

# AI ASSISTANT CODING

## ASSIGNMENT-11.5

**Course Title : AI Assisted Coding**

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### **Lab 11 – Data Structures with AI: Implementing Fundamental Structures**

#### **Task Description #1 – Stack Implementation**

Task: Use AI to generate a Stack class with push, pop, peek, and is\_empty methods.

Sample Input Code:

```
class Stack:
```

```
pass
```

Expected Output:

- A functional stack implementation with all required methods and docstrings.

```
"""Prompt:
Generate a Python class named Stack that implements the stack data
structure using a list. The class should include the following
methods:
push(item) - to add an element to the top of the stack
pop() - to remove and return the top element
peek() - to return the top element without removing it
is_empty() - to check whether the stack is empty
Include proper docstrings for the class and each method. Handle edge
cases such as popping from an empty stack."""
```

```
main.py  Run  Output
10 class Stack:
11     """
12     A class to represent a stack data structure.
13     Uses a Python list to store stack elements.
14     """
15     def __init__(self):
16         """Initialize an empty stack."""
17         self.items = []
18
19     def push(self, item):
20         """
21         Add an element to the top of the stack.
22         :param item: Element to be added to the stack
23         """
24         self.items.append(item)
25
26     def pop(self):
27         """
28         Remove and return the top element of the stack.
29         :return: Top element of the stack
30         :raises IndexError: If the stack is empty
31         """
32         if self.is_empty():
33             raise IndexError("Pop from empty stack")
34         return self.items.pop()
35
36     def peek(self):
37         """
38         Return the top element without removing it.
39         :return: Top element of the stack
40
41     def is_empty(self):
42         """
43         Check whether the stack is empty.
44         :return: True if stack is empty, False otherwise
45         """
46         return len(self.items) == 0
47
48 if __name__ == "__main__":
49     stack = Stack()
50
51     stack.push(10)
52     stack.push(20)
53     stack.push(30)
54
55     print("Top element:", stack.peek()) # 30
56     print("Popped element:", stack.pop()) # 30
57     print("Is stack empty?", stack.is_empty()) # False
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```

""" Prompt:  
Generate a Python class named Queue that implements a FIFO (First-In-First-Out) queue using a Python list. The class should include the following methods:

enqueue(item) - to add an element to the rear of the queue  
dequeue() - to remove and return the front element  
peek() - to return the front element without removing it  
size() - to return the number of elements in the queue """

```
main.py  Run  Output  Clear
11- class Queue:
12-     """
13-     A class to represent a FIFO (First-In-First-Out) queue.
14-     Uses a Python list to store queue elements.
15-     """
16-     def __init__(self):
17-         """Initialize an empty queue."""
18-         self.items = []
19-
20-     def enqueue(self, item):
21-         """
22-         Add an element to the rear of the queue.
23-         :param item: Element to be added to the queue
24-         """
25-         self.items.append(item)
26-
27-     def dequeue(self):
28-         """
29-         Remove and return the front element of the queue.
30-         :return: Front element of the queue
31-         :raises IndexError: If the queue is empty
32-         """
33-         if self.is_empty():
34-             raise IndexError("Dequeue from empty queue")
35-         return self.items.pop(0)
36-
37-     def peek(self):
38-         """
39-         Return the front element without removing it.
40-         :return: Front element of the queue
41-         :raises IndexError: If the queue is empty
42-         """
43-         if self.is_empty():
44-             raise IndexError("Peek from empty queue")
45-         return self.items[0]
46-
47-     def size(self):
48-         """
49-         Return the number of elements in the queue.
50-         :return: Number of elements in the queue
51-         """
52-         return len(self.items)
53-
54-     def is_empty(self):
55-         """
56-         Check whether the queue is empty.
57-         :return: True if queue is empty, False otherwise
58-         """
59-         return len(self.items) == 0
60-
61- if __name__ == "__main__":
62-     queue = Queue()
63-
64-     queue.enqueue(10)
65-     queue.enqueue(20)
66-     queue.enqueue(30)
67-     print("Front element:", queue.peek()) # 10
68-     print("Dequeued element:", queue.dequeue()) # 10
69-     print("Queue size:", queue.size()) # 2
```

Front element: 10  
Dequeued element: 10  
Queue size: 2  
=== Code Execution Successful ===

### Task Description #3 – Linked List

Task: Use AI to generate a Singly Linked List with insert and display methods.

Sample Input Code:

class Node:

pass

class LinkedList:

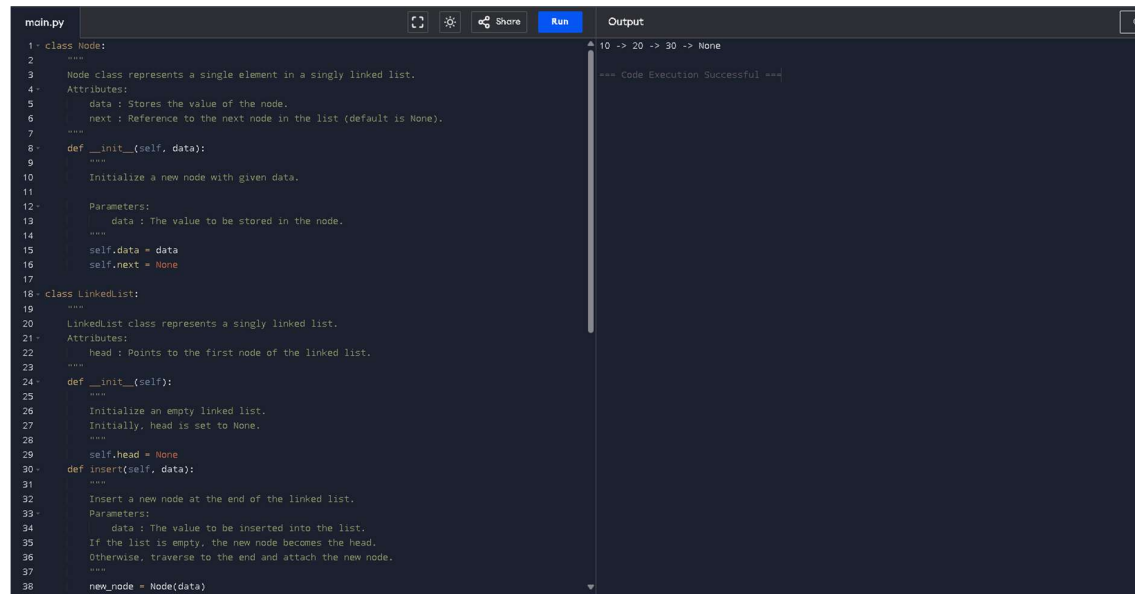
pass

Expected Output:

- A working linked list implementation with clear method documentation

```
""" Prompt:
Generate a Python implementation of a Singly Linked List.
Create a Node class to store data and a reference to the next node.
Create a LinkedList class with the following methods:

insert(data) - to insert a new node at the end of the list
display() - to display all elements of the linked list
Include clear docstrings for all classes and methods. """
```



```
main.py 10 -> 20 -> 30 -> 40 -> None
1 class Node:
2     """
3     Node class represents a single element in a singly linked list.
4     Attributes:
5     data : Stores the value of the node.
6     next : Reference to the next node in the list (default is None).
7     """
8     def __init__(self, data):
9         """
10        Initialize a new node with given data.
11        """
12        Parameters:
13        data : The value to be stored in the node.
14        """
15        self.data = data
16        self.next = None
17
18 class LinkedList:
19     """
20     LinkedList class represents a singly linked list.
21     Attributes:
22     head : Points to the first node of the linked list.
23     """
24     def __init__(self):
25         """
26        Initialize an empty linked list.
27        Initially, head is set to None.
28        """
29        self.head = None
30
31     def insert(self, data):
32         """
33        Insert a new node at the end of the linked list.
34        Parameters:
35        data : The value to be inserted into the list.
36        If the list is empty, the new node becomes the head.
37        Otherwise, traverse to the end and attach the new node.
38        """
39        new_node = Node(data)
```

```
main.py 10 -> 20 -> 30 -> None
34 data : The value to be inserted into the list.
35 If the list is empty, the new node becomes the head.
36 Otherwise, traverse to the end and attach the new node.
37
38 new_node = Node(data)
39 # If list is empty, make new node the head
40 if self.head is None:
41     self.head = new_node
42     return
43 # Traverse to the last node
44 current = self.head
45 while current.next:
46     current = current.next
47 # Link the last node to the new node
48 current.next = new_node
49
49 def display(self):
50     """
51     Display all elements in the linked list.
52     Traverses from head to the last node
53     and prints each element followed by '->'.
54     """
55     current = self.head
56     if current is None:
57         print("Linked List is empty.")
58         return
59     while current:
60         print(current.data, end=" -> ")
61         current = current.next
62
63     print("None")
64 if __name__ == '__main__':
65     linked_list = LinkedList()
66
67     linked_list.insert(10)
68     linked_list.insert(20)
69     linked_list.insert(30)
70
71     linked_list.display()
```

## Task Description #4 – Hash Table

Task: Use AI to implement a hash table with basic insert, search, and delete methods.

Sample Input Code:

class HashTable:

pass

Expected Output:

- Collision handling using chaining, with well-commented methods

```
1 """Task Description #4 - Hash Table
2 Task: Use AI to implement a hash table with basic insert, search, and delete
3 methods.
4 Sample Input Code:
5 class HashTable:
6     pass
7 Expected Output:
8 • Collision handling using chaining, with well-commented methods. """
```

```
main.py  Run Output Clear
1- class HashTable:
2-     """
3-     HashTable implementation using chaining for collision handling.
4-     Attributes:
5-         size : Size of the hash table
6-         table : List of buckets (each bucket is a list)
7-     """
8-     def __init__(self, size=10):
9-         """
10-        Initialize the hash table with given size.
11-        Parameters:
12-            size (int): Number of buckets in the hash table
13-        """
14-        self.size = size
15-        self.table = [[] for _ in range(self.size)]
16-
17-     def _hash(self, key):
18-         """
19-        Private method to compute hash index for a given key.
20-        Parameters:
21-            key : Key to hash
22-        Returns:
23-            int : Index within table range
24-        """
25-        return hash(key) % self.size
26-
27-     def insert(self, key, value):
28-         """
29-        Insert a key-value pair into the hash table.
30-        Handles collisions using chaining.
31-        If the key already exists, update its value.
32-        """
33-        index = self._hash(key)
34-        bucket = self.table[index]
35-        for pair in bucket:
36-            if pair[0] == key:
37-                pair[1] = value # Update existing key
38-                return
39-        bucket.append([key, value]) # Insert new key-value pair
40-
41-     def search(self, key):
42-         """
43-        Search for a key in the hash table.
44-        Parameters:
45-            key : Key to search
46-        Returns:
47-            Value associated with key, or None if not found.
48-        """
49-        index = self._hash(key)
50-        bucket = self.table[index]
51-        for pair in bucket:
52-            if pair[0] == key:
53-                return pair[1]
54-        return None # Key not found
55-
56-     def delete(self, key):
57-         """
58-        Delete a key-value pair from the hash table.
59-        Parameters:
60-            key : Key to delete
61-        Returns:
62-            True if deleted successfully, False if key not found.
63-        """
64-        index = self._hash(key)
65-        bucket = self.table[index]
66-        for i, pair in enumerate(bucket):
67-            if pair[0] == key:
68-                del bucket[i]
69-                return True
70-        return False
71-
72- if __name__ == "__main__":
73-     ht = HashTable()
74-     ht.insert("name", "Sathwik")
75-     ht.insert("age", 21)
76-     ht.insert("city", "Hyderabad")
77-     print("Search name:", ht.search("name"))
78-     print("Delete age:", ht.delete("age"))
79-     print("Search age:", ht.search("age"))
```

```
Search name: Sathwik
Delete age: True
Search age: None
--- Code Execution Successful ---
```

## Task Description #5 – Graph Representation

Task: Use AI to implement a graph using an adjacency list.

Sample Input Code:

```
class Graph:
```

```
    pass
```

Expected Output:

- Graph with methods to add vertices, add edges, and display connections.

```
""" Prompt:
Generate a Python class named Graph that represents a graph using an adjacency list.
The class should include the following methods:
add_vertex(vertex) - to add a new vertex to the graph
add_edge(vertex1, vertex2) - to add an edge between two vertices
display() - to display all vertices and their connected neighbors. """

main.py
1 class Graph:
2     """
3     Graph implementation using an adjacency list.
4     Attributes:
5     adj_list : Dictionary storing vertices as keys
6     and list of adjacent vertices as values.
7     """
8     def __init__(self):
9         """Initialize an empty graph."""
10        self.adj_list = {}
11    def add_vertex(self, vertex):
12        """
13        Add a vertex to the graph.
14        Parameters:
15        vertex : The vertex to be added.
16        """
17        if vertex not in self.adj_list:
18            self.adj_list[vertex] = []
19    def add_edge(self, vertex1, vertex2):
20        """
21        Add an edge between two vertices.
22        Parameters:
23        vertex1 : Starting vertex
24        vertex2 : Ending vertex
25        If vertices do not exist, they will be created.
26        """
27        if vertex1 not in self.adj_list:
28            self.add_vertex(vertex1)
29        if vertex2 not in self.adj_list:
30            self.add_vertex(vertex2)
31        self.adj_list[vertex1].append(vertex2)
32        self.adj_list[vertex2].append(vertex1)
33    def display(self):
34        """
35        Display the adjacency list of the graph.
36        For vertex in self.adj_list:
37            print(f'{vertex} -> {self.adj_list[vertex]}')
38    if __name__ == '__main__':
39        graph = Graph()
40        graph.add_vertex('A')
41        graph.add_vertex('B')
42        graph.add_vertex('C')
43        graph.add_edge('A', 'B')
44        graph.add_edge('A', 'C')
45        graph.display()
```

## Task Description #6: Smart Hospital Management System – Data Structure Selection

A hospital wants to develop a Smart Hospital Management System that handles:

1. Patient Check-In System – Patients are registered and treated in order of arrival.
2. Emergency Case Handling – Critical patients must be treated first.
3. Medical Records Storage – Fast retrieval of patient details using ID.
4. Doctor Appointment Scheduling – Appointments sorted by time.
5. Hospital Room Navigation – Represent connections between wards and rooms.

Student Task:

- For each feature, select the most appropriate data structure from the list below:

- o Stack
- o Queue
- o Priority Queue
- o Linked List
- o Binary Search Tree (BST)

o Graph

o Hash Table

o Deque

- Justify your choice in 2–3 sentences per feature.
- Implement one selected feature as a working Python program with AI-assisted code generation.

## Smart Hospital Management System – Data Structure Selection

---

### 1. Patient Check-In System

**Selected Data Structure:** Queue

**Justification:**

A Queue follows the First-In-First-Out (FIFO) principle. Patients are treated in the order they arrive, ensuring fairness. Therefore, a Queue is the most suitable structure for managing regular patient check-ins.

---

### 2. Emergency Case Handling

**Selected Data Structure:** Priority Queue

**Justification:**

Emergency patients must be treated based on severity rather than arrival time. A Priority Queue allows higher-priority (critical) patients to be treated first. This ensures immediate attention to life-threatening cases.

---

### 3. Medical Records Storage

**Selected Data Structure:** Hash Table

**Justification:**

Patient records need fast retrieval using a unique patient ID. A Hash Table provides average  $O(1)$  time complexity for search, insert, and delete operations. This makes record management efficient and scalable.

---



## 4. Doctor Appointment Scheduling

**Selected Data Structure:** Binary Search Tree (BST)

**Justification:**

Appointments must be maintained in sorted order based on time. A Binary Search Tree automatically keeps elements sorted. This makes scheduling and time-based retrieval efficient.

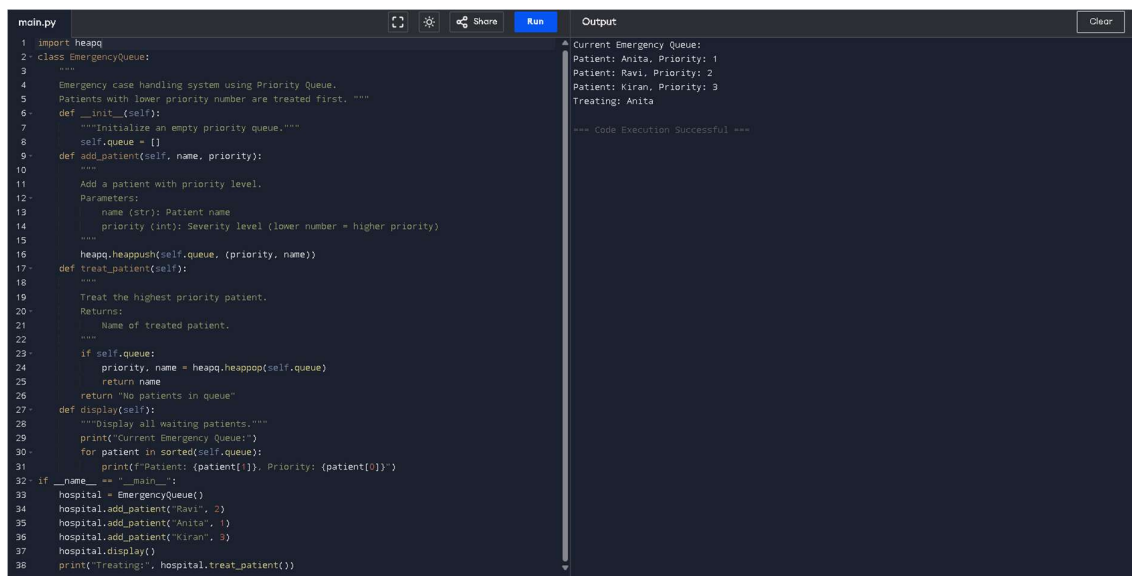
---

## 5. Hospital Room Navigation

**Selected Data Structure:** Graph

**Justification:**

Hospital rooms and wards can be represented as nodes, and pathways as edges. A Graph effectively models connections between locations. It also supports pathfinding for navigation within the hospital.



```
main.py
1 import heapq
2 class EmergencyQueue:
3     """
4     Emergency case handling system using Priority Queue.
5     Patients with lower priority number are treated first. """
6     def __init__(self):
7         """Initialize an empty priority queue."""
8         self.queue = []
9     def add_patient(self, name, priority):
10        """
11        Add a patient with priority level.
12        Parameters:
13        name (str): Patient name
14        priority (int): Severity level (lower number = higher priority)
15        """
16        heapq.heappush(self.queue, (priority, name))
17    def treat_patient(self):
18        """
19        Treat the highest priority patient.
20        Returns:
21        Name of treated patient.
22        """
23        if self.queue:
24            priority, name = heapq.heappop(self.queue)
25            return name
26        return "No patients in queue"
27    def display(self):
28        """Display all waiting patients."""
29        print("Current Emergency Queue:")
30        for patient in sorted(self.queue):
31            print(f"Patient: {patient[1]}, Priority: {patient[0]}")
32 if __name__ == "__main__":
33     hospital = EmergencyQueue()
34     hospital.add_patient("Ravi", 2)
35     hospital.add_patient("Anita", 1)
36     hospital.add_patient("Kiran", 3)
37     hospital.display()
38     print("Treating:", hospital.treat_patient())

Output
Current Emergency Queue:
Patient: Anita, Priority: 1
Patient: Ravi, Priority: 2
Patient: Kiran, Priority: 3
Treating: Anita

=== Code Execution Successful ===
```

## Task Description #7: Smart City Traffic Control System

A city plans a Smart Traffic Management System that includes:

1. Traffic Signal Queue – Vehicles waiting at signals.
2. Emergency Vehicle Priority Handling – Ambulances and fire trucks prioritized.
3. Vehicle Registration Lookup – Instant access to vehicle details.
4. Road Network Mapping – Roads and intersections connected logically.

## 5. Parking Slot Availability – Track available and occupied slots.

### Student Task

- For each feature, select the most appropriate data structure from the list below:

o Stack

o Queue

o Priority Queue

o Linked List

o Binary Search Tree (BST)

o Graph

o Hash Table

o Deque

- Justify your choice in 2–3 sentences per feature.
- Implement one selected feature as a working Python program with AI-assisted code generation.

### Expected Output:

- A table mapping feature → chosen data structure → justification.
- A functional Python program implementing the chosen feature with comments and docstrings.

## Smart City Traffic Control System

---

### 1. Traffic Signal Queue

**Selected Data Structure:** Queue

**Justification:**

Vehicles waiting at a traffic signal follow the First-In-First-Out (FIFO) principle. The vehicle that arrives first should move first when the signal turns green. Therefore, a Queue is the most appropriate structure for managing traffic signals fairly and efficiently.

---

### 2. Emergency Vehicle Priority Handling

**Selected Data Structure:** Priority Queue

**Justification:**

Emergency vehicles such as ambulances and fire trucks must be given immediate access regardless of arrival time. A Priority Queue allows higher-priority vehicles to be processed before regular vehicles. This ensures faster emergency response and improved public safety.

---

### **3. Vehicle Registration Lookup**

**Selected Data Structure:** Hash Table

**Justification:**

Vehicle details must be accessed instantly using a registration number. A Hash Table provides average  $O(1)$  time complexity for search operations. This makes it ideal for fast and efficient vehicle information retrieval.

---

### **4. Road Network Mapping**

**Selected Data Structure:** Graph

**Justification:**

Roads and intersections can be represented as nodes and edges. A Graph efficiently models connections between locations and supports route-finding algorithms. This makes it suitable for navigation and traffic management systems.

---

### **5. Parking Slot Availability**

**Selected Data Structure:** Binary Search Tree (BST)

**Justification:**

Parking slots can be stored in sorted order based on slot numbers. A Binary Search Tree maintains elements in sorted order and allows efficient insertion, deletion, and searching. This makes it suitable for tracking available and occupied parking slots.

```
main.py 1- class Stack:
2     """
3     Stack implementation using Python list.
4     Follows LIFO (Last-In-First-Out) principle. """
5     def __init__(self):
6         """
7         Initialize an empty stack.
8         """
9         self.items = []
10    def push(self, item):
11        """
12        Add an element to the top of the stack.
13        Parameters:
14            item : Element to be added
15        """
16        self.items.append(item)
17    def pop(self):
18        """
19        Remove and return the top element of the stack.
20        Returns:
21            The top element of the stack.
22        Raises:
23            IndexError: If stack is empty. """
24        if self.is_empty():
25            raise IndexError("Pop from empty stack")
26        return self.items.pop()
27    def peek(self):
28        """
29        Return the top element without removing it.
30        Returns:
31            The top element of the stack.
32        Raises:
33            IndexError: If stack is empty. """
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```

3. Top-Selling Products Tracker – Products ranked by sales count.
4. Product Search Engine – Fast lookup of products using product ID.
5. Delivery Route Planning – Connect warehouses and delivery locations.

#### Student Task

- For each feature, select the most appropriate data structure from the list below:
  - o Stack
  - o Queue
  - o Priority Queue
  - o Linked List
  - o Binary Search Tree (BST)
  - o Graph
  - o Hash Table
  - o Deque
- Justify your choice in 2–3 sentences per feature.
- Implement one selected feature as a working Python program with AI-assisted code generation.

#### Expected Output:

- A table mapping feature → chosen data structure → justification.
- A functional Python program implementing the chosen feature with comments and docstrings.

### Smart E-Commerce Platform – Data Structure Selection

---

#### 1. Shopping Cart Management

##### **Selected Data Structure: Linked List**

##### **Justification:**

Products in a shopping cart are added and removed dynamically. A Linked List allows

efficient insertion and deletion without shifting elements. This makes it suitable for managing frequently changing cart items.

---

## **2. Order Processing System**

### **Selected Data Structure: Queue**

#### **Justification:**

Orders must be processed in the order they are placed. A Queue follows the First-In-First-Out (FIFO) principle, ensuring fairness. Therefore, it is ideal for handling customer orders.

---

## **3. Top-Selling Products Tracker**

### **Selected Data Structure: Priority Queue**

#### **Justification:**

Products need to be ranked based on sales count. A Priority Queue allows items with higher sales to be accessed first. This ensures efficient tracking of top-selling products.

---

## **4. Product Search Engine**

### **Selected Data Structure: Hash Table**

#### **Justification:**

Products are searched using unique product IDs. A Hash Table provides average  $O(1)$  time complexity for search operations. This makes product lookup fast and efficient.

---

## **5. Delivery Route Planning**

### **Selected Data Structure: Graph**

#### **Justification:**

Warehouses and delivery locations can be represented as nodes, and roads as edges. A Graph efficiently models connections and supports shortest path algorithms. This makes it suitable for route optimization and logistics planning.

main.py

Share

Run

Output

Clear

```
1 # Smart E-Commerce Platform
2 # Feature: Product Search Engine using Hash Table
3 # Hash Table to store product details
4 products = {}
5 # Function to add a product
6 def add_product(product_id, name, price):
7     products[product_id] = {
8         "Name": name,
9         "Price": price
10    }
11    print("Product added successfully.")
12 # Function to search for a product
13 def search_product(product_id):
14     if product_id in products:
15         print("Product Found:")
16         print("Product ID:", product_id)
17         print("Name:", products[product_id]["Name"])
18         print("Price:", products[product_id]["Price"])
19     else:
20         print("Product not found.")
21 # Function to display all products
22 def display_products():
23     if len(products) == 0:
24         print("No products available.")
25     else:
26         print("Available Products:")
27         for pid in products:
28             print(pid, "->", products[pid])
29 # Main Function
30 add_product(101, "Laptop", 55000)
31 add_product(102, "Mobile", 20000)
32 add_product(103, "Headphones", 2000)
33 print()
34 display_products()
35 print("\nSearching for Product 102\n")
36 search_product(102)
37 print("\nSearching for Product 200\n")
38 search_product(200)
```

Product added successfully.  
Product added successfully.  
Product added successfully.  
  
Available Products:  
101 -> {'Name': 'Laptop', 'Price': 55000}  
102 -> {'Name': 'Mobile', 'Price': 20000}  
103 -> {'Name': 'Headphones', 'Price': 2000}  
  
Searching for Product 102  
  
Product Found:  
Product ID: 102  
Name: Mobile  
Price: 20000  
  
Searching for Product 200  
  
Product not found.  
  
=== Code Execution Successful ===