
FlyingFrames

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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 : 18.6.2021

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.
- more can be seen in chapter 4

1.1.1 Simple Example

First, we need to import manim

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

```
Manim Community v0.9.0
```

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):
    def construct(self):
```

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```
m= ManimBanner()  
self.add(m)
```



1.1.2 Initializing Objects 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).

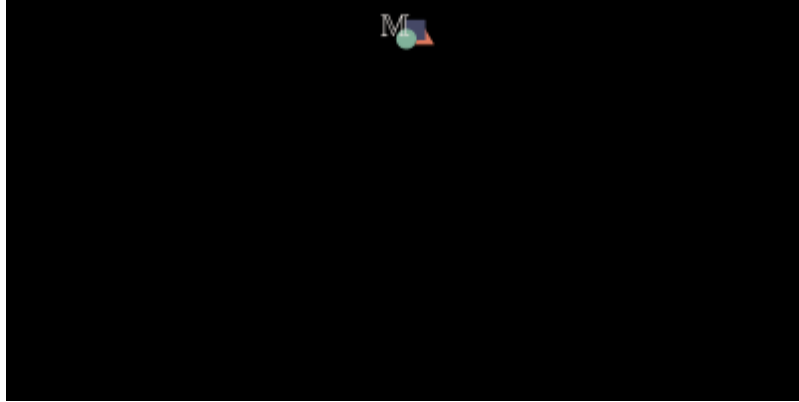
```
[6]: m = ManimBanner()
```

```
[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:

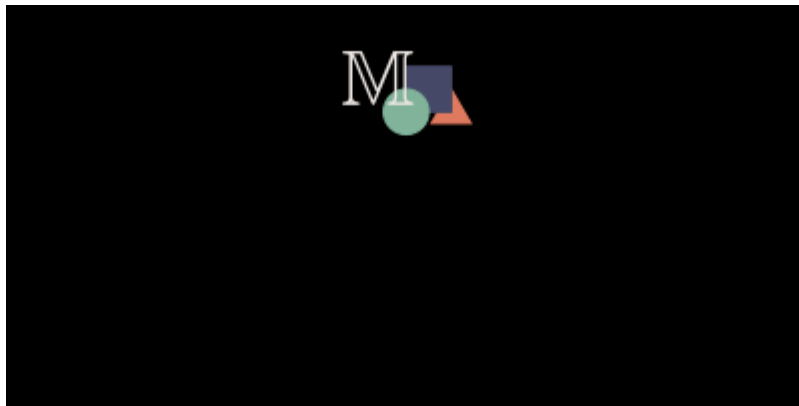
```
[8]: %%manim $paramsSMALL
class Example(Scene):
    def construct(self):
        m.scale(0.4)
        m.shift(1.5*UP)
        self.add(m)
```



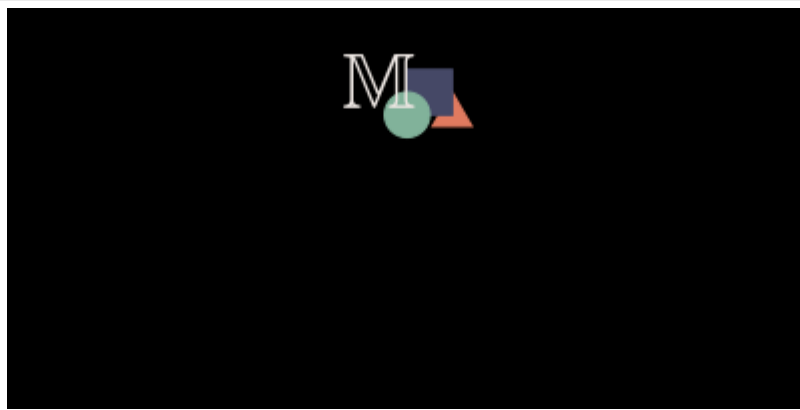
To avoid this, it is better to add only a copy of these mobjects to scenes, and keep the originals untouched:

```
[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)
```



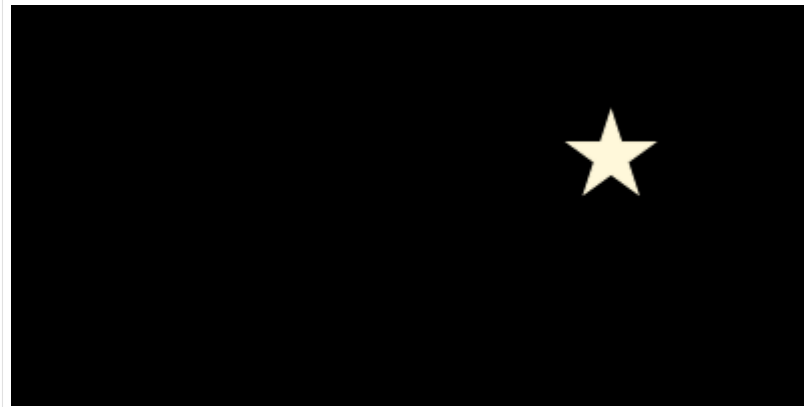
1.1.3 Defining Global Mobjets

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.

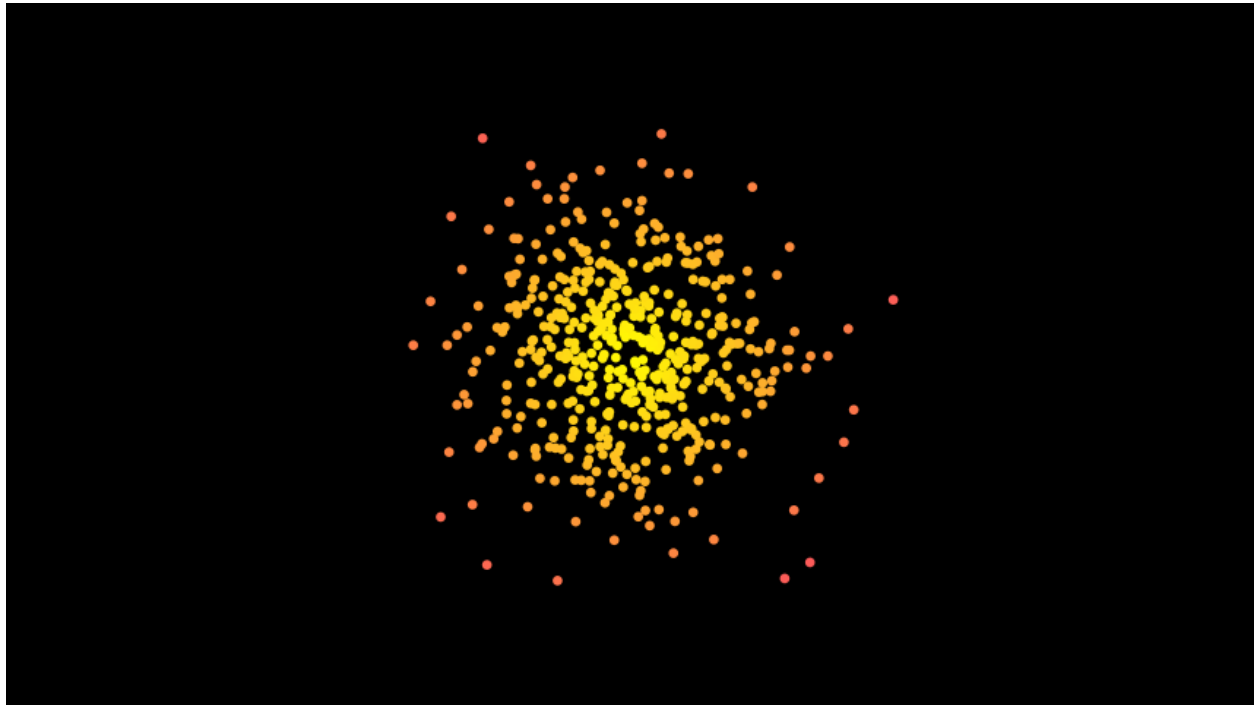
Making aesthetic changes to the scene will then become easier.

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 2.18 s, sys: 978 ms, total: 3.16 s
Wall time: 3.16 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 410 ms, sys: 2.17 ms, total: 412 ms
Wall time: 413 ms

1.1.5 Installing Plugins

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

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

```
Collecting manim-rubikscube
  Downloading manim_rubikscube-0.1.0-py2.py3-none-any.whl (7.5 kB)
Requirement already satisfied: manim in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim-rubikscube)
↳ (0.9.0)
Collecting kociemba-manim-rubikscube
  Downloading kociemba_manim_rubikscube-0.0.1-py3-none-any.whl (33.3 MB)
    || 33.3 MB 4.7 MB/s
Requirement already satisfied: pydub in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (0.25.1)
Requirement already satisfied: moderngl<6.0.0,>=5.6.3 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages
↳ (from manim->manim-rubikscube) (5.6.4)
Requirement already satisfied: click>=7.1 in /home/docs/checkouts/readthedocs.org/
↳ user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (8.0.1)
Requirement already satisfied: colour in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (0.1.5)
Requirement already satisfied: Pillow in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (5.4.1)
```

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```

Requirement already satisfied: requests in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (2.26.0)
Requirement already satisfied: click-default-group in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (1.2.2)
Requirement already satisfied: setuptools in /home/docs/checkouts/readthedocs.org/
↳ user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (57.4.0)
Requirement already satisfied: networkx<3.0,>=2.5 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->
↳ manim-rubikscube) (2.6.2)
Requirement already satisfied: manimpango<0.4.0,>=0.3.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (0.3.0)
Requirement already satisfied: moderngl-window<3.0.0,>=2.3.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (2.4.0)
Requirement already satisfied: screeninfo<0.7.0,>=0.6.7 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (0.6.7)
Requirement already satisfied: pygments in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (2.9.0)
Requirement already satisfied: decorator<6.0.0,>=5.0.7 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (5.0.9)
Requirement already satisfied: watchdog in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (2.1.3)
Requirement already satisfied: pycairo<2.0,>=1.19 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->
↳ manim-rubikscube) (1.20.1)
Requirement already satisfied: tqdm in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (4.62.0)
Requirement already satisfied: cloup<0.8.0,>=0.7.0 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (0.7.1)
Requirement already satisfied: mapbox-earcut<0.13.0,>=0.12.10 in /home/docs/checkouts/
↳ readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳ (from manim->manim-rubikscube) (0.12.10)
Requirement already satisfied: numpy<2.0,>=1.9 in /home/docs/.pyenv/versions/3.8.6/
↳ lib/python3.8/site-packages (from manim->manim-rubikscube) (1.19.2)
Requirement already satisfied: scipy in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (1.7.1)
Requirement already satisfied: rich>=6.0 in /home/docs/checkouts/readthedocs.org/user_
↳ builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from manim->manim-
↳ rubikscube) (10.6.0)
Requirement already satisfied: glcontext<3,>=2 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from moderngl
↳ <6.0.0,>=5.6.3->manim->manim-rubikscube) (2.3.4)
Requirement already satisfied: pyglet<2,>=1.5.8 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from moderngl-
↳ window<3.0.0,>=2.3.0->manim->manim-rubikscube) (1.5.18)
Requirement already satisfied: pyrr<1,>=0.10.3 in /home/docs/checkouts/readthedocs.
↳ org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from moderngl-
↳ window<3.0.0,>=2.3.0->manim->manim-rubikscube) (0.10.3)

```

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```

Requirement already satisfied: multipledispatch in /home/docs/checkouts/readthedocs.
↳org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from pyrr<1,>
↳=0.10.3->moderngl-window<3.0.0,>=2.3.0->manim->manim-rubikscube) (0.6.0)
Requirement already satisfied: colorama<0.5.0,>=0.4.0 in /home/docs/checkouts/
↳readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳(from rich>=6.0->manim->manim-rubikscube) (0.4.4)
Requirement already satisfied: commonmark<0.10.0,>=0.9.0 in /home/docs/checkouts/
↳readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳(from rich>=6.0->manim->manim-rubikscube) (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->manim-rubikscube) (1.15.0)
Requirement already satisfied: charset-normalizer~2.0.0 in /home/docs/checkouts/
↳readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳(from requests->manim->manim-rubikscube) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in /home/docs/checkouts/readthedocs.
↳org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from requests-
↳>manim->manim-rubikscube) (2021.5.30)
Requirement already satisfied: idna<4,>=2.5 in /home/docs/checkouts/readthedocs.org/
↳user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages (from requests->
↳manim->manim-rubikscube) (3.2)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /home/docs/checkouts/
↳readthedocs.org/user_builds/flyingframes/envs/v0.9.0/lib/python3.8/site-packages_
↳(from requests->manim->manim-rubikscube) (1.26.6)
Installing collected packages: kociemba-manim-rubikscube, manim-rubikscube
Successfully installed kociemba-manim-rubikscube-0.0.1 manim-rubikscube-0.1.0

```

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

```

from manim_rubikscube import *

class Example(ThreeDScene):
    def construct(self):
        cube = RubiksCube().scale(0.6)
        self.add(cube)
        self.set_camera_orientation(phi=50*DEGREES, theta=160*DEGREES)
        self.renderer.camera.frame_center = cube.get_center()
        self.play(CubeMove(cube, "F"))
        self.play(CubeMove(cube, "U2"), run_time=2)
        self.play(CubeMove(cube, "R"))
        self.wait(0.5)

<IPython.core.display.Video object>

```

1.2 2. 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 v0.9.0
```

```
[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"
```

1.2.1 Positioning

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

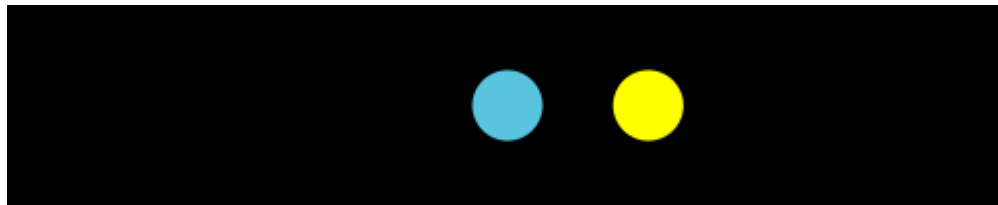
set positions

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):
```

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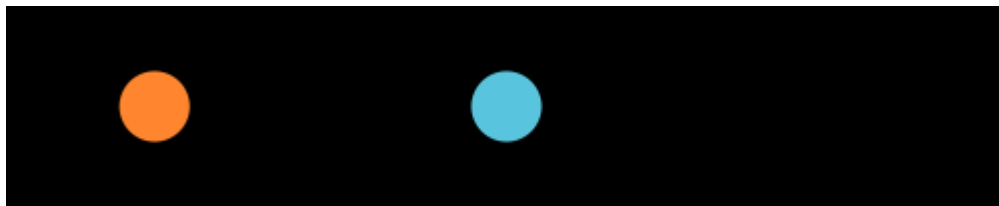
```
d= Dot(color= ORANGE, radius=0.5)
d.next_to(dORIGIN, LEFT)
self.add(dORIGIN, d)
```



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



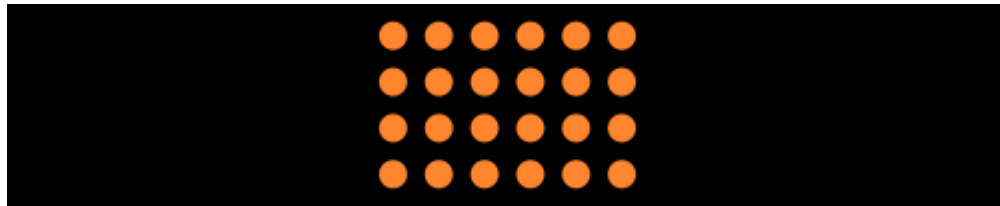
```
[12]: %%manim $params
class Example(Scene):
    def construct(self):
        s= Star(stroke_width=10)
        d=Dot(color= ORANGE, radius=0.5)
        d.next_to(s,RIGHT, aligned_edge=UP) #next to and align combined
        self.add(s,d)
```



```
[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))
```

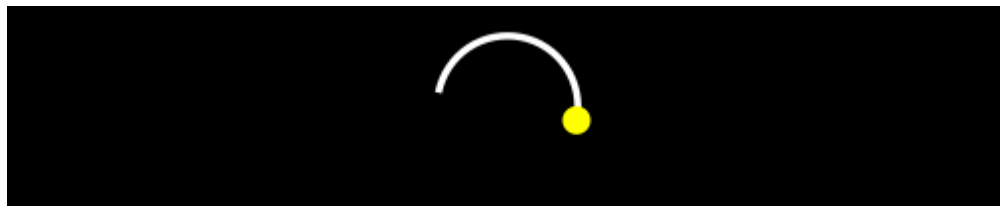


```
[23]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= s.get_corner(DR)
        self.add(s, d.move_to(pos))
```

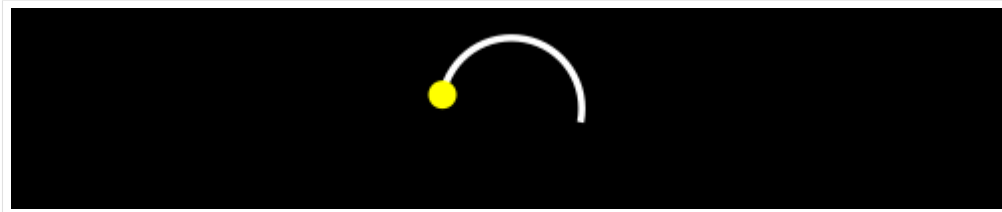


```
[24]: arc= Arc(radius=1.0, start_angle=-PI/16, angle=PI, stroke_width=10)
```

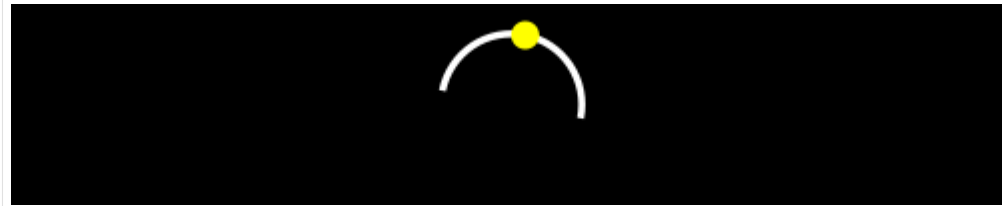
```
[25]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_start()
        self.add(arc, d.move_to(pos))
```



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

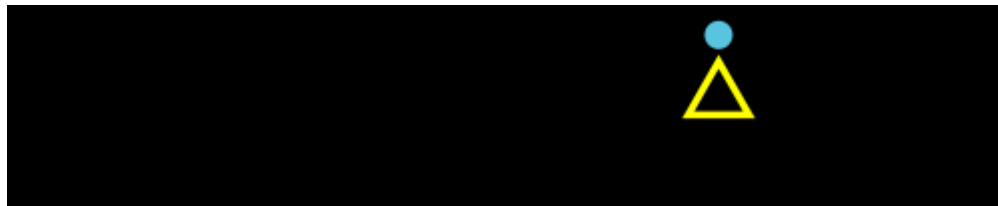


```
[31]: %%manim $params
class Example(Scene):
    def construct(self):
        pos= arc.get_arc_center()
        self.add(arc, d.move_to(pos))
```



```
[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

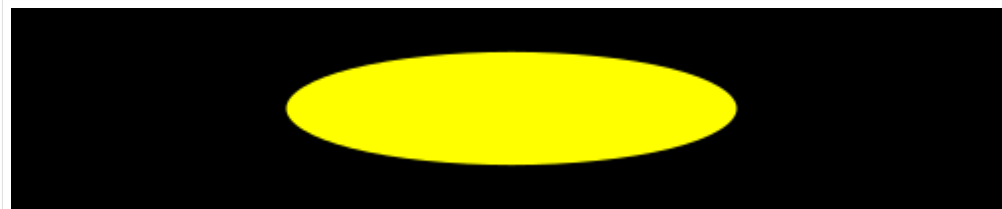


1.2.2 Scaling and Stretching

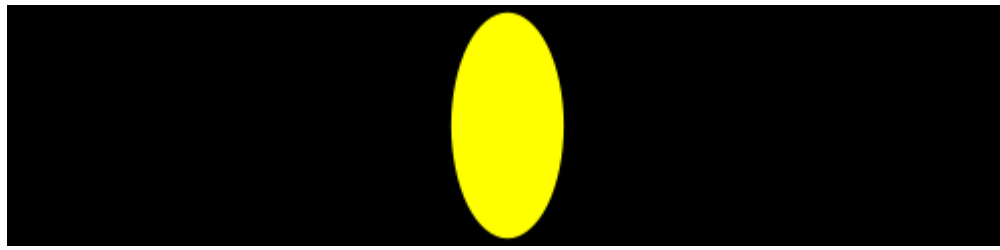
```
[34]: %%manim $params
class Example(Scene):
    def construct(self):
        d= Dot(color= YELLOW)
        d.scale(10)
        self.add(d)
```



```
[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)
```



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

1.2.4 Colors and Opacity

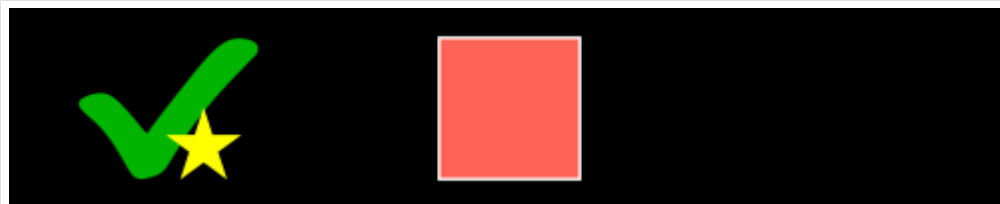
- Color parameters for Mobjects are `stroke_color`, `fill_color` and `color`. The parameter `color` automatically sets both `stroke_color` and `fill_color`.
The recommended ways to set **colors** are via `c = Circle(fill_color= BLUE, fill_opacity= 1)`, `c.set_fill(color=RED)` or `c.set_style(fill_color=GREEN)`
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)
        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):
```

(continues on next page)

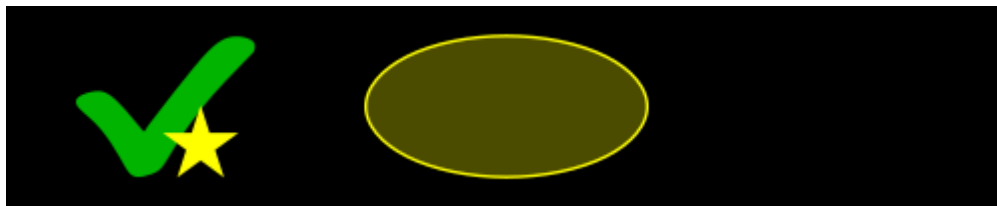
(continued from previous page)

```
def construct(self):
    self.camera.background_color = PURPLE
    self.add(BEST)
```

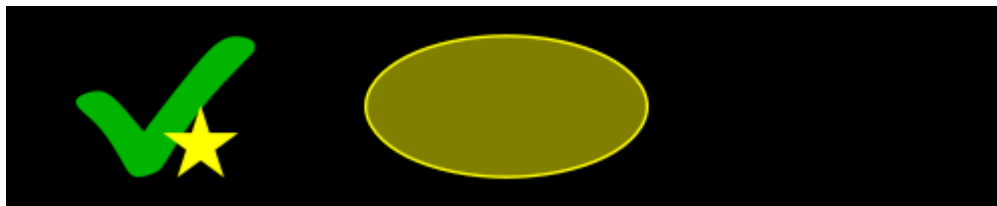


Opacity

```
[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)
```



1.2.5 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().



1.2.6 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)
```

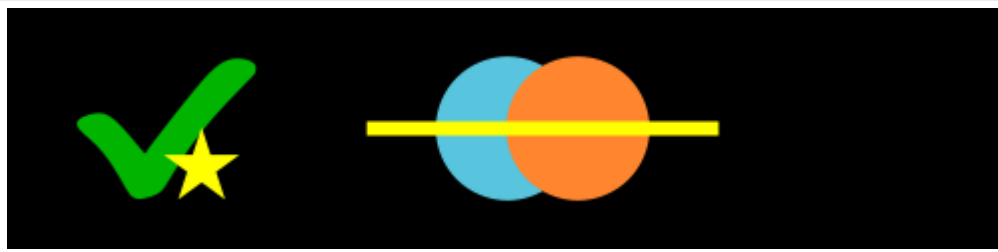
```
[60]: %%manim $paramsbigger
      class Example(Scene):
          def construct(self):
              self.add(circleLeft, circleRight)
              self.add(BEST)
```



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

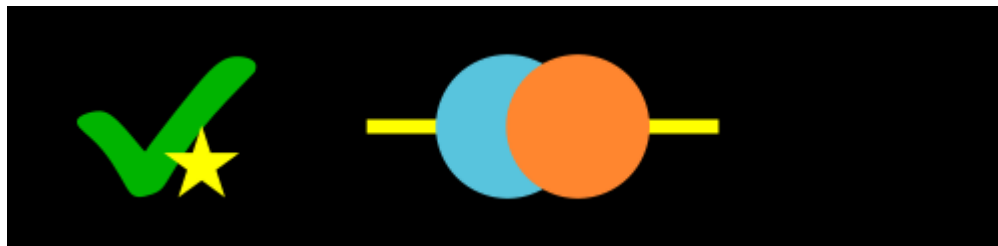


```
[62]: %%manim $paramsbigger
      class Example(Scene):
          def construct(self):
              self.add(circleLeft, circleRight, line)
              self.add(BEST)
```

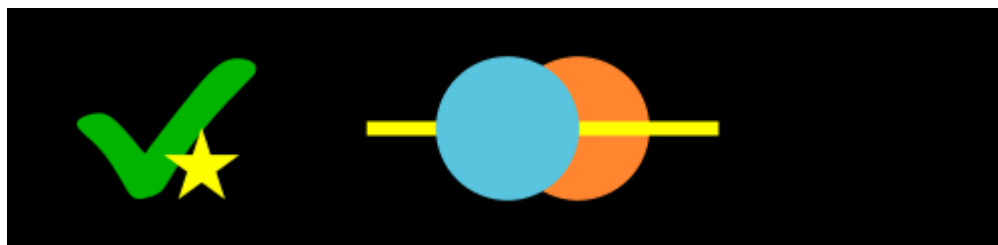
```
[63]: %%manim $paramsbigger
class Example(Scene):
    def construct(self):
        self.add(circleLeft, circleRight, line)
        print(self.mobjects)
        self.bring_to_back(line)
        print(self.mobjects)
        self.add(BEST)
```

```
[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
        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` blog, 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



1.2.7 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()
```

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```
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)
```

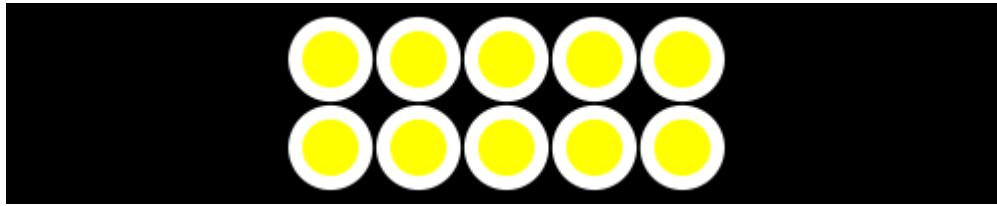


```
[83]: %%manim $params
blue1,blue2, yellow1,yellow2 = create_dots()
class Example(Scene): # empty initializing
    def construct(self):
        g=VGroup()
        for _ in range(0,10):
            g += yellow1.copy()
        g.set_stroke(color=WHITE, width=20)
        g.arrange_in_grid(rows=2) # 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

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```
g.move_to(ORIGIN)
self.add(g)
```



Note:

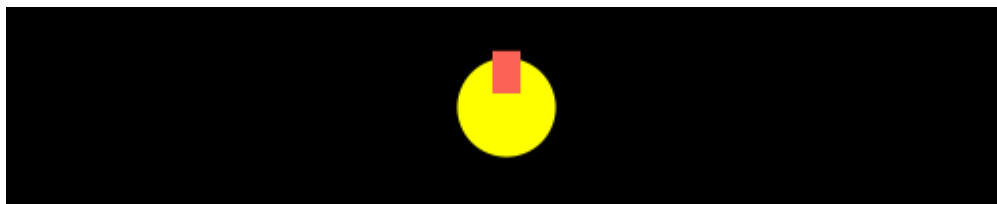
`VMOBJECT().add(...)` is functionally equivalent to `VGroup(...)`, but it is recommended to use `VGroup`, as

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

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

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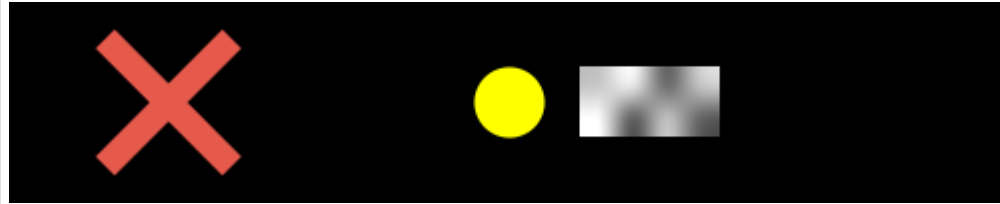
(continued from previous page)

```

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!



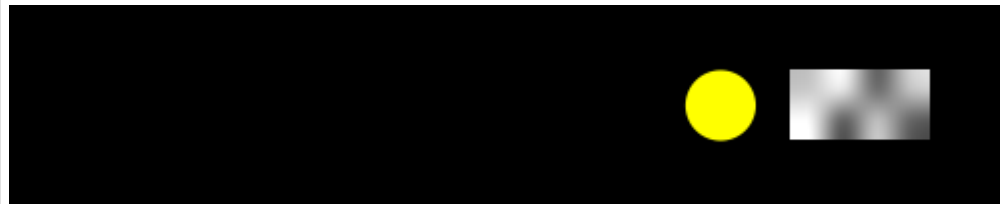
Group

Groups Mobjects and VMobjects together. You can only use the methods of Mobject here. Methods of VMobject wont 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)
        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!

1.3 3. 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 v0.9.0
```

```
[2]: #ignore this cell, only for setup
params= "-v WARNING --progress_bar None -r 500,200 --disable_caching Example"
```

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```

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));

```

1.3.1 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>

```

1.3.2 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>
```

1.3.3 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)
```

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```

self.add(dot, NO)
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

1.3.4 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 mobobjects, 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>
```

1.3.5 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>
```

1.3.6 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()
        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)

        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_
↪continuously watch
```

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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>
```

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__(
            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)
```

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```
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>
```

```
[ ]:
```

1.4 (4. Building Scenes)

Scenes in manim can become cluttered very easily. As you want to have videos in the end, and not the code, code tidyness is not crucial, but often it is useful to stay organized and to not get lost in complex scenes.

1.4.1 More coming soon!

```
[ ]:
```

1.5 5. Resolution and Camera

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

```
Manim Community v0.9.0
```

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

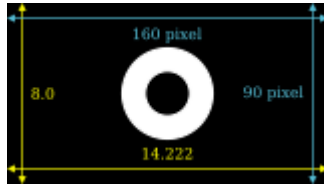
def blue_pixel_annotation(framew, frameh, pixelw, pixelh):
    d1 = DoubleArrow(framew * LEFT / 2, framew * RIGHT / 2, buff=0).to_edge(UP)
    t1 = Text(str(pixelw) + " pixel").next_to(d1, DOWN)
    d2 = DoubleArrow(frameh * UP / 2, frameh * DOWN / 2, buff=0).to_edge(RIGHT)
    t2 = Text(str(pixelh)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

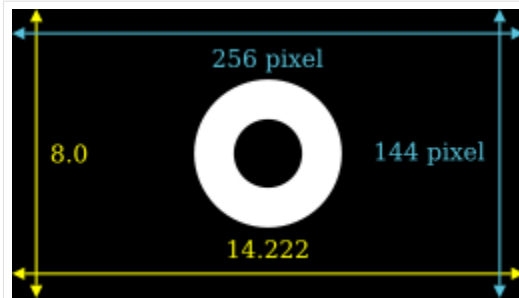
Pixel Ratio of 16/9

See a table of common 16/9 resolutions here: https://en.wikipedia.org/wiki/16:9_aspect_ratio#Common_resolutions

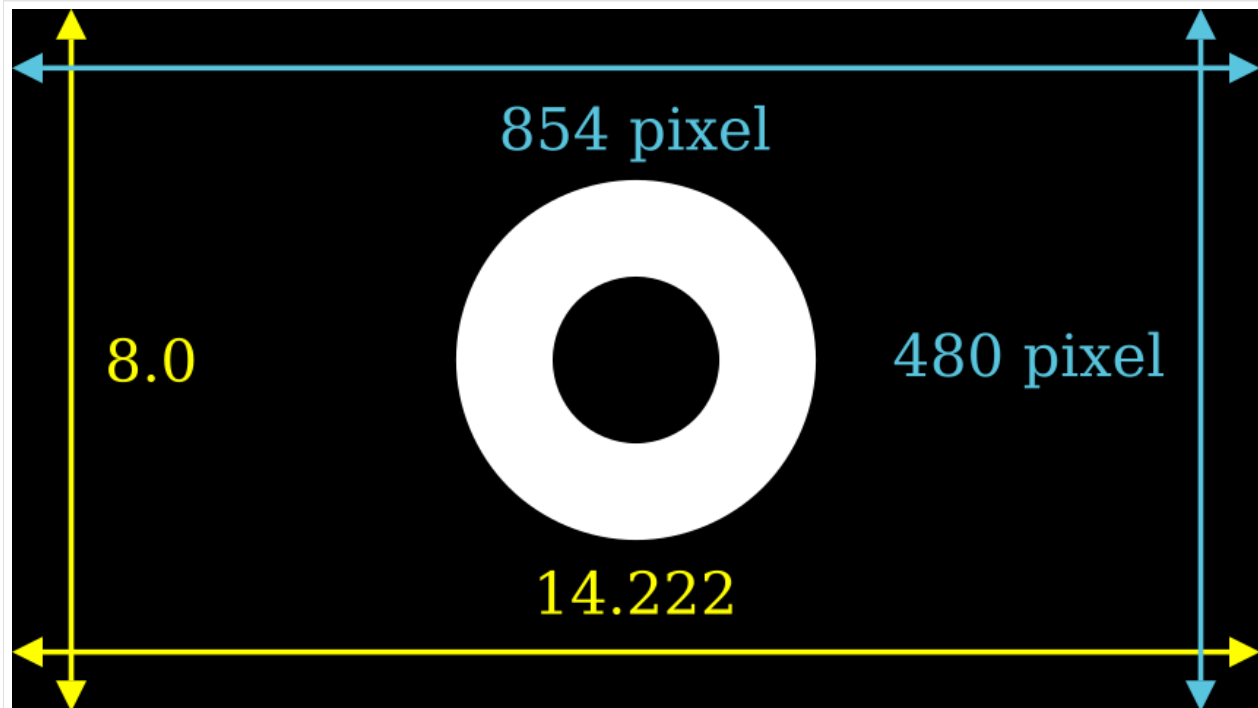
```
[6]: %%manim -v WARNING -s -r 160,90 --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
↪height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_
↪height,config.pixel_width,config.pixel_height)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



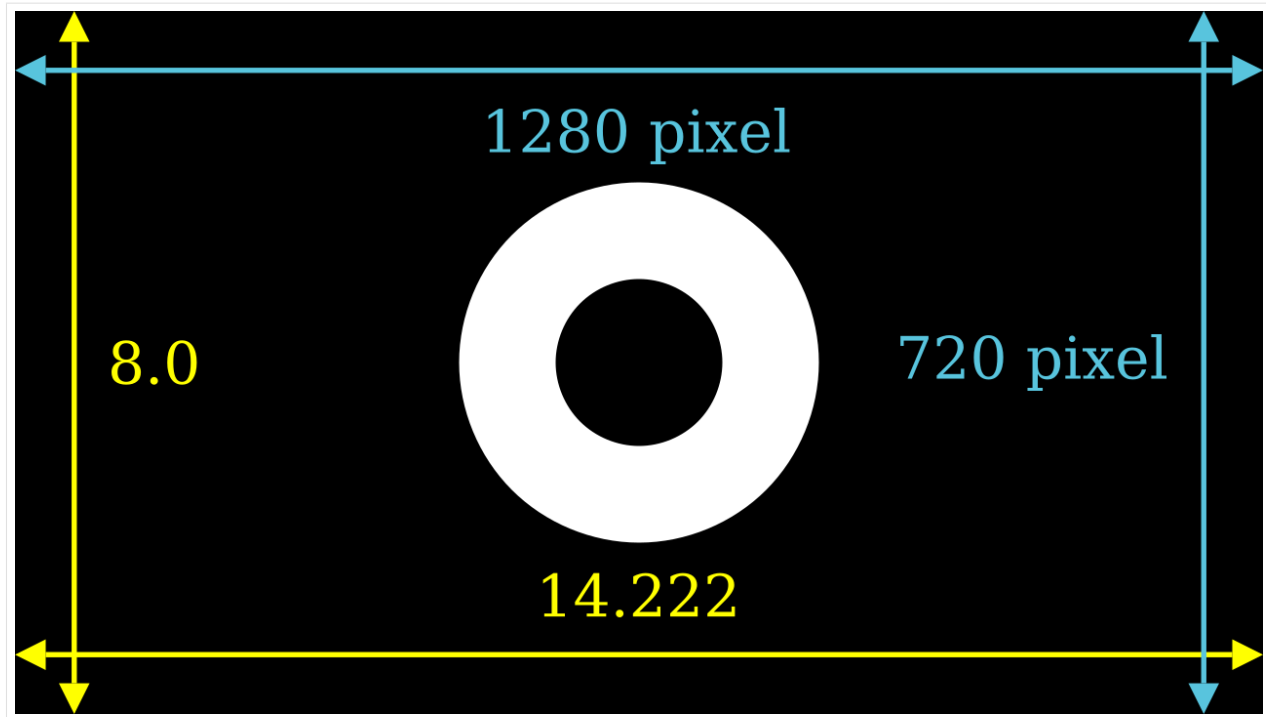
```
[7]: %%manim -v WARNING -s -r 256,144 --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
↪height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_
↪height,config.pixel_width,config.pixel_height)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

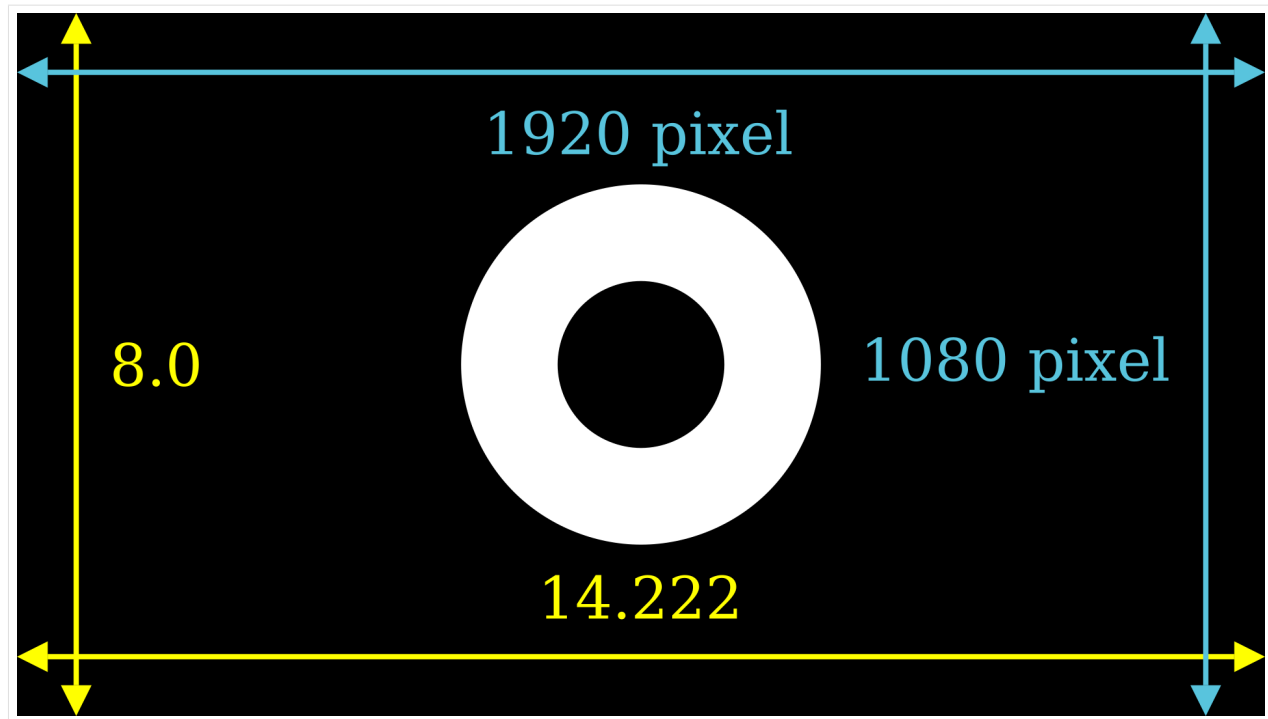


Note

The borders of this website are narrow.

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

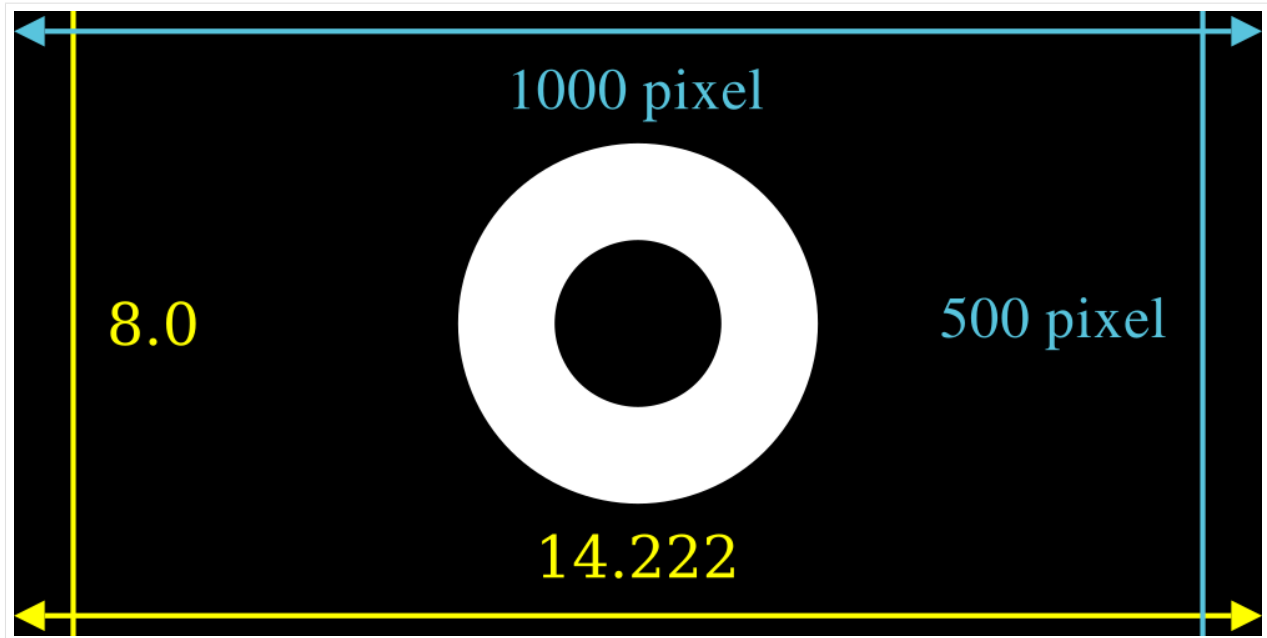
```
[10]: %%manim -v WARNING -s -qh --disable_caching Example
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
        ↪height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_
        ↪height,config.pixel_width,config.pixel_height)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

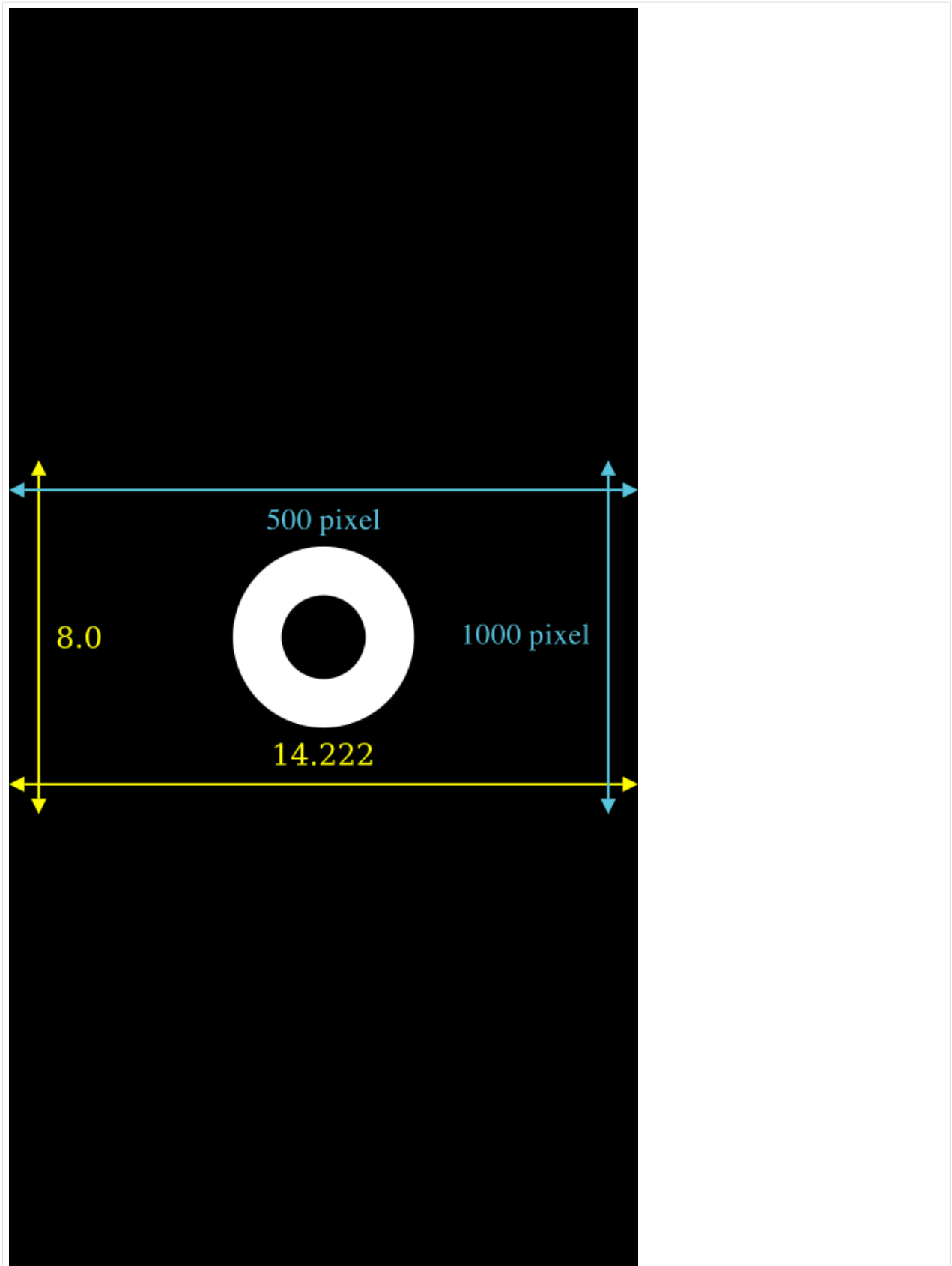
```
[11]: %%manim -v WARNING -s -r 1000,500 --disable_caching Example
#ratio of 2/1
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
        ↪height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_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

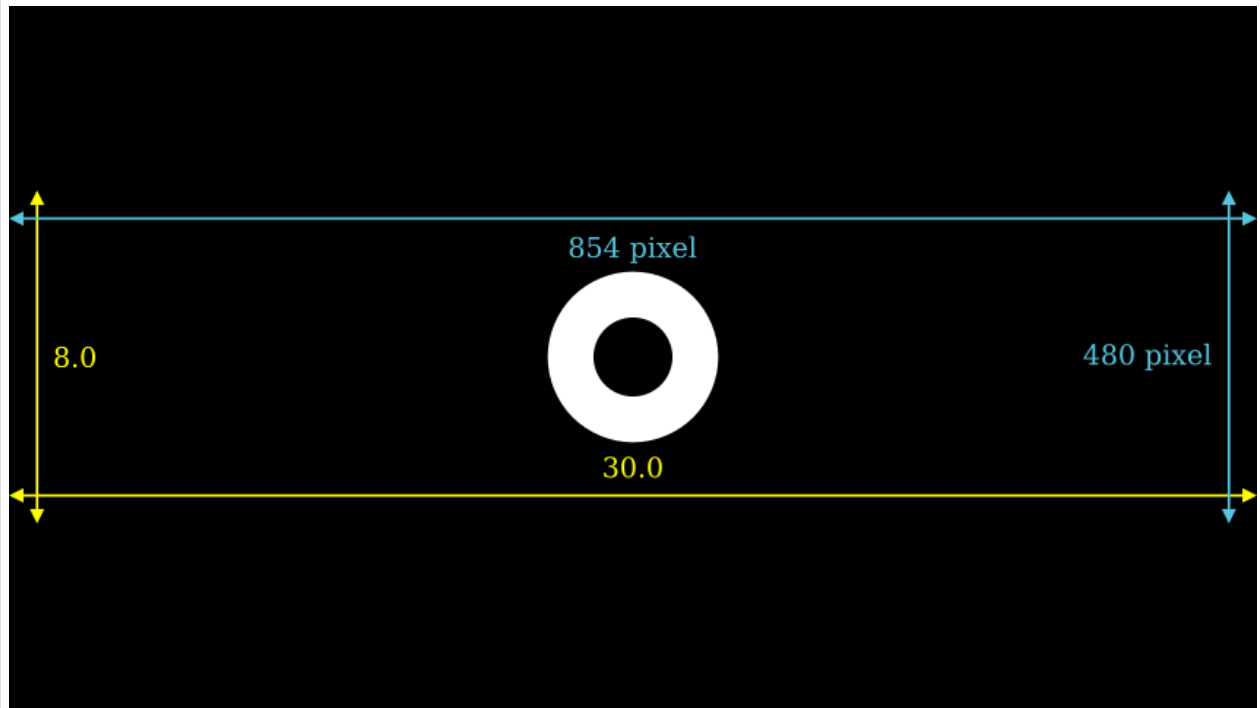


1.5.2 Changing the frame_width

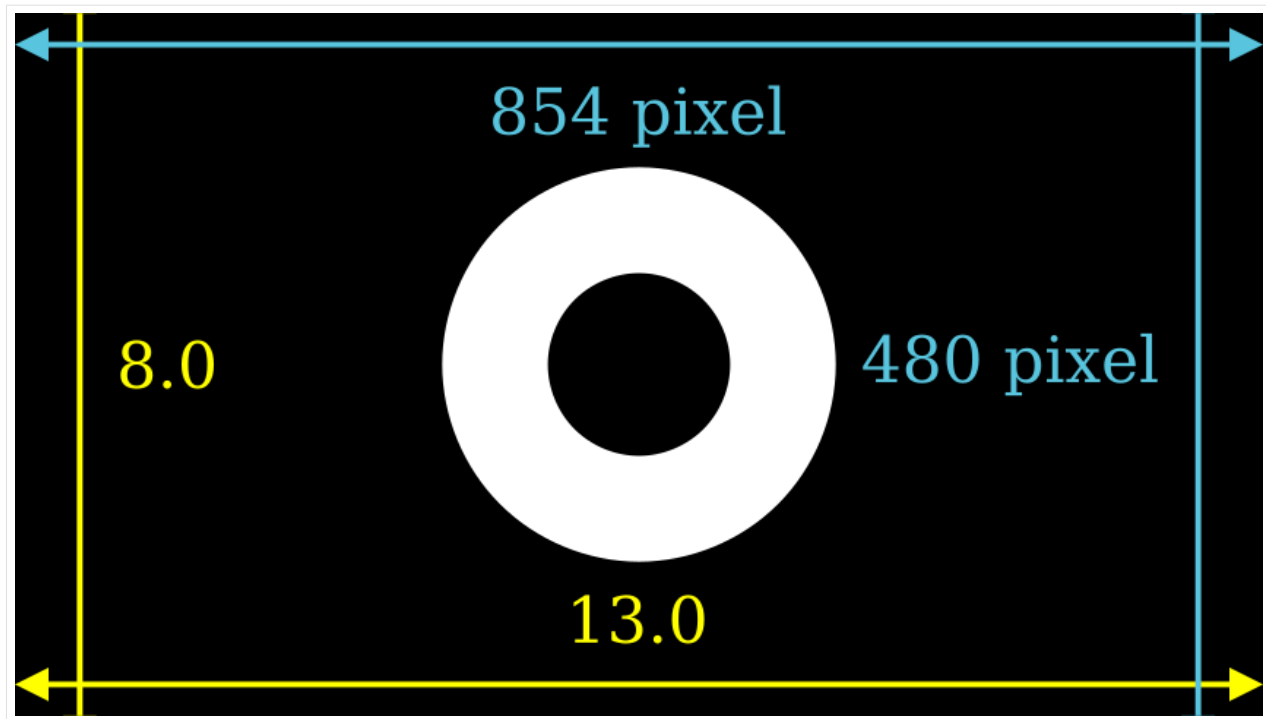
- Increasing the value `config.frame_width` will **zoom out** the Mobject
- Decreasing the value `config.frame_width` will **zoom in** the Mobject

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.

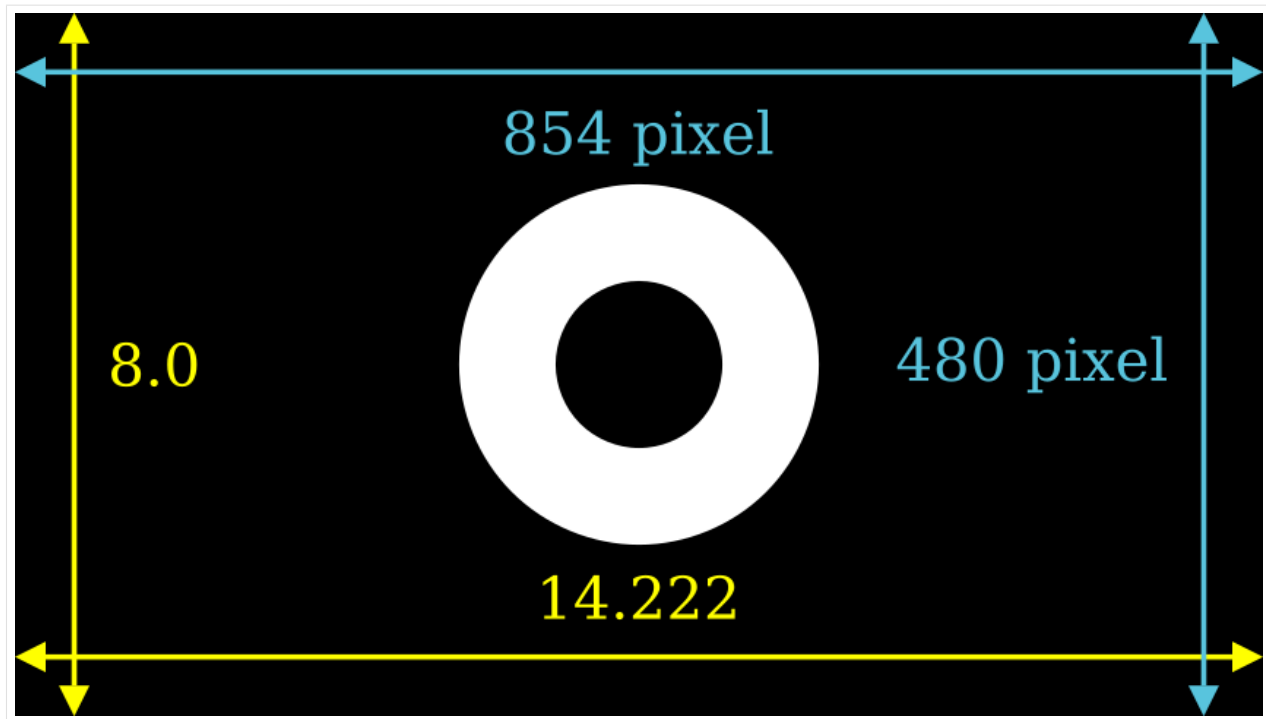
```
[14]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_width = 30
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
↪height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_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



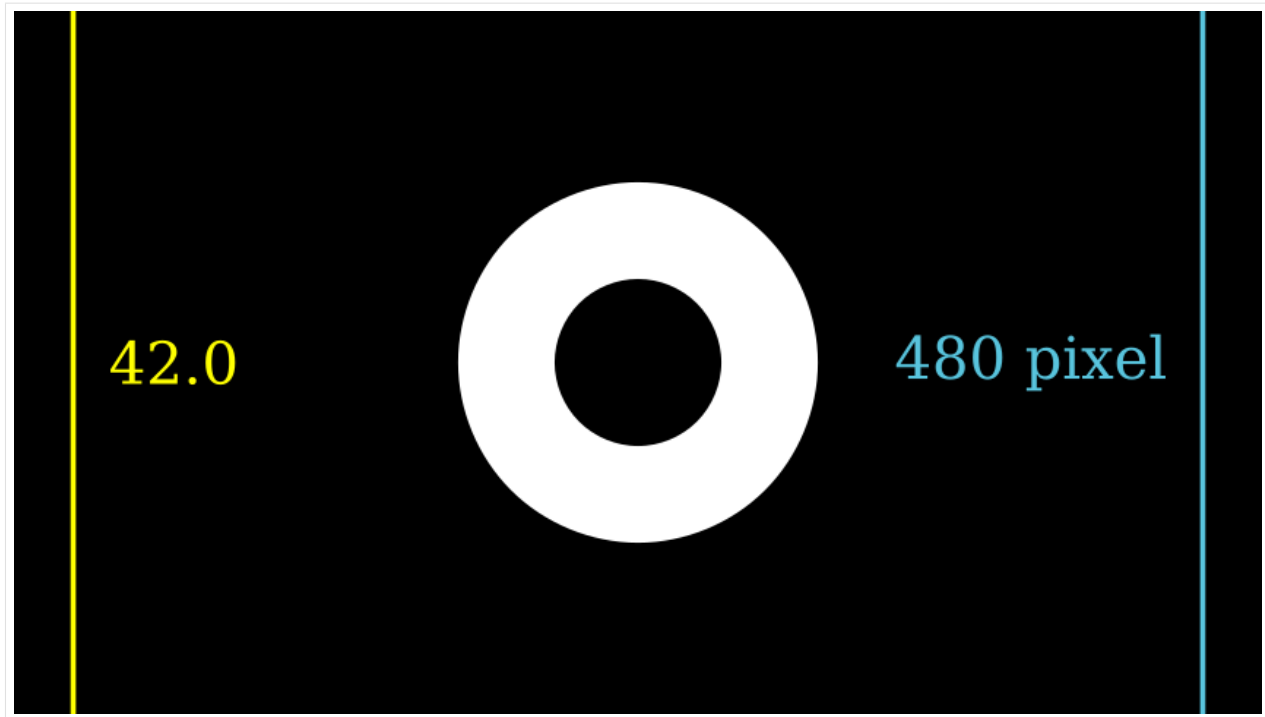
```
[16]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_width =14.22222
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
↪height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_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

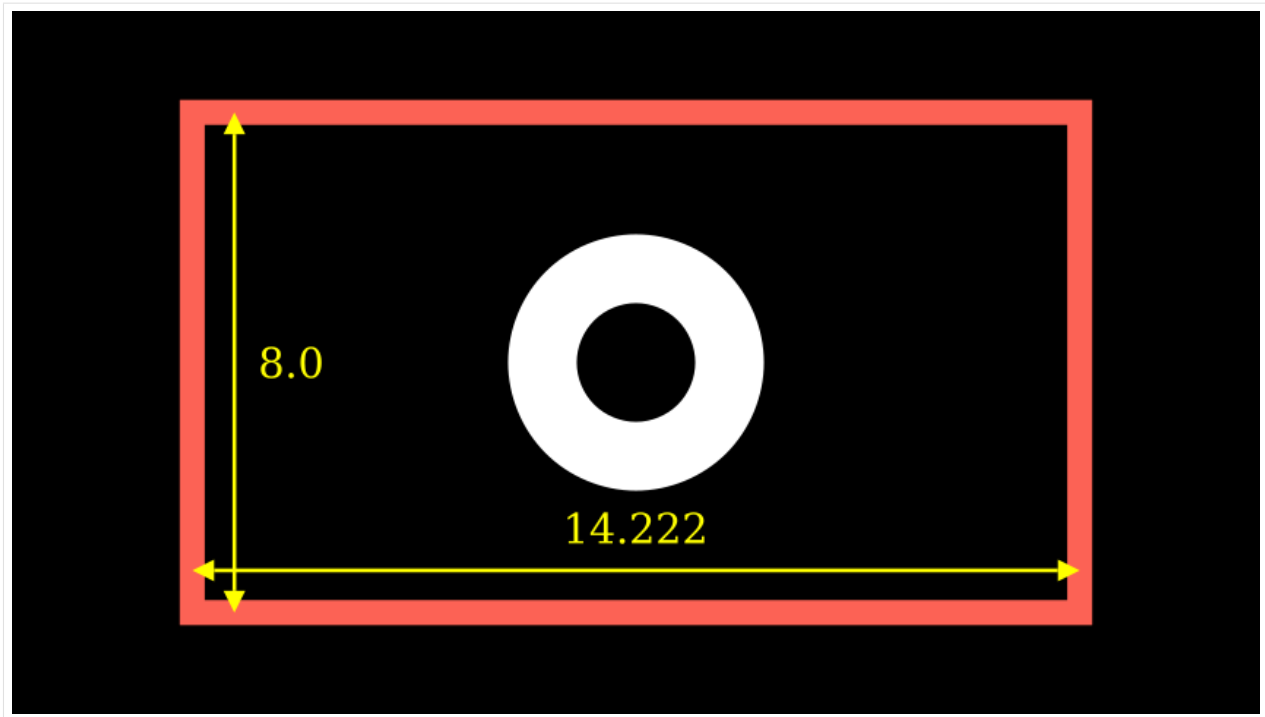
```
[17]: %%manim -v WARNING -s -ql --disable_caching Example
config.frame_height = 42
class Example(Scene):
    def construct(self):
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
        height)
        pixel_annotation= blue_pixel_annotation(config.frame_width,config.frame_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



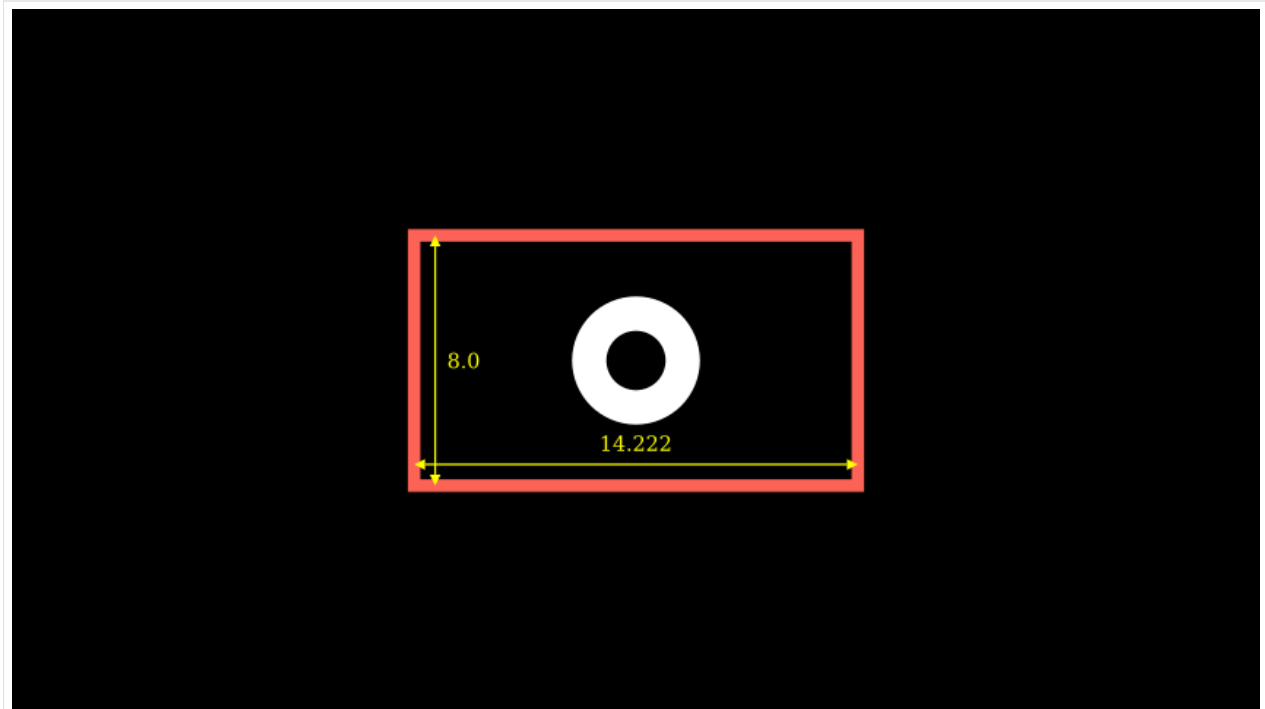
```
[18]: config.frame_height = 8 # resetting the frame_height value to default
```

1.5.3 Camera Scene

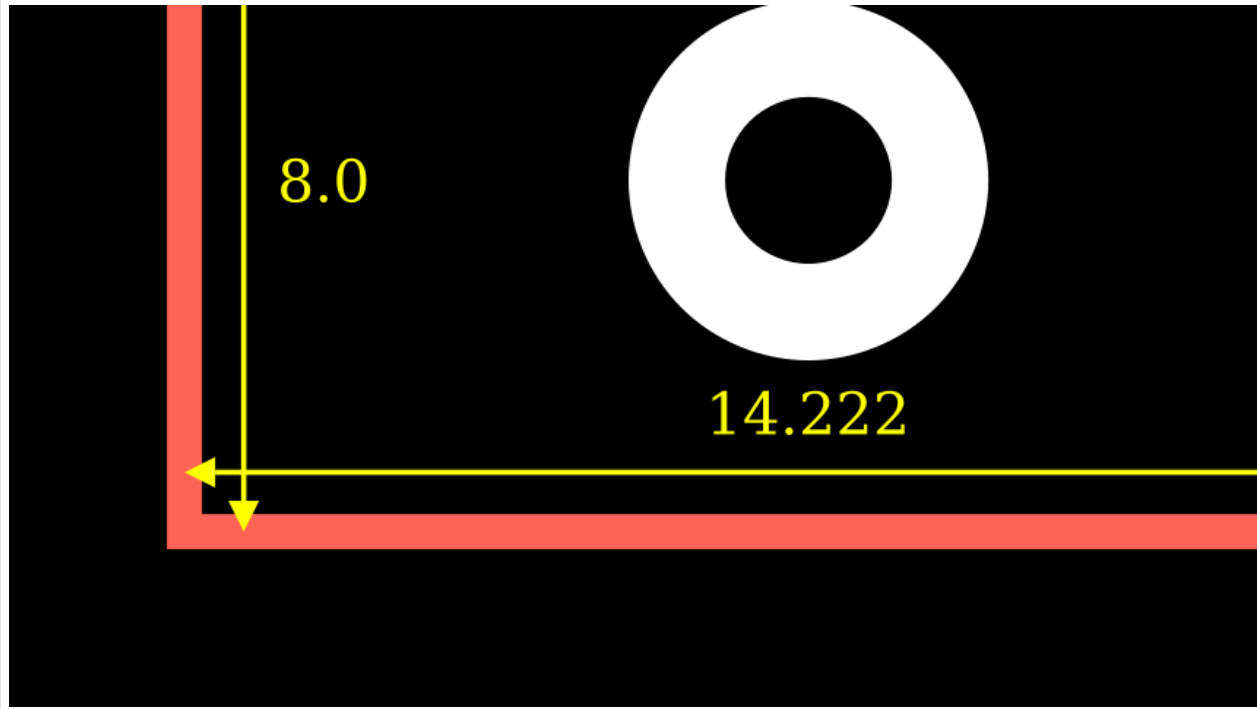
```
[19]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        self.camera.frame.set(width=20)
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
↪height)
        self.add(FullScreenRectangle(color=RED,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



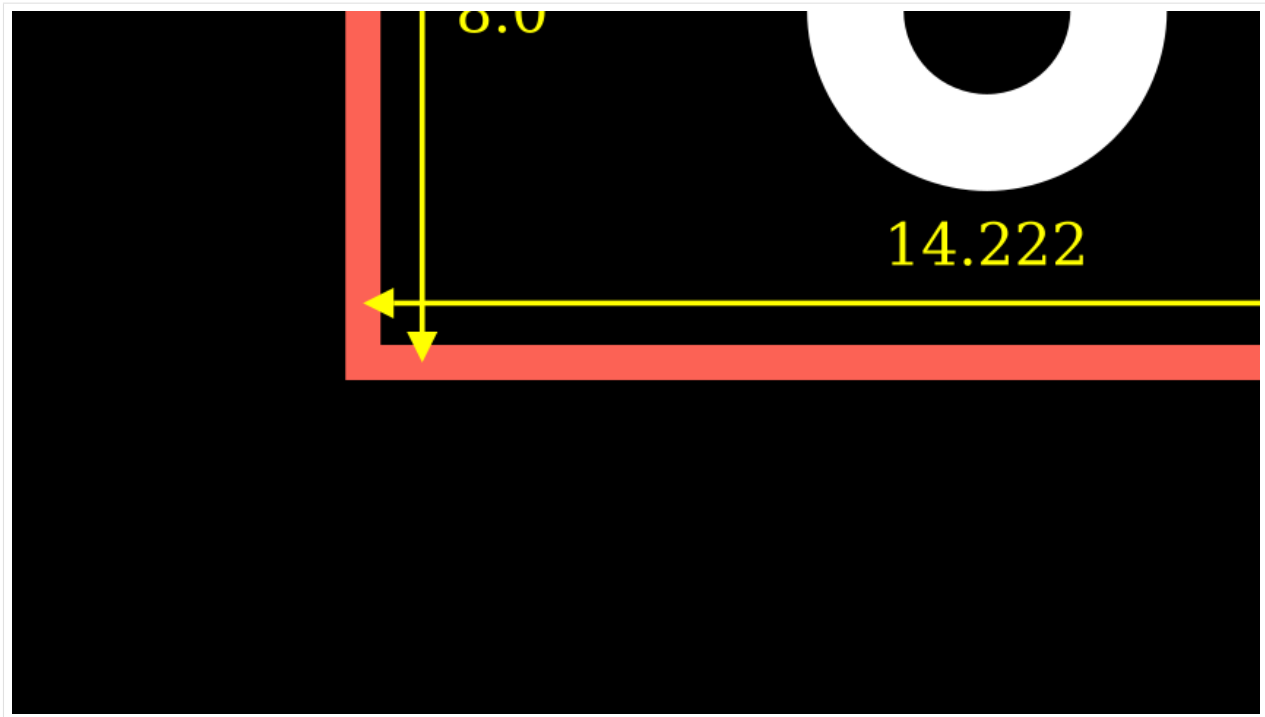
```
[20]: %%manim -v WARNING -s -ql --disable_caching Example
class Example(MovingCameraScene):
    def construct(self):
        self.camera.frame.set(width=40)
        frame_annotation= yellow_frame_annotation(config.frame_width,config.frame_
        ↪height)
        self.add(FullScreenRectangle(color=RED, 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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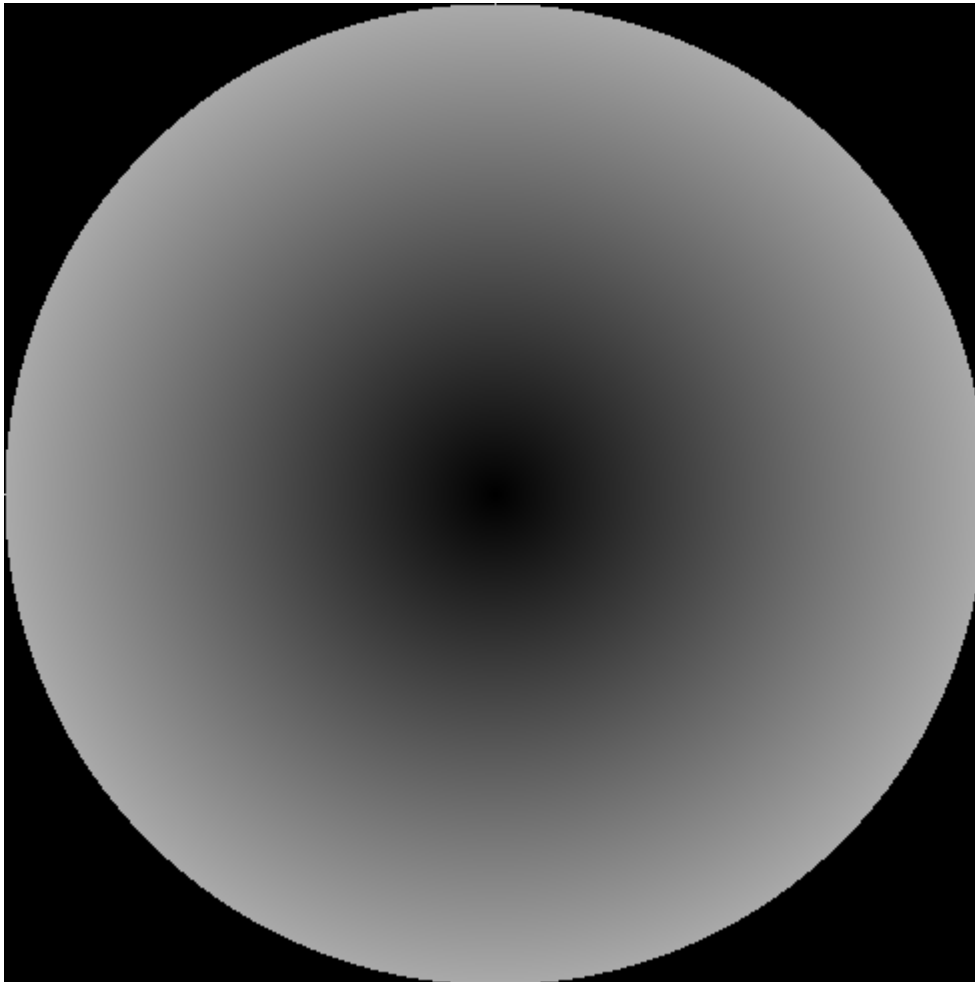
```
[2]: size=490
im = Image.new("RGB", (size,size))
radius = min(im.size)/2.0
cx, cy = im.size[0]/2, im.size[1]/2
pix = im.load()

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)
          im_hue = ImageMobject(hsv_hue_sat).set_z_index(-5)
          im_val = ImageMobject(hsv_value).set_z_index(-5)
```

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```

#     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.subobjects).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])))
        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()))

```

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```
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)

        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(
```

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```

        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)
/tmp/ipykernel_2662/4206570128.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)

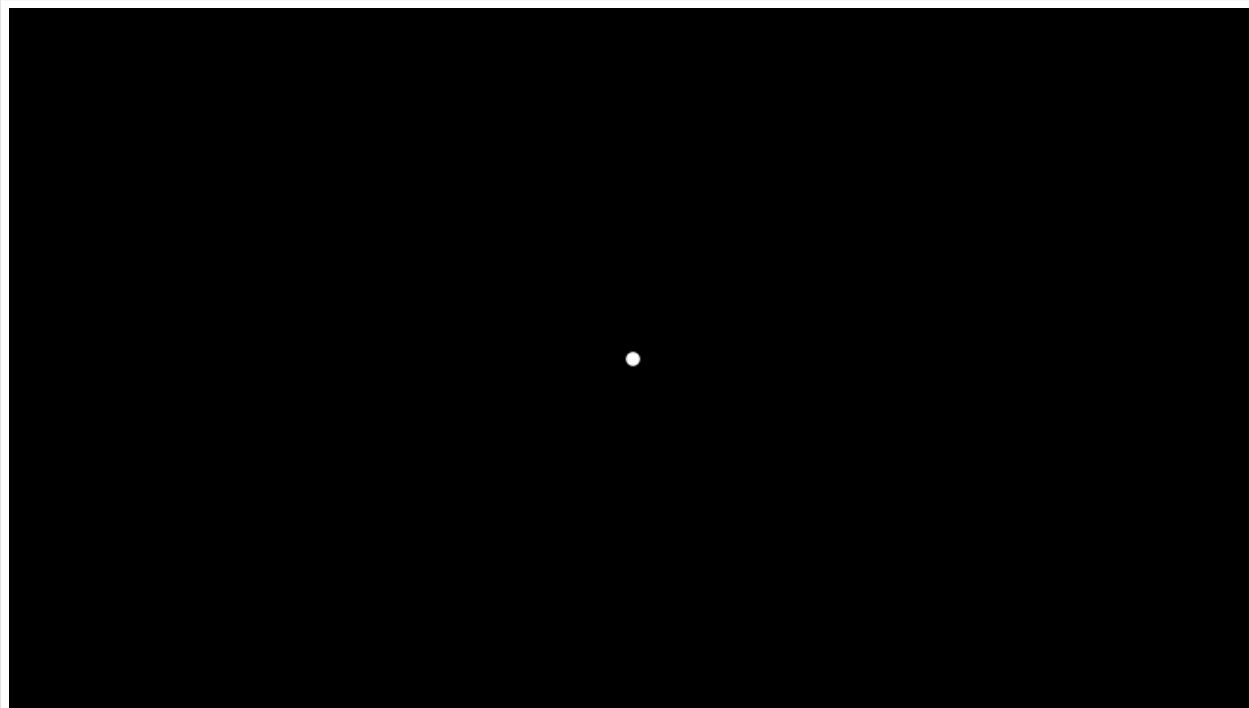
[1]: `from manim import *`

```
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.

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```

--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).

--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

-r, --resolution TEXT     Resolution in (W,H) for when 16:9 aspect
                           ratio isn't possible.

--fps, --frame_rate FLOAT Render at this frame rate.

--renderer [cairo|opengl|webgl]

                           Select a renderer for your Scene.

--use_opengl_renderer     Render scenes using OpenGL (Deprecated).

--use_webgl_renderer      Render scenes using the WebGL frontend
                           (Deprecated).

--webgl_renderer_path PATH The path to the WebGL frontend.

-g, --save_pngs           Save each frame as png (Deprecated).

-i, --save_as_gif         Save as a gif (Deprecated).

-s, --save_last_frame     Save last frame as png (Deprecated).

-t, --transparent        Render scenes with alpha channel.

--use_projection_fill_shaders Use shaders for OpenGLVMOobject fill which
                           are compatible with transformation matrices.

--use_projection_stroke_shaders Use shaders for OpenGLVMOobject stroke which
                           are compatible with transformation matrices.

```

Ease of access options:

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```
--progress_bar [display|leave|none]
                                Display progress bars and/or keep them
                                displayed.
-p, --preview                   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.
-f, --show_in_file_browser      Show the output file in the file browser.
--jupyter                       Using jupyter notebook magic.

Other options:
--help                           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