Visualizing the Convex Hull

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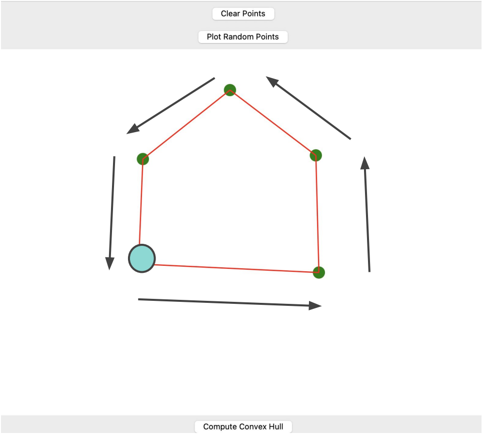
Calculating the Convex Hull

Gift Wrapping

1. Start with the bottom most left most point (lowest x, lowest y)
2. Use the cross product to determine what point is more counterclockwise
3. Do this until you return to the point you started at



Code Behind Our Project

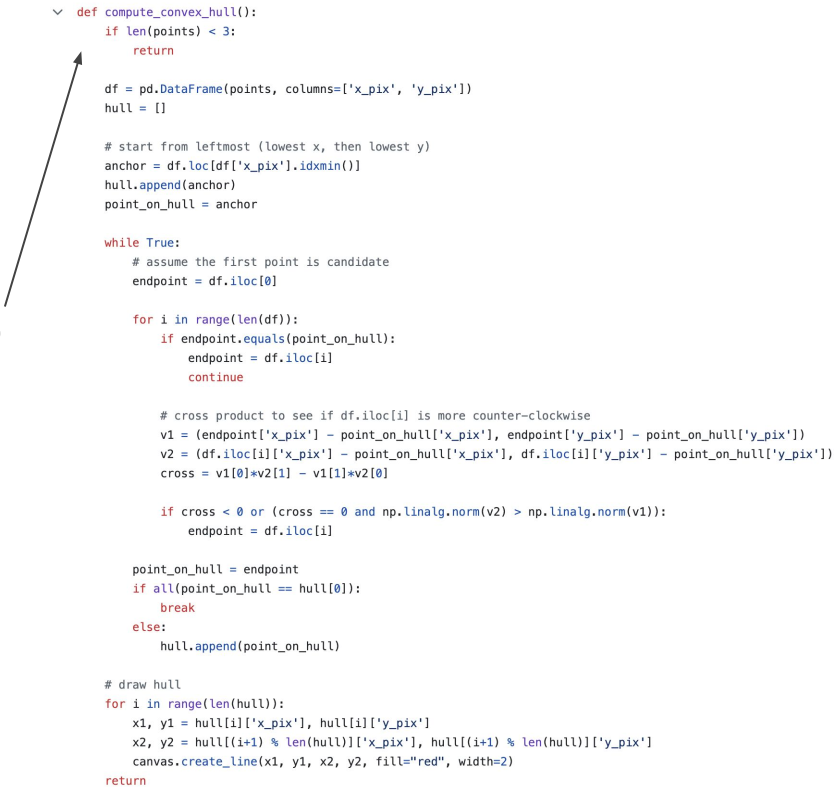
2 Options

1. Either choose your own points
2. Randomly generate points

Calculate the cross products to determine what point to go to next (used compute_convex_hull())

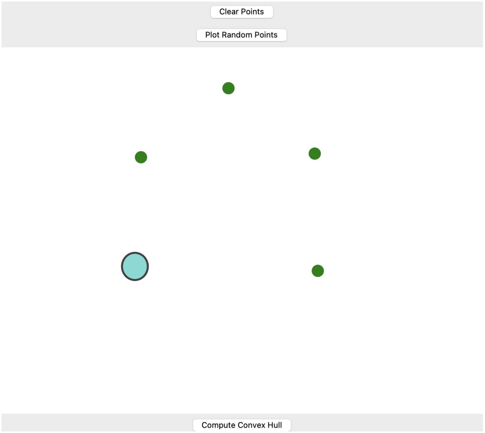
Draw the Line :)

Link to the code

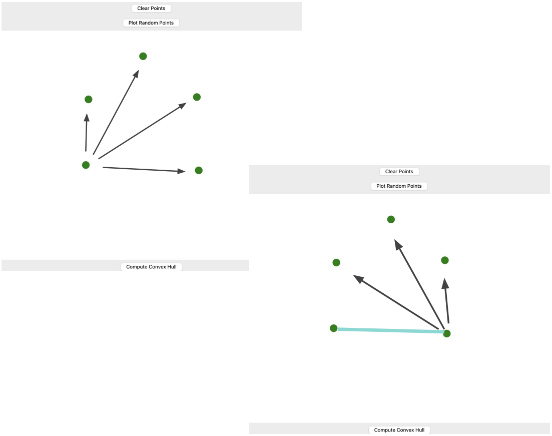


```
def compute_convex_hull():
    if len(points) < 3:
        return

    df = pd.DataFrame(points, columns=['x_pix', 'y_pix'])
    hull = []

    # start from leftmost (lowest x, then lowest y)
    anchor = df.loc[df['x_pix'].idxmin()]
    hull.append(anchor)
    point_on_hull = anchor

    while True:
        # assume the first point is candidate
        endpoint = df.iloc[0]

        for i in range(len(df)):
            if endpoint.equals(point_on_hull):
                endpoint = df.iloc[i]
                continue

            # cross product to see if df.iloc[i] is more counter-clockwise
            v1 = (endpoint['x_pix'] - point_on_hull['x_pix'], endpoint['y_pix'] - point_on_hull['y_pix'])
            v2 = (df.iloc[i]['x_pix'] - point_on_hull['x_pix'], df.iloc[i]['y_pix'] - point_on_hull['y_pix'])
            cross = v1[0]*v2[1] - v1[1]*v2[0]

            if cross < 0 or (cross == 0 and np.linalg.norm(v2) > np.linalg.norm(v1)):
                endpoint = df.iloc[i]

        point_on_hull = endpoint
        if all(point_on_hull == hull[0]):
            break
        else:
            hull.append(point_on_hull)

    # draw hull
    for i in range(len(hull)):
        x1, y1 = hull[i]['x_pix'], hull[i]['y_pix']
        x2, y2 = hull[(i+1) % len(hull)]['x_pix'], hull[(i+1) % len(hull)]['y_pix']
        canvas.create_line(x1, y1, x2, y2, fill="red", width=2)
    return
```

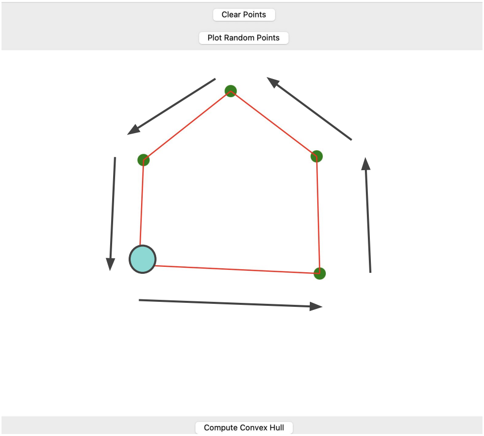
Example (User Picks Points)



Start at the bottom most left most point

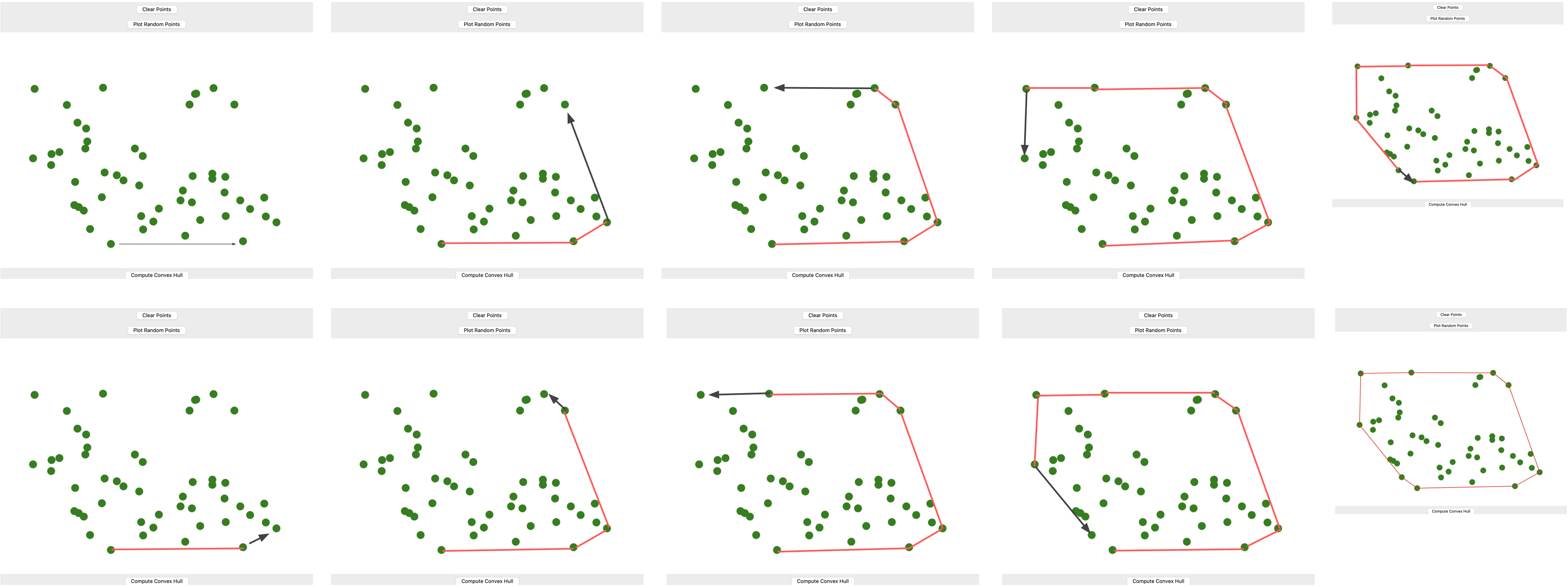


Calculate the cross product and choose the point that is the most counter clockwise



Repeat at each point until you return to the starting point

Example (Random Points)


Clear Points
Plot Random Points
Compute Convex Hull