Serial No. 9

Date: 02/02/2024

Aim: To compute the m-th roots of unity for m=2,3,4.

Language: Python3

Packages used: sys, cmath, numpy, matplotlib

Theory: By expressing 1 in the polar form as $e^{i(2n\pi)}$, we can compute the m-th roots as $e^{i(\frac{2n}{m}\pi)}$ where $n = 0, 1, 2, \cdots, m-1$

In [ ]:
```
import sys
import cmath
import numpy as np
import matplotlib.pyplot as plt


# Input code block
print("Enter the complex number of the form a+ib : ")
a = float(input("a: "))
b = float(input("b: "))

# converting the input into a complex number
z = complex(a, b)

# modulus
r = np.sqrt(a*a + b*b)

# principal argument
theta = cmath.phase(z)

print("\nModulus, r =",r,"\nPrincipal Argument, theta=",theta)

# m-th root input
m = int(input("\nFor calculating m-th root, enter the value of m: "))

# initializing lists
roots = []
x = []
y = []

for n in range(m):
    z_real = r**(1/m) * np.cos(theta/m + (2*n*np.pi)/m)
    x.append(z_real)
    z_img = r**(1/m) * np.sin(theta/m + (2*n*np.pi)/m)
    y.append(z_img)
    roots.append(complex(z_real.round(2),z_img.round(2)))

# displaying roots
print("\nThe roots are: ")
for root in roots:
    print("root %d : "%roots.index(root), root)

# plotting roots using matplotlib
fig,ax = plt.subplots()
plt.scatter(x,y, color='red')

for n in range(m):
    plt.text(x[n], y[n], (roots[n]))

for n in range(m):
    plt.plot([x[n], 0], [y[n], 0],linestyle=':', color='C0' )

R = r**(1/m)
circle = plt.Circle((0, 0), R, ec='gray', fill = False, ls = ':')
ax.add_patch(circle)
ax.set_aspect(1)

ax.spines['left'].set_position('center')
ax.spines['bottom'].set_position('center')
ax.spines['right'].set_color('none')
ax.spines['top'].set_color('none')
ax.set_xticks([-R, 0, R])
ax.set_xticklabels(['-%.2f'%R, 0, '+%.2f'%R])
```

```
ax.set_yticks([-R, R])
ax.set_yticklabels(['-%.2f'%R+'j', '+%.2f'%R+'j'])

plt.show()
```

Input:

Keep space of one page for inputs and outputs and pasting plot