Python Strings

Defining Strings in Python

- three ways:

```
>>> x = ‘Mozzarella”      # single quotes
>>>
>>> x = “Mozzarella”     # double quotes
>>>
>>> x = “””Mozzrella”””   # triple quotes
```

- use escape (\) for special characters

```
>>> print(“\a”)              # system bell
```

Character Encoding

- ASCII: each character is one byte
- (extended) ASCII: up to (256) 128
- not enough for many alphabets
- Unicode: up to 4 bytes per character
- three encoding schemes:

1. UTF−32: use 4 bytes
2. UTF−16: use 2 bytes
3. UTF−8: variable length encoding

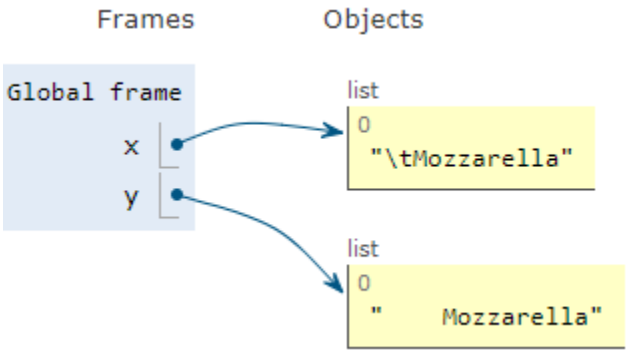
Character Escape Codes

character	description
\	newline continue
\\	backlash
\a	system bell
\b	backspace
\e	escape
\t	horizontal tab
\v	vertical tab
\”	double quotes

- raw strings: ignore escape codes

  >>> x = r‘\tMozzarella’

  >>> y = ‘\tMozzarella’



Escape Sequences

- Use "\" (backlash) for special characters:

```
>>> x = 'Mozzarella\'s"   # single quotes
Mozzarella's
>>> x = "Mozza\trella"    # tab
Mozza    rella
>>> x = "Mo\"zz\"rella"   # double quotes
Mo"zz"arella
>>> x = "D:\\bu\\python"
D:\bu\python
```

- for dir/file names, use this:

```
>>> import os
>>> x = os.path.join("D:", "bu", "python")
D:\bu\python
```

String Operations

- concatenation

```
>>>  “Mozzarella”   + “Cheddar”
‘MozzarellaCheddar’
```

- repetition

```
>>> “Mozzarella” * 3
‘MozzarellaMozzarellaMozzarella’
```

- indexing

```
>>> “Mozzarella”[0]
‘M’
```

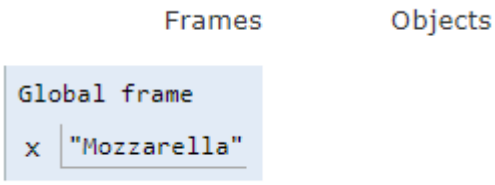
- slicng

```
>>> “Mozzarella”[0 : 4]
‘Mozz’
```

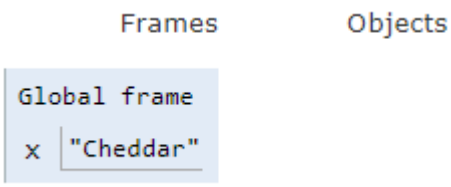
String Immutability

- once created, cannot be changed

```
>>> x = “Mozzarella”
>>> id(x)
139685060402176
```




```
>>> x =”Cheddar”
>>> id(x)
139760688281904
```



String as an Object

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x = “Mozarella”
>>> y = x.index(‘r’)
>>> y
>>> 5
```

- string is an object
- what are string attributes?

variable name	delimiter	attribute	arguments
x	.	index	(‘r’)

String as an Object

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x = “Mozzarella”       # double quotes
>>> x = ‘Mozzarella’       # single quotes
>>> x = “””Mozzarella”””  # triple quotes
>>> y = x.index(‘r’)
>>> y
>>> 5
```

- string is an object
- what are string attributes?

variable name	delimiter	attribute	arguments
x	.	index	(‘r’)

Slicing

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

>>> x = “Mozzarella”

- slice operator:

variable		start		one past end	
x	[	i	:	j	]

Indexing for String Slicing

- each element is identified by its position
- slice – elements between two positions

>>> x = “Mozzarella”

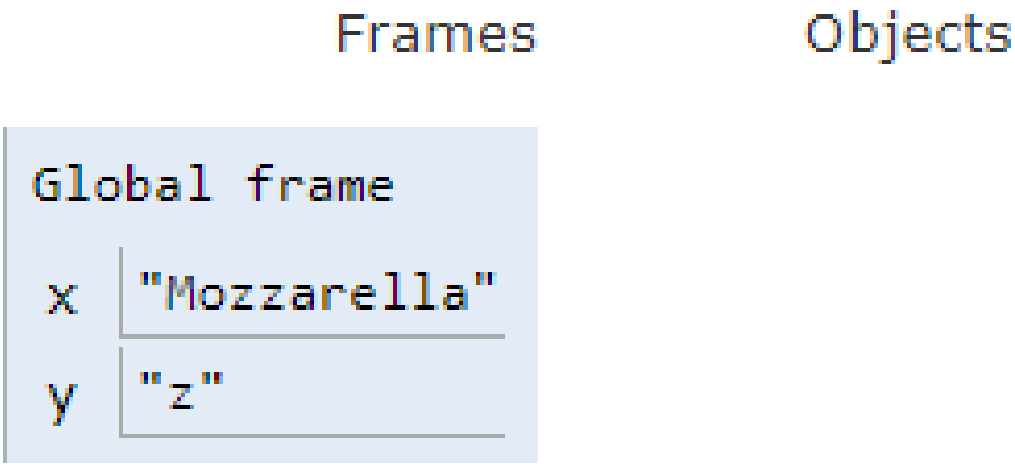
0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

- indexing starts at 0, ends at (length – 1)
- can refer to slices but positive or negative indices

Slicing with a Single Index

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

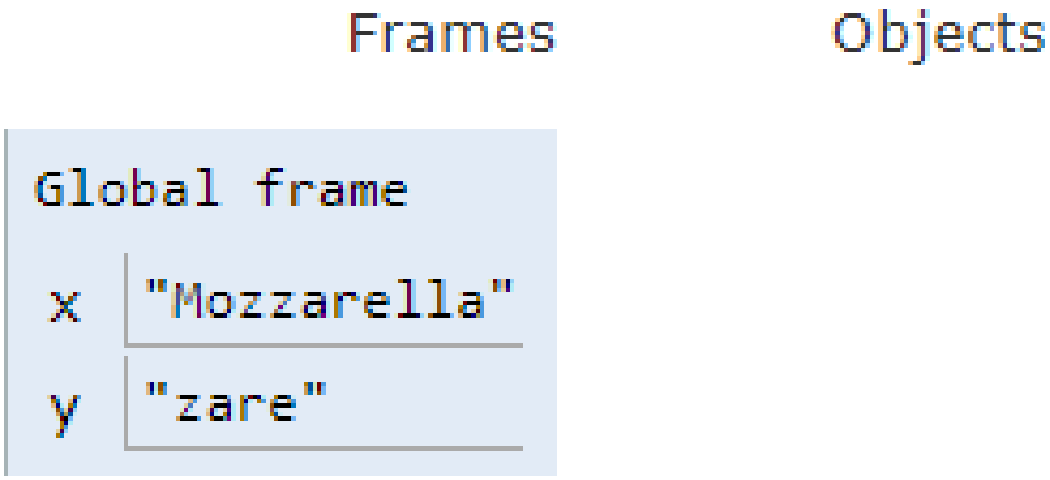
```
>>> x = “Mozzarella”
>>> y = x[2]
>>> y
>>> z
```



Slicing with Positive Indices

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

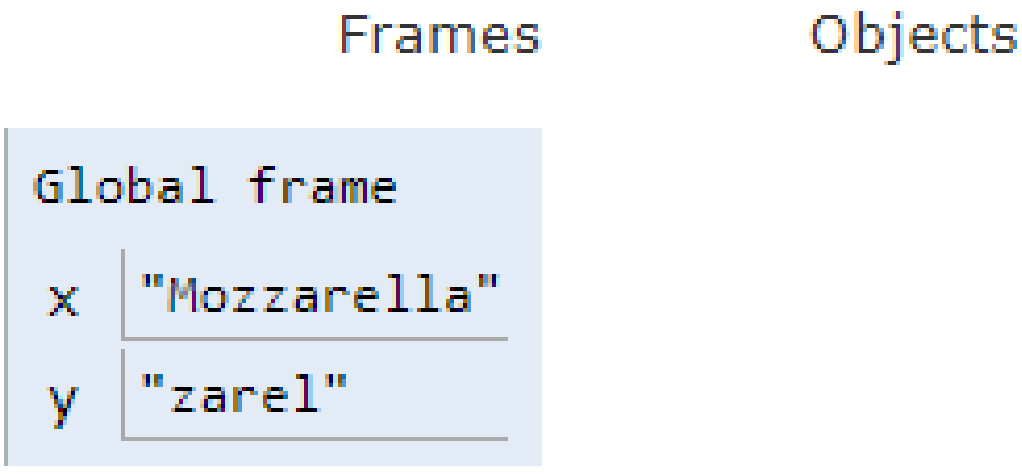
```
>>> x = “Mozzarella”
>>> y = x[3 : 7]
>>> y
>>> zare
```



Slicing w. Negative Indices

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

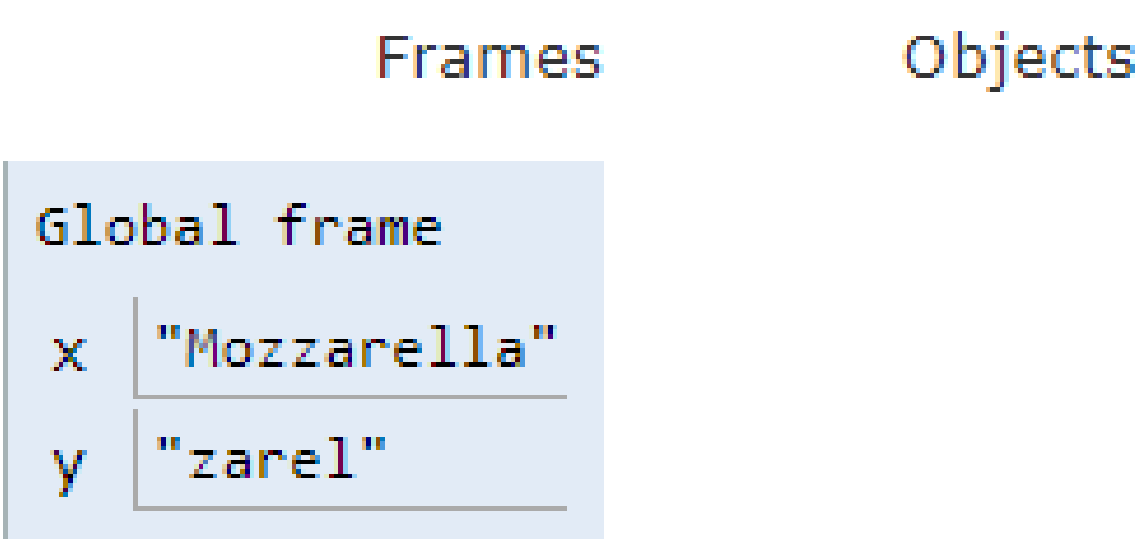
```
>>> x = “Mozzarella”
>>> y = x[−7 : −2]
>>> y
>>> zarel
```



Slicing with Positive and Negative Indices

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x = “Mozzarella”
>>> y = x[3 : -2]
>>> y
>>> zarel
```

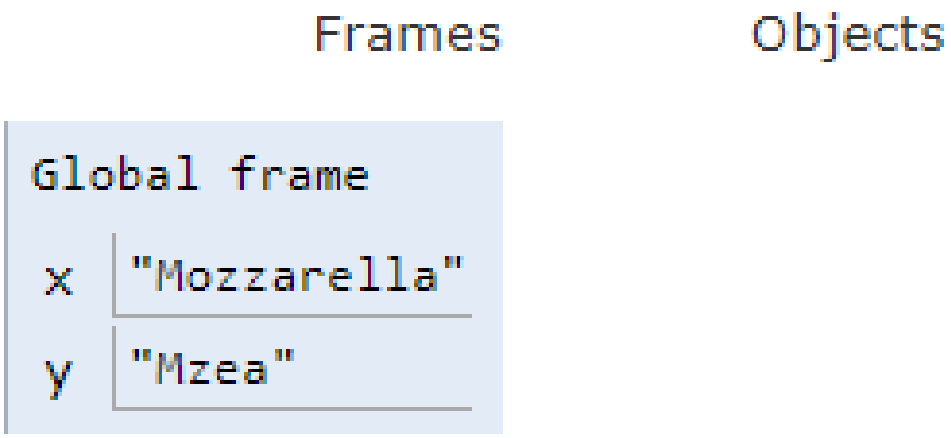


Extended Slicing

- [start: finish: count]

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

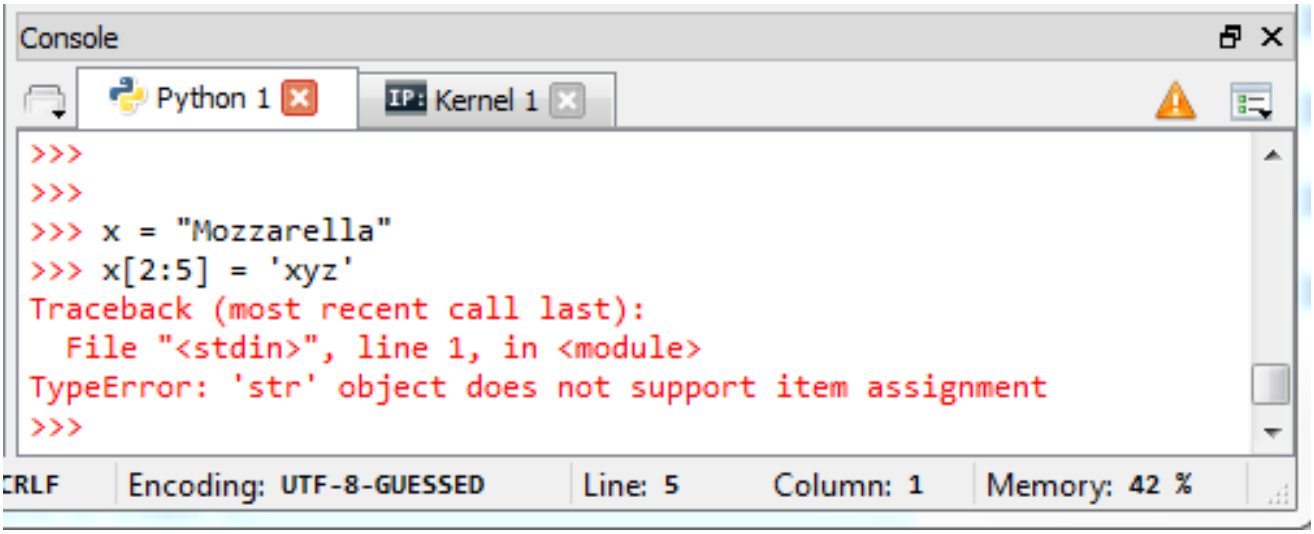
```
>>> # extract every third letter
>>> x = “Mozzarella”
>>> y = x[0 : 10 : 3]
>>> y
>>> Mzea
```



Slice Replacing

- strings are immutable
- cannot change substrings without creating new strings!!!

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

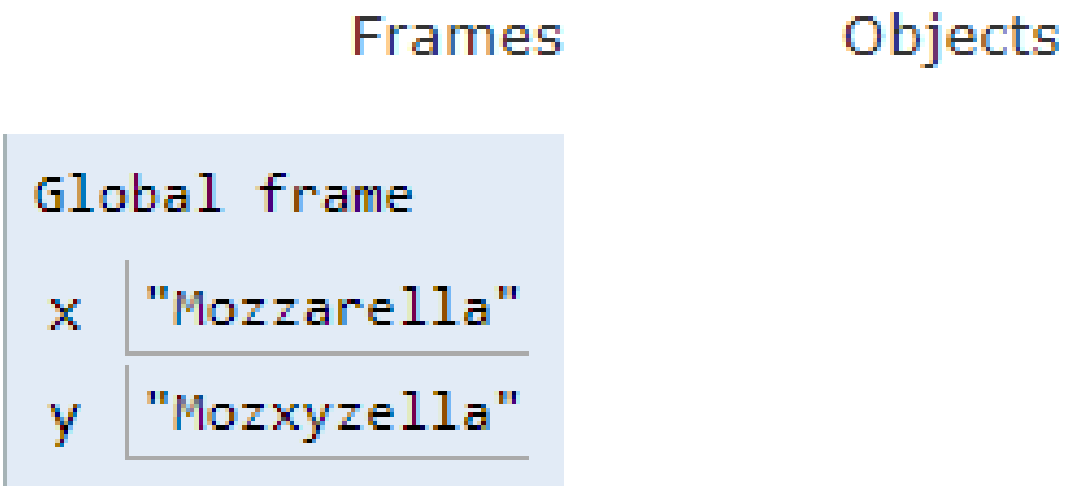


Substring Replacement

- can create a new string

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

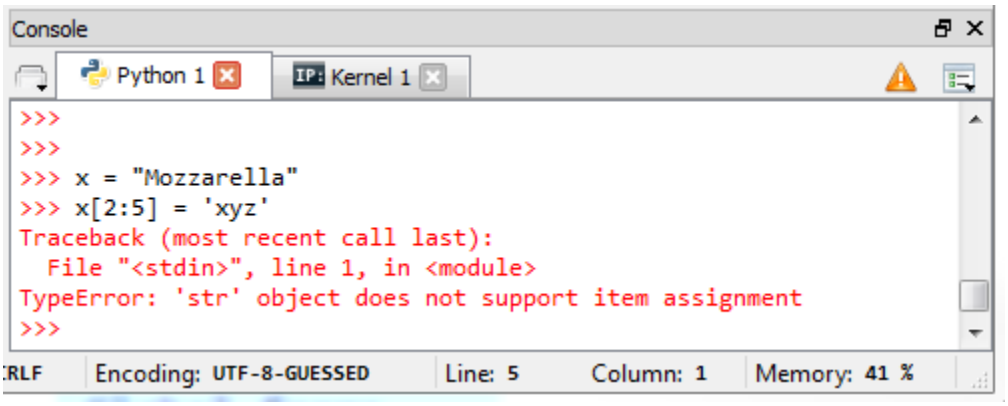
```
>>> x = “Mozzarella”
>>> y = x.replace(“zar”, “xyz”)
>>> y
>>> Mozxyzella
```



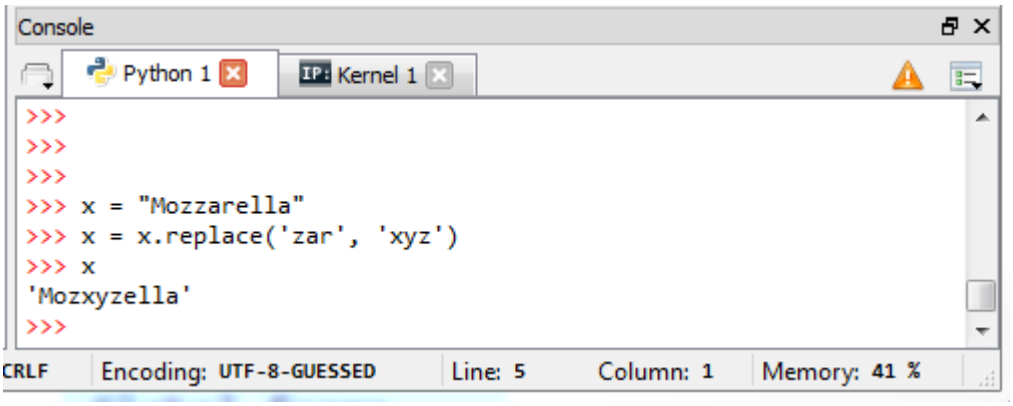
Valid vs. Invalid Slicing

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

- why is this illegal?



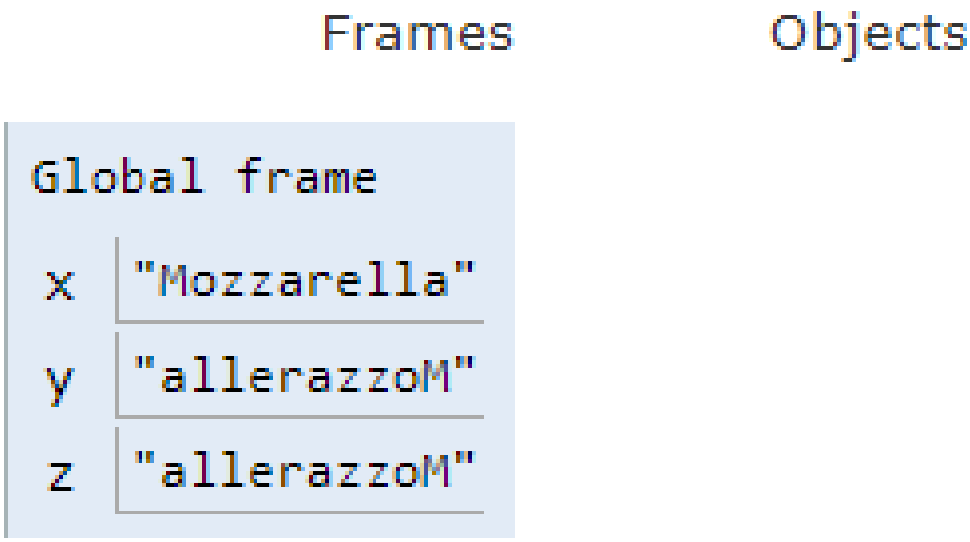
- why is this legal?



String Reversal

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x = “Mozzarella”
>>> y = x[: : −1]                    # idiomatic
>>> z = “”.join(reversed(x))    # slower
```



Slicing: Quiz

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

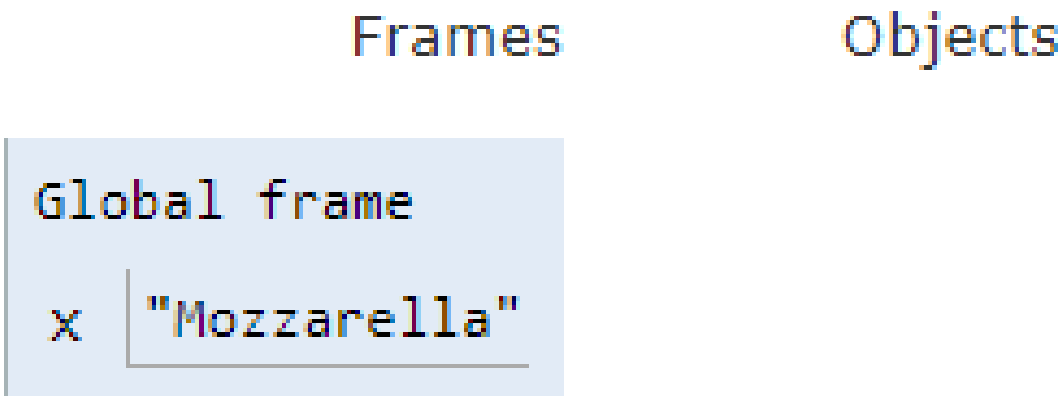
- what is the result of these operations?

```
>>> x =  “Mozzarella”
>>> y = x[−1]
>>> z = x[2 : 6]
>>> w = x[−7 : −3]
>>> v = x[ : ]
```

Slicing: Quiz (cont'd)

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x =  "Mozzarella"
```

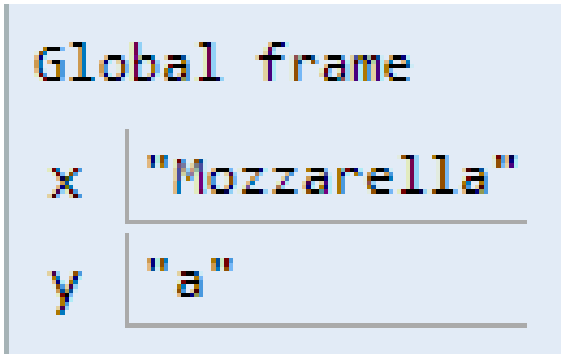


Slicing: Quiz (cont'd)

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x =  "Mozzarella"
>>> y = x[−1]
```

Frames Objects

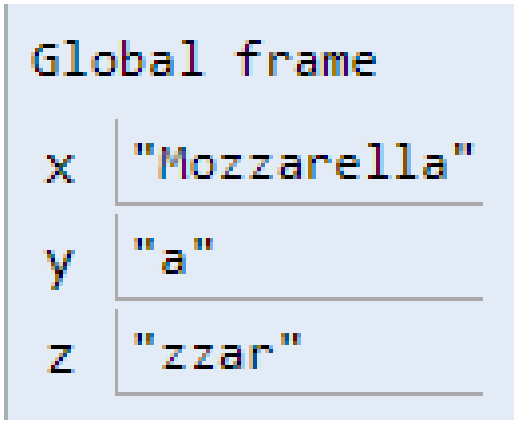


Slicing: Quiz (cont'd)

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x =  "Mozzarella"
>>> y = x[−1]
>>> z = x[2 : 6]
```

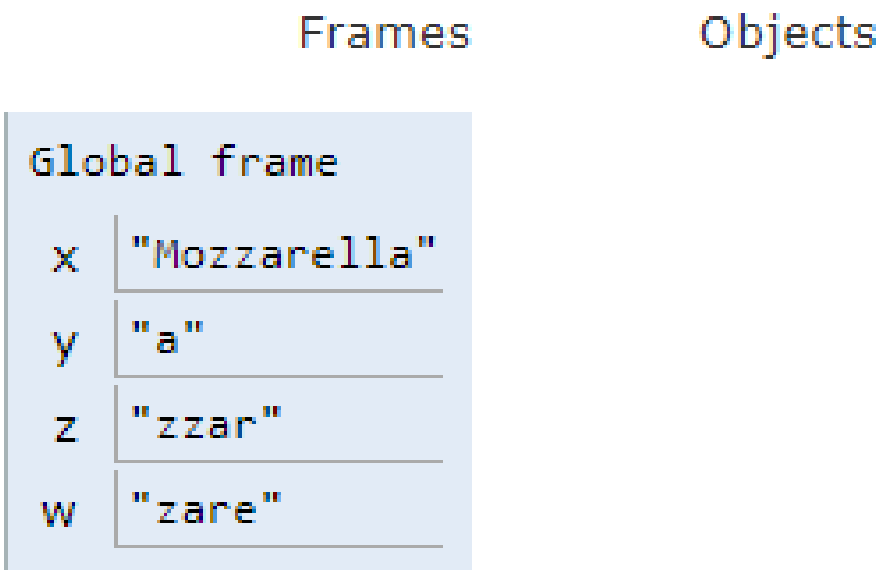
Frames Objects



Slicing: Quiz (cont'd)

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x =  "Mozzarella"
>>> y = x[−1]
>>> z = x[2 : 6]
>>> w = x[−7 : −3]
```

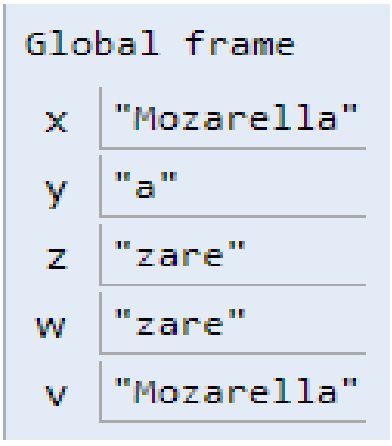


Slicing: Quiz (cont'd)

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x =  "Mozzarella"
>>> y = x[ −1]
>>> z = x[2 : 6]
>>> w = x[ −7 : −3]
>>> v = x[ : ]
```

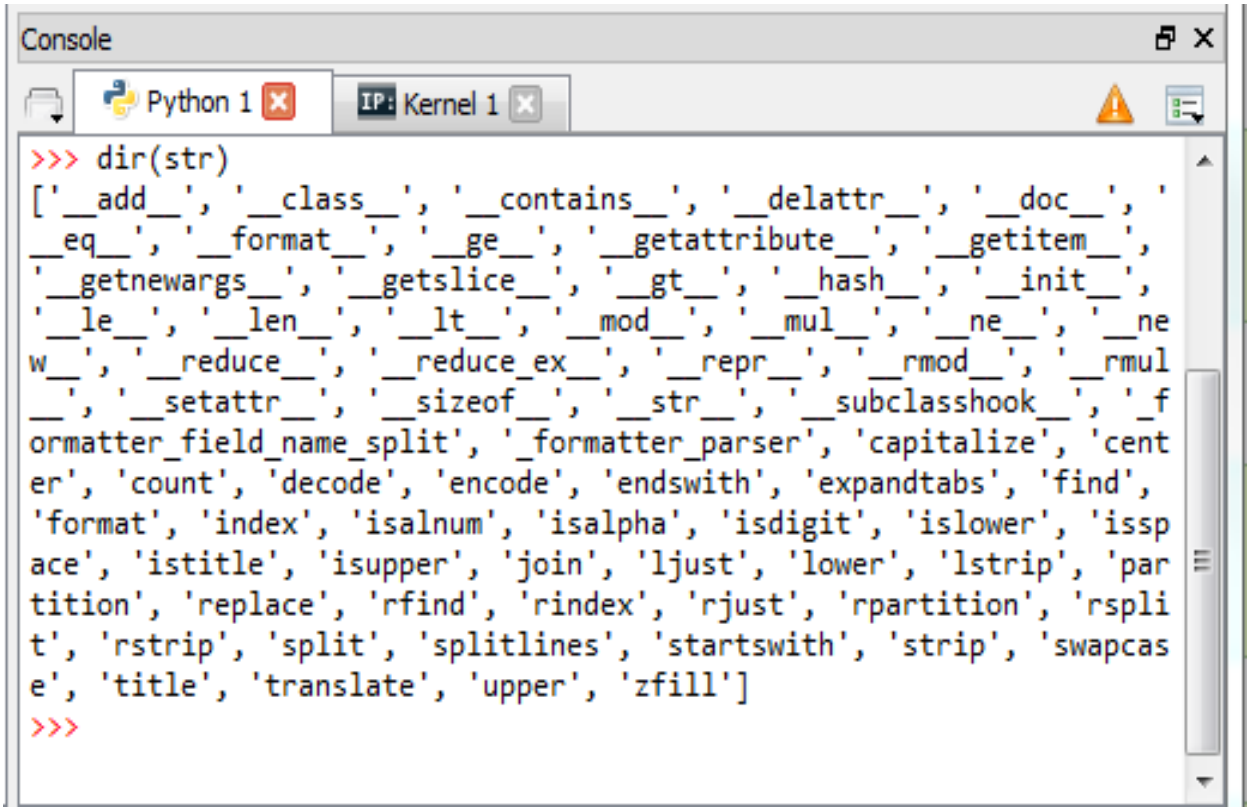
Frames Objects



- example of a shallow copy

String Attributes

- use dir(str) command



- names starting with __ refer to “local” class names/methods

String Comparisons

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> x = “Mozzarella”
>>> y = x.upper()
>>> condition_1 = (x[4] == y[9])
>>> condition_2 = (x[4] == y[9].lower())
>>> condition_3 = (x[0 : 2] <= y[0 : 2])
>>> condition_4 = (x[0 : 2] > y[0 : 2])
```

Frames Objects

Global frame

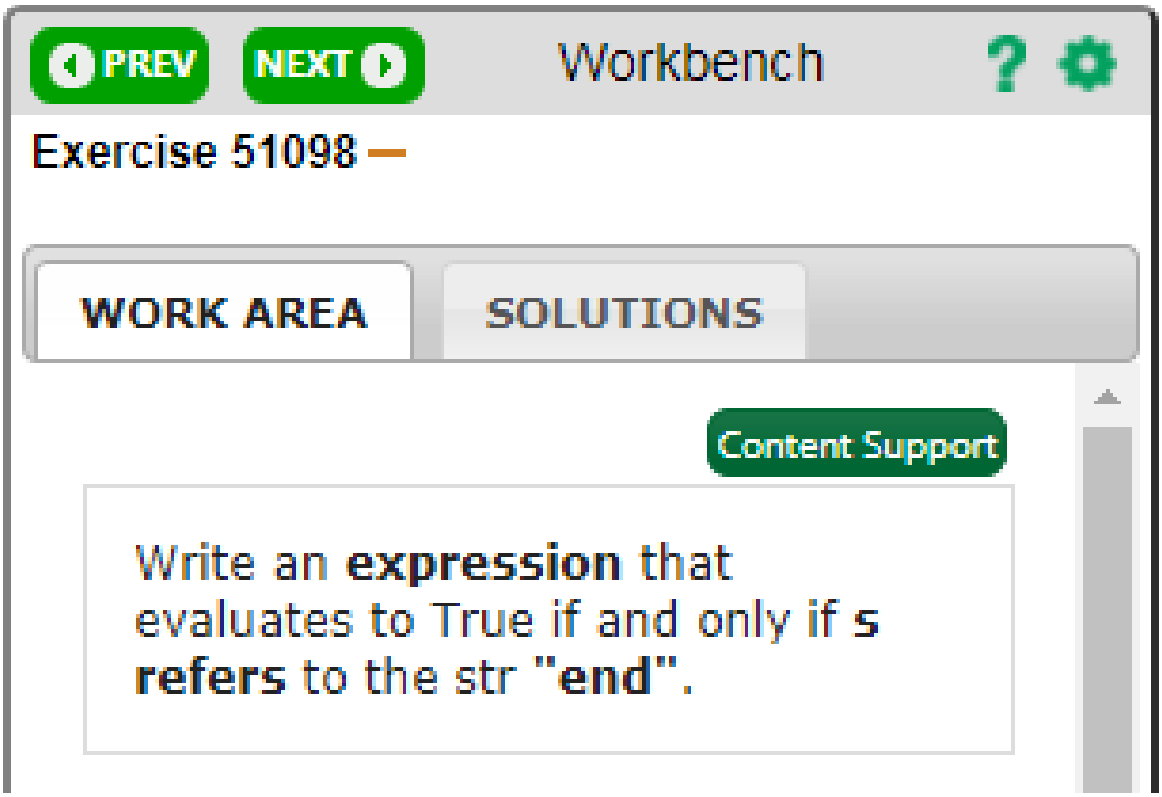
x	"Mozzarella"
y	"MOZZARELLA"
condition_1	False
condition_2	True
condition_3	False
condition_4	True

Review Problems

Interview Problem

- what is negative index?

Programming Exercise



Programming Exercise Worksheet

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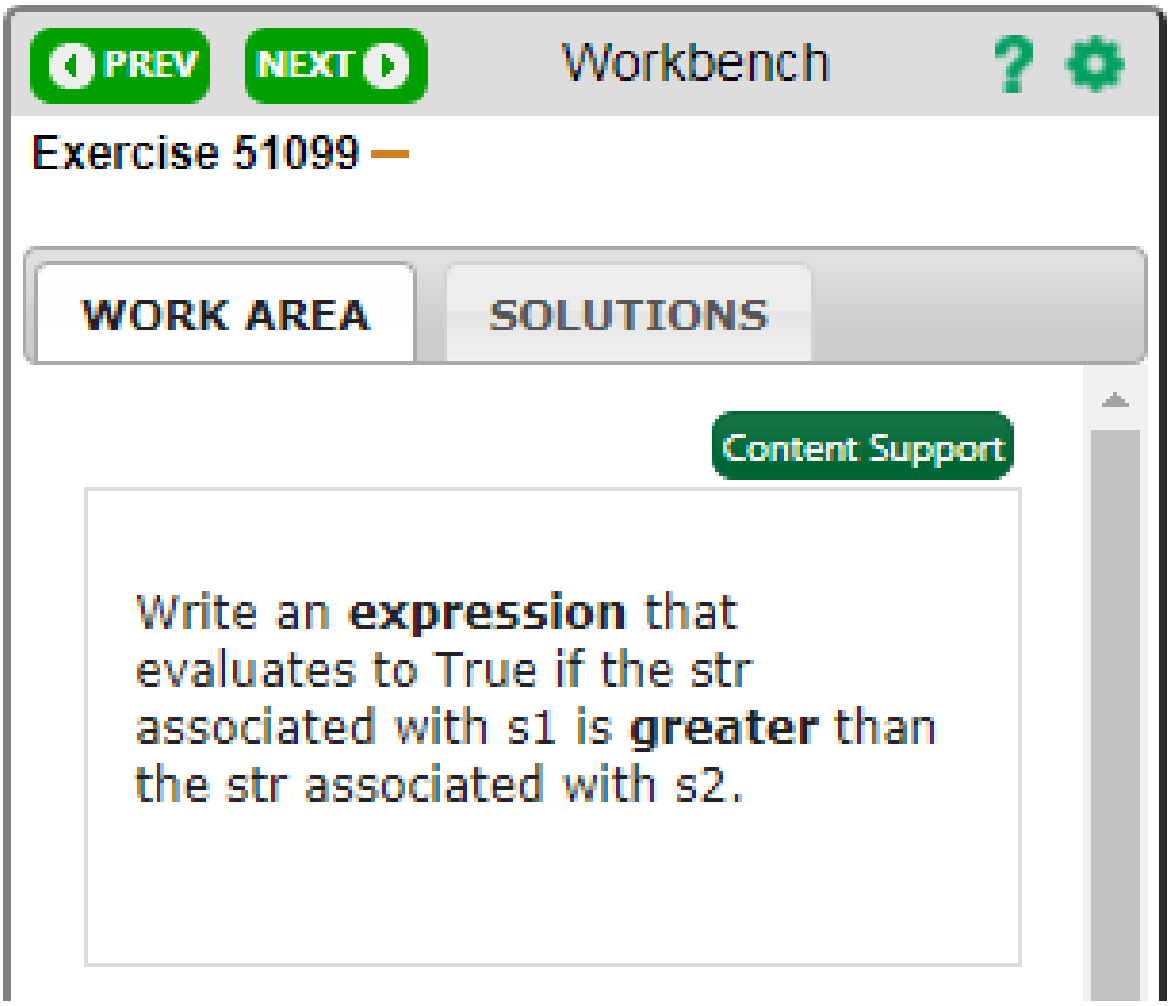
Programming Exercise



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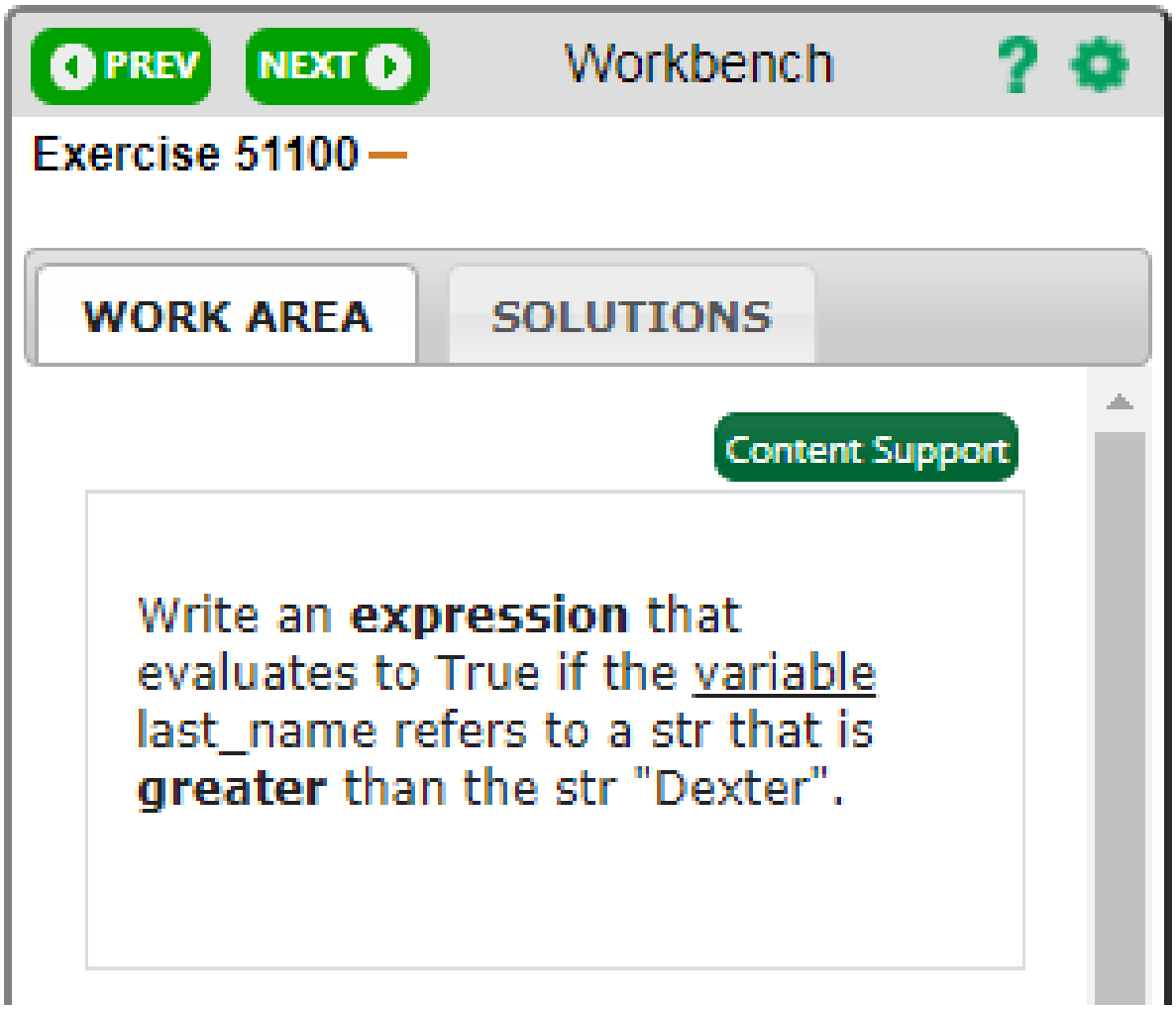

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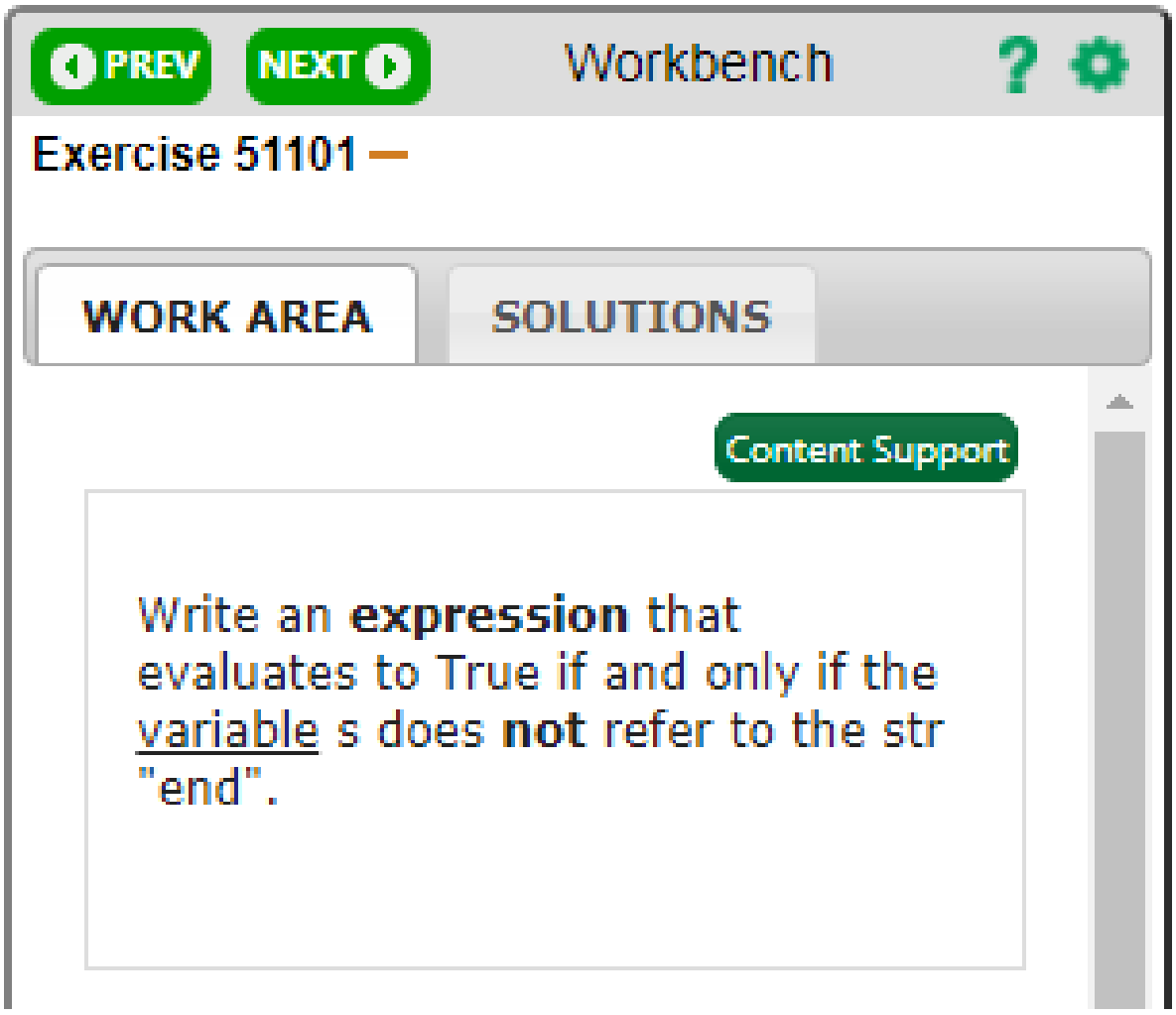

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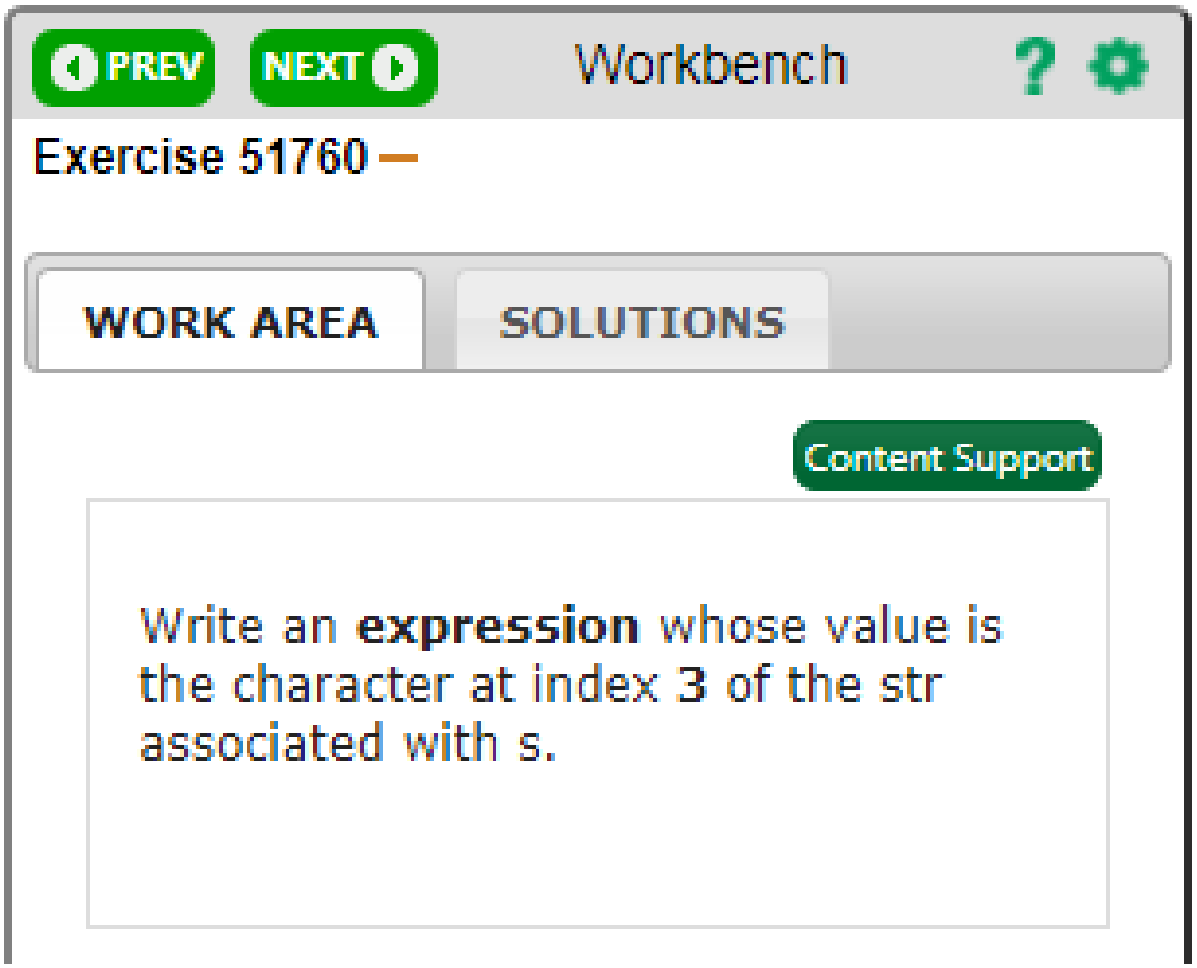

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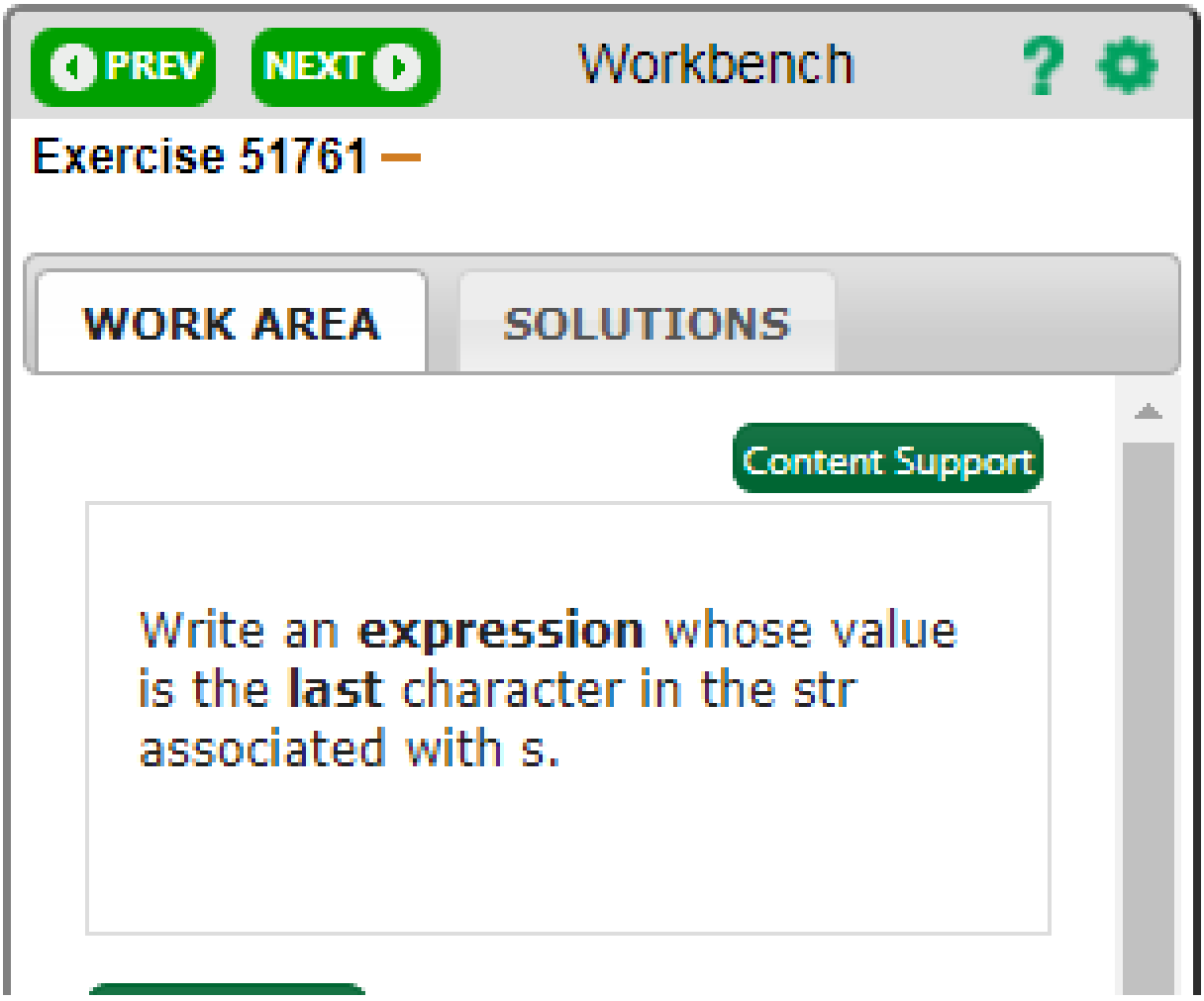

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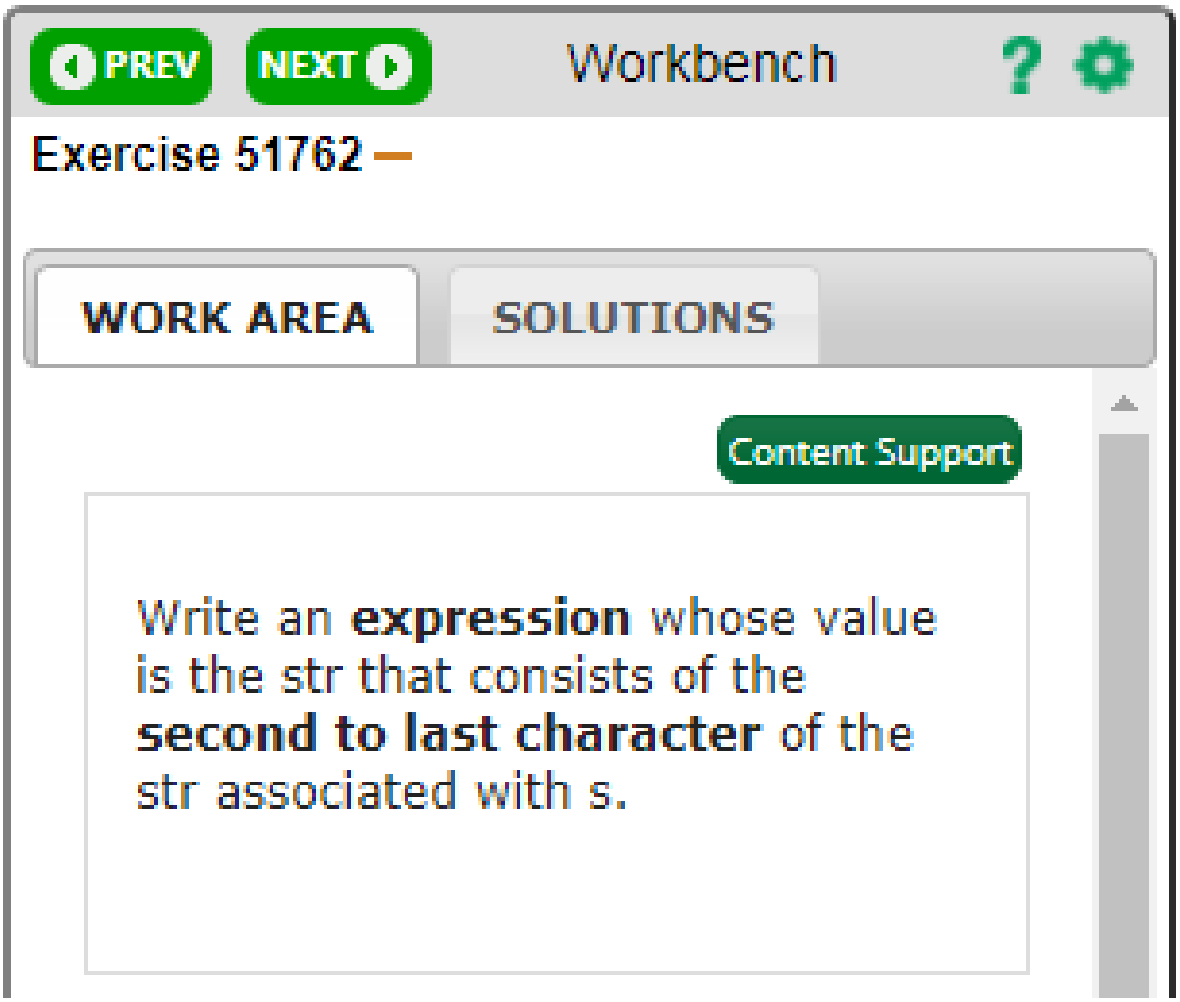

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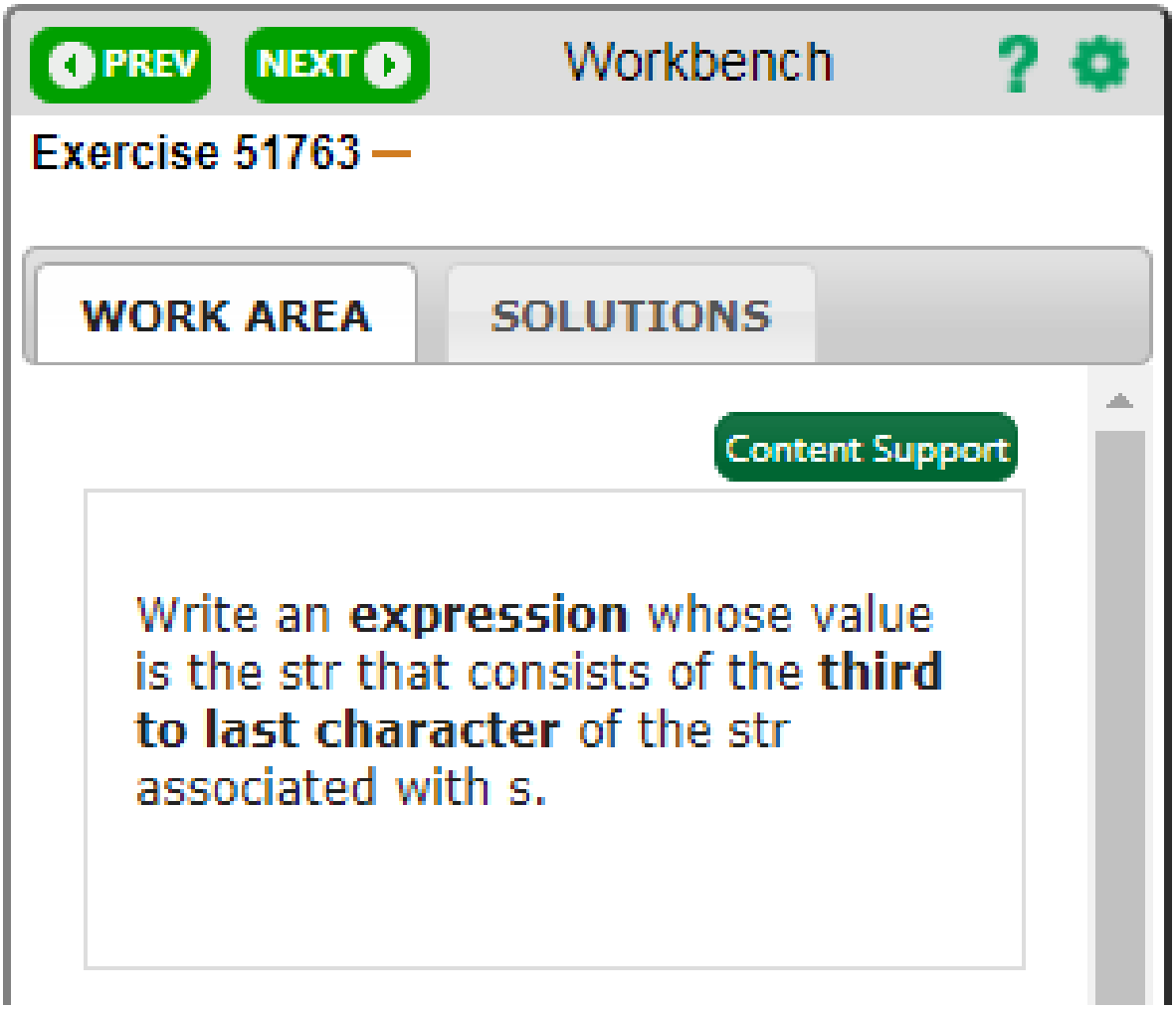

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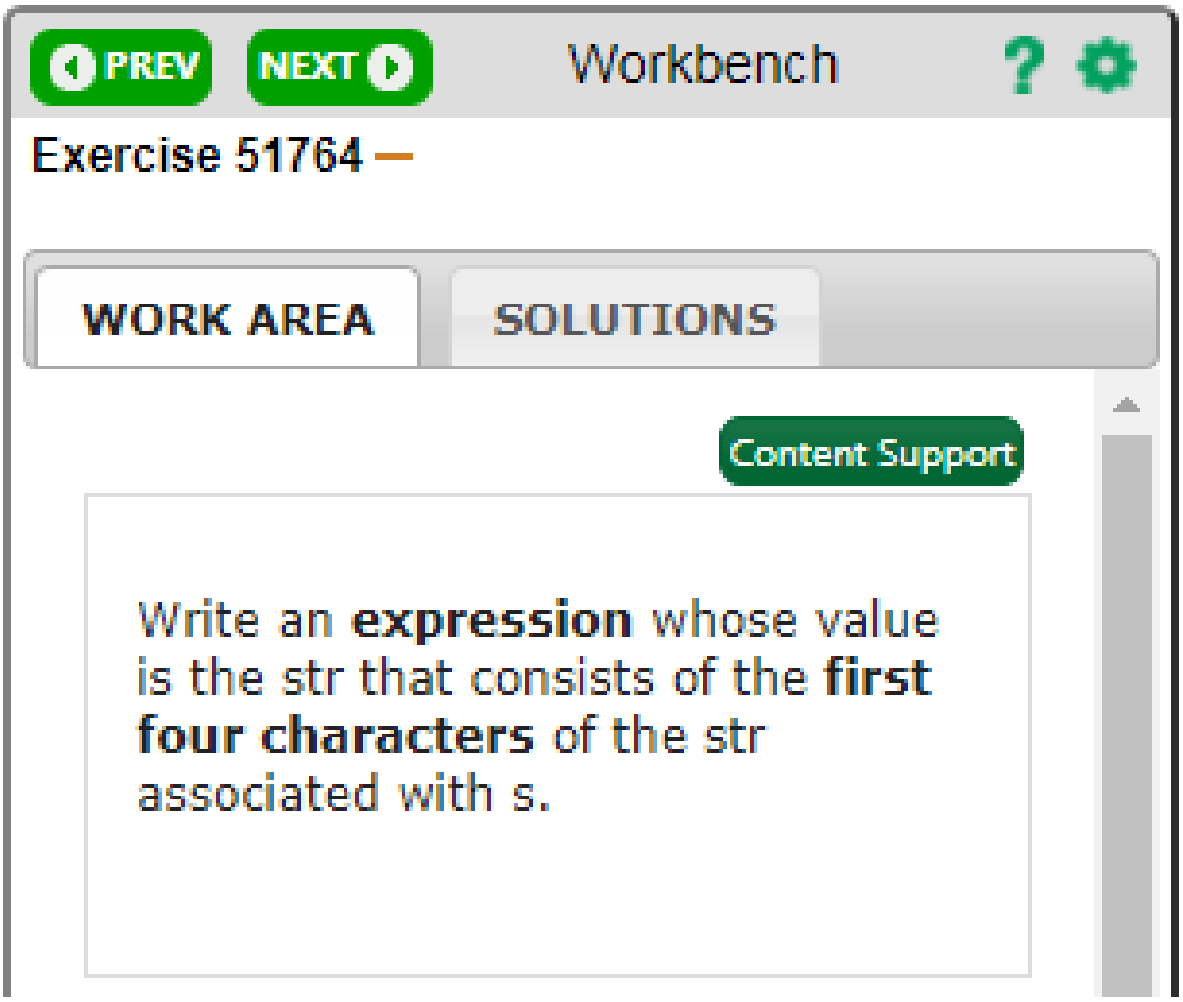

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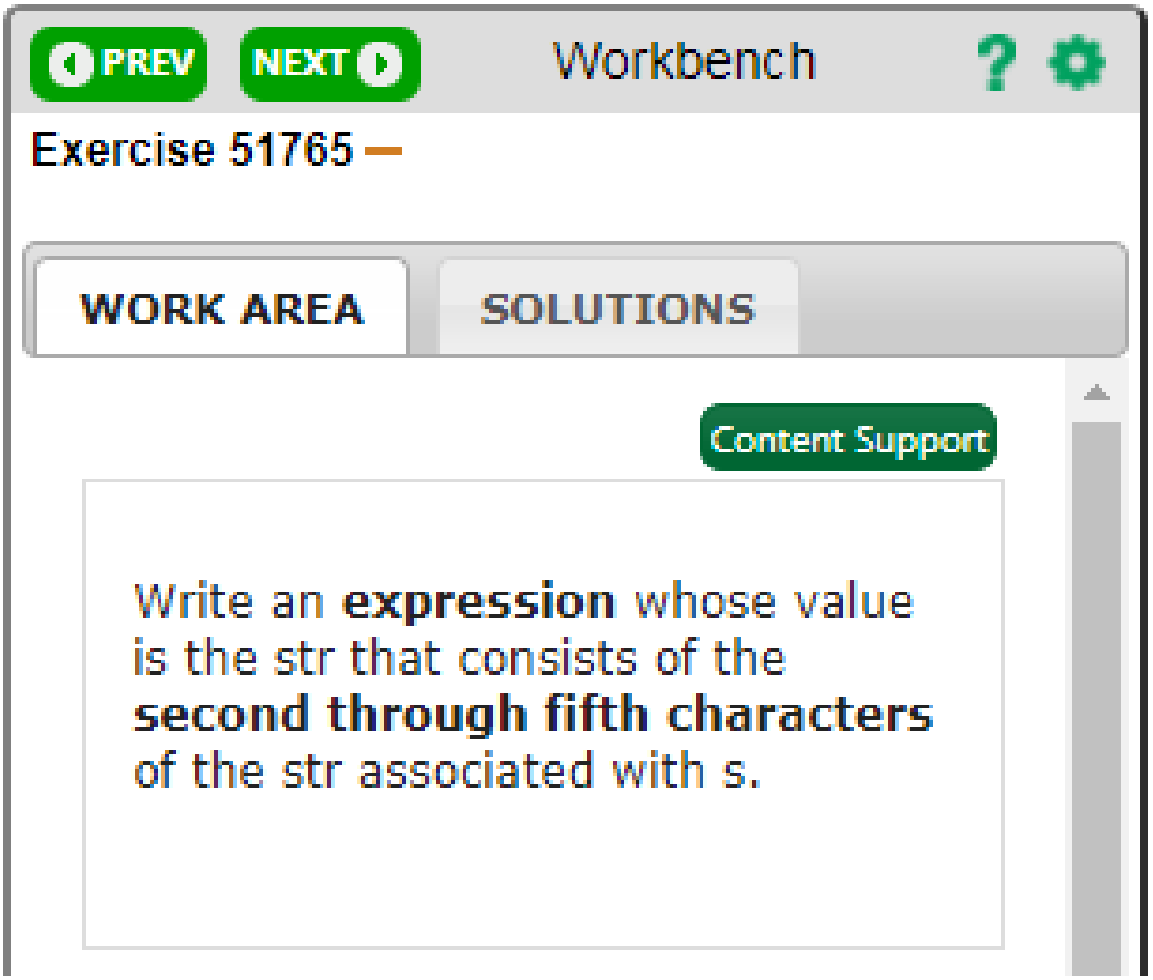

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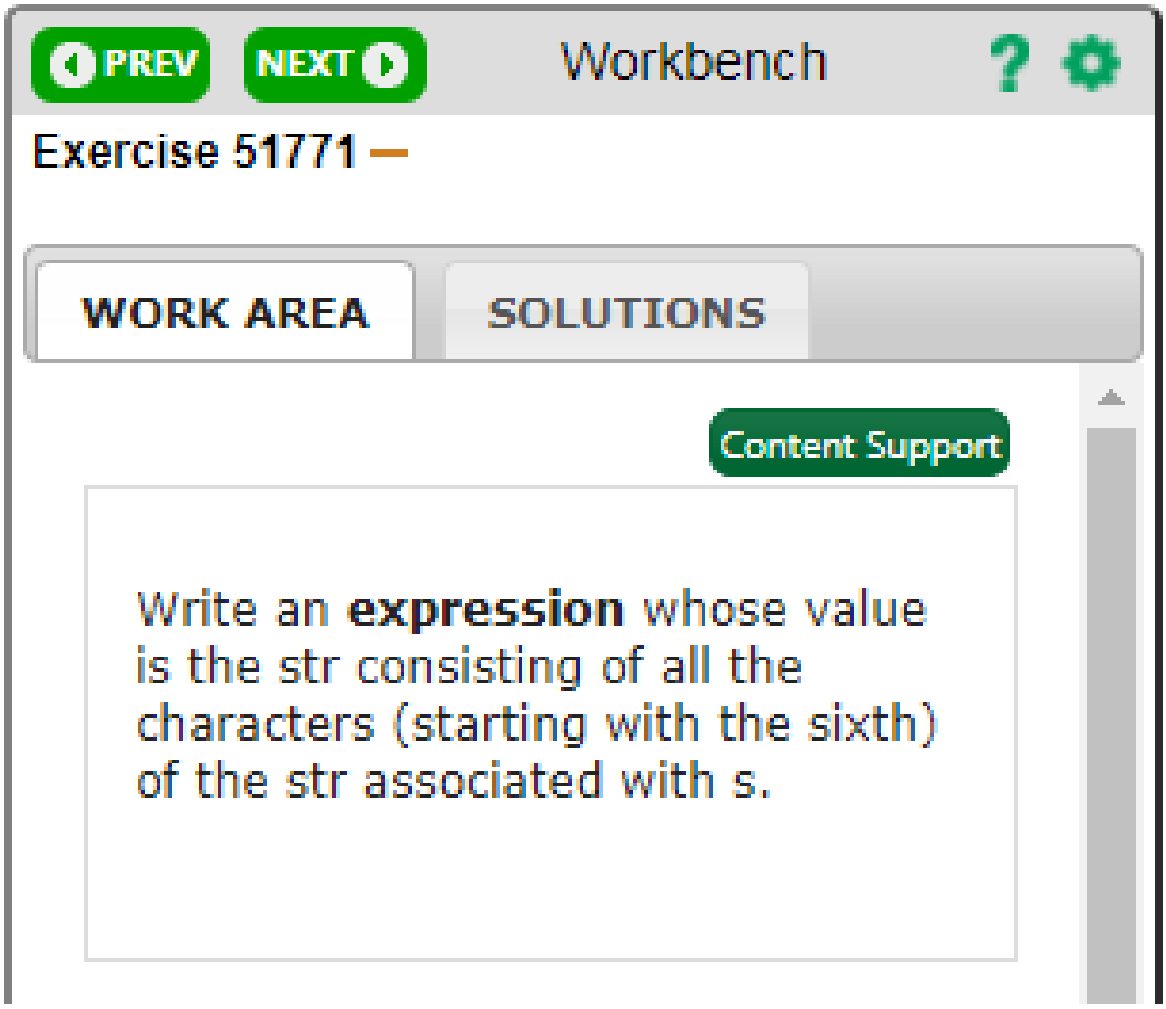

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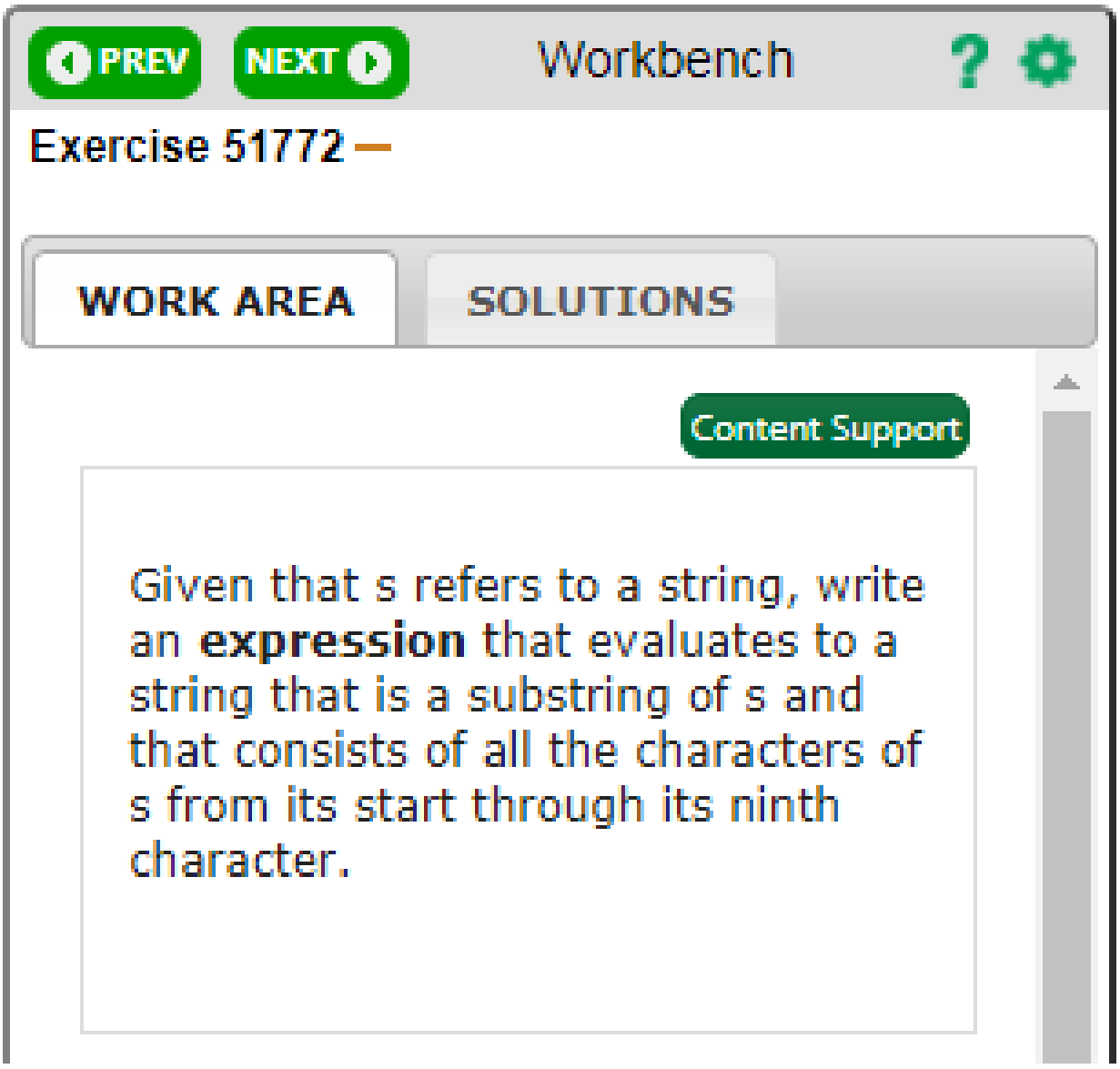
Programming Exercise



Programming Exercise Worksheet

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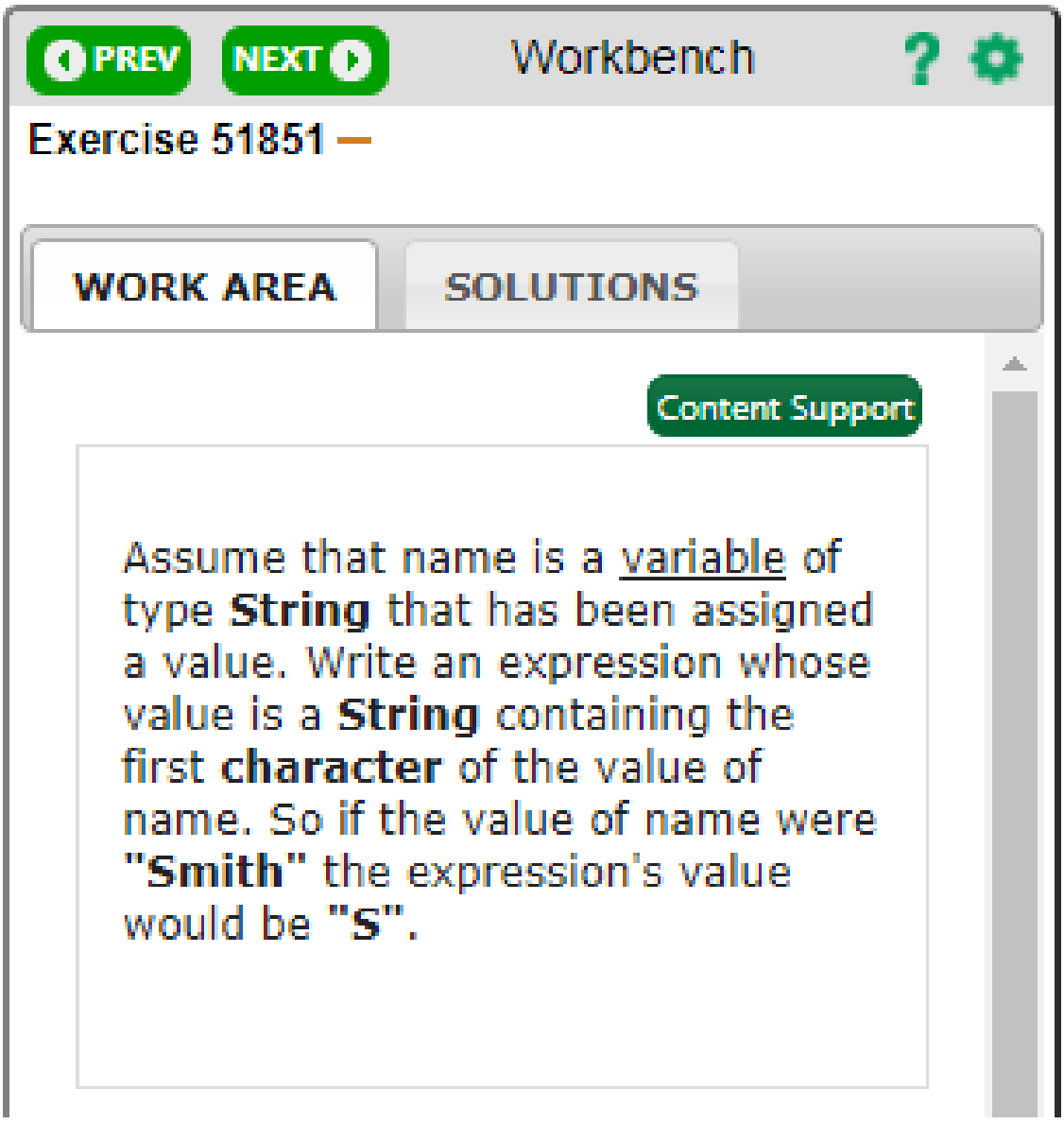
Programming Exercise



Programming Exercise Worksheet

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