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CHAPTER-3
Plotting Using PyLab

- **Plotting using PyLab**
- **Plotting Mortgages**
- **Extended Example**
- **Fibonacci Sequence Revisited**
- **Dynamic Programming**
- **0/1 Knapsack Algorithm**
- **Dynamic Programming with Divide and Conquer**

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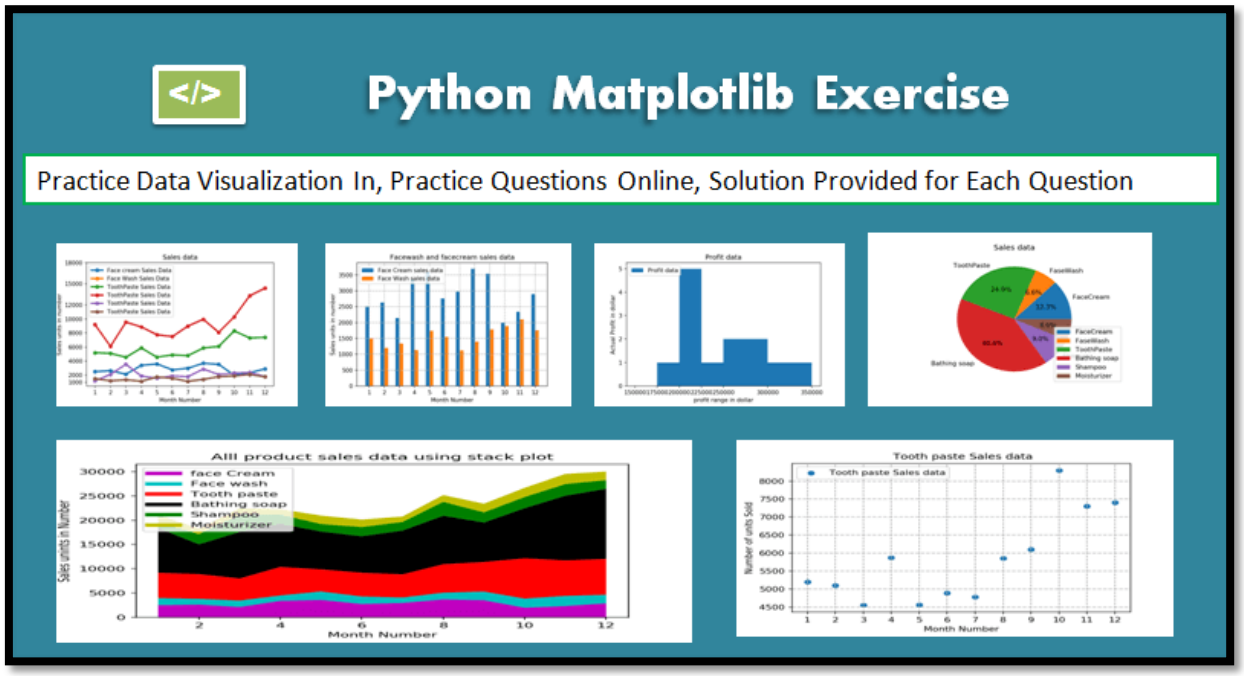
Q-1 Explain How to plotting using PyLab.



Detail :-

- PyLab is a module inside MATPLOTLIB library.
- MATPLOTLIB was developed by John . D. Hunter in 2003.
- MATPLOTLIB has it's roots in MATLAB which need to decide PyLab.
- MATLAB support many built – in function for users to develop the code.
- It become easy for MATLAB user who don't want to use import statement.
- PyLab having number of functions and classes for generating the drawings.
- MATPLOTLIB in python having 1000 lines of code to create quality graphics.

✓ MATPLOTLIB :-

MATPLOTLIB is free python library for generating plots in 1D , 2D Graphics.
MATPLOTLIB is easy to use interface for PyLab modules.

Example :-

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```
Import matplotlib.pyplot as plt
Import numpy as np
        X = np.linspace(0,10,100)
         Plt.plot(x , x.Label = “linear”)
         Plt.legend()
         Plt.show()
```

1 Word Question – Answer

SR.NO.	QUESTION	ANSWER
1	MATPLOTLIB was developed by _____in 2003.	John . D. Hunter
2	_____is a module inside MATPLOTLIB library.	PyLab
3	_____is free python library for generating plots in 1D , 2D Graphics.	MATPLOTLIB
4	_____ support many built – in function for users to develop the code.	MATLAB

Q-2 Explain Plotting Mortgage in brief.

	15-year Fixed (3.375%)		30-year Fixed (3.750%)	
Down Payment (%)	Monthly Payment (P & I) ($)	Total Interest Over Loan Term ($)	Monthly Payment (P & I) ($)	Total Interest Over Loan Term ($)
0	$1,949.09	$75,836.13	$1,273.57	$183,484.44
5	$1,851.64	$72,044.32	$1,209.89	$174,310.21
10	$1,754.18	$68,252.52	$1,146.21	$165,135.99
15	$1,656.73	$64,460.71	$1,082.53	$155,961.77
20	$1,559.27	$60,668.90	$1,018.85	$146,787.55

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$$M = P \times \frac{i_{monthly}}{1 - \left(1 + i_{monthly}\right)^{-L_{months}}}$$

where

M = monthly principle and interest payment

P = principle (loan amount)

i = monthly interest rate, decimal form (eg. 1% = 0.01)

L = length of loan in months

Detail :-

- Mortgage is a simple calculation to find out or understand true cost of any loan or interest.
- To install mortgage you have to write following command at CMD prompt.
    - **Pip install mortgage**
- The above package can provide easy way to compare different mortgages.
- It you are consider in mortgage loan , you should understand all the dtails about how principal and interest will be calculated.
- It will be also easy to find out monthly payment system for mortgage loan which include following :
    - HOA :- [Home Owner Association fee]
    - PMI :- [Private Mortgage Insurance fee]
    - Home Owner Insurance
    - Taxes
- Here are some common tricks to find out mortgage loan calculation :-
    1. **Provide sales price of house.**
    2. **Enter down payment.**

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3.Calculate loan amount.
4.Enter loan terms in years.
5.Enter interest rate.
6.Calculate monthly payment.
7.Calculate final balance and monthly interest.

Example :-

Calculate simple mortgage

```
From mortgage import loan
l = Loan(p=2,00,000 , i=0.06 , term  = 30)
l.summarize
>>>original balance : 2,00,000
>>>interest rate : 0.06%
>>>terms : 30 years
>>>monthly payment :
```

1 Word Question – Answer

sr. no		
.	_____is a simple calculation to find out or understand true cost of any loan or interest.	Mortgage
	To install mortgage you have to write _____command.	Pip install mortgage

Q-3 Explain Fibonacci sequence revisited with example.

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Detail :-

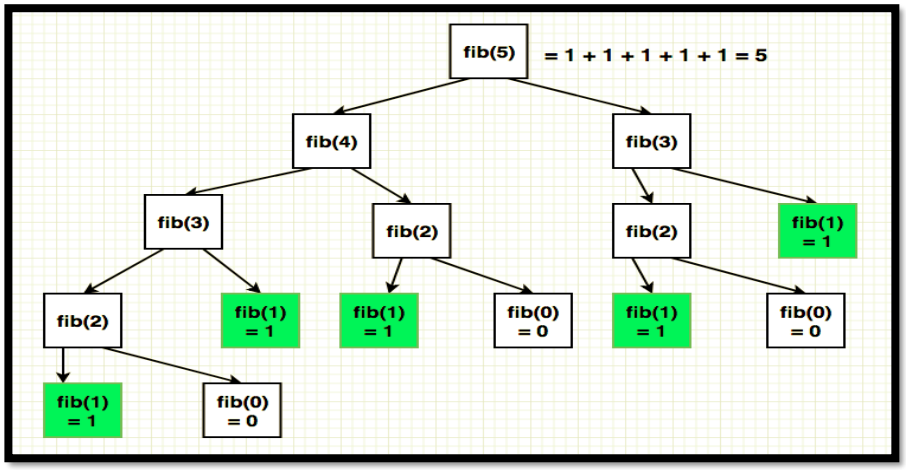
- One of the most common type of math based technical challenges are ones that deal with Fibonacci sequence.
- Each new term in the Fibonacci sequence is generated by adding the previous two terms.
- For example , starting with 1 and 2 ,the first 10 numbers in the sequence would be :

  o **1,2,3,5,8,13,21,34,55,89**

- One of the favourite challenge that deals with Fibonacci sequence is one that asks for index value of some high number in the sequence.
- It might be good idea to record the value returned by the first call , and then look it up rather than compute it each time it is needed.This is called "memorization".
- "Memorization" is key idea behind any dynamic programming.

- Normally , easy way to go about doing something like would be to put all the numbers in array and then cycle them with for loop.
- First it requires two different functions , one function to generate Fibonacci sequence and second function to cycle through all the numbers we have generated.

- Let's see ,implementation of Fibonacci sequence by following figure.



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As above figure , look at tree of calls associated with the invocation fib(6).
Notice that we are computing same values over & over again.

o**Example :-**

```
Def
fib_seq(n)
A=0
B=1
If n==1:
   Print(a)
Elif n==2:
   Print(a,b)
Else:
   Print(a,b,end="     ")
For I in range(n-2):
   c=a+b
   a=b
   b=c
   print(c , end=" ")
#calling
   fib_seq(10)
```

1 Word Question – Answer

SR.NO.	QUESTION	ANSWER
1	Each new term in the Fibonacci sequence is generated by adding the previous____ terms.	two
2	_____is key idea behind any dynamic programming.	Memorization

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Q-4 Explain 0/1 knapsack algorithm.

0/1 Knapsack with Dynamic programming

- Step 1:
  - Let S^i be a pair of (p,w) where p is profit and w is weight of an object.
  - Initially $S^0 = \{(0,0)\}$
  - Compute $S^{i+1} = \{$ merge S^i and $S_1^i \}$
- Step 2:
  - Generate a sequence of decisions using the following formula.

(p1,p2,p3) =(1,2,5)
(w1,w2,w3)=(2,3,4) m=6 n=3

S_1^0 : **(p1,w1)=(1,2)**
S_1^0 =(0+1,0+2)= (1,2)
S^1 ={ (0,0)(1,2)}

S_1^1 : **(p2,w2)=(2,3)**
S_1^1 ={(2,3)(3,5)}
S^2 ={ (0,0)(1,2)(2,3)(3,5)}

S_1^2 : **(p3,w3)=(5,4)**

CSE GURUS @ M3

Weight Limit (i):	0	1	2	3	4	5	6	7	8	9	10	11
$w_1 = 1\ v_1 = 1$	0	1	1	1	1	1	1	1	1	1	1	1
$w_2 = 2\ v_2 = 6$	0	1	6	7	7	7	7	7	7	7	7	7
$w_3 = 5\ v_3 = 18$	0	1	6	7	7	18	19	24	25	25	25	25
$w_4 = 6\ v_4 = 22$	0											
$w_5 = 7\ v_5 = 28$	0											

Detail :-

- In 0-1 knapsack , items can not be broken.
- It means if 1 than cover all the elements and if 0 than leave all the elements.
- This is the main reason behind calling it as 0-1 knapsack.
- In case of 0-1 knapsack , the value of $\mathbf{x_i}$ can be either 0 or 1 where other elements remains same.
- Let's consider the capacity of the knapsack is w=25 and the items as shown in the following table.

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ITEM	A	B	C	D
PROFIT	24	18	18	10
WEIGHT	24	10	10	7

- Here , profit per unit weight = **(p_i/w_i).**
- First item A will be selected as it will contribute maximum profit among allthe elements.
- After selecting item A , no more item will be selected.
- Here , for this given set of items total profit is 24.
- The optimal solution can be achieved by selecting items , B and C , where total profit is 18+18=36.
- In this example , the items are selected based on ratio **(p_i/w_i).**
- Let's us consider capacity of knapsack is w=60 and the items are as shown in following table.

ITEM	A	B	C
PRICE	100	280	120
WEIGHT	10	40	20
RATIO	10	7	8

- First item A is selected , then next item B is select.
- Here , total profit is 100 + 280 =380.
- The optimal solution of this instance can be achieved by selecting items B and C , where total profit is 280 + 120 = 400.
- 0/1 knapsack alogorithm takes following inputs :
  - The maximum weight = W.
  - The number of items = n.
  - The two sequences ….
    - Value V = <v1,v2,……,vn>
    - Weight W = <w1,w2,…..,wn>

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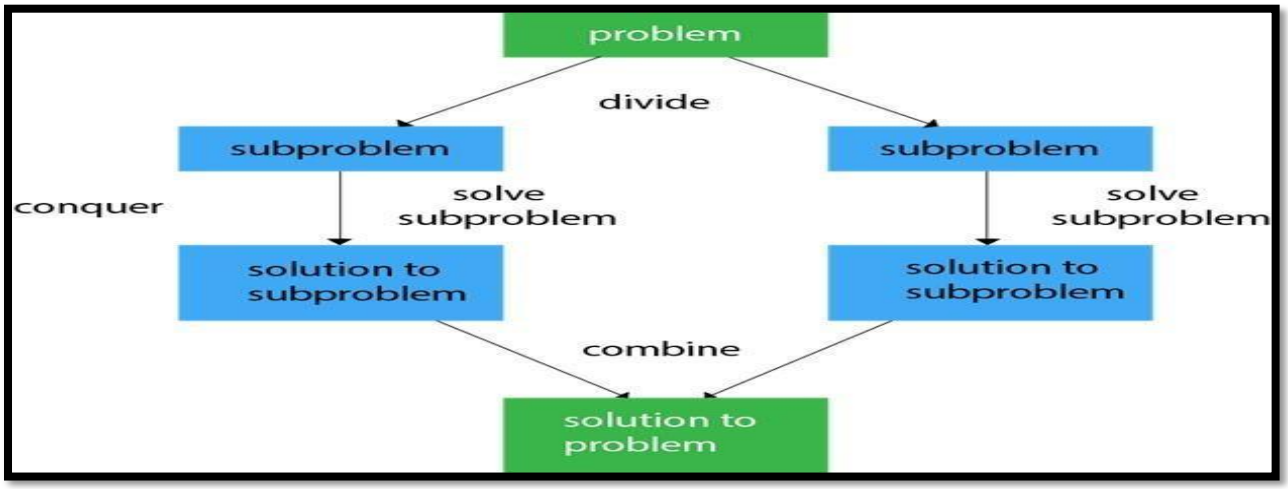
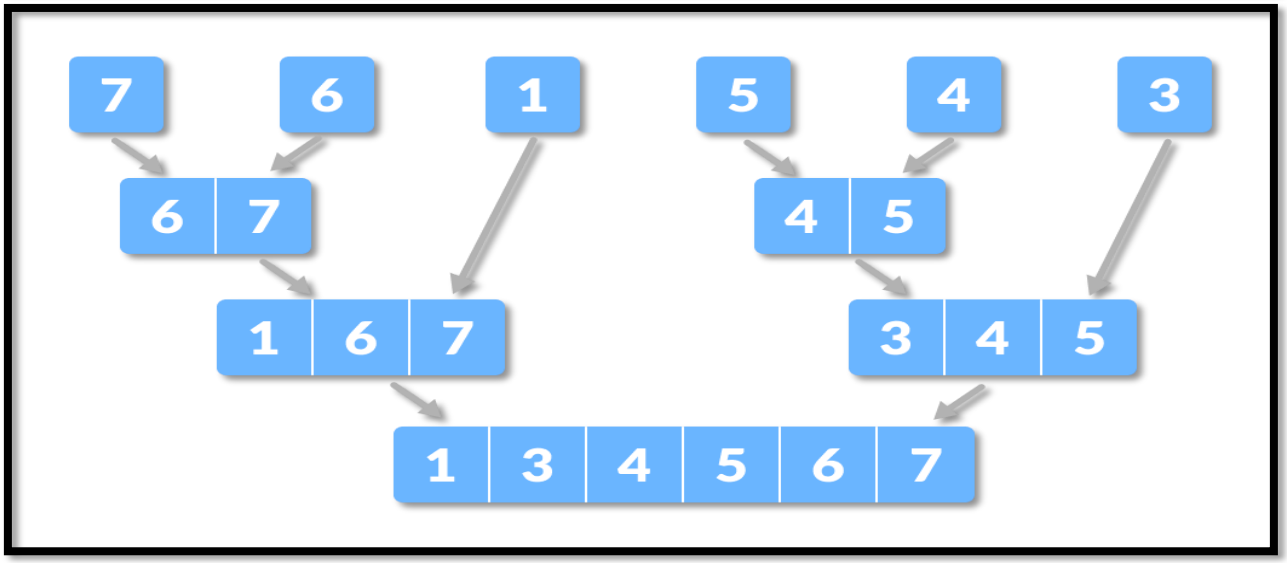
1 Word Question – Answer

SR.NO.	QUESTION	ANSWER
1	In_____, items can not be broken.	0-1 knapsack
2	In 0-1 knapsake algorithm,_____means cover all the elements and_____means leave all the elements.	1 0





Q-5 Explain dynamic programming with divide & conquer algorithm.

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DIVIDE & CONQUER ALGORITHM

Detail :-

- Devide & conquer is the process of breaking down problem into smaller parts.
- Break a problem into subprograms that are similar with original problems.
- Recursively , solves the sub problems , and finally combines the solutions to the sub programs to solve the original problem.
- Divide & conquer is an alogorithm paradigm.
- A typical divide & conquer algorithm solve a problem using following 3steps:
  - **DIVIDE (Break) :-**
    - It breaks the given problem into sub – problems of same type.
    - Ths step involves breaking the problem into smaller sub – problems.
    - At this stage , sub- problem should represent a part of original problem.
  - **CONQUER(Solve) :-**
    - It include process of recursively solve the sub – problems.
    - This step receives a lot of smaller sub – problem to be solved.
    - Generally , at this level , the problems are considered as “solved”.
  - **COMBINE (Merge):-**
    - It combines the appropriate answers as well as results.
    - When smaller sub – problems are solved , this stage recursively combines them until they found solution of original problem.

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- **Example :-**

```
def     bsearch(list     ,val):
        list_size = len(list) -1
        idx0 = 0
        idxn = list_size #find middle most value
        While idx0 < = idxn :
              Midval = (idx0 _ idxn)/2
              If list[midval] == val:
          Return midval
#compare value – middle most value
        If val > list[midval]:
              Idx0 = midval +1
        Else:
              Idxn = midval – 1
              If idx0 > idxn:
           Return none
#calling
        l1 = [55,44,2,4,9,8]
           Print (bsearch(l1,4)
```

- A classic example of divide & conquer is merge sort which demonstrated below.
- In merge sort , we divide array into two halves & sort the two halves recursively & then finally merge the sored halves.