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%{
Aidan Chin ECE 296C Fall 2023
1/14/24
--- Getting Started with C11 in ECE 296C, Complex Numbers ---
given rectangular form complex numbers, this script will plot and find the roots
%}
clf   % clear all figures
clear   % remove all variables from the workspace

% needed to draw axes
ax = [-100,100]; ze = [0,0];

hold on
% plot x- and y-axes as black lines (draw the axes before using QUIVER)
plot(ax,ze, 'k', 'LineWidth', 1)
plot(ze,ax, 'k', 'LineWidth', 1)


% ----- input z = a + jb, then convert to exponential form -----

z = input('Input a complex number z as a+bj: ');
n = input('Input the power of the root, i.e., n of z^1/n: ');
a = real(z); b = imag(z);

% z = a+jb = A e^jP

A = norm(z);   % amplitude of z
P = rad2deg(angle(z));   % phase of z in degrees, -180deg < phi <= 180deg


% ----- set up parameters needed to find n roots of z -----

% z^1/n = R e^jB

R = A^(1/n);   % amplitude R of z^1/n
B = P/n;  % phase in deg, associated with principal value of z^1/n
dB = 360/n;   % difference between phase angles, in degrees


% R e^jB = X + jY

X = R*cosd(B); Y = R*sind(B);


% ----- plot roots and compute checks -----

% plot an arrow to represent the principal value of z^1/n, in red
quiver(0, 0, X, Y, 0, 'r', 'LineWidth', 3)

check = zeros(n,1);   % initialize n checks as a column vector

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52 check(1) = z - (X + j*Y)^n;   % first check, output at the end
53
54 for i = 2:n   % cycle through the other values to make the rest of the arrows
55
56     B = B + dB;   % add dB to find the next nth root of z
57     X = R*cosd(B); Y = R*sind(B);
58
59     % plot an arrow for the next root, in blue
60     quiver(0, 0, X, Y, 0, 'b', 'LineWidth', 3)
61
62     check(i) = z - (X + j*Y)^n;   % the rest of the checks
63
64 end
65
66 check   % output the n checks; each should be close to 0+j0
67
68
69 % ----- make the figure look nicer -----
70
71 grid on; axis equal   % make the frame square (emphasize symmetry of the roots)
72
73 ac = gca;
74 ac.FontSize = 16; ac.GridAlpha = 0.5;   % change fonts to 16pt; make grid darker
75
76 xlabel('Re({\textbf{z}})', 'FontSize', 20, 'Interpreter', 'latex');
77 ylabel('Im({\textbf{z}})', 'FontSize', 20, 'Interpreter', 'latex')
78
79 % determine the sign of b, so that we can include z in the title
80 bSgn='+';
81 if b<0
82     bSgn='-';
83 end
84 bMag = norm(b);   % magnitude of b
85
86 title({'ECE 296C Exercise C11', ...
87     sprintf('Finding and drawing the %g values of $(%g%sj%g)^{1/%d}$', ...
88     n,a,bSgn,bMag,n)}, 'FontSize', 24, 'Interpreter', 'latex')
89
90 max = ceil(R+0.1);   % round up R to the next integer
91 axis([-max max -max max])   % set the upper and lower limits of the axes
92
93 hold off
```