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- The following are the ten skills to be possessed by a software Developer
 - Analytical ability
 - Analysis
 - Design
 - Technical knowledge
 - Programming ability
 - Testing
 - Quality planning and Practice
 - Innovation
 - Team working
 - Communication

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Performance measures

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- The following are the five points deciding the performance of a software developer
 - Timeliness
 - Quality of work
 - Customer Orientation
 - Optimal solution
 - Team satisfaction

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Problem-Definition

- Definition:** A *problem* is a puzzle that requires logical thought or mathematics to solve
- What is **Problem solving** ?
The act of defining a problem; determining its cause; identifying, prioritizing and selecting alternatives for a solution; and implementing that solution.

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Problem Solving-Steps

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Problem Classification

- Concurrent: Operations overlap in time
- Sequential: Operations are performed in a step-by-step manner
- Distributed: Operations are performed at different locations
- Event-Based: Operations are performed based on the input

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Distributed/Concurrent Problems

Computers connected by a network

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Sequential/Event based-Example

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```
graph TD; CollectCash[Collect Cash] --> CollectCard[Collect the Card]; CollectCard --> Exit[EXIT]; CollectCash --> EnterAmount[Enter the amount]; EnterAmount --> EnterPin[Enter the Pin #]; EnterPin --> InsertCard[Insert ATM CARD]; InsertCard --> CollectCash;
```

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Problem solving methods

- Heuristic approach/ Brute Force technique
- Greedy approach
- Divide and Conquer technique
- Dynamic Programming technique

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Heuristic/ Brute Force approach

- Brute force approach is a straight forward approach to solve the problem. It is directly based on the problem statement and the concepts
- Brute force is a simple but a very costly technique
- Example: Breaking Password

Watch the video to get more clarity on Heuristic

<https://www.youtube.com/watch?v=ZiNodNT-33g>

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Greedy Approach

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- Greedy design technique is primarily used in Optimization problems
- The Greedy approach helps in constructing a solution for a problem through a sequence of steps where each step is considered to be a partial solution. This partial solution is extended progressively to get the complete solution
- The choice of each step in a greedy approach is done based on the following
 - It must be feasible
 - It must be locally optimal
 - It must be irrevocable
- Example: TSP- Traveling Salesman Problem
- <https://www.youtube.com/watch?v=SC5CX8drAtU>

GREEDY decisions based on the local optimum

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Divide-and-Conquer

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The most-well known algorithm design strategy:

1. Divide instance of problem into two or more smaller instances
2. Solve smaller instances recursively
3. Obtain solution to original (larger) instance by combining these solutions

Example:

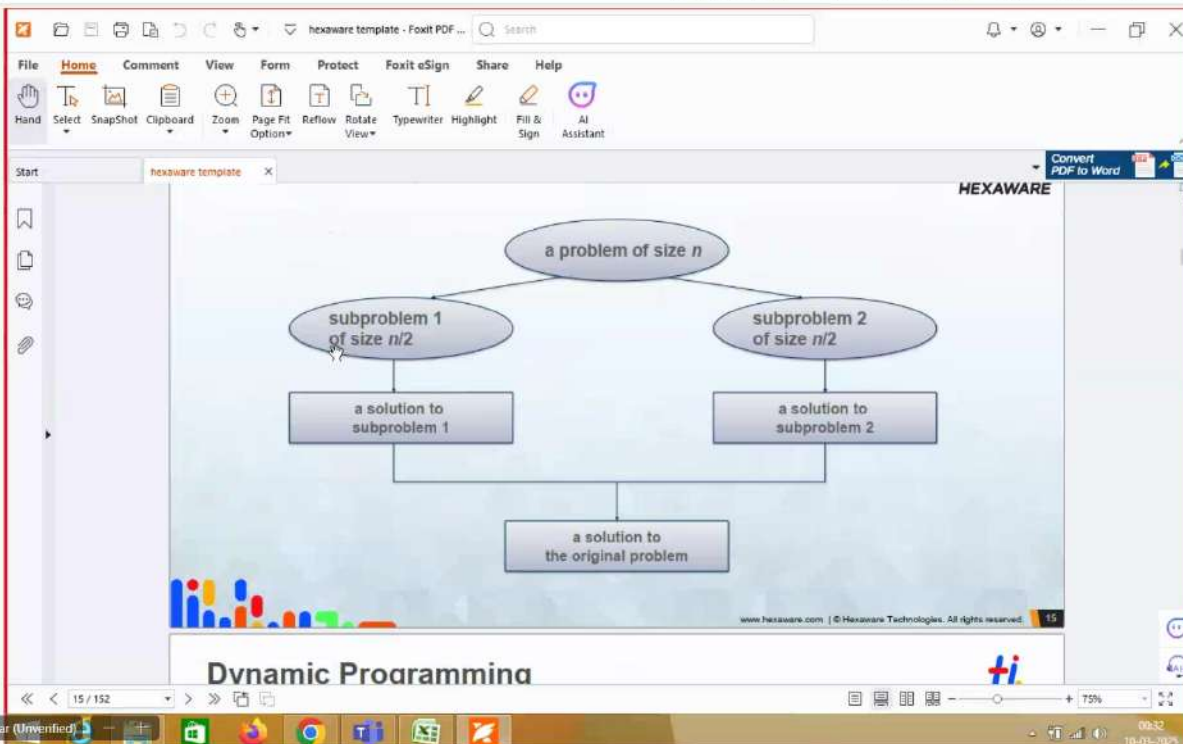
- Binary Search

<https://www.youtube.com/watch?v=wVPCT1VjySA>

Divide and Conquer

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Dynamic Programming

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- Dynamic Programming is a design principle which is used to solve problems with overlapping sub problems
- It solves the problem by combining the solutions for the sub problems
- "Programming" here means "planning"
- Main idea:
 - set up a recurrence relating a solution to a larger instance to solutions of some smaller instances
 - solve smaller instances once
 - record solutions in a table
 - extract solution to the initial instance from that table
- The difference between Dynamic Programming and Divide and Conquer is that the sub problems in Divide and Conquer are considered to be disjoint and distinct whereas in Dynamic Programming they are overlapping

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Solution

Step 1: First fill the 8L bucket full.

Step 2: Pour the water from 8L bucket to 5L bucket. Water remaining in 8L bucket is 3L.

Step 3: Pour the water from 5L bucket to 3L bucket. Water remaining in 5L bucket is 2L.

Step 4: Pour the water from 3L bucket to 8L bucket. Water in 8L bucket is 6L now and 3L bucket gets empty.

Step 5: Pour the water from 5L bucket to 3L bucket. Water in 3L bucket is 2L now and 5L bucket gets empty.

Step 6: Pour the water from 8L bucket to 5L bucket. Water remaining in 8L bucket is 1L 5L bucket gets full.

Step 7: Pour the water from 5L bucket to 3L bucket. Water remaining in 5L bucket is now 4L as 3L bucket already had 2L of water and when we poured water from 5l bucket to 3L bucket we poured 1L of water from 5L bucket and thus the remaining water in 5L bucket is now 4L.

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Computer Based Problem Solving -Steps

Understand the Problem

Develop a Logic to solve

Represent the logic as a diagram

Write the step by step process of the Logic

Convert the steps into a program

Test the Program

- Analysis of the Problem
- Selecting a solution method
- Draw Flowcharts
- Develop Algorithms using Pseudo codes
- Develop Program using Programming language
- Test the program

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Modeling Tools

- Diagrammatic Representation of Logic
- Different Types:
 - Flow Charts
 - Data flow Diagrams
 - Entity Relationship diagram
 - Unified Modeling Language

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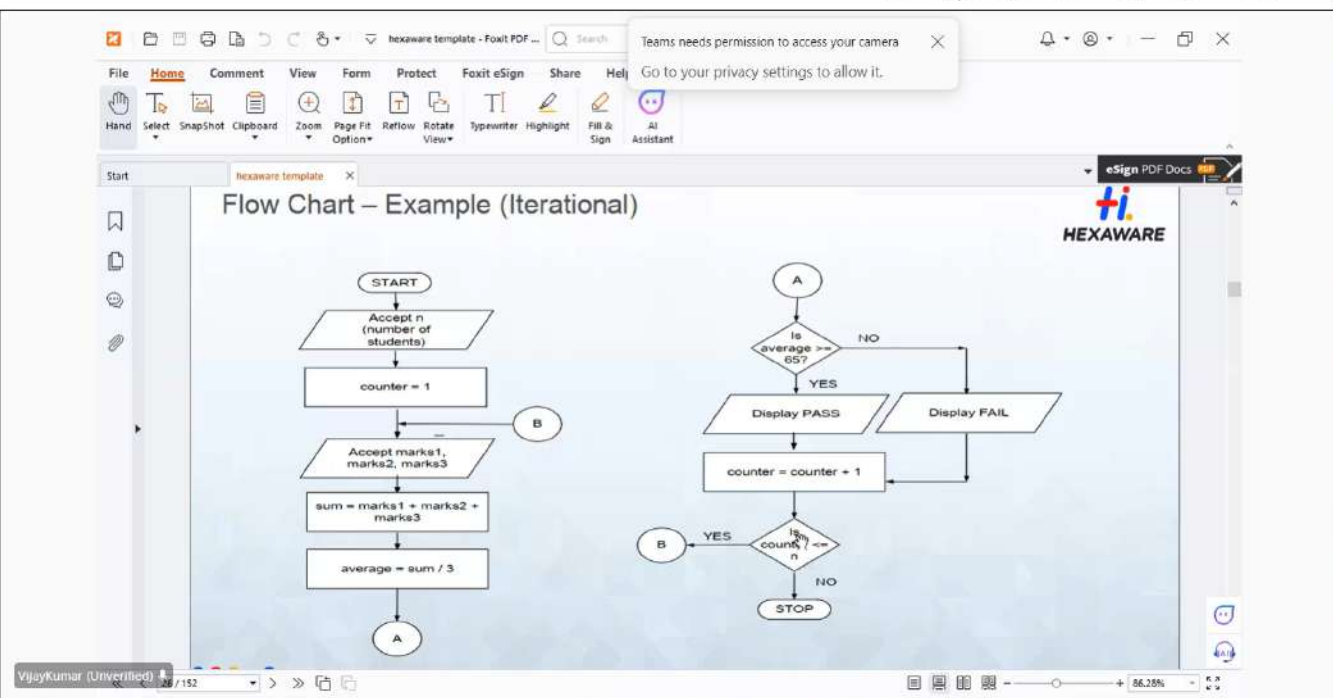
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- TL THARUN...
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Algorithm – Example (1 of 2)

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Find the average marks scored by a student in 3 subjects:

BEGIN

Step 1 : Accept 3 marks say **Marks1, Marks2, Marks3** scored by the student

Step 2 : Add **Marks1, Marks2, Marks3** and store the result in **Total**

Step 3 : Divide **Total** by 3 and find the **Average**

Step 4 : Display **Average**

END

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Algorithm-Example (2 of 2)

Find the average marks scored by a student in 3 subjects:

BEGIN

Step 1 : Read **Marks1, Marks2, Marks3**

Step 2 : **Sum = Marks1 + Marks2 + Marks3**

Step 3 : **Average = Sum / 3**

Step 4 : Display **Average**

END

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Different Patterns in Algorithms

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- **Sequential**
 - Sequential constructs execute the program in the order in which they appear in the program
- **Selectional (Conditional)**
 - Selectional constructs control the flow of statement execution in order to achieve the required result
- **Iterational (Loops)**
 - Iterational constructs are used when a part of the program is to be executed several times

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Example - Selectional

HEXWARE

- Write an algorithm to find the average marks of a student. Also check whether the student has passed or failed.
- For a student to pass, average marks should not be less than 65.

```
BEGIN
Step 1 : Read Marks1, Marks2, Marks3
Step 2 : Total = Marks1 + Marks2 + Marks3
Step 3 : Average = Total / 3
Step 4 : Set Output = "Student Passed"
Step 5 : if Average < 65 then Set Output = "Student Failed"
Step 6 : Display Output
END
```

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Example - Iterational

Find the average marks scored by 'N' number of students

BEGIN

- Step 1 : Read **NumberOfStudents**
- Step 2 : **Counter** = 1
- Step 3 : Read **Marks1, Marks2, Marks3**
- Step 4 : **Total** = **Marks1** + **Marks2** + **Marks3**
- Step 5 : **Average** = **Total** / 3
- Step 6 : Set Output = "Student Passed"
- Step 7 : If (**Average** < 65) then Set Output = "Student Failed"
- Step 8 : Display Output
- Step 9 : **Counter** = **Counter** + 1
- Step 10 : If (**Counter** <= **NumberOfStudents**) then goto step 3

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Data Structures

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- Data structures is concerned with the representation and manipulation of data
- All programs manipulate data
- So, all programs represent data in some way
- Data manipulation requires an algorithm
- The study of Data Structure is fundamental to computer programming

12345678910111213141516171819202122232425262728293031323334353637383940414243444546474849505152535455565758596061626364656667686970717273747576777879808182838485868788899091929394959697989910010110210310410510610710810911011111211311411511611711811912012112212312412512612712812913013113213313413513613713813914014114214314414514614714814915015115215315415515615715815916016116216316416516616716816917017117217317417517617717817918018118218318418518618718818919019119219319419519619719819920020120220320420520620720820921021121221321421521621721821922022122222322422522622722822923023123223323423523623723823924024124224324424524624724824925025125225325425525625725825926026126226326426526626726826927027127227327427527627727827928028128228328428528628728828929029129229329429529629729829930030130230330430530630730830931031131231331431531631731831932032132232332432532632732832933033133233333433533633733833934034134234334434534634734834935035135235335435535635735835936036136236336436536636736836937037137237337437537637737837938038138238338438538638738838939039139239339439539639739839940040140240340440540640740840941041141241341441541641741841942042142242342442542642742842943043143243343443543643743843944044144244344444544644744844945045145245345445545645745845946046146246346446546646746846947047147247347447547647747847948048148248348448548648748848949049149249349449549649749849950050150250350450550650750850951051151251351451551651751851952052152252352452552652752852953053153253353453553653753853954054154254354454554654754854955055155255355455555655755855956056156256356456556656756856957057157257357457557657757857958058158258358458558658758858959059159259359459559659759859960060160260360460560660760860961061161261361461561661761861962062162262362462562662762862963063163263363463563663763863964064164264364464564664764864965065165265365465565665765865966066166266366466566666766866967067167267367467567667767867968068168268368468568668768868969069169269369469569669769869970070170270370470570670770870971071171271371471571671771871972072172272372472572672772872973073173273373473573673773873974074174274374474574674774874975075175275375475575675775875976076176276376476576676776876977077177277377477577677777877978078178278378478578678778878979079179279379479579679779879980080180280380480580680780880981081181281381481581681781881982082182282382482582682782882983083183283383483583683783883984084184284384484584684784884985085185285385485585685785885986086186286386486586686786886987087187287387487587687787887988088188288388488588688788888989089189289389489589689789889990090190290390490590690790890991091191291391491591691791891992092192292392492592692792892993093193293393493593693793893994094194294394494594694794894995095195295395495595695795895996096196296396496596696796896997097197297397497597697797897998098198298398498598698798898999099199299399499599699799899910001001100210031004100510061007100810091010101110121013101410151016101710181019102010211022102310241025102610271028102910301031103210331034103510361037103810391040104110421043104410451046104710481049105010511052105310541055105610571058105910601061106210631064106510661067106810691070107110721073107410751076107710781079108010811082108310841085108610871088108910901091109210931094109510961097109810991100110111021103110411051106110711081109111011111112111311141115111611171118111911201121112211231124112511261127112811291130113111321133113411351136113711381139114011411142114311441145114611471148114911501151115211531154115511561157115811591160116111621163116411651166116711681169117011711172117311741175117611771178117911801181118211831184118511861187118811891190119111921193119411951196119711981199120012011202120312041205120612071208120912101211121212131214121512161217121812191220122112221223122412251226122712281229123012311232123312341235123612371238123912401241124212431244124512461247124812491250125112521253125412551256125712581259126012611262126312641265126612671268126912701271127212731274127512761277127812791280128112821283128412851286128712881289129012911292129312941295129612971298129913001301130213031304130513061307130813091310131113121313131413151316131713181319132013211322132313241325132613271328132913301331133213331334133513361337133813391340134113421343134413451346134713481349135013511352135313541355135613571358135913601361136213631364136513661367136813691370137113721373137413751376137713781379138013811382138313841385138613871388138913901391139213931394139513961397139813991400140114021403140414051406140714081409141014111412141314141415141614171418141914201421142214231424142514261427142814291430143114321433143414351436143714381439144014411442144314441445144614471448144914501451145214531454145514561457145814591460146114621463146414651466146714681469147014711472147314741475147614771478147914801481148214831484148514861487148814891490149114921493149414951496149714981499150015011502150315041505150615071508150915101511151215131514151515161517151815191520152115221523152415251526152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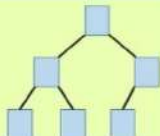
Types of Data Structure

There are basically two types of data structure

- 1.Linear Data Structure
- 2.Non-Linear Data Structure.



Linear Data Structure



Non-Linear Data Structure

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- A **static** data structure has a **fixed size**

This meaning is different from the meaning of the static modifier (variable shared among all instances of a class)

- Arrays are static; once you define the number of elements it can hold, the number doesn't change
- A **dynamic data structure** grows and shrinks at **execution time as required by its contents**
- A dynamic data structure is implemented using **links**

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HEXWARE

Age



(Arrays are like objects)

Age

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	0	0	0	0	0	0	0	0

Age

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	0	0	0	38	0	0	0	0

__ Initialization

Linked List



- a **linked list** is a linear collection of data elements, in which linear order is not given by their physical placement in memory.
- Elements may be added in front, end of list as well as middle of list.
- Linked List may be use for dynamic implementation of stack and queue.



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Stack

HEXWARE

- Stack is a linear data structure which works on LIFO order. So that Last In First Out .
- In stack element is always added at top of stack and also removed from top of the stack.
- Stack is useful in recursive function, function calling, mathematical expression calculation, reversing the string etc.

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- Stack is useful in recursive function, function calling, mathematical expression calculation, reversing the string etc.

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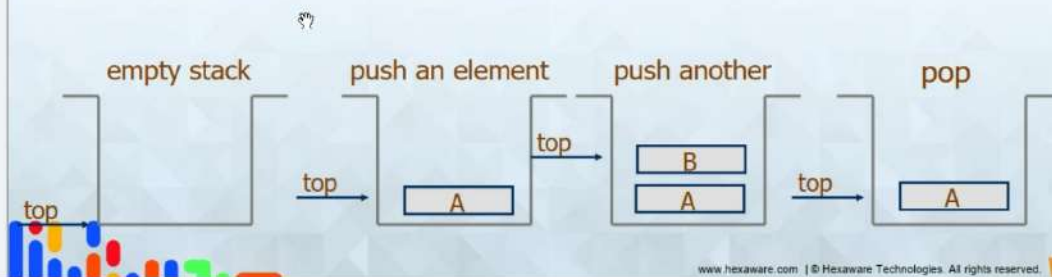
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- **LIFO** (Last In, First Out) in Stack:
The **last** element inserted will be the **first** to be retrieved, using **Push** and **Pop**
- **Push**
 - Add an element to the top of the stack
- **Pop**
 - Remove the element at the top of the stack



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Data Structures -- Stacks

Attributes of Stack

- maxTop: the max size of stack
- top: the index of the top element of stack

Operations of Stack

- empty: return true if stack is empty, return false otherwise
- full: return true if stack is full, return false otherwise
- top: return the element at the top of stack
- push: add an element to the top of stack
- pop: delete the element at the top of stack
- displayStack: print all the data in the stack

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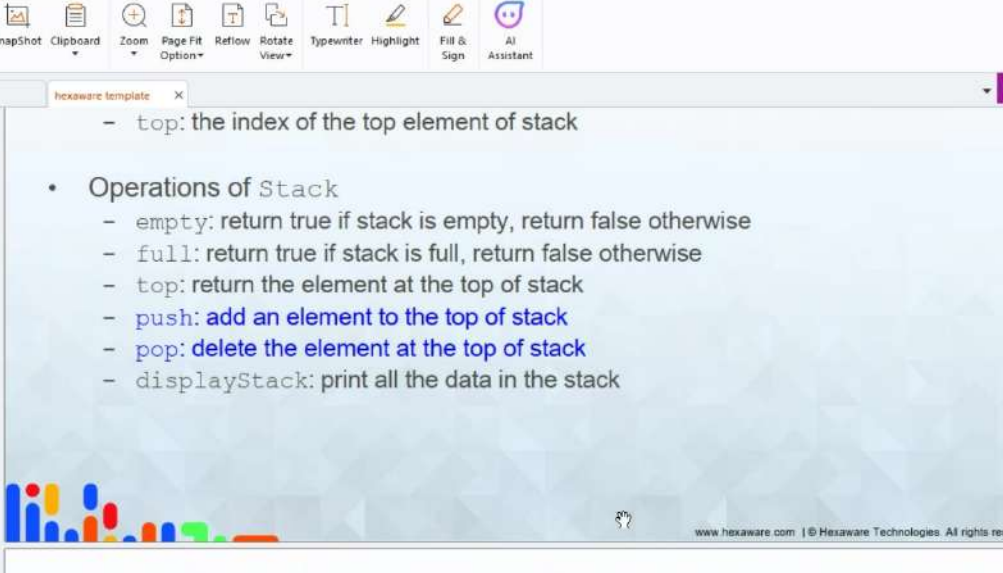
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- top: the index of the top element of stack
- Operations of Stack
 - empty: return true if stack is empty, return false otherwise
 - full: return true if stack is full, return false otherwise
 - top: return the element at the top of stack
 - push: add an element to the top of stack
 - pop: delete the element at the top of stack
 - displayStack: print all the data in the stack

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Data Structure -- Stacks

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- Real life analogy:
 - Elevator
 - Dish holders (stacks)
- Typical uses of stacks:
 - Prefix-/Postfix- calculators
- Any list implementation could be used to implement a stack
 - Arrays (**static**: the size of stack is given initially)
 - Linked lists (**dynamic**: never becomes full)

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Data Structure -- Stacks

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Top of stack (accessible)

Bottom of stack (inaccessible)

A stack of four books

Push a new book on top

Pop a book from top

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