AI ASSISTED CODING

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BATCH – 03 **30 – 01 – 2026**

ASSIGNMENT – 5.5

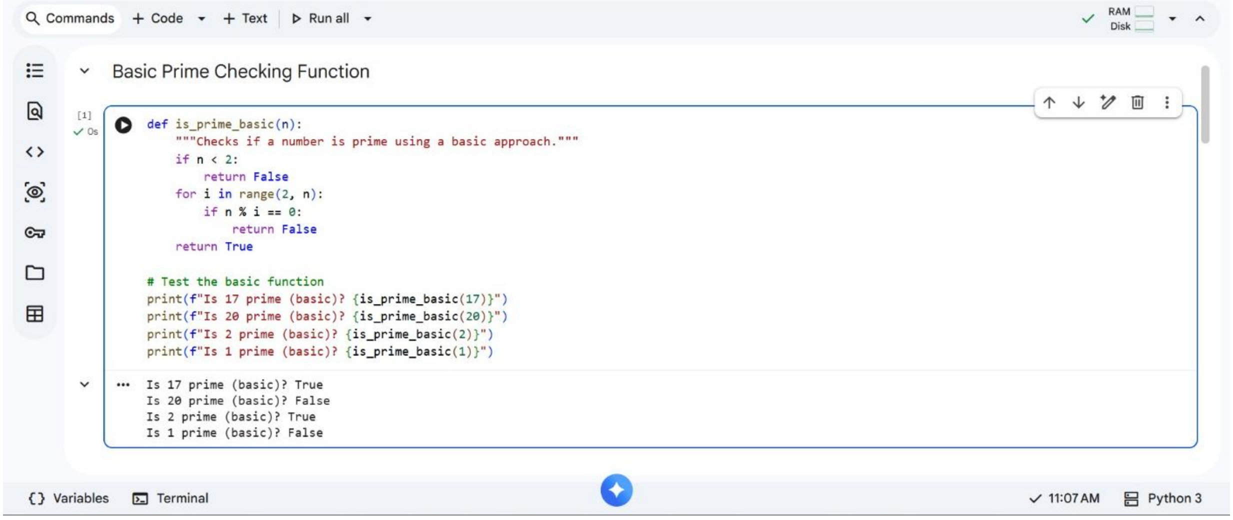
Lab 5: Ethical Foundations – Responsible AI Coding Practices.

TASK - 01 : (Transparency in Algorithm Optimization)

Prompt : Generate Python code for two prime-checking methods and explain how the optimized version improves performance.

Code:

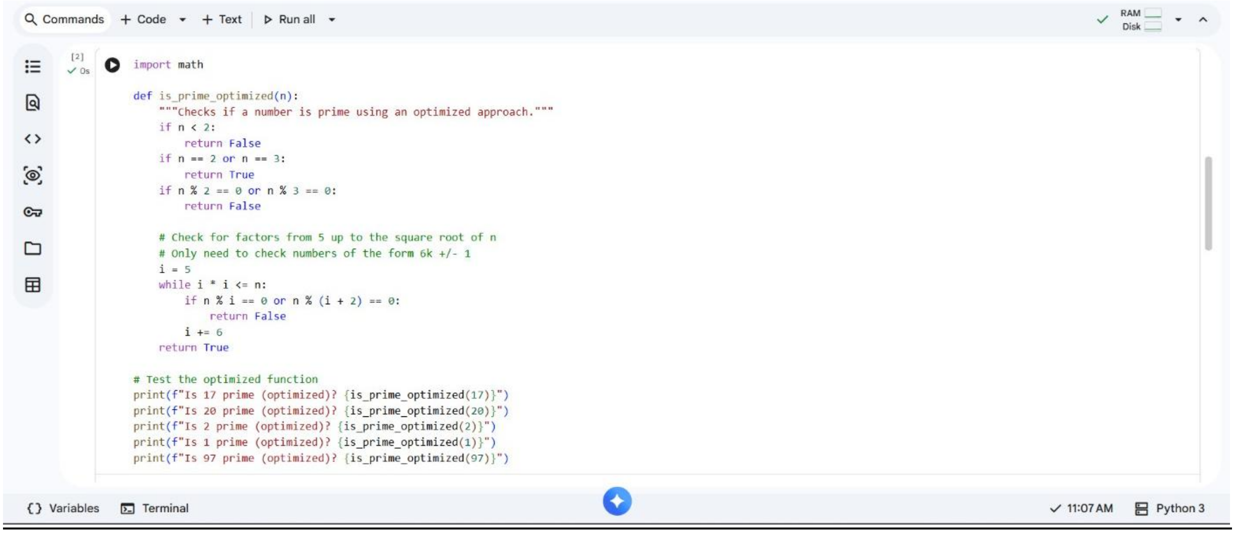
1. Basic Prime Checking Function



```
def is_prime_basic(n):
    """Checks if a number is prime using a basic approach."""
    if n < 2:
        return False
    for i in range(2, n):
        if n % i == 0:
            return False
    return True

# Test the basic function
print(f"Is 17 prime (basic)? {is_prime_basic(17)}")
print(f"Is 20 prime (basic)? {is_prime_basic(20)}")
print(f"Is 2 prime (basic)? {is_prime_basic(2)}")
print(f"Is 1 prime (basic)? {is_prime_basic(1)}")
```

```
Is 17 prime (basic)? True
Is 20 prime (basic)? False
Is 2 prime (basic)? True
Is 1 prime (basic)? False
```

2. Optimized Prime Checking Function



```python
import math

def is_prime_optimized(n):
    """Checks if a number is prime using an optimized approach."""
    if n < 2:
        return False
    if n == 2 or n == 3:
        return True
    if n % 2 == 0 or n % 3 == 0:
        return False

    # Check for factors from 5 up to the square root of n
    # Only need to check numbers of the form 6k +/- 1
    i = 5
    while i * i <= n:
        if n % i == 0 or n % (i + 2) == 0:
            return False
        i += 6
    return True

# Test the optimized function
print(f"Is 17 prime (optimized)? {is_prime_optimized(17)}")
print(f"Is 20 prime (optimized)? {is_prime_optimized(20)}")
print(f"Is 2 prime (optimized)? {is_prime_optimized(2)}")
print(f"Is 1 prime (optimized)? {is_prime_optimized(1)}")
print(f"Is 97 prime (optimized)? {is_prime_optimized(97)}")
```

Transparent Explanation:

Naive Method Time Complexity: O(n) → Checks all numbers from 2 to n-1.
Optimized Method Time Complexity: O(√n) → Only checks up to square root of n.

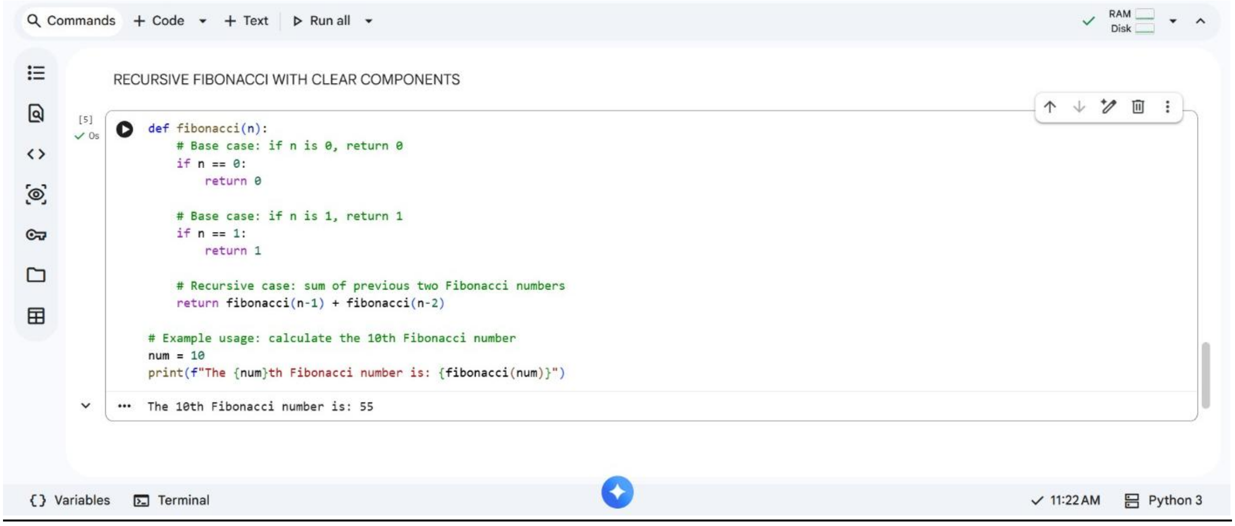
Comparison :

Method	Time Complexity	Performance
Naive	O(n)	Slower
Optimized	O(√n)	Faster

Task – 02 : Transparency in Recursive Algorithms.

Prompt : Give me the Recursive Fibonacci code with clear comments.

Code:



RECURSIVE FIBONACCI WITH CLEAR COMPONENTS

```python
def fibonacci(n):
    # Base case: if n is 0, return 0
    if n == 0:
        return 0

    # Base case: if n is 1, return 1
    if n == 1:
        return 1

    # Recursive case: sum of previous two Fibonacci numbers
    return fibonacci(n-1) + fibonacci(n-2)

# Example usage: calculate the 10th Fibonacci number
num = 10
print(f"The {num}th Fibonacci number is: {fibonacci(num)}")
```

```
The 10th Fibonacci number is: 55
```

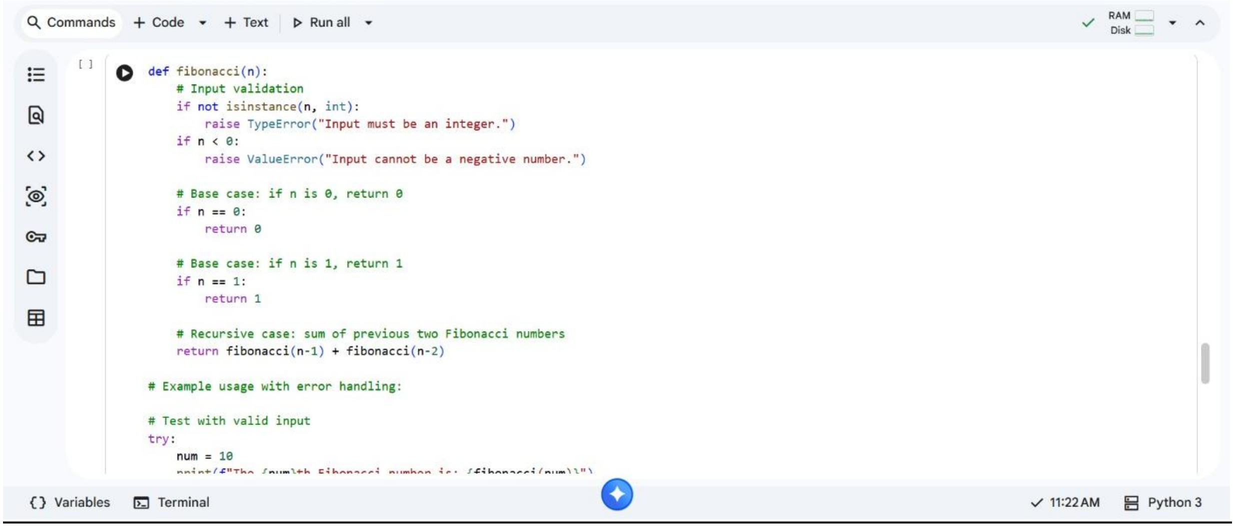
Explanation:

- Base Cases:
  - fibonacci(0) → 0
  - fibonacci(1) → 1
- Recursive Call:
  - fibonacci(n) = fibonacci(n-1) + fibonacci(n-2)

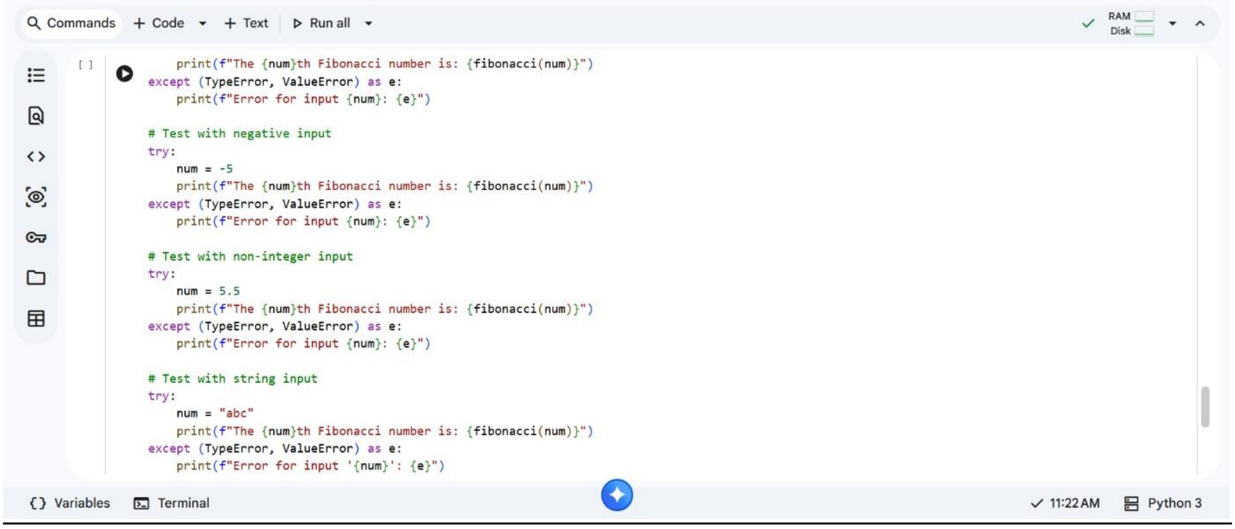
Task – 03 : Transparency in Error Handling.

Prompt : Generate code with proper error handling and clear explanations for each exception.

Code:



```python
def fibonacci(n):
    # Input validation
    if not isinstance(n, int):
        raise TypeError("Input must be an integer.")
    if n < 0:
        raise ValueError("Input cannot be a negative number.")

    # Base case: if n is 0, return 0
    if n == 0:
        return 0

    # Base case: if n is 1, return 1
    if n == 1:
        return 1

    # Recursive case: sum of previous two Fibonacci numbers
    return fibonacci(n-1) + fibonacci(n-2)

# Example usage with error handling:

# Test with valid input
try:
    num = 10
    print(f"The {num}th Fibonacci number is: {fibonacci(num)}")
```



```python
    print(f"The {num}th Fibonacci number is: {fibonacci(num)}")
except (TypeError, ValueError) as e:
    print(f"Error for input {num}: {e}")

# Test with negative input
try:
    num = -5
    print(f"The {num}th Fibonacci number is: {fibonacci(num)}")
except (TypeError, ValueError) as e:
    print(f"Error for input {num}: {e}")

# Test with non-integer input
try:
    num = 5.5
    print(f"The {num}th Fibonacci number is: {fibonacci(num)}")
except (TypeError, ValueError) as e:
    print(f"Error for input {num}: {e}")

# Test with string input
try:
    num = "abc"
    print(f"The {num}th Fibonacci number is: {fibonacci(num)}")
except (TypeError, ValueError) as e:
    print(f"Error for input '{num}': {e}")
```

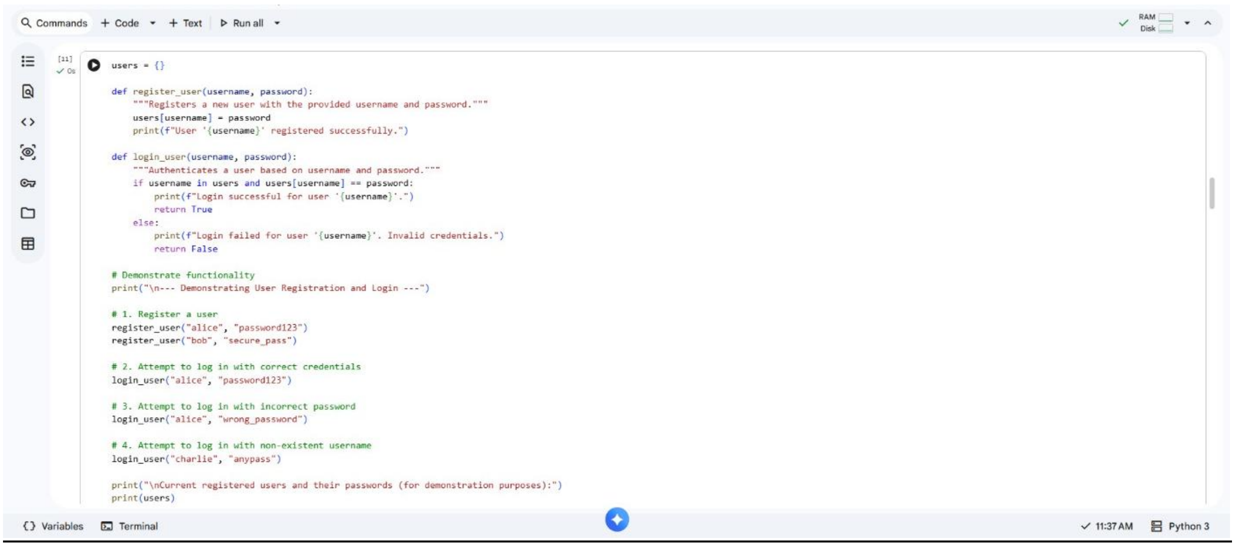
Explaining the Errors:

Exception Meaning

FileNotFoundError File does not exist

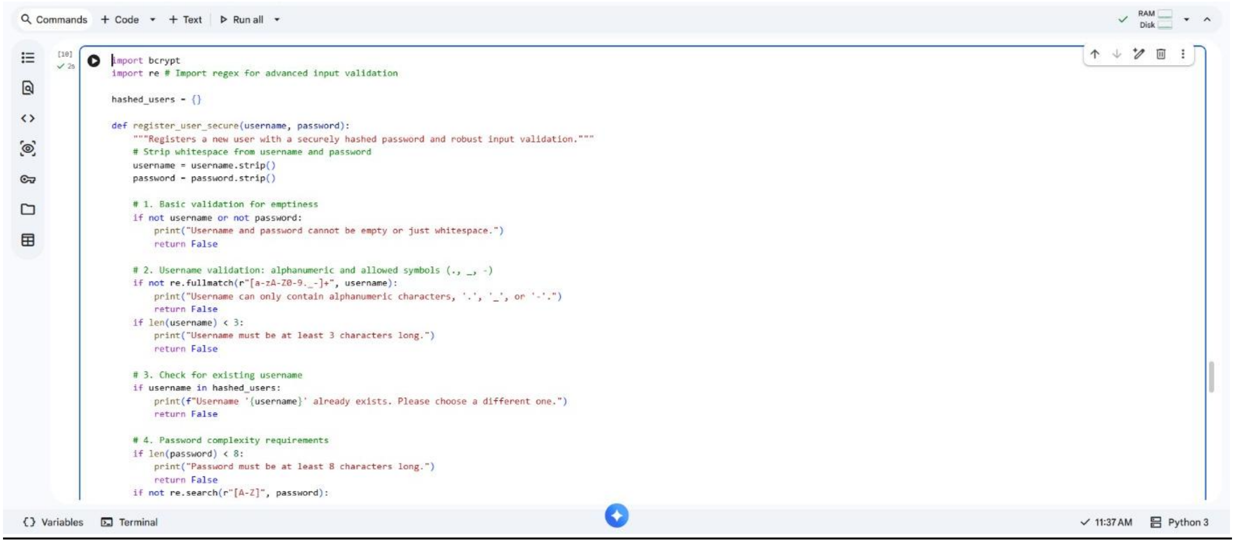
PermissionError No permission to read file Exception Any other unknown error **Task – 04 :** Security in User Authentication. **Code:**

Insecure Version:

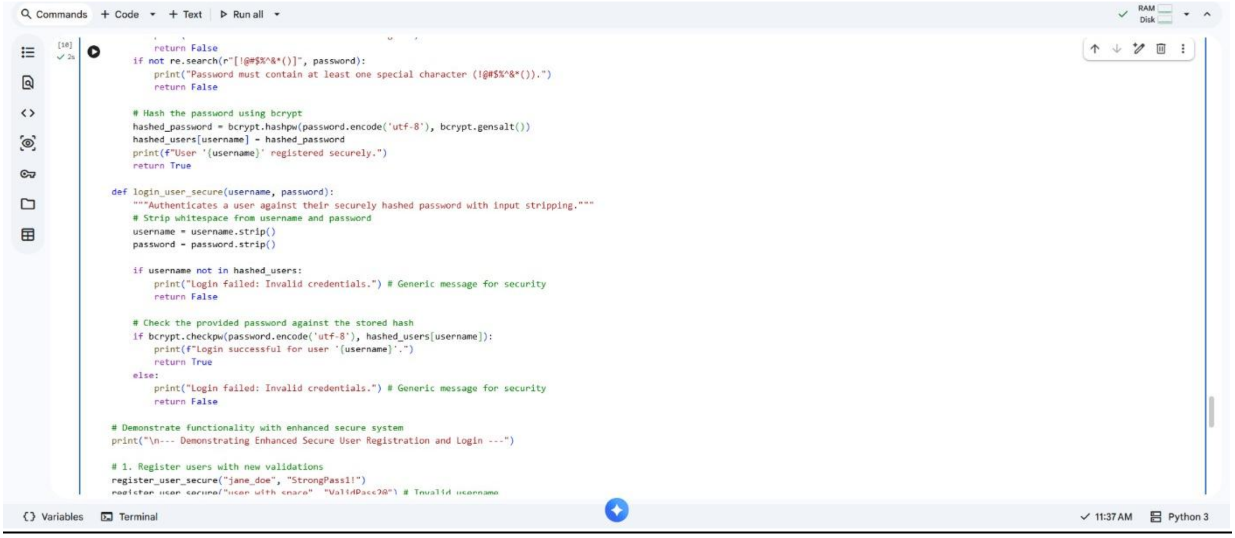


```python
users = {}

def register_user(username, password):
    """Registers a new user with the provided username and password."""
    users[username] = password
    print(f"User '{username}' registered successfully.")

def login_user(username, password):
    """Authenticates a user based on username and password."""
    if username in users and users[username] == password:
        print(f"Login successful for user '{username}'.")
        return True
    else:
        print(f"Login failed for user '{username}'. Invalid credentials.")
        return False

# Demonstrate functionality
print("\n--- Demonstrating User Registration and Login ---")

# 1. Register a user
register_user("alice", "password123")
register_user("bob", "secure_pass")

# 2. Attempt to log in with correct credentials
login_user("alice", "password123")

# 3. Attempt to log in with incorrect password
login_user("alice", "wrong_password")

# 4. Attempt to log in with non-existent username
login_user("charlie", "anypass")

print("\nCurrent registered users and their passwords (for demonstration purposes):")
print(users)
```

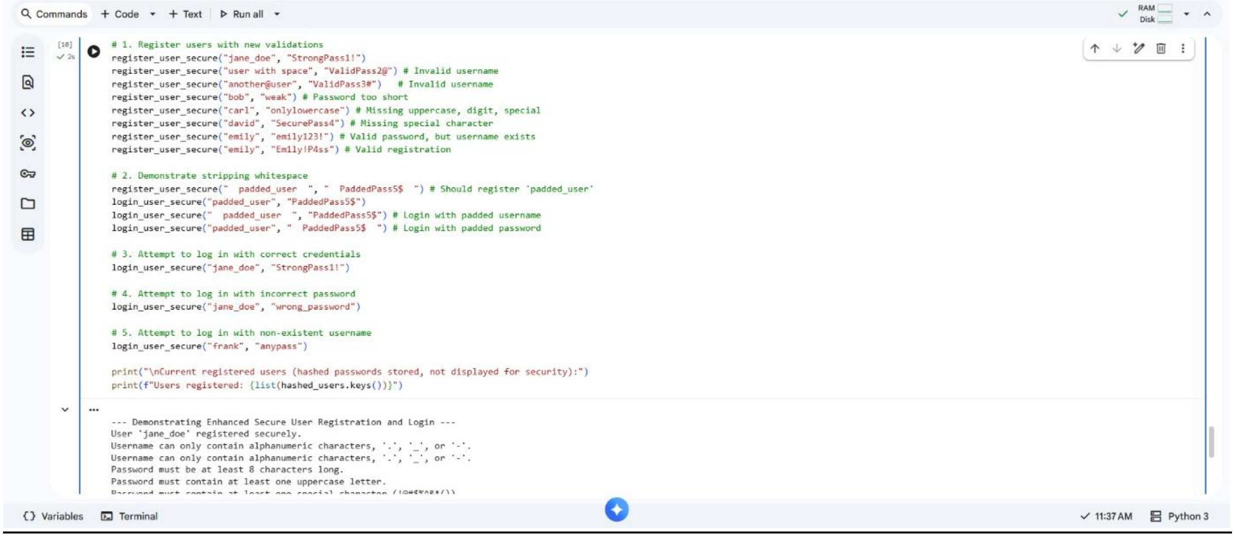
Secure Version:



```python
import bcrypt
import re # Import regex for advanced input validation

hashed_users = {}

def register_user_secure(username, password):
    """Registers a new user with a securely hashed password and robust input validation."""
    # Strip whitespace from username and password
    username = username.strip()
    password = password.strip()

    # 1. Basic validation for emptiness
    if not username or not password:
        print("Username and password cannot be empty or just whitespace.")
        return False

    # 2. Username validation: alphanumeric and allowed symbols (., _, -)
    if not re.fullmatch(r"[a-zA-Z0-9._-]+", username):
        print("Username can only contain alphanumeric characters, '.', '_', or '-'.")
        return False
    if len(username) < 3:
        print("Username must be at least 3 characters long.")
        return False

    # 3. Check for existing username
    if username in hashed_users:
        print(f"Username '{username}' already exists. Please choose a different one.")
        return False

    # 4. Password complexity requirements
    if len(password) < 8:
        print("Password must be at least 8 characters long.")
        return False
    if not re.search(r"[A-Z]", password):
```



```
        return False
    if not re.search(r"[!@#$%^&*()]", password):
        print("Password must contain at least one special character (!@#$%^&*()).")
        return False

    # Hash the password using bcrypt
    hashed_password = bcrypt.hashpw(password.encode('utf-8'), bcrypt.gensalt())
    hashed_users[username] = hashed_password
    print(f"User '{username}' registered securely.")
    return True

def login_user_secure(username, password):
    """Authenticates a user against their securely hashed password with input stripping."""
    # Strip whitespace from username and password
    username = username.strip()
    password = password.strip()

    if username not in hashed_users:
        print("Login failed: Invalid credentials.") # Generic message for security
        return False

    # Check the provided password against the stored hash
    if bcrypt.checkpw(password.encode('utf-8'), hashed_users[username]):
        print(f"Login successful for user '{username}'.")
        return True
    else:
        print("Login failed: Invalid credentials.") # Generic message for security
        return False

# Demonstrate functionality with enhanced secure system
print("\n--- Demonstrating Enhanced Secure User Registration and Login ---")

# 1. Register users with new validations
register_user_secure("jane_doe", "StrongPass1!")
register_user_secure("user with space", "ValidPass2@") # Invalid username
```



```
# 1. Register users with new validations
register_user_secure("jane_doe", "StrongPass1!")
register_user_secure("user with space", "ValidPass2@") # Invalid username
register_user_secure("another@user", "ValidPass3#")   # Invalid username
register_user_secure("bob", "weak") # Password too short
register_user_secure("carl", "onlylowercase") # Missing uppercase, digit, special
register_user_secure("david", "SecurePass4") # Missing special character
register_user_secure("emily", "emily123!") # Valid password, but username exists
register_user_secure("emily", "Em1ly!P4ss") # Valid registration

# 2. Demonstrate stripping whitespace
register_user_secure("  padded_user  ", "  PaddedPass5$  ") # Should register 'padded_user'
login_user_secure("padded_user", "PaddedPass5$")
login_user_secure("  padded_user  ", "PaddedPass5$") # Login with padded username
login_user_secure("padded_user", "  PaddedPass5$  ") # Login with padded password

# 3. Attempt to log in with correct credentials
login_user_secure("jane_doe", "StrongPass1!")

# 4. Attempt to log in with incorrect password
login_user_secure("jane_doe", "wrong_password")

# 5. Attempt to log in with non-existent username
login_user_secure("frank", "anypass")

print("\nCurrent registered users (hashed passwords stored, not displayed for security):")
print(f"Users registered: {list(hashed_users.keys())}")
```

```
--- Demonstrating Enhanced Secure User Registration and Login ---
User 'jane_doe' registered securely.
Username can only contain alphanumeric characters, '.', '_', or '-'.
Username can only contain alphanumeric characters, '.', '_', or '-'.
Password must be at least 8 characters long.
Password must contain at least one uppercase letter.
Password must contain at least one special character (!@#$%^&*())
```

Explaination :

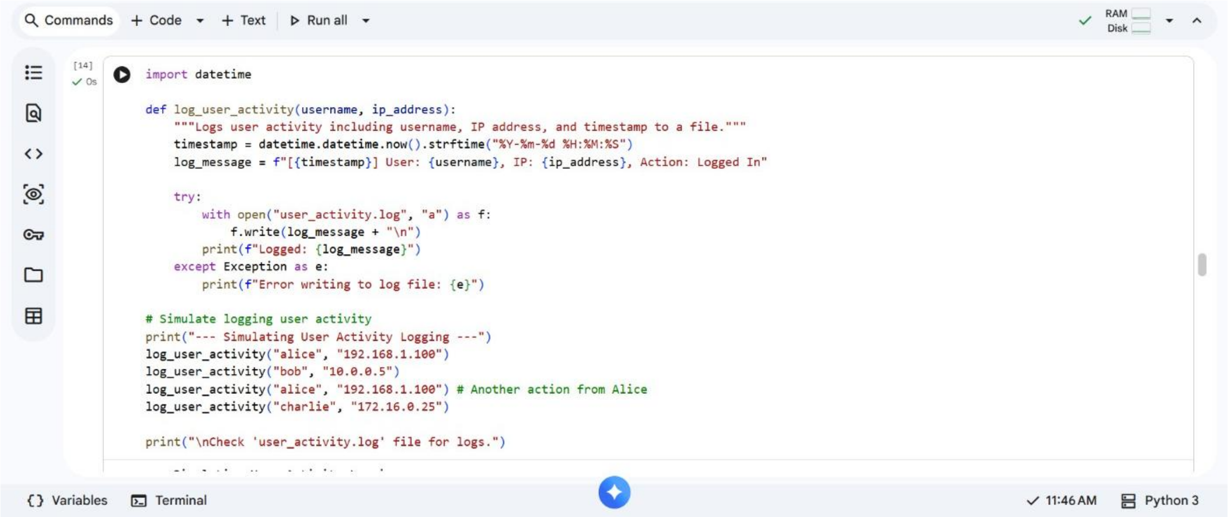
- ✓ Always hash passwords
- ✓ Never store plain-text passwords
- ✓ Validate user input
- ✓ Use strong hashing algorithms

Task – 05 : Privacy in Data Logging.

Prompt – 01 : Create a basic Python script that simulates logging user activity, including username, IP address, and timestamp, to a file or console.

Code:

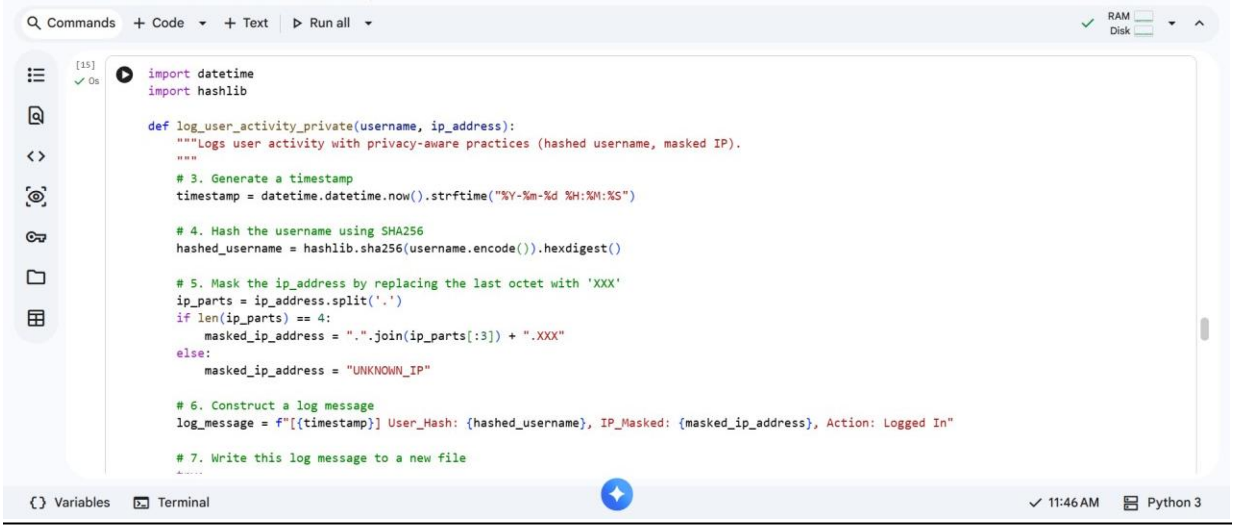
Privacy and Risky Logging:



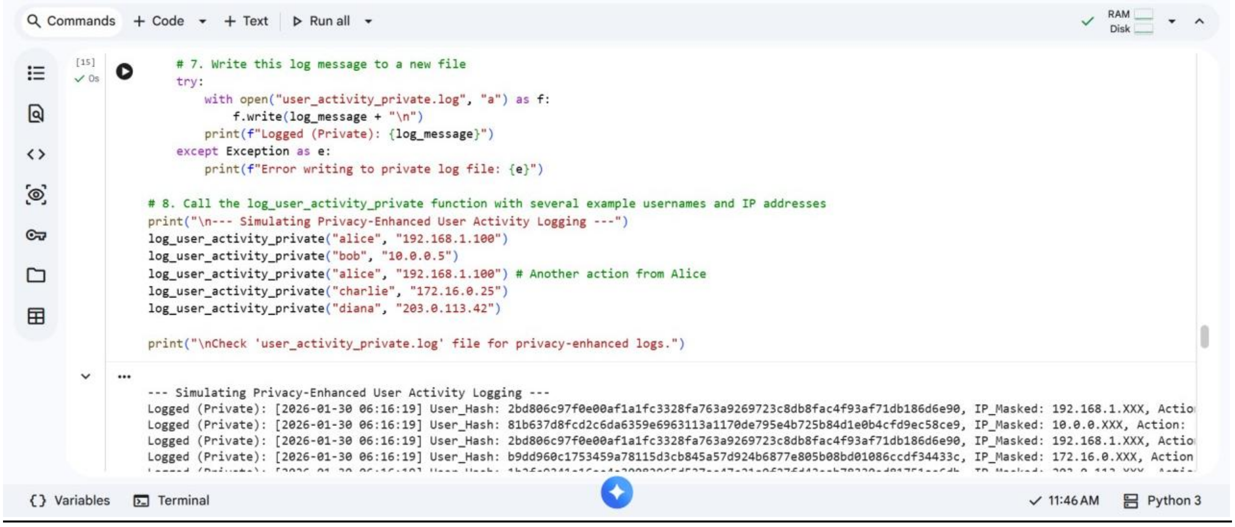
```python
import datetime

def log_user_activity(username, ip_address):
    """Logs user activity including username, IP address, and timestamp to a file."""
    timestamp = datetime.datetime.now().strftime("%Y-%m-%d %H:%M:%S")
    log_message = f"[{timestamp}] User: {username}, IP: {ip_address}, Action: Logged In"

    try:
        with open("user_activity.log", "a") as f:
            f.write(log_message + "\n")
        print(f"Logged: {log_message}")
    except Exception as e:
        print(f"Error writing to log file: {e}")

# Simulate logging user activity
print("--- Simulating User Activity Logging ---")
log_user_activity("alice", "192.168.1.100")
log_user_activity("bob", "10.0.0.5")
log_user_activity("alice", "192.168.1.100") # Another action from Alice
log_user_activity("charlie", "172.16.0.25")

print("\nCheck 'user_activity.log' file for logs.")
```

Prompt – 02 : Examine the initial logging script to identify specific privacy risks associated with logging sensitive data like usernames and IP addresses directly. Detail potential negative impacts.

Code:



```python
import datetime
import hashlib

def log_user_activity_private(username, ip_address):
    """Logs user activity with privacy-aware practices (hashed username, masked IP).
    """
    # 3. Generate a timestamp
    timestamp = datetime.datetime.now().strftime("%Y-%m-%d %H:%M:%S")

    # 4. Hash the username using SHA256
    hashed_username = hashlib.sha256(username.encode()).hexdigest()

    # 5. Mask the ip_address by replacing the last octet with 'XXX'
    ip_parts = ip_address.split('.')
    if len(ip_parts) == 4:
        masked_ip_address = ".".join(ip_parts[:3]) + ".XXX"
    else:
        masked_ip_address = "UNKNOWN_IP"

    # 6. Construct a log message
    log_message = f"[{timestamp}] User_Hash: {hashed_username}, IP_Masked: {masked_ip_address}, Action: Logged In"

    # 7. Write this log message to a new file
```



```python
    # 7. Write this log message to a new file
    try:
        with open("user_activity_private.log", "a") as f:
            f.write(log_message + "\n")
        print(f"Logged (Private): {log_message}")
    except Exception as e:
        print(f"Error writing to private log file: {e}")

# 8. Call the log_user_activity_private function with several example usernames and IP addresses
print("\n--- Simulating Privacy-Enhanced User Activity Logging ---")
log_user_activity_private("alice", "192.168.1.100")
log_user_activity_private("bob", "10.0.0.5")
log_user_activity_private("alice", "192.168.1.100") # Another action from Alice
log_user_activity_private("charlie", "172.16.0.25")
log_user_activity_private("diana", "203.0.113.42")

print("\nCheck 'user_activity_private.log' file for privacy-enhanced logs.")
```

```
--- Simulating Privacy-Enhanced User Activity Logging ---
Logged (Private): [2026-01-30 06:16:19] User_Hash: 2bd806c97f0e00af1a1fc3328fa763a9269723c8db8fac4f93af71db186d6e90, IP_Masked: 192.168.1.XXX, Actio
Logged (Private): [2026-01-30 06:16:19] User_Hash: 81b637d8fcd2c6da6359e6963113a1170de795e4b725b84d1e0b4cfd9ec58ce9, IP_Masked: 10.0.0.XXX, Action:
Logged (Private): [2026-01-30 06:16:19] User_Hash: 2bd806c97f0e00af1a1fc3328fa763a9269723c8db8fac4f93af71db186d6e90, IP_Masked: 192.168.1.XXX, Actio
Logged (Private): [2026-01-30 06:16:19] User_Hash: b9dd960c1753459a78115d3cb845a57d924b6877e805b08bd01086ccdf34433c, IP_Masked: 172.16.0.XXX, Action
```

Explaination :

- ✓ Mask or anonymize sensitive data
- ✓ Log only what is necessary
- ✓ Avoid storing personal identifiers
- ✓ Protect log files from unauthorized access

THANK YOU!!