

✓ Roll : BEAD22547

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```
!pip install qiskit
!pip install qiskit_aer
```

```
Requirement already satisfied: qiskit in /usr/local/lib/python3.12/dist-packages (2.1.2)
Requirement already satisfied: rustworkx>=0.15.0 in /usr/local/lib/python3.12/dist-packages
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Requirement already satisfied: stevedore>=3.0.0 in /usr/local/lib/python3.12/dist-packages
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.12/dist-packages
Collecting qiskit_aer
  Downloading qiskit_aer-0.17.1-cp312-cp312-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.
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Downloading qiskit_aer-0.17.1-cp312-cp312-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1
12.4/12.4 MB 87.2 MB/s eta 0:00:00
Installing collected packages: qiskit_aer
Successfully installed qiskit_aer-0.17.1
```

```
from qiskit import QuantumCircuit, QuantumRegister, ClassicalRegister
from qiskit_aer import AerSimulator
import numpy as np
```

```
class QuantumRNG:
    def __init__(self, qubits=16):
        self.qubits = qubits
        self.sim = AerSimulator()

    def create_circuit(self):
        """Step 1-2: Initialize registers and create circuit"""
        qr = QuantumRegister(self.qubits, 'q')
        cr = ClassicalRegister(self.qubits, 'c')
        circuit = QuantumCircuit(qr, cr)
        return circuit, qr, cr

    def add_superposition(self, circuit, qr):
        """Step 3: Apply Hadamard gates for superposition"""
        circuit.h(qr) # Apply H gate to all qubits at once
        return circuit

    def measure_all(self, circuit, qr, cr):
```

```
"""Step 4: Measure qubits"""
```

```
circuit.measure(qr, cr)
```

```
return circuit
```

```
def generate(self):
```

```
    """Generate one random number (0 to 2^qubits - 1)"""
```

```
    circuit, qr, cr = self.create_circuit()
```

```
    circuit = self.add_superposition(circuit, qr)
```

```
    circuit = self.measure_all(circuit, qr, cr)
```

```
    result = self.sim.run(circuit, shots=1).result()
```

```
    binary = list(result.get_counts().keys())[0]
```

```
    return int(binary, 2)
```

```
def random_int(max_val=None):
```

```
    """Generate random integer. If max_val given, returns 0 to max_val-1"""
```

```
    rng = QuantumRNG()
```

```
    num = rng.generate()
```

```
    return num % max_val if max_val else num
```

```
def random_float():
```

```
    """Generate random float between 0 and 1"""
```

```
    return random_int() / (2**16 - 1)
```

```
def random_choice(items):
```

```
    """Randomly select from list"""
```

```
    return items[random_int(len(items))]
```

```
def random_password(length=8):
```

```
    """Generate random password"""
```

```
    chars = "ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789"
```

```
    return ''.join([random_choice(chars) for _ in range(length)])
```

```
def demo():
```

```
    print("16-Qubit Quantum Random Number Generator")
```

```
    print("=" * 40)
```

```
    # Basic usage
```

```
    print(f"Random number: {random_int()}")
```

```
    print(f"Random 1-100: {random_int(100) + 1}")
```

```
    print(f"Random float: {random_float():.4f}")
```

```
    print(f"Random choice: {random_choice(['A', 'B', 'C', 'D'])}")
```

```
    print(f"Random password: {random_password(12)}")
```

```
    # Multiple numbers
```

```
    print(f"\n10 Random numbers:")
```

```
    for i in range(10):
```

```
        print(f" {i+1:2d}. {random_int():5d}")
```

```
def test_circuit():
```

```

"""Show circuit structure"""
rng = QuantumRNG(4) # 4-qubit for clean display
circuit, qr, cr = rng.create_circuit()
circuit = rng.add_superposition(circuit, qr)
circuit = rng.measure_all(circuit, qr, cr)

print("4-Qubit Circuit (16-qubit same pattern):")
print(circuit.draw(output='text'))

```

```

def test_distribution(n=100):
    """Test randomness distribution"""
    numbers = [random_int(10) for _ in range(n)]
    counts = {i: numbers.count(i) for i in range(10)}

    print(f"\nDistribution test (n={n}, range 0-9):")
    for digit, count in counts.items():
        print(f"  {digit}: {'█' * (count * 20 // n)} {count}")

```

```

demo()
test_circuit()
test_distribution()

```

➤ 16-Qubit Quantum Random Number Generator

=====

```

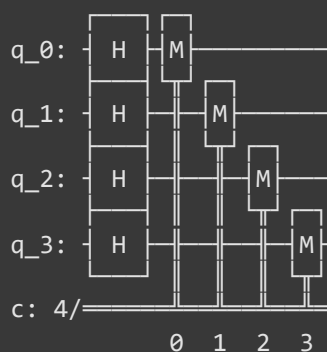
Random number: 27636
Random 1-100: 24
Random float: 0.0304
Random choice: B
Random password: jpvMDY95fp1o

```

10 Random numbers:

1. 24217
2. 35271
3. 57937
4. 15813
5. 8585
6. 52218
7. 24923
8. 19652
9. 28316
10. 4636

4-Qubit Circuit (16-qubit same pattern):



Distribution test (n=100, range 0-9):

```

0: █ 10
1: █ 8
2: █ 9

```

```
3: 12
4: 8
5: 10
6: 13
7: 15
8: 8
9: 7
```