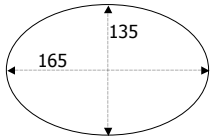
An Example

1

Problem

Using OCD, design and implement a program that computes the area and circumference of an Australian Rules Football field, which is an ellipse that is (ideally) 165m x 135m.



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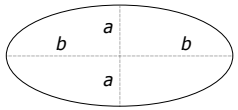
Problem Generalization

Using OCD, design and implement a program that computes the area and circumference of an *ellipse*.

$$area = \pi ab$$



$$circumference = 2\pi\sqrt{\frac{a^2 + b^2}{2}}$$

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Behavior

Our program should display on the screen a prompt for the major axis and minor axis. It should then read the major axis and the minor axis from the keyboard. It should then compute and display the ellipse's area and circumference along with a descriptive label.

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Objects

Our program should display on the screen a prompt for the major axis and minor axis. It should then read the major axis and the minor axis from the keyboard. It should then compute and display the ellipse's area and circumference along with a descriptive label.

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Operations

Our program should display on the screen a prompt for the major axis and minor axis. It should then read the major axis and the minor axis from the keyboard. It should then compute and display the ellipse's area and circumference along with a descriptive label.

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Representing Objects

Description	Java Type	Kind	Name
program	**new class**	**--**	_____
screen	`Screen`	**variable**	***theScreen***
prompt	`String`	**constant**	**--none--**
major axis	`double`	**variable**	_____
minor axis	`double`	**variable**	_____
keyboard	`Keyboard`	**variable**	***theKeyboard***
area	`double`	**variable**	***area***
circumference	`double`	**variable**	***circumference***

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Performing Operations

Description	Built-in/Class	Name
• **display a string**	`Screen`	_____
• **read a double**	`Keyboard`	_____
• **compute area**		
• **compute circumference**		
• **display doubles**	`Screen`	_____

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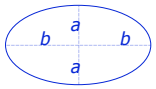
Algorithm

1. Ask *theScreen* to display a prompt for the length and width of an ellipse.
2. Ask *theKeyboard* to read *majorAxis*, *minorAxis*.
3. Compute *area*

$$area = \pi ab$$



4. Compute *circumference*.

$$circumference = 2\pi\sqrt{\frac{a^2+b^2}{2}}$$

5. Display *area* and *circumference* with descriptive labels.

Representing Objects

Description	Java Type	Kind	Name
program	**new class**	**--**	***Ellipse***
screen	`Screen`	**variable**	***theScreen***
prompt	`String`	**constant**	**--none--**
major axis	`double`	**variable**	***majorAxis***
minor axis	`double`	**variable**	***minorAxis***
keyboard	`Keyboard`	**variable**	***theKeyboard***
area	`double`	**variable**	***area***
circumference	`double`	**variable**	***circumference***
π	`double`	_____	_____
half major axis	`double`	_____	_____
half minor axis	`double`	_____	_____

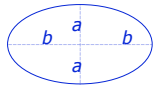
Performing Operations

Description	Built-in/Class	Name
• **display a string**	`Screen`	`print()`
• **read a double**	`Keyboard`	`readDouble()`
• **compute area**		
•	**– multiply doubles built-in**	
*****		
• **compute circumference**		
•	**– multiply doubles built-in**	
*****		
•	**– add doubles built-in**	**+**
•	**– divide doubles built-in**	
/		
•	**– power**	_____

Algorithm

0. Ask *theScreen* to display a prompt for the length and width of an ellipse.
1. Ask *theKeyboard* to read *majorAxis*, *minorAxis*.
2. Compute *semiMajor* = *majorAxis* /2.0; *semiMinor* = *minorAxis* /2.0.
3. Compute *area* _____

$$area = \pi ab$$



4. Compute *circumference* _____

_____

$$circumference = 2\pi\sqrt{\frac{a^2+b^2}{2}}$$

5. Display *area* and *circumference* with descriptive labels.

Coding

```
/* Ellipse.java computes an ellipse's area and circumference.
 * Input:  Ellipse's length and width
 * Output: Ellipse's area and circumference
 */

import ann.easyio.*;     // Keyboard, Screen

class Ellipse
{
  public static void main(String [] args)
  {
    ____________________________________________________________
    Keyboard theKeyboard = new Keyboard();

    theScreen.print("To compute the area and circumference of an "
                  + "ellipse,\n\tenter its major & minor axes: ");
    ____________________________________________________________
    double minorAxis = theKeyboard.readDouble();
    ____________________________________________________________
    double semiMinor = minorAxis / 2.0;

    double area = ____________________________________________

    double circumference = 2.0 * Math.PI * Math.sqrt(
        ( Math.pow(semiMajor, 2) + Math.pow(semiMinor, 2) ) / 2.0 ) ;
    theScreen.println("\nThe area is " ____________________
                      "\nand the circumference is " _________________);
  }
}
```

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Execution & Testing

First execute it with some values for which the results are easy to check by hand:

```
To compute the area and circumference of an ellipse,
        enter its major & minor axes: 2 2

The area is 3.141592653589793
and the circumference is 6.283185307179586


To compute the area and circumference of an ellipse,
        enter its major & minor axes: 8 6

The area is 37.69911184307752
and the circumference is 22.21441469079183
```

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When you are convinced of the program's correctness, execute it with the required inputs:

```
To compute the area and circumference of an ellipse,
        enter its major & minor axes: 165 135

The area is 17494.74408967816
and the circumference is 473.5892313120682
```

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