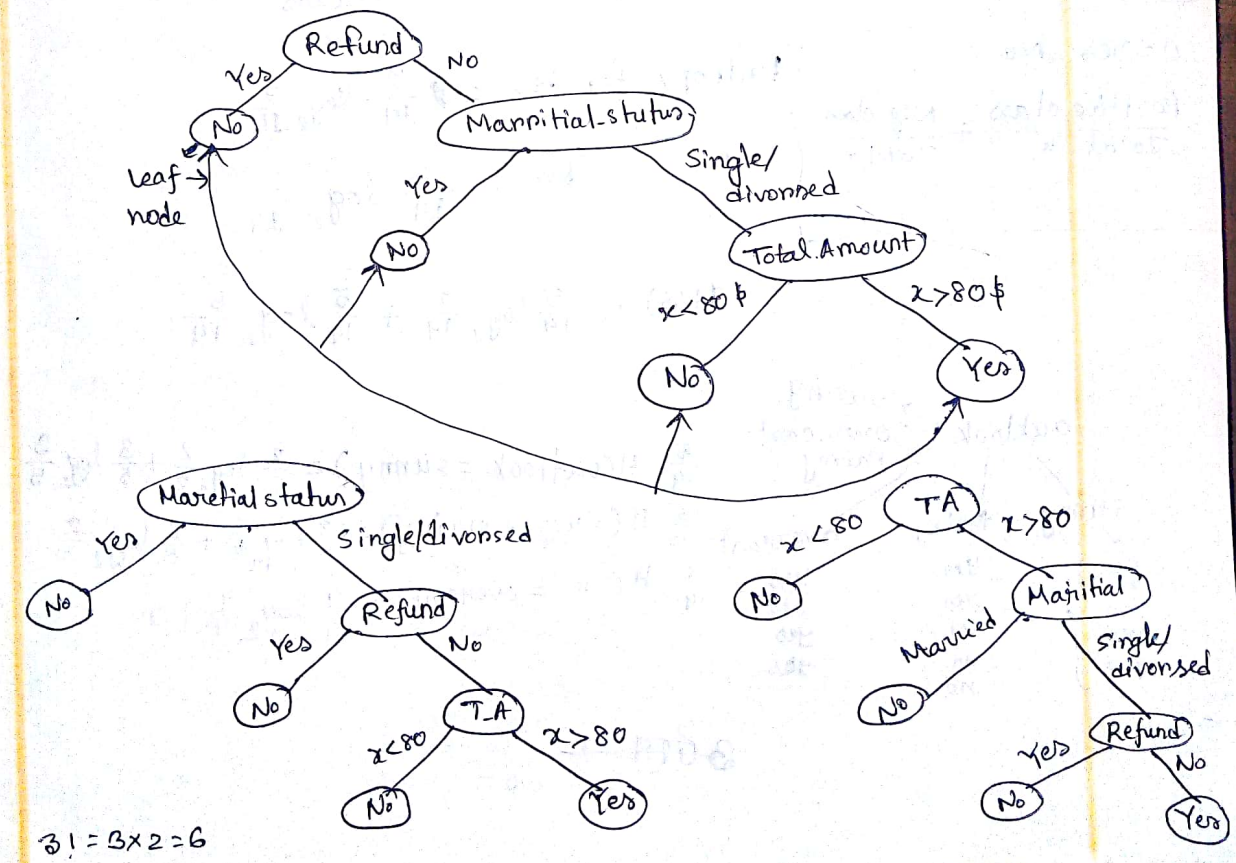
Refund	Marital Status	Total Amount	Decision
No	Yes	60	No
Yes	No	x>80 $	No
No	single	x>80 $	Yes



3! = 3×2=6

29.07.18.

Root node →
branch u → attribute.
leaf u → decision.

Refund · .234 → leaf
Marritial .946 → root
Total Amount .546 → branch

① ID3 Algorithm → Entropy, Information Gain
② CART u → Gini Index.

Huat u

Classification with using the ID3 algorithm:-

$$\text{Information Gain} = H(S) - \sum_{t \in T} P(t)H(t)$$

$$\text{Entropy } H(S) = \sum_{s \in S} P(c) \log_2 P(c)$$ ↳ class

C = Yes, No

$$\frac{\text{Positive class}}{\text{Total u}} + \frac{\text{Neg. class}}{\text{Total u}}$$

Entropy for Yes $= \frac{9}{14} \log_2 \frac{9}{14}$

u u No $= \frac{5}{14} \log_2 \frac{5}{14}$

$$H(S) = \frac{9}{14} \log_2 \frac{9}{14} + \frac{5}{14} \log_2 \frac{5}{14}.$$

outlook ↔ sunny, overcast, rainy

sunny	rainy	overcast
no	yes	yes
no	yes	yes
no	yes	yes
yes	no	yes
yes	no	yes

$\frac{5}{14}$ H(outlook = sunny) $= \frac{2}{5} \log_2 \frac{2}{5} + \frac{3}{5} \log_2 \frac{3}{5}$

$\frac{5}{14}$ H(u = rainy) $= \frac{3}{5} \log_2 \frac{3}{5} + \frac{2}{5} \log_2 \frac{2}{5}$

$\frac{4}{14}$ H(u = overcast) $= \frac{4}{4} \log_2 \frac{4}{4} + 0$

=0=

22.07.18

AI Lab

3টার মধ্যে 2টা

(_ , _) → ignore করবো।

go :- main function.

write → printf.
read → scanf.

% → comment

0 1A
A B

c = A+B

D ← B
E ← C

0 1 1 2 3 5
4 4

5

move(M, chr) :-

memory(string),
param(chr), int(n).

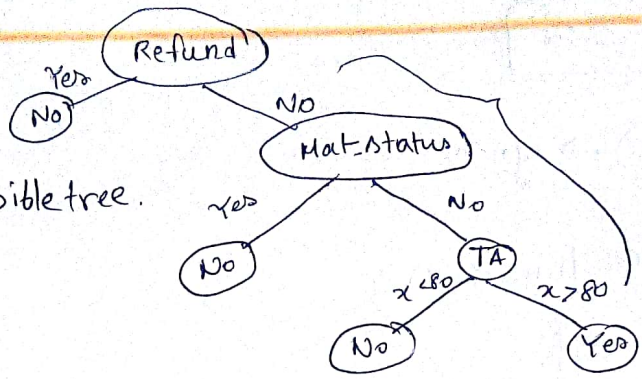
Sum Series :

5 – R

9 (6+3)

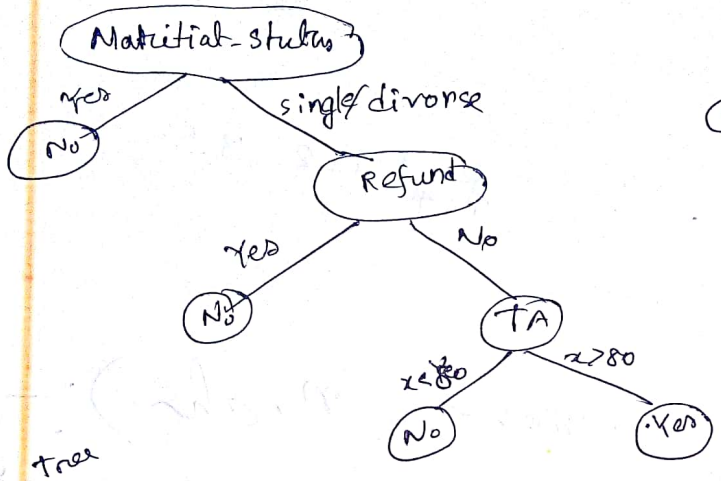
segment

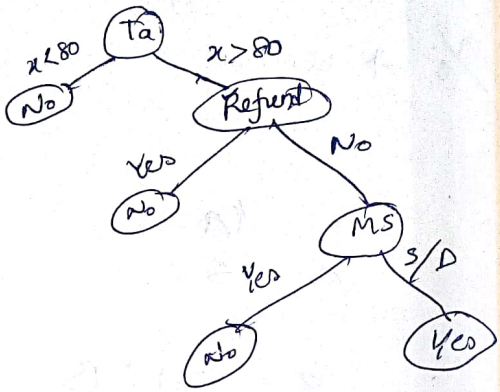
01.08.18.



attribute = 3

3! = 6 টি possible tree.





Decision tree

draw করার পদ্ধতি

(i) ID3 Algorithm : Information gain

(ii) ~~CART~~

(ii) CART ঃ
Gini index. (যার GI বেশি সে top এ যাবে)

(iv) C 4.5 ঃ
Gain Ratio

Algorithm :

$$P(t) = P\left(\frac{3}{n}\right) = \frac{4}{10}$$ (3 ← single; n ← total no of situation)

Input : 1. ID_3 :- Information Gain $\propto (A, D) = H(D) - E_A(D)$

$$= H(S) - \sum_{c \in C} P(c) H(c)$$

$$= H(S) - \sum_{t \in T} P(t) H(t)$$

↓ for attribute for entropy calculation

$$H(S) = -\cdot \sum_{c \in C} P(c) \log_2 P(c)$$

↑ for class

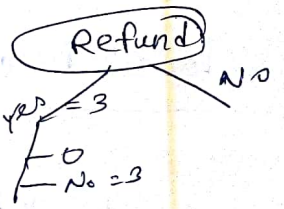
$$P(\text{Yes}) = \frac{3}{10} \log_2 \frac{3}{10}$$

$$P(\text{No}) = \frac{7}{10} \log_2 \frac{7}{10}$$

$$H(S) = \frac{3}{10} \log_2 \frac{3}{10} + \frac{7}{10} \log_2 \frac{7}{10} = 0.987$$

Refund :

$\propto$ (Refund) .



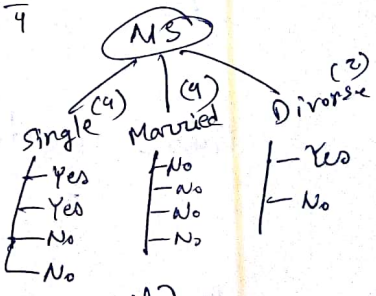
$$H(\text{Refund} = \text{Yes}) = \frac{3}{10} \log_2$$

$$H(\text{Marital status} = \text{single}) = \frac{2}{4} \log_2 \frac{2}{4} + \frac{2}{4} \log_2 \frac{2}{4}$$

$$H(\text{" } = \text{Divorced}) = \frac{1}{2} \log_2 \frac{1}{2} + \frac{1}{2} \log_2 \frac{1}{2}$$

$$H(\text{" } = \text{Married}) = 0 + \frac{4}{4} \log \frac{4}{4}$$

$$= 1 \log 1 .$$



$$\text{Information Gain} \propto (\text{Meritial-status}) = H(S) - \sum_{t \in T} P(t) H(t)$$

$$= \frac{10}{10} \log_2 0.987 - \left[\frac{4}{10} \times \left(\frac{2}{4} \log_2 \frac{2}{4} + \frac{2}{4} \log_2 \frac{2}{4}\right) + \frac{2}{10} \times \left[\frac{1}{2} \log_2 \frac{1}{2} + \frac{1}{2} \log_2 \frac{1}{2}\right) + \frac{4}{10} \times (1 \log 1)\right]$$

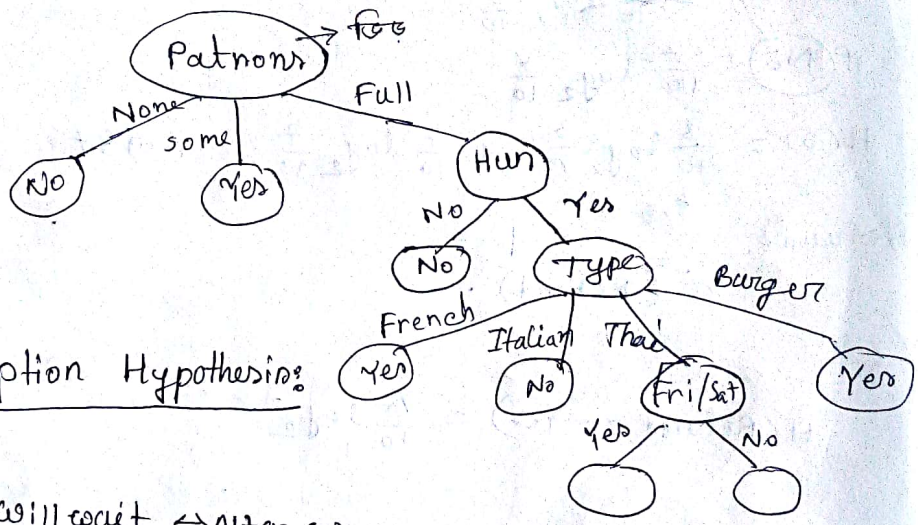
(- +) False Negative
a Positive

Attribute	Information Grain
Marital-sta	0.437
Refund	0.768
Total	0.034

① Refund
② Marital-status
③ Total Amount.

29.08.18.

Hungry ≡ Hun



Logical Description Hypothesis:

H1 : ∀x will wait ⇔ Alter(x)

H2 : ∀x will wait ⇔ Alter(x) . Negative, Positive False Positive

False negative : Predict it should be negative but it is infact positive

(- -, - +)

u positive :

(+ +, − +)

(i) False Negative . ~~Generalization~~
Generalization / include
(ii) " Positive
specification / exclude

H1 : $\forall x$ willwait $\Leftrightarrow$ Alter(x) Positive (1)

H2 : $\forall x$ willwait $\Leftrightarrow$ Alter(x) $\wedge$ Patrons(x, some) x_1 = Yes, x_2 = No (0)

$\forall x$ willwait $\Leftrightarrow$ Alter(x) $\wedge$ Est(30-40) $\wedge \neg$ Bar(x)) x_3 = No, Yes, False Posi

=0=

NLP (Natural Language Processing)

Input : human language. 12.09.18.

→ SVO

Structure ভিত্তিক

(i) English } I eat rice (S V O)
(ii) Arabic } O V S
(iii) Hindi } S O V

আমি ভাত খাই (S O V)

أكل الرز انا (O V S)

"NLP is the process of computer analysis of input provided in a human language (natural language), and conversion of this input into a useful form of representation."

Steps of NLP :

- Phonology → sound শুনতে পাই
- Morphology → একটা word এর অনেক meaning থাকবে,
- Syntax → কয়েকটা word মিলে syntax
- Semantics → word এর অনেকগুলো
- Pragmatics → ~~basic~~ উচ্চারিতের জন্য ইংরেজ থেকে → কাজের আনিতাদের সাথে একরকম ভাবে আমাদের ভাবে নিতেদের।
- Discourse → কথা শেষ হয়ে যাওয়া
- World knowledge →

13.09.18.

1. Genetic Algorithm :-

Gene → 0 1

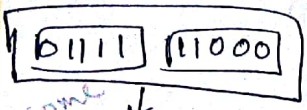
Chromosome . 01111 → অনেকগুলো gene একত্র করে chromosome.

Three steps

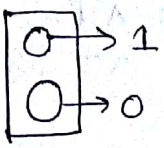
① Selection

② Cross over.

③ Mutation.

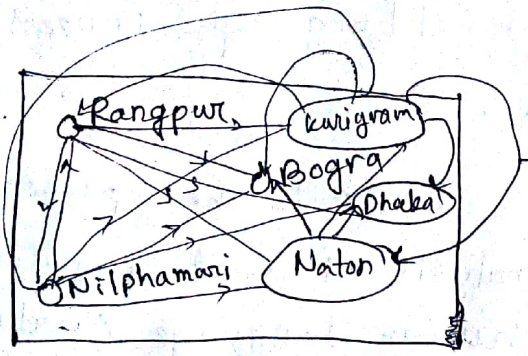


(chromosome এর সংখ্যা) → Population



x	y	z
1	0	1

101



→ edge গুলোকে বলব gene.

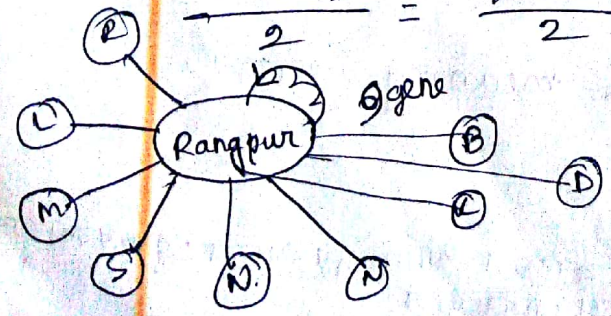
R - 5
N - 5
K - 5
B - 5
N - 5
D - 5

$n(n-1) = 30$ path / $\frac{30}{2}$ gene.

R → Nil
Nil → R
} ২টা রাস্তার দরকার নাই।

Important

$$\frac{n(n-1)}{2} = \frac{10 \times 9}{2} = 45$$



111111111 → chromosome

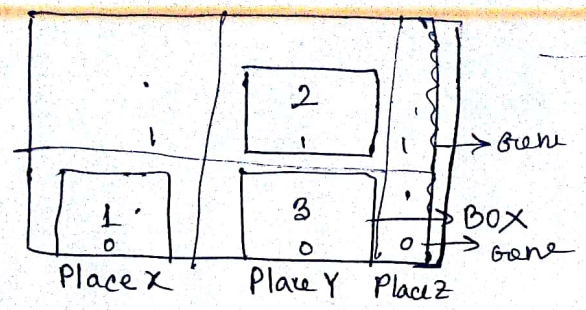
· graph → $n(n-1)$ total path.

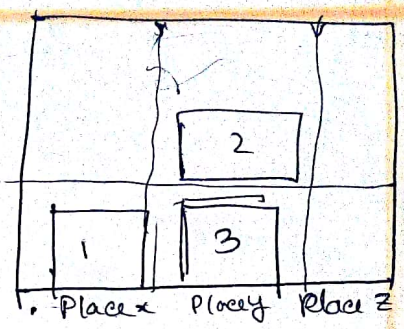
· Genetic → $\frac{n(n-1)}{2} = 45$.

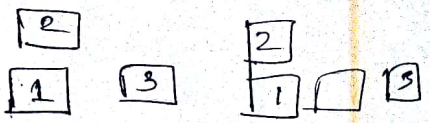
$4! = 24$

$3! = 6$

$3 \times 2 \times 1 = 6$

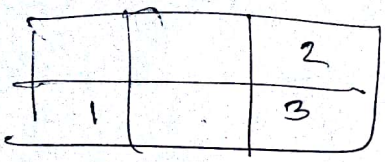


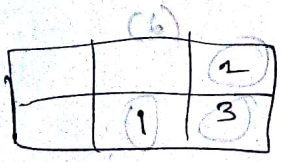




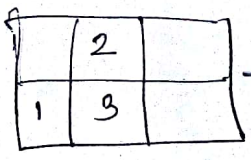
010 chromosome

$3 \times 6 = 18$ gene.

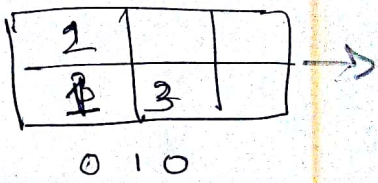




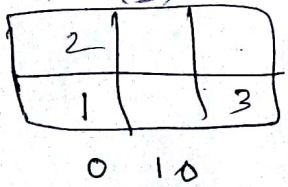
(1)



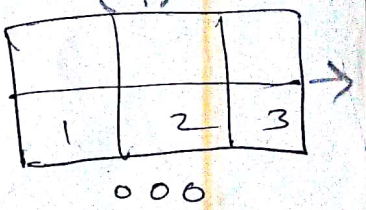
(2)



(3)



(4)



— o —

15.09.18

$a \to b$

$\neg a \vee b$

$a \wedge \neg b$

~~$\neg(\neg a \vee b)$~~ $\neg(\neg a \vee \neg(\neg b))$

$\neg(\neg a \vee b)$

$\neg(a \to b)$

$P \to (Q \to R)$

$\neg(Q \to R)$

$\therefore \neg P$

$Q \wedge \neg R$

$\neg(\neg Q \vee R)$

$\neg(Q \to R)$