arch_calculator_v4

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1 Arch Calculator:

1.1 A Python program for calculating coordinates of arches

1.2 More documentation to come shortly!

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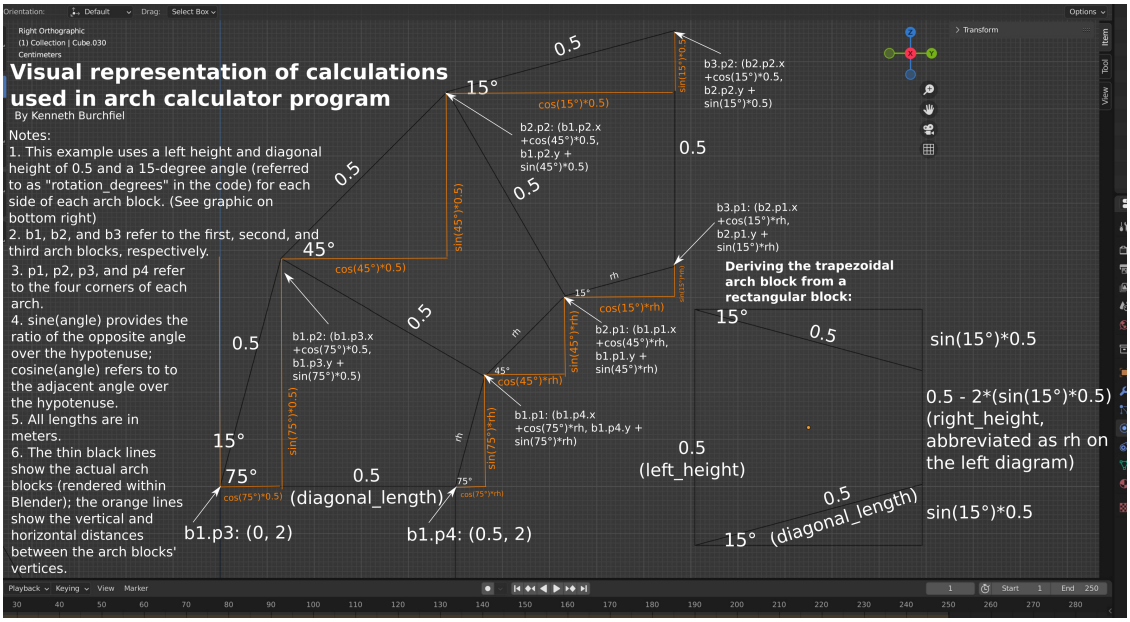
[ ]:
```
import math
dtr = math.pi/180 # Converts degrees to radians;
# useful because math.tan, math.sin, and math.cos take radian inputs.
import matplotlib.pyplot as plt
from matplotlib.patches import Polygon # From https://matplotlib.org/stable/
↪gallery/shapes_and_collections/patch_collection.
↪html#sphx-glr-gallery-shapes-and-collections-patch-collection-py
from matplotlib.collections import PatchCollection
from IPython.display import Image # from: Magno Naoli at:
# https://stackoverflow.com/a/62985628/13097194
```

[ ]:
```
# The image display code below comes from Magno Naoli at:
# https://stackoverflow.com/a/62985628/13097194
Image(filename = 'annotated_arch_output.png')
```

[ ]:



[ ]:
```
class Arch_block:
    def __init__(self, left_height = 0.5, diagonal_length = 0.5, p4 = (0.5, 2),␣
↪p3 = (0, 2), rotation_degrees = 15, rotation_multiplier = 1):
        self.left_height = left_height
        self.rotation_degrees = rotation_degrees
        self.diagonal_length = diagonal_length
        self.right_height = left_height - 2*(math.sin(rotation_degrees *␣
↪dtr))*diagonal_length
        self.p4 = p4
        self.p3 = p3
        # self.p3 = (p4[0] - diagonal_length, p4[1])
        self.p1 = (self.p4[0] + math.cos((90-rotation_degrees *␣
↪rotation_multiplier)*dtr) * self.right_height, self.p4[1] + math.sin((90 -␣
↪rotation_degrees * rotation_multiplier)*dtr) * self.right_height)
        self.p2 = (self.p3[0] + math.cos((90-rotation_degrees *␣
↪rotation_multiplier)*dtr) * self.left_height, self.p3[1] + math.sin((90 -␣
↪rotation_degrees * rotation_multiplier)*dtr) * self.left_height)
    def __str__(self):
        return '{} {} {} {} {} {} {} {}'.format("P1:", self.p1, "P2:", self.p2,␣
↪"P3:", self.p3, "P4:", self.p4)
        # The .format() function converts the tuple values into a string.
        # See https://stackoverflow.com/a/39884000/13097194
```

[ ]:
```
def create_arch(rotation_degrees, starting_p4, starting_p3, arch_count,␣
↪left_height, diagonal_length):
```

```
    arch_block_list = []
    for i in range(arch_count):
        if i == 0:
            arch_block_list.append(Arch_block(left_height = left_height,␣
↪diagonal_length=diagonal_length, p4 = starting_p4, p3=starting_p3,␣
↪rotation_degrees = rotation_degrees, rotation_multiplier = 1))
        else:
            arch_block_list.append(Arch_block(left_height = left_height,␣
↪diagonal_length=diagonal_length, p4 = arch_block_list[-1].p1,␣
↪p3=arch_block_list[-1].p2, rotation_degrees = rotation_degrees,␣
↪rotation_multiplier = 1 + i*2))

    return arch_block_list
```

[ ]:
```
three_block_arch = create_arch(rotation_degrees = 15, starting_p4 = (0.5, 2),␣
↪starting_p3 = (0, 2), left_height = 0.5, diagonal_length = 0.5, arch_count =␣
↪3)
```

[ ]:
```
[three_block_arch[0].p1[0], three_block_arch[0].p2[0], three_block_arch[0].
↪p3[0], three_block_arch[0].p4[0]]
```

[ ]:
```
[0.5624222244434797, 0.12940952255126037, 0, 0.5]
```

[ ]:
```
min([three_block_arch[0].p1[0], three_block_arch[0].p2[0], three_block_arch[0].
↪p3[0], three_block_arch[0].p4[0]])
```

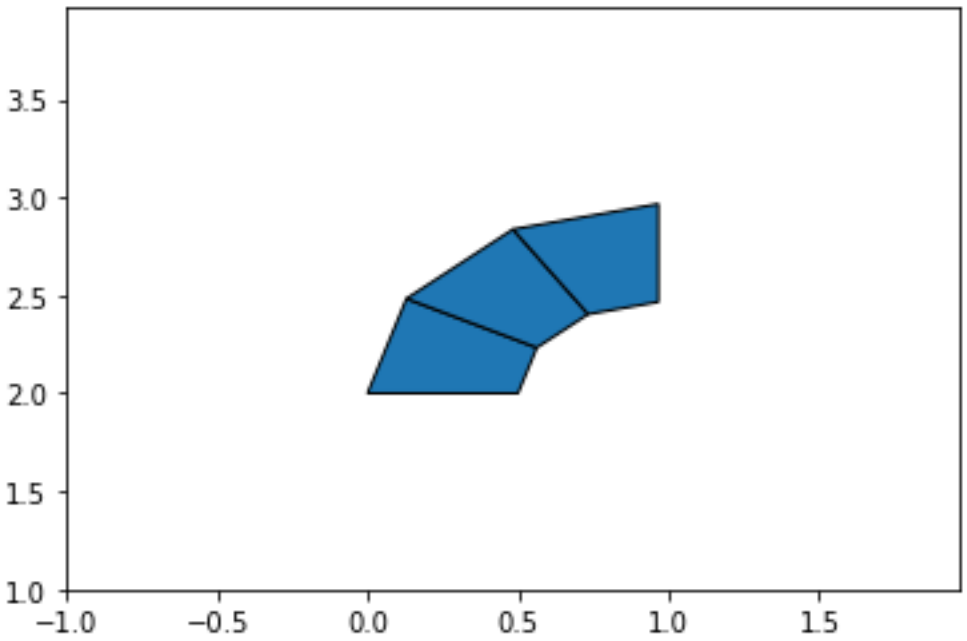
[ ]:
```
0
```

[ ]:
```
def print_and_plot_points(arch_block_list, image_name):
    for i in range(len(arch_block_list)):
        if i == 0:
            xmax = max([arch_block_list[i].p1[0], arch_block_list[i].p2[0],␣
↪arch_block_list[i].p3[0], arch_block_list[i].p4[0]])
            xmin = min([arch_block_list[i].p1[0], arch_block_list[i].p2[0],␣
↪arch_block_list[i].p3[0], arch_block_list[i].p4[0]])
            ymax = max([arch_block_list[i].p1[1], arch_block_list[i].p2[1],␣
↪arch_block_list[i].p3[1], arch_block_list[i].p4[1]])
            ymin = min([arch_block_list[i].p1[1], arch_block_list[i].p2[1],␣
↪arch_block_list[i].p3[1], arch_block_list[i].p4[1]])
        else:
            local_xmax = max([arch_block_list[i].p1[0], arch_block_list[i].
↪p2[0], arch_block_list[i].p3[0], arch_block_list[i].p4[0]])
            local_xmin = min([arch_block_list[i].p1[0], arch_block_list[i].
↪p2[0], arch_block_list[i].p3[0], arch_block_list[i].p4[0]])
            local_ymax = max([arch_block_list[i].p1[1], arch_block_list[i].
↪p2[1], arch_block_list[i].p3[1], arch_block_list[i].p4[1]])
```

```
            local_ymin = min([arch_block_list[i].p1[1], arch_block_list[i].
↪p2[1], arch_block_list[i].p3[1], arch_block_list[i].p4[1]])
            if local_xmax > xmax:
                xmax = local_xmax
            if local_xmin < xmin:
                xmin = local_xmin
            if local_ymax > ymax:
                ymax = local_ymax
            if local_ymin < ymin:
                ymin = local_ymin
        print("Block number",str(i)+":")
        print(arch_block_list[i])
    patches = []
    # Based on: https://stackoverflow.com/questions/43971259/
↪how-to-draw-polygons-with-python
    # and; https://stackoverflow.com/a/68532480/13097194
    fig, ax = plt.subplots()
    fig.set_facecolor('white')
    for arch_block in arch_block_list:
        arch_block_polygon = Polygon([arch_block.p1, arch_block.p2, arch_block.
↪p3, arch_block.p4], edgecolor = 'black', closed = 'True')
        ax.add_patch(arch_block_polygon)
    plt.xlim(xmin - 1, xmax + 1)
    plt.ylim(ymin -1, ymax + 1)
    plt.savefig(str(image_name)+'.png')
```

[ ]:
```
print_and_plot_points(three_block_arch,'three_block_arch')
```

```
Block number 0:
P1: (0.5624222244434797, 2.2329629131445343) P2: (0.12940952255126037,
2.4829629131445343) P3: (0, 2) P4: (0.5, 2)
Block number 1:
P1: (0.7329629131445341, 2.4035036018455886) P2: (0.48296291314453416,
2.8365163037378083) P3: (0.12940952255126037, 2.4829629131445343) P4:
(0.5624222244434797, 2.2329629131445343)
Block number 2:
P1: (0.9659258262890683, 2.465925826289068) P2: (0.9659258262890683,
2.9659258262890686) P3: (0.48296291314453416, 2.8365163037378083) P4:
(0.7329629131445341, 2.4035036018455886)
```

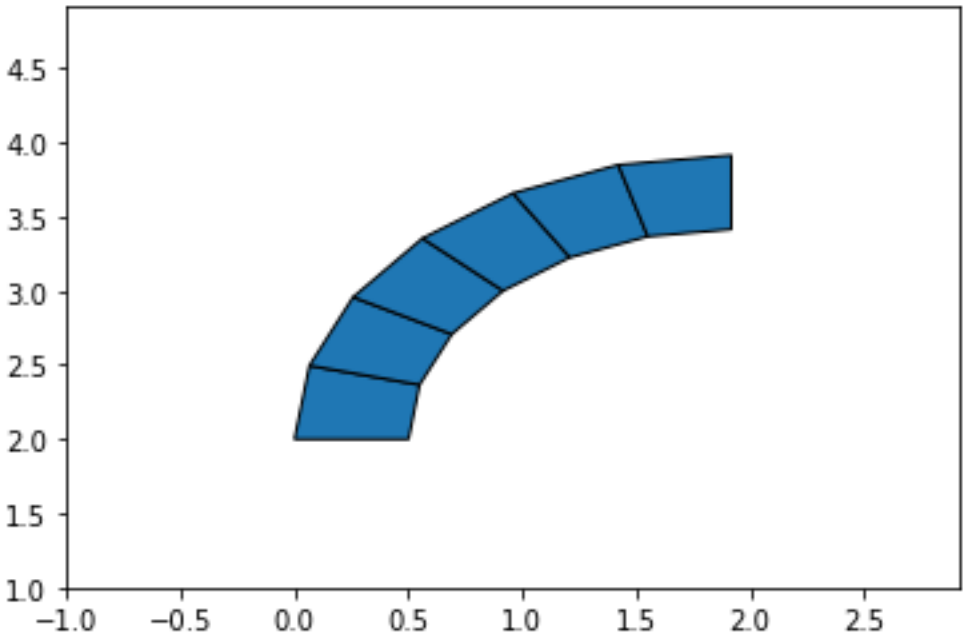


[ ]:
```
six_block_arch = create_arch(rotation_degrees = 7.5, starting_p4 = (0.5, 2),␣
↪starting_p3 = (0, 2), left_height = 0.5, diagonal_length = 0.5, arch_count =␣
↪6)
```

[ ]:
```
print_and_plot_points(six_block_arch,'six_block_arch')
```

```
Block number 0:
P1: (0.54822600925456, 2.3663129081356447) P2: (0.06526309611002586,
2.495722430686905) P3: (0, 2) P4: (0.5, 2)
Block number 1:
P1: (0.6896175141847901, 2.7076621969425485) P2: (0.25660481229257076,
2.9576621969425485) P3: (0.06526309611002586, 2.495722430686905) P4:
(0.54822600925456, 2.3663129081356447)
Block number 2:
P1: (0.9145389173902049, 3.0007854764948925) P2: (0.560985526796931,
3.354338867088166) P3: (0.25660481229257076, 2.9576621969425485) P4:
(0.6896175141847901, 2.7076621969425485)
Block number 3:
P1: (1.2076621969425487, 3.2257068797003075) P2: (0.9576621969425486,
3.658719581592526) P3: (0.560985526796931, 3.354338867088166) P4:
(0.9145389173902049, 3.0007854764948925)
Block number 4:
P1: (1.5490114857494526, 3.3670983846305376) P2: (1.419601963198192,
3.850061297775071) P3: (0.9576621969425486, 3.658719581592526) P4:
(1.2076621969425487, 3.2257068797003075)
Block number 5:
```

```
P1: (1.9153243938850975, 3.4153243938850975) P2: (1.9153243938850972,
3.915324393885097) P3: (1.419601963198192, 3.850061297775071) P4:
(1.5490114857494526, 3.3670983846305376)
```

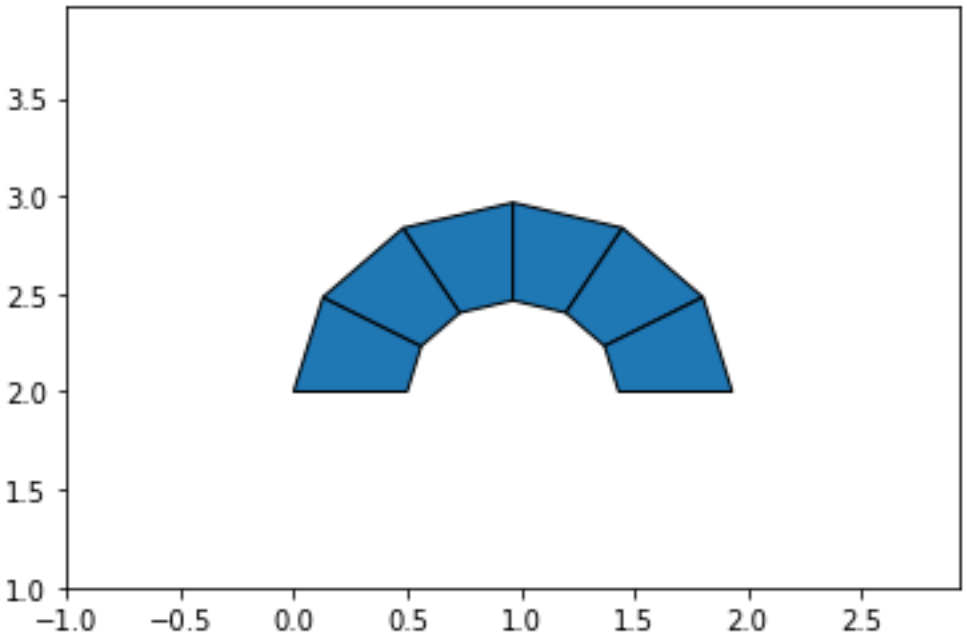


[ ]:
```
full_arch = create_arch(rotation_degrees = 15, starting_p4 = (0.5, 2),␣
↪starting_p3 = (0, 2), left_height = 0.5, diagonal_length = 0.5, arch_count =␣
↪6)
```

[ ]:
```
print_and_plot_points(full_arch, 'full_arch')
```

```
Block number 0:
P1: (0.5624222244434797, 2.2329629131445343) P2: (0.12940952255126037,
2.4829629131445343) P3: (0, 2) P4: (0.5, 2)
Block number 1:
P1: (0.7329629131445341, 2.4035036018455886) P2: (0.48296291314453416,
2.8365163037378083) P3: (0.12940952255126037, 2.4829629131445343) P4:
(0.5624222244434797, 2.2329629131445343)
Block number 2:
P1: (0.9659258262890683, 2.465925826289068) P2: (0.9659258262890683,
2.9659258262890686) P3: (0.48296291314453416, 2.8365163037378083) P4:
(0.7329629131445341, 2.4035036018455886)
Block number 3:
P1: (1.1988887394336025, 2.4035036018455886) P2: (1.4488887394336025,
2.8365163037378083) P3: (0.9659258262890683, 2.9659258262890686) P4:
(0.9659258262890683, 2.465925826289068)
Block number 4:
```

```
P1: (1.369429428134657, 2.2329629131445343) P2: (1.8024421300268763,
2.4829629131445343) P3: (1.4488887394336025, 2.8365163037378083) P4:
(1.1988887394336025, 2.4035036018455886)
Block number 5:
P1: (1.4318516525781368, 2.0) P2: (1.9318516525781366, 2.0) P3:
(1.8024421300268763, 2.4829629131445343) P4: (1.369429428134657,
2.2329629131445343)
```



[ ]:
```
octagonal_walls = create_arch(rotation_degrees = 22.5, starting_p4 = (1.5, 4),␣
↪starting_p3 = (1, 4), left_height = 2, diagonal_length = 0.5, arch_count = 8)
```

[ ]:
```
print_and_plot_points(octagonal_walls,'octagonal_walls')
```

```
Block number 0:
P1: (2.118920255323453, 5.4942056744293) P2: (1.7653668647301797,
5.847759065022574) P3: (1, 4) P4: (1.5, 4)
Block number 1:
P1: (3.613125929752753, 6.113125929752753) P2: (3.613125929752753,
6.613125929752753) P3: (1.7653668647301797, 5.847759065022574) P4:
(2.118920255323453, 5.4942056744293)
Block number 2:
P1: (5.107331604182053, 5.4942056744293) P2: (5.460884994775327,
5.847759065022574) P3: (3.613125929752753, 6.613125929752753) P4:
(3.613125929752753, 6.113125929752753)
Block number 3:
P1: (5.726251859505506, 4.0) P2: (6.226251859505506, 4.0) P3:
```

```
(5.460884994775327, 5.847759065022574) P4: (5.107331604182053, 5.4942056744293)
Block number 4:
P1: (5.107331604182053, 2.5057943255707) P2: (5.460884994775327,
2.1522409349774265) P3: (6.226251859505506, 4.0) P4: (5.726251859505506, 4.0)
Block number 5:
P1: (3.613125929752753, 1.8868740702472464) P2: (3.6131259297527536,
1.3868740702472468) P3: (5.460884994775327, 2.1522409349774265) P4:
(5.107331604182053, 2.5057943255707)
Block number 6:
P1: (2.118920255323453, 2.5057943255706996) P2: (1.76536686473018,
2.152240934977426) P3: (3.6131259297527536, 1.3868740702472468) P4:
(3.613125929752753, 1.8868740702472464)
Block number 7:
P1: (1.5000000000000004, 3.999999999999999) P2: (1.0000000000000009, 4.0) P3:
(1.76536686473018, 2.152240934977426) P4: (2.118920255323453,
2.5057943255706996)
```