

# ***ASSIGNMENT – 22.1***

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***BATCH NUMBER : 01***

***COURSE CODE : 24CS002PC215***

***PROGRAM NAME : B.TECH***

***YEAR/SEM : 2ND AND 3<sup>RD</sup>***

## ***Task 1 – Bias Detection in AI Suggestions***

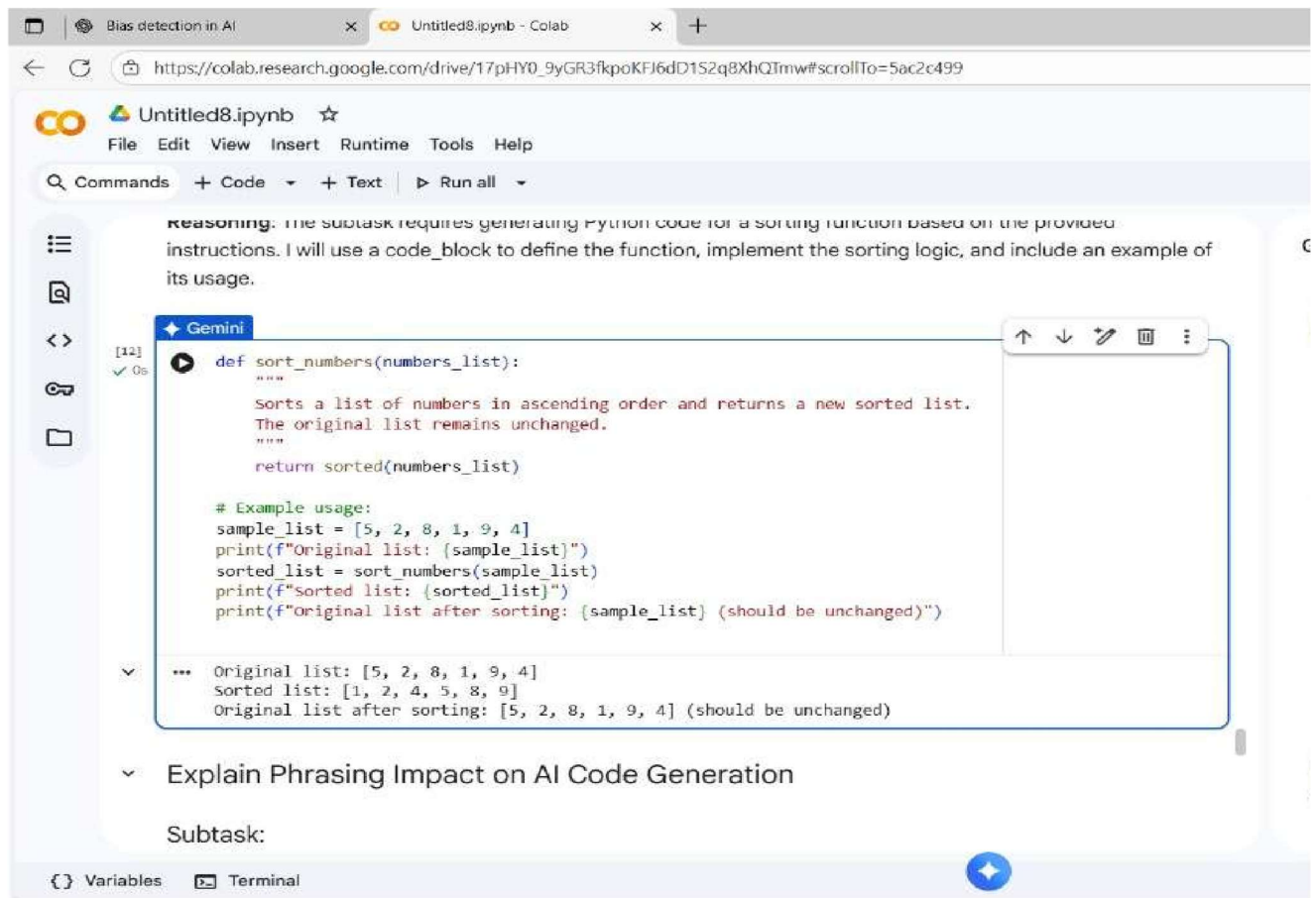
- *Provide the same coding task to an AI tool multiple times.*
- *Check if AI outputs different results depending on prompt phrasing.*
- *Discuss:*

*Are there hidden assumptions or biases in the responses?*

*How could biased AI code impact fairness or accessibility?*

***PROMT :** Write a single Python solution for the task: ‘Create a function that sorts a list of numbers.’ After giving the code, also explain:*

- *how changing the phrasing of this same task might lead the AI to generate different styles of code,*
- *whether any hidden assumptions or biases may appear in such responses,*
- *and how biased AI-generated code could impact fairness, accessibility, or user experience.”*



### **OBSERVATION :**

*The selected cell is a 'Reasoning' text cell. It explains that the purpose of the next step was to generate Python code for a sorting function, define the function, implement the sorting logic, and include an example of its usage. This reasoning served as the prelude to the Python code cell that followed, which contains the actual sorting function implementation.*

### **Task 2 – Privacy and Sensitive Data Handling**

- ☐ *Ask AI to write a script that processes user personal data (e.g., names, phone numbers).*

*Discuss:*

- o How should sensitive data be anonymized?
- o What ethical/legal issues could arise if AI-generated code mishandles it? o
- What role does developer responsibility play here?

**PROMT :** Write a Python script that processes user personal data such as names, phone numbers, and email addresses. The script should read a list of user records, store them, and print them in a structured format.

After generating the code, also explain:

- how this sensitive data should be anonymized or masked (with examples),
- what ethical or legal issues could occur if the code mishandles personal data (GDPR, privacy risks, misuse),
- and what responsibilities developers have when building systems involving personal information.”

**CODE :**

```

import uuid
import hashlib

# 1. Define the UserRecord class
class UserRecord:
    def __init__(self, name, phone_number, email_address):
        self.name = name
        self.phone_number = phone_number
        self.email_address = email_address

    def __str__(self):
        return f"Name: {self.name}, Phone: {self.phone_number}, Email: {self.email_address}"

# 2. Initialize an empty list to store user records
user_database = []

# 3. Create a function to add new user records
def add_user_record(name, phone_number, email_address):
    new_record = UserRecord(name, phone_number, email_address)
    user_database.append(new_record)

# 4. Create a function to display all stored records
def display_all_records(records, title="User Records"):
    if not records:
        print(f"No {title} to display.")
        return

    print(f"\n--- {title} ---")
    for record in records:

```

Bias detection in AI x Untitled8.ipynb - Colab x +

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Untitled8.ipynb ☆

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Commands + Code + Text ▶ Run all

```
[8] ✓ 0s
print(f"\n--- {title} ---")
for record in records:
    print(record)
print("-----")

--# Populate user database with sample records
add_user_record("Alice Smith", "111-222-3333", "alice.s@example.com")
add_user_record("Bob Johnson", "444-555-6666", "bob.j@example.com")
add_user_record("Charlie Brown", "777-888-9999", "charlie.b@example.com")
add_user_record("Diana Prince", "123-456-7890", "diana.p@example.com")

display_all_records(user_database, "Original User Records")

--# 5. Define the pseudonymize records function
def pseudonymize_records(records):
    pseudonymized_records = []
    name_to_pseudonym = {}
    for record in records:
        --# Create a copy to avoid modifying the original record directly in the loop
        new_record = UserRecord(record.name, record.phone_number, record.email_address)
        if new_record.name not in name_to_pseudonym:
            name_to_pseudonym[new_record.name] = f"User_{uuid.uuid4().hex[:8]}"
        new_record.name = name_to_pseudonym[new_record.name]
        pseudonymized_records.append(new_record)
    return pseudonymized_records

--# 6. Define the hash_records function
def hash_records(records):
    hashed_records = []
    for record in records:
```

Variables Terminal

Bias detection in AI x Untitled8.ipynb - Colab x +

https://colab.research.google.com/drive/17pHY0\_9yGR3fkpoKF6dD1S2q8XhQImw#scrollTo=c102007a

Untitled8.ipynb ☆ Saving...

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Commands + Code + Text ▶ Run all

```
[8] ✓ 0s
for record in records:
    new_record = UserRecord(record.name, record.phone_number, record.email_address)
    hashed_email = hashlib.sha256(new_record.email_address.encode()).hexdigest()
    new_record.email_address = hashed_email
    hashed_records.append(new_record)
return hashed_records

--# 7. Define the generalize_records function
def generalize_records(records):
    generalized_records = []
    for record in records:
        new_record = UserRecord(record.name, record.phone_number, record.email_address)

        if new_record.phone_number and len(new_record.phone_number) >= 4:
            new_record.phone_number = new_record.phone_number[:4] + 'XXXX'
        else:
            new_record.phone_number = 'XXXX-XXXX'

        if new_record.email_address and '@' in new_record.email_address:
            username, domain = new_record.email_address.split('@')
            if len(username) > 3:
                new_record.email_address = username[:3] + '***' + domain
            else:
                new_record.email_address = '***' + domain
        else:
            new_record.email_address = '***@example.com'

        generalized_records.append(new_record)
    return generalized_records
```

Variables Terminal

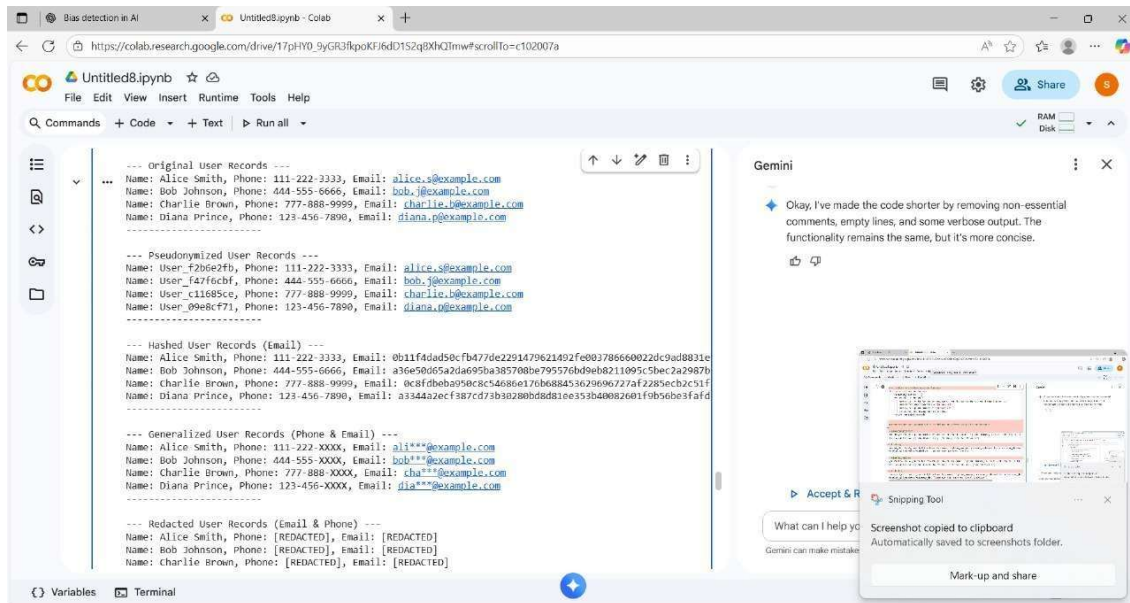
Gemini

Okay, I've made the code shorter, removed comments, empty lines, and the functionality remains the same.

Accept & Run Snippet

What can I help you with? Gemini can make mistakes.

Screenshot Automatic



**OBSERVATION :** Certainly! This script defines a `UserRecord` class to manage user data (name, phone, email). It then demonstrates four data anonymization techniques:

*Pseudonymization:* Replaces names with unique, artificial IDs (e.g., "User\_abc123").

*Hashing:* Transforms email addresses into irreversible hash values.

*Generalization:* Masks parts of phone numbers (e.g., "XXXX") and email usernames (e.g., "ali\*").

*Redaction:* Completely replaces sensitive fields (phone, email) with [REDACTED].

Each technique is applied to a copy of the original data, and the results are printed to show how sensitive information is protected.

### Task 3 – AI-Generated Security Risks

- Use AI to generate login/authentication code.
- Identify possible security flaws (e.g., weak password storage, lack of encryption).
- Students must document risks and propose ethical guidelines for safe AI code usage.

**PROMT :** “Generate a simple Python login/authentication script that handles usernames and passwords. After giving the code, identify all possible security flaws in the AI-generated code (such as plain-text passwords, lack of hashing, weak validation, no encryption, or insecure storage). Then explain the risks these flaws create and propose ethical guidelines for safely using AI-generated code in authentication systems.” **CODE :**



Untitled8.ipynb

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141

✓

0s

```
def register_user(username, password):
    """
    Registers a new user by adding their username and password to the registered_users dictionary.
    """
    if username in registered_users:
        print(f"Username '{username}' already exists. Please choose a different one.")
    else:
        registered_users[username] = password
        print(f"User '{username}' registered successfully.")

def login_user(username, password):
    """
    Attempts to log in a user. Returns True for successful login, False otherwise.
    """
    if username in registered_users:
        if registered_users[username] == password:
            return True
        else:
            print("Incorrect password.")
            return False
    else:
        print("Username not found.")
        return False

# 4. Add sample users
print("... Registering Users ...")
```

Gemini

- Propose Ethical Guidelines for AI-Generated Authentication Code: Outline ethical guidelines and best practices for responsibly using AI-generated code, particularly in critical systems like authentication, emphasizing security, privacy, and user trust.
- Final Task: Summarize the generated script, the identified security flaws, the associated risks, and the proposed ethical guidelines for using AI-generated code in authentication systems.

Generating...

Preparing

- Generate Python Login/Authentication Script
- Identify Security Flaws in the AI-Generated Code
- Explain Risks Created by Security Flaws
- Propose Ethical Guidelines for AI-Generated Authentication Code
- Final Task

What can I help you build?

Gemini can make mistakes so double-check it and use code with caution. [Learn more](#)

Variables Terminal

✓ 1:51 PM Python 3

Untitled8.ipynb

File Edit View Insert Runtime Tools Help

Commands + Code + Text Run all

144

✓

0s

```
# 4. Add sample users
print("... Registering Users ...")
register_user("admin", "admin123")
register_user("user1", "password123")
register_user("guest", "guestpass")
print("-----")

# 5. Demonstrate successful login
print("\n--- Demonstrating Successful Login ---")
if login_user("admin", "admin123"):
    print("Login successful for admin")
else:
    print("Login failed for admin.")
print("-----")

# 6. Demonstrate failed login attempts
print("\n--- Demonstrating Failed Login Attempts ---")
# Incorrect password
if login_user("user1", "wrongpass"):
    print("Login successful for user1 (should fail).")
else:
    print("Login failed for user1 (as expected due to wrong password).")

# Non-existent username
if login_user("nonexistent", "anypass"):
    print("Login successful for nonexistent user (should fail).")
else:
    print("Login failed for nonexistent user (as expected).")

# Summary and final task
```

Gemini

- Propose Ethical Guidelines for AI-Generated Authentication Code: Outline ethical guidelines and best practices for responsibly using AI-generated code, particularly in critical systems like authentication, emphasizing security, privacy, and user trust.
- Final Task: Summarize the generated script, the identified security flaws, the associated risks, and the proposed ethical guidelines for using AI-generated code in authentication systems.

Generating...

Preparing

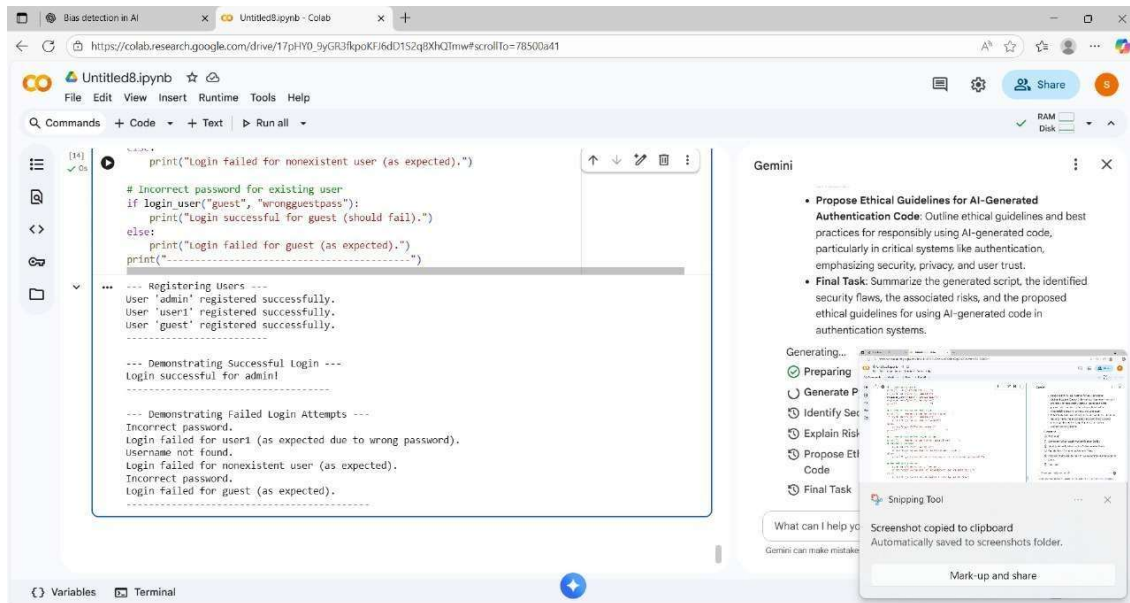
- Generate Python Login/Authentication Script
- Identify Security Flaws in the AI-Generated Code
- Explain Risks Created by Security Flaws
- Propose Ethical Guidelines for AI-Generated Authentication Code
- Final Task

What can I help you build?

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Variables Terminal

✓ 1:51 PM Python 3



**OBSERVATION :** A key observation is that while the AI-generated login script fulfills the basic functional requirement, it severely lacks fundamental security measures essential for any real-world application, primarily by storing passwords in plain text. This highlights the critical need for developers to scrutinize AI-generated code for security vulnerabilities, especially in sensitive areas like authentication.

#### Task 4 – Accountability in Human–AI Collaboration

- Scenario: AI writes code for a hospital's patient monitoring system.
- If the code fails and causes harm, who is responsible?
  - The AI tool?
  - The human developer?
  - The organization using it?
- Students must debate and submit a reflection report.

**PROMT :** “Write a simple Python code snippet for a basic patient-monitoring system that checks vital signs (e.g., heart rate and temperature) and prints alerts if values exceed safe limits.

After generating the code, explain who would be responsible if such AI-assisted code fails in a real hospital environment and causes harm — the AI tool, the human developer, or the organization using it. Provide a detailed reflection discussing accountability, shared responsibility, and ethical considerations in human–AI collaboration.”

**CODE :**

The image shows a Google Colab notebook titled 'Untitled8.ipynb'. The code defines a patient monitoring system with safe limits for heart rate (60-100 bpm) and temperature (36.0-37.5°C). It includes functions to generate random vital signs and check them against these limits. The notebook is running, and the output shows the system initialization and the start of monitoring cycles. The Gemini AI interface is open on the right, showing a prompt to explain accountability for AI-assisted code failure and a final task to summarize the code and discussion.

```
import random
import time

# 1. Define acceptable ranges for vital signs
# Heart Rate (bpm)
HR_MIN_SAFE = 60
HR_MAX_SAFE = 100

# Body Temperature (Celsius)
TEMP_MIN_SAFE = 36.0
TEMP_MAX_SAFE = 37.5

print("Patient Monitoring System Initialized")
print(f"Safe Heart Rate Range: {HR_MIN_SAFE}-{HR_MAX_SAFE} bpm")
print(f"Safe Temperature Range: {TEMP_MIN_SAFE}-{TEMP_MAX_SAFE}°C\n")

# 2. Function to simulate generating random vital sign readings
def get_vital_signs():
    # Simulate heart rate (some within, some outside safe range)
    heart_rate = random.randint(50, 120)
    # Simulate temperature (some within, some outside safe range)
    temperature = round(random.uniform(35.0, 39.0), 1)
    return heart_rate, temperature

# 3. Function to check vital signs against predefined safe limits
def check_vitals(heart_rate, temperature):
    alert_triggered = False
```

Patient Monitoring System Initialized  
Safe Heart Rate Range: 60-100 bpm  
Safe Temperature Range: 36.0-37.5°C

Starting 10 monitoring cycles...

Cycle 1/10:  
Checking Vitals: HR=72 bpm, Temp=38.5°C  
ALERT: High Temperature - 38.5°C!

Cycle 2/10:  
Checking Vitals: HR=92 bpm, Temp=37.1°C  
Vitals are within normal limits.

Cycle 3/10:  
Checking Vitals: HR=82 bpm, Temp=36.5°C  
Vitals are within normal limits.

Gemini

system that checks vital signs (e.g., heart rate and temperature) and prints alerts if values exceed safe limits.

- **Explain Accountability for AI-Assisted Code Failure:** Explain who would be responsible if such AI-assisted code fails in a real hospital environment and causes harm — the AI tool, the human developer, or the organization using it. Provide a detailed reflection discussing accountability, shared responsibility, and ethical considerations in human–AI collaboration.
- **Final Task:** Summarize the generated patient monitoring code and the detailed discussion on accountability, shared responsibility, and ethical considerations in human–AI collaboration for critical systems.

Generating...

Preparing

Generate Python Patient Monitoring Code

Explain Accountability for AI-Assisted Code Failure

Final Task

What can I help you build?

Gemini can make mistakes so double-check it and use code with caution. [Learn more](#)



The image displays two screenshots of a Google Colab notebook titled "Untitled8.ipynb".

The top screenshot shows the execution output of a simulation. It displays a series of cycles (5/10 to 10/10) where vital signs (Heart Rate and Temperature) are checked. Alerts are triggered for high temperature, high heart rate, and low temperature. The output is formatted as follows:

```
ALERT: High Temperature - 38.0°C!

Cycle 5/10:
Checking Vitals: HR=63 bpm, Temp=36.4°C
Vitals are within normal limits.
-----

Cycle 6/10:
Checking Vitals: HR=116 bpm, Temp=37.5°C
ALERT: High Heart Rate - 116 bpm!
-----

Cycle 7/10:
Checking Vitals: HR=88 bpm, Temp=36.6°C
Vitals are within normal limits.
-----

Cycle 8/10:
Checking Vitals: HR=79 bpm, Temp=35.8°C
ALERT: Low Temperature - 35.8°C!
-----

Cycle 9/10:
Checking Vitals: HR=50 bpm, Temp=39.0°C
ALERT: Low Heart Rate - 50 bpm!
ALERT: High Temperature - 39.0°C!
-----

Cycle 10/10:
Checking Vitals: HR=117 bpm, Temp=38.9°C
ALERT: High Heart Rate - 117 bpm!
ALERT: High Temperature - 38.9°C!
```

The bottom screenshot shows the Python code used for the simulation. It includes a function to check vital signs against predefined safe limits and a loop to simulate the monitoring process over 10 cycles.

```
# 3: Function to check vital signs against predefined safe limits
def check_vitals(heart_rate, temperature):
    alert_triggered = False

    print(f"Checking Vitals: HR={heart_rate} bpm, Temp={temperature}°C")

    if heart_rate < HR_MIN_SAFE:
        print(f"ALERT: Low Heart Rate - {heart_rate} bpm!")
        alert_triggered = True
    elif heart_rate > HR_MAX_SAFE:
        print(f"ALERT: High Heart Rate - {heart_rate} bpm!")
        alert_triggered = True

    if temperature < TEMP_MIN_SAFE:
        print(f"ALERT: Low Temperature - {temperature}°C!")
        alert_triggered = True
    elif temperature > TEMP_MAX_SAFE:
        print(f"ALERT: High Temperature - {temperature}°C!")
        alert_triggered = True

    if not alert_triggered:
        print("Vitals are within normal limits.")
        print("-----")

# 6. Simulate the monitoring process
monitoring_cycles = 10
print(f"Starting {monitoring_cycles} monitoring cycles...")
for i in range(monitoring_cycles):
    print(f"\nCycle {i+1}/{monitoring_cycles}:")
```

**OBSERVATION :** A key observation is that this script provides a simplified, simulated patient monitoring system. While it effectively demonstrates basic vital sign checking and alerting logic, a real-world medical application would require significantly more robust data handling, error checking, and advanced features for patient safety.

## Task 5 – Limitations of AI in Critical Systems

- Ask AI to generate code for a life-critical application (e.g., railway signaling, medical diagnosis).
- Discuss:
  - Should AI code be used directly in such systems? ◦ What level of human oversight is mandatory?
  - How do we balance efficiency vs safety?

**PROMPT :** Generate a simple Python script for a life-critical system, such as a basic railway-signal safety checker that monitors track status and prints warnings if a collision risk is detected.

After the code, discuss:

- whether AI-generated code should ever be used directly in life-critical systems,
- what level of human oversight is mandatory,
- and how to balance efficiency, automation, and safety when using AI in high-risk environments.”
- **CODE :**

The screenshot shows a Google Colab notebook titled 'Untitled8.ipynb'. The code in the notebook defines a 'Train' class and initializes three sample trains. The Gemini chat interface on the right displays a discussion prompt about balancing efficiency, automation, and safety in life-critical systems, along with a list of tasks to be discussed.

```
import time
import random

# 1. Define a list of simulated 'tracks' or 'track segments'
tracks = [str(i) for i in range(10)] # Tracks named "0" to "9"
print(f"Defined Tracks: {tracks}\n")

# 2. Create a class to represent 'trains'
class Train:
    def __init__(self, train_id, current_track_position, direction=1): # direction: 1 for forward, -1 for backward
        self.train_id = train_id
        self.current_track_position = current_track_position
        self.direction = direction

    def __str__(self):
        return f"Train ID: {self.train_id}, Position: {self.current_track_position}, Direction: {'Forward' if self.direction == 1 else 'Backward'}"

# 3. Initialize a few sample trains
trains = []
train("T001", "0", 1), # Train 1 starts at track 0, moving forward
train("T002", "2", 1), # Train 2 starts at track 2, moving forward
train("T003", "8", -1) # Train 3 starts at track 8, moving backward

print("Initial Train Positions:")
for train in trains:
    print(train)
print("\n")
```

**Gemini**

- **Discuss Balancing Efficiency, Automation, and Safety:**  
Detail how to balance efficiency, automation, and safety when deploying AI in high-risk environments, such as railway signaling, emphasizing strategies to mitigate risks without sacrificing necessary advancements.
- **Final Task:** Summarize the generated railway-signal safety checker code and the key points from the discussions on using AI-generated code in life-critical systems, human oversight, and the balance between efficiency, automation, and safety.

Generating...

Preparing

- Generate Python Railway-Signal Safety Checker Code
- Discuss Use of AI-Generated Code in Life-Critical Systems
- Discuss Mandatory Human Oversight
- Discuss Balancing Efficiency, Automation, and Safety
- Final Task

What can I help you build? +

Gemini can make mistakes so double-check it and use code with caution. [Learn more](#)

2:03 PM Python 3

Untitled8.ipynb - Colab

https://colab.research.google.com/drive/17pHY0\_9yGR3lkoKF6dD1S2qBXHQImw#scrollTo=67233d86

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```
[15] ✓ 5s
# 4. Define a function to simulate train movement
def simulate_train_movement(trains, tracks):
    print("\n--- Simulating Train Movement ---")
    track_length = len(tracks)
    for train in trains:
        current_index = tracks.index(train.current_track_position)
        next_index = current_index + train.direction

        # Ensure trains stay within track segments (wrap around for simplicity)
        if next_index >= track_length:
            next_index = 0 # Wrap to the beginning
        elif next_index < 0:
            next_index = track_length - 1 # Wrap to the end

        train.current_track_position = tracks[next_index]
        print(f"Train {train.train_id} moved to track {train.current_track_position}")

# 5. Create a function to check for collision risk
def check_collision_risk(trains):
    print("\n--- checking for collision risk ---")
    positions = {}
    for train in trains:
        if train.current_track_position not in positions:
            positions[train.current_track_position] = []
        positions[train.current_track_position].append(train.train_id)

    collision_detected = False
    for track_segment, trains_on_segment in positions.items():
        if len(trains_on_segment) > 1:
```

Gemini

- **Discuss Balancing Efficiency, Automation, and Safety:** Detail how to balance efficiency, automation, and safety when deploying AI in high-risk environments, such as railway signaling, emphasizing strategies to mitigate risks without sacrificing necessary advancements.
- **Final Task:** Summarize the generated railway-signal safety checker code and the key points from the discussions on using AI-generated code in life-critical systems, human oversight, and the balance between efficiency, automation, and safety.

Generating...

Preparing

Generate Python Railway-Signal Safety Checker Code

Discuss Use of AI-Generated Code in Life-Critical Systems

Discuss Mandatory Human Oversight

Discuss Balancing Efficiency, Automation, and Safety

Final Task

What can I help you build?

Screenshot copied to clipboard. Automatically saved to screenshots folder.

Mark-up and share

Untitled8.ipynb - Colab

https://colab.research.google.com/drive/17pHY0\_9yGR3lkoKF6dD1S2qBXHQImw#scrollTo=67233d86

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```
[15] ✓ 5s
collision_detected = False
for track_segment, trains_on_segment in positions.items():
    if len(trains_on_segment) > 1:
        print(f"!!! COLLISION RISK DETECTED on Track {track_segment} involving trains: {'', '.join(
            collision_detected = True

    if not collision_detected:
        print("No collision risk detected.")
    print("-----")

# 7. Simulate the system over several time steps
simulation_steps = 5
print(f"\nStarting {simulation_steps} simulation steps...")
for step in range(simulation_steps):
    print(f"=== Simulation Step {step + 1} ===")
    simulate_train_movement(trains, tracks)
    check_collision_risk(trains)

    # Introduce a small delay for better readability
    time.sleep(1)

print("\nSimulation Complete.")

...
Starting 5 simulation steps...

=== Simulation Step 1 ===

--- Simulating Train Movement ---
Train T001 moved to track 1
Train T002 moved to track 3
Train T003 moved to track 2
```

Gemini

- **Discuss Balancing Efficiency, Automation, and Safety:** Detail how to balance efficiency, automation, and safety when deploying AI in high-risk environments, such as railway signaling, emphasizing strategies to mitigate risks without sacrificing necessary advancements.
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Generating...

Preparing

Generate Python Railway-Signal Safety Checker Code

Discuss Use of AI-Generated Code in Life-Critical Systems

Discuss Mandatory Human Oversight

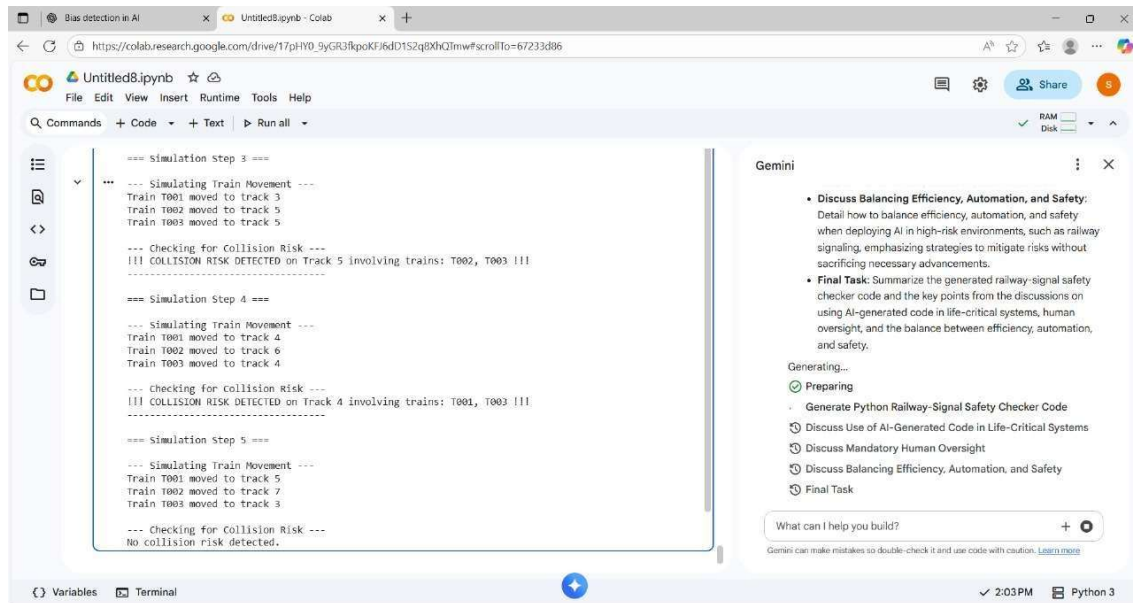
Discuss Balancing Efficiency, Automation, and Safety

Final Task

What can I help you build?

Gemini can make mistakes so double-check it and use code with caution. [Learn more](#)

2:03 PM Python 3



## OBSERVATION :

*This script is a simplified simulation of a railway safety system. It effectively demonstrates the core idea of tracking multiple trains and detecting potential collision risks by checking if more than one train occupies the same track segment. While basic, it clearly illustrates the principle of collision detection.*

## Task 6 – Ethical Use of AI-Generated Code

- Students analyze real-world cases (e.g., plagiarism, copyright violation, misuse of open-source code).
- Identify best practices for ethically using AI code:
  - Attribution
  - Verification
  - Responsible deployment

**PROMT :** “Write a simple Python program (any small utility, such as a text formatter or calculator). After giving the code, analyze ethical issues related to AI-generated code using real-world concerns such as plagiarism, copyright violations, and misuse of opensource code. Then explain best practices for ethically using AI-generated code, including proper attribution, verification, and responsible deployment.”

## CODE :

Bias detection in AI

Untitled8.ipynb - Colab

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Untitled8.ipynb

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Commands Code Text Run all

17

5/5

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    def __init__(self, train_id, current_track_position, direction=1): # direction: 1 for forward, -1 for backward
        self.train_id = train_id
        self.current_track_position = current_track_position
        self.direction = direction

    def __str__(self):
        return f"Train ID: {self.train_id}, Position: {self.current_track_position}, Direction: {'Forward' if self.direction == 1 else 'Backward'}"

# 3. Initialize a few sample trains
trains = [
    Train("T001", "0", 1), # Train 1 starts at track 0, moving forward
    Train("T002", "2", 1), # Train 2 starts at track 2, moving forward
    Train("T003", "8", -1) # Train 3 starts at track 8, moving backward
]

print("Initial train positions:")
for train in trains:
    print(train)
print("\n")
```

Variables

Terminal

2:10 PM

Python 3

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such as plagiarism, copyright violations, and misuse of open-source code. Then explain best practices for ethically using AI-generated code, including proper attribution, verification, and responsible deployment.

Certainly! I'll generate a simple Python utility program for you, and then we'll dive into the critical ethical issues surrounding AI-generated code, including plagiarism, copyright, and misuse of open-source resources, along with best practices for its ethical use. Here is the plan:

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Generate a simple Python calculator program

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Explain best practices for ethically using AI-generated code

What can I help you build?

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Bias detection in AI

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17

5/5

```
# 4. Define a function to simulate train movement
def simulate_train_movement(trains, tracks):
    print("\n--- Simulating Train Movement ---")
    track_length = len(tracks)
    for train in trains:
        current_index = tracks.index(train.current_track_position)
        next_index = current_index + train.direction

        # Ensure trains stay within track segments (wrap around for simplicity)
        if next_index >= track_length:
            next_index = 0 # Wrap to the beginning
        elif next_index < 0:
            next_index = track_length - 1 # Wrap to the end

        train.current_track_position = tracks[next_index]
        print(f"Train {train.train_id} moved to track {train.current_track_position}")

# 5. Create a function to check for collision risk
def check_collision_risk(trains):
    print("\n--- Checking for Collision Risk ---")
    positions = {}
    for train in trains:
        if train.current_track_position not in positions:
            positions[train.current_track_position] = []
        positions[train.current_track_position].append(train.train_id)

    collision_detected = False
    for track_segment, trains_on_segment in positions.items():
        if len(trains_on_segment) > 1:
            print(f"!!! COLLISION RISK DETECTED on track {track_segment} involving trains: {trains_on_segment}")
```

Variables

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```
if not collision_detected:
    print("No collision risk detected.")
    print("-----")

# 7. Simulate the system over several time steps
simulation_steps = 5
print(f"Starting {simulation_steps} simulation steps...")
for step in range(simulation_steps):
    print(f"\n== Simulation Step {step + 1} ==")
    simulate_train_movement(trains, tracks)
    check_collision_risk(trains)

    # Introduce a small delay for better readability
    time.sleep(1)

print("\nsimulation Complete.")
```

Starting 5 simulation steps...

=== Simulation Step 1 ===

--- Simulating Train Movement ---

Train T001 moved to track 1

Train T002 moved to track 3

Train T003 moved to track 7

--- checking for collision Risk ---

No collision risk detected.

Variables Terminal

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```
=== Simulation Step 3 ===
```

--- Simulating Train Movement ---

Train T001 moved to track 3

Train T002 moved to track 5

Train T003 moved to track 5

--- Checking for Collision Risk ---

!!! COLLISION RISK DETECTED on Track 5 involving trains: T002, T003 !!!

=== Simulation Step 4 ===

--- Simulating Train Movement ---

Train T001 moved to track 4

Train T002 moved to track 6

Train T003 moved to track 4

--- Checking for Collision Risk ---

!!! COLLISION RISK DETECTED on Track 4 involving trains: T001, T003 !!!

=== Simulation Step 5 ===

--- Simulating Train Movement ---

Train T001 moved to track 5

Train T002 moved to track 3

Train T003 moved to track 7

--- Checking for Collision Risk ---

No collision risk detected.

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***OBSERVATION :*** *A key observation is that this script delivers a functional basic calculator with an interactive menu and includes essential error handling for invalid input and division by zero, making it user-friendly for simple arithmetic operations.*