Python Classes

Procedural vs. Object Oriented Programming

- procedural programming:

1. functions operate on data
2. data is passed between procedures

- object-oriented programming:

1. encapsulation: functions and data are combined into object
2. objects provide *methods* to operate on *data attributes*

- outside programs do not know the internal details of an object

Base Class: *Circle*()

```
class Circle():
    pi = 3.14                       # static variable
    def __init__(self, r = 1):      # constructor
        self.radius = r             # with default

    def __str__(self):              # representation
        s_radius = str(self.radius) # local variable
        return "circle r=" + s_radius

    def set_radius(self, r):        # mutator
        self.radius = r             # (setter)

    def get_radius(self):           # accessor
        return self.radius          # (getter)

    def area(self):                 # method
        return self.pi * self.radius**2
```

Python Class Template

```
Class Circle()                  # class name
```

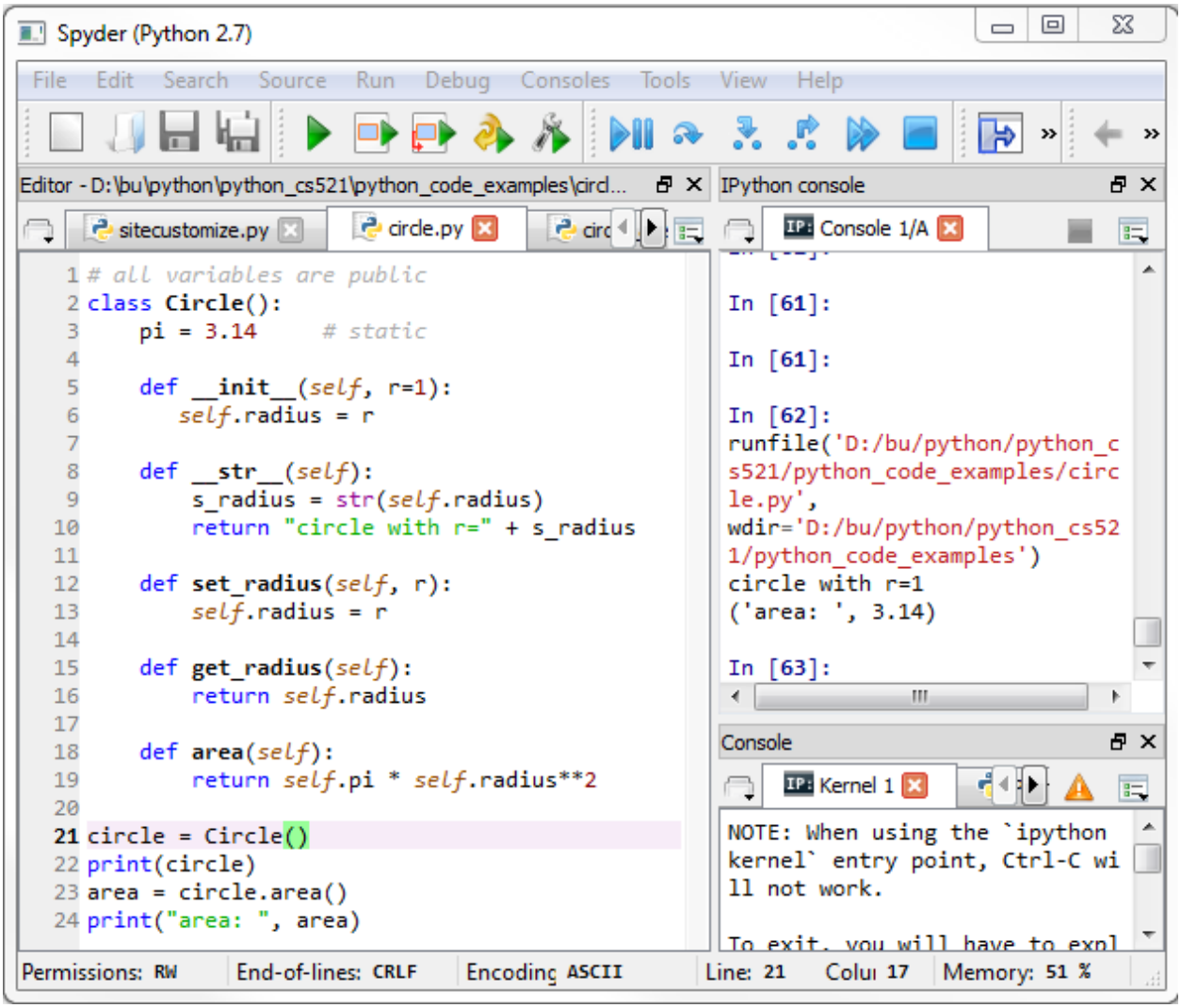
```
    pi = 3.14                   # (static) data fields
```

```
                                #    Methods
    def __init__()              # constructor
    def  __str__()              # representation
    def set_radius()            # setter
    def get_radius()            # getter
    def area()                  #  other methods
```

- class methods use “dot” notation

```
>>> circle = Circle(5)
>>> area = circle.area()
```

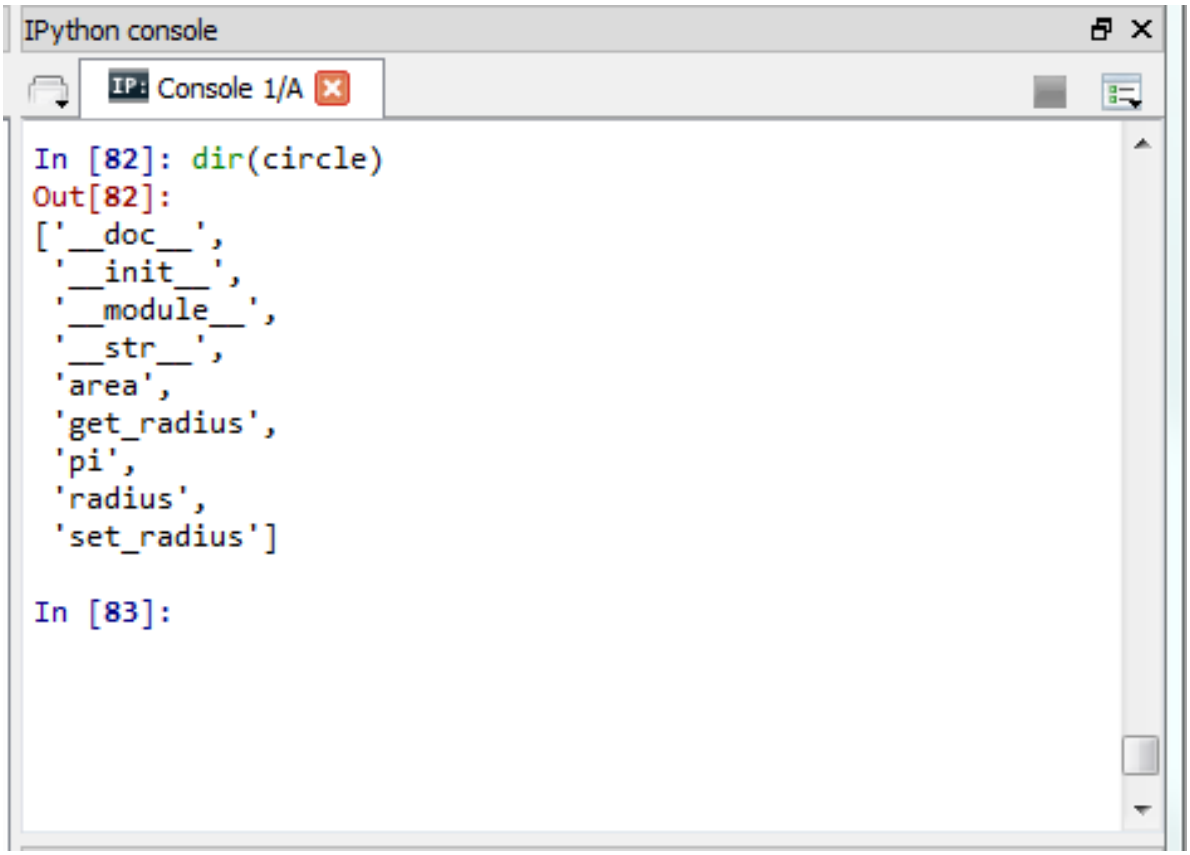
Base *Circle*() Class Run



Class Methods and Variables

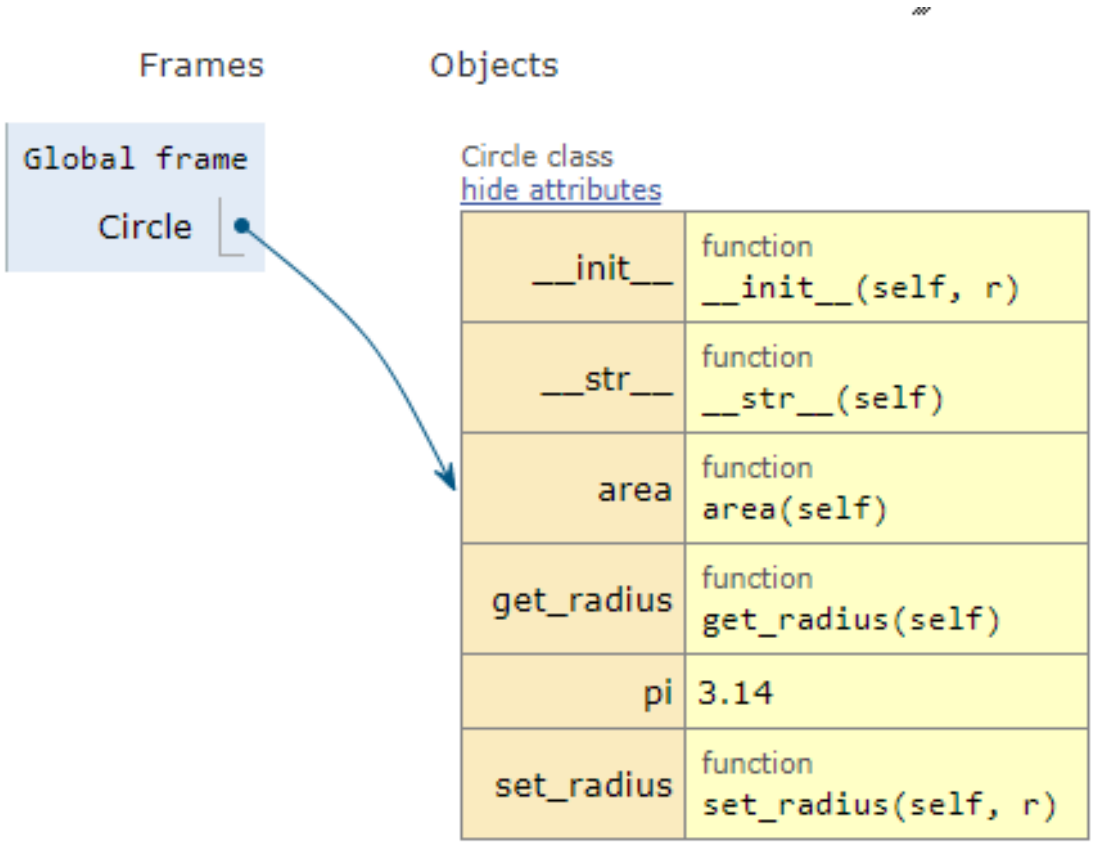
- use dir() command

```
>>> dir(circle)
```



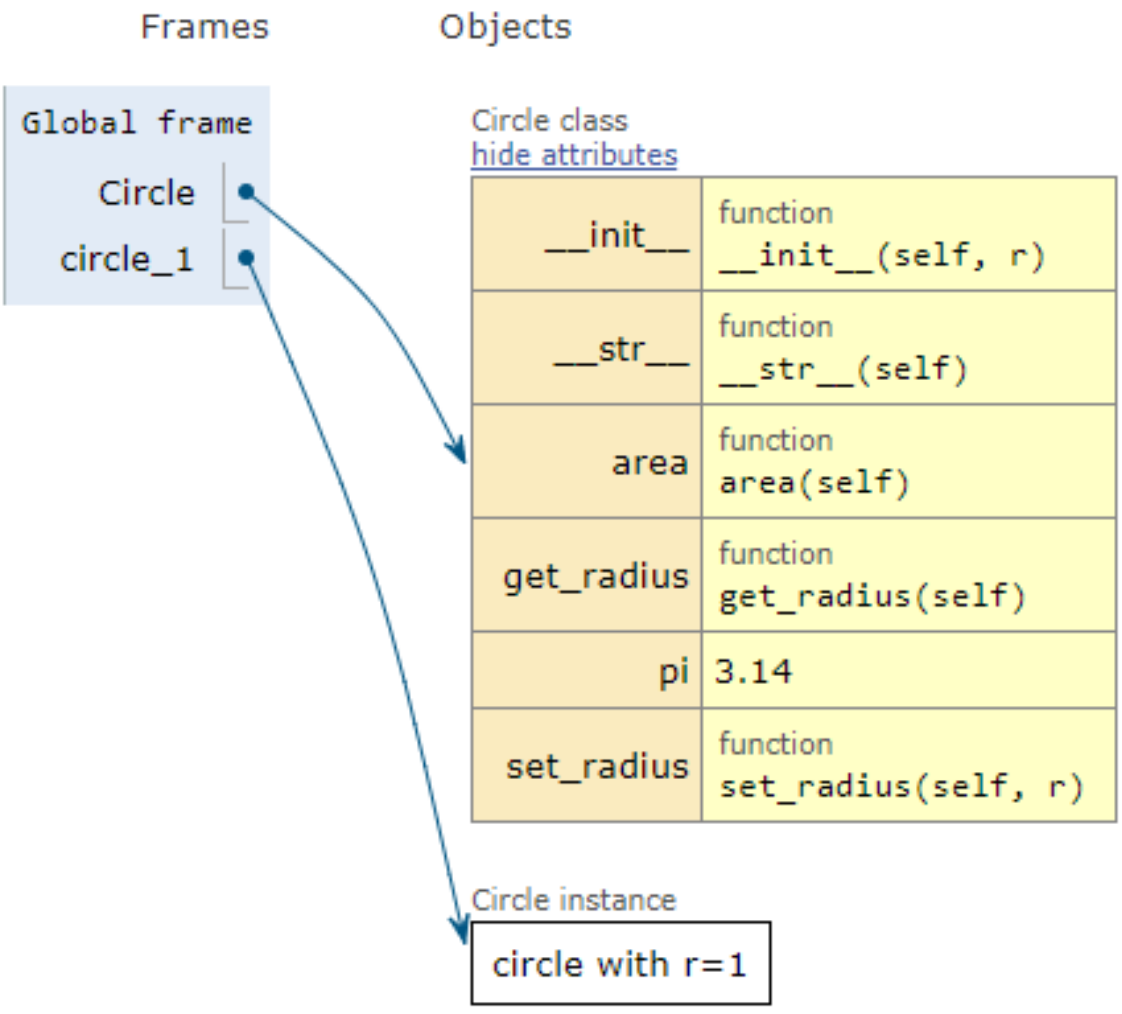
Circle() **Class**

```
>>> import circle
```



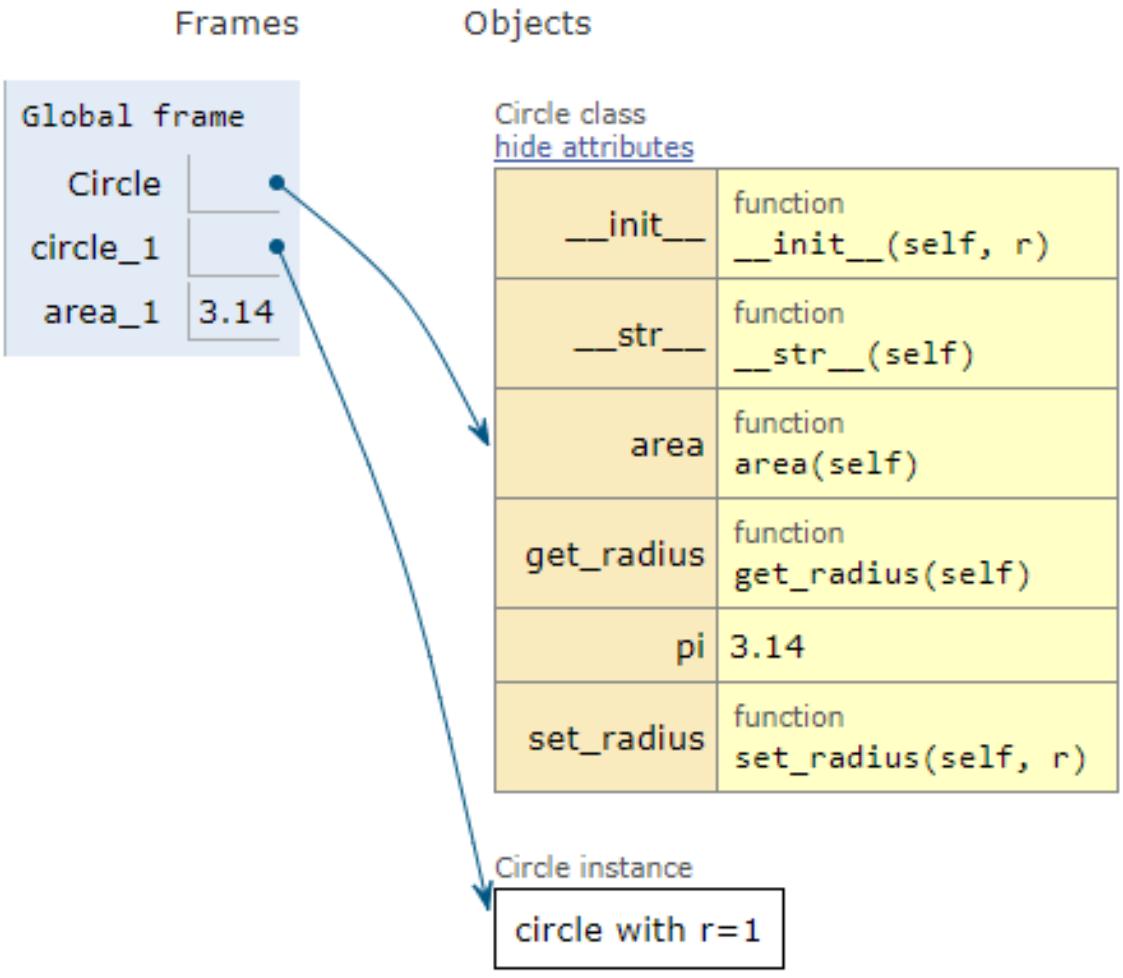
Circle() Class (cont'd)

```
>>> circle_1 = circle.Circle()
```



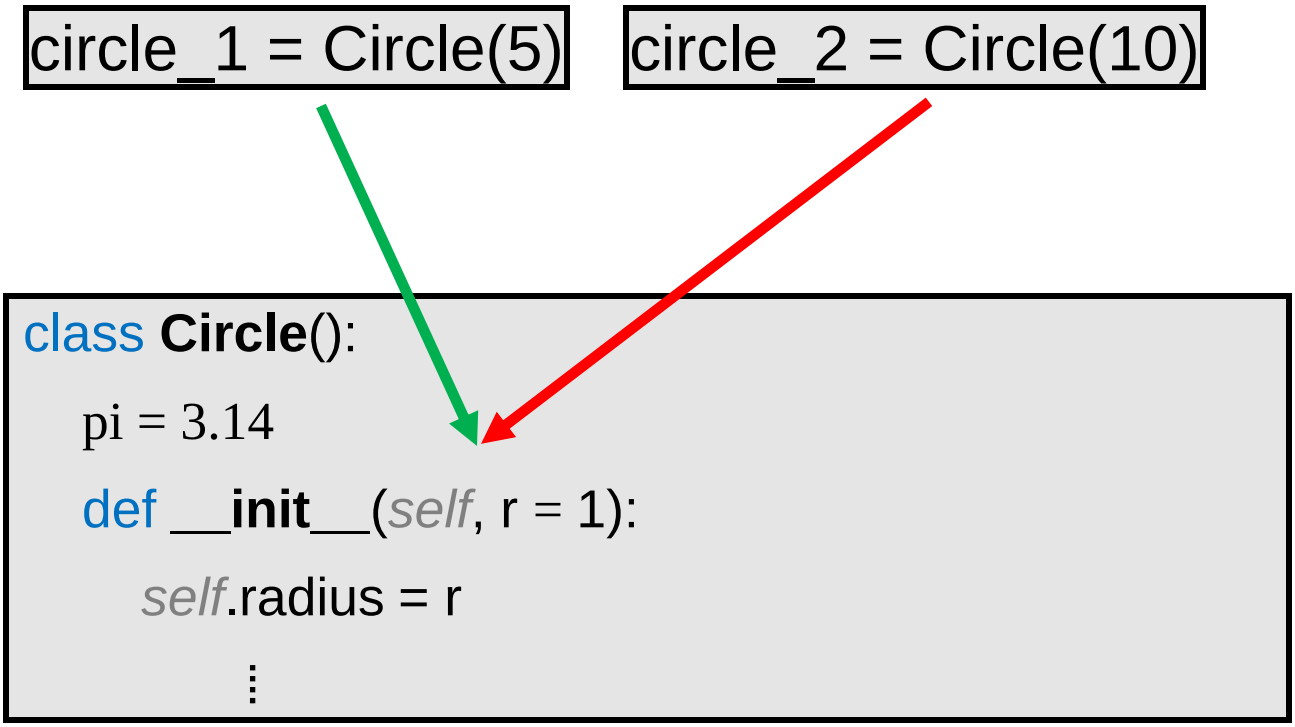
Circle() **Class (cont'd)**

```
>>> area_1 = circle_1.area()
```



self Parameter

- when an object is initiated, it is passed to the *self* parameter



- allows the object to keep its own data
- similar to *this* in Java and C++

Constructors and Destructors

- executed when an instance is created
- first parameter is always *self*

```
def __init__(self, r = 1):    # constructor
    self.radius = r
```

- destructor is executed upon deletion

```
def __del__(self):            # (optional) destructor
```

Static vs. Non-Static Variables

- non-static variables exist in each class instance (multiple copies)
- static variables are shared (single copy) and are defined before class methods

```
class Circle():
    self.pi = 3.14          # NOT STATIC !
```

```
class Circle():
    pi = 3.14               # STATIC !
```

Object State Representation:

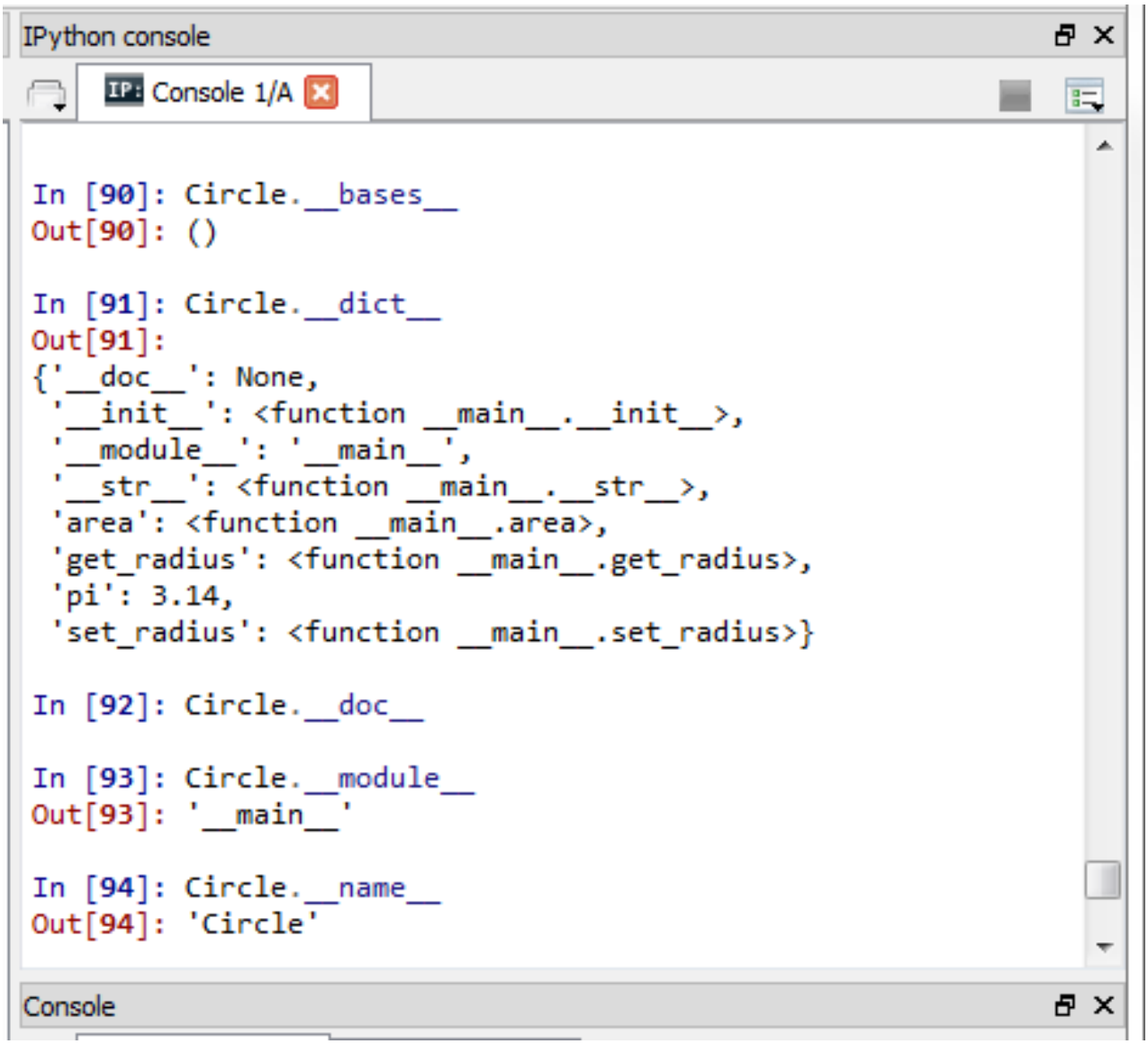
__*str*__() and __*repr*__()

- __*repr*__() is a built-in function to compute "official" representation of an object
- __*str*__() gives "human" representation of an object

```
>>> repr(circle)
>>>  '<__main__.Circle instance at 0x000000000DB7F548>'
>>> str(circle)
>>> 'circle r=1'
```

- __*str*__() uses __*repr*__() as a fall-back

Circle() Class Attributes



Private Variables

- no mechanism
- textual replacement via name mangling
- _var replaced by _classname_var
  interface for different types

  >> [name for name in dir(Circle) if 'Circle' in name]
  ['_Circle__pi']

- prevents accidental modification

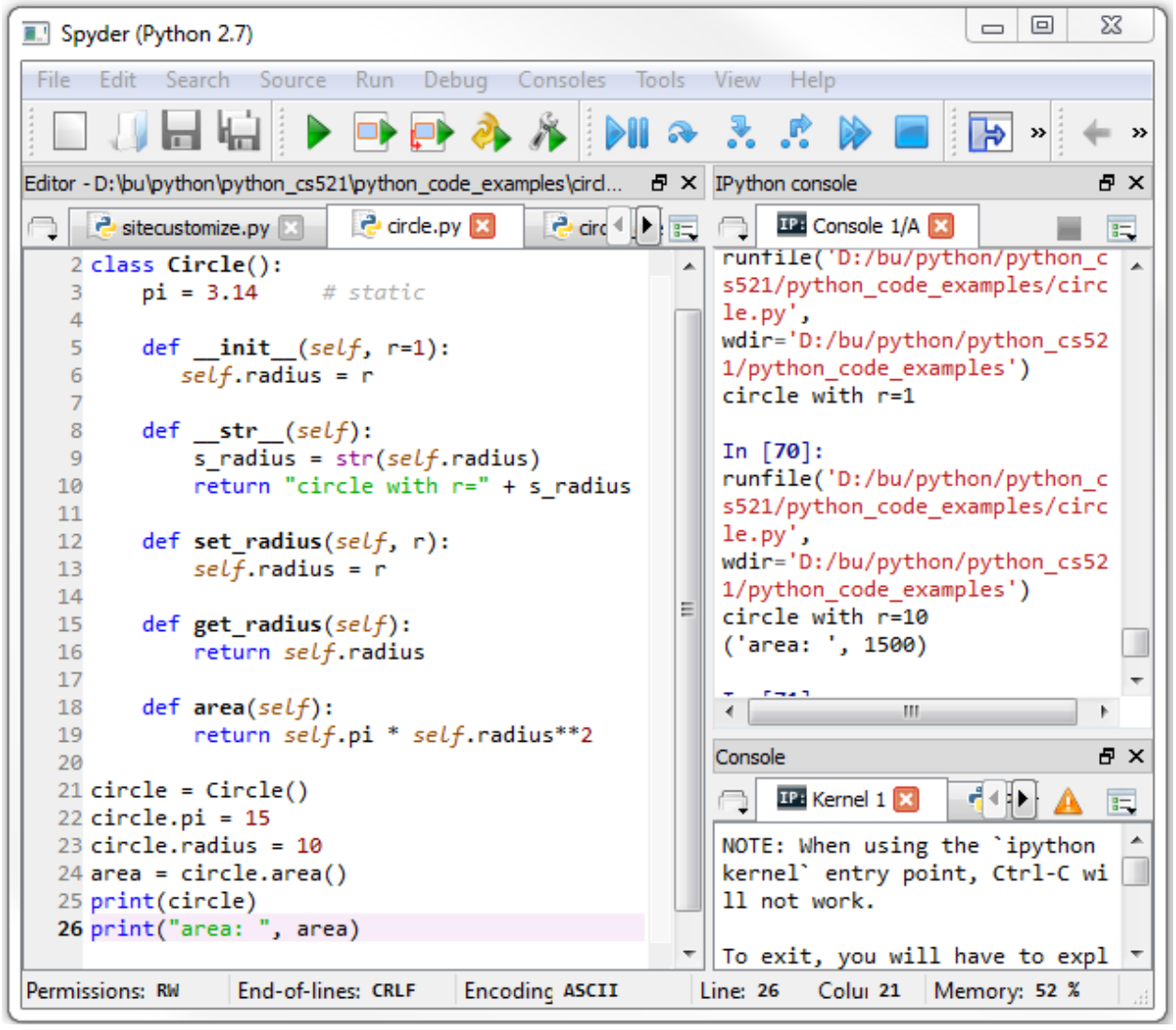
Private Variables

- make variable private with __
- __radius and __pi are now private
- access private variables with methods

```
class Circle():
    __pi = 3.14
    def __init__(self, r = 1):
        self.__radius = r
    def __str__(self):
        s_radius = str(self.__radius)
        return "circle r=" + s_radius
    def set_radius(self, r):
        self.__radius = r
    def get_radius(self):
        return self.__radius
    def area(self):
        return self.__pi * self.__radius**2
```

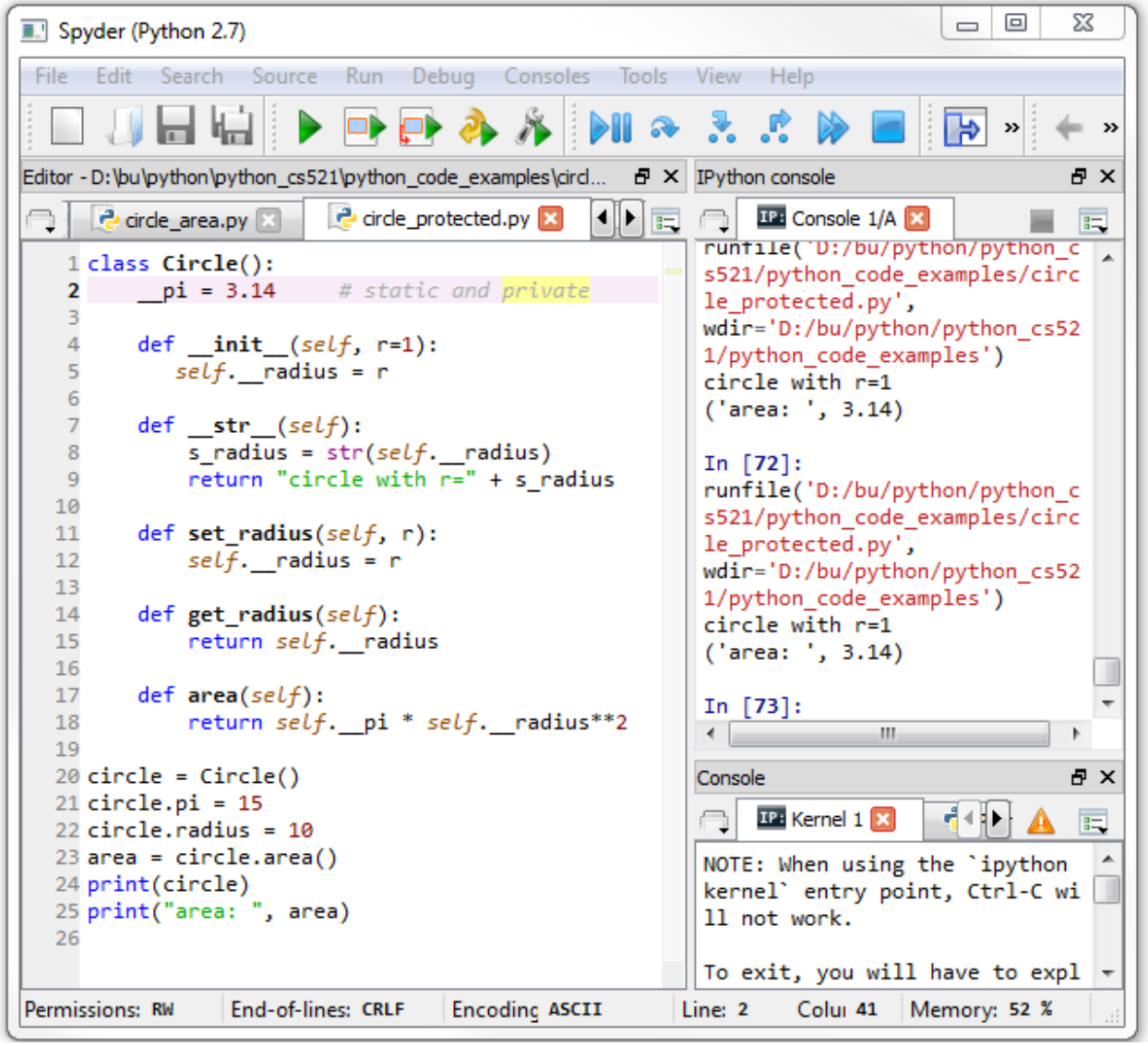
Public vs. Private Variables

- can change variables (pi and radius)
- this is undesirable



Circle(): Private Variables

- cannot change variables (pi and radius)
- add class methods to set/get variables



Accessing and Setting Class Variables

- data field encapsulation
- expose instance variables by methods
- accessors: return values w/o changes
- mutators: set and/or change values

```
def set_radius(self, r):          # mutator
    self.radius = r               # (setter)
```

```
def get_radius(self):             # accessor
    return self.radius            # (getter)
```

Pre-defined Class Attributes

attribute	description	type
__bases__	classes from which this class inherits	tuple of classes
__dict__	class name space	dictionary
__doc__	class documentation	None/string
__module__	name of class module	string
__name__	class name	string

- instance attributes are created by methods using *self* parameter

Object Documentation

```
def area(self):
    return self.pi * self.radius**2
```

```
>>> print circle.area.__doc
>>> None
>>> # now add docstring as first line
```

```
def area(self):
    "" computing area ""
    return self.pi * self.radius**2
```

```
>>> print circle.area.__doc
>>> computing area
```

Review Problems

Interview Problem

- explain the characteristics of Python's objects

Interview Problem

- how is a Python class created?

Interview Problem

- what is __init__.py file?

Interview Problem

- what is encapsulation?

Interview Problem

- what is *repr*() function and what does it return?

Interview Problem

- what does the *self* keyword do?

Interview Problem

- how is a class instantiated?

Interview Problem

- in a class definition, what does the __ *init* _() function do?

Interview Problem

- what is the output of the following:

```
class C(object)
    def __init__(self)
        self.x = 1
```

```
>>> c = C()
>>> print c.x
>>> print c.x
>>> print c.x
```

Interview Problem

- what is a class?
- how do you create class in Python?

Interview Problem

- how instance variables are different from class variables?

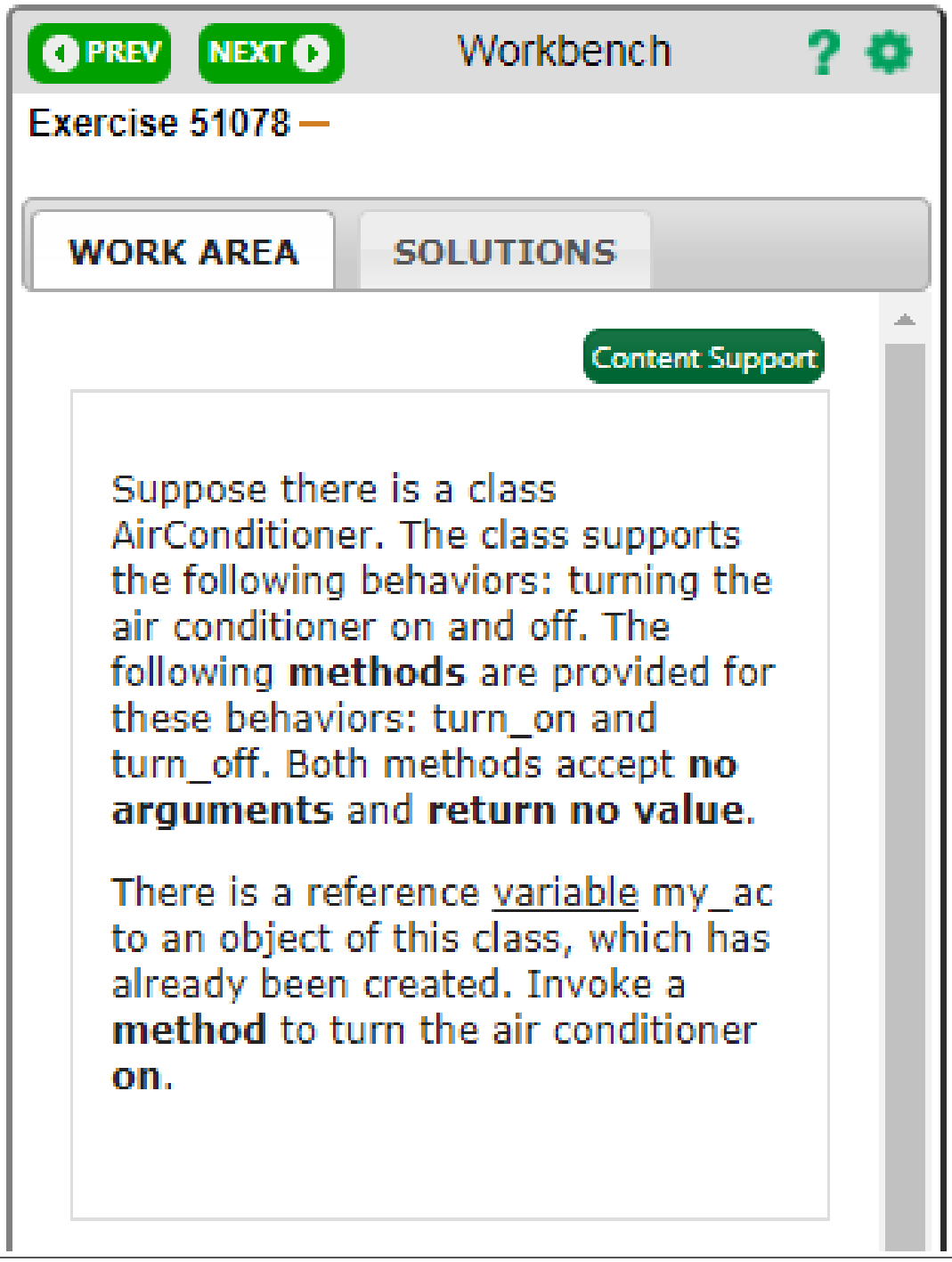
Interview Problem

- what are accessors, mutators, @property?

Interview Problem

- define a protected member in class

Programming Exercise



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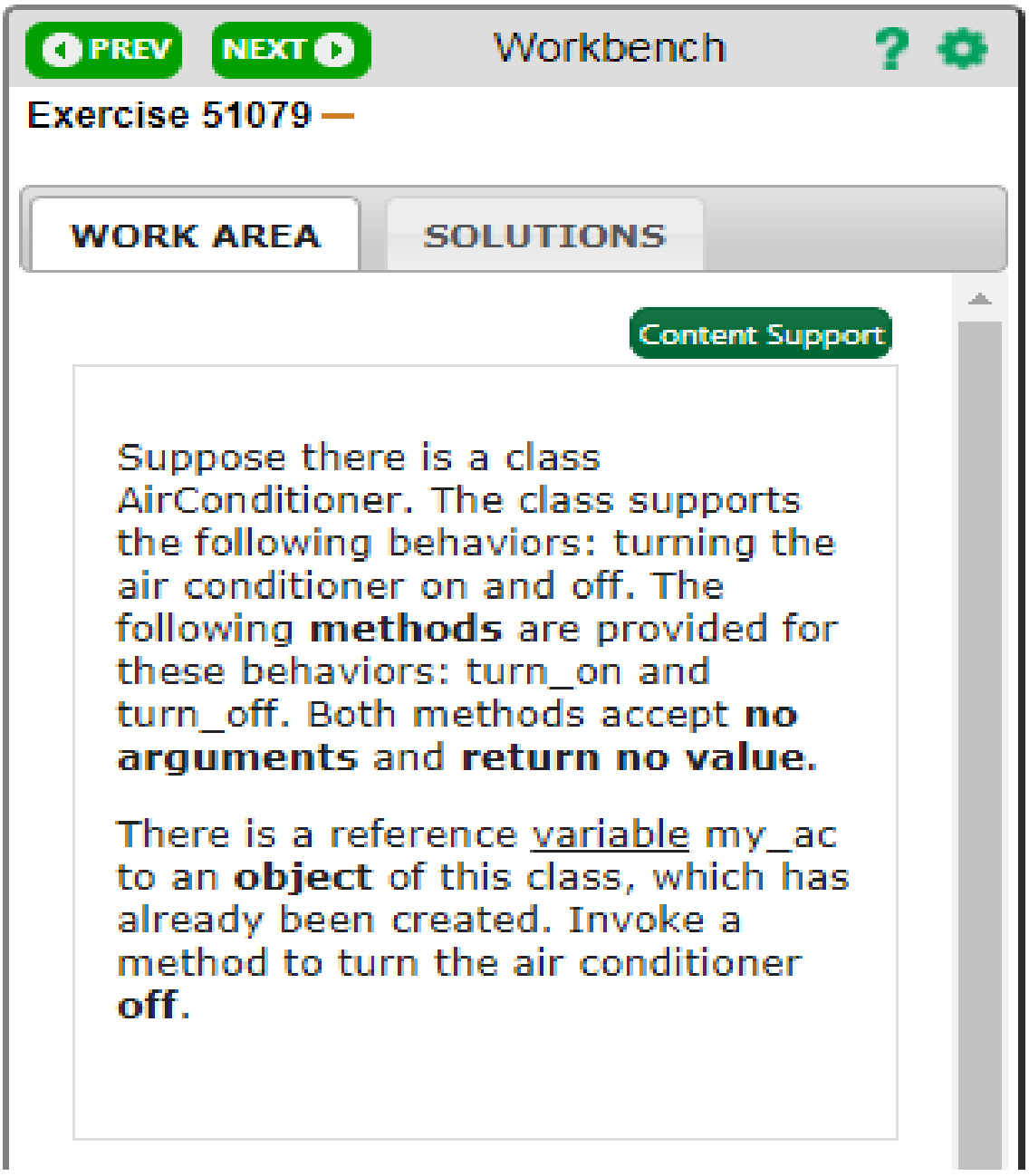

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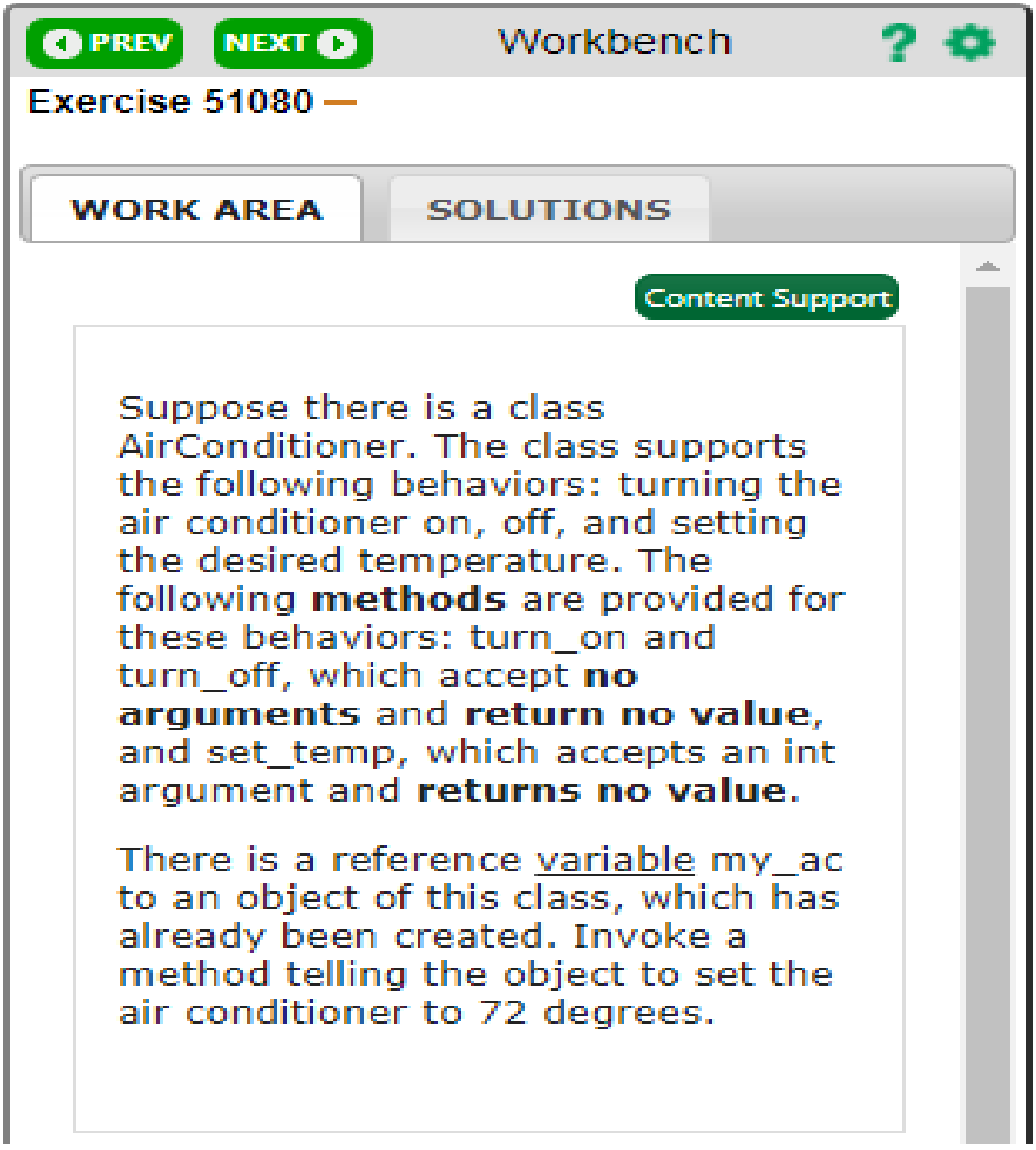

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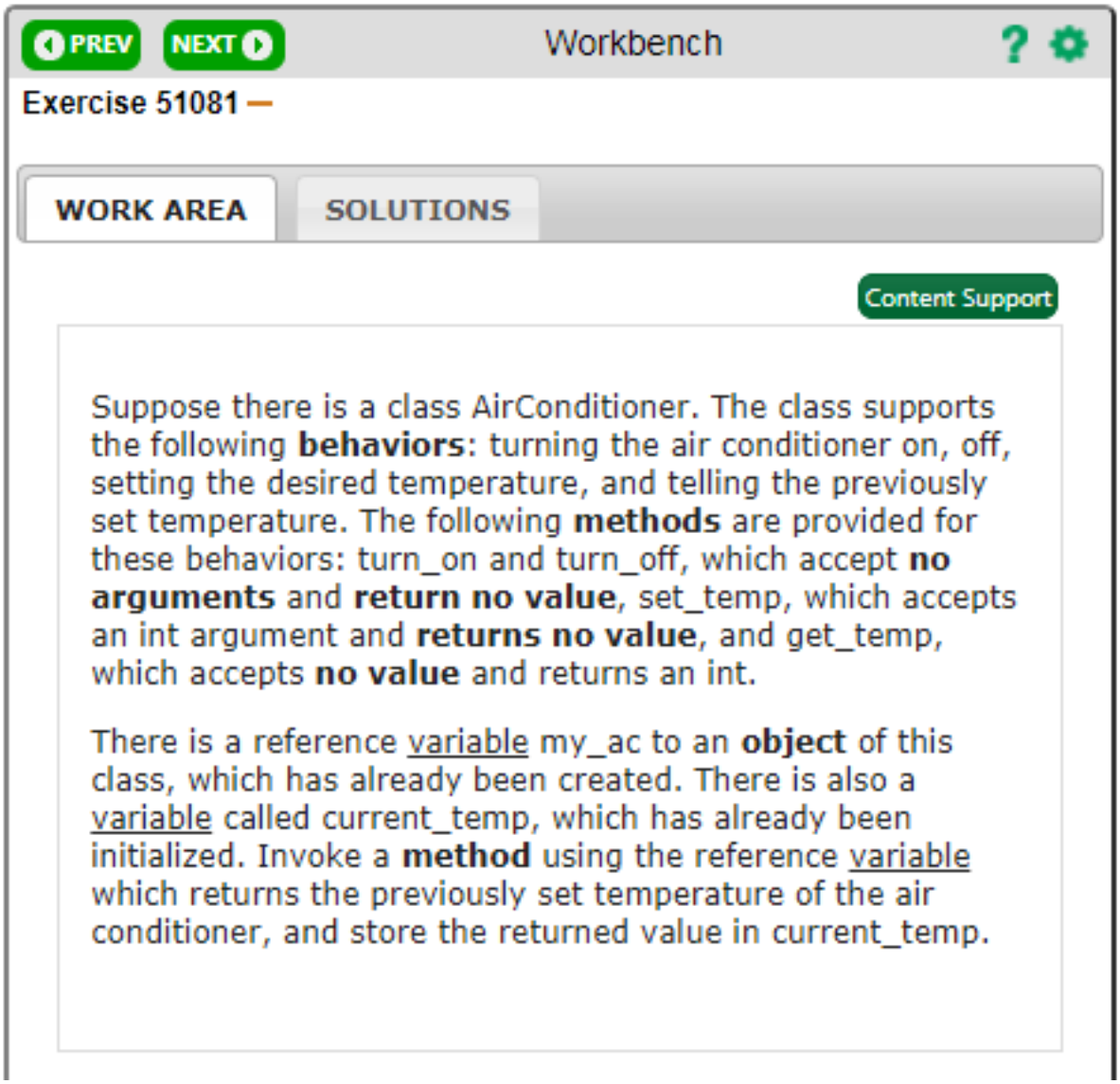

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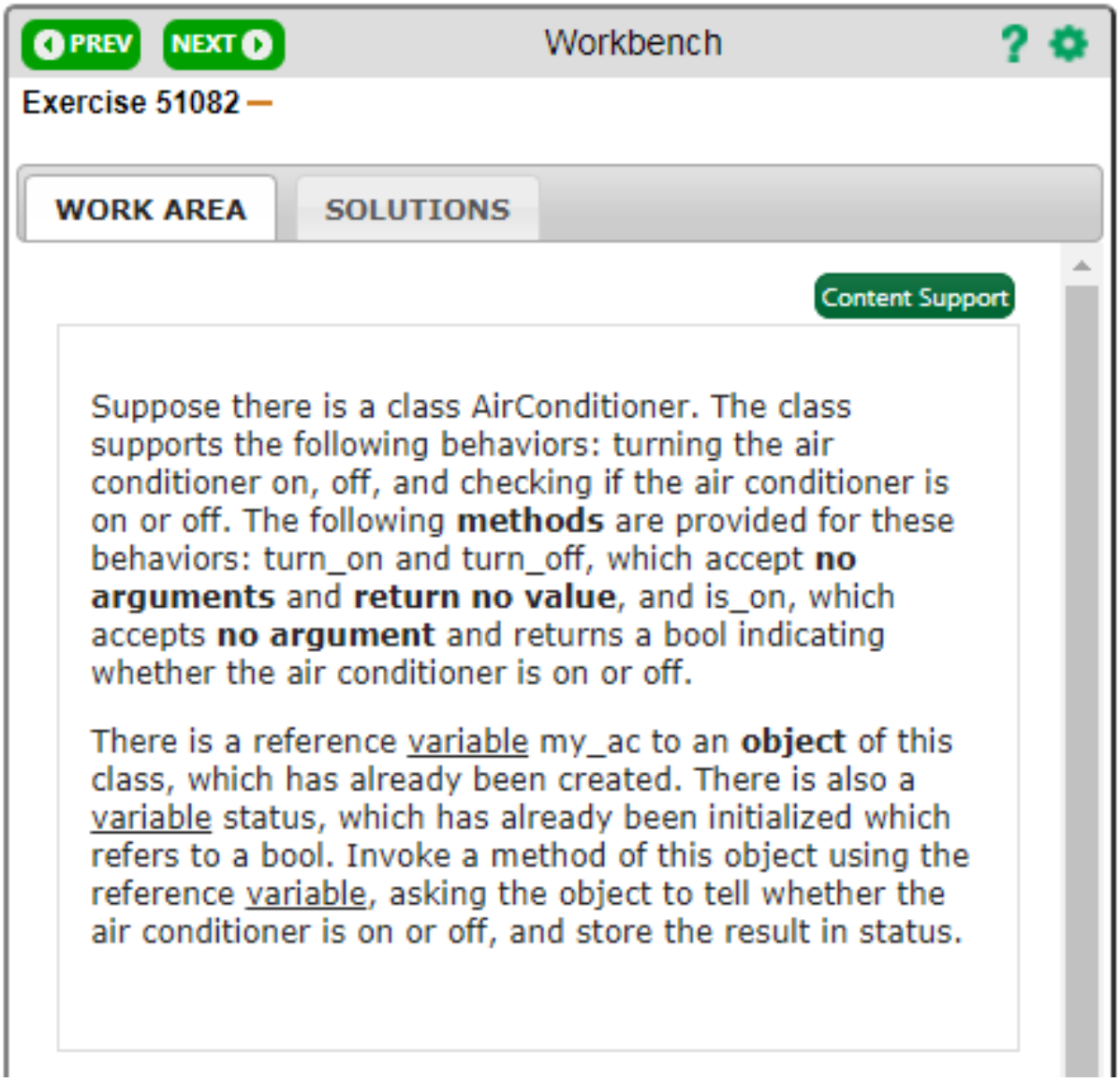

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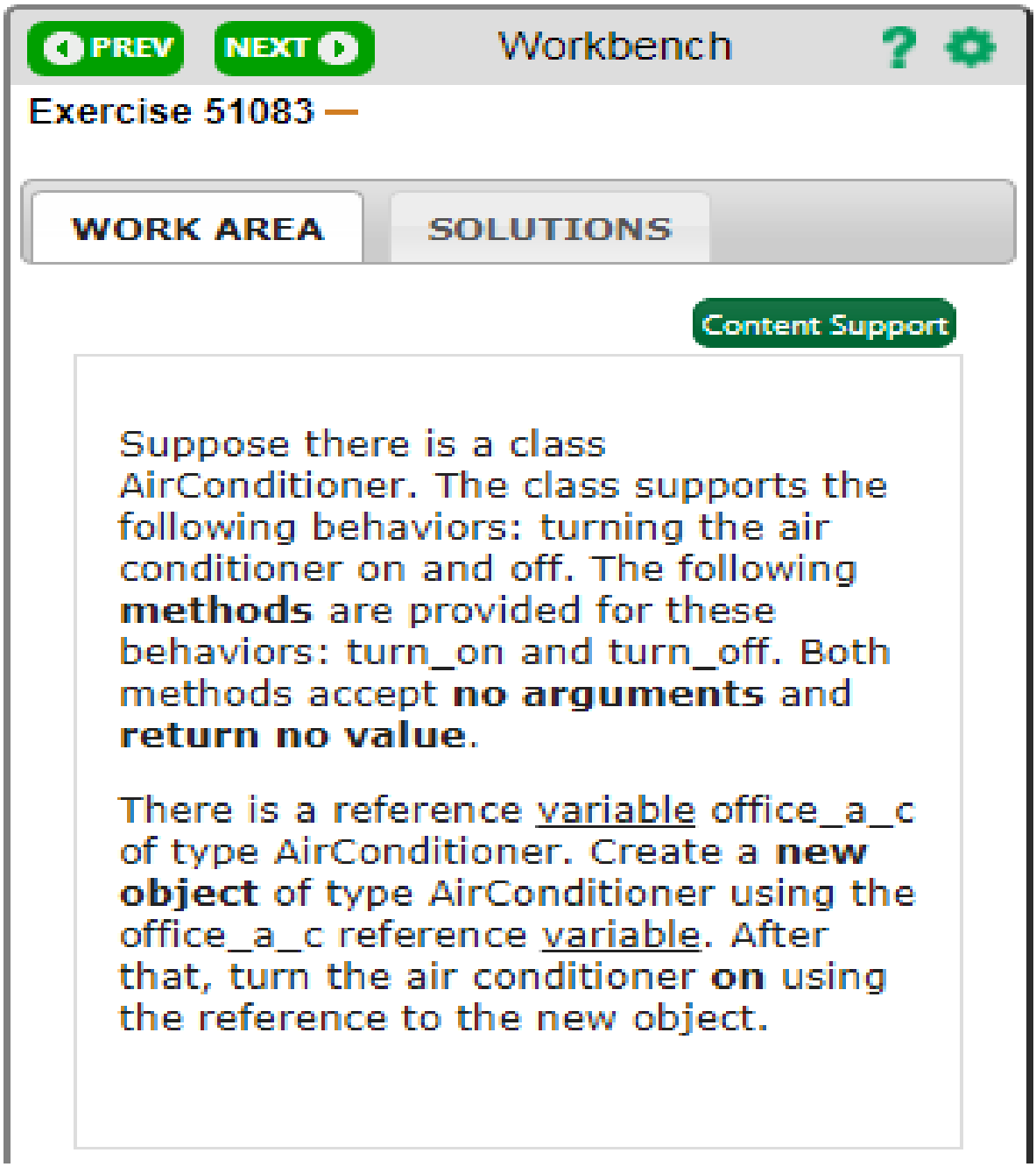

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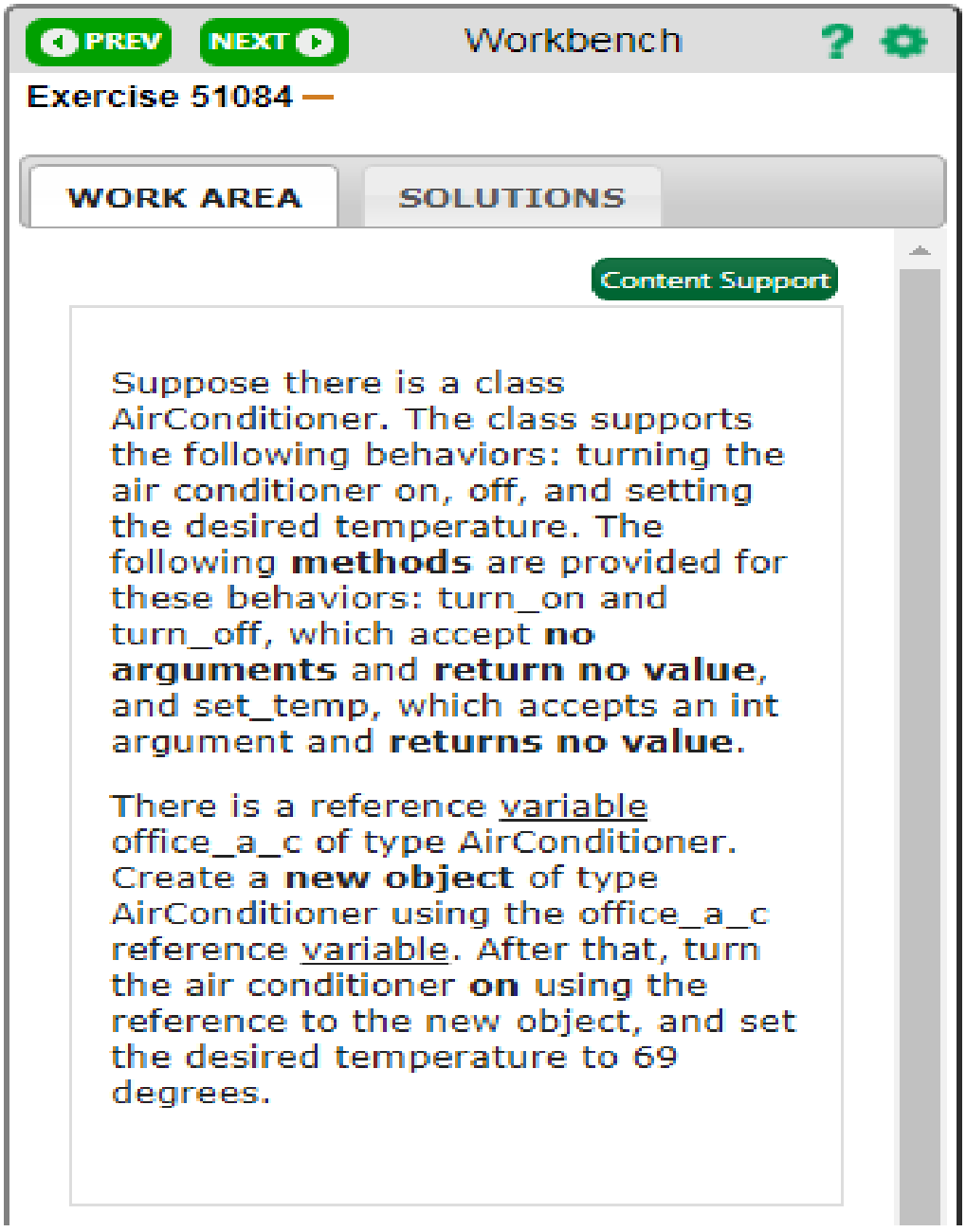

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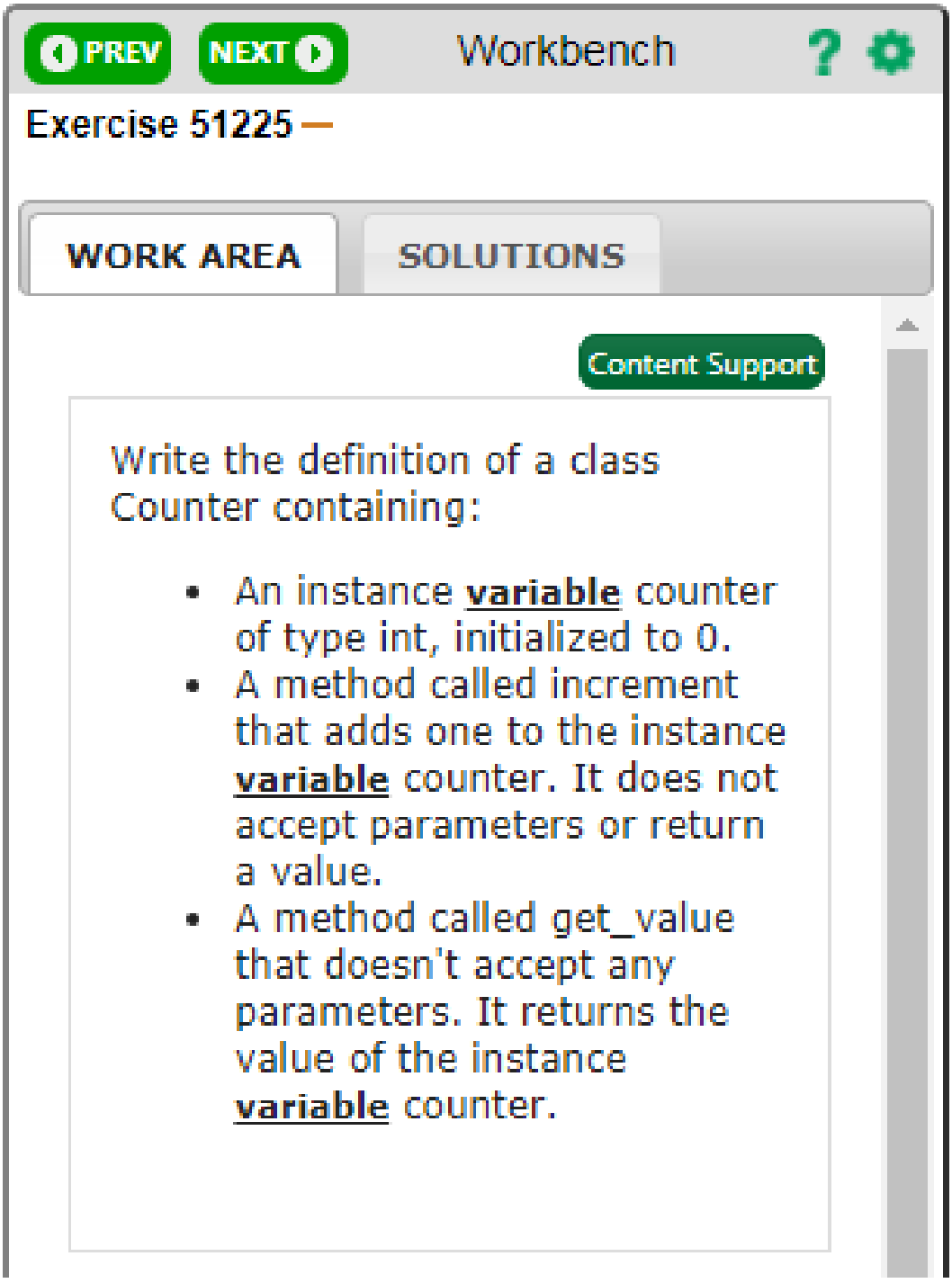

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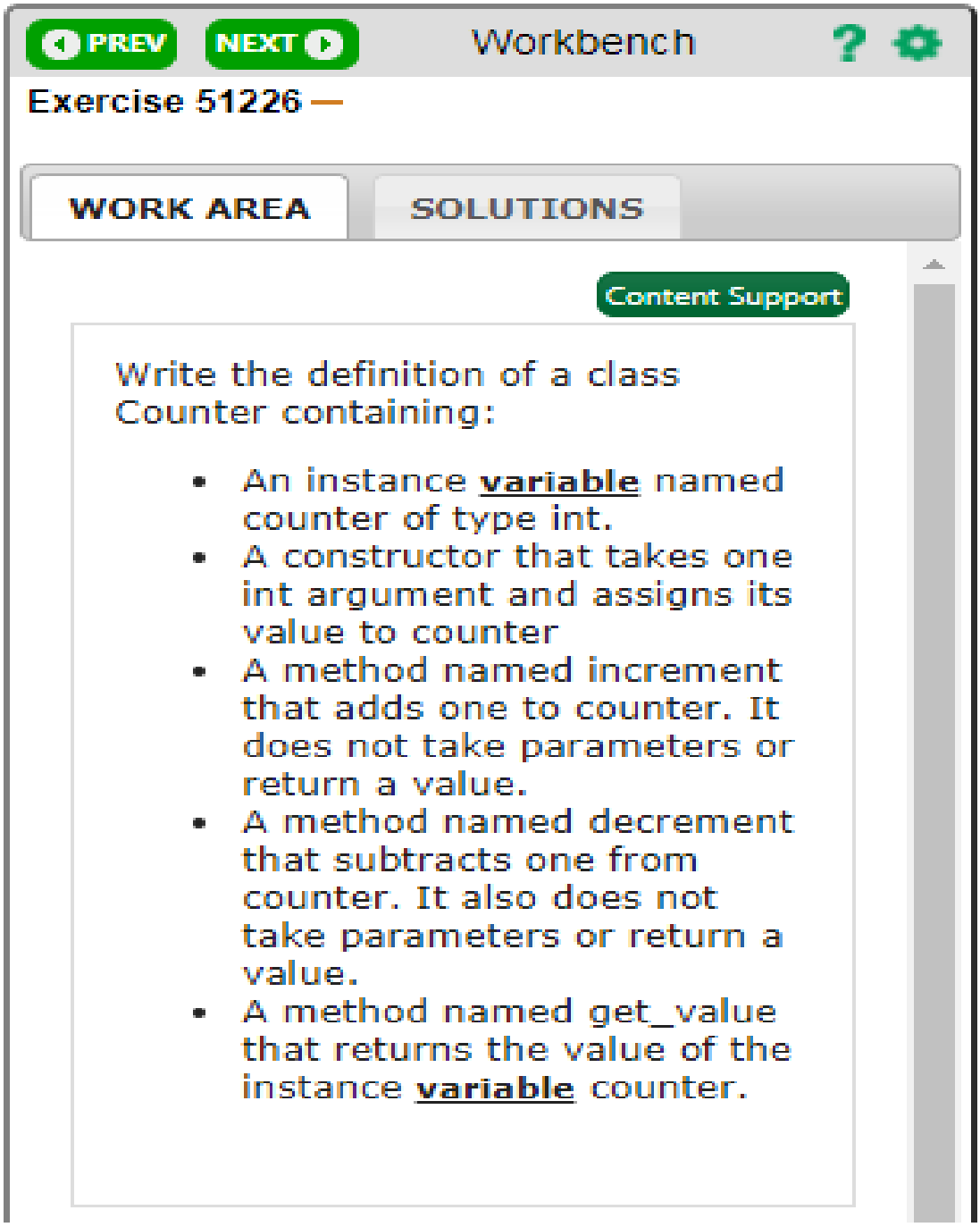

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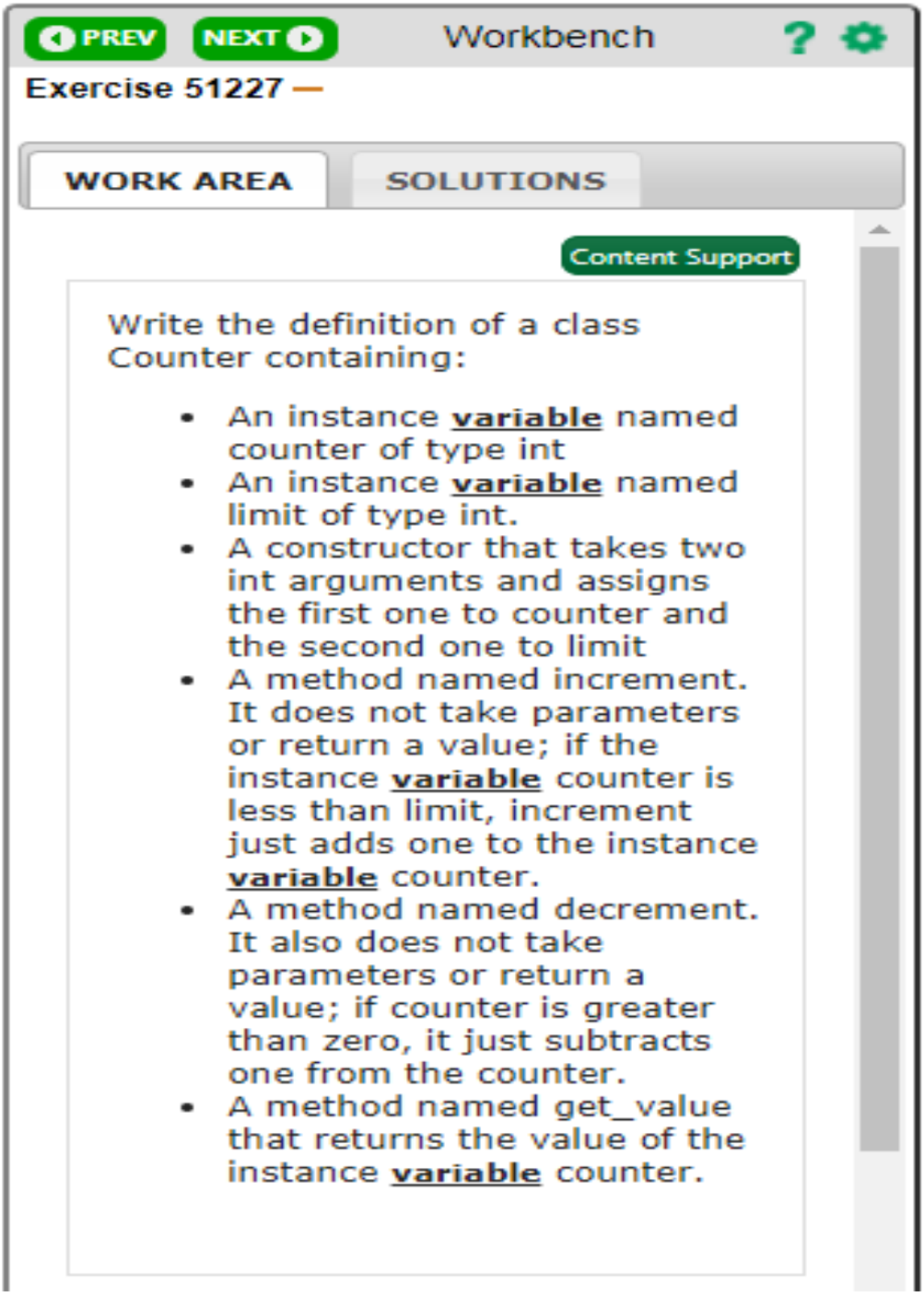

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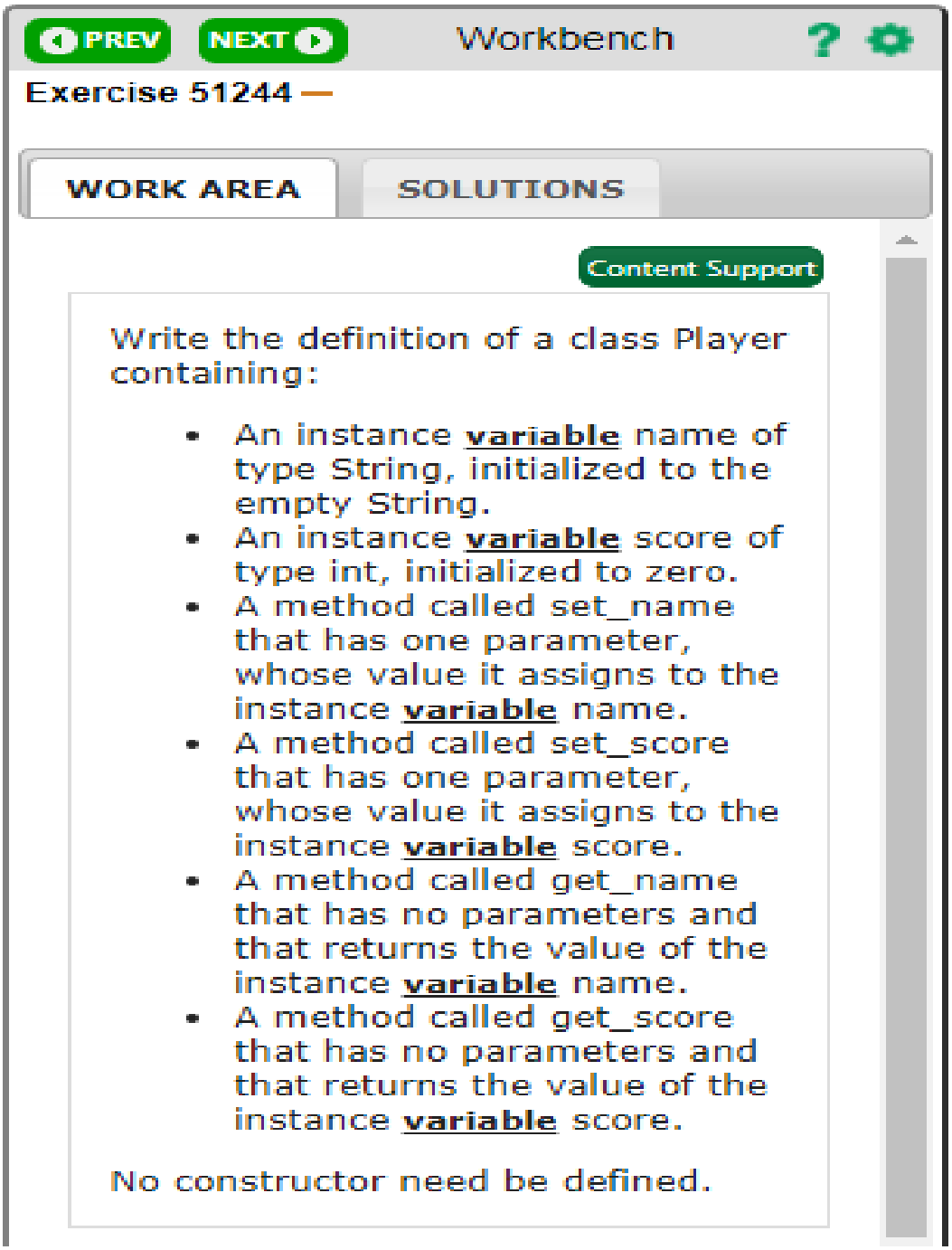

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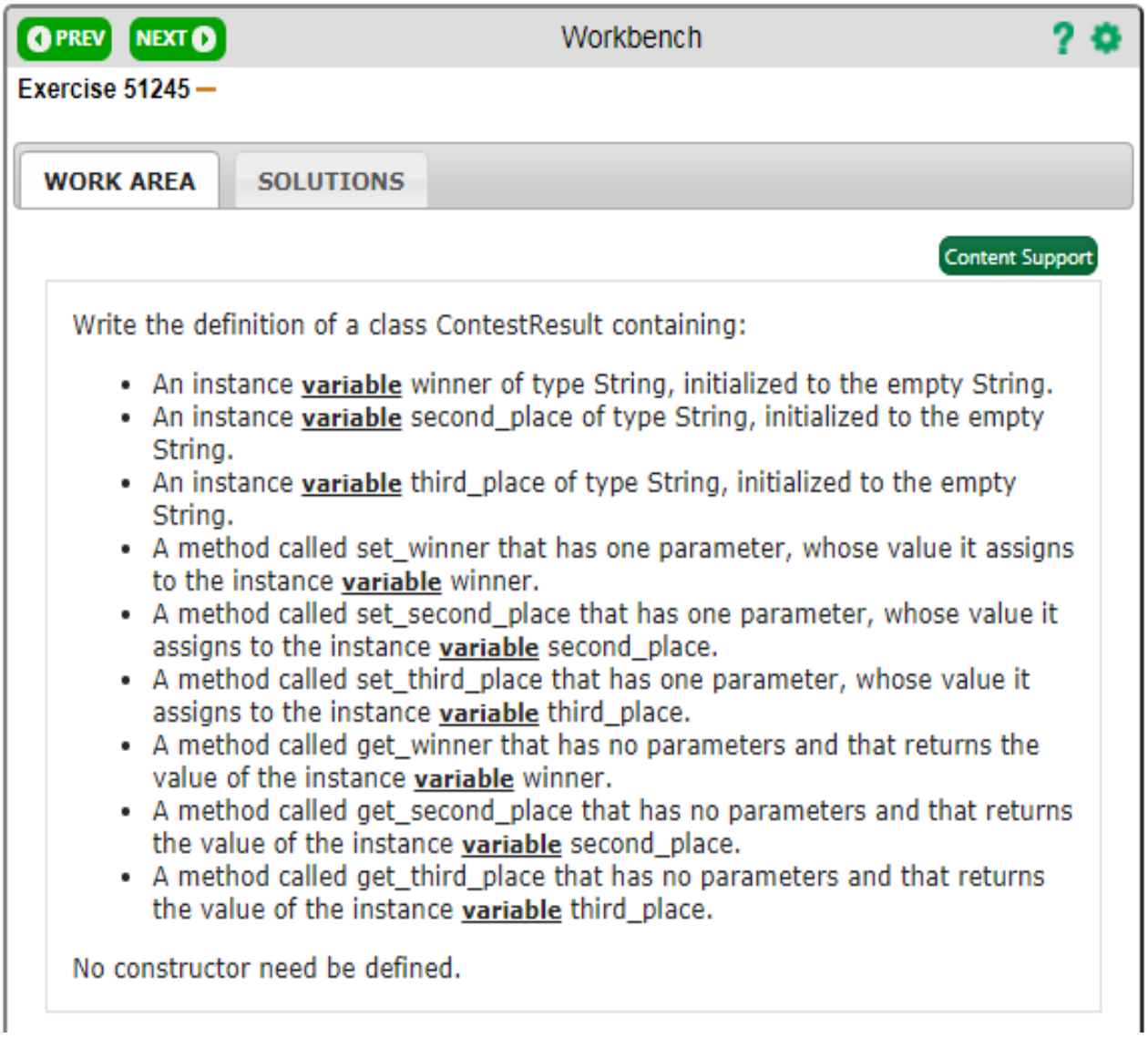

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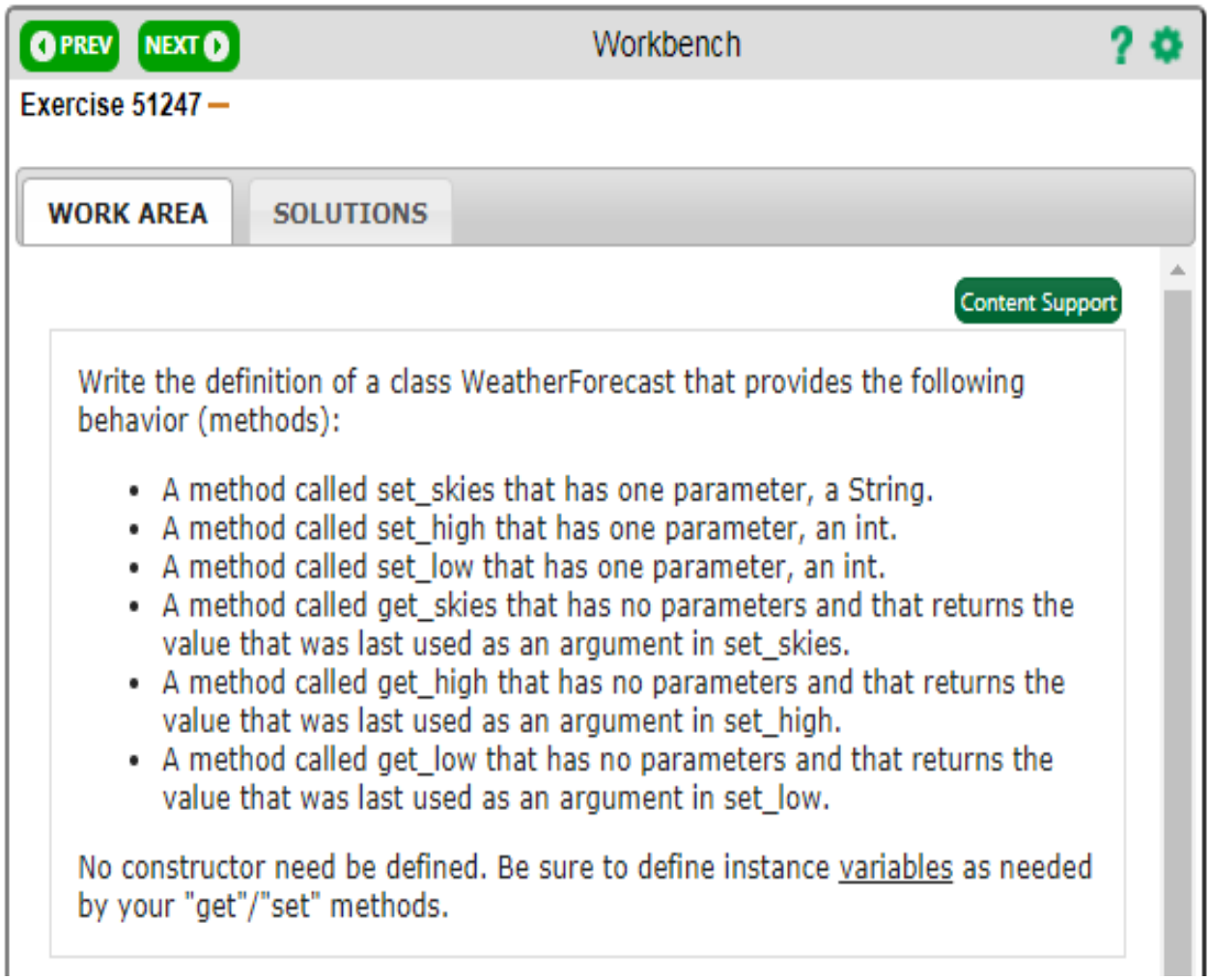

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