Introduction to Computer Vision
Lab 02: Drawing Functions

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Code Files:

1- Main
2- Optional/Extra
3- Report

Task 01: Drawing Ellipses

Description:

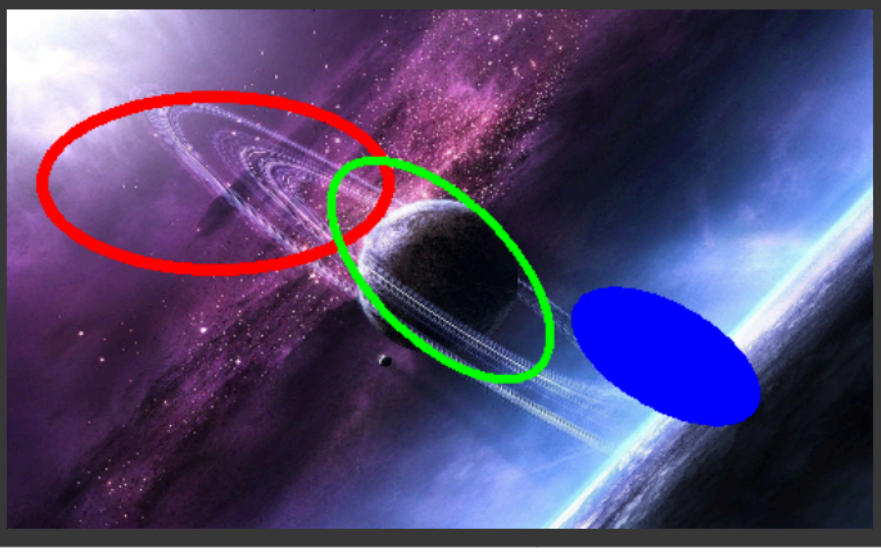
This code loads an image, resizes it to **500×300**, and then draws **three ellipses** with different styles:

- A **red ellipse** with a thick border.
- A **green ellipse** rotated at **45°** with a thinner border.
- A **blue ellipse** tilted at **30°** and **filled in completely**.

Finally, the modified image with all three ellipses is displayed.

Image:

```python
# Task 1

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

ellipses = [
    # center, axesLength, angle, startAngle, endAngle, color, thickness
    ((120, 100), (100, 50), 0,   0, 360, (0, 0, 255), 5),   # Red, thick
    ((250, 150), (80, 40), 45,  0, 360, (0, 255, 0), 3),   # Green, tilted
    ((380, 200), (60, 30), 30,  0, 360, (255, 0, 0), -1),  # Blue, filled
]

for (center, axes, angle, start, end, color, thick) in ellipses:
    cv2.ellipse(image, center, axes, angle, start, end, color, thick)

cv2_imshow(image)
```



Task 02: Converting Ellipses to Polygon

Description:

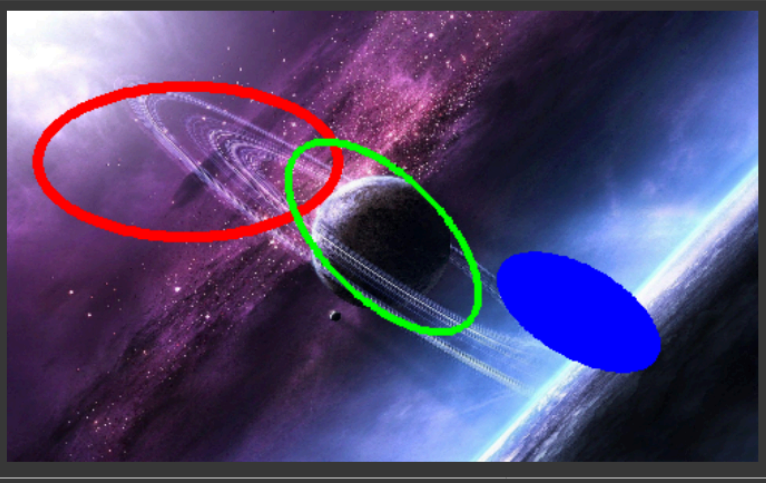
Here's what happens step by step:

1. The image is loaded and resized to **500×300**.
2. Three ellipses are defined (red, green, and blue with different sizes and angles).
3. For each ellipse:
    - `cv2.ellipse2Poly` generates a set of polygon points approximating the ellipse.
    - If the thickness is `-1`, the ellipse is **filled** using `cv2.fillPoly`.
    - Otherwise, only the **outline** is drawn with `cv2.polylines`.
4. The result is displayed, showing the same three ellipses, but created from polygonal approximations.

Task 1 draws ellipses directly, while Task 2 recreates them using polygonal approximations (points + polyline/polyfill).

Image:

```python
# Task 2

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

ellipses = [
    # center, axesLength, angle, startAngle, endAngle, color, thickness
    ((120, 100), (100, 50), 0,   0, 360, (0, 0, 255), 5),   # Red, thick
    ((250, 150), (80, 40), 45,  0, 360, (0, 255, 0), 3),   # Green, tilted
    ((380, 200), (60, 30), 30,  0, 360, (255, 0, 0), -1),  # Blue, filled
]

for (center, axes, angle, start, end, color, thick) in ellipses:
    points = cv2.ellipse2Poly(center, axes, angle, start, end, delta=2)
    if thick == -1:  # fill ellipse
        cv2.fillPoly(image, [points], color)
    else:  # draw ellipse outline
        cv2.polylines(image, [points], isClosed=True, color=color, thickness=thick)

cv2_imshow(image)
```



Task 03: Filling Convex Polygons

Description:

Here's what it does:

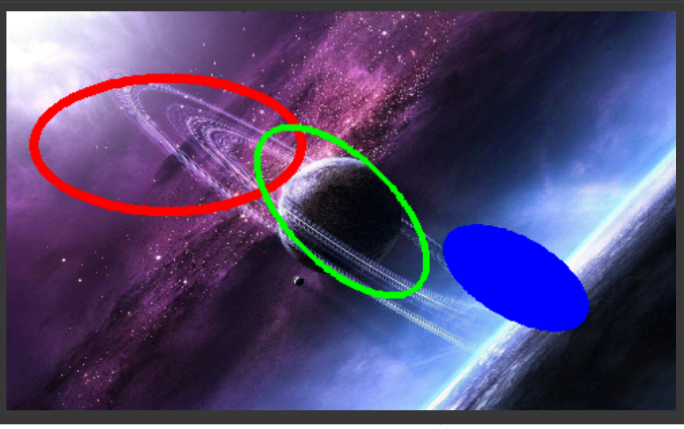
1. Loads the input image and resizes it to **500×300**.
2. Defines three ellipses (red, green, blue) with different sizes, orientations, and thickness styles.
3. For each ellipse:
    - Uses `cv2.ellipse2Poly` to generate polygon points along the ellipse boundary.
    - If `thickness == -1`, it uses **`cv2.fillConvexPoly`** to fill the ellipse area (blue one).
    - Otherwise, it uses **`cv2.polylines`** to draw only the outline (red and green ellipses).
4. Finally, displays the result with the three ellipses.

Difference from Task 2:

- Task 2 used `cv2.fillPoly` for filling.
- Task 3 uses `cv2.fillConvexPoly`, which is optimized for convex shapes like ellipses and guarantees proper filling without gaps.

Image:

```python
# Task 3

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

ellipses = [
    # center, axesLength, angle, startAngle, endAngle, color, thickness
    ((120, 100), (100, 50), 0,   0, 360, (0, 0, 255), 5),   # Red outline
    ((250, 150), (80, 40), 45,  0, 360, (0, 255, 0), 3),   # Green outline tilted
    ((380, 200), (60, 30), 30,  0, 360, (255, 0, 0), -1),  # Blue filled
]

for (center, axes, angle, start, end, color, thick) in ellipses:
    points = cv2.ellipse2Poly(center, axes, angle, start, end, delta=2)

    if thick == -1:
        cv2.fillConvexPoly(image, points, color)
    else:
        cv2.polylines(image, [points], isClosed=True, color=color, thickness=thick)

cv2_imshow(image)
```



Task 04: Drawing Rectangles

Description:

Here's what happens step by step:

1. The image is loaded and resized to **500×300**.
2. Two rectangles are defined in a list:
   - **Green rectangle** from `(100, 100)` to `(300, 200)` with outline thickness `2`.
   - **Red rectangle** from `(200, 150)` to `(400, 250)` with `-1` thickness, meaning it is **filled**.
3. A loop iterates through the rectangle definitions and uses `cv2.rectangle()` to draw each one.
4. The final image is displayed with both rectangles.

Image:

```python
# Task 4

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

start = (100, 100)
end = (300, 200)
color = (0, 255, 0)
thickness = 2

rectangle = [
    (( 100, 100), ( 300, 200), (0, 255, 0), 2),
    (( 200, 150), ( 400, 250), (0, 0, 255), -1),
]

for (start, end, color, thickness) in rectangle:
  cv2.rectangle(image, start, end, color, thickness)

cv2_imshow(image)
```

Task 05(a): Draw Lines

Description:

The image is loaded and resized to **500×300**.

A list of line definitions is created, where each entry contains:

- `start` and `end` coordinates
- `color` (BGR format)
- `thickness`

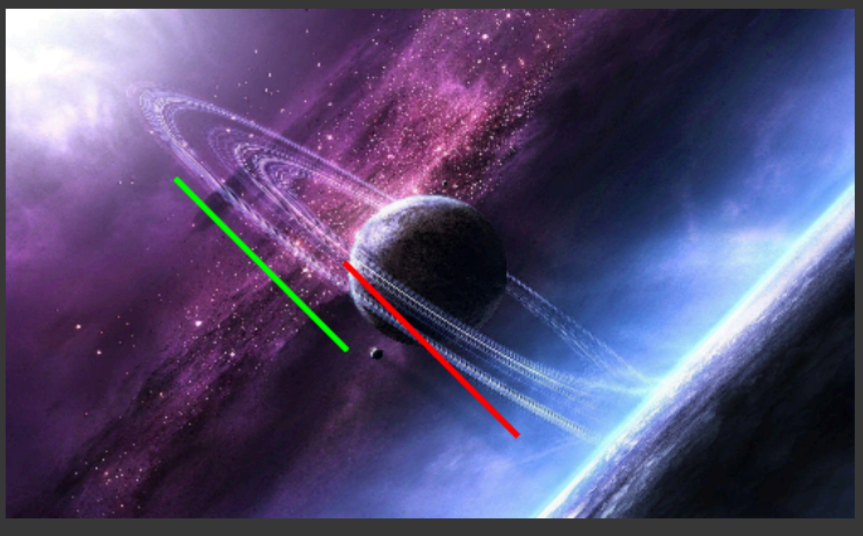
Two lines are drawn:

- A **green line** from `(100, 100)` to `(200, 200)` with thickness `2`.
- A **red line** from `(200, 150)` to `(300, 250)` with thickness `3`.

The modified image with both lines is displayed.

Image:

```python
# Task 5 ( Lines )

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

lines = [
    ((100, 100), (200, 200), (0, 255, 0), 2),
    ((200, 150), (300, 250), (0, 0, 255), 3),
]

for (start, end, color, thickness) in lines:
  cv2.line(image, start, end, color, thickness)

cv2_imshow(image)
```



Task 05(b): Draw Arrows

Description:

The image is loaded and resized to **500×300**.

A list of arrow definitions is created with:

- `start` and `end` coordinates
- `color` (in BGR)
- `thickness`

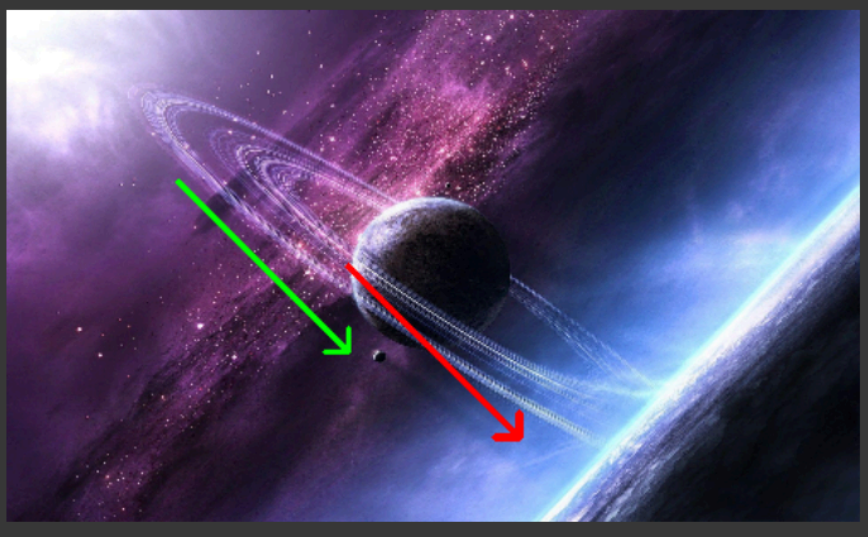
Two arrowed lines are drawn:

- A **green arrow** from `(100, 100)` to `(200, 200)` with thickness `2`.
- A **red arrow** from `(200, 150)` to `(300, 250)` with thickness `3`.

The final image displays both arrows.

Image:

```python
# Task 5 ( Arrows )

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

lines = [
    ((100, 100), (200, 200), (0, 255, 0), 2),
    ((200, 150), (300, 250), (0, 0, 255), 3),
]

for (start, end, color, thickness) in lines:
  cv2.arrowedLine(image, start, end, color, thickness)

cv2_imshow(image)
```



Task 06: Draw Polygons

Description:

The image is loaded and resized to **500×300**.

A list of polylines is defined, each with:

- A set of points `(x, y)` forming vertices
- A `color` in BGR format
- A `thickness` for the line width

Each polyline is converted to a **NumPy array** and reshaped to the format required by OpenCV: `(N, 1, 2)`.

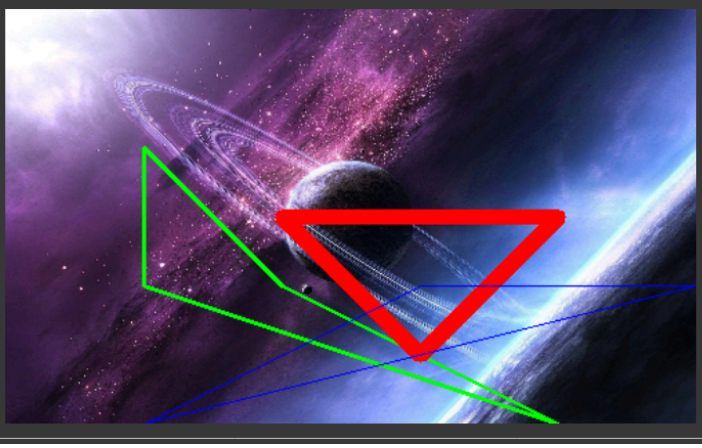
`cv2.polylines()` is used to draw each polyline, with `isClosed=True` meaning the last point connects back to the first.

The final image shows:

- A **green quadrilateral** with thickness 2.
- A **red triangle** with thickness 10.
- A **blue triangle** with thin lines (1).

Image:

```python
# Task 6

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

polylines = [
    ([(100, 100), (200, 200), (400, 300), (100, 200)], (0, 255, 0), 2),
    ([(200, 150), (300, 250), (400, 150)], (0, 0, 255), 10),
    ([(300, 200), (100, 300), (500, 200)], (255, 0, 0), 1),
]

for (points, color, thickness) in polylines:
    pts = np.array(points, np.int32)        # convert to NumPy array
    pts = pts.reshape((-1, 1, 2))           # reshape to (N,1,2)
    cv2.polylines(image, [pts], isClosed=True, color=color, thickness=thickness)

cv2_imshow(image)
```



Task 07: Write Text

Description:

The image is loaded and resized to **500×300**.

The text `"Hello, World!"` is defined along with font settings:

- **Font** → `cv2.FONT_HERSHEY_SIMPLEX`
- **Font scale** → `1`
- **Color** → White `(255, 255, 255)`
- **Thickness** → `2`
- **Line type** → `cv2.LINE_AA` for smooth edges

The size of the text is calculated using `cv2.getTextSize()`, and then `(text_x, text_y)` is computed to **center the text** in the image.

`cv2.putText()` is used to render the text on the image.

The final image shows the **centered white text** `"Hello, World!"`.

Image:

```python
# Task 7

image = cv2.imread("/content/P8ORt6M.jpg")
image = cv2.resize(image, (500, 300))

text = "Hello, World!"

font = cv2.FONT_HERSHEY_SIMPLEX
font_scale = 1
color = (255, 255, 255)
thickness = 2
line_type = cv2.LINE_AA

text_size, _ = cv2.getTextSize(text, font, font_scale, thickness)
text_x = (image.shape[1] - text_size[0]) // 2
text_y = (image.shape[0] + text_size[1]) // 2

cv2.putText(image, text, (text_x, text_y), font, font_scale, color, thickness, line_type)

cv2_imshow(image)
```