

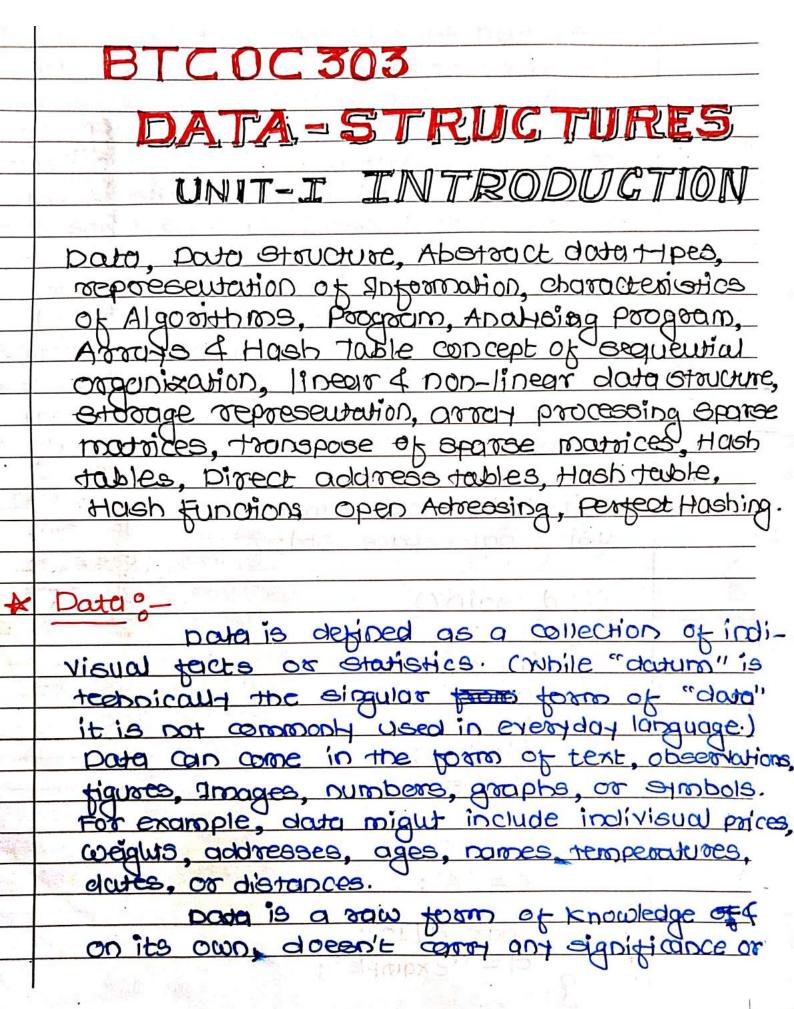
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at MET Bhujbal Knowledege City

Data Structures Department

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	purpose DOMMIN ORDER ON BROKTSAMS TOU DONE to inter-
	pret date for it to have meaning. Data
	can be simple and may even seen use-
	Icas until it analysed, organised, & Interpore-
	ted.
L	
*	Data THPES:-
	A data type is the most basic and i
	the most common classification of day.
	Ut is this through which the compiler
-	gets to know the poor or the type of
5.167	gets to know the poor or the type of - information that will be used throughout -
	the code. So basically, data type is at the
0	of intomation transmithed between the
192	programmer and the compiler above
10	the programmer informe the compiler -
30	about at the of date is to be stored -
14	and also tells how much space it requi-
12	The memory. Some basic examples -
	are int, Stoing etc. It is the the of and
15-5-5	variable used in the code.
Hitty.	the second state and the second s
14 3	# include <iostream.h></iostream.h>
100 mg	Using namespace std;
C NUTTER	9
1.000	Void main()
the start	
TAL VI-	int q;
75AS	Q=5;
Hadden -	
	float b;
AN CO	b = 5.0;
BED ES	Ohan a
· · · · · · · · · · · · · · · · · · ·	Char C;
	c = cA';
等約1%	chox d lint.
	char d[10]; d= "example";
Sec. ala	? - Enginple;

1	AS SERVINILOAPER AROM HAVE - EXAMS pitcined above we
	and the KROW that in the above on in the
	Valorable 4 15 of data type inter an which
	19 depoted of int 9. So the works in is a in
	be used us an integer type violate the
	the bonceases of the map. And in the
Tix	and the variables b. C' and d' are al tras
	Float, character and stong the perivery And
Q†	all these are kinds of data types.
	Hob to consult of the classical of the data
	and paisanopar to have a at the mount
*	Data Structure :- 10 and di ecuri
	10 with the property of the internation
$\neg \pi$	-> Data Stoucture is a representation of the
	logical relationship existing between individual
	elements of data han and in the
	-> para structure is a way of organizing all data
• 11	items that considers not only the elements
	stored but also their relationship to each other.
98	-> We an also define data structure às a moth-
	matical or logical model of a particular orga-
1	nization of data items.
121-11	-> The representation of particular data structure
	in the main memory of a computer is called
	-> The storage structure.
1	The storage stoucture representation in auxiliary
25	memory is called as file structure.
	-> 112 Lis defined as the and of storing and
A AN	it can be used efficiently.
	-> para structure mainty specifies the following
	four things:-
7. C	- Otogonization of Data.
6.	- Accessing Methods.
A STATE	- Degree of Associativity.
C. Carolina	- processing alternatives for information.
	-> Algorithme + para stougure = program.

> poto stoucture study overs the following points:-- Amount of memory requires to store. - Amount of time requires to process. - Representation of data in memory. - Operations performed on that data. A data structure is a collection of different tomes and different types of data that has a set of specific operations that an be performed. It is a collection of data tipes. It is a way of organizing the items in terms of memory, and also the way of accessing each iton through come defined logic. some examples of data star-crutes are stack, queues, linked lists, binary trees and many more. Party skyching and a set of the place Data structures performs some special opetraversal. For example you have to store data for roany employees where each employee has his name, employee id and mobile number. So this kind of information data requires complex data mangament. which means it requires data structure so, duy stoucheres are one of the most in important aspect when implementing oding concepts in real-world applications. ·HUSIDINIA G

DOWNLOADER PROMOBATUREXANS .]n NOD-Paintive Primitive data dato GTOUCHURE Stanchare Float Chasocter Pointer Integer ADDOIS Lists Files inear NOD lingo lists Lists stack Graphs Course Trees figure: - classification of data standures. pare structures are normally classified into two autegories. 1. primitive Data Staucture. 2. Non-Pointive date stoucture. pata Types A pasticular kind of data item, as defined by the values it an take, the programming language used, or the operations that and be performed on it. pointive pate stoucture - Primitive day etouchure are basic stauctures and are directly operated upon by reachine instructions. Poinditive data structure have different represent tations on different consputers. Integers, floats, character of pointers are examples Of paintitive data stouctures.

- These down or per from Bate - Examplituble in most
programming languages as built in types.
-> Integers- It is a date type abich allows
an values without function part foraction
part. We ain use it for whole number.
-> Float: - It is a data type ablich use for
Blooing freictional numbers.
Der chargeter values.
- pointer: A variable that holds memory add
reas of another variable are called pointer.
Non-poimitive Data Type
- These are more cophisticated date stoucture.
- These are devived form potritive data Structure.
- The non-pointive data structure ephosize
on structuring of a group of homogeneous
or neterogeneous data items.
- Examples of DOD-Pairoitive data types are
Around List, and File etc.
- A Non-pairoitive data types is thather
divided into Linear and Non-Linear data
10 ADDING - OD ADDING COLLEGE MINY ON
->Arrays- an Array is fixed-sized sequence
collection of elements of the same data types.
- LISCO AN ORDERED EPT motoring visit
number of elements is called as lists.
FILC A KIP 15 COLLONHAR
teol information. It an be viewed as
various fields.

DOWNLOADED FROM BATU-EXAMS.in P8 11:21-00:60-00:80 - - the restrict Linear pata stouctures A data stoucture is easid to be linear, it its elements are connected in linear telephion by medine of logically or in sequence memory locations. These are two actes to represent a linear data staucture in memory. -> static memory allocation. -> Dynamic memory allocation. The possible operations on the linear data Staucture are: traversal, Insertion, Deletion, Searching, scotting and Merging. 10 06 00:51 F MA LUNG 1 al rande in miles the Colonies the ment

*	Abetract Data 7-1 pes :- (ADT)
3	provide tradent shift a date of the state
.10	- Abstadt Data the (ADT) is a type (or elabs) whose behaviour is defined by a bet of values and a set of operations:
	- The definition of ADT ONLY mentions what
	operations are to be performed but not
	how these operations will be implemented.
54 - S	10 23 35 MC 53 40 53 40
12	- It does not specify how data will be organized
	in memory and about algorithms will be used
	for implementing the operations. It is called
	" abstract" because it gives an implementation
69	independent view
	Heil off at plats od trapyans m
	- The process of Providing only essentials and
Lo:	hiding the details is known as abstraction.
-	i abža izvi adt it alajog doille, andion
	- tient setter
	- ADT ADT ADD SAINED SAINED DELCE:
1	Application Interface Public Private
	Programo Functions Functions
1	histor hap to the element of the polar
	Arroys Linked List
HI	Arrans Linked List
	Wender Mender Mender

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	- The user of data type does not need to
	Know how that date type is implemented
	MOT example we have been using Pormitive -
	values like int. Hoat char data types only -
	with the knowledge that these data thee -
	can operate and be performed on without
	any idea of how they are implemented.
	- So a user only needs to know what a
	data type can do, but not how it will be
	implemented. Think of ADT as a black
	box which hides the inner structure
2.0	and design of the data tipe. Now
10	we'll define three ADTS Damely List ADT.
Production and	Stack ADT, Queue ADT.
	List ADT - TOTA TO DOMINIUL ON
10.00	TREASTRES WERE TREASTRESSED
Musi	tou aneres appression of the second
a the second	10 20 30 40 50 60
1.55	- "It alcola uto analy hore any club
24 B	- The data is generally stored in key sequence in a list which bas a head
1.Billo	Bequence in a list which has a head
Tasal	structure consisting of count, pointers,
-	to compare the data in the list.
-	to compare the data in the list.
600	- The data node contains the pointers
achor	to a data structure and self-referential.
	pointer which points to the next node in
	the list.
	- The List APT functions is given below:-
11. Y 15	get () - returns an elements from the list
Care p 1 - 1	- the list APT functions is given below:- get() - Returns an elements from the list at any given position.
ha de	insert() - Insert an element at any position
	of the list.
Kontart	and the second for the second s
" kylinger	remove() - Remove the first occurance of any
ten sin n	element trong a part occurance of and
	element from a non-empty list.
	The second

L	remove At (DOWNLORDER BAFTLE EXAMENTENT at a specified		
+]	location from a non-empty list.		
Ĩ.	a fight of the state of the	11. 1	11 Acres 1
	replace () - Replac	e an	element at any position
2010	and the second s	other	element
	Bize() - Return	the n	umber of elements in the list.
	is Empty () - Return	true	if the list is empty, otherwise
	router.		
	a balleti a la c	14.	22 with 2
	is Full () - Return	toue it	the list is full, otherwise
	return t	alse.	0 -
-			- TOK MUSER OF
0		<i>[</i>	1 1 1 1 K - 19 and
2.	Stack ADT :-		
		50	OF LCL
	datuica ser non .	40	
(L)	HUD TO THE SHEET NOT	30	
		20	and alaber all a
		10	. Search Philip States and
	and at an and a birt of	Bound	an share ddil 🦷
			tation instead of data being
	Stored in each no	de, H	he pointer to data is stored.
1	ni provisia studiolla i		Pilldinger + -
1	- The program allo	cates	menoory for the data and
Sec. 1	address is pass	201 10	The Glack ADT.
192	- the head hode a	nd the	e data nodes are encapsubted
1			og functions an only see
A.13	the pointer to n		
et.			re also contains a pointer
	to top and count	E OF	number of entries arreatly
6 * 11 6	- wathin shock to thomas a standard		
ragino dollari sumuo all'y rinni. Y no			
	Push() - Insert an element at one end of the stock		
	Called top.		
	POP() - Remover and return the element at the top		
	of exack, if it is not empty.		
		·Jord	I TORN -

	POURI ONDED EDON DAEU EVANO			
Hill No.	Peek() - Retyon the element at the top -			
·deil	of the stack without repoving it -			
	it the stack is not empty.			
pieleo.	FOR SUD TO BELLE ON BELLEVILLE OF CUL CON			
	Size () - Return number of elements in the Stop.			
att di	is Empty () - Return true if the stack is			
	empty, otherwise return false.			
a the st				
	is Full () - Return true if the stack is full,			
	Otherwise return false.			
- mextle	ANNELL STATE AND THE POST AND A STATE AND AND A			
	· 5 (12) · 7012397			
- ত	Queue ADT :-			
	10 20 30 40 50 60			
	- The queue abstract data type (ADT) follows			
	the basic design of the stock abstruct data type.			
-	Maid The.			
	- Each node contains a void pointers to the			
o nin	data and the link pointer to the next			
Bair	element in the quere. The popparin's			
	responsibility is to allocate memory for			
p pick	Storing the data will another will			
	The All of the state of the second for			
e inoxite	enqueue () - Insert on element at the end of the			
11- 110	and queue: I and a line and a line			
	dequeue() - Remove and return the first elero-			
lain p	ent of the queue, if the queue is			
90700 8	not empty.			
	peek () - Return the element of the queue without -			
	removing it, if the queue is not empty.			
Brail .	Size () - Returns the no. of elements in queue.			
	DEMPLY () - HETUONS TOUE IN THE QUELE IS EMPLY			
9d1 tr	Otherwise Jeturn balso			
•	19 Full () - Return true it the queue is Full otherwise -			
	is Full () - Return true it the queue is Full, otherwise -			

*	Features of ADT FROM BATU-EXAMS.in
1	a star in the start for all the start and all and the start
• +1	-> Abstract data types (ADT) are a way of encaped-
a	lating data and operations on that data into a single unit. Some of the key features of ADTs
	a single unit. some of the key features of ADTs
•1*	ipqude:
11	the of motor anticological but publications
	- Abstraction - the user does not need to
	know the implementation of the data structure
	only essentials are provided.
ste	- de sterre a polonia (a la Cata angla nagla)
6	- Better Conceptualization - ADT gives us a better
	conceptualization of the real world.
	0
	- Robust - The poppoint is vobust and has the ability
	to catch errors.
	TA ALLAND ALLAND ATCA ACCOUNT IN CONTRACT
	- Encapsulation - ADTS hide the internal details of
stil.	the date and provide a public interface for
2	users to interact with the date. This allows
1	for edicier maintendance & madification of the
3.11	dara etsucrute
1-	indiana anidui , eiletata antenara anda a
	- Data Abstraction - ADTs provide a level of abstra-
$\langle \mathcal{A} \rangle$	erion from the implementation details of the
	data. Users only need to know the operations
i.c	that can be performed on the close, not
5	how those operations are implemented.
	all stalled in the set state of the their states of the
	- Data Structure Independence - ADTs can be imple-
361	mented using different date structures, such
it;	as arrays or linked lists. Without alterning the
c.	functionality of the ADT.
	al contrational present the second contration of the second second
_	- Information Hiding - ADTS OID probert the inte-
_	gait of the data by allowing access only to
	gritt of the data by allowing access only to authorized users and operations. This helps
_	gritt of the data by allowing access only to authorized users and operations. This helps prevent errors 4 misuse of the data.

	DOWNLOADED FROM BATU-EXAMS.in
	- Modulgoity - ADTS can be combined with
	other ADTS to form larger, more complex
(1)	rotione roj ecollo eidri convurtes plub
1.1.1	Hexibility and modularity in programming.
1	all the set of a bounder of the
	Overall, APTS poovide a powerful tool for
	-unurte ai plata paitaluqian bap paizinopro
1.1	red and efficient manper?
nte.	plate my get haddening de ai sets on set
	Abstauce data types (ADTS) have several
	advantages and disciduantages that should
d p	be considered other deciding to use them
	in software development.
*	Advantuges of ADT :-
1	Contraction of the first of
	- En capsulation - ADTS provide a work to encop-
6.11 c	80 10th, BIATH ON ADOMAHOUD into a signal
121	UDIT. MOKIDA IT POLICIES to manage and mult
11-11	- INC GOUG BROUGH P.
	- Abstraction - ADTS allow users to work with
	- and cloudles without have
-	The second secon
4 11	
***** U	Muly Divertige todependence
212.7	emented using different data staugures,
	TALLE TO PORT AT A DE AL
0.1.101	needs and require ments.
15	+1/DOMAHOD Hidion Ant
72 ()	
1.1-	- Modularity - ADTS ON be malifications.
	- Modularity - ADTS can be combined with others
	ADTS to form more complex data structures,
SCD.	Which an increase texibility & modularity in
t le ·	programming. Fickibility & modularity in
1 8	APRIL AND A STATE AND AND AND A STATE AND
	A CARCENE THE THE THE THE ACCOUNTS AND A CARCENESS

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*	Disadvantages of ADT :-
	- <u>Overhead</u> - Implementing ADTs can add overhead in terms of memory and processing, which an affect performance.
	- <u>Complexity</u> - ADTs can be complex to implement, especially too large and complex data Stauctures.
• 1	- Learning Curve - Using ADTS orequires knowledge of their implementation and usage, which can take time and effort to learn.
	- Limited Flexibility - Some ADTS may be limited in their functionality or may not be evitable for all types of data structures.
-	- <u>Cost:</u> - Implementing ADTS may require additional resources and investment, which can increase
	the cost of development.
	100 11 100 ¹⁰
	- cate balance of the state of
	a de la companya de l

DOWNLOADED FROM BATU-EXAMS.in * What is an Algorithm ? had The wood Algorithm means "A eet of fibite rules or instructions to be followed in calculations or other problem Bolving operations " or Producutty involves rearraive operations.» Therefore, Algorithm referes to a sequence of tipite steps to solve a particular problem. Algorithm an be simple and amplex depending terri on about you want to achieve. escuburde blob . 1441 Set of rules to obtain the nput expected output output trong the given ipput Algorithm * characteristics of Algorithm:-- well-defined anputs. - Well - defined outputs. - clear and Unambiguous Finite-Bteps Language Andependent Feelsible.

	and in a thought and it will be the
and the	D well-defined Inputs - If an algorithm 60+3
• 60 • • 4	to take inputs, it should be well-defined inputs.
	It may or may not take inputs.
	2) Wey-defined outputs - The algorithm must clean
	W device about output will be relided and it
	Should be acel-defined as well. It should take
with	at least output of put of put of the
	@ Clear and Unambiguous - The algorithm should be
, di	clear and unambiguous. Each of its steps should
	be clear in all aspects and must lead to only
971	on one meaning and bain with and the
:(a	A Finiteness - the algorithm must be finite, i.e.
	in should tempinate after a finite time.
-	B Feasible - The algorithm must be simple, generic,
	and particul, such that it can be executed
0((1)	with the grailable recources. It must not
	Contain some tuture technology or antithing.
3	Elanguage Independent - The algorithm designed must be language - independent, i.e. it must be
+	must be language-indépendent, i.e. it must be
1144	inst plain. instauctions that can be implemented
4	in any language, and yet the output will be the
d ·	same as expected a
- 71 +	drig out pairles sliden beschieare 1
×	Properties of Algorithm:-
loc a	- It should terrininate after a finite time.
	- It should produce at least one output.
dt c	- It should take 3000 on more autout input.
	- It should be deterministic means giving the
dt .	Same output: for the sime input are.
•6	islaoug unt asidoa statut duue ensistrioung
1 1 4	

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	- Every step in the algorithm must be
	effective i.e. every step should do
	Some cootk.
4	Advantages of Algorithms:-
	- It is easy to understand.
	- An algorithm is Stop-wise representation
	of a solution to a given problem.
	- In Algorithm the problem is broken down
(X ⁴ (1))	into smaller pieces or steps hence,
i Lai	it is easier for the programmer to
	convert it into an actual program.
61. ¹ . 1. 1	and the and a day the bodga .
*	Diadvantare at Alconitions
	Disadvantages of Algorithm:-
	- Valation and all the later is
1.1.2.45	- Writing an algorithm takes a long time so it is time- concurning.
da a	BO IT IS AIDE- ODEURDING.
and and	- Understanding complex logic through algorithms an be very difficult.
11.21	algorithme an be very difficult.
· • •	
201 2211	difficult to show in Algorithms (imp).
·	
A	How to pesign an Algorithme
(
107 1	things are needed as a pre-requisite:
Per A.	things are needed as a pre-requisite.
8. (M	
Jenhu .	1. The problem - thet is to be solved by
(0, n)	this algorithm i.e. clear problem defini-
d Wit	HOD. U
	2. The constraints of the problem must be
	UDDIGESED CODILE POLICE the optime
	3. The input to be derken to eave the problem.
	4. The output to be expected when the problem.
	is solved.
1114	
Fil.	5. The Bolution to this problem, is within the given constraints.
(- AIVED CODOLOGUDE6.
•	Then the algorithm is written with the help of the
1	Parameters such that it solves the problem.

*	Example: - EXAMPLE TO add three
1.31.35	numbers and point the sum.
	the life it have all set
	Step 1: Fulfilling the poe-requisites
841	As discussed above, in order to write an
	algorithm, its pre-requisites must be pupilled.
	1. The problem that is to be solved by this
	algorithm: Add 3 numbers and print their
	eum. () autor auto
	2. The constraints of the problem that must
	be considered while solving the problem?
	The three numbers to be added.
	3. The input to be taken to solve the problems
	The three numbers to be added.
	4. The output to be expected when the pooblem
	is conved: The sum of the three numbers
-	taken as the input i.e. single integer value.
	5. The solution to this problem, in the given constraints; the solution consist of adding
	the 3 numbers. It an be done with the
	belp of '+' operator, or bit-wise, or any
1	other method.
	CARDER D. M. CENSE
	Step 2: Designing the algorithm
	Now let's design the algorithm with the help of
3	the above pore-orequities:
_	Algorithm to add 3 numbers and print their cum;
	J. START SAME SAME AND
	2. Declare 3 integer variables num1, num2, num3.
10	3. Take the three numbers, to be added, as inputs
	in variables numl, num2 num3 respectively.
25	4. peclase an integer variable sum to store the
	resultant sum of the 3 numbers.
18	5. Add the 3 numbers and store the result in
	time raviable eum.
	6. Print the value of the variable sum.
-	F. END.

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	Step3: testing the algorithm by implementing it
78 di	
	the order to test the algorithm, let's implements
	it in C#1/2 longuage.
	U U
an et	11 c program to add three numbers with the
1101 1	11 help of above designed algorithm.
ald	#include <stdio.b></stdio.b>
11 11	is the second of the second include
	int main ()
1907 -1	A cit is a set to white teason with the
\$ 613.31	// voriables to take the input of the 3 numbers.
	int numl, num2, num3;
del to	edt og in en
	"variable to store the resultant sum.
the ar	int sum; and that the fur
tions	LITTH ALL HT CODE AND Theadar of
11 +1:3	1/ Take the 3 numbers as input.
110 -	points ("Enter the 1st number :");
tit of	Scent ("%d", Em (num1);
di	point ("in", numi);
5.70	Scienced of the interview and the interview of the
×	pointy ("Enter the 2nd number:");
	Sant ("%d", & num2);
	$print \in ("10" num2)$
alad .	de ante composite de la tradition de la contra
	Pointf ("In Enter the 3 od number:");
3 75	Sount ("%d", 4 num3);
	point ("ID", DUM3); THURAN
antion .	Child I and
AL ALL	1/ colour the sum using + operator and
lavit	1 STORE IT IN VONABLE BUM.
300	SUM = DUM1 + DUM2 + DUM3;
	allestation of statist statistics
41116	Print the sum have have
	pointf ("In sum of the 3 numbers is; %d " sum);
	all - a Print all the all the all sole thing of the
	return O;
	9
	J

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170 A	
no	name in the head of a state of the state of a
S.	output :-
	Enter the 1st number: 5
1	and the second of the second
CIT.	Enter the 2nd number: 7
m	Learning on the and how some the threads
14	Enter the 3rd number: 3
1. A	A boy When it will and an ele enclored
1.	sum of the 3 numbers is: 15
1	mail plots and the apple of laisy timel
1	and anoth it water ban block thereaster a
*	How to analyze on Algorithm?
*	
5.55	For a standard algorithm to be good, it must be efficient. Hence the efficiency of an algorithm must be checked and maintained. It can be in
	ensignent. Hence the entriciency of an algorithm
170	must be checked and maintained. It can be in
	intwo stages in pair to material alto
	antimula national sali at sadiate
	1. point Analysis: - "point" means "before". Hence
12	Priori analysis means cheeking the algorithm
	before its implementation. In this, the aportition.
4.0	is checked when it is written in the form of
na-	theoretical steps. This efficiency of an algorithm
	is measured by assuming that all other factors,
2.0	Fix example processor speed, are wostent and
1	have no extent on the implementation. This is
	done usyally by the algorithm designer. This
	amplicia is independent of the type of morelugie
	and language of the compiler. It gives the appro-
pr.	xincate answers for the complexity of the program
-	Allogate answers qui the completion of the allogation

2. POSterior Annippersense BATTLE EXAMPLES " MEDIDE " Office".
Hence posterior analysis means checking
the algorithm after its implementation. That
the algorithm after its implementation. In this, the algorithm is checked by implementing it in
any programming language and execution it
any programming language and executing it. This analysis helps to get the actual and real
analysis report about correctness (for every
possible input/s if it shows returns correct
output or not), space required, time consumed
etc. That is, it is dependent on the language
of the compiler and the type of hard ware used.
What is Algorithm complexity and how to find it?
under of space and Time it approved limes
the complexity of an algorithm refers to the
the time the that it will made to
the poddy date and output. House there is
foctors define the efficiency of an algorithm.
The two factors of Algorithm Winplexity are;
U U U U U U U U U U U U U U U U U U U
• Time Factor - time is medicuted by coupting
the number of Key operations such as man
the number of Key operations such as counting and in the economic algorithm.
· Roman F
• Space Factor - Space is measured by counting
the maximum memory space required by counting the algorithm to the suplance required by
genning to suis execute.
theoregene, the complexity of an algorithm can be divided into two types:-
divided into two types:-
Carrier and the second and the
a stable conductor and an anna set and the last

1. Space Complexic The space complexity of an algorithm referes to the amount of memory required by the algorithm to store the variables and get the result. This can be for inputs, tempoordoy operations, or outputs. How to calculate Brace complexity? the space complexity of an algorithm is calculated · Fixed Part - this refers to the space that is definitely required by the algorithm. For example, input variables, output variables, program size etc. · Variable Part - This refers to the epace that can be different based on the implementation of the algorithm. For example, temporary variables, dynamic memory allocation, rearresion BACK Space, etc. Therefore Space Complexity S(P) of any algorithm P is S(P) = C + SP(1), where C is the fixed part and s(1) is the variable part of the algorithm, which depends on instance characteristic 7. ab lan 2. Time Complexity:the time complexity of an algorithm reference to algorithm to execute and get the result. This and be for normal operations, conditional if-else statements, loop statements, etc. How to calculate time complexity? the time complexity of an algorithm is also calculated by determining the 2 components;

	DOWNE ON DED. EDON. DAELL EVANO.
4	· Constant time part - Any instanction that
	is executed just once comes in this part.
c183	For example, input, output, if-else, switch.
in soft	orithmatic operations etc.
11-1-1	Los and the second seco
01120	· Variable time part - Any instruction that is
	executed more than once, Bay n times,
	comes in this part. For example, 100ps,
Secol	recurssion, etc.
N and	
	Therefore time appelority that at an in the
15-14	therefor time complexity T(P) of any algorithm
1. 15 1.	P is T(P) = C + TP(1), above C is the con-
e me	Stant time part and TP(7) is the variable
-	past of the algosithm, which depends on
	the instance characteristic1.
*	L'ast de projectes stat - the "the ?
	How to express an Algorithm?
Co Miles	1. Note combile an autor
1.1.1.1	1. Natural Language - Here we express the
-	algorithm in natural language English langu-
4120	age. It is too bard to understand the gen
a lan	aboaithm from it.
4100	0. Elmal obard llong and a di
11.1	2. Flow chart - Here we express the Algorithm
	by making graphical/pictosial representation
	of it. It is earlier to understand than
	Natural Language.
a cat	Z. Desirile Cale Hois
-1.2	3. <u>Pseudo code - Here we exposes the Algorithm</u>
	in the torn of annotations and intromative
× 1.	text additted in plain English which is very
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	much similar to real ande but quit has
	DO ENDLOX like any of the programming
	language, it count be compiled or interpre-
1	teel by the computer. It is the best any
	to express an algorithm become it can be
aln	undernatood by even a layman with some
19(10)	Bobool level programming knowledge.

1. No. 47	IN Set Saber COH ANHER GENE D JOS T
*	Array Data Structure - Lui soli 10
10)	it and the the characteris characteris
1	An avoid is a collection of items stored at
	contiguous menousy locations. The idea is to
	store multiple items of the same type together. This make it easier to calculate
	together. This make it easier to calculate
-	the position of each element by simply adding an offset to a base value, i.e., the memory location of the first element of the arrow (generally denoted by the base name of
	adding an offset to a base value, i.e., the
No.	memory location of the first element of the
	array (generally denoted by the lame name of
_	assay).
	200-201-202 203 204 205 206 = = =
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
	0123456
	Index dected
	the above image an be looked as top-level
1.019	wiew of a startase ashere you are at the
	base of the stadingse. Each element an be
1-	Uniquely identified by their index in the group
(m)	in a similar way you could identify your
	triends by the step on which they avere
dina.	on in the above example).
	ole tudi guildide plob plor platerient A
01	d aprovano par par lano apricante parte a porte
	And I have the india on property in Ker
102	source last of app start dend odly such the second started

* 10 shing and a for a for the start the start of the start Hashing is a technique or process of mapping key, and values into the hash done for faster access to elements. The efficiency of mapping depends on the Let a hash function H(x) maps the valuex at the index x%10 in an Array. For example, if the list of value is [11, 12, 13, 14, 15] it will be stored at positions \$1,2,3,4,5] in the erroy or tellash tuble respectively. List = [11,10,13,14,15] H(x) = [x + 10]119/10 Lash [X% 10] H(x)= 9 0 2 З 5 Habb table 11 12 13 14 15 * Hash Table :-- Hash table is one of the most important data structure that uses a special function known as a hash function that maps a given value with a key to access the element feister. A Hash table is a data structure that store some information, and the information has basically two main components, i.e. Key and value. The bash table can be implemented with

	DOWNLOADED FROM BATH-EXAMS, in
	the help of an assosiotive and the efficiency
	at mapping depends upon the ethiciency of
han	the hash function used for mapping.
10. 21	mi se misi dell'and dell'and
have	- For example, suppose the key value is John
6	and the value is the phone number, so when
	we pass the key value in the hash function
at h	shown as below: a pali awa adi
17	The Charles mine inplus had add in
1-1	Hash (key) = index; indication of
	of any it to the an future southy act in
	When we pages the key in the bash function,
	then it gives the index.
	Hash (John) =3;
0G (
-leez	The above example adds the John at the
_	index 3.
	Deawback of Hash function
	A Hab MUDCHON assigns each value with
1.5	unique key. Bornetimes hash table uses on
	imperfect hash function that causes a collision
ant	because the hash function generates the
_	eame Key of two different values.
_	badland anienvia
	bodygar paibra -
*	Hashingg-Har manika bild
mit	Hashing is one of the searching techniques -
	that uses a constant time. The time complexity -
-	in bashing is O(1). Till now, we read the -
<u> </u>	two techniques for seelsching lineour seelsching
	and bingry seerch. The coost time comple-
	ritt in linear search is O(n), and O(logn) -
	in binary seerch. In both the searching -
1100	techniques, searching depends upon the humber -
	of elements but are agent the peoplique that -
2	takes a constant time. So hashing technique -
-	

ane that for boundance from Batu-Exams.in
On Hashing technique, the hash table and
hash function are used. Using the bash func-
tion, we an adaulate the olderess of at
Which the value can be poted. stored.
anto up de la
The main idea behind the bashing is to create
the (key/value) mine si the bashing is to create
the (key/value) pairs. If the key is given; then the algorithm computes the index at abich
the value coould be stored. It can be
How he have the ideal and and the ideal
Value 10 Key
AL adol.) dept
a 2 Actual bate
Hach Hash
Ke - Europian Value 74
Actual data inter dous equipart and a double A
to be stored. In dend abaril in a most emicin
addition estimation that antipant dava thetraini
there are three adys of calculating the
an hash indunction: ball to the barried the
- pivision method
- Folding method
- Mid Square method
the the division method, the bash function
riveran con be defined do; and part tot
is basing is only the tall band at
$\frac{h(k_i) = k_i \% \omega_i \dots \omega_i}{h(k_i) = k_i \% \omega_i \dots \omega_i \dots \omega_i$
cobere mis size of the bash table.
For example, it the key value is and the
size of the hash table is 10, when are apply
the hash function to key & then index would be
The index is 6 at which the value is stored.
The Index is a work the tame is stored.

	(" * (p cot.") · Hourg
*	
	Data structure is the coay of storing data
	in amouters's memory so that it an be
	used easily and efficiently. These are
	different data-structures used for the storge - of data. It can also \$ be defined as a
	of data. It an also the defined as a
	noathernatical or logical model of a particular organization of data (items.) The representati-
	on of particular dava structure in the main
	memory of a computer is called as storage
	structure. For Example: Array, stack, Queue, Tree,
:[[]	Gogph etc. When a street of the
	:(a. roop) +bortA: Jahagi
	* Operations on different Data structure:-
	There are different tipes of operations that
	Can be perporned for the manipulation of data in every data structure. some operations are below:-
	in every data structure. some operations are
	below:- c. O. d. C. t.
	The traversing: - traversing a data structure
D	means to visit the element stored in it. It
DC.	Visite data in a statematic manner. This an
11 <u>(</u>	add be done with any type of DB. di
-1	the Openeution abids the sampes ound
4 100	Hudail : proposil asurunda - parts

DOWNLOADED FROM BATU-EXAMS.in I C program to traverse the ground # include (stdio.h) 11 Function to traverse and point the array Void print Array (int * arr, int n) 3 ipt :: point ("Array: "); tor (i=0; i<D; i++) poloth ("%d", arrij); printy ("In"); Priver program int main () while Sullinto nun int arr [1 = 22, -1, 5, 6, 0, -3];int n = sizeof (arr)/sizeof (arr [0]); print Array (arr, n); return O; a south Annandalla Output :--1, 5, 6, 0, -3<2> Seanching:-Seeliching means to find a It is considered as successful abon the the Operation which we an peopormed on date- Structures like array linked-list. tree, graph etc.

	# include on the state of the BATU-EXAMS. in
	#include < conio. b>
un at	parts and deliver and the set
in bla	int main () - at servicities public off
invagi.	ant 2 and the plate and an education
6.37 (1	ipt a [10000], i, n, key; mingening
IN ME T	denseute to sublid to the susciple
11	Printy ("In Enter the Size of and ");
red i	Scolot (",", 4D);
1- 1271	printy ("In Enter the elements in gray;");
0.21	tor (i=0; i <n; 101="" 101<="" 110="" i++)="" th=""></n;>
det a	Losin Zai ale de calle outre outre outre outre
·	scent ("%d", cacij);
	THURSDAY STUDIES IN STREET, INTOR
1 stars	print ("Enter the Key: ");
	Scent ("%d", 4.Key); in the ai
	for (i=o; i <n; #<="" a="" i++)="" states="" th="" uboi=""></n;>
	2 Zaina toi
	· it (acit== Key) is traction -
. The last	
1. · · · · ·	Printy ("element found");
	Conter : areturne ;
	· · · · · · · · · · · · · · · · · · ·
	Scaple ("Scaple ("Scaple").
	Printy ("element not found");
	?
	S designed a high inter and
	output :-
	<u></u>
k,	Epter Size of the arrive 5
	Enter elements in and : 4
	6
	2
1	
3	
	3
	Entor the Key : 2
	element found.
6 30	

	DOWNLOADED FROM BATU-EXAMS.in
	(37 <u>Insection</u> -
	TE IS The operation which me dealy and
	The cloud-structures. Inserting means to add an
	Charles in the given drite attraction day opportion
	- CHARTER SUCCESSION (DEED THE MOONING
	element is added to the required duta-structure
	At is unsuccessful in some cases abon the
	Olde of the date of allowing to will be
	there is no space in the date - structure to
	add any additional element. The insertion
	has the earne name as an insertion in the
	data stoucture de an arody, linked-liet,
	grauph, tree. In stack, this operation is
al.	couled Push. In the queue, this operation
1.50	15 called Enquered Mar) Happe
盐 4	and any dater , ta. I strike
444	#indude <stdio.b> (++i;a>i;o=i) rot</stdio.b>
141	int main US
ile.	int arrE407, pos, i, size, volue;
10/20	Dripth (In China State, Volue:
. NG	printy (in Enter no. of elements in an amay:").
·	Sconf (" , fisize)
	priot f ("In Enter " d clements are;", Size);
1	for (1=0;1< Bize; 1++)
and the second s	Scapt (""d" & amr: 1).
	Printy: ("", d' 4 am [1]);
-12	#include < stdio.b>
75	#include < conjo. h}
it for	int main()
A CONTRACTOR	3
	int arriver side of the ment of and
12	printh ("In Enter 5 gray Elements:").
	for (i=0; i<5; i++)
10	Scant ("%d", 4000 [1]);
	points ("in Enter elements to insert: ").!
	SCADE ("ord" & element):
	Am Fire element. Chest all main
	Printk ("In the New Arrest is: ID") / 100110
	prints ("In The New Amery is: In") ////////////////////////////////////
	0

1	
Na na ter	Printy ("%d.", artij);
01.11	antch (): (()) () () () () () () () () () () () (
	SELLISO,
farm 1	"arginan ai cheannes bar ronai aren paina
Marph.	CHIP (1991) CHI CASSACHIAN CHIPT IN CONTRACT IN CONTR
	During an encount a proprior of good and a sufficiency
	(++1; mud>i; opi) col
	1. (1."=[base] rep ") Hadieg
	(LiJvan) (duy) daws
	ALLARD AND A MONTH AND A MAN
_	and a state of the second field of the second field of the second field of the second se
	15'2' shar tuentale anto an onitional alt marent
- ki	de inno salt to anitag adt anitag") tidate
-WEW	Notorio de tarro une sado
548	Deletion: - of tand way and a sector
	- It is the operation which we apply on all the
1	data-structure. Deletion means to delete an element
in a sta	in the given data structure. The operation of
the Robert of Part	deletion is successful eaben the required element
15 Lines	is deleted from the data structure. The deletion
2 Del Per	has the same name as a deletion in the data-
	structure as an array, linked-list, graph, tree,
	etc. In stack, this operation is called pop,
See.	In queue, this operation is colled pequelle.
alari a	Mars to loop to solo a good at appart
A MIN & Sal	(1++i:1-mud>::1-209=i).rot
1	e Little
This stere	
1	

#include (Stdio b) FROM BATU-EXAMS.in #include<conio.h> int main() 11 de claration of the int type variable int arr [50]; int pos, i, num // dedare int type variable. Point/ ("ID Enter the no.017 elements in an amod: 10"); Sount ("%d", &num); printf ("ID EDter "/d elements in array: ID" num); l'use for loop to insert elements one by one in array tor (i=0; i<num; i++) pointy (" arr [%d]=", i); Bank ("%d", farrEiz); renter the position of the element to be deleted point/ (" Define the position of the array element asterne you agot to delete: In"); 800nK(" %d", \$ pos); ere data della anti anti et 40 --I check klether the deletion is possible or not (Pos >= Dum + 1) put unit point; ("In Deletion is not possible in the array."); else aland a late ... 3 I use for loop to delete the element fundate the index. tor (i= pos-1; i< num-1; i++)

G DOWNEDADED FROM BATULEXAN DEDIGO CON [i+1] to ON [i] 3 Printfor in the resultant array is; in"); Ildisplay the final arroy for (i=0; i<nume-1; i++) printy ("arr E%d]=", i); Point ("%d in", are [i]); return Operand continen Output :-- ninh nilinger 12 e toslee kan and he Enter the no. of Elements in an array: 8 Enter 8 elements in array; gro EOJU = 3 th at black add anthall 4! arr LIJ = Grade with station rate and us amE27 - allas solil and ai aviiban sa gm[3] = 15 arr[4] = 10artista = 5 plusinon o ai plob pains Qmrej = 811amE77 = 12 11 -1 alad adl · sharmaria past ni nint petine the position of the articly element. Where you wantto deletes 5 a shinu . Horse artitusture Inne antitadata the resultant group is: E = 601 790 Marcine clothe in neuro aireany anon E2J = 2 p uppi color singe p ai

	DOWNLOADED FROM BATU-EXAMS.in
mon	arr [3] = 15
	arr r47 = 5
	orr [5] = 8
	9m[6] = 12
	("at the firme damages sails (n")-fund
	Some other Methoda:-
	Carl Hayannia and Cropi
-	E and the second s
	Create:-
	It reserves memory for program elements
	by declaring them. The creation of data
	Structure an be done during
	1. Compile-time
	2. Run-time
	You can use malloc function?
6	
(2)	Geleerion:-
-	It select specific data from present data.
1000	You an any select specific data by giving
	Inter the north Element gool an aottibaco
(3)	Update: - : por uni adusanses & restries
	It updates the date in the date structure.
7.	You can also update any specific data by giving some condition in loop like selection approach.
i.e.	al = tylnin
(4)	Soot:-
	Gooting data in a particular order (ascending
der an	or descending).
	We and take the help of many sorting algorithms
Survey bearing	to sort date in less time. Example: bubble sort
9090	
1	are many algorithms present like merge sort,
na Shere	insertion sort, selection sort, quick sort etc.
	rei proro dantmaste sala
(5)	Merge :-
and the second	Merge:- Merging data of two different orders in a specific order may ascend or descend.
an Anna anna an	in a specific water may ascend on descend.

10-0	Lagando del en prissiona deno poper la component
10-0-1	
	We use merge soot to merge soot data.
(Ĉ)	Split Data - million and will be stilled
	Dividing data into different sub-pasts to
	make the process complete in less time.
intra-	Le invent to thad to a poreant a search
3	to be and some senti and the all did in
*	Avory Poocessing Sporse Matrices:-
i tubo	al atriant - maked or and a granting to xot xit and a start
t.	A matrix is a two-dimensional data object
	made of m rows and n columns, therefore
	having total mxn values. If most of the
•	elements of the matrix have O value, then
1 2	it is called a sparse motorix.
4	L-IF Manio N COCONS
1 P	Why to use sparse matoix instead of simple
	Matsix 8
2	
	- Storage - There are lesser non-zero elements
1003	than zeros and thus leseer memory
10:HD	can be used to store only those
64	de duriero dall' elemente : Darras reiscu di
lacin	- computing time - computing time can be saved
UNCO	by logically designing a data stoucture
191 100	inter and bar traversing only non-zero elements.
	Example:- 00304
4	00570
5. 	00000
and the set	02600

1	DOWNLOADED FROM BATU-EXAMS.in				
	Representing a sparse matrix by 2D arrays				
	leads to wastage of lots of memory as zeros				
1.	in matrix are of no use in most of ases.				
1	Bo, instead of stoping zeroses with non-zero				
	elements, we only alore non-zero elements.				
	This means storing non-zero elements with				
	triples - (ROW, Column, value).				
2					
	Sparse Matrix Representations can be done in				
	many cogyes following are two common repres.				
	entations:-				
-	1. Astury Reposentation				
	2. Link-ed-list Representation				
	stops and the ship the ship interview				
-	Using Anruy-				
	2 D'arrow is used to represent a sparse matrix				
	in abid there are three rows named us				
	• ROW: - Index of row, where non-zero elements is located. • Column: - Index of column, where non-zero elements is located.				
-Invide	• Value: - Value of the non-zero elements located at				
	· index - (vous, column)				
	000304				
Row	100570 ROW 001133				
	2 0 0 0 0 0 Column 2 4 2 3 1 2				
10- I	302600 Value 345726				
113071-13	steris - 1971 to sea static includio - peter the				
10.11.1	Given two eporse matrices, perporto operations				
	Buch as add, multiply or transpose of the matrices				
	in their sparse from itself. The result should				
WID	consist of three sparse matrices, one obtained				
1 Marriel	by adding the two in put matrices, one by multip-				
. 3 44	Hing the two matrices and one obtained by				
	transpose of the first matrix.				

10:	Example found and Bartoner AMERITANES of matrices
	aill be zero as matrices are oparse.
-	opdise.
	Input:-
	Mataix 1: (4×4)
	Row Column Value
	1 2 10
	1 4 12
	6 5 5
17. J. 1	at al month in the 1 state 15 percent and
inst-	1
*7 - 14	and was desided above when but duit when
-	Matrix 2: (4×4)
	Row Column Value
32A	ind that 1 anidus it 18 i and
5 -111	all internet 2. and 4 at 1 23 dament
1150	division to Sala . Source State
frin	- institute a 4 stail (- 1000 1- 20 mm mad
Now to	illes turned 4 in sen 2: 125 an off
10 in	usite de Alder dende Lan von acaña
ni li	outputs- the difference which what hope it
4	Result of Addition: (4×4)
Nt 1	Row Column Value
F 110	miduis is 1100 2 av 1000 ot
MAN	and an and 1 and 3 Trans 8 and 10
4	The state of the s
201	1.401 -4 -01 -23 -100 -50
- 1	dana and mini Biolo 175 Mini 140 min
y	136
2 100	2. 1.37 miles
Gunta	a structure domains a contract of the state of the state
not-	Result of Multiplication: (4×4)
41.	Row Column Nalue
-	$L_1 = \frac{1}{240}$
	1 1 2 300
	1 4 230
11115-	
Anila	
- and the sec	4 4 4 276 111
Adia	tag as vistor in place a subject a matrice

	ROW	column	Value	
	1	4	15	
	2	(about 1)	10	
	2	4	12	
	3	3	5	
	4	t	12	
	i.e	8	e.	
The Bpg.	rse mat	n'x lised	anywhere in th	Pe Dong?
is soot	ed okmo	rding to	Its row values	TIM
ents mi	th the	Burne at	w values are	HITTLEX
6031-60	accordi	Do to the	r Column value	
	autu V			
Now to	Add th	e matrice	s, we simply t	TINEROP
through	both	matrices	element by e	lement
insert	the on	Daller e	ement (one co	th and
10 000	od col V	alue) int	the resulting	t matal
75 00	e come	QCIDES	an element co	th the
equipe	3060 01	nd column	value; we st	Et cim
add t	beir va	wes and	insect the a	Hdeol do
ipto	resultar	totom JC	CHE HURSH	
13	DIDY 6	naiula) (6.5%	
TO Tac	nspose	a most	JX, we an a	Hamis
change	e every	Column	value to the ?	DOW Valu
and v	ice-ver	ed bow	ever in this	MAR H
result	ant mat	VIX COON	be easted a	a' me me
wire: +	lence init	tally det	emine the num	ber of
elener	us less	than th	e current eler	Deuts
Column	being	inserted	in noder to as	t the
exact	index	of the re	xiotant matoix	where s
autren	r elemeu	ut should	be placed. th	is is dor
by mo	printming	1 an ano	index [] abo	nee ith
Value	indicat	es the r	under of elan	ents in
the m	itox les	sthan t	ne column i.	
C	ē. A	1 -		
to Mut	HPH H	to tom sc	ces, we flost word motifix d maintain the	calgulat
tenoco	rise of	"the ex	and maker	
100000		VIE O	LODG DOTAX A	n Simol

order. So, the resultant matrix is obtained

	SUMMONTO BUNDATED FROM LATER LIERS HOLLEG:-					
1	result [1] [1] = A[1] [3] * B[1] [3]=12*8 = 96					
-	xesult [J] [2] = A[J][2] * B[2][2] = 10*1 = 10					
	$\frac{\partial e_{SULL} [2] [1] = A[2][1] * B[1][1] + A[2][3] * B[1][3] = 2*1 + 2*8}{\partial e_{SULL} [2] [2] = A [2][1] * B[2][2] = 1*5 = 5}$					
	Apy other element and not be obtained					
	by doy combination of sow in					
ł	Matoix A and ROW in Matoix B.					
	Alger integer into terran Pla part amonter of the					
12	Hence the final resultant matrix coil be:					
	Suchas In site it to set					
-1	Row col value					
7 A	List 1 96 million line have					
Sec. 15	1 2 10 million interior					
Sec. 1.9	Line 12 hand 18 to the terms of the second					
	2. 1-2. 5. duanta tour 11					
	allow and there will be have and to be					
· · · · · · · · · · · · · · · · · · ·	the state bar white the state of the state of the state					
*	Hash Tables					
	Habb tables are the data stauctures					
	which favour efficient storage and					
	retrieval of data -elements which are linear					
	ip nature.					
14 (14 - 14) 14	Dictionaries:-					
	- Dictionaries is a collection of data elements					
attion	Uniquely identified by field alled key.					
1	A diction discervery supports operations of					
	Search, insert and delete.					
	- A directory dictionary supports both sequential					
	and random access is the process in which					
	the data elements of the dictionary are					
	ordered and accessed according to the					
S. Mar. and	order of the process in which the date					
	elements of the dictionary are not accessed					
	according to particular order.					
	and a strange order.					

I	DOWNLOADED FROM BATU-EXAMS.in					
	The second s					
- Hash	- Hash tables are ideal data structures for					
diction	navies.	1 B. H. M.	ine -	him is	ares po	
And I dont 112	101 - C	international	HP .	11111		
cast forther roll		Stel Ilm	ani	Pre ITT.		
Hash 9	earch :-	1.0		- 3		
			3		1	
- Hash	selectio	n iba e	seerch	ind	obid ++	e
Key,	through	an digor	ithmi	C tun	CHODIO	1.etor
topine mine	s the lo	cation of	the	· otob		
		2.53		1.		
- Has	hing it i	Bia Key	to gd	dress	s transt	er-
mat	on in a	which the	e ker	mar	bba ot c	1000
es	in a list	t. In end	Lizi 44		i .	
	D_{i}	· · · · · · · · · · · · · · · · · · ·	and the	_		
	· 1>4 · · · / · · · · ·	x = 117	CALLI	arcit	- · ·	
Key		ash a	CT II	Add	reas	
	tun	A)	ap.			
CAL # AU IN	fig: Hash Search - contribution					
	a mid againerpla puidend in and a					
	white during the part of the state of the st					
Hash F	Hash Function: - losignoss physicili					
	- A hash function is a mathematical function					
ALAN	ash func	HON 16 Q	matt	matic	cal func	HOD
and white	ch maps	a given	key o	5 the	diction	004
TO	to its corresponding location in the sto-					
000	e table	CKNOWN GE	s hash	table	.).	
the states of the	server de la partir de la la contra de la co					
Ine	- the process of mapping the Keys to their respective position in bash teuble is could					
	DECHVE PO	DSiHON IN	hash			0
QS	Hashing	•		001	Aakash	
GE STATION I		linitas et t	$ \longrightarrow $	002	Rekha	
	1.1. 1	2	-) (-		
	Hash	5		005	Latita	
100 005	function	100	-	007	Brijesh	
100 100	Danalon	4	1.1.2	007	Dollar	
T ALL	1		-1 1			
Kejs	- 1 - <u>-</u> -	Address		100	Bachin	
	Aures- Ha			100	940,111	

DOWNLOADED FROM BATU-EXAMS.in
- the choice of the hash function plays a signi-
tuble. It is therefore essential that a hash function eatisties tollowing characteristics:-
function eatisties tollowing characteristics
Characteristics of Hash Functions:
East and quick to compute.
- Even distribution of keys across the hash
juble.
- A hash function mulst minimize collision.
THE OT YOU HAVE BUT UNDER OF CONTRACT
Basic Definitions of Hashing:
- Synonyms: - The set of keys that hash to the same location in our list is called as
the same location in our list is called as
BIDODYMB.
- Collision 3- cullision is the event that occurs
aben a hashing algorithm pundure an address
for an insection key and that address is
aready occupied. indication data
Home Address :- "the address produced by
the bashing algorithms is known as thome
18 at anondaress particular service estimates
agge Juble (Known as bash table).
- Poime Area: - the memory that contains all
of the home addresses is known as the
una si parme arreationalitation antica antic
Inglera Low opping the ch
Probe - Each colculation of an address and
test for success is known as probe.
Distant, ELC Read to an and the second secon
- Bucket :- A hash table uses a hash function
to compute an index into an array of
puckets or slots, from which the desired
value con be found.
an hour of the second sec



both the bar and the bar and the				
mining a An minthow accurs when the				
is full.				
sights sister. A torrar acipant dand A to				
- Open Hashing: In open hashing, key are				
stored in linked lists attached to cell of				
g hash table.				
at a fixed and the mail and that a construct which is				
- closed Hushing & In closed hashing, all keys are stored in linked lists attached to cell				
and stored in linked lists attached to cell				
of hash table.				
- Load Density / Load Factor :- The loading densi-				
the or loading factor of a hash table is				
a = n/(sb)				
- Sis number of slots.				
- b is number of buckets.				
* Issues in Hashing:-				
Following are some basic issues which are				
consider while hashing:-				
- computing the bash function.				
- computing the bash function. - collision Resolution: - Algorithm and data				
structure to handle two keys that hash				
to the same index.				
- Equality Test: - Method for charging abether				
two keys are equal.				

*	Properties of Good Hashing Function:-				
	Hash tupctions should have tollowing properties.				
-	Hash functions should have following properties: - Fast computation of the bash value (0(1)).				
	- Hast value should be distributed (nearly)				
	Uniporaly:				
	-> Every bash value ccell in the bash table)				
bas equal probability.					
	-> This Bhowld hold even if Keys are				
	non-uniformly distributed.				
0.71	- The goal of a hash function is: disperse?				
tuente	the key in an apparently random way.				
234	- A back function must minimize collisions.				
1					
-	Forms of Hashing Date Structure				
	<u> </u>				
U	<1>> Linear Open Addressing:-				
	- The queres and pumpher at months to be				
	- It allows any number of records to be				
	stored, because the space is of partic.				
1101 4	hadapetto stell hagail ar lange ann				
-					
a at r					
10	aldow and in the second provide the				
-	$(de)(d \neq p)$				
-					
1					
Ale a					
in 1	tan august stand and second standards				
	Address List of Elements				
ter series and	tique:- Linear Open Addressing				
Nut	1 June - Furridade com				
- i i i					
() - (I dente and contraction allocated and any statements of the				
	· · · · · · · · · · · · · · · · · · ·				
adjod4	a painta and balland - trait Hilbing -				
1	Initial sorp and and				

	DOWNLOADED FROM BATU-EXAMS.in					
	<27 Linear Closed Addressing:-					
	U .					
	It uses a fixed epace for storage and hence this limits the size of hash table.					
	1/1/2					
	1.71/1					
	5.6 • L					
	16/1/h h h h h h h h h h h h h h h h h h h					
-	tigunges lippar clanad addressie					
dr. s	figure:- Linear closed addressing.					
14 LT - 1	In this case maximum 7 elements can be stored					
n teacht	as another fixe is only 2 and that is thread					
e. 1	as array size is only 7 and that is fixed.					
nn.	istered and earth of been eligible					
*	Direct Address Tables					
	PICCO MORCO .					
Soli La	- Direct Address Table is a data structure that					
Sam.	bas the monbility of papeing monode to 11 at					
the .	has the capability of mapping records to their					
	Corresponding key using arrays. In direct					
•	address tables, records are placed using their					
mala	Key values directly as indexes. They facili- tate tast searching, insection and deletion					
1	a me there and deletion					
	Operations.					
	- We are indepetend the access into the late					
	- We ain understand the concept using the follo-					
8). (5).	coing example. We create an arrey of size					
	equal to maximum value plus one (assuming					
•	Obcised index) and then use values as indexes.					
andz i Bati	for example, in diagram which is on next page					
	Key 21 is used directly as index.					

	DOWNLOADED FROM BATU-EXAMS.in				
	T:	201 11 10 1 1 2 2 1			
ad L	Key = 2110 000 000	H r. creation of the			
¥1	1.0. (0) 20. 10 Mil	an estimit aidi			
		data for key = 21			
_	21				
	22				
-					
-	1991				
1	figure:- Direct	eicid dees table.			
	Adjobbacoog				
-	Advantages ?-				
	- Secretion in (1)7	ime : pirect address tables			
-12		ohich are random access			
. [o, the key values (which			
	events used to seerch the goods in O(1)				
	time.				
all.	IDSection in O(1) Tin	ne ? We can easily inset			
igd!	- an etement in an and in O(1) time.				
	the same thing follows in a direct add-				
9(il-	Tess table also.				
inst	ind realebot on Hom	No coulos post			
151.	- Deletion in O(1) Time & Deletion of an element				
	Takes U(1) HIDE ID OD OTTON BIDUIDTY.				
	to delete an el-	ement in diseet address			
101 :	di miditable coe need				
	- Antiparties and alle conde an anomenick.				
rice II.					
pai		morximum key value.			
1- 1-	podchcally useful	ONH if the maximum value			
	. 16 VERY leas.				
	- 45 couses wastag	e of memory space if			
	areas is a signif	cant difference between			
	total records and	maximum value.			

Hashing OID overcome these limitations of
direct address tables.
How to handle collisionse
Collisions an be handles like hashing.
We an either use chaining or open
addressing to bandle collisions. The only
dilference from hashing here is, we do
Dot use hash function to find the index.
We attoo directly use values as indexes.
※ HASH FUNCTIONS
Hashing
Methods
Direct Modulo Midequare Rotation
Division
Substraction Digit Folding Random
Extraction Generations
<17 Direct Hashing:-
- In direct bracking address tomation in
- In direct hashing, address for a key is generated without any algorithmic manipulation inerefore the data structure must writin an address for every possible key.
Therefore the data structure must anterin an
address for every possible key.



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