

Name: Gaurav S. Gadkari

Roll No.: 19CO022

Batch: B

Artificial Intelligence Lab Assignment No. 1

Title:-

Aim :- Implement depth first search algorithm and Breadth first search algorithm. Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph or tree data structure.

Theory: Breadth-First Search

Breadth-First Search is the most common search strategy for traversing a tree or graph. This algorithm search breadthwise in a tree or graph, so it is called breadth first search.

BSF algorithm starts searching from the root node of the tree and expands all successor node of the current level before moving to nodes of next level.

The breadth-first search algorithm is an example of a general-graph search algorithm.

Breadth-First search implemented using FIFO queue data structure.

The aim of BFS data structure is to traverse the graph as close as possible to the root node

Advantages of BFS:

i> A BFS will find the shortest path between the starting point and any other reachable node. A ~~depth~~

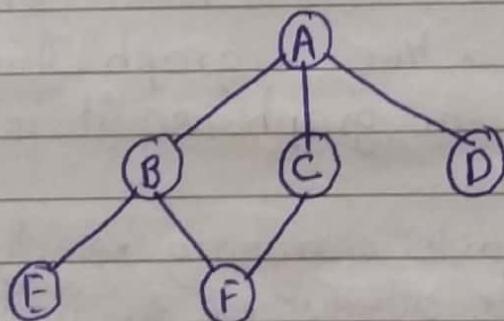
Disadvantages of BFS :-

- i) A BFS on a binary tree generally requires more memory than a DFS
- ii) If a solution is far away then it consumes time.

Applications of BFS :-

- i) Finding the shortest path.
- ii) Checking graph with petiteness
- iii) Copying Cheney's algorithm

Example of BFS:-



start Node : A
goal Node : B

visited [A]

queue [B, C, D]

visited [A, B]

queue [C, D, E, F]

visited [A, B, C]

queue [D, E, F]

visited [A, B, C, D]

Goal : D

Path : A → B → C → D

2. Depth - First search

Depth - First search is a recursive algorithm for traversing a tree or graph data structure.

It is called depth - first because it starts from root node and follows each path to its greatest depth node before moving to next path.

DFS uses a stack data structure for its implementation.

The process of the DFS algorithm is similar to the BFS algorithm.

Advantages of DFS :-

- ⇒ i) The memory requirement is linear WRT nodes
- ii) Less time and space complexity rather than BFS.
- iii) The solution can be found out without much more search.

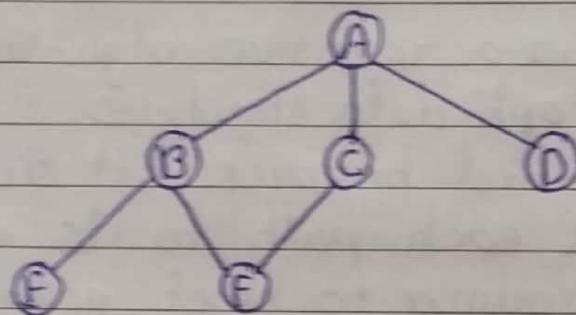
Disadvantages of DFS :-

- i) Not guaranteed that it will give you a solution.
- ii) Cut-off depth is smaller so time complexity is more.

Applications of DFS :-

- i) Finding connected components
- ii) Topological sorting
- iii) Finding Bridge of the graph.

Example of DFS :-



start Node : A
Goal Node : D

visited [A]

stack | B |
| C |
| D |

visited [A, B]

stack | E |
| F |
| C |
| D |

visited [A, B, E]

stack | F |
| C |
| D |

visited [A, B, E, F]

stack | C
| D

visited [A, B, E, F, C]

stack | D

visited [A, B, E, F, C, D]

stack |

Path : A → B → E → F → C → D

Algorithm :

① Breadth - first search :-

Step 1 : push the root node in the queue.

Step 2 : pop the first element in queue if popped element is Goal node then return true from the function.

Step 3 : push the children or neighbouring nodes of previously popped node in queue.

Step 4 : Repeat step 2 and 3 until we find required solution.

② Depth - first search :-

Step 1 : Push the root node into the stack

Step 2 : Visit the adjacent unvisited vertex. Mark it as visited. Display and push it in a stack.

Step 3 : If no adjacent vertex is found, pop up a vertex from the stack

step 4: Repeat step 2 and step 3 until stack is empty.

Conclusion:

Hence, we understand DFS and BFS algorithms. And program implemented successfully

Name: Geetavir S. Gadkar
Roll No.: 19CE022
Batch: B

Artificial Intelligence Lab Assignment No. 2

Title: A star Algorithm

Aim: Implement A star Algorithm for any game search problem.

Theory: A star Search:-

A^* search is the most commonly known form of best-first search. It uses heuristic function $h(n)$, and cost to reach the node n from the start node $g(n)$. It has combined features of UCS and greedy best-first search, by which it solves the problem efficiently. A^* search algorithm finds the shortest path through the search space using the heuristic search. The search algorithm expands less search tree and provides optimal result faster. A^* search is similar to UCS except that it uses $g(n) + h(n)$ instead of $g(n)$.

In A^* search algorithm, we used search heuristic as well as the cost to reach the node. Hence, we can combine both costs as following, and this sum is called as a fitness number.

$$f(n) = g(n) + h(n)$$

$f(n)$: Estimated cost of the cheapest solution

$g(n)$: Cost to reach node n from start state

$h(n)$: Cost to reach from node n to goal node

Advantages of A star algorithm

- I) A star algorithm is the best algorithm than other search algorithms.
- II) A star search algorithm is optimal complete.
- III) This algorithm can solve very complex problems.

Disadvantages of A star algorithm:

- I) It does not always produce the shortest path as it mostly.
- II) A* search algorithm has some complexity.
- III) The main drawback of A* is memory requirements as it keeps all generated nodes in the memory, so it is not practical for various large-scale problems.

Algorithm of A* search:

Step 1: Place the starting node in the OPEN list
Step 2: Check if the OPEN list is empty or not, if the list is empty then return failure and stop.

Step 3: Select the node n and generate all of its successors from the OPEN list.

Step 3: Select the node from the OPEN list which has the smallest value of evaluation function ($g(n)$), if node n is goal node then return success and stop, otherwise

Step 4: Expand node n and generate all of its successors, and put n into the closed list. For each successor n' ; check whether n' is

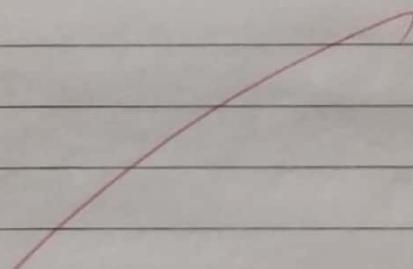
already in the OPEN / closed list, if not then compute evaluation function for n' and place into open list.

step 5: Else if node n' is already in OPEN / CLOSED, then it should be attached to the back pointer which reflects the lowest $g(n)$ value.

step 6: Return to step 2.

Conclusion:

Hence, we understand A* stor algorithm and program implemented successfully.



Name: Gaurav S. Gadkari

Roll No.: 19C0022

Lab Assignment No. 3 Artificial Intelligence

Aim: Implement Greedy search algorithm for any of the following applications :-

- i) Selection sort
- ii) minimum Spanning Tree
- iii) Single-source shortest path problem
- iv) Job Scheduling Problem
- v) Prim's Minimal Spanning Tree algorithm
- vi) Kruskal's minimal Spanning Tree algorithm.
- vii) Dijkshtra's minimal Spanning Tree algorithm.

Theory: Minimal Spanning Tree:

The cost of the spanning tree is the sum of weights of the edges in the tree. There can be many spanning trees. Minimum Spanning tree is the spanning tree where the cost is minimum among all the spanning tree. There also can be many minimum spanning trees.

Minimum spanning tree has direct application in the design of network. It is used in algorithms approximating the travelling salesman problem, multi-terminal minimum cut problem and minimum cost weighted perfect matching.

Prim's Algorithm:

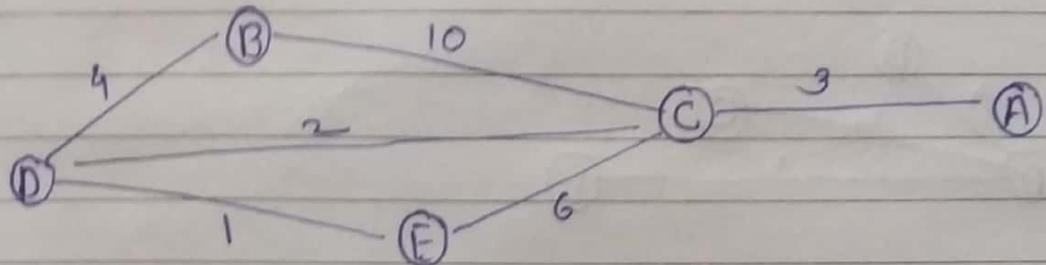
Prim's algorithm is a minimum spanning tree algorithm which helps to find out the edge of the graph to form the tree including every node with the minimum sum of weights to form the minimum spanning tree.

Prim's algorithm starts with the single source node and later explores all the adjacent nodes of a source node with all connecting edges, while we are exploring the minimum graphs, we will choose the edges with minimum weight and those which cannot cause the cycle in the graph.

Algorithm:

- ① Select a starting vertex.
- ② Repeat steps ③ to ④ until there are no more vertices
- ③ Select an edge 'e' connecting the tree vertex and a vertex that has minimum weight.
- ④ Add the selected edge and the vertex to the minimum spanning tree.
- ⑤ Exit

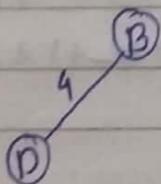
Example -
weighted graph:



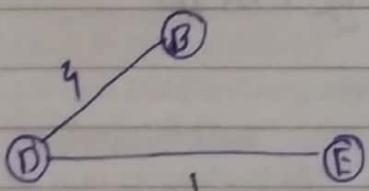
Step 1: we have to choose vertex from graph or
start vertex
∴ start vertex: B

(B)

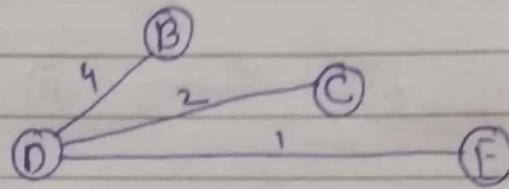
Step 2: choose shortest edge B
Here, shortest edge is with node D



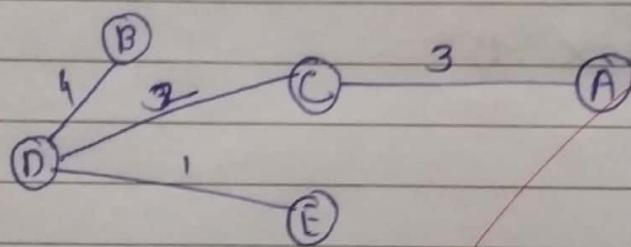
Step 3: Now, chose shortest edge with node D



step 4: choose cn and add to spanning tree,
so it cannot create cycle



step 5: Now, choose CA , so it cannot create
cycle



∴ Above is minimal spanning tree,

∴ Cost of minimal spanning tree = $4+2+1+3=10$

Conclusion:

Hence, we have successfully implemented
Prim's algorithm minimal spanning tree applica-
tions for greedy search algorithm.

Lab Assignment No. 4 Artificial Intelligence

Aim: Implement a solution for a constraint satisfaction problem using Branch and Bound and Backtracking for n-queens problem or a graph coloring problem.

Theory: 8 Queen problem using Branch and Bound:

The N-Queen problem is a puzzle of placing exactly N-queens on an $N \times N$ chessboard, such that no two queens can attack each other in that configuration. Thus, no two queens can lie in the same row, column or diagonal.

The Branch and Bound solution is somehow different it generates and a partial solution until it figures that there's no point going deeper as we would ultimately lead to a dead end.

In the Backtracking approach, we maintain an 8×8 binary matrix for keeping track of safe cells and update it each time we place a new queen. However, it requires $O(n^2)$ time to check safe cell and update the queen.

Applying the Branch and Bound Approach:

The branch and Bound approach suggest that we create a partial solution and use it to ascertain whether we need continue in a particular direction or not. For this problem, we create 3 arrays to check for conditions 1, 3 and 4. The boolean array tells which

row and diagonals are already occupied. To achieve this, we need to numbering system to specify which queen is placed.

The indexes of these arrays would help us to know which queen we are analysing.

Processing: Creating two $N \times N$ matrices, one for top-left to bottom-right diagonal and other for top-right to bottom-left diagonal. We need to fill these in such a way that two queens sharing same top-left-bottom-right diagonal will have same value in slash diagonal and two queens sharing same top-right-bottom-left diagonal will have same value in backslash-diagonal.

Graph coloring problem using Backtracking :

The graph coloring problem is to discover whether the nodes of graph G can be covered in such a way, that no two adjacent nodes have the same color yet only m colors are used. This graph coloring problem is also known as m -colorability decision problem.

The m -colorability optimization problem deals with the smallest integer m for which the graph G can be colored. The integer is known as a chromatic number of the graph.

Graph coloring problem can also be solved using a state tree, where by applying a backtracking method required results are obtained

Algorithm for finding the m-coloring of a graph -

1. Algorithm mcoloring (R)
2. If this algorithm is formed using the recursive backtracking schema.
3. The graph is represented by its Boolean adjacency matrix $G[1:n, 1:n]$
4. All assignments of $1, 2, \dots, m$ to the vertices of graph such that adjacent vertices are assigned distinct are printed.
5. k is the index of the next vertex to color
6. i
7. repeat
8. j
9. If generate all legal assignments for $x[R]$
10. Next value (R);
11. If ($x[R] = 0$) then return;
12. If ($\text{B}[R] = 0$) then
13. write ($x[1:n]$);
14. Else mcoloring (R+1);
15. j
16. until (False);
17. j

Conclusion:

Hence, we have successfully implemented solutions for 8 queens problem and graph coloring problem using Branch and Bound and Backtracking.

Lab Assignment 5 Artificial Intelligence

Aim: Develop an elementary chatbot for any suitable customer interaction application.

Theory: Chatbots -

A chatbot is computer program designed to have a conversation with human being over the internet. It is also known as conventional agents, which communicate and collaborate with human users, through text messaging, in order to accomplish a specific task.

Basically, there are two types of chatbot - one that uses Artificial Intelligence and another one is based on multiple choice scripts.

Both types of chatbots aim to create a more personalized content experience for the users, whether that's while watching a video, reading articles or buying new shoes.

These chatbots hold the promise of being the next generation of technology that people use to interact online with business enterprises.

These chatbots offer a lot of advantages, one of which is that, because chatbots communicate using a natural language, users don't need to learn yet another new website interface, to get comfortable with unavoidable quirks.

Benefits of chatbot :-

① Available 24*7:-

Since chatbots are basically virtual robots they never get tired and continue to obey your command

② Handling customers:-

We humans are restricted to number of things we can do at same time. Chatbot on other hand can simultaneously have conversations with thousands of people.

③ Helps you save money:-

Chatbots are one time investment which helps business reduce down on staff required

④ Provides 100% satisfaction to customers:-

Chatbots are bounded by some rules and obey them as long as they are programmed to. They always treat a customer in most polite and perfect way no matter how rough the person is.

⑤ Automation of repetitive work:-

Chatbot now helps to automate tasks which are to be done frequently and at the right time

Applications of chatbot :

- i) Chatbot in restaurant and retail industry
- ii) Chatbot in hospitality and travel.
- iii) Chatbot in E-commerce
- iv) Chatbot in health industry
- v) Chatbot in Fashion industry
- vi) Chatbot in Finance .

Conclusion:

Hence, we have successfully developed a chatbot for a suitable customer interaction application.

Name: Gaurav S. Gadkari
Roll No.: 19CO022

Artificial Intelligence Lab Assignment No. 6

Aim: Implement any one of the following expert system

- i) Information management
- ii) Hospital and medical facilities
- iii) Help desk management
- iv) Employee performance evolution
- v) Stock market trading
- vi) Airline scheduling and cargo schedule

Theory:-

Expert system →

An expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and interface rules according to user queries.

Example of Expert System:-

- i) Pendral - It was an AI system that was made as a chemical analysis expert system. It was used in organic chemistry to detect unknown organic molecules with help of their mass spectra.
- ii) PXDPS :- It is an expert system that is used to determine the type and level of lung cancer.

iii) Cadet - The Cadet expert system is a diagnostic support that can detect cancer at early stages

Characteristics of Expert System :

① High Performance :

The expert system provides high performance for solving any ~~any~~ type of complex problem of specific domain with high efficiency and accuracy.

② Understandable :

It response in a way that it can be easily understandable by the user. It can take input in human language and provide output in same way.

③ Reliable :

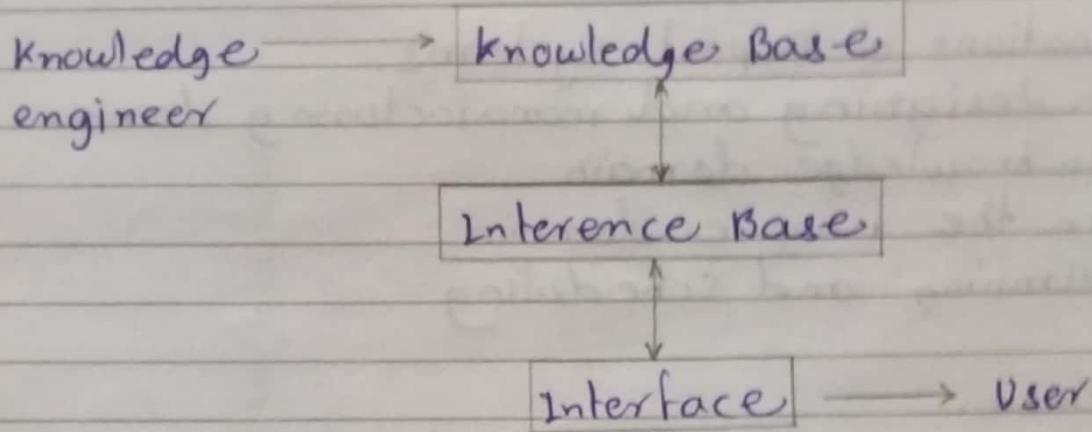
It is much reliable for generating an efficient and accurate output.

④ High responsive :

ES provides the result for any complex query within a very short period of time.

Components :

Expert System mainly contains three components :



Advantages of Expert system:

- i) These systems are highly reproducible
- ii) They can be used for risky places where human presence is not safe.
- iii) Error possibilities are less if KB contains correct knowledge.
- iv) The performance of these system remains steady as it is not affected by emotions, tension or fatigue..
- v) They provide a very high speed to respond to particular query.

Limitations of Expert Systems:-

- It can't learn from itself and hence require manual updates.
- ii) For each domain, we require specific ES, which is one of biggest limitations.
- iii) Knowledge acquisition for designing is much difficult.
- iv) Maintenance and development cost is high.
- v) like human being, it cannot produce creative output for different scenarios.

Applications of Expert Systems:

- i) In designing and manufacturing domain
- ii) In knowledge domain
- iii) In the finance domain
- iv) planning and scheduling

Conclusion:

Hence, we have studied about Expert System in detail and successfully implemented the employee performance evaluation system.

Lab Assignment 1 Cloud Computing

Aim: Case study on Amazon EC2 and learn about Amazon EC2 web services.

Theory:

Amazon Elastic Compute Cloud (EC2) provides scalable computing capacity in Amazon's web services cloud. Using Amazon EC2 eliminates your need to invest in hardware upfront, so you can develop and deploy applications faster.

You can use Amazon EC2 to launch as many as few virtual servers as you need, configure security and networking and manage storage.

Amazon EC2 enables you to scale up or scale down your cloud resources and services.

Instances:

Virtual computing environments are known as instances. Pre-configured templates for the instances known as Amazon machine images that package the you need for your instances.

Various configuration of CPU memory storage, networking capacity and other services are possible using instances.

We can use metadata known as tags that you can create and assign to your Amazon EC2 resources. such as regions and availability zones.

Creating an EC2 Instances:

The following steps are taken to create and launch an EC2 instance manually.

- I) Create credentials that you want to assign to the EC2 instance.
- II) Choose an Amazon Machine Image(AMI)
- III) Choose an Instance type
- IV) Configure Instance detail such as network and storage
- V) Add labels or tags for identifying for your EC2 instances.
- VI) Configure Firewall (called security group) as appropriate
- VII) Review and launch the EC2 instance.
- VIII) Once the EC2 instance is created, you can connect to it using the chosen credentials.
- IX) Let us see the detailed procedure for each of these.

Amazon EC2 use Case:

I) Hosting Environment:

One of the uses of EC2 is hosting a variety of applications, software and websites on the cloud. Users are even hosting games on the cloud, turning servers on/off when needed.

2> Development and test environment :-

The scalable nature of EC2 means that the organizations, now have the ability to create and deploy large scale testing and development environment with unprecedented scale

Amazon EC2 web service :-

It is the collection of remote computing resources / services also called as web services, that makes up a cloud computing platform. The most central and well known of these services are Amazon EC2 and S3. The service capacity is much faster and cheaper than building a physical server.

Benefits of AWS:-

- i) It does not require any hardware unit.
- ii) It is easily scalable
- iii) It is pay as per use platform.
- iv) Since it is IaaS cloud model, we have complete control on our project.

Conclusion :

Amazon EC2 instance has been created and launched

Lab Assignment No.2 Cloud Computing

Aim: Installation and Configuration of Google App Engine

Theory:

Google App Engine is a cloud computing platform, which is platform as a service (PaaS). It is used for developing and hosting web applications in Google managed data unless Google App Engine offers automatic scaling for web service applications. As number of requests increases for an application, App engine automatically allocates more resources for the web application to handle additional demands.

Installation of Google App Engine:

i) Pre-requisites - Python

The app engine SDK allows you to run Google App Engine applications on your local computer.

ii) Download and install Google App Engine SDK by going to <http://code.google.com/appengine/downloads.html> and download an appropriate package for your system.

iii) Double click on Google Application Engine. Click through the installation wizard and it should install

the app.

Configuring an application for Google App Engine. The app engine does not understand the source code for deployment. The source code needs to be repressed with the configuration file called app.yaml.

Runtime environment:

The source code is mentioned here during runtime so that the app engine can set up environment to support and deploy the code for public usage.

Scaling information:

Here, we provide the information of scaling, type of scaling required, number of instances required and available for scaling. It also checks how we can scale the application.

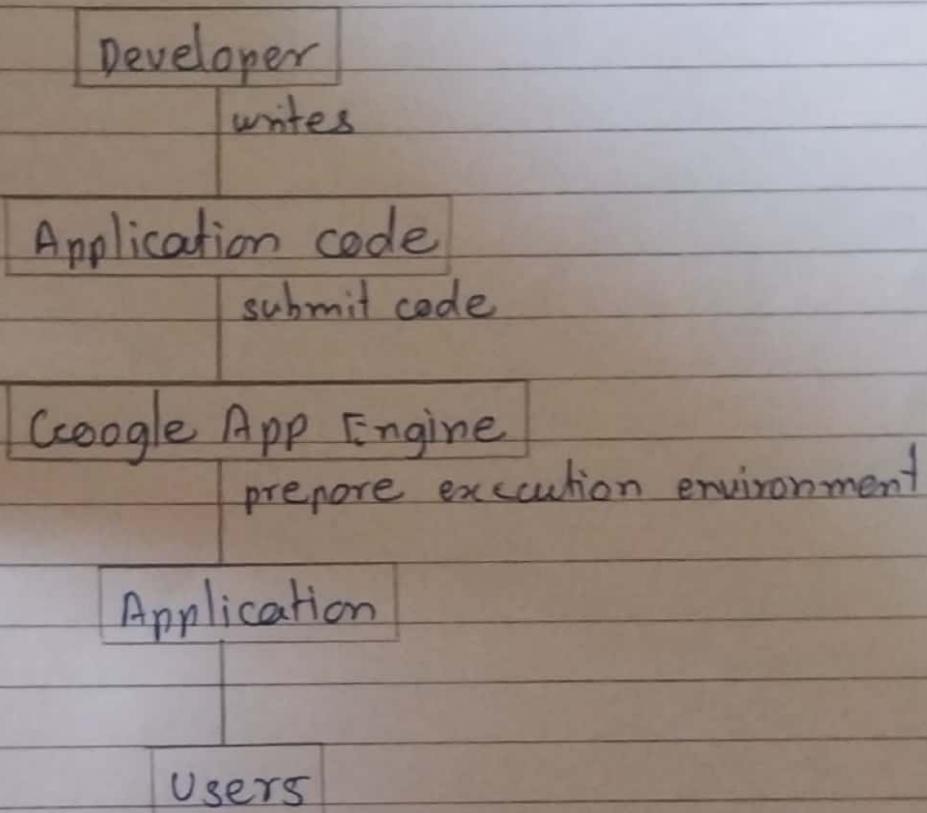
Environment variables:

We need to provide environment variables for application can be used safely.

Resource information:

We need to mention the number of CPU, memory, disk size available, etc to the application.

Working:



Conclusion:

Google App Engine has been installed and configured.

Lab Assignment No. 3 Cloud Computing

Aim: creating an application in software salesforce.com using Apex programming language.

Theory: Salesforce-

- 1) It is cloud-based software company which provides customer relationship management (CRM) software and application focuses on sales, customer service, marketing automation, analytics and application development.
- 2) It offers users a customer community, partner community, developer community and an app exchange marketplace.
- 3) Salesforce provides more power and flexibility to manage customer and other relationships.
- 4) The main purpose of the Salesforce platform is to make business platform processes more effective. You can easily access all the data from anywhere and anytime.

Benefits of Salesforce:

- ① Salesforce is a cloud-based solution that is secure, easy to use and accessible anywhere.
- ② You can create custom reports to help you better understand your business data.
- ③ Salesforce has an extensive app store that makes it easy to add tools for your business.

④ Ultimate Accessibility - It is accessible anywhere and any time

⑤ Improved Team collaboration - The software allows you to connect and communicate with team members.

Apex Programming language:

① It is proprietary language developed by salesforce.com

② It is strongly-typed, object oriented programming lang that allows developers to execute flow and transaction control statements on the force.com platform server

③ It has a Java-like syntax and acts like database stored procedures.

④ It enables the developers to add business logic to most system events, including button click, related records updates and visual-force effects.

Features of Apex language:

① Integrated - Apex has built in support for DML operations like insert, update, delete. It has support for online SQL query handling which returns the set of object records.

② Java-like syntax and easy to use.

③ Apex runs in a multitenant environment.

④ Apex provides built in support for unit test creation and execution.

Simple Hello Word Program in Apex
test.apex -

```
public class MyHelloWorld {  
    public void mytest() {  
        system.debug('hello word')  
    }  
}
```

Enter Apex Code

```
MyHelloWorld ts = new MyHelloWorld();  
ts.mytest()
```

Conclusion:

We have successfully implemented code using in salesforce.

Lab Assignment 4 Cloud Computing

Aim: Design and develop custom application using sales force cloud

Theory: Custom Application using sales force:-

- ① The design of software application for a specific user or group of users within an organization is known as custom application development.
- ② A salesforce custom app has a name, description and an ordered series of tabs as well as an optional custom logo and landing page.
- ③ Custom applications are easier to build as console development over and above simple configuration requires visual force, apex and sometimes javascript skills.
- ④ A salesforce application is a logical container for all of the objects, tabs, processes and services associated with a given business function.

Benefits of salesforce custom Apps:-

- ① Quick, easy and secure systems integration:-
Salesforce custom apps are hosted in the salesforce cloud and operate on the same server as the salesforce lightning platform and sales cloud.

② Improved identity management :-

For each user in your salesforce instance, salesforce identity provider a single, security identity records.

③ Faster implementation of Apps :-

Customized salesforce apps integrate seamlessly with your company's salesforce configuration.

④ You get accurate and relevant data :-

Because of the power of the salesforce ecosystem, data in a native salesforce application is always 100% correct and up to date.

To create an application in salesforce follow below-mentioned steps

setup → App setup → Create → Apps → click on 'New'
→ select custom application radio button → provide
the name of app → click on 'Next' button →
select the image from document object →
select the objects → click on visible check box
and save

Conclusion:

Hence, we have successfully design custom application using salesforce cloud