

Unit 4:

Introduction to Capstone Project

Approach:  
Hands on, Team Discussion, Web search,  
Case studies

## Learning Objectives:

- Understand the meaning of the Capstone Project and its goals.
- Understand how problems can be identified, decomposed and solved using Design Thinking Methodology.
- Learn the steps of Design Thinking and apply for solving simple issues.
- Learn to create Empathy maps.
- Understand the importance of 5W1H in Design Thinking and Capstone Project development.
- Relate the importance of Sustainable Development Goals and how these issues can be aligned with Capstone Project.

Key Concepts: Design Thinking, Empathy Map,  
SDG's, Capstone Project

# Introduction to Capstone Project

Can you think of a problem or challenge in your everyday life, schoolwork, or hobbies that you might be able to solve using technology? Is there a pattern involved in this problem?

Imagine you are working on a team for an AI Capstone project. What skills would be important for each team member to have in order to be successful?

A Capstone project is a project where students must research a topic, deeply understand the subject matter and integrate all their knowledge gathered about a particular subject to develop a solution to a problem.



## What will you learn from this capstone project

- how to work as a team member?
- how to clearly identify an issue? and how it is affecting (the user)?
- how to brainstorm solutions and select the best one?
- how to decide which type of AI may be useful for the proposed solution?
- how to ethically gather and use data to train a computer to help solve the issue?
- how to test the prototype with users and use their feedback to improve the solution?
- how to pitch their solution to people who will be able to help them take action?

Some Examples for Capstone Project are given below:

1. Stock Prices Predictor
2. Develop A Sentiment Analyzer
3. Movie Ticket Price Predictor
4. Students Results Predictor
5. Human Activity Recognition using Smartphone Data set
6. Classifying humans and animals in a photo

## Asking the right question before starting the AI Capstone Project

- Before Starting a Project, one should analyze whether a problem has a pattern associated with it.
- If there is no pattern, then the problem cannot be solved with AI technology.
- It is fundamental that this question, “Is there a Pattern?” is asked before deciding to embark on an AI development journey.

- Predictive Analysis helps in identifying the patterns by asking different questions which fall into different approaches.

Some of the questions are given below:

- 1) Which category? (Classification)
- 2) How much or how many? (Regression)
- 3) Which group? (Clustering)
- 4) Is this unusual? (Anomaly Detection)
- 5) Which option should be taken? (Recommendation)

Then we try to simplify the complex problem to analyze it. This is known as Problem Decomposition.

## Problem decomposition steps

1. Understand the problem and then restate the problem in your own words.
2. Break the problem down into a few large pieces.
3. Break complicated pieces down into smaller pieces.
4. Code one small piece at a time.

## Activity

Many people are facing serious issues with traffic jams during office hours which may be caused due to multiple reasons. Considering this as a major issue to resolve, write down the problem decomposition steps to make it simple to solve.

**First Step** → Understand the Problem and Restate it.

Public is facing difficulty due to the problem of traffic jams especially during the busy office hours.

**Second Step** → Break the problem down into a few large pieces.  
Split the traffic issue separately for each reason

a. Bad Roads

b. Accidents

c. Office Hours

d. Rash Driving

e. Inappropriate Signals

f. Over Crowded Area

**Third Step** → Break complicated pieces down into smaller pieces.  
From the above sub steps (reasons), if any reason is of complicated type, we can split it into more simpler units.

For example, Rash Driving can be further split into  
a. Over Speed b. New Drivers with less experience  
c. Careless Driving

**Fourth Step** → Take each issue at a time and try to find the solution



## 2. Critical and Creative Thinking

**Definition:** Critical thinking is the ability to analyze a situation and make a judgment based on facts and data.

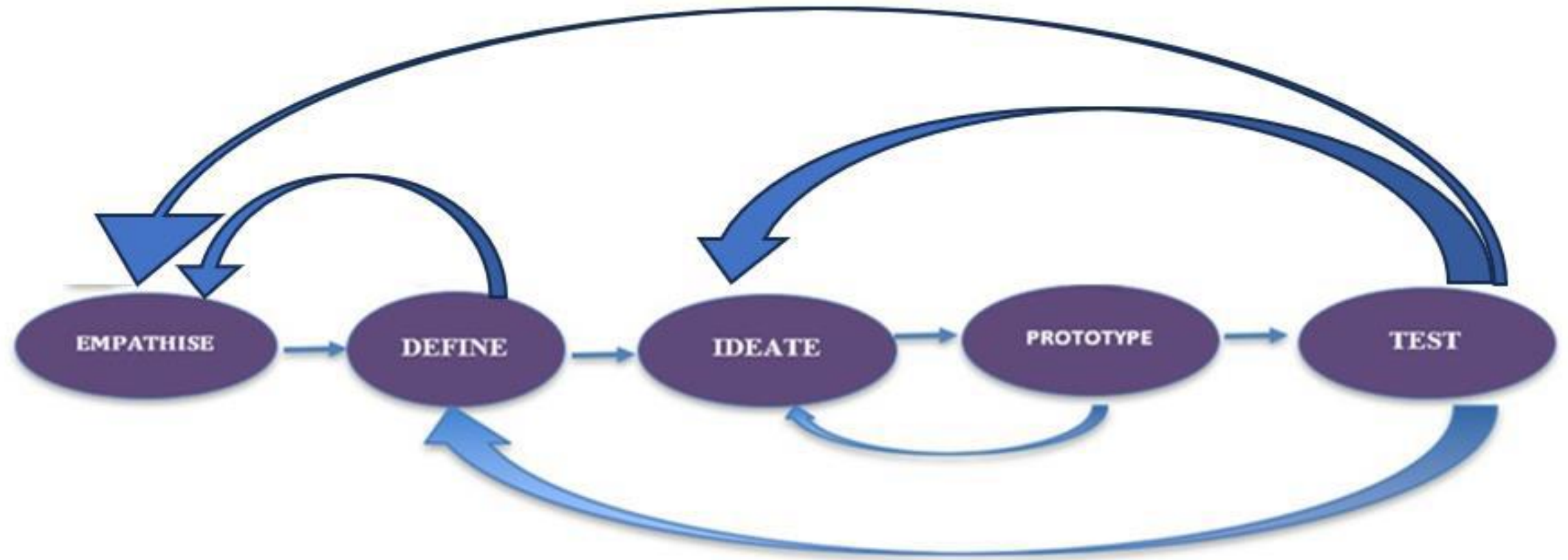
- Creative thinking on the other hand refers to the ability to come up with new ideas or rather solutions.
- Complex problems can be easily solved using critical and creative thinking which has a systematic approach to address any problem which has to be solved. This approach is known as Design Thinking.

## Introduction to Design Thinking

Definition: Design thinking is a **non-linear, iterative process** that expert teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test.

## Design Thinking framework

- Design Thinking is a design methodology that provides a solution-based approach to solving problems.
- It's extremely useful in tackling complex problems that are ill-defined or unknown.



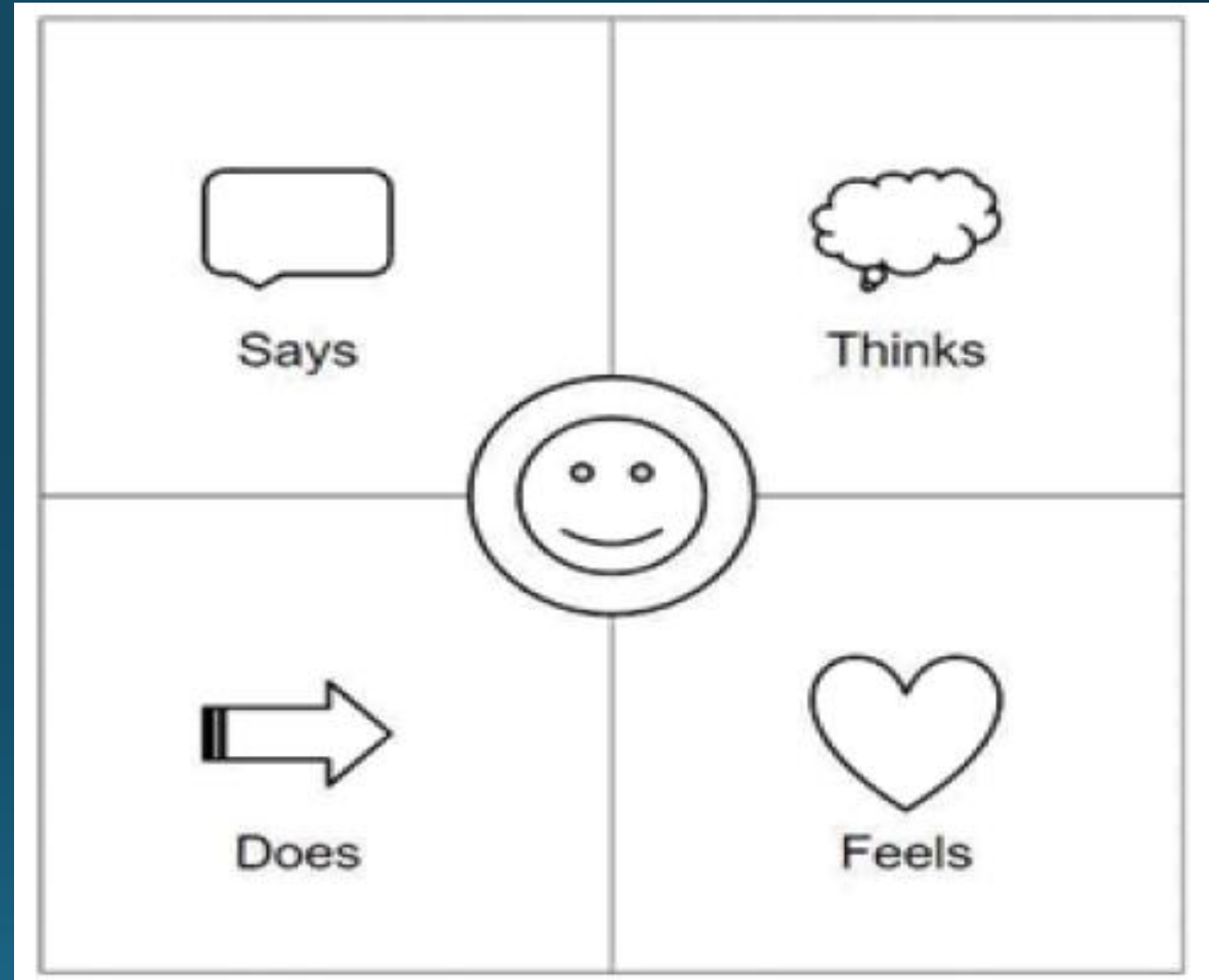
## i) Empathize

- Design thinking begins with empathy.
- In simple words, through empathy, one is able to put oneself in other people's shoes and connect with how they might be feeling about their problem, circumstance, or situation.
- Designers are expected to interact with customers / users very frequently to gather detailed facts about the problems and user's expectations.

## Empathy Map:

An extremely useful tool for understanding the users' needs and gaining a deeper insight into the problem at hand is the empathy map.

It also helps in deepening that understanding, gaining insight into the user's behavior.



- To create a “**persona**” or profile for the user, you can use the empathy map activity to create a realistic general representation of the user or users.
- Personas can include details about a **user’s education, lifestyle, interests, values, goals, needs, thoughts, desires, attitudes, and actions.**

An Empathy Map is divided into 4 quadrants.

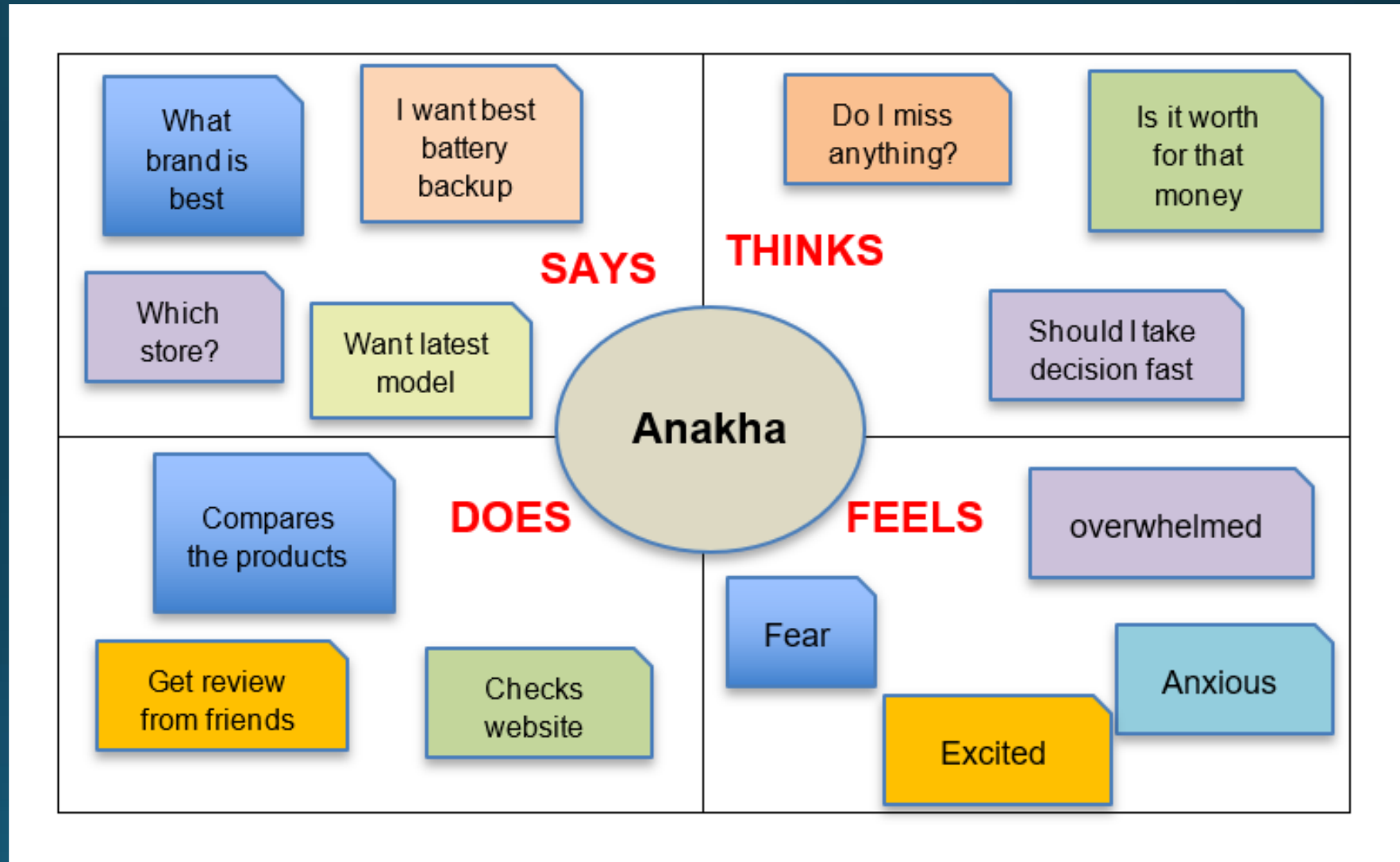
—Says, Thinks, Does, Feels

- **Says** – This quadrant contains whatever the user says aloud
- **Thinks** – This quadrant depicts the thoughts which user have about the problem
- **Does** – This quadrant depicts the actions of user
- **Feels** – This quadrant displays the emotional status of the user.



# Creating Empathy Map

Let us understand through an example. Anakha is having a desktop computer. She is planning to buy one new Laptop for her educational purpose.



Online tool to create Empathy Map

<https://online.visual-paradigm.com/diagrams/features/empathy-map-template/>

Reference: <https://www.ibm.com/design/thinking/page/toolkit/activity/empathy-map>



## Activity

Ashmitha daily drives to her office and back. The Office is hardly 30 minutes' drive from her home. However, due to traffic jams, it takes more than 1 hour. Ashmitha is hoping for a solution to this traffic issue. Prepare an Empathy map related to Ashmitha.

## SAYS

How can we escape from traffic

I want to go office early

Should I change my time of travel?

How will the ambulance go in this traffic?

Traffic is increasing pollution

Ashmitha

## THINKS

Should sort out the problems of traffic

Is traffic same all the day

should I change my vehicle

Will someone clear the traffic

## DOES

talks with traffic police to understand the issue more

changes the time of travel

changed to bike from car

## FEELS

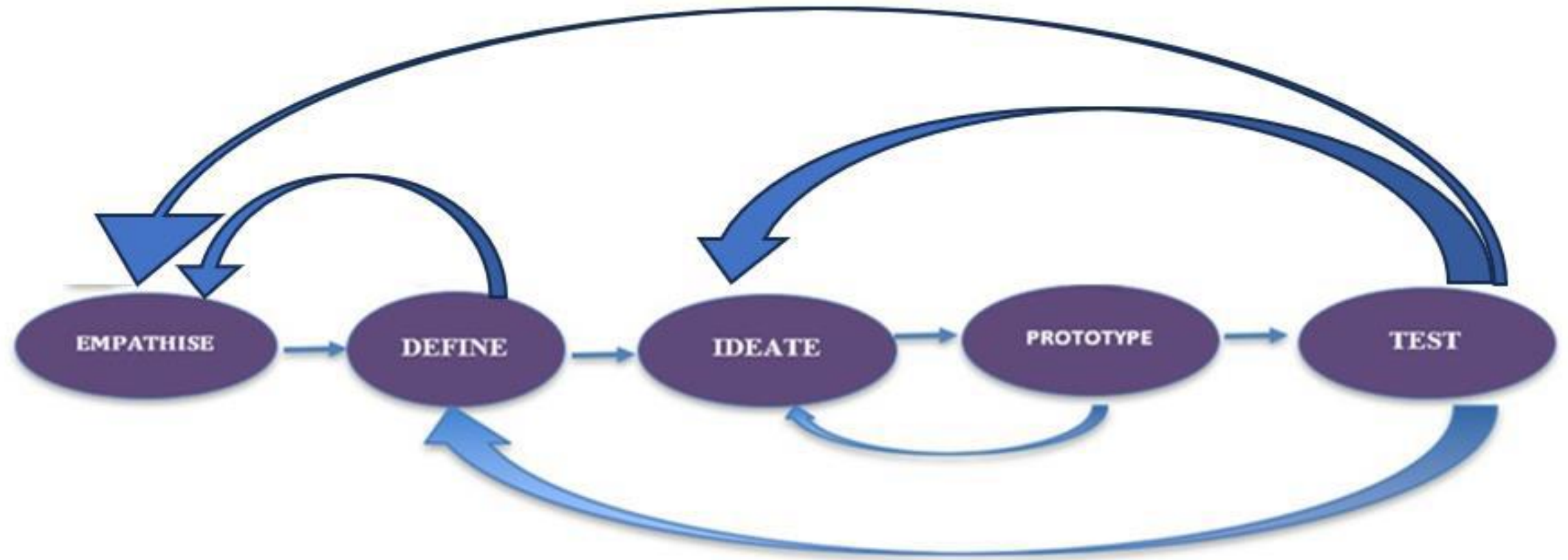
Angry

Stressed

Fear

Tired

Exhausted



## ii) Define

- In the Define stage, information collected during Empathize is used to draw insights and is instrumental in stating the problem that needs to be solved.
- In order to extract / gather relevant facts and information from users/customers, it is recommended to use this simple and reliable method of questioning: the 5W1H method—i.e. asking questions starting with **Who? What? When? Where? Why? and How?**

For Example,  
For the traffic issue in a city, we could define the problem in detail after getting the answers of 5W1H questions. Sample questions of the problem is given below

<u>Who ?</u>	<u>What ?</u>	<u>Where ?</u>
<ul style="list-style-type: none"><li>• Who are the sufferers?</li><li>• Who is responsible?</li><li>• Who can control it?</li><li>• Who all are involved in it?</li><li>• Who needs immediate help?</li><li>• Who questions it?</li><li>• Who identifies it?</li></ul>	<ul style="list-style-type: none"><li>• What can be done?</li><li>• What should be done?</li><li>• What is the issue?</li><li>• What causes the issue?</li><li>• What steps are necessary?</li><li>• What to be avoided?</li><li>• What may be the reason?</li></ul>	<ul style="list-style-type: none"><li>• Where is the problem seen?</li><li>• Where else it can occur?</li><li>• Where to start the solution?</li><li>• Where to concentrate more?</li><li>• Where are the issues severe?</li><li>• Where can we ignore issue?</li><li>• Where is solution impossible</li></ul>
<u>When ?</u>	<u>Why ?</u>	<u>How ?</u>
<ul style="list-style-type: none"><li>• When does traffic occurs?</li><li>• When can we start clearing the traffic?</li><li>• When is it more problematic</li><li>• When to think about a quick solution?</li><li>• When is traffic ignorable?</li></ul>	<ul style="list-style-type: none"><li>• Why traffic occurs?</li><li>• Why it becomes a problem?</li><li>• Why should we find a solution to it?</li><li>• Why to clear traffic in that city?</li><li>• Why can't we ignore traffic?</li></ul>	<ul style="list-style-type: none"><li>• How will we find a solution?</li><li>• How to deal with the traffic?</li><li>• How to manage the users affected by traffic?</li><li>• How to solve without creating more issues?</li><li>• How to identify the traffic?</li></ul>



## Activity

Considering Ashmitha's traffic issue answer the following questions given below in order to help define the problem.

**a. Who is the sufferer of the Problem?**

All the people who travel through the traffic area.

**b. What is the Problem?**

Due to heavy traffic, people are not able to reach the office on time, all are wasting a lot of time.

**c. Where does it happen?**

In busy streets, places with bad roads, Accident prone areas.

#### d. When can it happen usually?

Especially during the morning and evening hours when schools/offices start and ends.

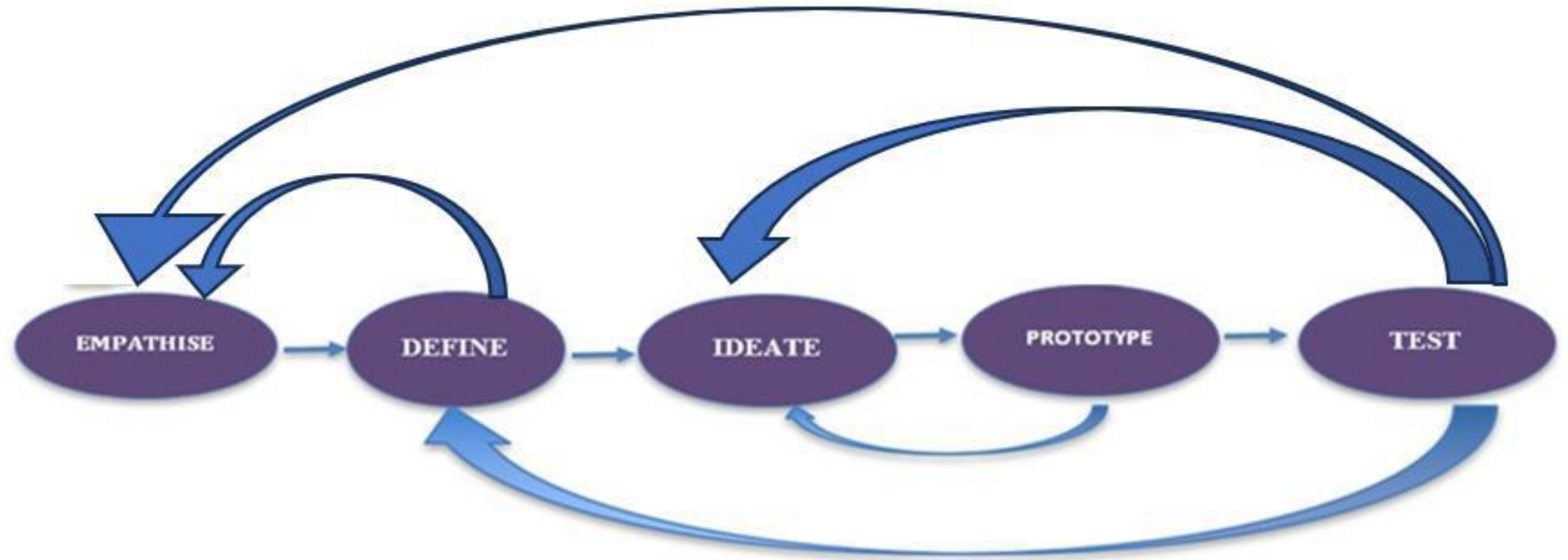
#### e. Why does it happen?

It may happen due to many reasons such as: a. Bad Roads, b. Accidents, c. Office Hours, d. Rash Driving, e. Inappropriate Signals, f. Over Crowded Area

#### f. How can it be solved?

It can be solved by developing a system which could prevent intense traffic by giving some suggestions





### iii) Ideate

- Ideation is all about idea generation.
- During brainstorming, one should not be concerned if the generated ideas are possible, feasible, or even viable.
- The only task of the thinkers is to think of as many ideas as possible for them.
- It requires "going wide" mentally in terms of concepts and outcomes.
- There are many brainstorming tools that can be used during this stage.

## Brainstorm

- During a Brainstorming session, students leverage the synergy of the group to generate new innovative ideas by building on others' ideas.
- Participants should be able to discuss their ideas freely without fear of criticism.
- A large number of ideas are collected so that different options are available for solving the challenge.

## Brain dump

- Brain dump is very similar to Brainstorm; however, it's done individually.
- It allows the concerned person to open the mind and let the thoughts be released and captured onto a piece of paper.
- The participants write down their ideas onto paper or post-it notes and share their ideas later with the larger group.

## Brain writing

- Brain writing is also very similar to a Brainstorm session and is known as 'individual brainstorming'.
- The participants write down their ideas on paper and, after a few minutes, pass on their own piece of paper to another participant who then elaborates on the first person's ideas and so forth.
- After about 15 minutes, the papers are collected and posted for instant discussion.
- After everyone shares their ideas, specific measures are applied to evaluate the ideas without being judgmental or critical to narrow the list.
- It may so happen that the solution comes from the unlikeliest of ideas. So, at this point focus is on quantity over quality of ideas.
- The most feasible ideas are chosen for further exploration. Storyboarding, or making a visual mock-up of an idea, can also be useful during ideation.



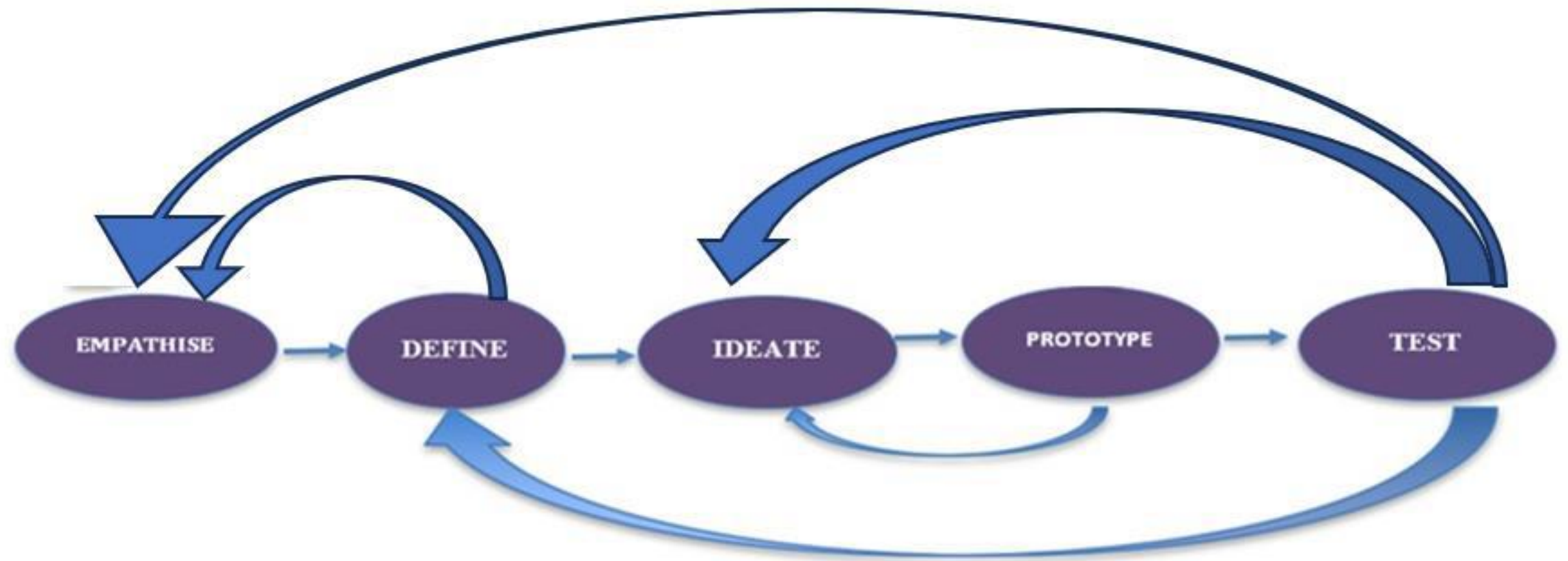
For the traffic problems in a city, brainstorm and generate different ideas as a team.

Some of the ideas generated by brainstorming a team is given below:

1. Give **alternate route suggestions** through Digital boards kept at important junctions identifying the traffic so that it could control traffic getting worsen
2. Make some system so that the **percentage of road issues and the severity of traffic issue can be predicted**. It may be seriously taken by officials and they will consider repairing of roads.

3. Keep track of rash driving persons. If more than one time the rash driving person causes traffic issues, his/her license can be cancelled.
4. Make some systems to clear the area immediately when accidents occur, so that traffic doesn't cause issue.
5. Signaling system should be rearranged if found inappropriate.
6. Announce the traffic areas live, so other people won't drive into traffic area.
7. Introduce Intelligent Traffic Signal.

[ All these are ideas and does not require to be implemented]





## iv) Prototype

- The prototype stage involves creating a model designed to solve consumers' problems which is tested in the next stage of the process.
- Creating a prototype is not a detailed process. It may include a developing simple drawing, poster, group role-playing, homemade “gadget, or a 3d printed product.”
- The prototypes must be quick and easy to develop and cheap.
- Prototyping is intended to answer questions that get you closer to your final solution.
- Prototypes can be made with everyday materials also.

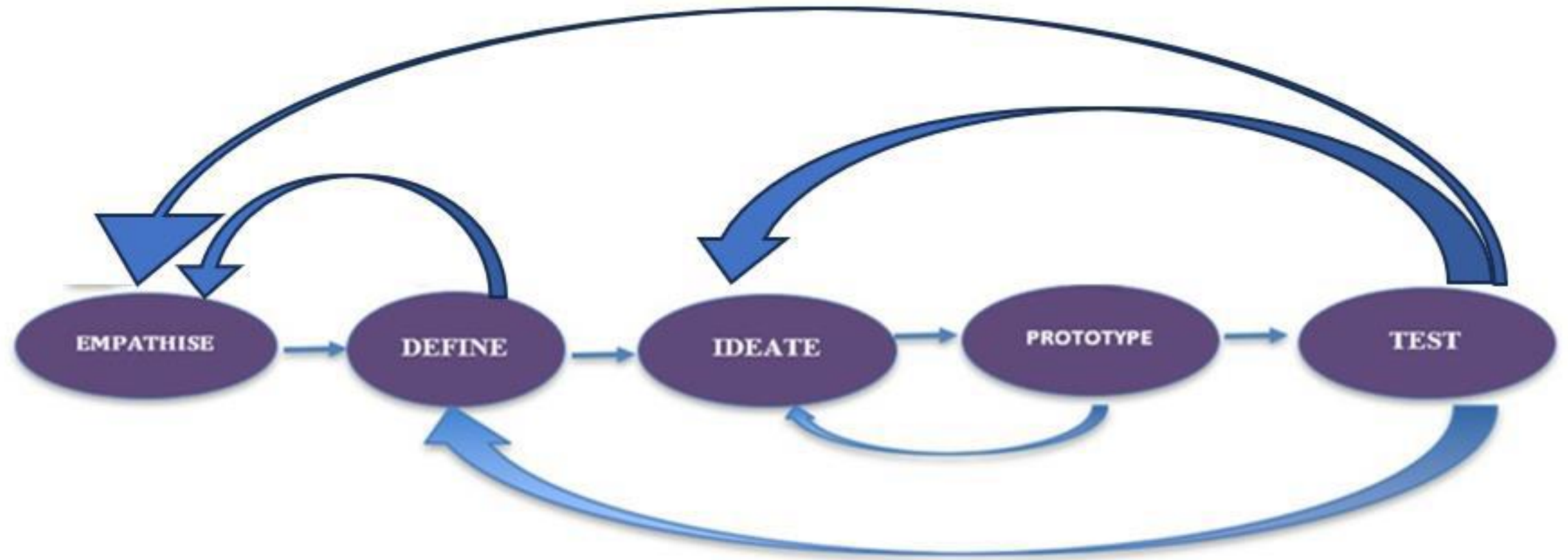


## Activity

Through a poster or simple drawing depict a prototype for any one solution for the traffic issue.

### Controlling Traffic with Intelligent Signals





## v) Test

- One of the most important parts of the design thinking process is to **test the prototypes** with the end users.
- This step is often seen going **parallel to prototyping**.
- During testing, the designers **receive feedback** about the prototype(s), and **get another opportunity to interact and empathize** with the people they are finding solutions for.



## Activity

Show the prototype made by you to your parents/teachers/relatives who usually get stuck in traffic issues. Collect the feedback from them and understand whether your prototype will work or not.

Write down the views your users shared and the conclusion you arrived.

Response after Testing the Prototype:

- Very good if it controls the traffic
- What happens if from all sides equal traffic block comes in a road
- Will be good before traffic jam.

# Sustainable Development Goals

## SUSTAINABLE DEVELOPMENT GOALS





## For example:

- SDG 2 was adopted to achieve “Zero Hunger”.
- That means it is essential to recognize that the successful transformation of our current food systems (shift to a sustainable food system) should tackle the main global challenges in a sustainable, healthy, and inclusive manner.
- Healthy food habits, food Supply to all areas, consumption of food as per the production, Seasonal Foods etc. are the areas where students can concentrate for identifying problems and try to derive simple AI based solution.

## Some other use cases of the SDGs are given below

- Good health and well being
- Gender equality
- Renewable energy
- Combating hunger and poverty
- Protecting resources
- Promoting responsible consumption and production
- Providing access to education
- Sustainable and safe cities and communities





Write down a few problems which you notice from any five SDGs which can be taken up as a Capstone project.

**a. Quality Education:**

- i. Providing education remotely, leveraging hi-tech, low-tech and no-tech approaches;
- ii. Ensure coordinated responses and avoid overlapping efforts;
- iii. Ensuring return of students to school when they reopen to avoid an upsurge in dropout rates.

## b. Reduced inequalities:

- i. Reduction of relative economic inequalities inequality in some countries having poorest and most vulnerable communities.
- ii. Improving the situations in countries with weaker health systems.

### c. Life on Land:

- i. Prevention of Deforestation caused by humans and restoration of land
- ii. Preventions and cure of diseases that are transmissible between animals and humans

#### d. No Poverty

- i. Creation of Strong social protection systems to prevent people from falling into poverty
- ii. Reduction of social exclusion, and high vulnerability of certain populations to disasters and diseases.
- iii. Responsible distribution of resources.

## e. Clean Water and Sanitation

- i. To increase access to clean drinking water and sanitation mostly in rural areas
- ii. Managing our water sustainably to manage our production of food and energy

# Project Abstract Creation Using Design Thinking Framework

## Format for Project Abstract Creation

1. Project Name:
2. Team Members Name:
3. Problem Selection –Important issue which you think can be solved using AI by doing survey or interview and which is aligned to any of the SDGs.
4. Users Affected by the Problem
5. Empathise – create Empathy Map
6. Define the Problem – Write down the 5W1H questions and write the problem statement
7. Ideate – Brainstorm and write down the ideas
8. Prototype- create prototype by simple drawing, poster, group role-playing, homemade “gadget, or a 3d printed product.”
9. Test (optional at this stage)

## Now let us see an example

1. Project Name: {Suitable name related to your problem and your creativity}
2. Team Members Name: { Students can fill by themselves}
3. Problem Selection: After doing a survey amongst the school students who are in Class X, it was observed that most of the students are confused about the subjects that they have to choose in future.

## Details about the issue:

- While taking admission to plus-two courses, students are confused with subject selection.
- To provide quality education students should be provided with the subjects in which they have aptitude.
- A system to analyze their interests, choose subjects from the available options and choose the institutions which provide those subjects are a big problem.
- After seeing the issue, it was aligned to SDG-4, Quality Education.



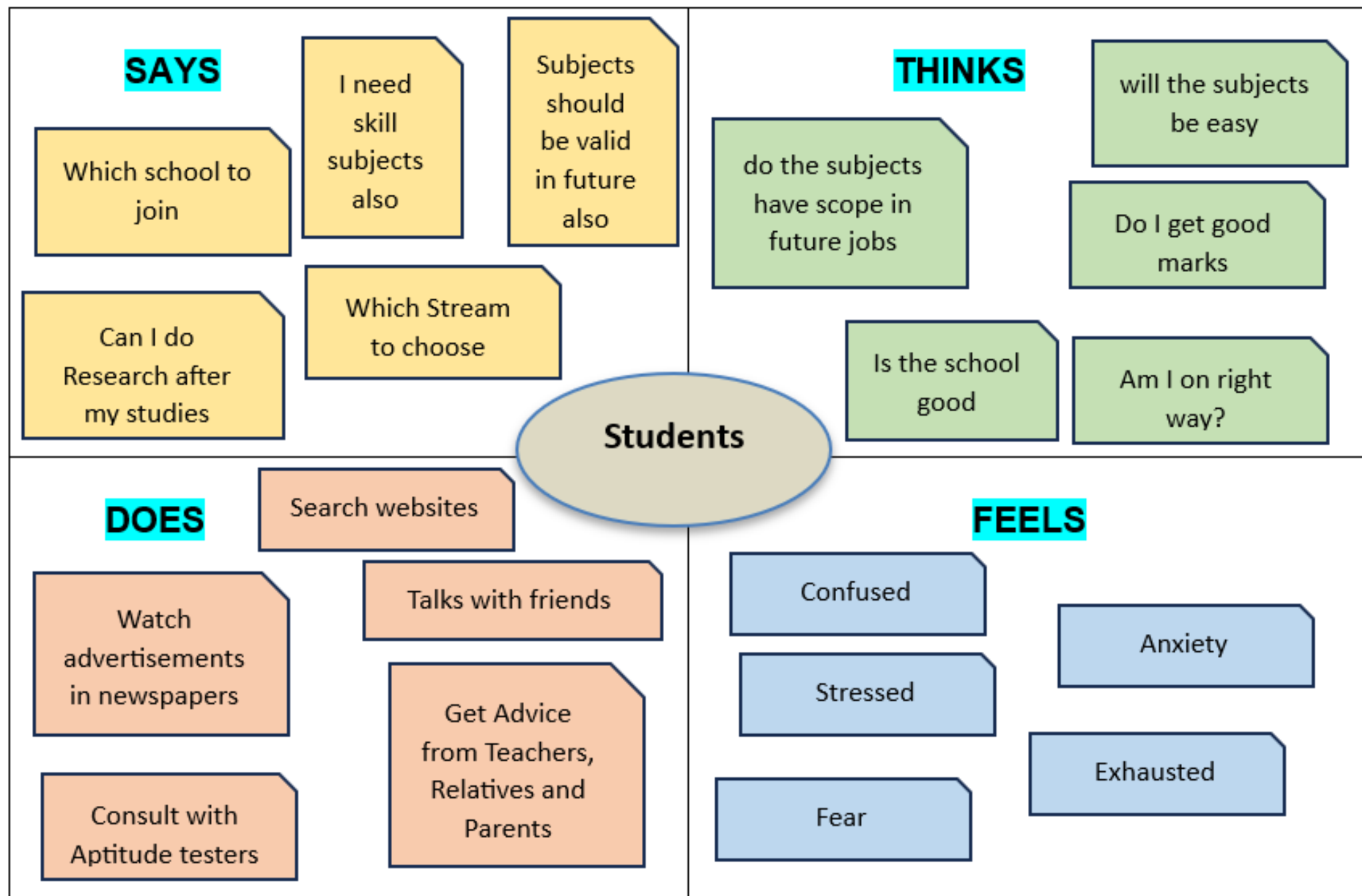
## Users:

All the students who pass class X face the issue of selecting an appropriate subject for their higher studies as it is their turning point to move on according to their interest.

## Empathise:

Two categories of students can be met and interviewed.

- **First**—Those students who are studying in plus-two (to know how difficult it was to choose a subject and a school)
- **Second**—Those students who are going to take admission (can know about their anxieties and expectations)



## Define

- After Empathetically understanding the students, the problem may be defined.
- Get the Answers of 5W1H Questions. Write down the Problem Statement.

## 5W1H Questions & Answers

### Who?

1. Who are the users?

Students seeking admission in plus-two course

2. Who else can be the users?

Parents/well-wishers who seek admission for their wards

3. What do you know about the users?

Users are students who are interested in taking plus-two admissions. Students have well defined future plans. Now they have to select the appropriate subject as per their plan.

## What?

1. What is the Problem?

Not able to select the subject of their choice

2. What else are the Problems?

They can't choose the school which provides these subjects.

## Where?

1. Where is the problem/ In which situation does the problem arises.?

All the places where admission takes place & all the place where students wish to take admission the problem persists.

## When?

1. When does the problem occur?

Problem occurs during the time of admission

## Why?

1. Why does the problem occur?

Problem occurs due to the lack of knowledge of subjects available as part of the curriculum

2. Why should it be solved?

Only if students pursue the course, they have aptitude, a well-developed society can be built in future.



## How

1. How can we solve it?

Through a system which will analyze a student's aptitude and suggests the subject to take. After checking the database, the system can suggest the schools giving the subject combinations also.

2. How will the solution improve the situation?

The solution could help students in choosing the appropriate subjects and could give effective education

## PROBLEM STATEMENT

Our students have the problem of not being able to choose the subjects of their interest while taking admission to their plus-two course and it can be solved by developing a system which will analyze students' aptitude and suggest the subject to take.

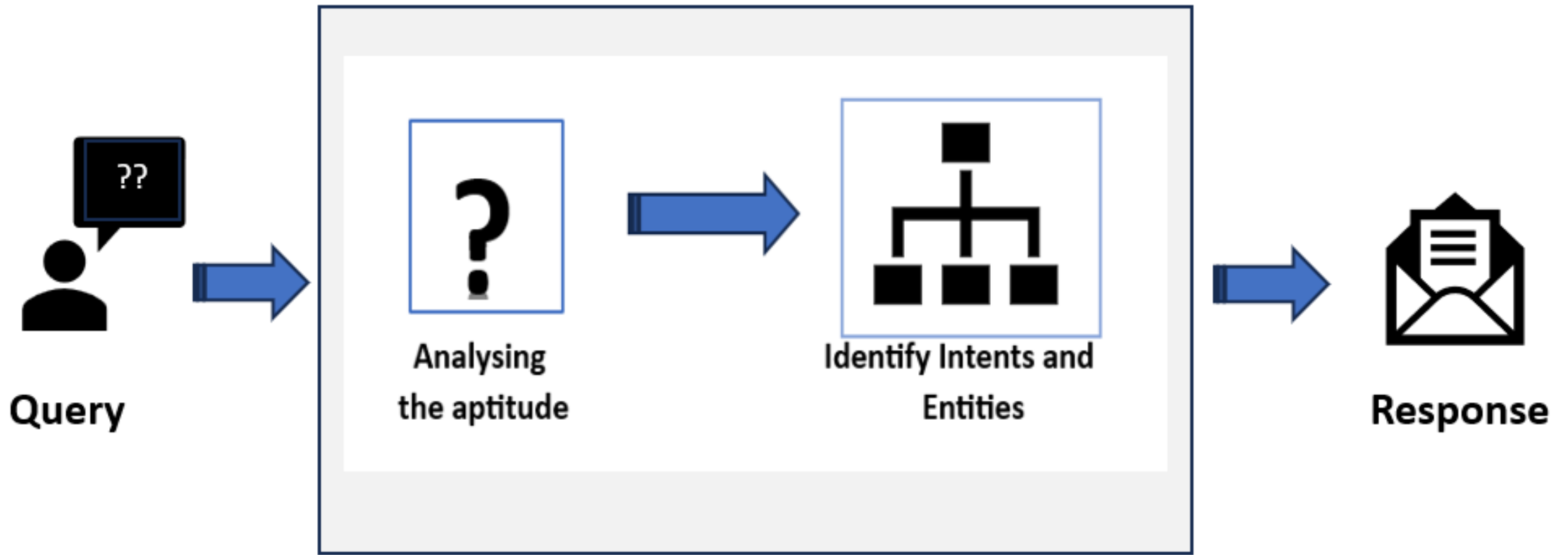
## Ideate

As a team students can discuss and put forward different ideas to implement the solution

1. Create an application to input the interest and get suggestions on subjects
2. Create a chatbot to converse with
3. Make a robot to discuss with and give advice
4. Create a mobile application where through different sources queries can be given and the application will give the result.

## Prototype

Select any one idea and prepare the prototype of the solution - Here we select the idea of creating a chatbot to give the solution



THANK YOU