ACES NEWSLETTER: THE ACES PULSE

Wednesday,
October 4, 2023

Data Structures : Beyond the Books

Understanding the real-world applications of data structures is crucial for tech enthusiasts for several reasons. Firstly, it bridges the gap between theory and practice, allowing them to apply their knowledge in practical scenarios. Secondly, it enhances problem-solving skills by providing effective tools to organize and manipulate data efficiently, a skill vital in software development. Thirdly, it prepares them for job interviews and industry roles where data structures are fundamental. Fourthly, it fosters innovation by inspiring them to develop novel solutions to real-world challenges. Lastly, it cultivates a deeper appreciation for the impact of data structures in modern technology, motivating them to stay current and adaptable in an ever-evolving field.

Arrays in image processing

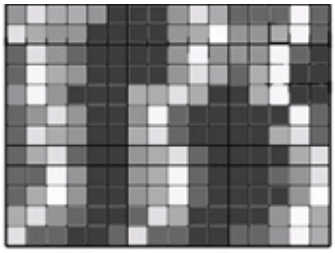
Arrays are used to store the pixels in an image. Each pixel is represented by a three-element array, where the first element is the red value, the second element is the green value, and the third element is the blue value.

To render an image, the computer starts at the top-left pixel and reads the RGB values from the array. It then sets the colour of the pixel on the screen to the corresponding RGB values. The computer then moves to the next pixel in the array and repeats the process.

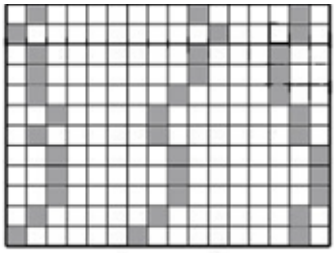
Example

Let's say we have a simple image that is 10 pixels wide and 10 pixels high. The image data would be stored in an array that is 100 elements long, with each element representing a pixel. The first 10 elements of the array would represent the pixels in the top row of the image, the next 10 elements would represent the pixels in the second row of the image.

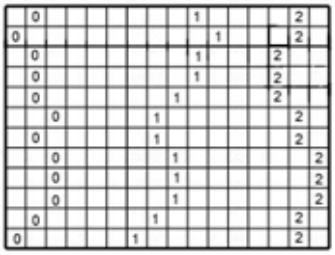
To render the image, the computer would start at the first element of the array and read the RGB values. It would then set the pixel's colour at the screen's top-left corner to the corresponding RGB values. The computer would then move to the next element in the array and read the RGB values. It would then set the colour of the pixel next to the top-left pixel to the corresponding RGB values. The computer would continue this process until it has rendered all of the pixels in the image.



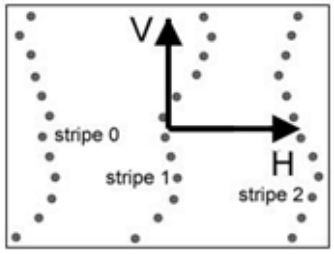
bitmap array A_B



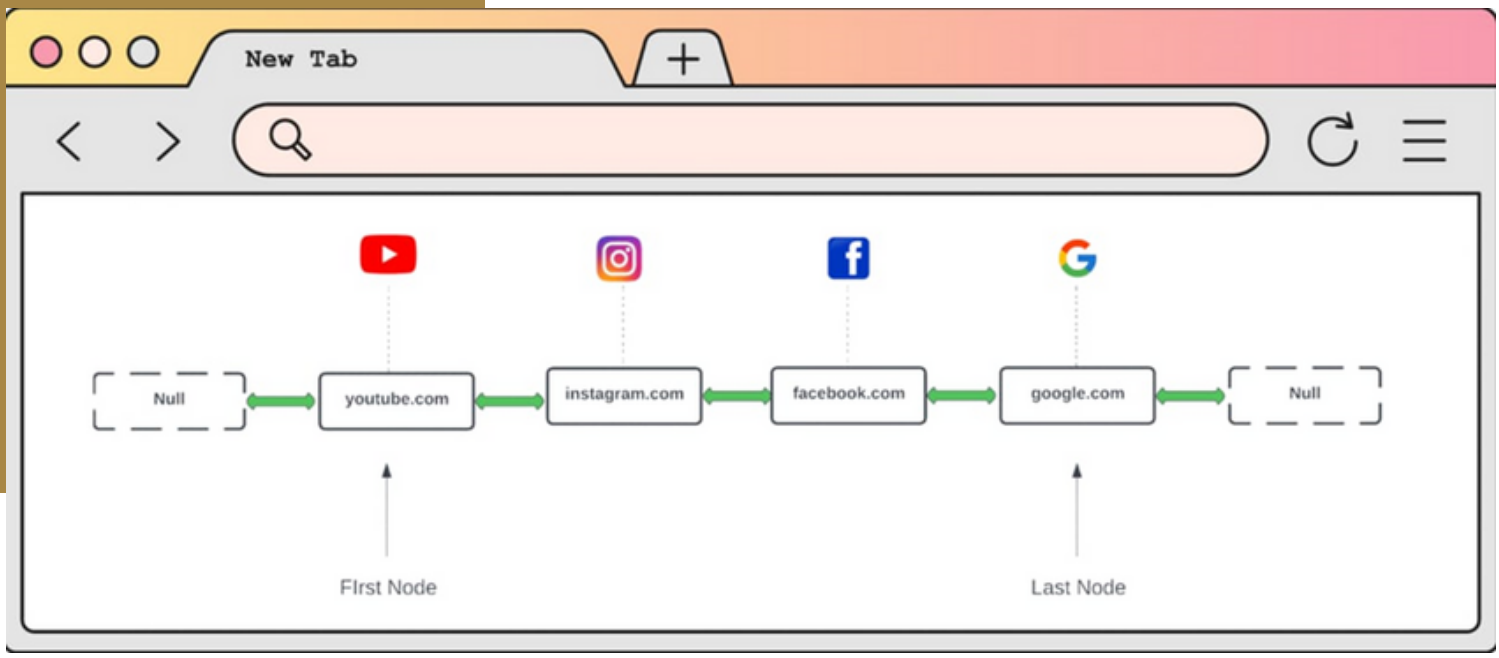
peak array A_P



index array A_I



indexed points I



Linked lists in web browser history

Linked lists are used to store the history of a web browser. Each item in the linked list represents a web page that the user has visited. The items in the linked list are stored in the order that the user visited the pages.

To display the user's history, the web browser starts at the first item in the linked list and displays the web page associated with that item. The web browser then moves to the next item in the linked list and displays the web page associated with that item.

For example, let's say we have a web browser with the following history:

Google

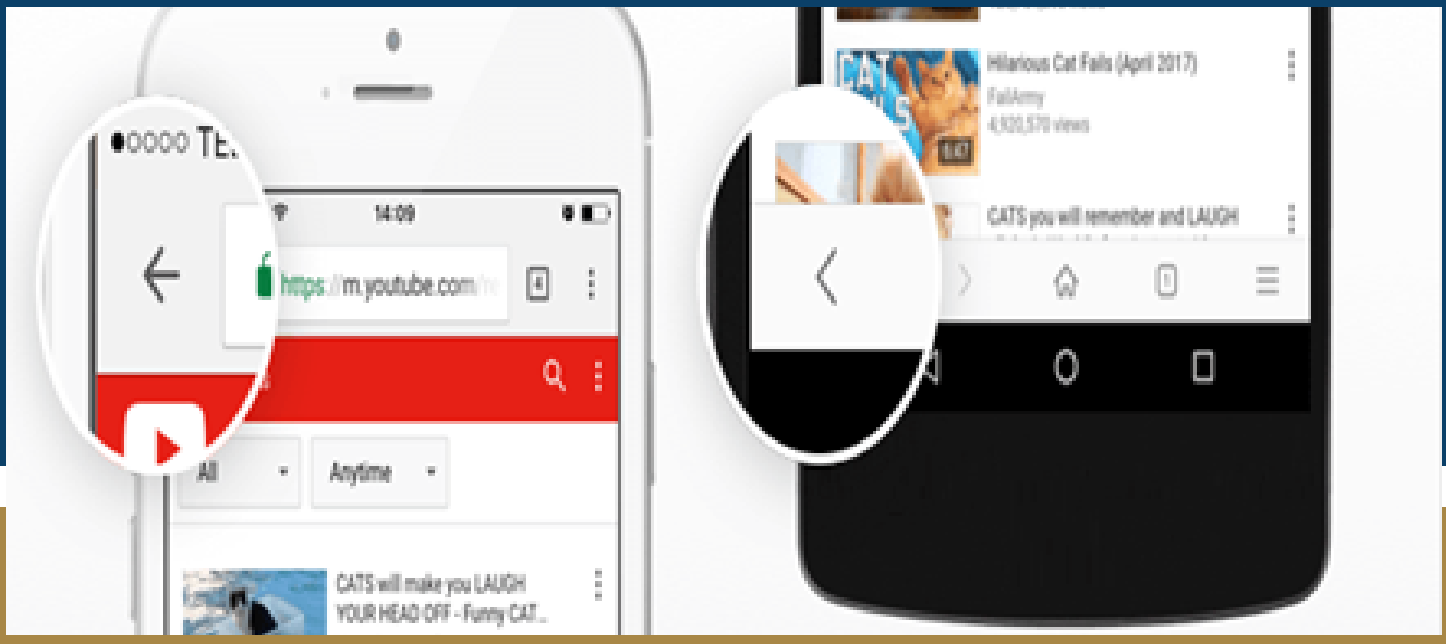
Facebook

Twitter

The web browser would store this history in a linked list with the following structure:

Head -> Google -> Facebook -> Twitter -> Tail

To display the user's history, the web browser would start at the head of the linked list and display the web page associated with that item, which is Google. The web browser would then move to the next item in the linked list, which is Facebook, and display that web page. The web browser would continue this process until it reaches the tail of the linked list.

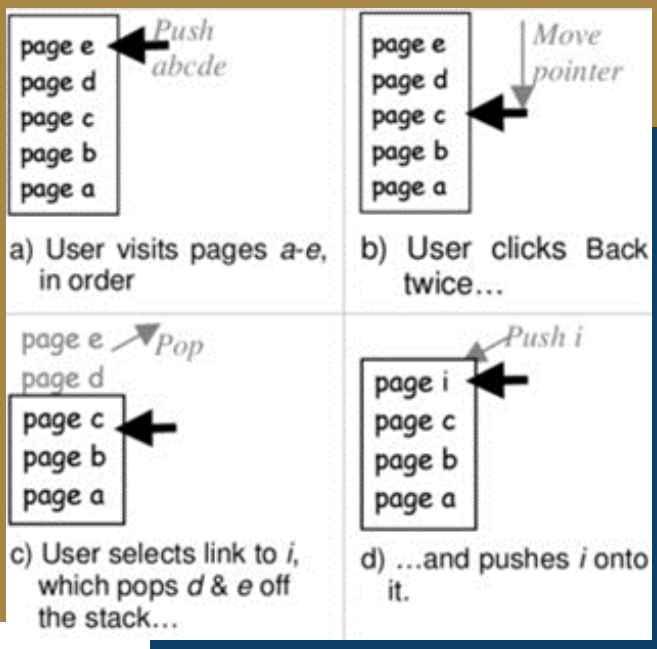


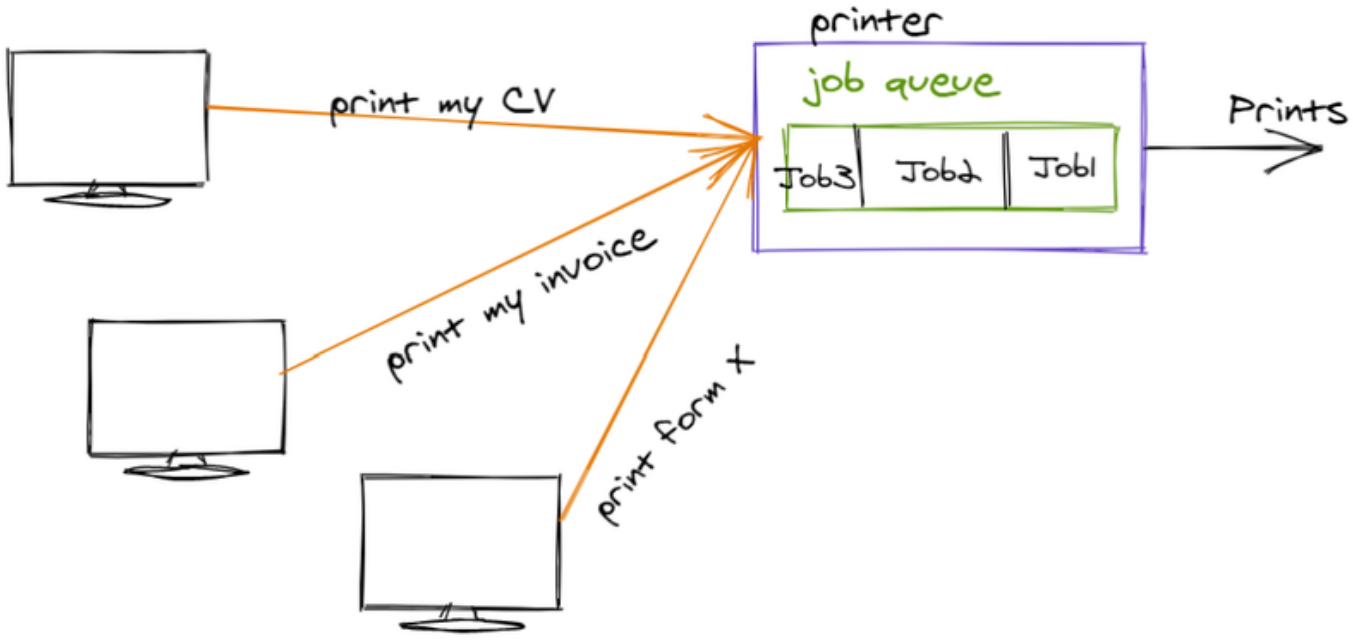
Stacks in the back button of a web browser

Stacks are used to implement the back button in a web browser. When the user clicks on the back button, the web browser pops the current web page off the stack and displays the previous web page.

To implement the back button, the web browser maintains a stack of all the web pages that the user has visited. When the user clicks on the back button, the web browser pops the current web page off the stack and displays the previous web page.

For example, let's say we start with a web browser that is displaying the Google homepage. We then click on the back button. The web browser would pop the Google homepage off the stack and display the previous web page, which is the blank web page that we started with.



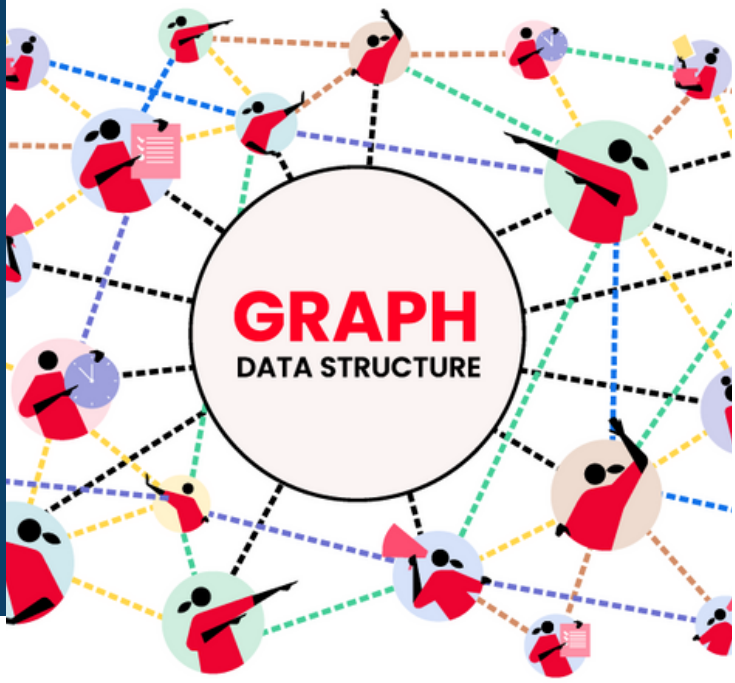


Queues in the print queue

Queues are used to implement the print queue in an operating system. When the user submits a print job, the operating system adds the print job to the queue. The operating system then prints the print jobs in the order that they were added to the queue.

To implement the print queue, the operating system maintains a queue of all the print jobs that have been submitted. When the printer is available, the operating system removes the first print job from the queue and prints it.

For example, let's say we have a printer that is currently printing a document. We then submit a new print job. The operating system would add the new print job to the queue. The
operating system would then wait until the printer is finished printing the current document before starting to print the new print job.



Graphs

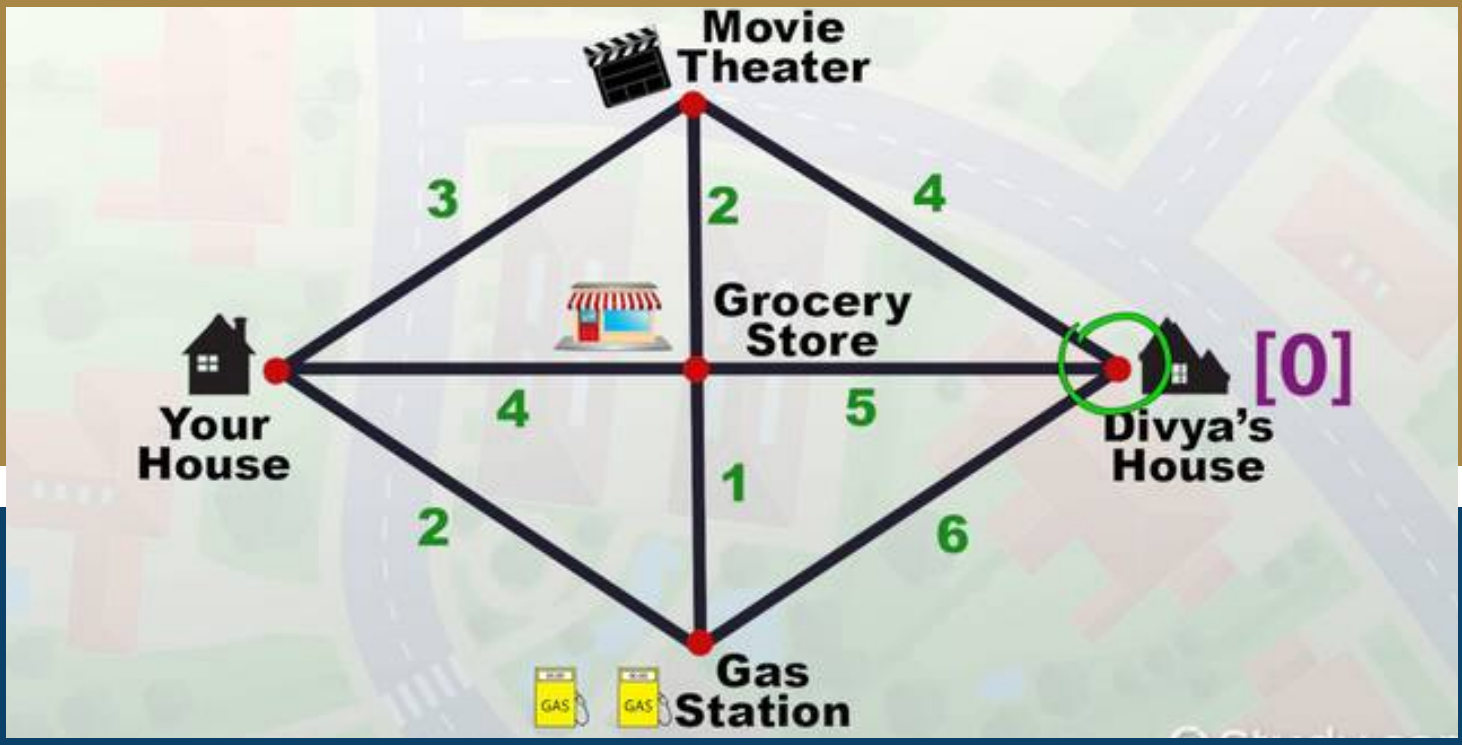
Graphs are a data structure that represents relationships between data elements. Graphs are used in a wide variety of applications, including social networks, navigation systems, and scheduling algorithms.

Applications: Graphs are also used in a variety of applications, such as:

- Recommender systems: Graphs can be used to recommend products, movies, and other items to users.
- Fraud detection: Graphs can be used to detect fraudulent transactions and other anomalous activity.
- Network analysis: Graphs can be used to analyse the structure and behaviour of networks, such as computer networks and social networks.

Here are some examples of how graphs are used in real-world :

1. Social networks: Graphs are used to represent the relationships between users in a social network. For example, a graph could be used to represent the friendship network on Facebook. In this graph, each node would represent a user, and each edge would represent a friendship between two users.
2. Navigation systems: Graphs are used to represent the roads in a navigation system. For example, a graph could be used to represent the roads in a city. In this graph, each node would represent a road intersection, and each edge would represent a road segment.
3. Scheduling algorithms: Graphs are used to represent the tasks and dependencies in a scheduling algorithm. For example, a graph could be used to represent the tasks in a software development project. In this graph, each node would represent a task, and each edge would represent a dependency between two tasks.



How graphs can be used to solve a real-world problem ?

Problem: Find the shortest path between two points on a map.

Solution: We can use a graph to represent the roads on the map. Each node in the graph would represent a road intersection, and each edge in the graph would represent a road segment. We can then use a graph search algorithm, such as Dijkstra's algorithm, to find the shortest path between the two points.

Dijkstra's algorithm works by maintaining a set of visited nodes and a set of unvisited nodes. The algorithm starts by initializing the set of visited nodes to be empty and the set of unvisited nodes to contain all of the nodes in the graph. The algorithm then selects the node from the set of unvisited nodes with the shortest distance from the start node. The algorithm then marks this node as visited and updates the distances of all of its neighbours. The algorithm continues this process until it reaches the end node. Once the algorithm reaches the end node, the shortest path from the start node to the end node can be found by tracing back the path through the visited nodes.

Graphs are a powerful data structure that can be used to solve a wide variety of real-world problems.

Resources , Games and Fun Activity :

1. DSA resources and Problem Solving Platforms:
   - GeeksforGeeks
   - LeetCode
   - HackerRank
   - CodeChef
   - Codeforces
   - TopCoder

   Love Babbar DSA

   Striver DSA Cheat Sheet

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2. Game

   You be the detective! This is an image of a messy house; can you identify no of persons living here?

*Answer at the end of the newsletter!

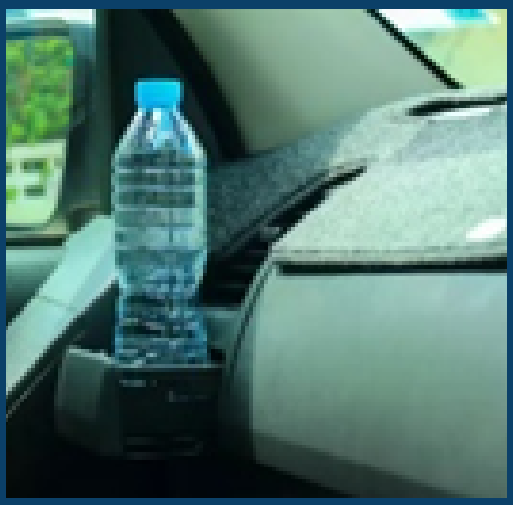
3. Horror story: A Haunted Shortcut

By Atharva Pathak

That day, Mona had a high-level meeting with a group of managers in Rajasthan. She lived in a nearby city, and the meeting required her to travel 150 kilometers. The meeting lasted until 10:00 PM, and Mona had to return home the same night. She decided to take a shortcut, which she found on Google Maps.

However, the shortcut was deserted. Not a single person or vehicle was in sight. Mona drove her car at high speed, with the music on full blast. Suddenly, she felt thirsty. She searched for her water bottle, which she had filled to the brim before leaving for the meeting. To her surprise, the bottle was empty, even though she hadn't taken a sip. Mona felt uneasy.

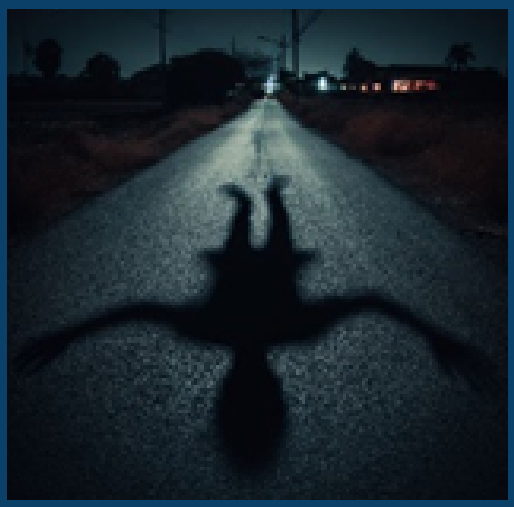
A few minutes later, she saw a tea shop. She immediately stopped her car and went inside to buy a water bottle. The shopkeeper was an old man with a weathered face. Mona asked him for a water bottle, and he gave her one. She drank it greedily, quenching her thirst.



Then, Mona asked the shopkeeper about the shortcut route. He laughed in a strange way and said, "This road never ends. Just keep driving until you reach your destination.
Mona thought the shopkeeper was drunk, so she ignored him and got back into her car. She started driving again, with the water bottle on the passenger seat.

After a while, she opened the bottle to take another sip. But this time, she was shocked. The manufacturing date on the bottle was 25 years old!

Mona threw the bottle out the window in disgust. A few hours later, the streetlights went out, and a cold breeze swept through the air. The only light came from Mona's headlights. She continued driving, but the road seemed endless.



Suddenly, a man with a smiling face appeared in front of her car. Mona slammed on the brakes and got out of the car to ask him why he was standing in the middle of the road

But when she got out, she only saw a large shadow of the man, but no body.

Mona was terrified. She immediately got back in the car and drove away. But when she looked in the rearview mirror, she saw the man again, standing in the middle of the road with the same eerie smile. This time the face of man was extremely evil.

This time, Mona decided to drive as fast as she could. She drove for 50 kilometers, then 70 Kilometers, but the road never ended. She was returning to the same spot again and again. Mona was terrified. This went on until the next morning.

At dawn, Mona saw the same tea shop where she had stopped for the water bottle the night before. But when she saw it, she was filled with dread. The shop looked like it had been closed for 20 or 30 years. Mona managed to find another route to her destination.

Even today, when she remembers that night, she gets chills.

Answer to the game:
In the image, there is only one single teacup,
hence only one person lives in the house

Team ACES 23-24