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SAVITRIBAI PHULE PUNE UNIVERSITY

Seat No T19035201
Stk. No 2539471
Sub. AI
Centre 4035

310253-AI



Sem:5 7031966

Examination End Sem - May - Jun
Day & Date Thursday 6/7/23
Subject Artificial Intelligence
Paper No. 6003-537 Sec
Medium of Answer English

Seat No. : In figure & In words

19035201

One - Nine - Zero - Three

Five - Two - Zero - One

One

Signature of Candidate

Suresh

Signature of Supervisor

6/7/23

Instruction to Candidate

- Candidate has to confirm seat number, subject and centre number printed on Bar code and write it on attendance sheet.
विद्यार्थ्यांनी प्रथम बार कोडवरील आसन क्रमांक, विषय व केंद्र क्रमांक तपासून योग्य असल्याची खात्री करावी, आणि उपस्थित पत्रकावर नोंदवावी.
- Paste Bar Code in prescribed space.
उत्तरपत्रिकेवरील विहित जागेतच बार कोड लावावा.
- Do not write anything on bar code sticker, otherwise it will be treated as unfair means.
बार कोड स्टिकरवर काहीही लिहू नये, अन्यथा परीक्षा गैरप्रकार समजला जाईल.

Supplements attached

Main Answer Book	No. of Supplements	Total
1	+	0 = 1

Specific remarks of Centre conductor regarding malpractice (in Red ink)

Total	Marks in Figure	Marks in Words	Sign
Examiner	31	thirtyone	
Moderator	31	thirtyone	

Q. No.	Examiner		Moderator	
1				
2	0	9	0	9
3				
4	0	8	0	8
5				
6	0	5	0	5
7				
8	0	9	0	9
9				
10				
11				
12				
Total in Figure	0	31	0	31
Total in Words	thirtyone		thirtyone	
Signature				

१. विद्यार्थ्यानि उत्तरपत्रिकेच्या मुखपृष्ठावर तसेच पुरवणी उत्तरपत्रिकेवर आणि उपस्थिती पत्रकावर विहित जागेत आसन क्रमांक अंकात व अक्षरात बिनचूक लिहून स्वाक्षरी करावी.
२. उत्तरपत्रिकेवर फक्त निळ्या अथवा काळ्या शाईचा उपयोग करावा, अन्यथा उत्तरपत्रिकेचे मूल्यमापन केले जाणार नाही.
३. उत्तरपत्रिकेच्या पृष्ठक्रमांक ३ पासून लिहिण्यास प्रारंभ करावा.
४. संबंधित प्रश्नाचे अथवा उपप्रश्नाचे उत्तर जेथून सुरू होते तेथेच समासात प्रश्न क्रमांक, उपप्रश्न क्रमांक अचूक व स्पष्ट लिहावा, यासाठी वेगळ्या शाईचा उपयोग करू नये.
५. प्रत्येक पानाच्या दोन्ही बाजूस लिहावे, उत्तरपत्रिका किंवा पुरवणी उत्तरपत्रिकेचे कोणतेही पान फाडू नये. फाडल्यास परीक्षा गैरप्रकार समजून पुढील कार्यवाही करण्यात येईल.
६. पेपर संपण्यापूर्वी १० मिनिटे अगोदर इशारा घंटा होईल, त्यानंतर विद्यार्थ्याने उत्तरपत्रिका व पुरवणी उत्तरपत्रिकेवर होलोक्राफ्ट स्टिकर विहित जागेवरच लावावा.

Candidate shall fill all information about seat number, paper etc. in prescribed space and sign on the answer book and attendance sheet.

Candidate shall use blue or black ink only. Otherwise answer book will not be evaluated.

Candidate shall start writing answers from page no. 3 of the answer book.

Candidate shall mention question number, sub question number correctly at the beginning of the same and shall not use ink other than blue or black.

Candidate shall write on both sides of pages. Shall not tear off any page, it will be treated as unfair means.

Warning bell will be given before 10 minutes of the concluding time. Candidate shall paste Hollocraft sticker at appropriate space on the answer book and supplements.

Examiner and Moderator has to write marks on all given appropriate places only. Examiner should give assessment tick (✓) or (x) in the margin.

Q. No.	Examiner	Moderator	Verification	Revaluation
1		✓		
2	09	09		
3		✓		
4	08	08		
5		✓		
6	05	05		
7		✓		
8	09	09		
9				
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11				
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Total	31	31		



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प्र. क्र./Q. No.

2

9. ① Alpha-Beta pruning is the extended version of minimax algorithm.

ii. It has two types of node selection for each level. One is max node and other is min node.

iii. In alpha-beta tree search less number of nodes are explored for getting the path of the tree search.

iv. For minimax algorithm ::

Time Complexity: $O(b^d)$

b : branching factor

d : depth of the search tree.

v. For α - β pruning:

Time Complexity: $O(b^{d/2})$

For two branches, one is pruned so it gets divided.

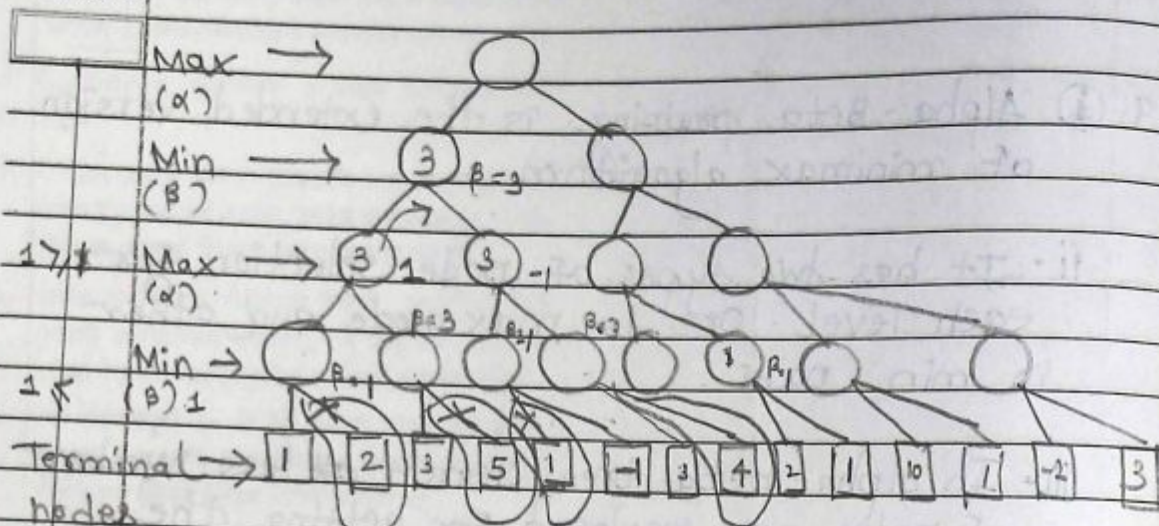
vi. This α - β pruning search is better than minimax due to less no. of branches are visited and therefore it takes less amount of time.



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vii. In α - β pruning,

1. Top most node is max node (α)
2. Next level node is min node (β)

and so on.

viii. While considering terminal node, upper level node is min node so minimum value is considered.

ix. Other part is pruned as there no use to explore as we got minimum node.

x. Likewise, we will consider α and β value for each level, if the value for

$$\alpha = 3$$

Exploration only if other branch terminal



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nodes have value

 $\alpha > \text{node terminal / value node}$

otherwise pruin it.

xi. similarly for β

Explore only if

 $\text{value / } \beta \text{ terminal node} \leq \beta$

Otherwise pruin it.

2 b. i. Constraints are the set of rules in the game theory for satisfying some conditions.

ii. For deterministic games, we require some constraints to play game and find solution.

iii. Constraints are important for playing a game with some strategy to win.

iv. In Artificial Intelligence, Constraints are used in various types of problems like graph-coloring problem, tic-tac-toe game, knapsack problem, n-queen problem.



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v. There are various types of constraints depending upon the problems, situation and conditions.

vi. There are major two types of constraints :

(1) Unary Constraints.

(2) Binary Constraints.

vii. Unary Constraints :

It has one ~~set~~ condition for solving any particular problem.

Example : Tic-Tac-Toe game

X	O	
O	X	
X	O	

Condition: No three variables will come in one line for opposition.

viii. Binary Constraints :

It has two condition for solving any particular problem.

Example : 2~~4~~ - Queen Problem

Condition: No two queens should be present in single row, or column or diagonally.



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- 2 c. i. Game Search algorithms are minimax type of algorithms.
- ii. In this type both player tries to find max move to win the game.
- iii. Conditions have limitation for solving or finding a solution.
- iv. Also time factor is limited in game search algorithms due to more conditions.
- v. Counter move have more probability to win the game if all solution space is explored.

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4.

a

Propositional Logic

First-Order Logic

i. It consists of facts and rules.

1. It consists of Function, relation and objects.

- ii. It has simple syntax defined in logical order.

ii. It has simple syntax with additional grammar variables.

- iii. It is a type of boolean logic, which is either true or false.

iii. It is a type of predicate logic, based on relation of natural language.

iv. Operations are:

Logical operations

Anding (A)

oring (v)

Disjunction (\vee)

Negation (7)

Implication (\Rightarrow)

iv. Operations are:

Complex operations

logical operations +
conditions.

V. It is the core of all logic.

4. It is present at outer of propositional logic due to extra operations.

Preposition logic

FOL

Proposition logic

04



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Inference Rules for First Order Logic are as below:

e.g. Ram is boy and he is clever.

Connective \Rightarrow and (\wedge)

~~$\forall R(\text{boy}) \wedge R(\text{clever})$~~

$\forall R(\text{boy}) \wedge R(\text{Clever})$

Inference Rules:

Conjunction : $A \wedge B$

Disjunction : $A \vee B$

Negation : $\neg A$ or $\neg A$

Implication : $A \Rightarrow B$

Double-Implication: $A \Leftrightarrow B$

Examples of above rules:

Conjunction: Raju is is clever and he is handsome

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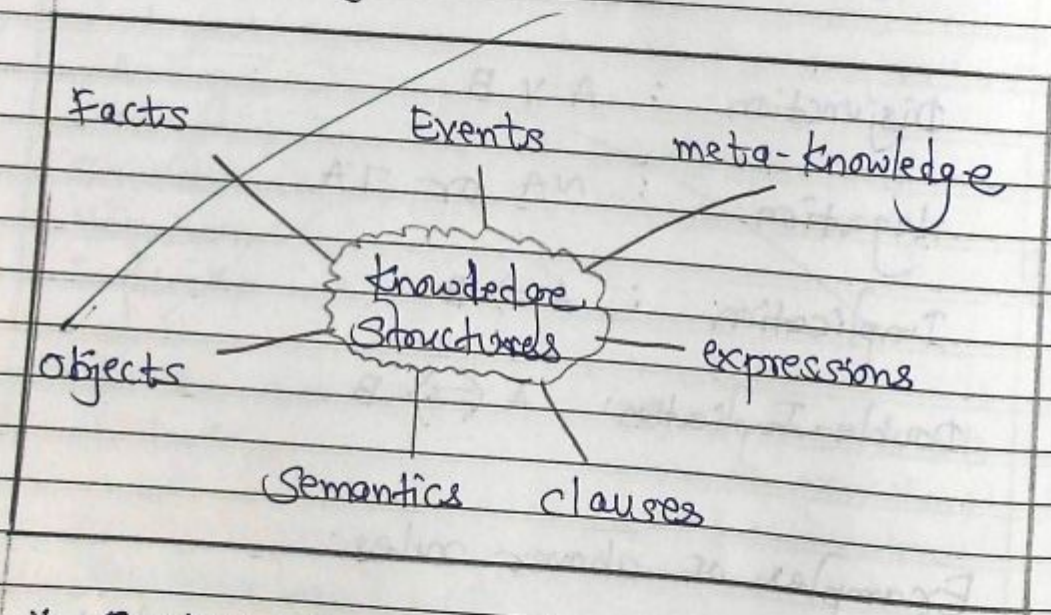
Disjunction: Pratik is on the ground or in the kitchen.

Negation: He is not tall.

Implication: It is raining so it is wet outside.

Double Implication: Karan is not fat and also he is not tall.

4. b i. Knowledge Representation Structures are as following diagram:



ii. Facts: There are logical expressions which has true or false value.

iii. Events: Set of rules for particular problem



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which governs the knowledge base

ix. Meta-knowledge: It is type of advanced knowledge which contains detailed information of problem statement.

x. Expressions: These are conditions/parameters which contains variables to elaborate a sentence.

xi. Clauses: Clauses have connectives to connect two functions.

$$F_1: A \wedge B \wedge C$$

$$F_2: A \vee B$$

It gives true or false results.

We require clauses in hard satisfiability problems.

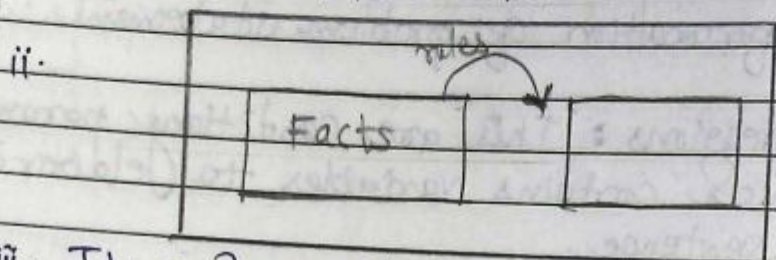
xii. Semantics: These are real-world entities which acts according to conditions.

xiii. Objects: These are entities which act according to a function they are defined for.

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6

i. Forward Chaining is the process which works on BFS order.

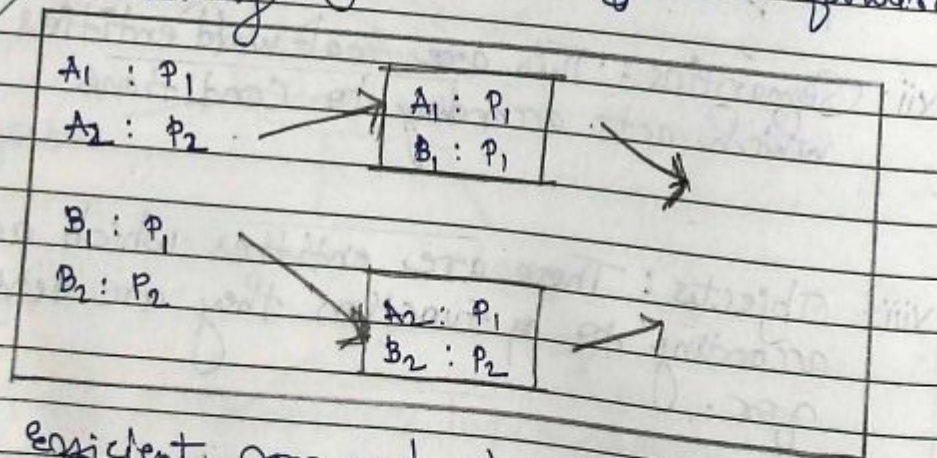


iii. It explores the tree in top down order.

iv. Data structure can be used is Queue for enqueue and dequeue operations.

v. Goals are processed in linear order.

vi. In knowledge base, we extract facts from the knowledge data base and perform operation using rules and move forward recursively.



vii. Efficient forward chaining has additional rules and strategy to implement moving forward



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6

b (1) Reasoning pattern in propositional logic

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c. Categories : i. Objects are divided into several categories according to requirements.

ii. As objects are categorized to various categories it becomes easy to sort them.

iii. Objects are called well-organized if they are categorized.



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iv. Knowledge Representation becomes easy if objects are classified in various domains.

Objects : i. This are entities of large set of domains.

ii. This describes the data more clearly.

iii. Objects are labelled data in dataset.



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7

Q. ① Planning Approaches are Strategic to implement and follows regular disciplines.

② It is necessary to implement any specific problem ~~due to~~ in correct order to get desired results.

③ Goals are planned according to get executed in strategic manner.

④ Various Planning approaches strategy is as follows:

i. Limitation and domain selection:

¶ This is initial phase of planning, we consider limitation and move ahead.

ii. Problem solving:

Problem needs to be addressed in appropriate order.

iii. Execution:

Goals are set and executed according to strategy planned.



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Various planners are as follows:

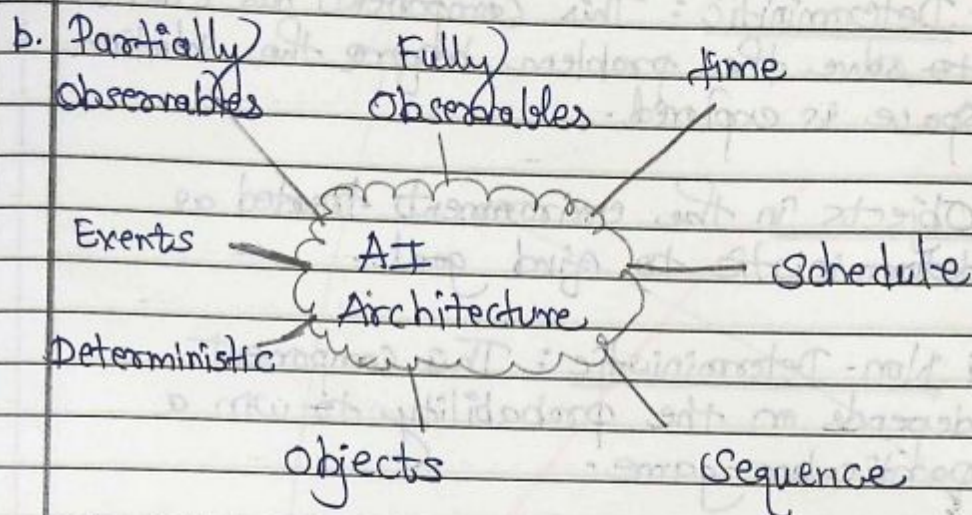
- ① Partial Ordered Planner: Dividing the task and executing.
- ② Fully ordered Planner: Executing whole task in linear order.
- ③ Sequence Planner: Executing goals in one after other in step-wise manner.
- ④ Timely ordered Planner: Timely executing tasks assigned in interval of time.
- ⑤ Hierarchical Planner: Assigning the task on importance and executing it.
- ⑥ Scheduled Planner: Scheduling activities and executing.
- ⑦ Evaluated Planner: Evaluating the goal and the executing.
- ⑧ Goal Stack Planner: Making a stack of goals and the moving ahead.
- ⑨ Intelligent Planner: Strategic and perfect planner with all the essential components to execute the goals.



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8



- i. Partially Observables: These are the components present in AI Architecture for external environment.
- ii. Fully Observables: These components are detailed description of objects in the environment.
- iii. Time: This is a crucial component for limiting time to a certain extent.
- iv. Schedule: Activities need to be scheduled before they are executed in the environment.
- v. Sequence: Also activities need to be arranged sequentially to achieve the goal.
- vi. Objects: This entity is used to access according to function in systems or environment.



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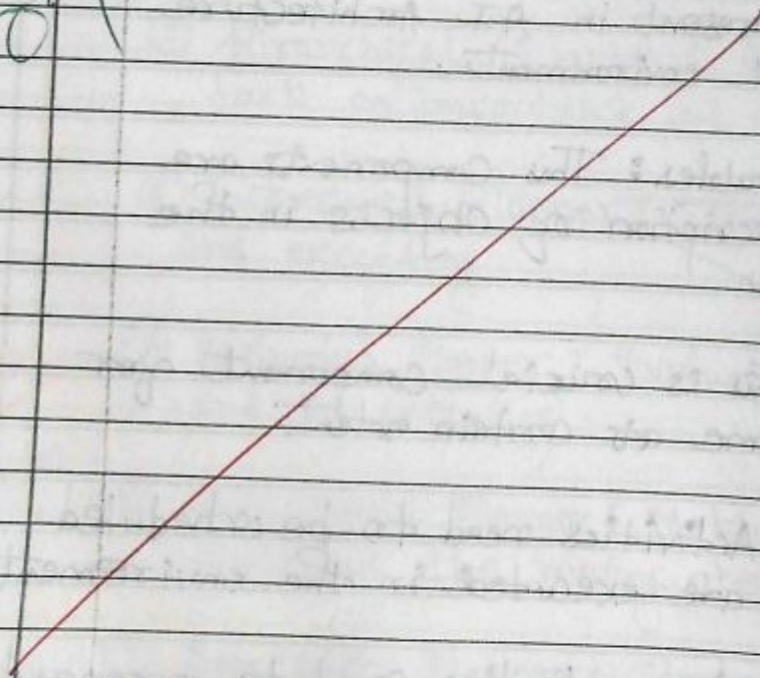
vii. Deterministic: This component has changes to solve the problem before the solution space is explored.

Objects in the environment treated as deterministic to find goal.

viii. Non-Deterministic: This component depends on the probability to win a particular game.

04

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University

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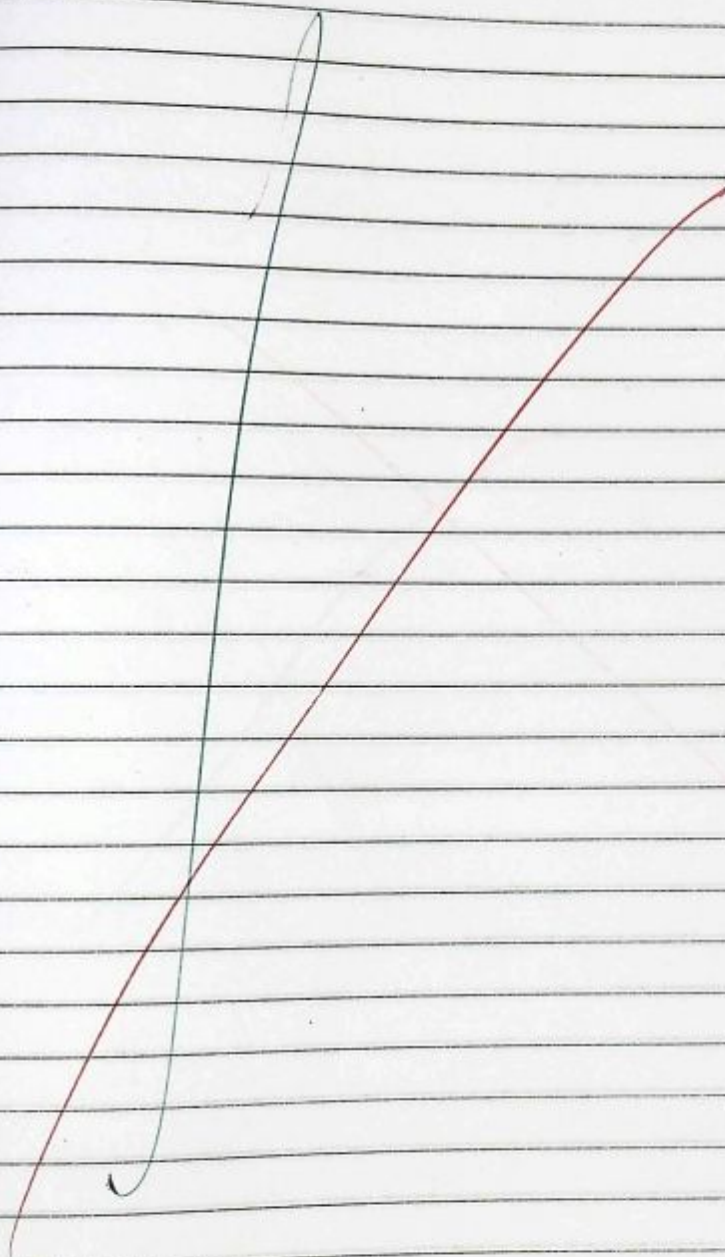
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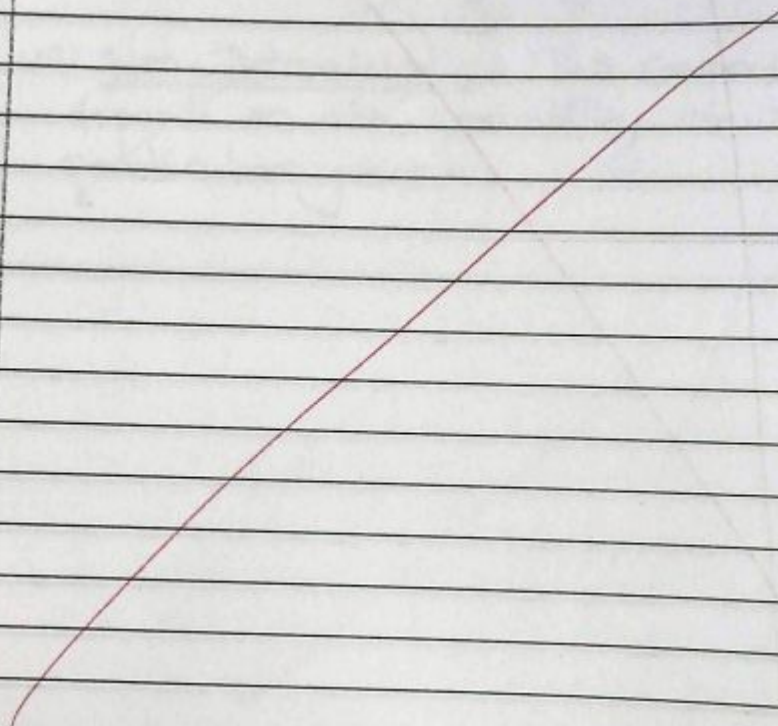


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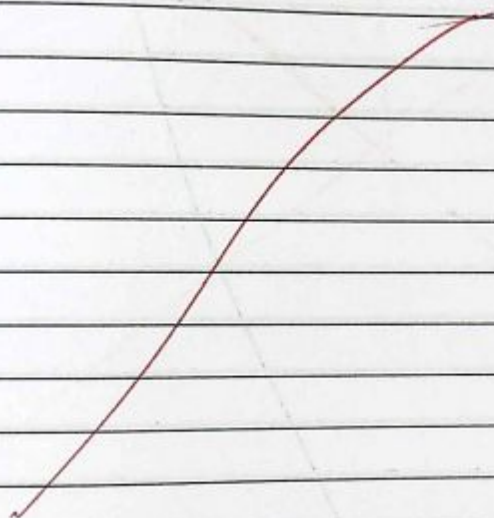
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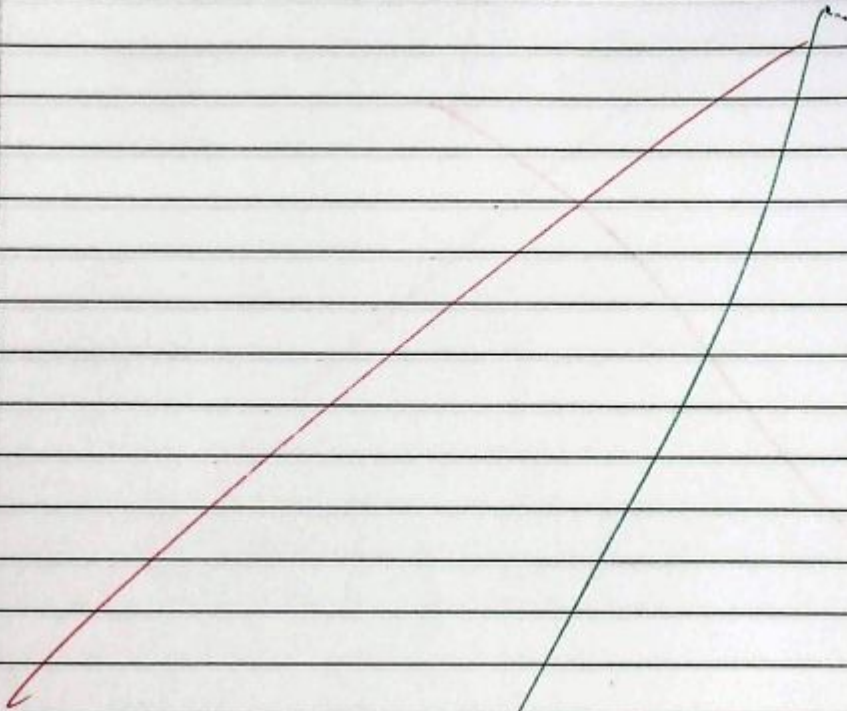




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