

Lists and Strings

Many interesting problems involve manipulating sequences of data. You've learned about lists and strings before, but this activity provides a more in-depth look at what they can do.

Content Learning Objectives

After completing this activity, students should be able to:

- Name four methods that lists provide, and describe what each method does.
- Explain the syntax and meaning of slice operations, with and without indexes.
- Name four methods that strings provide, and describe what each method does.

Process Skill Goals

During the activity, students should make progress toward:

- Gaining insight about data structures from many examples. (Information Processing)



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Model 1 Working with Lists

Recall that a variable can hold multiple values in the form of a list. The values are separated by commas and wrapped in square brackets.

Lists have *methods* (built-in functions) that can be called using dot notation. For example, to add a new element to the end of a list, we can use the `append` method.

Python code	Shell output
<code>rolls = [4, 6, 6, 2, 6]</code>	
<code>len(rolls)</code>	
<code>print(rolls[5])</code>	
<code>rolls.append(1)</code>	
<code>print(rolls)</code>	
<code>print(rolls[5])</code>	
<code>lucky.append(1)</code>	
<code>lucky = []</code>	
<code>print(lucky[0])</code>	
<code>lucky.append(5)</code>	
<code>print(lucky)</code>	
<code>print(lucky[0])</code>	
<code>rolls.count(6)</code>	
<code>rolls.remove(6)</code>	
<code>print(rolls)</code>	
<code>help(rolls.remove)</code>	
<code>help(rolls)</code>	

Questions (15 min)

Start time: _____

1. What is the result of calling the `append` method on a list?
2. What must be defined prior to using a method like `append`?

3. Explain why two lines in Model 1 caused an `IndexError`.
4. What is the result of calling the `remove` method on a list?
5. Based on the `help` output, name several list methods not shown in Model 1. Do not include methods that begin and end with two underscores (e.g., `__add__`).
6. Give one example of a list method that requires an argument and one that does not.
7. Describe the similarities and differences between using a list method like `append` and Python built-in functions like `print`.
8. Complete the function below (two lines are missing). It should prompt the user for numbers and build a list by adding one number at a time to the end of the list. The loop terminates when the user inputs the number 0.

```
def input_numbers():
    x = 1

    while x != 0:
        x = int(input("Enter the next number: "))

    return numbers
```

Model 2 Indexing and Slicing

A string is a sequence of characters in single quotes (') or double quotes ("). Depending on the application, we can treat a string as a single value (e.g., dna), or we can access individual characters using square brackets (e.g., dna[0]). We can also use *slice notation* (e.g., dna[4:8]) to refer to a range of characters. In fact, all types of sequences (including `list` and `tuple`) support indexing and slicing.

Python code	Shell output
<code>dna = 'CTGACGACTT'</code>	
<code>dna[5]</code>	
<code>dna[10]</code>	
<code>len(dna)</code>	
<code>dna[:5]</code>	
<code>dna[5:]</code>	
<code>dna[5:10]</code>	
<code>triplet = dna[2:5]</code>	
<code>print(triplet)</code>	
<code>dna[-5]</code>	
<code>dna[-10]</code>	
<code>dna[:-5]</code>	
<code>dna[-5:]</code>	
<code>triplet = dna[-4:-1]</code>	
<code>print(triplet)</code>	

Questions (15 min)

Start time: _____

9. What is the *positive* index of each character in the dna string? Check your answers above.

Character:

C	T	G	A	C	G	A	C	T	T
---	---	---	---	---	---	---	---	---	---

Index:

10. What is the *negative* index of each character in the dna string? Check your answers above.

Character:

C	T	G	A	C	G	A	C	T	T
---	---	---	---	---	---	---	---	---	---

Index:

11. Based on the previous questions, what are `dna[2]` and `dna[-2]`? Explain your answers.
12. Explain the `IndexError` you observed. What is the range of indexes for the `dna` string?
13. Consider the notation of the operator `[m:n]` for slicing the string.
 - a) Is the value at `m` the same as the corresponding index value (i.e., `dna[m]`)? If not, describe what it means.
 - b) Is the value at `n` the same as the corresponding index value (i.e., `dna[n]`)? If not, describe what it means.
 - c) Explain what it means when only a single number is referenced when creating a slice, such as `[m:]` or `[:n]`.
14. What is the simplest way to get the first three characters of `dna`? What is the simplest way to get the last three characters?
15. Write a Python expression that slices '`GACT`' from `dna` using positive indexes. Then write another expression that slices the same string using negative indexes.
16. Write a Python assignment statement that uses the `len` function to assign the last letter of `dna` to the variable `last`.
17. Write a Python assignment statement that uses a negative index to assign the last letter of `dna` to the variable `last`.

Model 3 Common String Methods

Like lists, strings have *methods* (built-in functions) that can be called using dot notation. See <https://docs.python.org/3/library/stdtypes.html#string-methods> for more details.

Python code	Shell output
<code>dna = 'CTGACGACTT'</code>	
<code>dna.lower()</code>	
<code>print(dna)</code>	
<code>lowercase = dna.lower()</code>	
<code>print(lowercase)</code>	
<code>dnalist = list(dna)</code>	
<code>print(dnalist)</code>	
<code>dnalist.reverse()</code>	
<code>print(dnalist)</code>	
<code>type(dna)</code>	
<code>dna = dna.split('A')</code>	
<code>print(dna)</code>	
<code>type(dna)</code>	
<code>dna.replace('C', 'g')</code>	
<code>print(dna[0])</code>	
<code>type(dna[0])</code>	
<code>dna[0].replace('C', 'g')</code>	
<code>print(dna)</code>	

Questions (15 min)

Start time: _____

18. Does the `lower` method change the contents of the `dna` string? Justify your answer.

19. Describe the `list` function—what does `list(dna)` return in Model 3?

20. Why is it possible to call the `replace` method on `dna[0]` but not `dna`?

21. Name several other string methods not shown in Model 3. (Read the documentation.)

22. Consider the application of a method on a variable:

- Does a string variable change after applying a method? Provide justification.
- Does a list variable change after applying a method? Provide justification.
- Identify the data type that is *immutable* (i.e., the value never changes).

23. Write a single statement to change the final contents of `dna` to `['CTG', 'cc', 'CTT']`. Confirm that your code works in a Python Shell.

24. Why do you think Python has a `replace` method for strings but not for lists?