PRIME NUMBER CHECKER AND GENERATOR

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Prime Number Checker and Generator

Introduction

This Python program is designed to perform two key functions related to prime numbers:

1**. Prime Number Checker** – It determines whether a given number is prime or not.

2**. Random Prime Number Generator** – It generates a random prime number within a specified range.

This program is structured to provide an efficient and user-friendly experience using a menu-driven interface. It employs an optimized algorithm to check for prime numbers and generate primes quickly, even for larger ranges.

Program Functionality

1. Prime Number Checker:

The program prompts the user to input a number.

It checks if the number is prime using an efficient algorithm

Numbers less than or equal to 1 are not prime.

2 is identified as prime directly.

Even numbers greater than 2 are immediately marked as non-prime.

The program checks divisibility of the number using odd divisors from 3 to the square root of the number (reducing the number of checks).

The result (prime or not) is displayed to the user.

2. Random Prime Number Generator

The user is prompted to enter a range (start and end values).

The program creates a list of all prime numbers within this range.

If the list is not empty, a random prime is selected and displayed.

If no primes exist in the range, the program informs the user.

3. Menu and User Interaction

A clear menu-driven interface allows the user to:

Check if a number is prime.

Generate a random prime number within a range.

Exit the program.

METHODOLOGY

1. Prime Checking (Trial Division):

A number is tested for primality using trial division up to its square root.

If divisible by any number within this range, it's marked non-prime; otherwise, it's prime.

2. Prime Generation:

Iterates through a user-defined range.

Uses the prime-checking function to identify primes and stores them in a list.

3. Optimization:

Checks divisibility only up to √n for efficiency.

Exits early if a divisor is found to save time.

4. User Interaction:

Takes input for single-number prime checking and range-based prime generation.

CODE:

```
import random
# Function to check if a number is prime
def is_prime(n):
    # A number less than or equal to 1 is not prime
    if n <= 1:
        return False
    # 2 is the only even prime number
    if n == 2:
        return True
    # Eliminate other even numbers greater than 2
    if n % 2 == 0:
        return False
    # Check odd divisors from 3 to the square root of n
    for i in range(3, int(n**0.5) + 1, 2):
        if n % i == 0:
            return False
    return True
```

```
# Function to generate a random prime number within a given range
def generate_random_prime(start, end):
    # Create a list of all prime numbers in the specified range
    primes = [num for num in range(start, end + 1) if is_prime(num)]
    # Return a random prime if the list is not empty, otherwise return None
    return random.choice(primes) if primes else None
# Main program loop
while True:
    # Display menu options
    print("\n1. Check Prime Number")
    print("2. Generate Random Prime Number")
    print("3. Exit")
 # Take user input for the choice
    choice = input("Enter your choice: ")
    # Option to check if a number is prime
    if choice == '1':
        num = int(input("Enter a number to check: "))
```

```
        if is_prime(num):
            print(f"{num} is a prime number.")
        else:
            print(f"{num} is not a prime number.")
    # Option to generate a random prime number in a given range
    elif choice == '2':
        start = int(input("Enter the start of the range: "))
        end = int(input("Enter the end of the range: "))
        # Call the function to get a random prime
        prime = generate_random_prime(start, end)
        if prime:
            print(f"Random prime number in range [{start}, {end}]: {prime}")
        else:
            print(f"No prime numbers found in range [{start}, {end}].")
    # Option to exit the program
    elif choice == '3':
        print("Exiting program. Goodbye!")
        break
```

```
    # Handle invalid input
else:
        print("Invalid choice! Please try again.")
```

```
1. Check Prime Number
2. Generate Random Prime Number
3. Exit
Enter your choice: 1
Enter a number to check: 467
467 is a prime number.

1. Check Prime Number
2. Generate Random Prime Number
3. Exit
Enter your choice: 2
Enter the start of the range: 34
Enter the end of the range: 45
Random prime number in range [34, 45]: 41

1. Check Prime Number
2. Generate Random Prime Number
3. Exit
Enter your choice: 3
Exiting program. Goodbye!
```