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1. Installation

```
pip install pillow
```

Verify Installation:

```
from PIL import Image
print(Image.__version__)
```

2. Import Pillow

```
from PIL import Image, ImageDraw, ImageFont, ImageFilter
```

3. Opening and Displaying an Image

```
img = Image.open('image.jpg')  
img.show()
```

4. Saving an Image

```
img.save('output.jpg')
```

5. Image Properties

```
print(img.format)      # Image format (JPEG, PNG)  
print(img.size)        # (width, height)  
print(img.mode)        # Color mode (RGB, L)
```

6. Resizing an Image

```
resized = img.resize((300, 200))  
resized.show()
```

7. Cropping an Image

```
cropped = img.crop((50, 50, 200, 200)) # (left, top, right, bottom)
cropped.show()
```

8. Rotating and Flipping

```
rotated = img.rotate(45)
flipped = img.transpose(Image.FLIP_LEFT_RIGHT)
rotated.show()
flipped.show()
```

9. Converting to Grayscale

```
gray = img.convert('L')
gray.show()
```

10. Drawing on Images

```
draw = ImageDraw.Draw(img)
draw.rectangle([50, 50, 150, 150], outline='red', width=5)
draw.text((10, 10), "Hello!", fill='white')
img.show()
```

11. Adding Filters

```
blurred = img.filter(ImageFilter.BLUR)
sharpened = img.filter(ImageFilter.SHARPEN)
blurred.show()
```

```
sharpened.show()
```

12. Adding Text (Custom Fonts)

```
font = ImageFont.truetype("arial.ttf", 40)
draw = ImageDraw.Draw(img)
draw.text((50, 50), "Hello World!", font=font, fill='blue')
img.show()
```

13. Creating a New Image

```
new_img = Image.new('RGB', (400, 300), color='green')
new_img.show()
```

14. Merging Images (Pasting)

```
background = Image.new('RGB', (500, 500), color='white')
foreground = img.resize((200, 200))
background.paste(foreground, (150, 150))
background.show()
```

15. Applying Transparency (Alpha Channel)

```
img = img.convert("RGBA")
pixels = img.load()

for y in range(img.height):
    for x in range(img.width):
        r, g, b, a = pixels[x, y]
        if r > 200 and g > 200:
```

```
pixels[x, y] = (r, g, b, 0) # Set transparent
```

```
img.show()
```

16. Thumbnail Generation

```
img.thumbnail((150, 150))  
img.show()
```

17. Drawing Shapes

```
draw = ImageDraw.Draw(img)  
draw.ellipse([100, 100, 200, 200], outline='yellow', width=4)  
draw.line((0, 0, img.width, img.height), fill='blue', width=3)  
img.show()
```

18. Image Blending

```
img1 = Image.open('image1.jpg')  
img2 = Image.open('image2.jpg')  
blended = Image.blend(img1, img2, alpha=0.5)  
blended.show()
```

19. Image Masking

```
mask = Image.new("L", img.size, 128) # 128 is 50% opacity  
img.putalpha(mask)  
img.show()
```

20. Combining Multiple Images (Grid Layout)

```
images = [Image.open('image1.jpg'), Image.open('image2.jpg')]
widths, heights = zip(*(i.size for i in images))

total_width = sum(widths)
max_height = max(heights)

combined = Image.new('RGB', (total_width, max_height))
x_offset = 0

for img in images:
    combined.paste(img, (x_offset, 0))
    x_offset += img.width

combined.show()
```

21. Image Metadata (EXIF)

```
exif_data = img._getexif()
for tag, value in exif_data.items():
    print(tag, value)
```

22. Key Pillow Functions

Function	Description
Image.open()	Opens an image file
Image.save()	Saves an image
resize()	Resizes an image
rotate()	Rotates an image

Function	Description
<code>crop()</code>	Crops an image
<code>convert()</code>	Converts image mode
<code>filter()</code>	Applies filters (BLUR, SHARPEN, etc.)
<code>transpose()</code>	Flips or rotates image
<code>draw.rectangle()</code>	Draws a rectangle
<code>putalpha()</code>	Adds transparency
<code>thumbnail()</code>	Creates a thumbnail
<code>paste()</code>	Pastes one image over another

Example: Simple Image Pipeline (Resize, Filter, Text)

```
img = Image.open('image.jpg')
img = img.resize((300, 300))
img = img.filter(ImageFilter.CONTOUR)

draw = ImageDraw.Draw(img)
draw.text((20, 20), 'OpenCV Rocks!', fill='blue')
img.show()
```