



Shuffleboard Slide with Proportions

In this project, you will create a disk gliding game (shuffleboard). The game lets us the user “aim” at a triangle scoreboard. Once the user presses “clear”, the disk will slide a random distance forward toward the scoreboard. The score will be determined based on the final resting location of the disk. You are tasked with writing the code to create the scoreboard and determine a score for each disk. The rest of the code will be provided by your teacher.

Objectives:

Programming Objectives:

- Use the draw_poly() function to draw triangles
- Use the set_color() function to set pen colors
- Use the randint() function to generate random integers.
- Use if statements to make conditional decisions

Math Objectives:

- Draw polygons on the coordinate plane
- Use ratios and proportions to transform units
- Decide whether two quantities are proportional
- Use proportions to create scaled polygons
- Draw geometric shapes using coordinates and technology

Math Course Connections: Middle School Mathematics

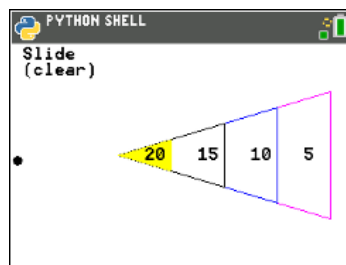
In this project, you will create a disk gliding game, “shuffleboard”. The game lets the user “aim” at a triangle scoreboard. Once the user presses “clear”, the disk will slide a random distance forward toward the scoreboard. The score will be determined based on the final resting location of the disk. You are tasked with writing the code to create the scoreboard and determine a score for each disk. The rest of the code will be provided by your teacher.

Sample Game:

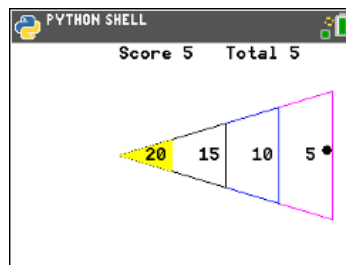
```

PYTHON SHELL
>>> # Shell Reinitialized
>>> # Running SHUFF_DN
>>> from SHUFF_DN import *
num shots: 3
    
```

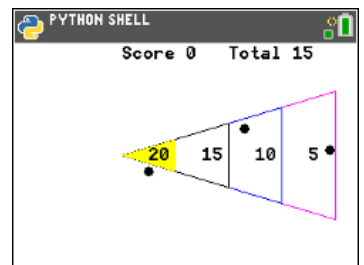
User selects 3 disks



Disk slides vertically until the user presses “clear” key



After “clear” key is pressed, the disk slides random distance



Final score displayed after all disks are played

Teacher Notes:

Student calculator needs the additional ti_draw.8xv AppVar which is available in the OS and Apps bundle version 5.7 for the handheld. If you are using SmartView, you will need to make sure you have updated the version 5.7 or above.

1. Obtain a copy of the “slideTMP.8vx” from your teacher. This contains the initial code for the project.



2. Let's examine the code

Libraries needed for the projects

*You will add the 12 lines to draw the points board

Animation code for "clear" slide key

Animation code to slide the disk towards board

*You will add the 11 lines to score the location of the disk after the slide.

Get the number of disks, initialize some variables

Use the functions to aim, slide and score for each disk

```

from ti_draw import *
from time import *
from ti_system import *
from random import *

def board():
    set_color(255,0,255)
    *
    *
    *

def aim(x,y):
    m=10
    while not escape():
        y+=m
        fill_circle(x,y,5)
        sleep(0.1)
        clear_rect(x-10,y-10,20,20)
        if y > 160 or y < 50:
            m*=-1
    return y

def glide(x,y,dx):
    clear_rect(0,0,300,30)
    while x < dx:
        clear_rect(x-5,y-5,11,11)
        x+=10
        board()
        set_color(0,0,0)
        fill_circle(x,y,5)
        sleep(0.1)
    return x

def score(x,y):
    points = 0
    *
    *
    *
    *
    *
    *
    *
    *
    *
    *
    *
    *
    *

    return points

num=int(input("num shots: "))
clear()
total = 0
xs,ys = [], []

for i in range(num):
    board()
    draw_text(10,20,"Slide")
    draw_text(10,35,"clear")
    x,y = 5,randint(5,16)*10
    y = aim(x,y)

```



Display the final score after clearing old values

```

**dx = randint(8,30)*10
**x = glide(x,y,dx)
**points = score(x,y)
**draw_text(100,20,"Score "+str(
    points))
**total+=points
**draw_text(200,20,"Total "+str(
    total))
**xs.append(x)
**ys.append(y)
**for i in range(len(xs)):
    *** fill_circle(xs[i],ys[i],5)
**draw_text(10,35,"(clear)")
**while not escape():
    *** continue

draw_text(100,40,"Final Total "+
    str(total))
while not escape():
    *** continue_
    
```

3. Let's first execute the initial code [trace], to see where we are.

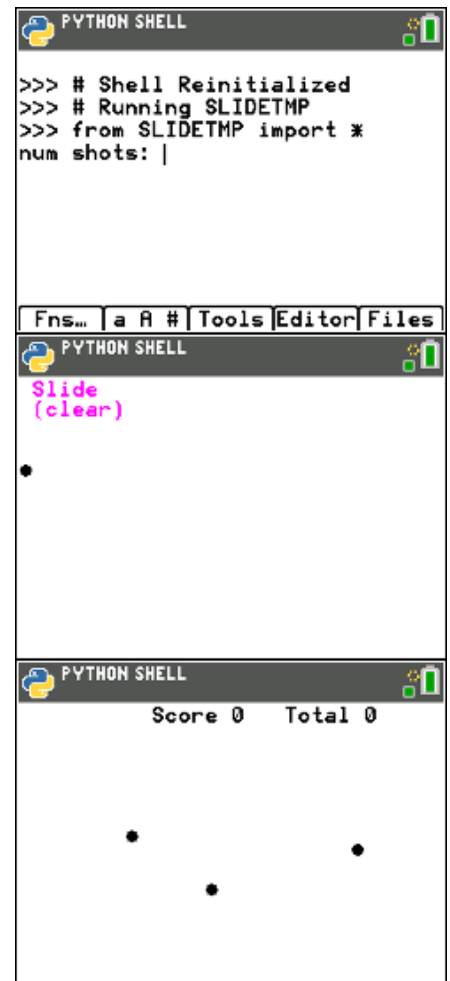
Enter 3 for the number of shots.

Observe the disk sliding back and forth before the "clear" key is selected.

After pressing "clear" three times, the game is over. The final score displays.

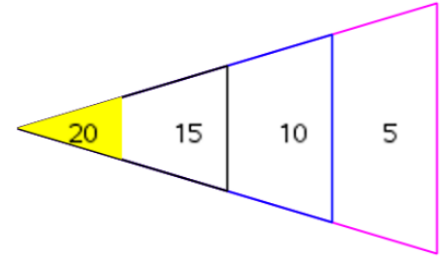
Your disks will be in different locations. The location depends on when you press the "clear" key as well as the random distance the disk travels.

Doesn't look too much like a shuffleboard right now, but it will, after we add some additional code!





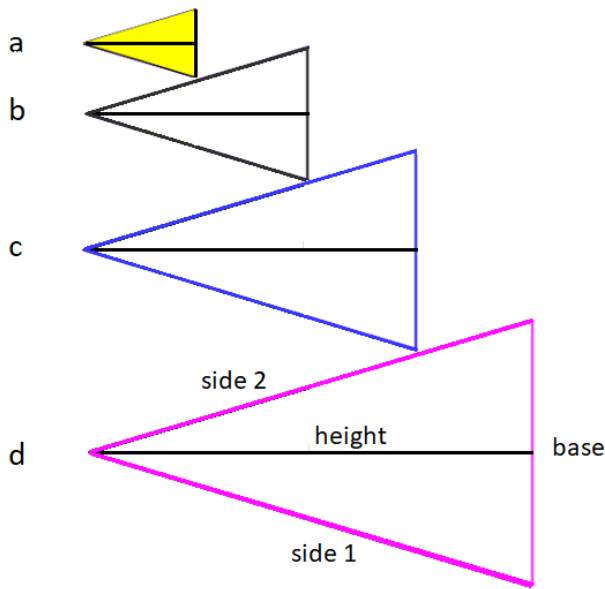
- 4. Before programming the score board, we need to investigate its composition. Once you understand the board's proportional relationships, you can code it using the drawing tools.



- 5. Below is a scaled and deconstructed version of the scoring board.

Use a ruler to measure the height and base length for each triangle in centimeters.

Then calculate $\frac{\text{height}}{\text{base}}$.



Triangle	Side 1 (cm)	Side 2 (cm)	Height (cm)	Base (cm)	$\frac{\text{height}}{\text{base}}$
a					
b					
c					
d					

Teacher Notes:

Triangle	Side 1 (cm)	Side 2 (cm)	Height (cm)	Base (cm)	$\frac{\text{height}}{\text{base}}$
a	1.1	1.1	1	0.7	1.43
b	2.2	2.2	2	1.4	1.43
c	3.3	3.3	3	2.1	1.43
d	4.4	4.4	4	2.8	1.43



6. What do you notice about $\frac{\text{height}}{\text{base}}$ for all 4 triangles?

Teacher Notes:

Students should notice they are all the same.

7. There are a few more observations to be made.

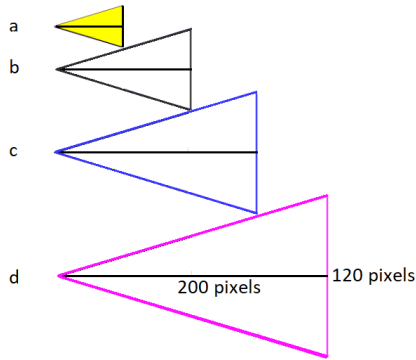
	Fraction	Decimal	Percent
$\frac{\text{triangle a height}}{\text{triangle d height}}$			
$\frac{\text{triangle b height}}{\text{triangle d height}}$			
$\frac{\text{triangle c height}}{\text{triangle d height}}$			
$\frac{\text{triangle a height}}{\text{triangle c height}}$			

Teacher Notes:

	Fraction	Decimal	Percent
$\frac{\text{triangle a height}}{\text{triangle d height}}$	$\frac{1}{4}$	0.25	25%
$\frac{\text{triangle b height}}{\text{triangle d height}}$	$\frac{2}{4}$	0.5	50%
$\frac{\text{triangle c height}}{\text{triangle d height}}$	$\frac{3}{4}$	0.75	75%
$\frac{\text{triangle a height}}{\text{triangle c height}}$	$\frac{1}{3}$	0. $\overline{33}$	33. $\overline{33}$ %



8. You know how the four triangles are related. **Now to scale these values to match the calculator screen.** The largest triangle is 200 pixels by 120 pixels. Use your relationships from the steps above to find the height and base for the three smallest triangles.



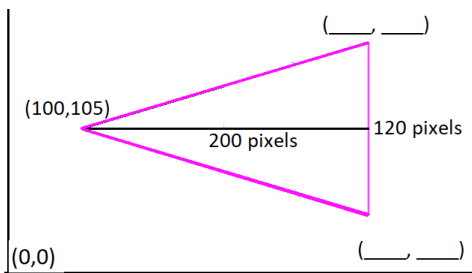
Triangle	Height (pixels)	Base (pixels)
a		
b		
c		
d	200	120

- i. Show work or explain how you found the height and base length for triangle a.
- ii. Show work or explain how you found the height and base length for triangle b.
- iii. Show work or explain how you found the height and base length for triangle c.

Teacher Notes:

Triangle	Height (pixels)	Base (pixels)
a	50	30
b	100	60
c	150	90
d	200	120

9. The largest triangle will have a vertex at (100,105). The height is 200 pixels while the base is 120 pixels. Where are the other two vertices?

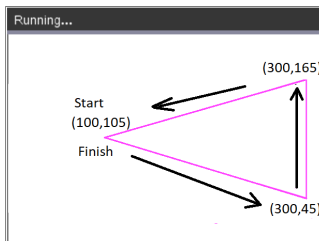


Teacher Notes:

(300, 165) and (300, 45)

10. Look at the two vertices you calculated.
 - i. Because the highest vertex is directly above the lowest vertex, your x-coordinates should be the same.
 - ii. Subtract your smallest y-coordinate from the largest coordinate.
Is the distance 120 pixels?
 - iii. The y-value 105 should be the middle y-coordinate for the 120-pixel base.
Find the average of your two y-coordinates. Is the average 105?

11. To draw the triangle, start at (100,105). Draw a segment to (300,145). Then draw a segment to (300,165). Finally draw a segment back to (100,105).



The command `draw_poly`, requires the list of x-values in order of travel as well as the y-values in order of travel. The x values are [100, 300, 300, 100]. The y-values are [105,45,165,105].

Add the following code to line 8 just below the `set_color` in the `board` function:

```
draw_poly([100,300,300,100],[105,45,165,105])  
[y=] → Modul → ti_draw → draw_poly
```

Make sure the `draw_poly` line is indented two spaces. That means there should be two diamonds in front of this line.

12. Execute your code [trace]. Enter "1" for the number of shots. You need at least one shot for the board to appear.

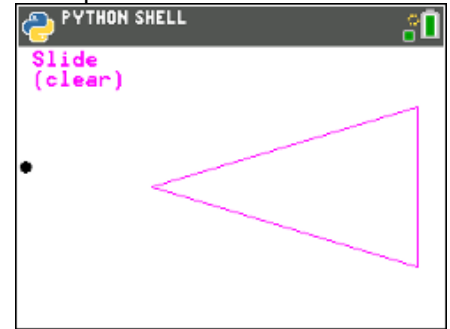
If everything is typed correctly, you shouldn't have any errors in your code. If you have an error, fix the error before you continue. Mostly likely, your error is on the `draw_poly` line of code. Make sure all the parenthesis (), square brackets [] and commas, are correct.

```
EDITOR: SLIDETMP  
PROGRAM LINE 0008  
from ti_draw import *  
from time import *  
from ti_system import *  
from random import *  
  
def board():  
    set_color(255,0,255)  
    draw_poly([100,300,300,100],[105,45,165,105])  
    ..  
    ..  
Fns... a A # Tools Run Files
```

```
PYTHON SHELL  
  
>>> # Shell Reinitialized  
>>> # Running SLIDETMP  
>>> from SLIDETMP import *  
num shots: 1  
Fns... a A # Tools Editor Files
```



Example Run:



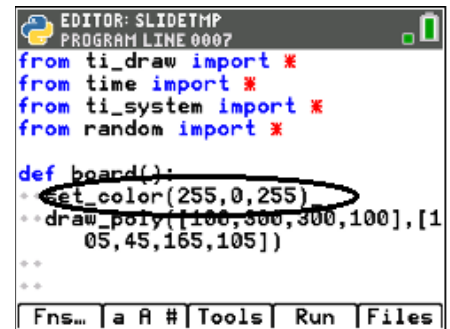
13. The line `set_color(255, 0, 255)` sets the pen color to magenta before the `draw_poly` line is executed. Magenta is made with 255-red, 0-green, 255-blue.

This `set_color` function needs three colors, red, green, and blue.

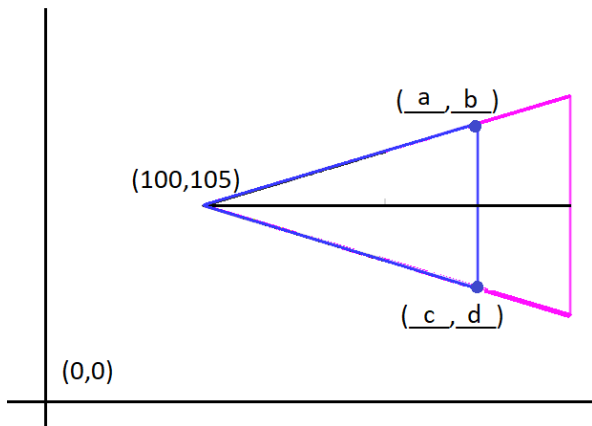
- `set_color(255,0,0)` is red. 255 red, 0 green, 0 blue
- `set_color(0,255,0)` is green. 0 red, 255 green, 0 blue
- `set_color(0,0,255)` is blue. 0 red, 0 green, 255 blue
- `set_color(255,255,0)` is yellow. 255 red, 255 green, 0 blue

You can pick any integer values from 0 to 255 for each red, blue, green.

You may choose to change this color or keep it magenta. If you choose to change the color, execute your code to ensure you've entered valid integers.



14. In step 7, you found the height and base for the 2nd largest triangle. Use these values to find the other two vertices (a,b) and (c,d).



(a,b) = (,)

(c,d) = (,)

15. Starting at the point (100,105), trace around the smaller triangle.

Record the x-values for the vertices in order [100, _____, _____, 100]

Record the y-values for the vertices in order [105, _____, _____, 105]



16. Change the color in the board function to blue, or any other color.
Draw the new triangle.

```
set_color(0,0,255)
draw_poly([100, ___, ___, 100],[105, ___, ___, 105])
```

*set_color [y=] → Modul → ti_draw → control → set_color

*to copy and paste a line of code, put the cursor on the line to copy,
[zoom] → 6 Copy Line
[zoom] → 7 Paste Line Below

```
EDITOR: SLIDETMP
PROGRAM LINE 0010
from time import *
from ti_system import *
from random import *

def board():
    *set_color(255,0,255)
    *draw_poly([100,300,300,100],[105,45,165,105])
    *set_color(0,0,255)
    *draw_poly([100,___,___,100],[105,___,___,105])
```

(You shouldn't have ___ in your code. You should have the correct values you found in step 15).

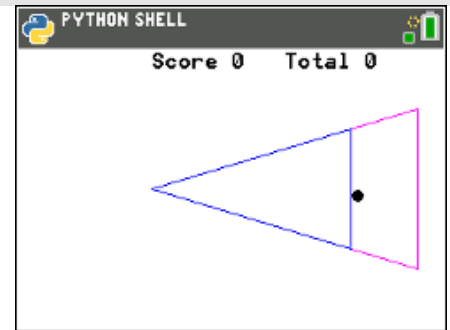
Teacher Notes:

```
draw_poly([100, 250, 250, 100],[105, 60, 150, 105])
```

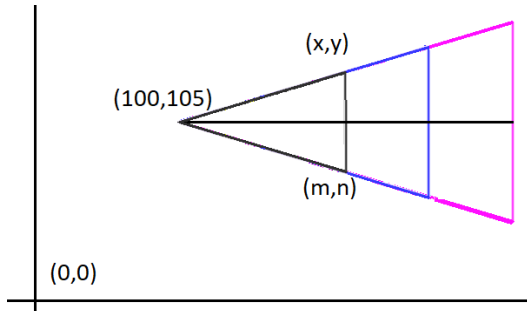
17. Execute your code [trace]. Enter "1" for the number of shots.

Does it give you the picture to the right?
(Your disk could be in a different location)

If you have an error, fix it. If the new triangle isn't correct, re-evaluate the numbers in your last draw_poly.



18. Repeat the same process for the 2nd smallest triangle.
Look back at step 5 to find the dimensions for the triangle.
Find the values for the two vertices



$(x,y) = (\quad , \quad)$

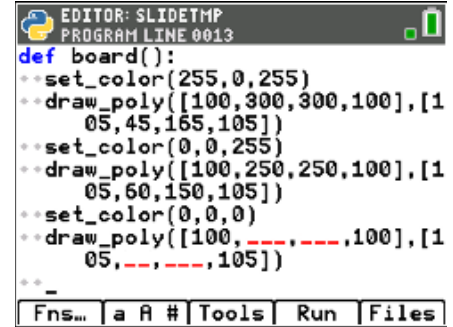
$(m,n) = (\quad , \quad)$



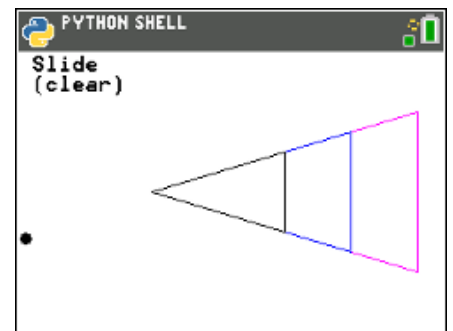
- 19. Change your pen color to black or a color of your choosing. Plot your new triangle.

```
set_color(0,0,0)
draw_poly([100, ___, ___, 100],[105, ___, ___, 105])
```

Execute your code. Verify the new triangle is in the correct location.



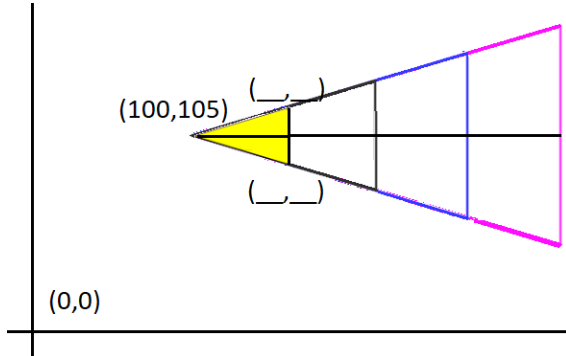
(You shouldn't have ___ in your code. You should have the correct values you found in step 18).



Teacher Notes:

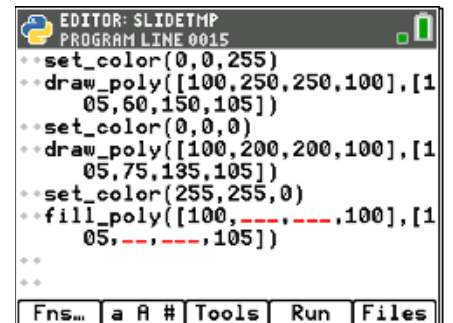
```
draw_poly([100, 200, 200, 100],[105, 75, 135, 105])
```

- 20. Repeat the same process for the smallest triangle. Look back at step 5 to find the dimensions for the triangle. Find the values for the two vertices



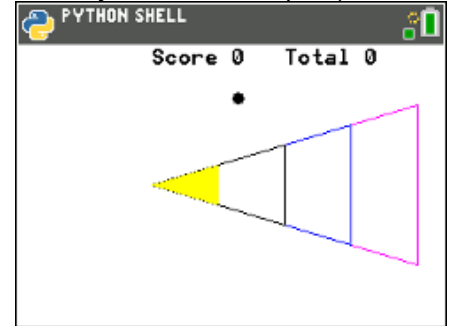
- 21. Instead of draw_poly, you will use fill_poly to fill in the triangle. If r = 255 and g = 255, set_color(255,255,0) will produce yellow. You may choose a different color if you like.

```
set_color(255,255,0)
fill_poly([100, ___, ___, 100],[105, ___, ___, 105])
```



Verify your code works.

(You shouldn't have `__` in your code. You should have the correct values you found in step 20).

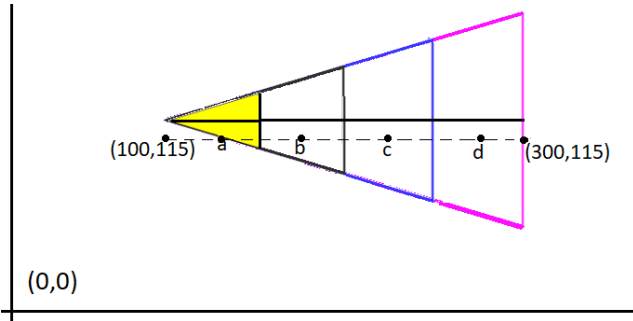


Teacher Notes:

```
fill_poly([100, 150, 150, 100],[105, 90, 120, 105])
```

22. Now to label the point values.

Points a, b, c and d will be halfway between the left and right boundary of the scoring zones. Where should each point label be placed?



a. (,)

b. (,)

c. (,)

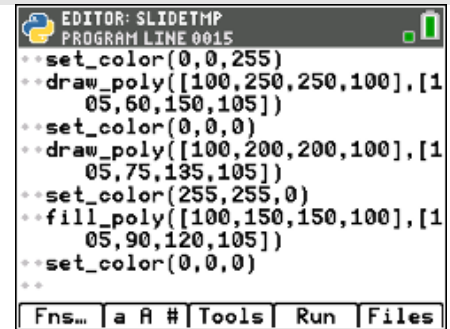
d. (,)

Teacher Notes:

- a. (125, 115) b. (175, 115) c. (225, 115) d. (275, 115)

23. Change the pen color back to black.

```
set_color(0,0,0)
```





24. The command `draw_text(x,y,string)` will draw on the screen.

To draw the first value type

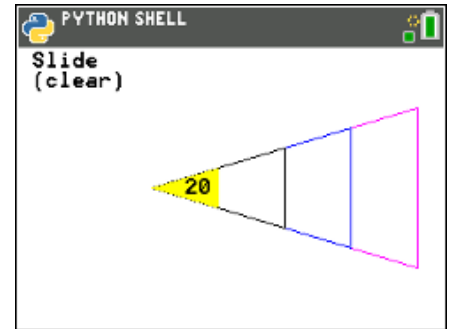
```
draw_text(125,115,"20")
```

[y=] → Modul → ti_draw → draw_text

```

EDITOR: SLIDETMP
PROGRAM LINE 0016
**draw_poly([100,250,250,100],[105,60,150,105])
**set_color(0,0,0)
**draw_poly([100,200,200,100],[105,75,135,105])
**set_color(255,255,0)
**fill_poly([100,150,150,100],[105,90,120,105])
**set_color(0,0,0)
**draw_text(125,115,"20")
**
Fns... | a A # | Tools | Run | Files

```



25. Use the values you found in step 22 to draw the remaining values.

```
draw_text(175,115,"15")
```

```
draw_text(225,115,"10")
```

```
draw_text(275,115,"5")
```

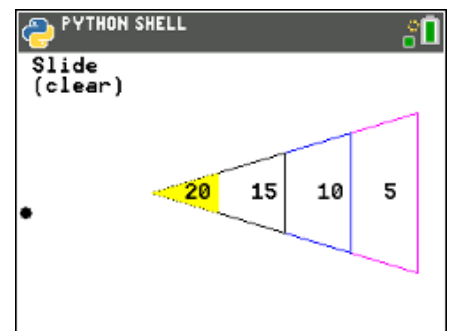
```

EDITOR: SLIDETMP
PROGRAM LINE 0012
05,75,135,105)
**set_color(255,255,0)
**fill_poly([100,150,150,100],[105,90,120,105])
**set_color(0,0,0)
**draw_text(125,115,"20")
**draw_text(175,115,"15")
**draw_text(225,115,"10")
**draw_text(275,115,"5")
def aim(x,y):
Fns... | a A # | Tools | Run | Files

```

(You shouldn't have `__` in your code. You should have the correct values you found in step 22).

Execute your code. Make sure the labels appear in the correct location.



Teacher Notes:

```
draw_text(175,115,"15")
```

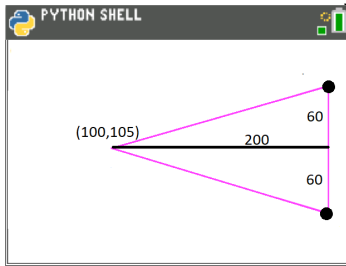
```
draw_text(225,115,"10")
```

```
draw_text(275,115,"5")
```

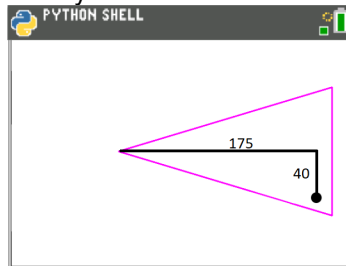
26. Your game is almost complete. All you need to do is code the scoring mechanism. How do you score points? How do you know if the disc is inside a scoring region or outside a scoring region?

Let's look for a scoring pattern.

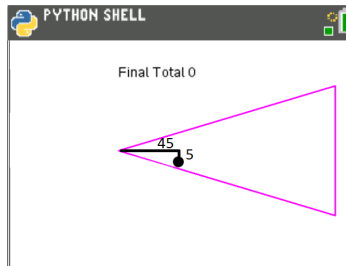
Calculate the rate of change between the distance the disc travels past the closest vertex on the x-axis and the distance from the line of symmetry.



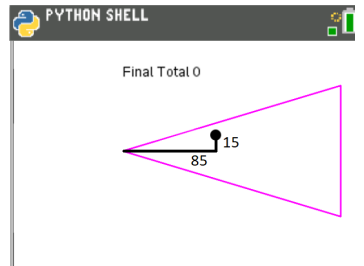
$$\frac{60}{200} = 0.3$$



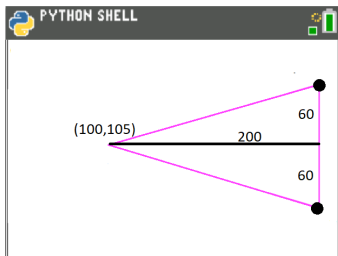
— ≈



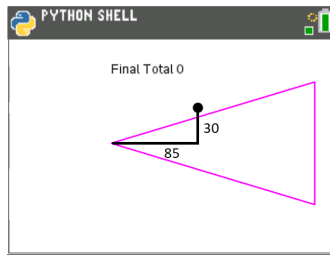
— ≈



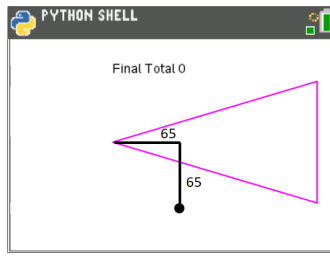
— ≈



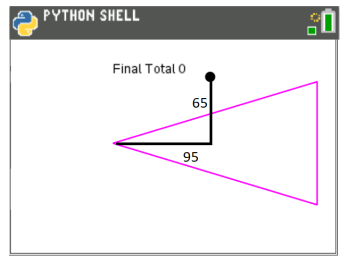
$$\frac{60}{200} = 0.3$$



— ≈



— ≈



— ≈

Look at all the shots in step 26 that **would** earn points. How do they compare to the gameboard rate of 0.3?

Look at all the shots that would **not** earn points. How do they compare to the gameboard rate of 0.3?

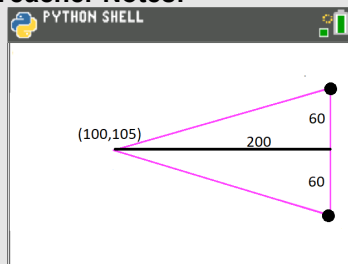
Complete the following statement.

In order to earn points,

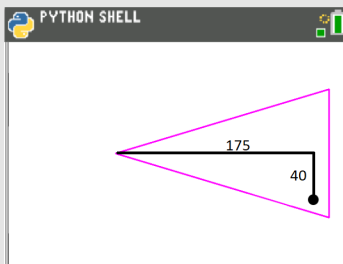
the disc x value must be greater than or equal to 100, less than or equal to _____

and $\frac{y \text{ distance past } 105}{x \text{ distance from } 100}$ must be _____

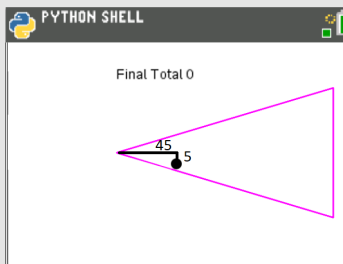
Teacher Notes:



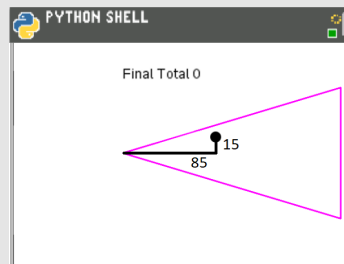
$$\frac{60}{200} = 0.3$$



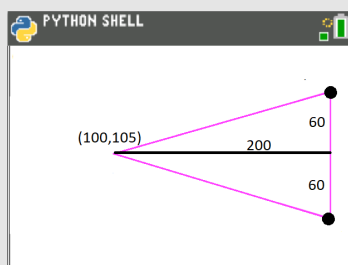
$$\frac{40}{175} \approx 0.23$$



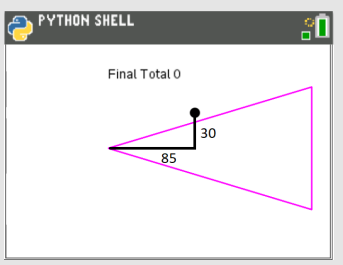
$$\frac{4}{45} \approx 0.11$$



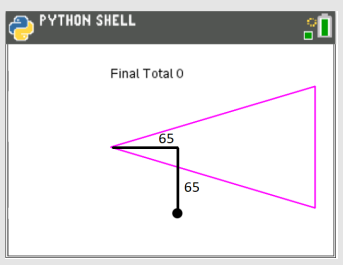
$$\frac{15}{85} \approx 0.18$$



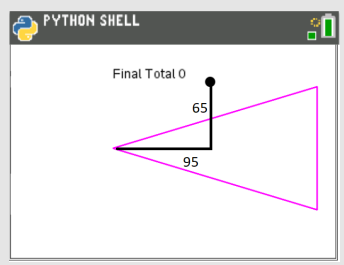
$$\frac{60}{200} = 0.3$$



$$\frac{30}{85} \approx 0.35$$



$$\frac{65}{65} \approx 1$$



$$\frac{65}{95} \approx 0.68$$

In order to earn points, the ratio should be 0.3 or less.

27. Now to translate your word statement above, called **pseudo code** into Python.

if $x \geq 100$ and $x \leq 300$ and $\text{abs}((y - 105)/(x - 100)) \leq 0.3$:

Add this line of code to the score function.
 Make sure you include a colon, :, at the end of the line.

if
 [y=] → ctl → if

>=, <=, and
 [2nd] [math]

abs

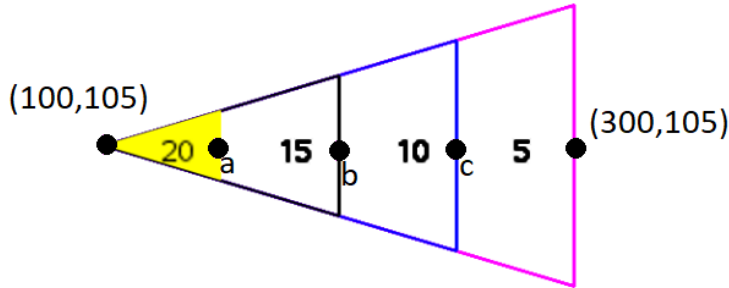
You need the absolute value function to measure the distance from the line of symmetry.

```

EDITOR: SLIDETMP
PROGRAM LINE 0046

def score(x,y):
  points = 0
  if x >= 100 and x <= 300 and abs((
    y-105)/(x-100)) <= 0.3:
    . . . . .
    . . . . .
    . . . . .
    . . . . .
    . . . . .
  
```

If a disc is within the boundaries to score points, how many points should the user get?



To earn 20 points, the x value should be between _____ and _____.

To earn 15 points, the x value should be between _____ and _____.

To earn 10 points, the x value should be between _____ and _____.

To earn 5 points, the x value should be between _____ and _____.

Explain or show how you found the boundaries above.

Teacher Notes:

To earn 20 points, the x value should be between 100 and 150.

To earn 15 points, the x value should be between 150 and 200.

To earn 10 points, the x value should be between 200 and 250.

To earn 5 points, the x value should be between 250 and 300.

28. Use your answers from step 27 to fill in the Python template:

```

if x >= ___ and x < ___:
    points = 20
elif x >= ___ and x < ___:
    points = 15
elif x >= ___ and x < ___:
    points = 10
elif x >= ___ and x < ___:
    points = 5

```

**elif [y=] → ctl → elif

Notice the indenting in the picture on the right. The new **if**, **elif**, **else** statements need indented two spaces from the original if. The **points =** lines are indented two additional spaces from the if, elif, else statements.

```

EDITOR: SLIDETMP
PROGRAM LINE 0046
if x >= 100 and x <= 300 and abs((
y-105)/(x-100)) <= 0.3:
    if x >= 100 and x < 150:
        points = 20
    elif x >= 150 and x < 200:
        points = 15
    elif x >= 200 and x < 250:
        points = 10
    elif x >= 250 and x < 300:
        points = 5
return points

```

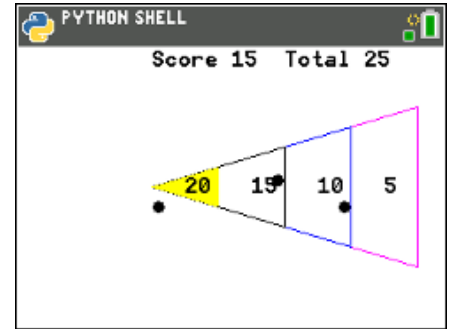
(You shouldn't have ___ in your code, you should have the correct values you found in step 27).

29. Execute your code.

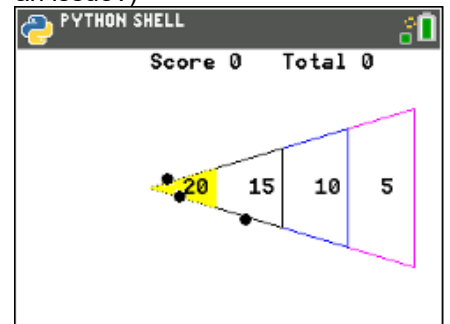
Play your game *three* times.
Each time enter **3** shots.

Verify your boundaries create the correct score.
If they are not correct, re-evaluate your work in step 27.

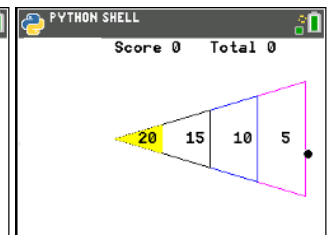
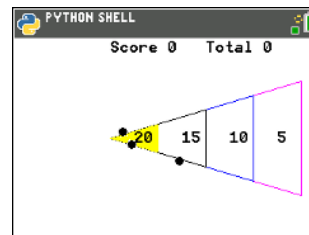
Two example runs are shown on the right.



(We will discuss this case in the next step, why might this score be an issue?)



30. The code was written using the **CENTER** of the disk and the assumption it would land **inside** the triangle. The picture to the right has two discs with centers *outside* the triangle, however, parts of the circles overlap the triangle. These two discs are not counted in the score. The same issue happens if the center goes past the large triangle. How might we adjust the code to fix this?



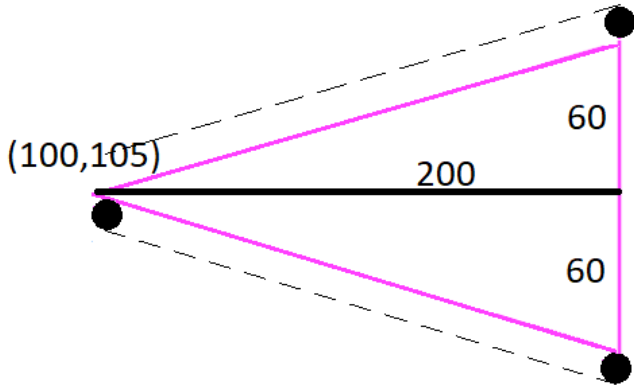
31. The disc radius is 5 pixels.

That means, instead of using the ratio $\frac{60}{200} = 0.3$, we should use $\frac{65}{200} = 0.325$.

```

EDITOR: SLIDETMP
PROGRAM LINE 0045
*return x
def score(x,y):
*points = 0
if x>=100 and x<=300 and abs(
y-105)/(x-100))<=0.325:
*if x>=100 and x<150:
*points=20
*elif x>=150 and x<200:
*points=15
*elif x>=200 and x<250:

```

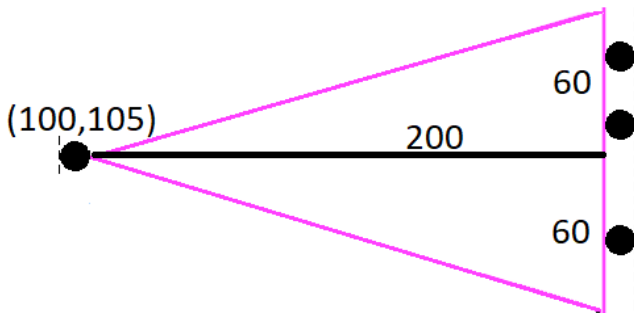
Modify the first if statement in the score function to accommodate this adjustment.

Teacher Notes:

if $x \geq 100$ and $x \leq 300$ and $\text{abs}((y-105)/(x-100)) < 0.325$:

32. Instead of making 300 the maximum x value, what should it be?
Change the maximum x value from 300 to the new x value.

Instead of making 100 the minimum x value, what should it be?
Change the minimum x value from 100 to the new x value.



```

EDITOR: SLIDETMP
PROGRAM LINE 0045
**return x

def score(x,y):
**points = 0
**if x>=___ and x<=___ and abs((
y-105)/(x-100))<=0.325:
****if x>=100 and x<150:
*****points=20
****elif x>=150 and x<200:
*****points=15
****elif x>=200 and x<250:

```

(You should have the new value where the ___ is in the highlighted line)

Teacher Notes:

if $x \geq 95$ and $x \leq 305$ and $\text{abs}((y-105)/(x-100)) < 0.325$:

33. Play your game several times. Make sure the modifications we made to the code work correctly.

Teacher Notes: Completed Code

```

from ti_draw import *
from time import *
from ti_system import *
from random import *

```

```

def board():

```



```
set_color(255,0,255)
draw_poly([100,300,300,100],[105,45,165,105])
set_color(0,0,255)
draw_poly([100,250,250,100],[105,60,150,105])
set_color(0,0,0)
draw_poly([100,200,200,100],[105,75,135,105])
set_color(255,255,0)
fill_poly([100,150,150,100],[105,90,120,105])
set_color(0,0,0)
draw_text(125,115,"20")
draw_text(175,115,"15")
draw_text(225,115,"10")
draw_text(275,115,"5")
```

```
def aim(x,y):
    m=10
    while not escape():
        y+=m
        fill_circle(x,y,5)
        sleep(0.1)
        clear_rect(x-10,y-10,20,20)
        if y > 160 or y < 50:
            m*=-1
    return y
```

```
def glide(x,y,dX):
    clear_rect(0,0,300,30)
    while x < dX:
        clear_rect(x-5,y-5,11,11)
        x+=10
        board()
        set_color(0,0,0)
        fill_circle(x,y,5)
        sleep(0.1)
    return x
```

```
def score(x,y):
    points = 0
    if x>=95 and x<=305 and abs((y-105)/(x-100))<=0.325:
        if x>=100 and x<150:
            points=20
        elif x>=150 and x<200:
            points=15
        elif x>=200 and x<250:
```



```
    points=10
    elif x>=250 and x<300:
        points=5
    return points

num=int(input("num shots: "))
clear()
total = 0
xs,ys = [], []

for i in range(num):
    board()
    draw_text(10,20,"Slide")
    draw_text(10,35,"(clear)")
    set_color(0,0,0)
    x,y = 5,randint(5,16)*10
    y = aim(x,y)
    dX = randint(8,30)*10
    x = glide(x,y,dX)
    points = score(x,y)
    draw_text(100,20,"Score "+str(points))
    total+=points
    draw_text(200,20,"Total "+str(total))
    xs.append(x)
    ys.append(y)
    for i in range(len(xs)):
        fill_circle(xs[i],ys[i],5)
    draw_text(10,35,"(clear)")
    while not escape():
        continue

draw_text(100,40,"Final Total "+str(total))
while not escape():
    continue
```