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# FlyingFrames

*Release 7/2021*

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Hi! FlyingFrames is a project by me (kolibril13), where I want to provide you some tutorials and code snippets that I often use when I prepare my animations for my youtube channel: <https://www.youtube.com/channel/UCq-aIJ8sN1-G2ZzIyWYostw>

It does not replace the amazing documentation at <https://docs.manim.community/en/stable/> , but I hope this blog will give you some inspiration for your future projects.



## CONTENT

## 1.1 1. Manim in Jupyter

**Latest update : 18.9.2021**

Working with manim in jupyter notebooks has several advantages:

- code snippets and rendered outputs are close together
- easy to iterate examples
- easy to try different varieties of one scene in multiple cells
- computation intensive code can be executed separately from the scenes
- global Mobjects can be used in multiple scenes.

### 1.1.1 Simple Example

First, we need to import manim

```
[1]: from manim import *
```

```
Manim Community v0.10.0
```

Now we build up our scene

```
[2]: %%manim -v WARNING --progress_bar None -s -ql --disable_caching MyExample
class MyExample(Scene):
    def construct(self):
        m= ManimBanner()
        self.add(m)
```



Note, that I use the following parameters:

- `-v WARNING` means that only warnings are shown in the log
- `--progress_bar None` will not show the animation progress bar
- `-s` will only show the last frame
- `-ql` renders in low quality
- `--disable_caching` will disable the manim caching system
- `MyExample` gives the scene name

for rendering a video, just remove the `-s` flag. To lower the resolution, you can use `-r 400,200` (pixel values in x and y direction).

```
[3]: %%manim -v WARNING --progress_bar None -r 400,200 --disable_caching HelloManim
class HelloManim(Scene):
    def construct(self):
        self.camera.background_color = "#ece6e2"
        banner_large = ManimBanner(dark_theme=False).scale(0.7)
        self.play(banner_large.create())
        self.play(banner_large.expand())

<IPython.core.display.Video object>
```

We can define the parameters as a string `params` and call this string by the cell magic with `$params`

```
[4]: params = "-v WARNING -s -ql --disable_caching Example"
paramsSMALL = "-v WARNING -r 400,200 -s --disable_caching Example"
```

```
[5]: %%manim $params
class Example(Scene):
```

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```
def construct(self):  
    m= ManimBanner()  
    self.add(m)
```



### 1.1.2 Initializing Mobjects Outside the Class

In some cases, it might be convenient to define mobjects outside the Scene class (e.g. for uncluttering or for speeding up the animation).

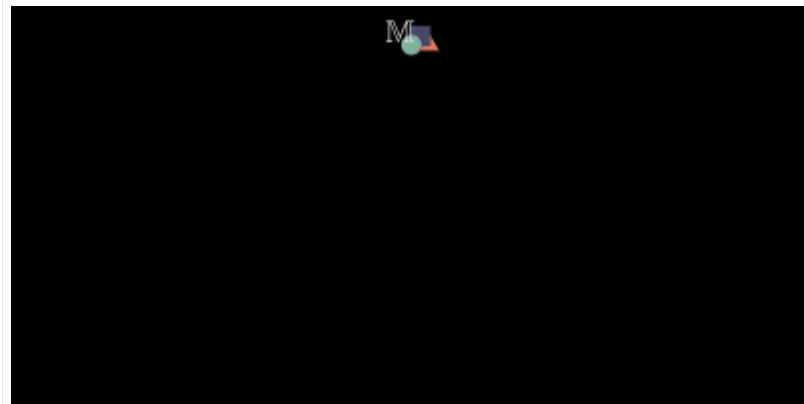
```
[6]: m = ManimBanner()
```

```
[7]: %%manim $paramsSMALL  
class Example(Scene):  
    def construct(self):  
        m.scale(0.4)      )  
        m.shift(1.5*UP)  
        self.add(m)
```



Because the mobject is manipulated in the class, the next cell might show some unexpected scaling and shifting:

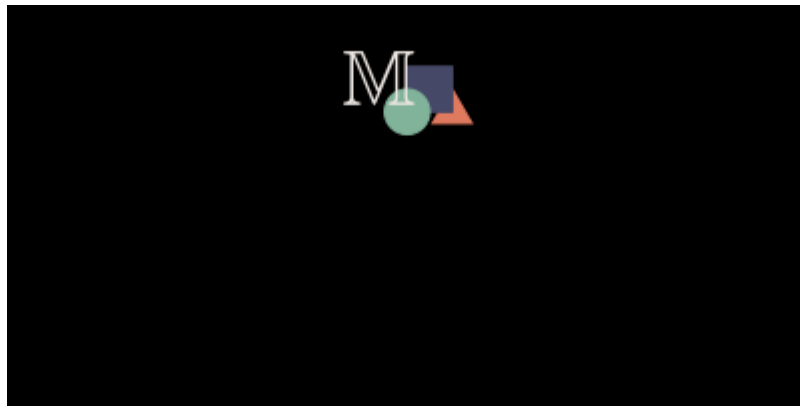
```
[8]: %%manim $paramsSMALL
class Example(Scene):
    def construct(self):
        m.scale(0.4)
        m.shift(1.5*UP)
        self.add(m)
```



To avoid this, it is better to add only a copy of these mobjects to scenes, and keep the originals untouched:

```
[9]: m_reference = ManimBanner()
```

```
[10]: %%manim $paramsSMALL
class Example(Scene):
    def construct(self):
        m = m_reference.copy()
        m.scale(0.4)
        m.shift(2*UP)
        self.add(m)
```



```
[11]: %%manim $paramsSMALL
class Example(Scene):
    def construct(self):
        m = m_reference.copy()
        m.scale(0.4)
        m.shift(2*UP)
        self.add(m)
```



### 1.1.3 Defining Global Mobjects

When you have to build complex scenes, you might want to use parts of that scene for your next scene. That is possible with global variables, which can be accessed in any other scene.

```
[12]: %%manim $paramsSMALL
class Example(Scene):
    def construct(self):
        stars= VGroup()
        for i in range(0,20):
            s= Star(color= random_bright_color(), fill_opacity=1).scale(0.8)
            stars.add(s)
        stars.arrange_in_grid()
        self.add(stars)
        global favoritstar
        favoritstar = stars[9]
```



```
[13]: %%manim $paramsSMALL
class Example(Scene):
    def construct(self):
        self.add(favoritstar)
```



### 1.1.4 Pre-Execute Slow Code

In this example, calculating a random walk for 500 particles and 100000 steps takes about 4 seconds.

This step can be done before the actual scene construction, which takes about 0.2 seconds.

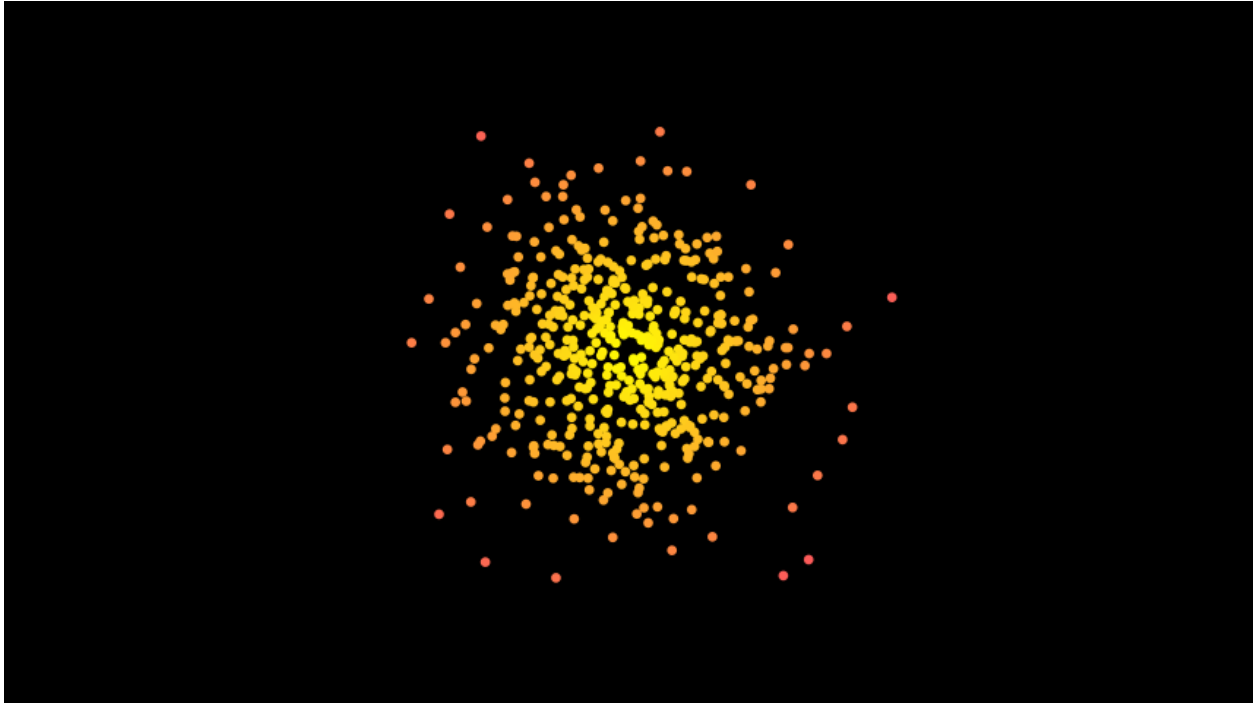
Making aesthetic changes to the scene will then become easier.

Note: The %%time command will print the execution time of the cells.

```
[14]: %%time
np.random.seed(20)
steps = np.random.choice(a=[-1, 0, 1], size=(100000,1000))
stop = steps.cumsum(0)
end_points= stop[-1]/stop[-1].max()
end_pointsX = end_points[0:499]
end_pointsY = end_points[500:-1]
```

```
CPU times: user 2.19 s, sys: 1.06 s, total: 3.25 s
Wall time: 3.27 s
```

```
[15]: %%time
%%manim $params
class Example(Scene):
    def construct(self):
        radius= (end_pointsX*end_pointsX + end_pointsY * end_pointsY)**0.5
        dots = VGroup()
        for x,y,r in zip(end_pointsX, end_pointsY,radius):
            c= interpolate_color(YELLOW, RED, r)
            dots.add(Dot(color=c,point=[3*x,3*y,0]).scale(0.7))
        self.add(dots)
```



CPU times: user 409 ms, sys: 3.14 ms, total: 412 ms  
Wall time: 412 ms

### 1.1.5 Installing Plugins

plugins can be found at <https://plugins.manim.community/>

```
[16]: !pip install manim-physics

Collecting manim-physics
  Downloading manim_physics-0.2.3-py3-none-any.whl (9.9 kB)
Collecting pymunk<7.0.0,>=6.0.0
  Downloading pymunk-6.2.0-cp38-cp38-manylinux2010_x86_64.whl (984 kB)
    || 984 kB 6.6 MB/s
Requirement already satisfied: manim>=0.6.0 in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim-physics) (0.
↳ 10.0)
Requirement already satisfied: manimpango<0.4.0,>=0.3.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages
↳ (from manim>=0.6.0->manim-physics) (0.3.0)
```

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Requirement already satisfied: click-default-group in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (1.2.2)

Requirement already satisfied: mapbox-earcut<0.13.0,>=0.12.10 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (0.12.10)

Requirement already satisfied: requests in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (2.26.0)

Requirement already satisfied: pydub in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (0.25.1)

Requirement already satisfied: pygments in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (2.10.0)

Requirement already satisfied: rich>=6.0 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (10.11.0)

Requirement already satisfied: scipy in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (1.7.1)

Requirement already satisfied: numpy<2.0,>=1.9 in /home/docs/.pyenv/versions/3.8.6/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (1.19.2)

Requirement already satisfied: tqdm in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (4.62.3)

Requirement already satisfied: moderngl-window<3.0.0,>=2.3.0 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (2.4.0)

Requirement already satisfied: networkx<3.0,>=2.5 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (2.6.3)

Requirement already satisfied: Pillow in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (5.4.1)

Requirement already satisfied: watchdog in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (2.1.5)

Requirement already satisfied: moderngl<6.0.0,>=5.6.3 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (5.6.4)

Requirement already satisfied: decorator<6.0.0,>=5.0.7 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (5.1.0)

Requirement already satisfied: cloup<0.8.0,>=0.7.0 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (0.7.1)

Requirement already satisfied: pycairo<2.0,>=1.19 in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (1.20.1)

Requirement already satisfied: colour in /home/docs/checkouts/readthedocs.org/user\_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-physics) (0.1.5)

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```

Requirement already satisfied: screeninfo<0.7.0,>=0.6.7 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages
↳ (from manim>=0.6.0->manim-physics) (0.6.7)
Requirement already satisfied: setuptools in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-
↳ physics) (58.1.0)
Requirement already satisfied: click>=7.1 in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from manim>=0.6.0->manim-
↳ physics) (8.0.1)
Requirement already satisfied: glcontext<3,>=2 in /home/docs/checkouts/readthedocs.org/
↳ user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from moderngl<6.0.0,
↳ >=5.6.3->manim>=0.6.0->manim-physics) (2.3.4)
Requirement already satisfied: pyrr<1,>=0.10.3 in /home/docs/checkouts/readthedocs.org/
↳ user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from moderngl-window
↳ <3.0.0,>=2.3.0->manim>=0.6.0->manim-physics) (0.10.3)
Requirement already satisfied: pyglet<2,>=1.5.8 in /home/docs/checkouts/readthedocs.org/
↳ user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from moderngl-window
↳ <3.0.0,>=2.3.0->manim>=0.6.0->manim-physics) (1.5.21)
Collecting cffi>1.14.0
  Downloading cffi-1.14.6-cp38-cp38-manylinux1_x86_64.whl (411 kB)
    || 411 kB 80.9 MB/s
Collecting pycparser
  Downloading pycparser-2.20-py2.py3-none-any.whl (112 kB)
    || 112 kB 87.7 MB/s
Requirement already satisfied: multipledispatch in /home/docs/checkouts/readthedocs.org/
↳ user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from pyrr<1,>=0.10.
↳ 3->moderngl-window<3.0.0,>=2.3.0->manim>=0.6.0->manim-physics) (0.6.0)
Requirement already satisfied: colorama<0.5.0,>=0.4.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages
↳ (from rich>=6.0->manim>=0.6.0->manim-physics) (0.4.4)
Requirement already satisfied: commonmark<0.10.0,>=0.9.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages
↳ (from rich>=6.0->manim>=0.6.0->manim-physics) (0.9.1)
Requirement already satisfied: six in /home/docs/.pyenv/versions/3.8.6/lib/python3.8/
↳ site-packages (from multipledispatch->pyrr<1,>=0.10.3->moderngl-window<3.0.0,>=2.3.0->
↳ manim>=0.6.0->manim-physics) (1.15.0)
Requirement already satisfied: charset-normalizer~2.0.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages
↳ (from requests->manim>=0.6.0->manim-physics) (2.0.6)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from requests->
↳ manim>=0.6.0->manim-physics) (1.26.7)
Requirement already satisfied: idna<4,>=2.5 in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from requests->manim>=0.
↳ 6.0->manim-physics) (3.2)
Requirement already satisfied: certifi>=2017.4.17 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.10.0/lib/python3.8/site-packages (from requests->
↳ manim>=0.6.0->manim-physics) (2021.5.30)
Installing collected packages: pycparser, cffi, pymunk, manim-physics
Successfully installed cffi-1.14.6 manim-physics-0.2.3 pycparser-2.20 pymunk-6.2.0

```

```
[17]: %%manim -v WARNING --progress_bar None -qm --disable_caching Example
```

```
from manim_physics import *

class Example(SpaceScene):
    def construct(self):
        circle = Dot(radius=1).shift(1.5*LEFT+3*UP)
        rect = Square(color=YELLOW, fill_opacity=1)
        ground = Line([-4, -3.5, 0], [4, -3.5, 0])
        wall1 = Line([-4, -3.5, 0], [-4, 3.5, 0])
        wall2 = Line([4, -3.5, 0], [4, 3.5, 0])
        walls = VGroup(ground, wall1, wall2)
        self.add(walls)
        self.add(rect, circle)
        self.make_rigid_body(rect, circle)
        self.make_static_body(walls)
        self.wait(5)
```

```
<IPython.core.display.Video object>
```

## 1.2 2. Mobject Gallery

Also available on this standalone website: <https://kolibril13.github.io/mobject-gallery/>

## 1.3 3. Mobject Basics

**Latest update : 16.6.2021**

After reading this chapter, you will be able to build up Mobjects on scenes, no animations included yet. There will be lots of minimal examples and only very brief explanations.

```
[1]: from manim import *
```

```
Manim Community v0.10.0
```

```
[2]: #ignore this cell, only for setup
```

```
params = "-v WARNING -r 500,100 -s --disable_caching Example"
```

```
paramsbigger = "-v WARNING -r 500,120 -s --disable_caching Example"
```



### 1.3.1 Positioning

First we want to position mobjects. There are tons of options, and not everything will be covered here.

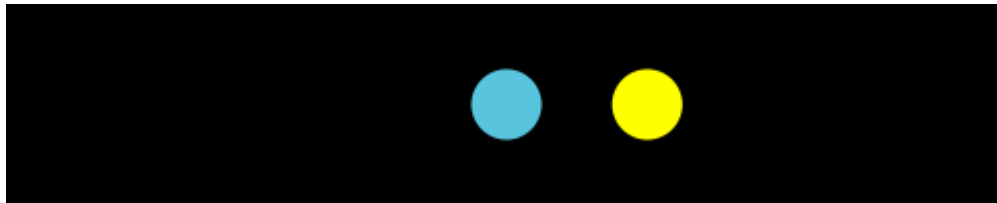
#### set positions

Some important methods to set positions are:

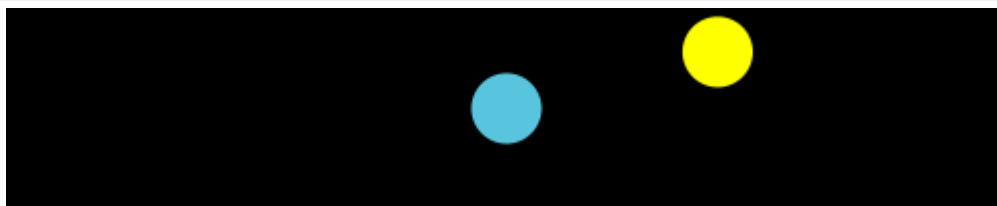
`shift` `move_to` `align_to` `next_to` `to_corner` `to_edge` `arrange` `arrange_in_grid`

```
[3]: dORIGIN= Dot(color= BLUE, radius=0.5)
```

```
[4]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW, radius=0.5)
        d.shift(2*RIGHT)
        self.add(dORIGIN, d)
```



```
[5]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW, radius=0.5)
        d.shift(3*RIGHT+0.8*UP)
        self.add(dORIGIN, d)
```



```
[6]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= ORANGE, radius=0.5)
        d.next_to(dORIGIN, LEFT)
        self.add(dORIGIN, d)
```



```
[7]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= ORANGE, radius=0.5)
        d.next_to(dORIGIN, LEFT, buff=0)
        self.add(dORIGIN, d)
```



```
[8]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= ORANGE, radius=0.5)
        d.next_to(dORIGIN, LEFT, buff=4)
        self.add(dORIGIN, d)
```



```
[9]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= ORANGE, radius=0.5)
        d.next_to(dORIGIN, UL, buff=-0.5) # UL is UPLEFT
        self.add(dORIGIN, d)
```

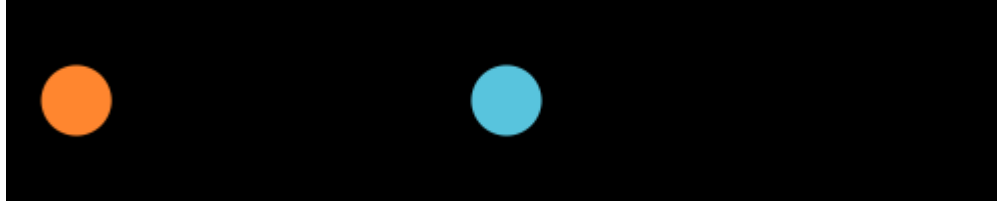


```
[10]: %%manim $params
class Example(Scene):
    def construct(self):
```

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```
d= Dot(color= ORANGE, radius=0.5)
d.to_edge(LEFT)
self.add(dORIGIN, d)
```



```
[11]: %%manim $params
class Example(Scene):
    def construct(self):
        s= Star(stroke_width=10)
        d=Dot(color= ORANGE, radius=0.5)
        d.align_to(s,DOWN)
        self.add(s,d)
```



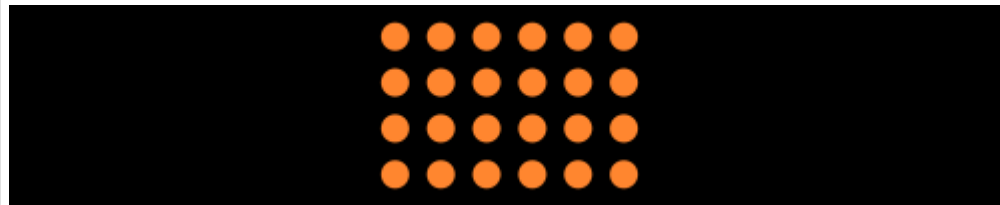
```
[12]: %%manim $params
class Example(Scene):
    def construct(self):
        s= Star(stroke_width=10)
        d=Dot(color= ORANGE, radius=0.5)
        d.next_to(s,RIGHT, aligned_edge=UP) #next to and align combined
        self.add(s,d)
```



```
[13]: %%manim $params
class Example(Scene):
    def construct(self):
        for i in range(0,10):
            self.add(Dot(color= ORANGE, radius=0.5))
        VGroup(*self.mobjects).arrange()
```



```
[14]: %%manim $params
class Example(Scene):
    def construct(self):
        for i in range(0,24):
            self.add(Dot(color= ORANGE, radius=0.2))
        VGroup(*self.mobjects).arrange_in_grid(cols=6)
```



### get positions

The most important methods to get positions:

get\_center , get\_top , get\_right , get\_start

```
[15]: s= Star(stroke_width=10)
d=Dot(color= YELLOW, radius=0.2)
```

```
[16]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_center()
        self.add(s, d.move_to(pos))
```



```
[17]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_center_of_mass()
        self.add(s, d.move_to(pos))
```



```
[18]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_top()
        self.add(s, d.move_to(pos))
```



```
[19]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_right()
        self.add(s, d.move_to(pos))
```



```
[20]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_bottom()
        self.add(s, d.move_to(pos))
```



```
[21]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_left()
        self.add(s, d.move_to(pos))
```



```
[22]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_corner(UL)
        self.add(s, d.move_to(pos))
```



```
[23]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_corner(DR)
        self.add(s, d.move_to(pos))
```



```
[24]: arc= Arc(radius=1.0, start_angle=-PI/16, angle=PI, stroke_width=10)
```

```
[25]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_start()
        self.add(arc, d.move_to(pos))
```



```
[26]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_end()
```

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```
self.add(arc, d.move_to(pos))
```



```
[27]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_midpoint()
        self.add(arc, d.move_to(pos))
```



```
[28]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.point_from_proportion(0.2)
        self.add(arc, d.move_to(pos))
```



```
[29]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_center()
        self.add(arc, d.move_to(pos))
```



```
[30]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_center_of_mass()
```

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```
self.add(arc, d.move_to(pos))
```

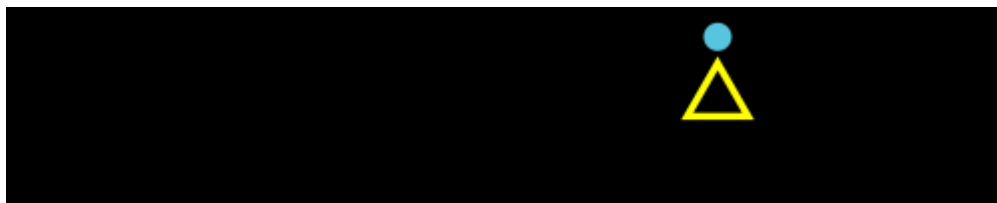


```
[31]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_arc_center()
        self.add(arc, d.move_to(pos))
```



```
[32]: %%manim $params
class Example(Scene): #Example for `get_x`, `get_y`, `set_x` and `set_y`
    def construct(self):
        d = Dot(point=[3,1,0],radius=0.2,color= BLUE)
        triangle= Triangle(color=YELLOW, stroke_width=10).scale(0.5)
        x_pos=d.get_x()
        print(x_pos)
        triangle.set_x(x_pos)
        self.add(d, triangle)
```

```
3.0
```



```
[33]: %%manim $params
class Example(Scene): #Example for `get_x`, `get_y`, `set_x` and `set_y`
    def construct(self):
        d = Dot(point=[3,1,0],radius=0.2,color= BLUE)
        triangle= Triangle(color=YELLOW, stroke_width=10).scale(0.5)
        y_pos=d.get_y()
        print(y_pos)
        triangle.set_y(y_pos)
        self.add(d, triangle)
```

```
1.0
```



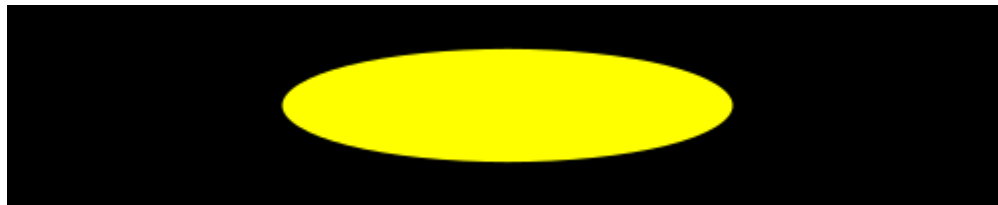


### 1.3.2 Scaling and Stretching

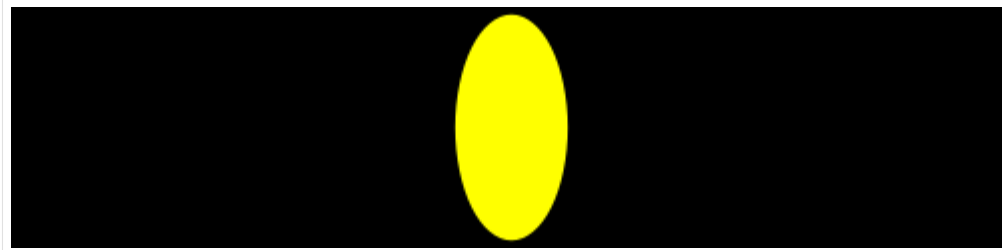
```
[34]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW)
        d.scale(10)
        self.add(d)
```



```
[35]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW)
        d.scale(10)
        d.stretch_in_place(4, dim = 0) # dim = 0 means vertical
        self.add(d)
```



```
[36]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW)
        d.scale(10)
        d.stretch_in_place(2, dim = 1) # dim = 1 means horizontal
        self.add(d)
```



```
[37]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW)
        d.scale(10)
        d.apply_matrix([[0.5, 0.5, 0], # shear matrix
                        [ 0 , 1 , 0],
                        [ 0 , 0 , 1]])
        self.add(d)
```



### 1.3.3 Rotating

```
[38]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        m= ManimBanner().scale(0.5)
        m.rotate(PI/8)
        self.add(m)
```



```
[39]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        m= ManimBanner().scale(0.5)
        m.rotate(-20*DEGREES)
        self.add(m)
```



```
[40]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        m= ManimBanner().scale(0.5)
        self.add(m.copy())
        m.rotate(about_point=2*LEFT, angle=180*DEGREES)
        self.add(m, Dot(2*LEFT,radius=0.1))
```



```
[41]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        m= ManimBanner().scale(0.5)
        m.rotate(axis=UP,angle=60*DEGREES)
        self.add(m)
```



#### Note

Python is very fertile tool, there multiple ways to accomplish a certain task, but some options are not “best practice”. For the methods in the next chapters, I want to show the best practice (labeled with **BEST** and the **green check with the star**), other possible options (labeled with **YES** and the **green check**), and options that do not work (labeled with **NO** and the **red cross**)

```
[42]: # ignore this cell, only for setup
YES = SVGObject("good.svg").to_edge(LEFT, buff=1)
BEST = YES.copy()
BEST.add(Star(color= YELLOW, fill_opacity=1).scale(0.5).move_to(BEST).shift(0.5*DOWN+0.
↪ 5*RIGHT))
```

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```
NO = Cross(Square(), stroke_color = RED_D, stroke_width = 38).scale(0.9).move_to(YES)
```

### 1.3.4 Colors and Opacity

- Color parameters for Mobjects are `stroke_color`, `fill_color` and `color`. The parameter `color` automatically sets both `stroke_color` and `fill_color`.  
The recommended ways to set **colors** are via `c = Circle(fill_color= BLUE, fill_opacity= 1 )`, `c.set_fill(color=RED)` or `c.set_style(fill_color=GREEN)`  
Not possible are `c.fill_color=YELLOW`, `c.set(fill_color=YELLOW)` and `c.set_fill_color(YELLOW)`
- Opacity parameters for Mobjects are `fill_opacity` and `stroke_opacity` (there is **not** opacity here).  
The recommended ways to set **opacity** are via `c = Circle(fill_color= BLUE, fill_opacity= 0.5 )`, `c.set_fill(color=RED)` or `c.set_style(fill_color=GREEN)`  
Analog to colors, `c.fill_opacity=1`, `c.set(fill_opacity=1)` and `c.set_fill_opacity(1)` are not possible. (to keep things short, these examples are not shown).

#### Colors

```
[43]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Square(fill_color= BLUE, fill_opacity= 1 )
        self.add(BEST,c)
```



```
[44]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Square(fill_color= BLUE, fill_opacity= 1)
        c.set_fill(color=RED)
        self.add(BEST,c)
```



```
[45]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Square(fill_color= BLUE, fill_opacity= 1)
```

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```
c.set_style(fill_color=GREEN)
self.add(BEST,c)
```



```
[46]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Square(fill_opacity= 1)
        c.fill_color=YELLOW
        self.add(NO,c)
```



```
[47]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Square(fill_opacity= 1)
        c.set(fill_color=YELLOW)
        self.add(NO,c)
```



```
[48]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Square(fill_opacity= 1)
        c.set_fill_color(YELLOW)
        self.add(NO,c)
```

```
<string>:4: DeprecationWarning: This method is not guaranteed to stay around. Please
→ prefer setting the attribute normally or with Mobject.set().
```

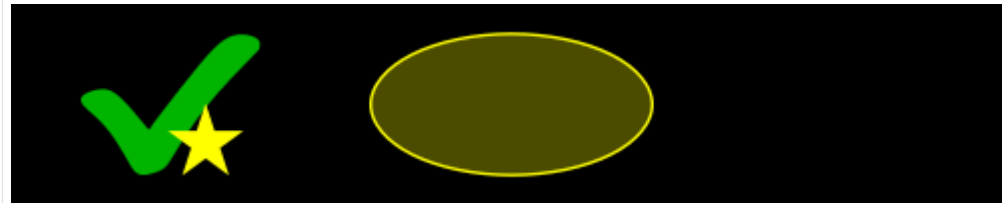


```
[49]: %%manim $params
class Example(Scene):
    def construct(self):
        self.camera.background_color = PURPLE
        self.add(BEST)
```

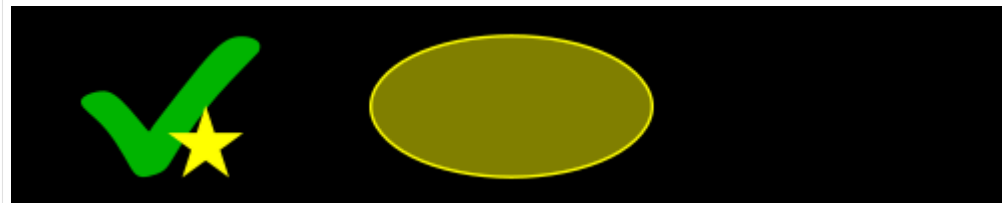


## Opacitiy

```
[50]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Ellipse(color= YELLOW, fill_opacity=0.3).scale(2)
        self.add(BEST,c)
```



```
[51]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Ellipse(color= YELLOW).scale(2)
        c.set_fill(opacity=0.5) # be careful: here, it must be `opacity` and not `fill_
        ↪opacity` !
        self.add(BEST,c)
```



```
[52]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Ellipse(color= YELLOW).scale(2)
        c.set_style(fill_opacity=0.7) # and here, it must be `fill_opacity` and not
        ↪ `opacity` !
        self.add(BEST,c)
```



### 1.3.5 Stroke width

Strokes can be set in multiple ways:

The recommended ways are via `Circle(stroke_width=30)`, `c.set_stroke(width = 30)` or `c.set_style(stroke_width= 30)`

Also possible, but not the best solution is `c.stroke_width = 30` and `c.set(stroke_width = 30)`

Also possible, but not recommended because deprecated is `c.set_stroke_width(30)`

```
[53]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Circle(stroke_width=30)
        self.add(BEST,c)
```



```
[54]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Circle()
        c.set_stroke(width = 30)
        self.add(BEST,c)
```



```
[55]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Circle()
        c.set_style(stroke_width= 30)
        self.add(BEST,c)
```



```
[56]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Circle()
        c.stroke_width = 30
        self.add(YES,c)
```



```
[57]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Circle()
        c.set(stroke_width = 30)
        self.add(YES,c)
```



```
[58]: %%manim $params
class Example(Scene):
    def construct(self):
        c = Circle()
        c.set_stroke_width(30)
        self.add(NO,c)
```

```
<string>:4: DeprecationWarning: This method is not guaranteed to stay around. Please
↳prefer setting the attribute normally or with Mobject.set().
```





### 1.3.6 Layers

There are two main ways to change the layers of Mobjects:

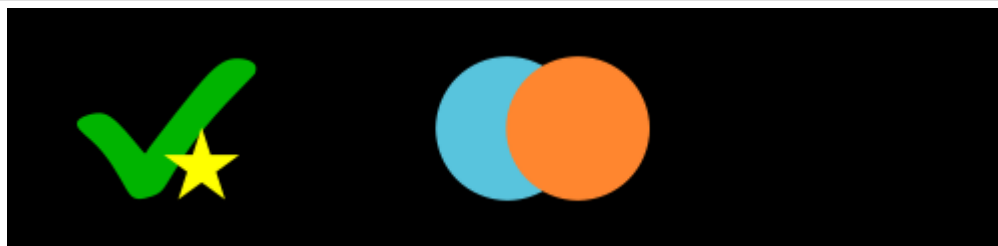
1. Reordering the list of submobjects that were added
2. Using the `z_index`

#### submobjects

A scene stores displayed mobjects in a list. They are displayed in the order that they are added to the scene with the syntax `self.add(circleLeft, circleRight)`. First, we have a look on positioning mobjects with `self.add` and the methods `self.bring_to_back` and `self.bring_to_front`. In most cases, this is completely enough. Later, we will come to the `z_index`, that is seen by manim by one priority higher: Even when a mobject is added first to the mobject list, it will be displayed on top of the others, if it has a higher `z_index`. An example about this will be seen later.

```
[59]: circleLeft = Circle(color=BLUE, fill_opacity=1)
      circleRight = Circle(color=ORANGE, fill_opacity=1).shift(RIGHT)
      line = Line(2*LEFT, 3*RIGHT, color=YELLOW, stroke_width=20)
```

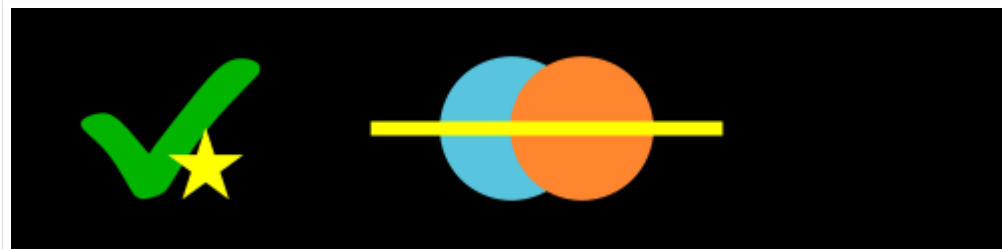
```
[60]: %%manim $paramsbigger
      class Example(Scene):
          def construct(self):
              self.add(circleLeft, circleRight)
              self.add(BEST)
```



```
[61]: %%manim $paramsbigger
      class Example(Scene):
          def construct(self):
              self.add(circleRight, circleLeft)
              self.add(BEST)
```

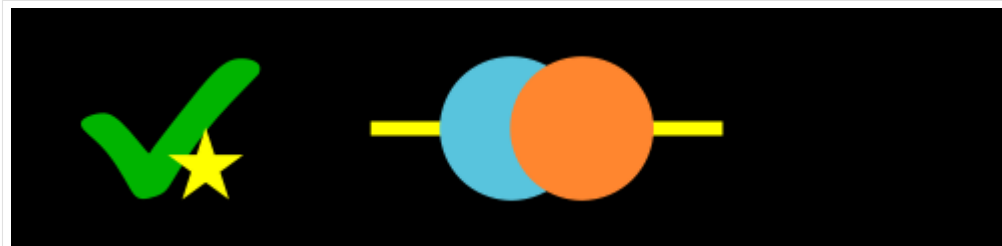


```
[62]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        self.add(circleLeft,circleRight, line)
        self.add(BEST)
```



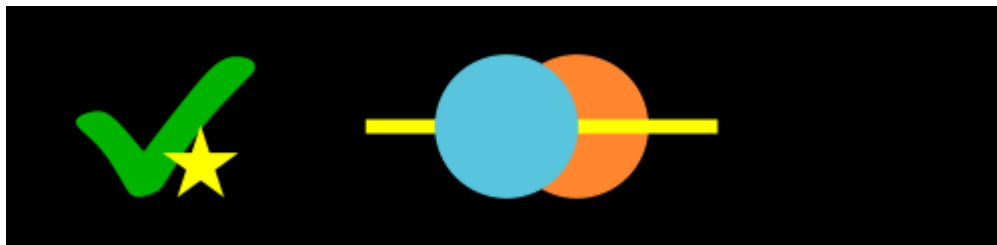
```
[63]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        self.add(circleLeft,circleRight, line)
        print(self.mobjects)
        self.bring_to_back(line)
        print(self.mobjects)
        self.add(BEST)
```

```
[Circle, Circle, Line]
[Line, Circle, Circle]
```



```
[64]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        self.add(circleLeft,circleRight, line)
        print(self.mobjects)
        self.bring_to_front(circleLeft)
        print(self.mobjects)
        self.add(BEST)
```

```
[Circle, Circle, Line]
[Circle, Line, Circle]
```



### z\_index

The default `z_index` is 0. Now we will see what happens, when we increase the value of the `z_index`.

The `z_index` can be changed by `triangle = Triangle(z_index=1)`, `triangle.z_index=1`, `triangle.set(z_index=1)` and `triangle.set_z_index(1)`

It can not be changed using `triangle.set_style(z_index=1)`

```
[65]: #initilizing line,circle,square and triangle
BUFF= 0.5*DOWN
line = Line(3*LEFT,3*RIGHT,color=YELLOW, stroke_width=20)
circle = Circle(color=GREEN_D, fill_opacity=1).shift(LEFT+BUFF)
square = Square(color=BLUE_D, fill_opacity=1).shift(UP+BUFF)
triangle = Triangle(color=RED_D, fill_opacity=1).shift(RIGHT+BUFF)
```

```
[66]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        self.add(line,triangle, square, circle) # order matters
        print(self.mobjects)
        print(f'{triangle.z_index=} , {square.z_index=} , {circle.z_index=} , {line.z_
        ↪index=}')
        self.add(BEST)
```

```
[Line, Triangle, Square, Circle]
triangle.z_index=0 , square.z_index=0 , circle.z_index=0 , line.z_index=0
```



```
[67]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        triangle.z_index=1
        self.add(triangle, square, circle,line) # order matters
```

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```

    print(self.mobjects)
    print(f"{triangle.z_index=} , {square.z_index=} , {circle.z_index=} , {line.z_
→index=}")
    self.add(BEST)

```

```
[Triangle, Square, Circle, Line]
```

```
triangle.z_index=1 , square.z_index=0 , circle.z_index=0 , line.z_index=0
```



```

[68]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        triangle.z_index = 1
        square.z_index    = 2
        circle.z_index    = 3
        self.add(triangle, square, circle,line) # order matters
        self.add(BEST)
        print(f"{line.z_index=}")

```

```
line.z_index=0
```



```

[69]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        triangle.z_index = 3
        square.z_index    = 2
        circle.z_index    = 1
        self.add(triangle, square, circle,line) # order matters
        self.add(BEST)
        print(f"{line.z_index=}")

```

```
line.z_index=0
```



```
[70]: %%manim $paramsbigger
triangle.z_index = 0
square.z_index   = 0
circle.z_index   = 0
class Example(Scene):
    def construct(self):
        triangle.set(z_index=1)
        self.add(triangle, square, circle, line) # order matters
        print(self.mobjects)
        print(f"{triangle.z_index=} , {square.z_index=} , {circle.z_index=} , {line.z_
↪index=}")
        self.add(BEST)
```

```
[Triangle, Square, Circle, Line]
triangle.z_index=1 , square.z_index=0 , circle.z_index=0 , line.z_index=0
```



```
[71]: %%manim $paramsbigger
triangle.z_index = 0
square.z_index   = 0
circle.z_index   = 0
class Example(Scene):
    def construct(self):
        try:
            triangle.set_style(z_index=1) # here we expect an error! Only for didactic_
↪purpose, it is put into this `try` block, so that no long error message is shown.
        except TypeError:
            print("TypeError, set_style() got an unexpected keyword argument 'z_index'.
↪")
            self.add(NO)
        self.add(triangle, square, circle, line) # order matters
        print(f"{triangle.z_index=} , {square.z_index=} , {circle.z_index=} , {line.z_
↪index=}")
```

```
TypeError, set_style() got an unexpected keyword argument 'z_index'.
triangle.z_index=0 , square.z_index=0 , circle.z_index=0 , line.z_index=0
```



### 1.3.7 VGroup and Group

#### VGroup

It is a Group of VMobjects (“V” stands for Vector)

```
[72]: #only for setup
def create_dots():
    blue1_ref= Dot(color= BLUE,      point=[-.3,-.5,0], radius=0.5)
    blue2_ref= Dot(color= BLUE_A,    point=[ .3,-.5,0], radius=0.5)
    yellow1_ref= Dot(color= YELLOW,   point=[-.3, .5,0], radius=0.5)
    yellow2_ref= Dot(color= YELLOW_A, point=[ .3, .5,0], radius=0.5)
    return blue1_ref, blue2_ref,yellow1_ref,yellow2_ref
```

```
[73]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        self.add(blue1,blue2, yellow1,yellow2)
```



```
[74]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        VGroup(yellow1,yellow2).shift(RIGHT)
        self.add(blue1,blue2, yellow1,yellow2)
```



```
[75]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        g1=VGroup(yellow1,yellow2).shift(2*RIGHT)
        self.add(blue1,blue2, g1)
```



```
[76]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        g1=VGroup(yellow1,yellow2).set_color(RED)
        self.add(blue1,blue2, g1)
```



```
[77]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        g1=VGroup(yellow1,yellow2).shift(0.5*DOWN)
        g2=VGroup(blue1,blue2)
        self.add(g1, g2)
```



```
[78]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        g1=VGroup(yellow1,yellow2).shift(0.5*DOWN)
        g2=VGroup(blue1,blue2)
        self.add(g2,g1)
```

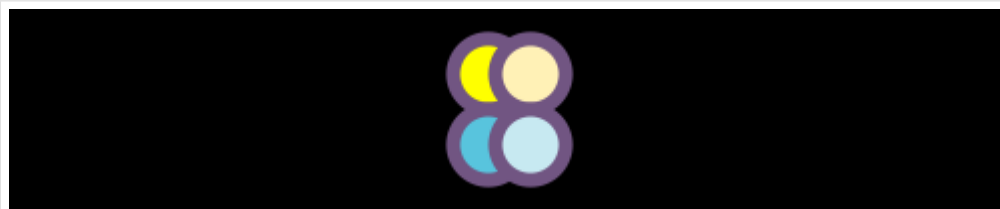


```
[79]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # Groups of Groups
    def construct(self):
        g1=VGroup(yellow1,yellow2).shift(0.5*DOWN)
        g2=VGroup(blue1,blue2)
        gAll = VGroup(g1, g2)
        self.add(gAll)
        print(gAll.submobjects)
        print(gAll.submobjects[0].submobjects)
        print(gAll.submobjects[1].submobjects)
```

```
[VGroup(Dot, Dot), VGroup(Dot, Dot)]
[Dot, Dot]
[Dot, Dot]
```



```
[80]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): #setting VMobject attributes
    def construct(self):
        g=VGroup(yellow1,yellow2,blue1,blue2)
        g.set_stroke(color=PURPLE_D, width=20) # <--
        self.add(g)
```



```
[81]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # add syntax
    def construct(self):
        g=VGroup(yellow1,yellow2,blue1)
        g.add(blue2) # <--
        g.set_stroke(color=GREEN, width=20)
        self.add(g)
```

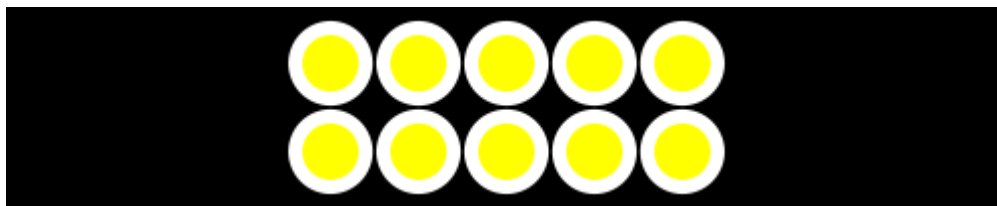




```
[82]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # += Syntax
    def construct(self):
        g=VGroup(yellow1,yellow2,blue1)
        g += blue2 # <--
        g.set_stroke(color=ORANGE, width=20)
        self.add(g)
```



```
[83]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # empty initilizing
    def construct(self):
        g=VGroup()
        for _ in range(0,10):
            g += yellow1.copy()
        g.set_stroke(color=WHITE, width=20)
        g.arrange_in_grid(rows=2) # <-- Groups and VGroups can be arranged in grids
        g.move_to(ORIGIN)
        self.add(g)
```



Note:

`VGroup().add(...)` is functionally equivalent to `VGroup(...)`, but it is recommended to use `VGroup`, as

- It is better readable
- supports the `+=` syntax

```
[84]: %%manim $params
```

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```

blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # using VMOBJECT instead
    def construct(self):
        g= VMOBJECT()
        g.add(yellow1,yellow2,blue1,blue2)
        g.set_stroke(color=PURPLE_D, width=20)
        self.add(g)

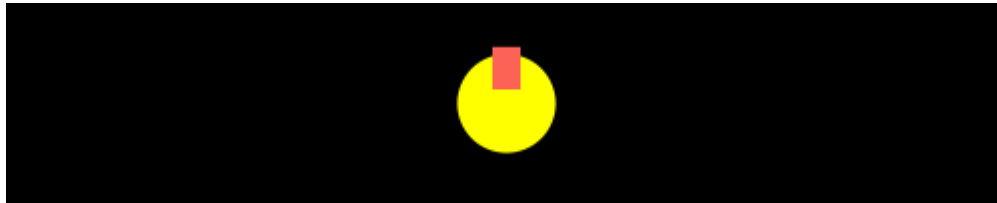
```



```

[85]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # other Mobjects can be added to any Mobjects
    def construct(self):
        d= Dot(color= YELLOW, radius=0.7)
        d.add(Line(0.2*UP, 0.8*UP, color=RED,stroke_width=40))
        self.add(d)

```



```

[86]: %%manim $params
dot= Dot(color= YELLOW, radius=0.5)
image = ImageMobject(np.uint8([[200, 233, 111, 200],
                                [255, 100, 190, 100]])).shift(2*RIGHT)

image.height = 1
class Example(Scene):
    def construct(self):
        self.add(dot, image)
        try: # Image is not a VMobject!
            VGroup(dot,image).shift(3*RIGHT)
        except TypeError:
            print("Adding an Mobject to a VGroup is not possible!")
            self.add(NO)

```

Adding an Mobject to a VGroup is not possible!

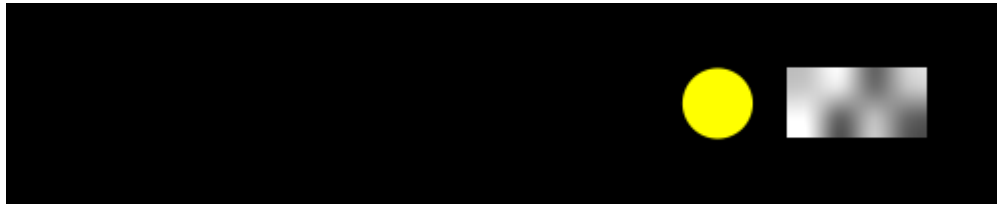


## Group

Groups Mobjects and VMobjects together. You can only use the methods of Mobject here. Methods of VMobject won't be supported.

```
[87]: %%manim $params
dot= Dot(color= YELLOW, radius=0.5)
image = ImageMobject(np.uint8([[200, 233, 111, 200],
                                [255, 100, 190, 100]])).shift(2*RIGHT)

image.height = 1
class Example(Scene):
    def construct(self):
        self.add(dot, image)
        Group(dot, image).shift(3*RIGHT)
```



```
[88]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): #
    def construct(self):
        g=Group(yellow1,yellow2,blue1,blue2)
        try:
            g.set_stroke(color=PURPLE_D, width=20)
        except TypeError:
            print("TypeError!")
            self.add(NO)
        self.add(g)
```

TypeError!



Note: `z_index` is not supported, neither for `VGroup` nor for `Group`

```
[89]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene):
    def construct(self):
        a=VGroup(yellow1,yellow2).shift(0.5*DOWN)
        b=VGroup(blue1,blue2)
        a.set_z_index(2)
```

(continues on next page)

(continued from previous page)

```
b.set_z_index(1)
self.add(a,b)
self.add(NO)
```



Congratulations!

You are now a master in setting up your Mobjects on a scene. Let's go on with the part you came to manim for in the first place: Animations!

## 1.4 4. Animations

**Latest update : 13.6.2021**

There are a wide range of possibilities to animate your mobjects that all work a bit differently. Here is a broad overview so that you can choose the animation strategy that fits best for your project. This chapter will cover ValueTrackers, Updaters, self.play Transformations the mobject.animate syntax and mobject.become syntax.

[1]: `from manim import *`

Manim Community v0.10.0

[2]: *#ignore this cell, only for setup*

```
params= "-v WARNING --progress_bar None -r 500,200 --disable_caching Example"
```

```
NO = Cross(Square(), stroke_color = RED_D, stroke_width = 38).scale(0.9).to_edge(LEFT, buff=1)
```

```
YES = SVGObject("good.svg").to_edge(LEFT, buff=1)
```

```
BEST = YES.copy()
```

```
BEST.add(Star(color= YELLOW, fill_opacity=1).scale(0.5).move_to(BEST).shift(0.5*DOWN+0.5*RIGHT));
```

### 1.4.1 Simple Replacements

```
[3]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        self.add(dot)
        self.wait()
        dot.scale(2)
        self.wait()
        dot.scale(2)
        self.wait(2)
```

<IPython.core.display.Video object>

```
[4]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        square= Square(side_length=4,color= BLUE, fill_opacity=1)
        triangle= Triangle(radius=3,color= ORANGE, fill_opacity=1).shift(DOWN*0.5)
        self.add(dot)
        self.wait()
        dot.become(square)
        self.wait()
        dot.become(triangle)
        self.wait()
```

<IPython.core.display.Video object>

### 1.4.2 Using .animate Syntax

```
[5]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        self.play(dot.animate.scale(2))
```

<IPython.core.display.Video object>

```
[6]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        self.play(dot.animate.shift(2*RIGHT))
```

<IPython.core.display.Video object>

```
[7]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        self.play(dot.animate.set_color(BLUE))
```

```
<IPython.core.display.Video object>
```

```
[8]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        self.play(dot.animate.shift(2*RIGHT).scale(2))

<IPython.core.display.Video object>
```

```
[9]: %%manim $params
class Example(Scene):
    def construct(self):
        dot= Dot(color= YELLOW, radius=0.5)
        self.play(dot.animate.shift(2*RIGHT).scale(2).set_color(BLUE))

<IPython.core.display.Video object>
```

### 1.4.3 Updaters

They are very diverse! And they can be used with and without a “dt” parameter

```
[10]: %%manim $params
class Example(Scene):
    def construct(self):
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot)
        def foo(mob,dt):
            mob.shift(2*RIGHT*dt)
        dot.add_updater(foo)
        self.wait(3)

<IPython.core.display.Video object>
```

```
[11]: %%manim $params
class Example(Scene):
    def construct(self):
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot)
        dot.add_updater(lambda x,dt: x.shift(2*RIGHT*dt))
        self.wait(3)

<IPython.core.display.Video object>
```

```
[12]: %%manim $params
class Example(Scene): # when there is no dt parameter, the updater does not work
    def construct(self):
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot,N0)
        dot.add_updater(lambda x : x.shift(2*RIGHT*0.1))
        self.wait(3)
```

```
<IPython.core.display.Video object>
```

Note: Not using the “dt” parameter will make your animation framerate dependent, but this can be solved using ValueTracker, which can be seen in the next section

### 1.4.4 Updaters + ValueTrackers

```
[13]: %%manim $params
class Example(Scene):
    def construct(self):
        tracker= ValueTracker(0)
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot)
        def foo(mob):
            mob.move_to(RIGHT*tracker.get_value())
        dot.add_updater(foo)
        self.play(tracker.animate.set_value(2), rate_func= linear)
```

```
<IPython.core.display.Video object>
```

Note: now you can also use rate functions:

```
[14]: %%manim $params
class Example(Scene):
    def construct(self):
        tracker= ValueTracker(0)
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot)
        def foo(mob):
            mob.move_to(RIGHT*tracker.get_value())
        dot.add_updater(foo)
        self.play(tracker.animate.set_value(2), rate_func= smooth)
```

```
<IPython.core.display.Video object>
```

```
[15]: %%manim $params
class Example(Scene):
    def construct(self):
        tracker= ValueTracker(0.5)
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot)
        def foo(mob):
            mob.move_to(RIGHT*tracker.get_value())
        dot.add_updater(foo)
        self.play(tracker.animate.set_value(2.2), rate_func= smooth)
        self.play(tracker.animate.increment_value(1), rate_func= smooth)
        self.play(tracker.animate.increment_value(-1), rate_func= smooth)
        self.play(tracker.animate.set_value(0.5), rate_func= linear)
```

```
<IPython.core.display.Video object>
```

```
[16]: %%manim $params
#one can now also add additional properties to mobjects, in this case a counter.
class Example(Scene):
    def construct(self):
        tracker= ValueTracker(0)
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot)
        dot.counter=0
        def foo(mob):
            mob.move_to(RIGHT*tracker.get_value())
            if mob.counter == 20:
                mob.set_color(random_bright_color())
                mob.counter = 0
            mob.counter += 1
        dot.add_updater(foo)
        self.play(tracker.animate.set_value(2), rate_func= linear, run_time=3)

<IPython.core.display.Video object>
```

### 1.4.5 Transformations

```
[17]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW, radius=0.5)
        d2= d.copy().shift(2*RIGHT)
        self.play(Transform(d, d2))

<IPython.core.display.Video object>
```

### 1.4.6 Does and Donts

Note that when you choose to work with updaters, your script might depend on the frame rate.

```
[18]: %%manim $params
class Example(Scene):
    def construct(self):
        print(f"{config.frame_rate = }fps")
        dotred= Dot(color= RED, radius=0.5).shift(UP)
        dotgreen = Dot(color= GREEN, radius=0.5)
        dotgreen.next_to(dotred,DOWN)
        self.add(dotgreen,dotred)
        DIR= 2*RIGHT
        dotgreen.add_updater(lambda x,dt: x.shift(DIR*dt))
        dotred.add_updater(lambda x,dt: x.shift(DIR*1/60))
        self.wait(3)

config.frame_rate = 60fps

<IPython.core.display.Video object>
```



```
[19]: params5fps = "-v WARNING --progress_bar None --frame_rate=5 -r 500,200 --disable_
      ↪ caching Example"
```

```
[20]: %%manim $params5fps
class Example(Scene):
    def construct(self):
        print(f"{config.frame_rate = }fps")
        dotred= Dot(color= RED, radius=0.5).shift(UP)
        dotgreen = Dot(color= GREEN, radius=0.5)
        dotgreen.next_to(dotred,DOWN)
        self.add(dotgreen,dotred)
        DIR= 2*RIGHT
        dotgreen.add_updater(lambda x,dt: x.shift(DIR*dt))
        dotred.add_updater(lambda x,dt: x.shift(DIR*1/60))
        self.wait(3)

config.frame_rate = 5.0fps

<IPython.core.display.Video object>
```

### Rotation animation

There are multiple ways to rotate a square, but not all will result in that animation that you might have expected.

```
[21]: %%manim $params

class Example(Scene):
    def construct(self, **kwargs):
        s1= Square().set_color(YELLOW)
        self.add(s1, BEST)
        self.play(Rotate(s1, angle=PI/2))

<IPython.core.display.Video object>
```

```
[22]: %%manim $params
class Example(Scene):
    def construct(self, **kwargs):
        s2= Square().set_color(PURPLE)
        self.add(s2, NO)
        self.play(s2.animate.rotate(PI/2))

<IPython.core.display.Video object>
```

```
[23]: %%manim $params

class Example(Scene):
    def construct(self, **kwargs):
        theta_track= ValueTracker(0)
        s3= Square().set_color(ORANGE)
        self.add(s3, YES)
        s3.previous_angle=0
        def pref(x):
            x.previous_angle=theta_track.get_value()
```

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```
s3.add_updater(lambda x: x.rotate(theta_track.get_value()-s3.previous_angle))
s3.add_updater(pref)
self.play(theta_track.animate.increment_value(PI/2))
```

```
<IPython.core.display.Video object>
```

```
[24]: #not yet implemented
#class Example(Scene):
#    def construct(self, **kwargs):
#        s3b= Square().set_color(YELLOW)
#        self.add(s3b)
#        theta_track= DeltaValueTracker(0)
#        s3b.add_updater(lambda x: x.rotate(theta_track.get_delta_value()))
#        self.play(theta_track.animate.set_value(90*DEGREES))
```

```
[25]: %%manim $params
# NOT WORKING!, BAD PRACTICE.
class Example(Scene):
    def construct(self, **kwargs):
        s4= Square().set_color(GREEN)
        self.add(s4, NO)
        theta_track= ValueTracker(0)
        s4.add_updater(lambda x: x.rotate(theta_track.get_value()))
        self.play(theta_track.animate.increment_value(PI/2))
```

```
<IPython.core.display.Video object>
```

```
[26]: %%manim $params
class Example(Scene):
    def construct(self, **kwargs):
        s6= Square().set_color(PINK)
        self.add(s6, YES)
        s6.add_updater(lambda x, dt: x.rotate(dt*PI/2))
        self.wait(1)
```

```
<IPython.core.display.Video object>
```

## Known bugs

### Bug with updaters that do not have a dt

```
[27]: %%manim $params
class Example(Scene):
    def construct(self):
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot,NO)

        #dot.add_updater(lambda x,dt : x)
```

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```
dot.add_updater(lambda x : x.shift(2*RIGHT*1/config.frame_rate))
self.wait(3)
```

```
<IPython.core.display.Video object>
```

```
[28]: %%manim $params
class Example(Scene):
    def construct(self):
        dot = Dot(color= GREEN, radius=0.7)
        self.add(dot,YES)

        dot.add_updater(lambda x,dt : x) #adding this line will make the updater_
        ↪continiously watch

        dot.add_updater(lambda x : x.shift(2*RIGHT*1/config.frame_rate))
        self.wait(3)

<IPython.core.display.Video object>
```

### Bugs with updater in ZoomedScene

```
[29]: %%manim $params
class Example(ZoomedScene):
    def __init__(self, **kwargs):
        ZoomedScene.__init__(
            self,
            zoom_factor=0.3,
            zoomed_display_height=4,
            zoomed_display_width=4,
            image_frame_stroke_width=20,
            zoomed_camera_config={
                "default_frame_stroke_width": 3,
            },
            **kwargs
        )
    def construct(self):
        d= Dot()
        self.add(d)
        imgo =Square().scale(0.3).set_color(RED)
        self.add(imgo)
        #imgo.add_updater(lambda x: x) # COMMENTED OUT
        self.activate_zooming(animate=True)
        self.play(self.zoomed_camera.frame.animate.shift(0.5 * (LEFT+UP*0.8)))
        self.play(self.zoomed_camera.frame.animate.shift(0.5 * (RIGHT+DOWN*2.8)))

<IPython.core.display.Video object>
```

```
[30]: %%manim $params
class Example(ZoomedScene):
    def __init__(self, **kwargs):
        ZoomedScene.__init__(
```

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```

        self,
        zoom_factor=0.3,
        zoomed_display_height=4,
        zoomed_display_width=4,
        image_frame_stroke_width=20,
        zoomed_camera_config={
            "default_frame_stroke_width": 3,
        },
        **kwargs
    )
def construct(self):
    d= Dot()
    self.add(d)
    imgo =Square().scale(0.3).set_color(RED)
    self.add(imgo)
    imgo.add_updater(lambda x: x) # INCLUDED
    self.activate_zooming(animate=True)
    self.play(self.zoomed_camera.frame.animate.shift(0.5 * (LEFT+UP*0.8)))
    self.play(self.zoomed_camera.frame.animate.shift(0.5 * (RIGHT+DOWN*2.8)))
<IPython.core.display.Video object>

```

[ ]:

## 1.5 5. Resolution and Camera

```
[1]: from manim import *
Manim Community v0.10.0
```

### 1.5.1 Scene Coordinates

First, let's learn a bit about how manim coordinates work.

There is the `config.frame_width`, `config.frame_height` which is unrelated to the pixelsize.

Their default values are 14.222 and 8.

These values are chosen, because it gives a width/height ratio of 16/9, which is a common screen resolution.

The coordinate center of scenes is in the center, which is at **(0,0)**.

The most left point is **(-7.1,0)**, right is **(7.1,0)**, top is **(0,4)**, and bottom is **(0,-4)**.

```
[2]: config.frame_width/config.frame_height
```

```
[2]: 1.7777777777777777
```

```
[3]: config.pixel_width/config.pixel_height
```

```
[3]: 1.7777777777777777
```

```
[4]: 16/9
```

```
[4]: 1.7777777777777777
```

```
[5]: # for setup only
def yellow_frame_annotation(framew, frameh):
    d1 = DoubleArrow(framew * LEFT / 2, framew * RIGHT / 2, buff=0).to_edge(DOWN)
    t1 = Text(str(framew)[:6]).next_to(d1, UP)
    d2 = DoubleArrow(frameh * UP / 2, frameh * DOWN / 2, buff=0).to_edge(LEFT)
    t2 = Text(str(frameh)).next_to(d2, RIGHT)
    x=Group(d1,d2,t1,t2).set_color(YELLOW)
    return x

def blue_pixel_annotation(framew, frameh,pixelw, pixelh):
    d1 = DoubleArrow(framew * LEFT / 2, framew * RIGHT / 2, buff=0).to_edge(UP)
    t1 = Text(str(pixelw) + " pixel").next_to(d1, DOWN)
    d2 = DoubleArrow(frameh * UP / 2, frameh * DOWN / 2, buff=0).to_edge(RIGHT)
    t2 = Text(str(pixelh) + " pixel").next_to(d2, LEFT)
    x=Group(d1,d2,t1,t2).set_color(BLUE)
    return x

annulus = Annulus(inner_radius =1,outer_radius=2,color=WHITE, stroke_width=10)
```

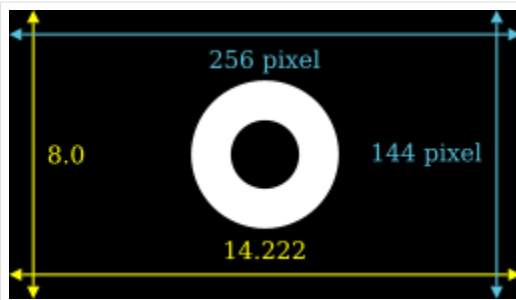
### Pixel Ratio of 16/9

See a table of common 16/9 resolutions here: [https://en.wikipedia.org/wiki/16:9\\_aspect\\_ratio#Common\\_resolutions](https://en.wikipedia.org/wiki/16:9_aspect_ratio#Common_resolutions)

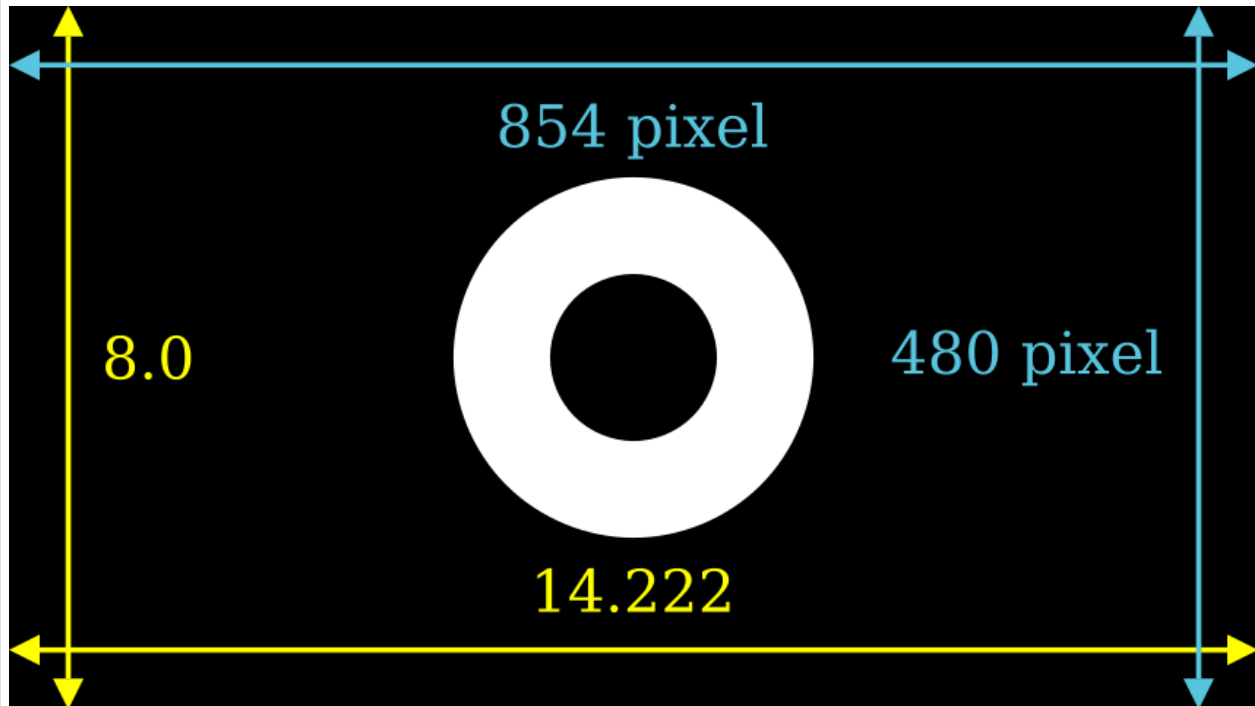
```
[6]: %%manim -v WARNING -s -r 160,90 --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



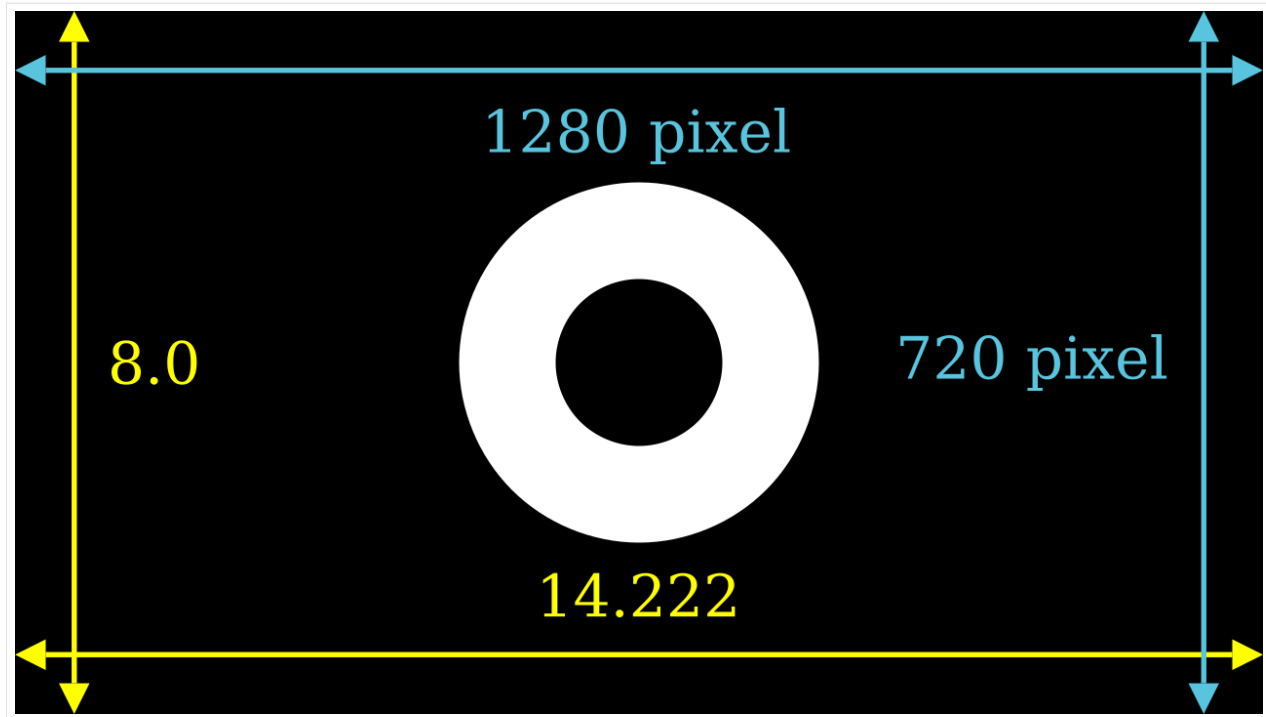
```
[7]: %%manim -v WARNING -s -r 256,144 --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



```
[8]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



```
[9]: %%manim -v WARNING -s -qm --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```

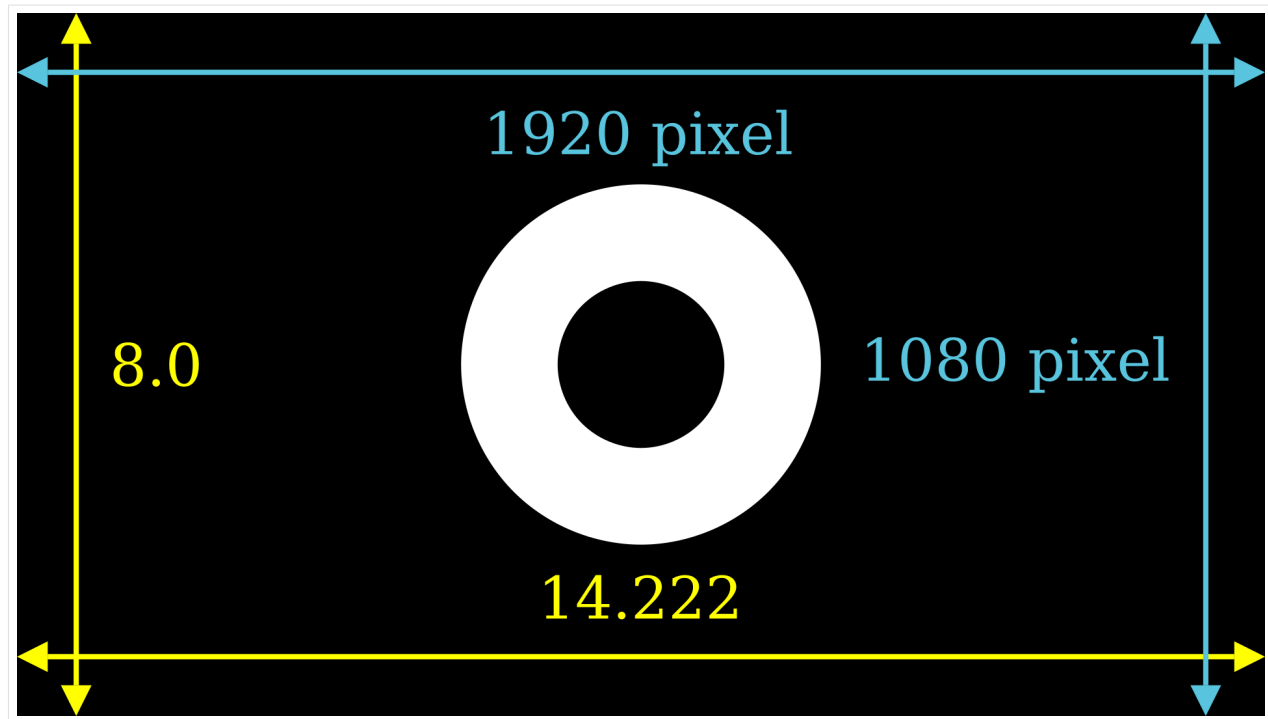


Note

The borders of this website are narrow.

To see the changes in high resolution, open this image in a new tab.

```
[10]: %%manim -v WARNING -s -qh --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```

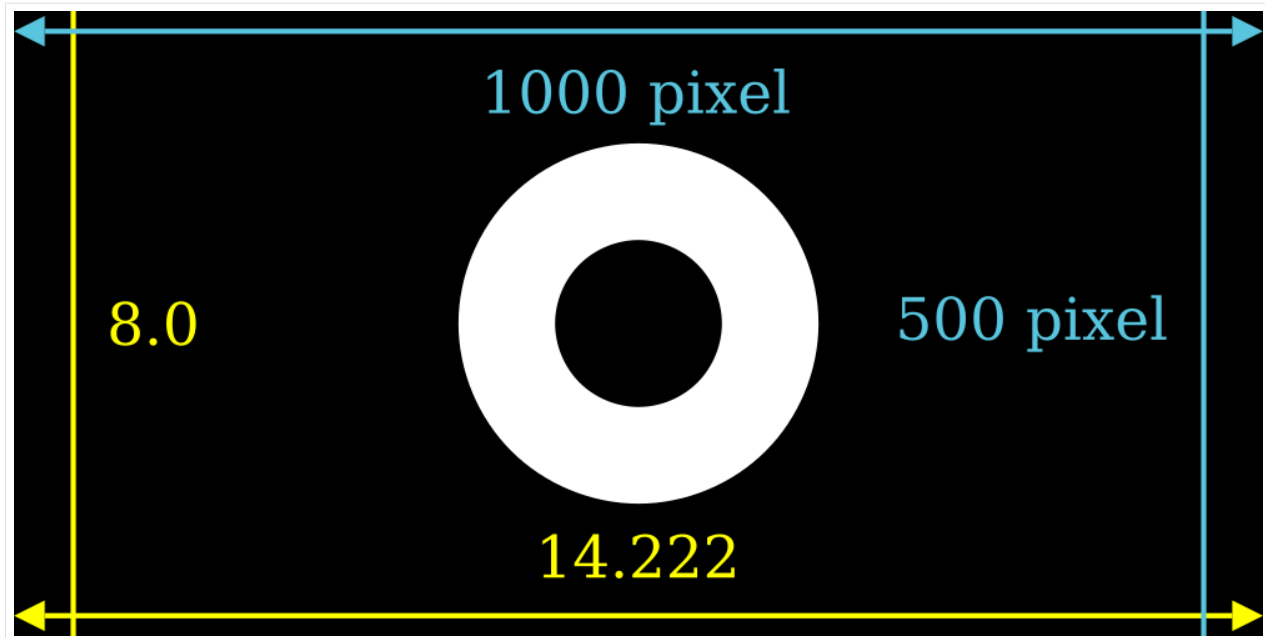


### Pixel Ratio Unequal to 16/9

- When the pixel ratio is higher than 16/9 frame\_height cropped.
- When the pixel ratio is lower than 16/9 frame\_height padded.

```
[11]: %%manim -v WARNING -s -r 1000,500 --disable_caching Example
#ratio of 2/1
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪ config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```

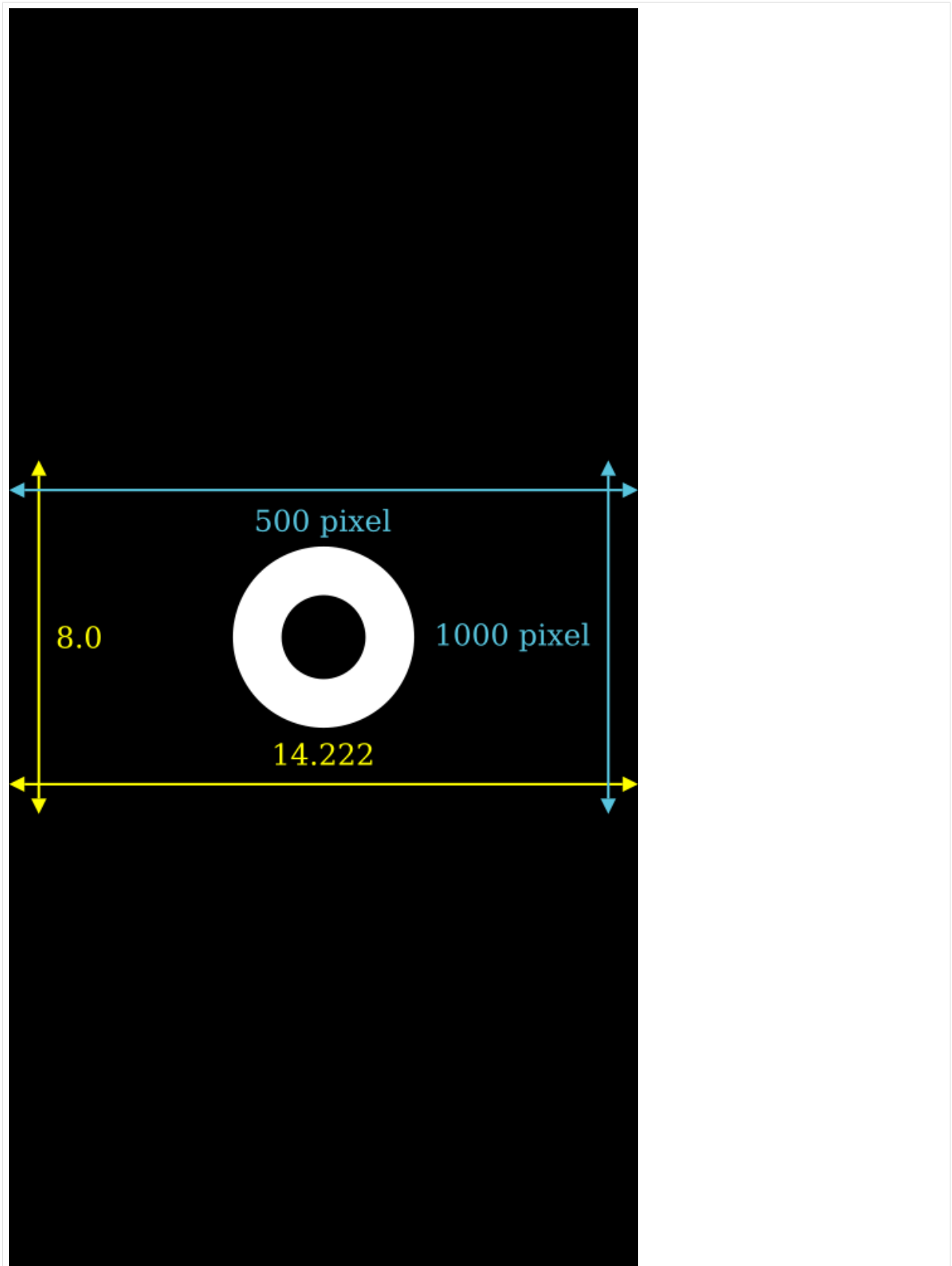




```
[12]: %%manim -v WARNING -s -r 1000,50 --disable_caching Example
#ratio of 20/1
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



```
[13]: %%manim -v WARNING -s -r 500,1000 --disable_caching Example
#ratio of 1/2
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```

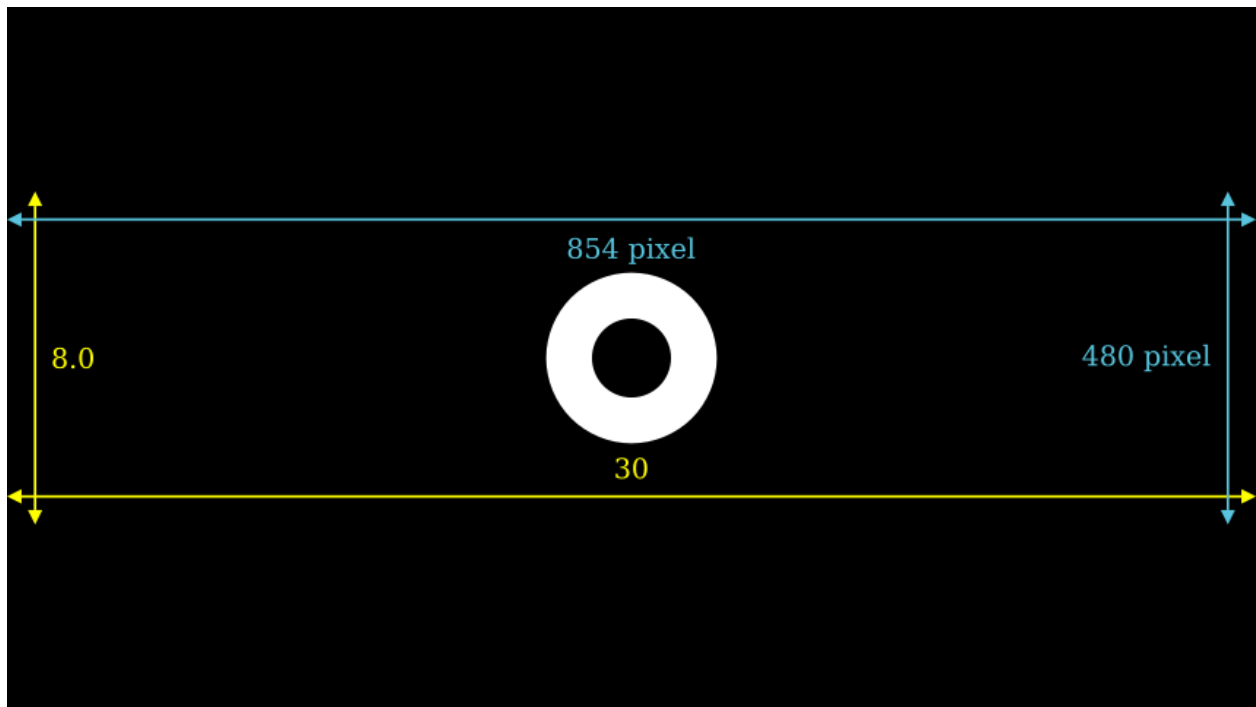


## 1.5.2 Changing the frame\_width

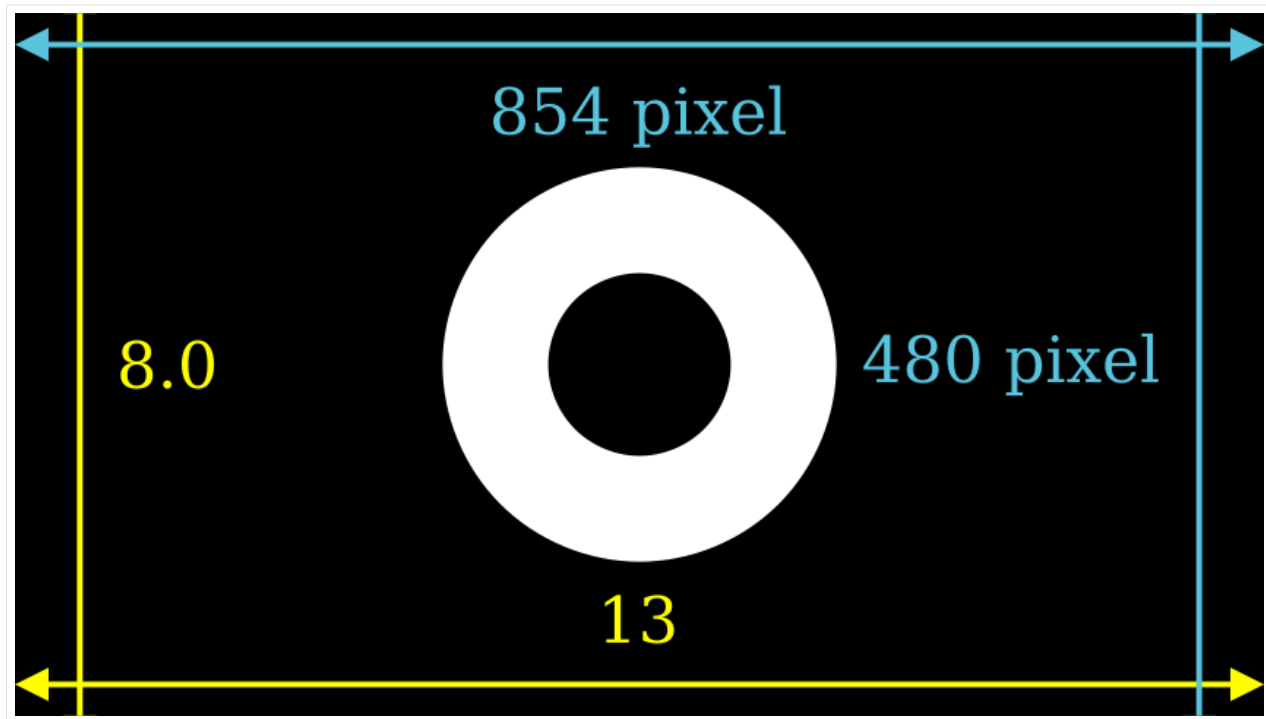
- **Increasing** the value `config.frame_width` will **zoom out** the Mobject
- **Decreasing** the value `config.frame_width` will **zoom in** the Mobject

Note: The `frame_height` is adjusted accordingly. Note 2: I do not recommend to change the frame width with `config.frame_width`, better use the `self.camera.frame.set(...)` syntax shown in the next section.

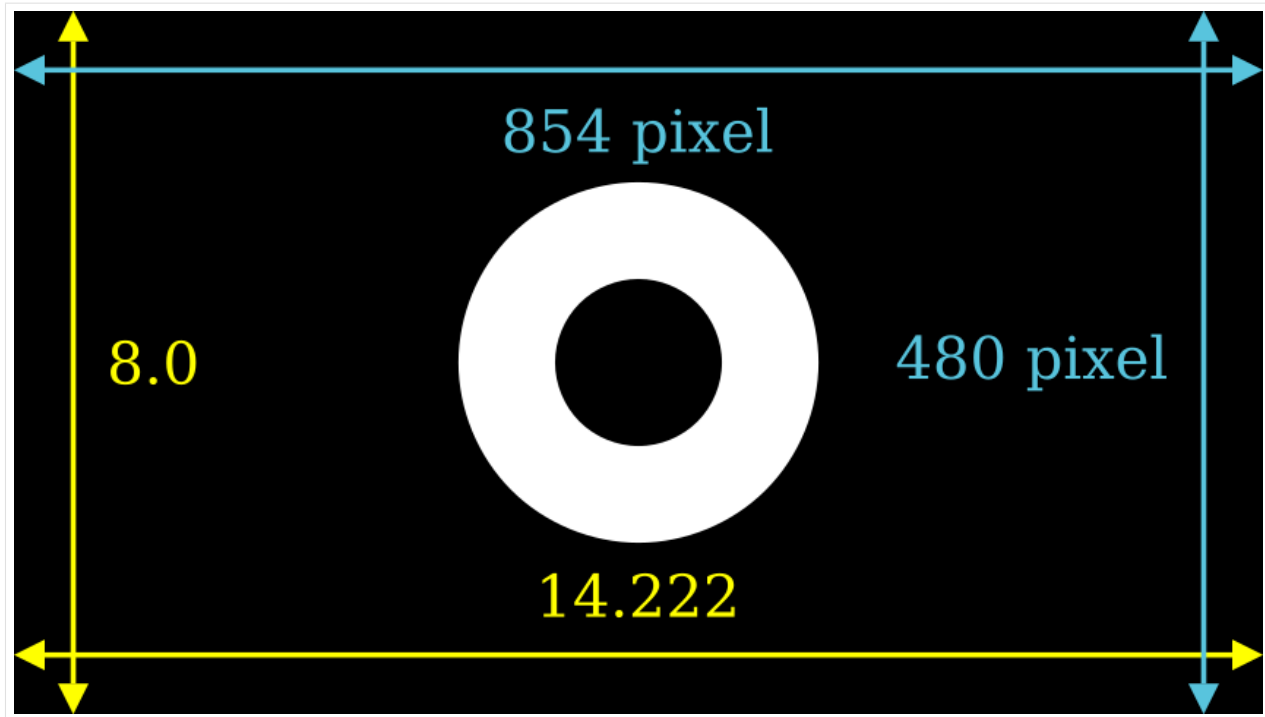
```
[14]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_width = 30
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



```
[15]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_width = 13
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



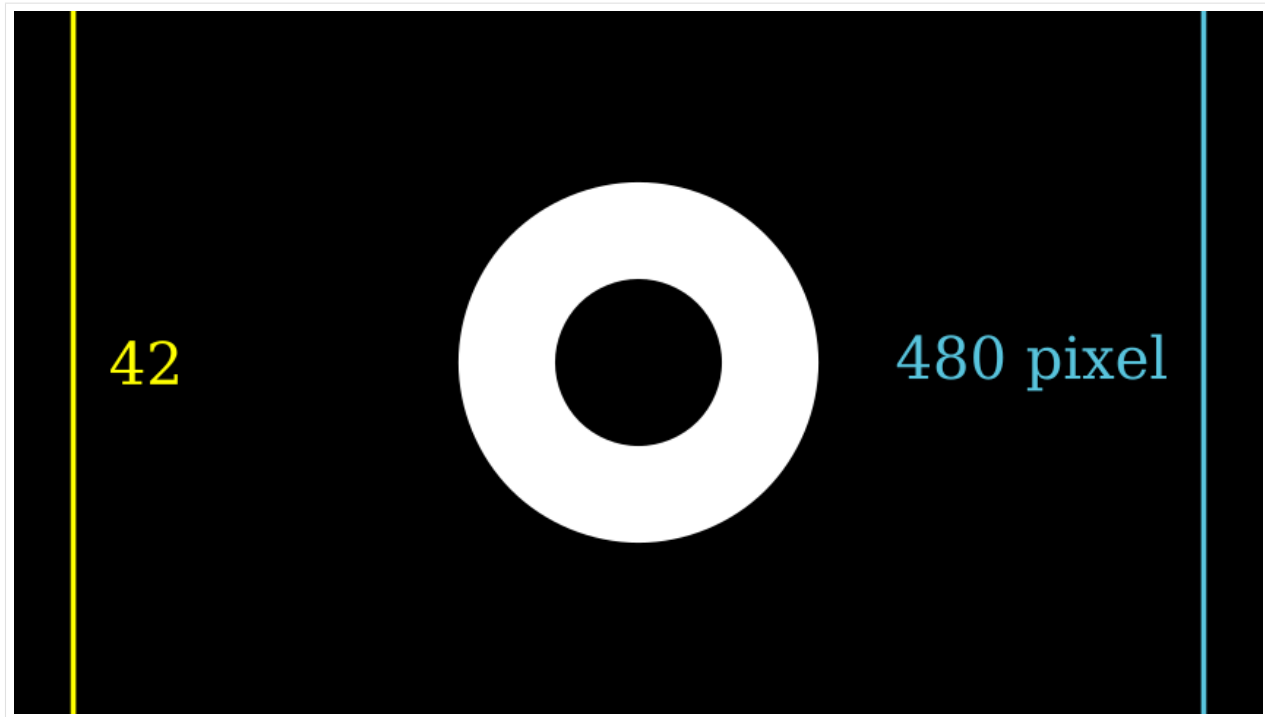
```
[16]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_width =14.22222
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



Note

Changing `config.frame_height` has no effect on the Mobjects displayed on the screen.

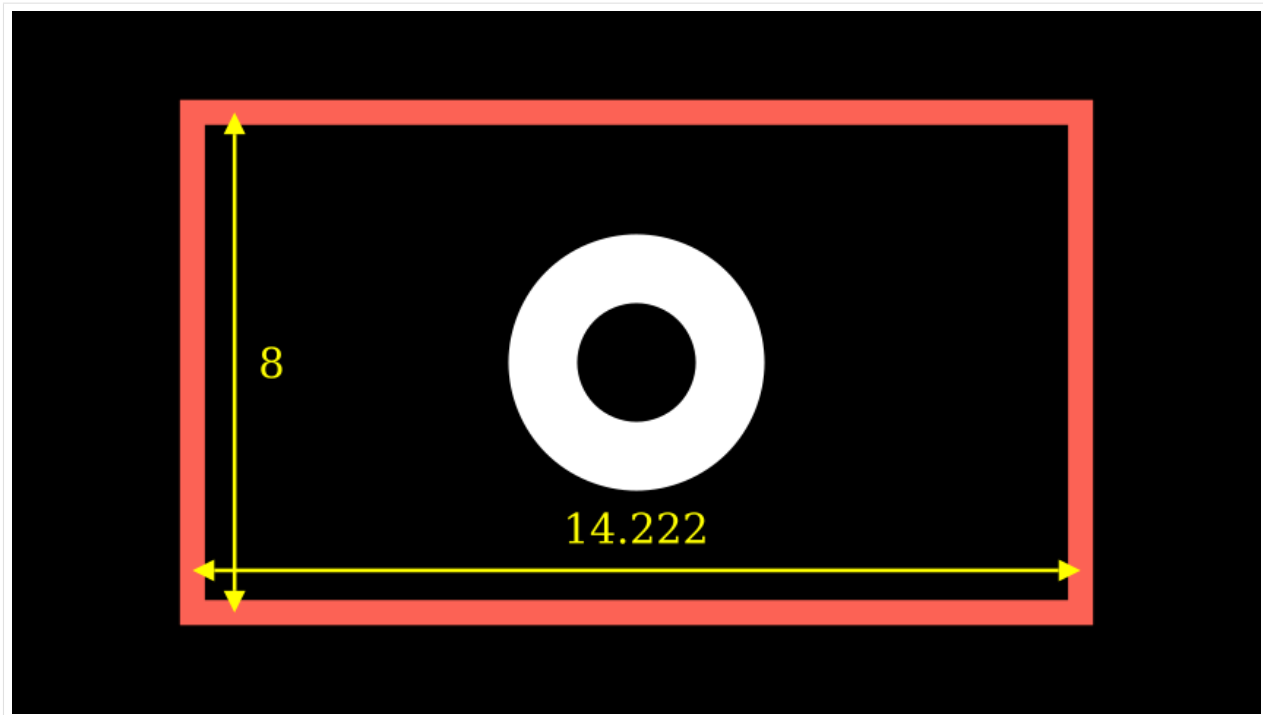
```
[17]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_height = 42
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_height,
        ↪config.pixel_width,config.pixel_height)
        self.add(frame_annotation, pixel_annotation, annulus)
```



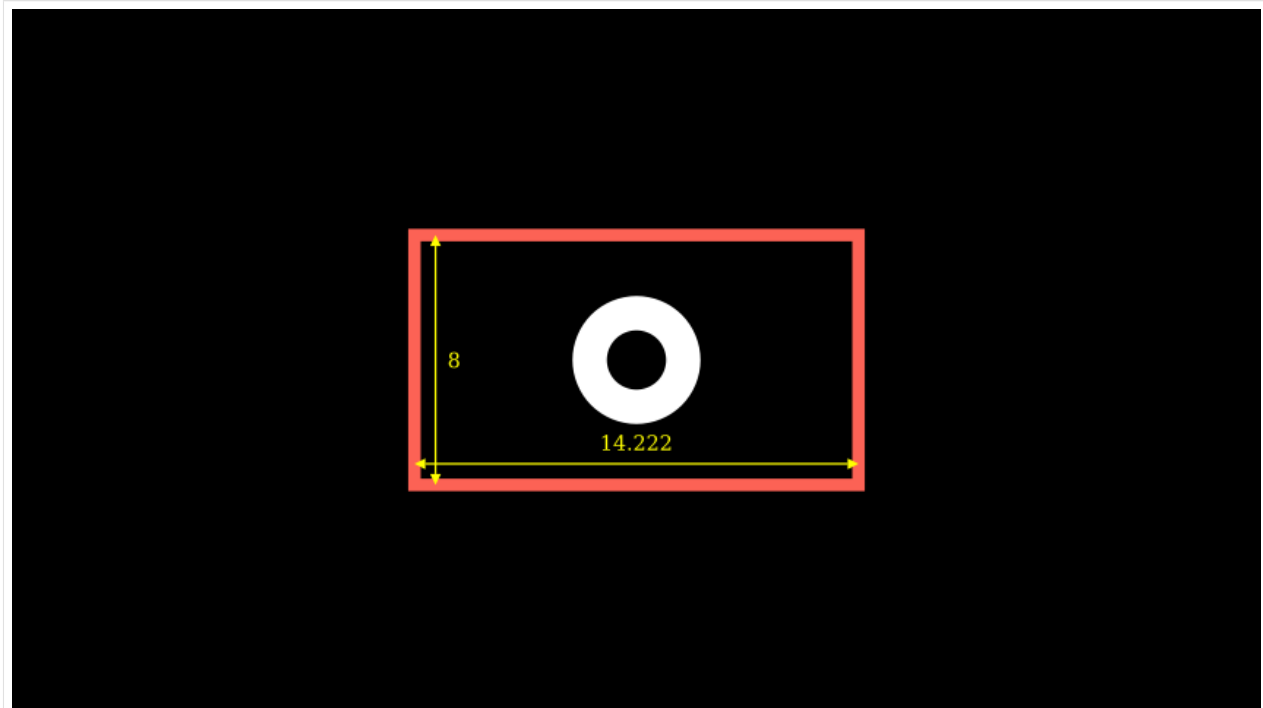
```
[18]: config.frame_height = 8 # resetting the frame_height value to default
```

### 1.5.3 Camera Scene

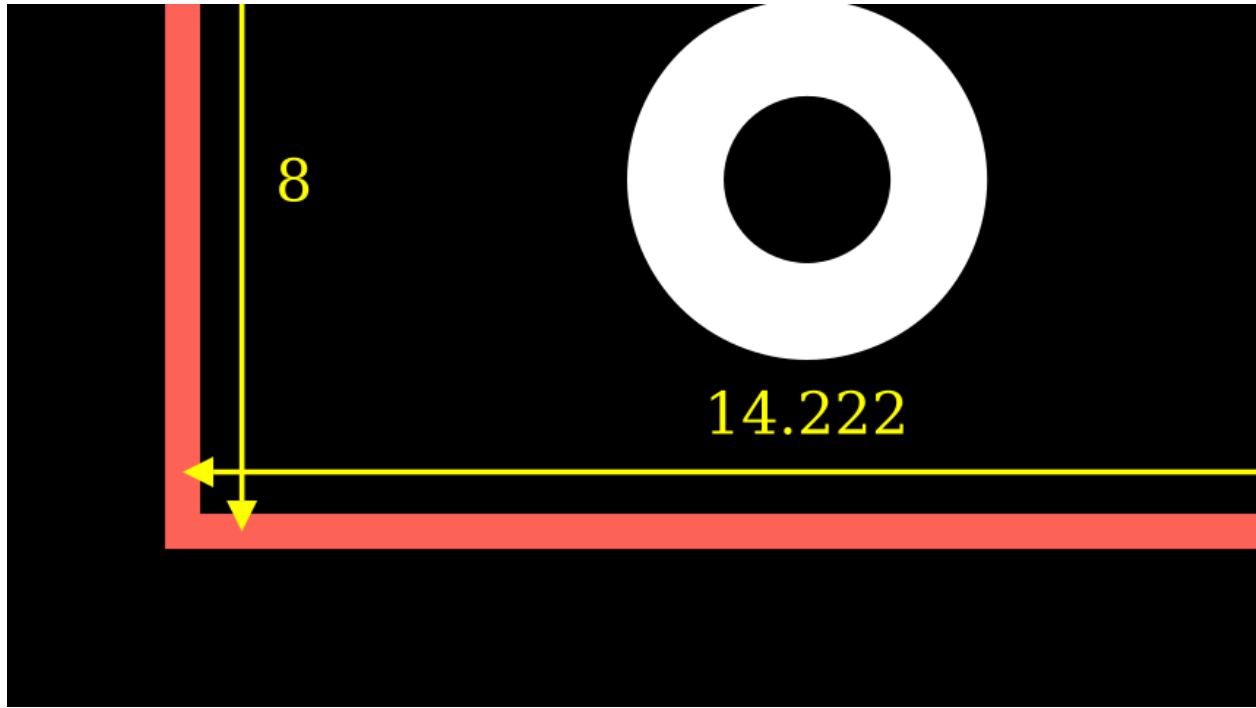
```
[19]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        self.camera.frame.set(width=20)
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        self.add(FullScreenRectangle(color=RED, stroke_width=40))
        self.add(frame_annotation, annulus)
```



```
[20]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        self.camera.frame.set(width=40)
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        self.add(FullScreenRectangle(color=RED, stroke_width=40))
        self.add(frame_annotation, annulus)
```

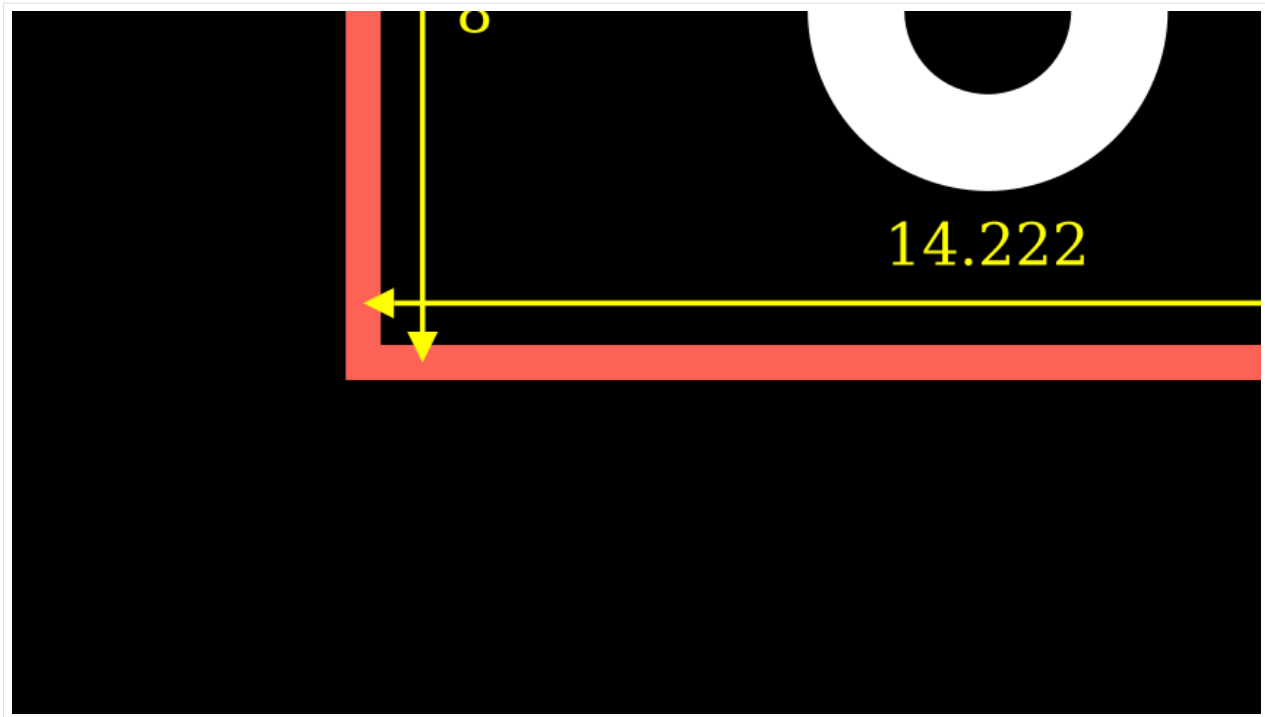


```
[21]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        self.camera.frame.shift(2*DOWN+2*LEFT)
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        self.add(FullScreenRectangle(color=RED, stroke_width=40))
        self.add(frame_annotation, annulus)
```



```
[22]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        self.camera.frame.shift(4*DOWN+4*LEFT)
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        self.add(FullScreenRectangle(color=RED, stroke_width=40))
        self.add(frame_annotation, annulus)
```





```
[23]: %%manim -v WARNING -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_height)
        self.add(FullScreenRectangle(color=RED, stroke_width=40))
        self.add(frame_annotation, annulus)

        self.play(self.camera.frame.animate.shift(UP+2*LEFT).set(width=20))
        self.play(self.camera.frame.animate.shift(2*DOWN+4*RIGHT))

        self.play(self.camera.frame.animate.move_to(ORIGIN).set(width=14.222))

<IPython.core.display.Video object>
```

## 1.6 6. Color Wheel Tutorial

**Latest update : 13.6.2021**

In this notebook, you will learn how to create a color picker with a moving wheel in manim (scroll to the end to see the result)

```
[1]: from manim import *
from PIL import Image
import colorsys
import math
#from manim.utils.color import Colors
from colorutils import hsv_to_hex,hex_to_hsv
```

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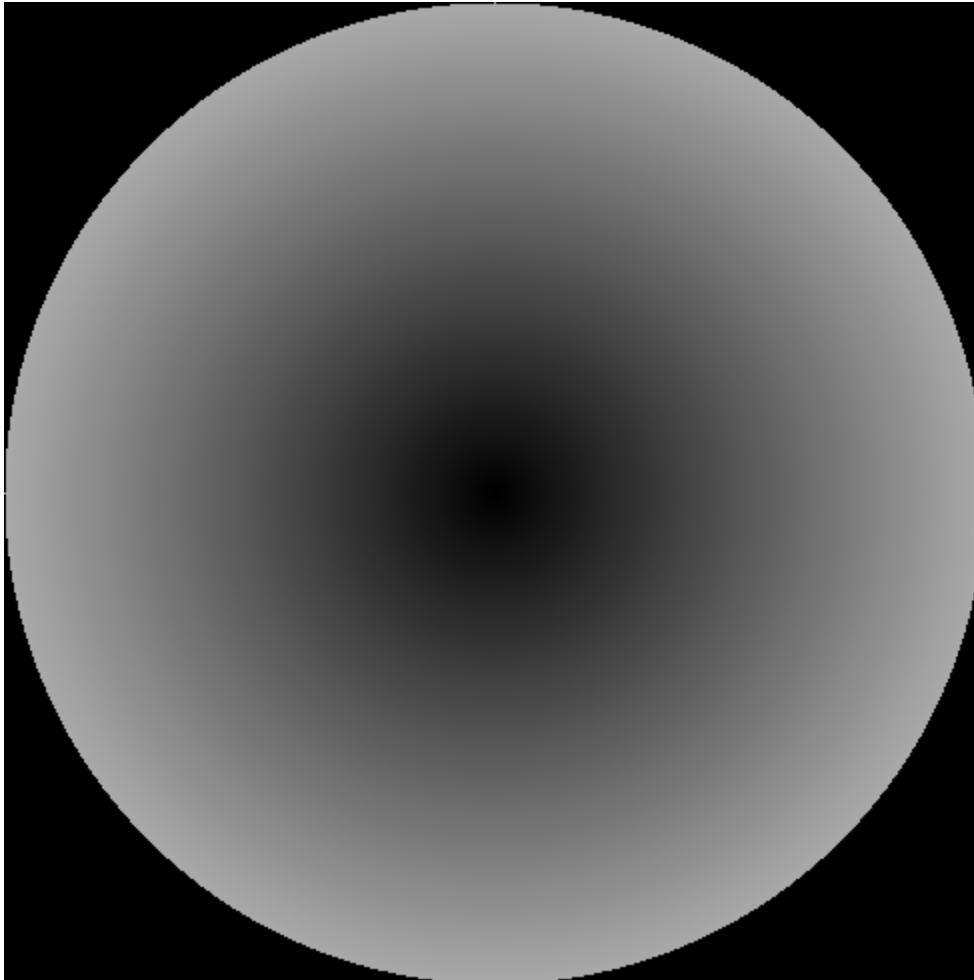
```
[2]: size=490
im = Image.new("RGB", (size,size))
radius = min(im.size)/2.0
cx, cy = im.size[0]/2, im.size[1]/2
pix = im.load()

for x in range(im.width):
    for y in range(im.height):
        rx = x - cx
        ry = y - cy
        s = (rx ** 2.0 + ry ** 2.0) ** 0.5 / radius
        if s <= 1.0:
            h = ((math.atan2(ry, rx) / math.pi) + 1.0) / 2.0
            rgb = colorsys.hsv_to_rgb(h, s, 1)
            pix[x,y] = tuple([int(round(c*255.0)) for c in rgb])
hsv_hue_sat = im
display(hsv_hue_sat)
```



```
[3]: im = Image.new("RGB", (size,size))
      radius = min(im.size)/2.0
      cx, cy = im.size[0]/2, im.size[1]/2
      pix = im.load()

      for x in range(im.width):
          for y in range(im.height):
              rx = x - cx
              ry = y - cy
              s = (rx ** 2.0 + ry ** 2.0) ** 0.5 / radius
              if s <= 1.0:
                  h = ((math.atan2(ry, rx) / math.pi) + 1.0) / 2.0
                  rgb = colorsys.hsv_to_rgb(0, s, 1 )
                  rgb = [np.mean(rgb)]*3
                  pix[x,y] = tuple([int(255-round(c*255.0)) for c in rgb])
hsv_value = im
display(hsv_value)
```



```
[4]: class ColorWheels(Group):
      def __init__(self, **kwargs):
          Group.__init__(self, **kwargs)
```

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```

        im_hue = ImageMobject(hsv_hue_sat).set_z_index(-5)
        im_val = ImageMobject(hsv_value).set_z_index(-5)
        #   im_hue = Circle(radius=1.5).set_style(fill_color=WHITE, fill_opacity=1).set_z_
↪index(-5)
        #   im_val = Circle(radius=1.5).set_style(fill_color=WHITE, fill_opacity=1).set_z_
↪index(-5)
        self.radius = im_hue.height/2
        self.add(im_hue, im_val)
        Group(*self.submobjects).arrange(DOWN, SMALL_BUFF*1.3).to_edge(RIGHT)
        t1= Text("Hue and Saturation").scale(0.3)
        t1.next_to(im_hue, UP, buff=SMALL_BUFF).rotate(35*DEGREES, about_point=im_hue.
↪get_center())
        self.add(t1)
        t2= Text("Value").scale(0.3)
        t2.next_to(im_val, UP, buff=SMALL_BUFF).rotate(35*DEGREES, about_point=im_val.
↪get_center())
        self.add(t2)
        global CENTER_HUE , CENTER_VAL
        CENTER_HUE = im_hue.get_center()
        CENTER_VAL = im_val.get_center()

```

```

[5]: class HueValSlider(Group):
    def __init__(self, wheels, h, s, v,**kwargs):
        hue_tracker= ValueTracker(h)
        sat_tracker= ValueTracker(s)
        val_tracker= ValueTracker(v)
        self.hue_tracker= hue_tracker
        self.sat_tracker= sat_tracker
        self.val_tracker= val_tracker

        Group.__init__(self, **kwargs)
        hue_dot = Dot(CENTER_HUE+LEFT).set_color(BLACK).scale(0.8).set_z_index(1)
        hue_line = Line(CENTER_HUE, hue_dot.get_center()).set_color(BLACK).set_
↪stroke(width=2)
        self.hue_line =hue_line
        hue_circ= Circle().set_color(BLACK).scale(0.08).move_to(hue_dot.get_center())
        hue_dot.add_updater(lambda x: x.move_to(CENTER_HUE+wheels.radius*sat_tracker.get_
↪value()* np.array([-np.cos(hue_tracker.get_value()*DEGREES),np.sin(hue_tracker.get_
↪value()*DEGREES),0])))
        hue_dot.add_updater(lambda x: x.set_color(hsv_to_hex((hue_tracker.get_value()
↪%360, sat_tracker.get_value(),val_tracker.get_value()))))
        hue_line.add_updater(lambda x: x.put_start_and_end_on(CENTER_HUE, hue_dot.get_
↪center()))

        hue_circ.add_updater(lambda x: x.move_to(hue_dot.get_center()))
        self.add(hue_dot, hue_circ, hue_line)

        val_dot = Dot(CENTER_VAL+LEFT).set_color(BLACK).scale(0.8).set_z_index(1)
        val_line = Line(CENTER_VAL, val_dot.get_center()).set_color(BLACK).set_
↪stroke(width=2)
        val_circ= Circle().set_color(BLACK).scale(0.08).move_to(val_dot.get_center())
        val_dot.add_updater(lambda x: x.move_to(CENTER_VAL+wheels.radius*val_tracker.get_
↪value()* np.array([-np.cos(hue_tracker.get_value()*DEGREES),np.sin(hue_tracker.get_
↪value()*DEGREES),0])))

```

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```

        val_dot.add_updater(lambda x: x.set_color(hsv_to_hex((hue_tracker.get_value()
↪%360, sat_tracker.get_value(), val_tracker.get_value()))))
        val_line.add_updater(lambda x: x.put_start_and_end_on(CENTER_VAL, val_dot.get_
↪center()))
        val_circ.add_updater(lambda x: x.move_to(val_dot.get_center()))
        self.add(val_dot, val_circ, val_line)

```

[6]: %%**manim** -v WARNING -qm --disable\_caching Idea3

```

class Idea3(Scene):
    def construct(self):
        wheels = ColorWheels()
        self.add(wheels)
        t1= Dot().scale(4)
        t2= Dot().scale(4)

        t3 = Dot().scale(4)
        gr = VGroup(t1,t2,t3).arrange(DOWN)
        self.add(gr)

        t1.add_updater(lambda x: x.set_color(hsv_to_hex((huevals1.hue_tracker.get_value()
↪%360, huevals1.sat_tracker.get_value(),1))))
        t2.add_updater(lambda x: x.set_color(hsv_to_hex((huevals2.hue_tracker.get_value()
↪%360, huevals2.sat_tracker.get_value(),1))))
        t3.add_updater(lambda x: x.set_color(hsv_to_hex((huevals3.hue_tracker.get_value()
↪%360, huevals3.sat_tracker.get_value(),1))))

        huevals1=HueValSlider(wheels,0,1,1)
        huevals2=HueValSlider(wheels,120,1,1)
        huevals3=HueValSlider(wheels,240,1,1)

        self.add(huevals1)
        self.add(huevals2)
        self.add(huevals3)
        hues_all_tracker = ValueTracker(0)

        self.add(hues_all_tracker)
        self.add(huevals1.hue_tracker)
        self.add(huevals2.hue_tracker)
        self.add(huevals3.hue_tracker)

        huevals1.hue_tracker.add_updater(lambda mobject, dt: mobject.increment_
↪value(dt*30))
        huevals2.hue_tracker.add_updater(lambda mobject, dt: mobject.increment_
↪value(dt*30))
        huevals3.hue_tracker.add_updater(lambda mobject, dt: mobject.increment_
↪value(dt*30))

        self.wait(3)

```

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```

self.play(
    huevals1.sat_tracker.animate.increment_value(-0.2),
    huevals2.sat_tracker.animate.increment_value(-0.2),
    huevals3.sat_tracker.animate.increment_value(-0.2),
)
self.wait(1)
self.play(
    huevals1.val_tracker.animate.increment_value(-0.2),
    huevals2.val_tracker.animate.increment_value(-0.2),
    huevals3.val_tracker.animate.increment_value(-0.2),
)
self.wait(1)

```

```
<IPython.core.display.Video object>
```

## 1.7 7. Additional Tools

Latest update : 13.6.2021

### 1.7.1 Extracting frames (FFMPEG)

In a video editor for post-processing, you might want to have the first frame as an image. This can be achieved with the following script, which will batch-process all videos in the Downloads folder and extract all first frames to the folder “Downloads/processed”

```

[1]: from pathlib import Path
import os
suffix = ".mp4"
input_path= Path.home() / "Downloads/"
file_paths= [subp for subp in input_path.rglob('*') if suffix == subp.suffix]
if len(file_paths) == 0:
    raise ValueError("No videos in folder")
file_paths.sort()
print(file_paths)
output_path = Path.home() / "Downloads/processed"
output_path.mkdir(parents=True, exist_ok=True)
print(output_path)

for file_p in file_paths:
    input = str(file_p)
    output = str( output_path / file_p.name)
    output = output[:-4] # delete the ending
    print(output)
    command = f"ffmpeg -i {input} -vframes 1 {output}.png"
    os.system(command)

```

```
ValueError
```

```
Traceback (most recent call last)
```

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```

/tmp/ipykernel_2632/4206570128.py in <module>
      5 file_paths= [subp for subp in input_path.rglob('*') if suffix == subp.suffix]
      6 if len(file_paths) == 0:
----> 7     raise ValueError("No videos in folder")
      8 file_paths.sort()
      9 print(file_paths)

```

ValueError: No videos in folder

## 1.8 (TL;DR CheatSheet)

[1]: `from manim import *`

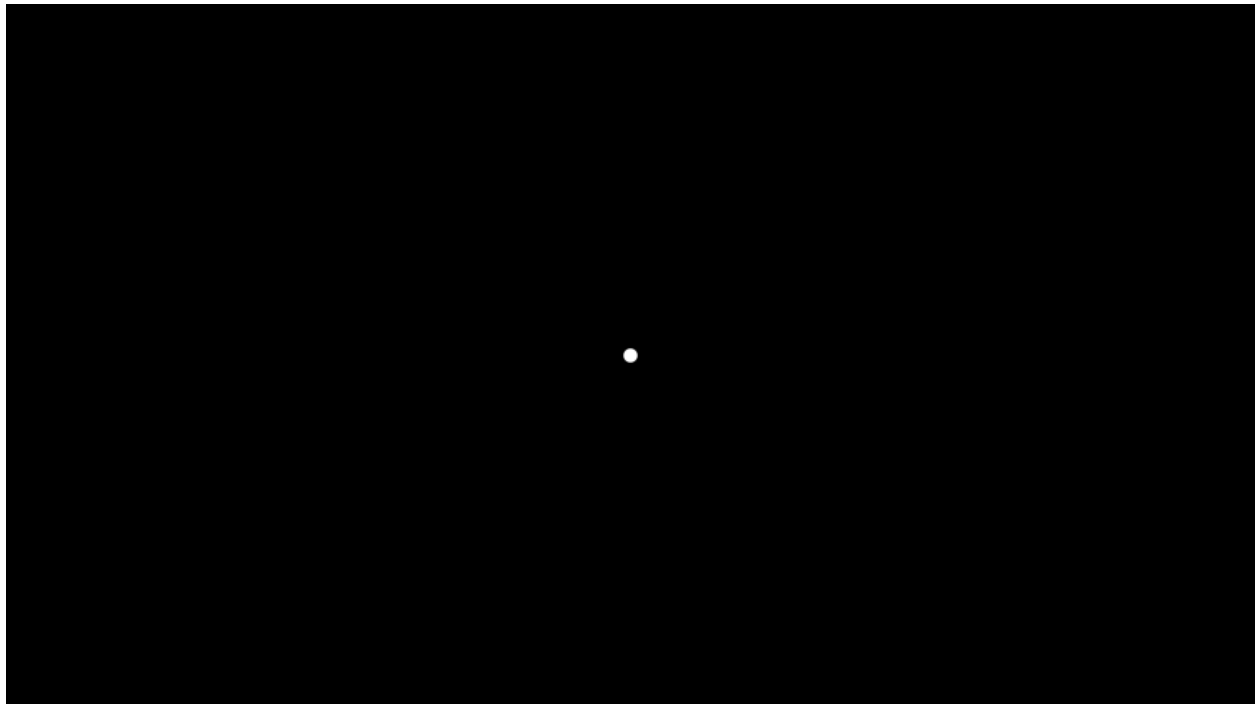
```

param   = "-v WARNING -s -ql --disable_caching --progress_bar None Example"
paramH  = "-v WARNING -s -qh --disable_caching --progress_bar None Example"
paramp  = "-v WARNING -ql --disable_caching --progress_bar None Example"
parampH = "-v WARNING -qh --disable_caching --progress_bar None Example"

```

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[2]: `%%manim $param`  
`class Example(Scene):`  
 `def construct(self):`  
 `self.add(Dot())`



```
[3]: !manim render --help
```

```
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```

```
Usage: manim render [OPTIONS] FILE [SCENE_NAMES]...
```

```
Render SCENE(S) from the input FILE.
```

```
FILE is the file path of the script.
```

```
SCENES is an optional list of scenes in the file.
```

```
Global options:
```

```
-c, --config_file TEXT      Specify the configuration file to use for
                             render settings.
--custom_folders            Use the folders defined in the
                             [custom_folders] section of the config file
                             to define the output folder structure.
--disable_caching           Disable the use of the cache (still
                             generates cache files).
--flush_cache              Remove cached partial movie files.
--tex_template TEXT        Specify a custom TeX template file.
-v, --verbosity [DEBUG|INFO|WARNING|ERROR|CRITICAL]
                             Verbosity of CLI output. Changes ffmpeg log
                             level unless 5+.
--notify_outdated_version / --silent
                             Display warnings for outdated installation.
--enable_gui               Enable GUI interaction.
--gui_location TEXT        Starting location for the GUI.
--fullscreen               Expand the window to its maximum possible
                             size.
```

```
Output options:
```

```
-o, --output_file TEXT      Specify the filename(s) of the rendered
                             scene(s).
-O, --zero_pad INTEGER RANGE
                             Zero padding for PNG file names. [0<=x<=9]
--write_to_movie            Write to a file.
--media_dir PATH            Path to store rendered videos and latex.
--log_dir PATH              Path to store render logs.
--log_to_file               Log terminal output to file.
```

```
Render Options:
```

```
-n, --from_animation_number TEXT
                             Start rendering from n_0 until n_1. If n_1
                             is left unspecified, renders all scenes
                             after n_0.
-a, --write_all             Render all scenes in the input file.
--format [png|gif|mp4|webm|mov]
-s, --save_last_frame
-q, --quality [l|m|h|p|k]   Render quality at the follow resolution
                             framerates, respectively: 854x480 30FPS,
                             1280x720 30FPS, 1920x1080 60FPS, 2560x1440
                             60FPS, 3840x2160 60FPS
```

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<code>-r, --resolution TEXT</code>	Resolution in (W,H) for when 16:9 aspect ratio isn't possible.
<code>--fps, --frame_rate FLOAT</code>	Render at this frame rate.
<code>--renderer [cairo opengl webgl]</code>	Select a renderer for your Scene.
<code>--use_opengl_renderer</code>	Render scenes using OpenGL (Deprecated).
<code>--use_webgl_renderer</code>	Render scenes using the WebGL frontend (Deprecated).
<code>--webgl_renderer_path PATH</code>	The path to the WebGL frontend.
<code>-g, --save_pngs</code>	Save each frame as png (Deprecated).
<code>-i, --save_as_gif</code>	Save as a gif (Deprecated).
<code>-s, --save_last_frame</code>	Save last frame as png (Deprecated).
<code>-t, --transparent</code>	Render scenes with alpha channel.
<code>--use_projection_fill_shaders</code>	Use shaders for OpenGLVMobject fill which are compatible with transformation matrices.
<code>--use_projection_stroke_shaders</code>	Use shaders for OpenGLVMobject stroke which are compatible with transformation matrices.
Ease of access options:	
<code>--progress_bar [display leave none]</code>	Display progress bars and/or keep them displayed.
<code>-p, --preview</code>	Preview the Scene's animation. OpenGL does a live preview in a popup window. Cairo opens the rendered video file in the system default media player.
<code>-f, --show_in_file_browser</code>	Show the output file in the file browser.
<code>--jupyter</code>	Using jupyter notebook magic.
Other options:	
<code>--help</code>	Show this message and exit.
Made with <3 by Manim Community developers.	

## 1.9 Changelog

### 1.9.1 0.9.0

- added copybutton
- updated manim version
- Shortened headings

## 1.9.2 0.10.0

- changed plugin to manim\_physics
- Added copy-paste gallery in chapter 2 as a link to <https://kolibril13.github.io/mobject-gallery/>

[ ]: