Strings are one of the most essential and commonly used data types in Python. Here's a comprehensive guide about strings in Python, from A to Z:

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1. What is a String?

- A string is a sequence of characters enclosed in single quotes `' '`, double quotes `" "`, or triple quotes `''' '''` or `""" """`.

Example:

python
Copy code
```
single_quoted = 'Hello'
double_quoted = "World"
triple_quoted = '''Python is fun!'''
```

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2. String Creation

- Strings can be created using:
  - Single quotes: `'Hello'`
  - Double quotes: `"Hello"`
  - Triple quotes (for multi-line strings): `'''Hello'''` or `"""Hello"""`

Example:

python
Copy code
```
multi_line = """This is
a multi-line
string."""
```

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3. Accessing Characters

- Strings can be accessed using **indexing** and **slicing**.

Example:

python
Copy code
```
text = "Python"
print(text[0])   # Output: P
print(text[-1])  # Output: n
print(text[1:4]) # Output: yth
```

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4. String Immutability

- Strings are immutable, meaning you cannot change their content after creation.

Example:

python
Copy code
```
text = "Hello"
# text[0] = 'J'  # This will raise an error
text = "Jello"    # But you can reassign a new string
```

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5. String Concatenation and Repetition

- Use + to concatenate strings and * to repeat strings.

Example:

python
Copy code
```
greeting = "Hello" + " World"
print(greeting)  # Output: Hello World

repeat = "Hi! " * 3
print(repeat)    # Output: Hi! Hi! Hi!
```

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6. Common String Methods

a) Length of String

python

Copy code

```
text = "Python"
print(len(text))  # Output: 6
```

b) Changing Case

python

Copy code

```
text = "hello"
print(text.upper())  # Output: HELLO
print(text.lower())  # Output: hello
print(text.capitalize())  # Output: Hello
print(text.title())  # Output: Hello
```

c) Trimming Whitespace

python

Copy code

```
text = "  hello  "
print(text.strip())    # Output: hello
print(text.lstrip())   # Output: hello
print(text.rstrip())   # Output:   hello
```

d) Finding and Replacing

python

Copy code

```
text = "hello world"
print(text.find("world"))  # Output: 6
print(text.replace("world", "Python"))  # Output: hello Python
```

e) Splitting and Joining

python

Copy code

```
text = "Python is fun"
words = text.split()  # Splits into a list ['Python', 'is', 'fun']
print(words)

joined = " ".join(words)  # Joins back with spaces
print(joined)  # Output: Python is fun
```

f) Checking String Properties

python
Copy code

```
text = "Python123"
print(text.isalpha())  # False (contains digits)
print(text.isdigit())  # False (contains letters)
print(text.isalnum())  # True (only letters and digits)
```

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7. String Formatting

a) Using `f-strings` (Python 3.6+)

python
Copy code

```
name = "Alice"
age = 25
print(f"My name is {name} and I am {age} years old.")  # Output: My name is Alice and I am 25 years old.
```

b) Using `.format()`

python
Copy code

```
print("My name is {} and I am {} years old.".format(name, age))
```

c) Old-style `%` formatting

python
Copy code

```
print("My name is %s and I am %d years old." % (name, age))
```

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8. Escape Characters

- Use backslash `\` to include special characters in strings.

Escape Sequence	Description
`\'`	Single quote
`\"`	Double quote
`\\`	Backslash
`\n`	Newline
`\t`	Tab

Example:

python
Copy code
```
text = "She said, \"Hello!\""
print(text)  # Output: She said, "Hello!"
```

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9. Raw Strings

- Use `r` before a string to treat backslashes as literal characters.

Example:

python
Copy code
```
path = r"C:\Users\Name"
print(path)  # Output: C:\Users\Name
```

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10. Iterating Through Strings

- Use loops to iterate through characters in a string.

Example:

python
Copy code
```
text = "Python"
```

```
for char in text:
    print(char)
```

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11. String Encoding and Decoding

- Convert strings to bytes and back.

Example:

python
Copy code
```
text = "Python"
encoded = text.encode("utf-8")
print(encoded)  # Output: b'Python'

decoded = encoded.decode("utf-8")
print(decoded)  # Output: Python
```

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12. Advanced String Operations

a) Checking Membership
python
Copy code
```
text = "Python is fun"
print("Python" in text)  # True
print("Java" not in text)  # True
```

b) Reversing a String
python
Copy code
```
text = "Python"
reversed_text = text[::-1]
print(reversed_text)  # Output: nohtyP
```

c) Counting Occurrences
python

Copy code
```
text = "banana"
print(text.count('a'))  # Output: 3
```

d) Startswith and Endswith

python
Copy code
```
text = "hello world"
print(text.startswith("hello"))  # True
print(text.endswith("world"))    # True
```

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13. Multi-Line Strings

python
Copy code
```
multi_line = """This is a
multi-line string."""
print(multi_line)
```

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14. String Comparison

- Strings can be compared lexicographically using comparison operators.

Example:

python
Copy code
```
print("abc" < "bcd")  # True
print("Python" == "python")  # False
```

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15. Useful Libraries for Strings

a) `string` Module

python
Copy code
```
import string
```

```
print(string.ascii_letters)  # All lowercase and uppercase letters
print(string.digits)         # '0123456789'
print(string.punctuation)    # Punctuation characters
```

b) `re` for Regular Expressions

python
Copy code

```
import re
text = "Python123"
numbers = re.findall(r'\d+', text)  # Extracts digits
print(numbers)  # Output: ['123']
```

Summary

- Strings are versatile and integral to Python programming.
- String methods and operations cover most text-processing needs.
- Python provides advanced tools like `re` and `string` for specialized tasks.

Experiment with these concepts to deepen your understanding!