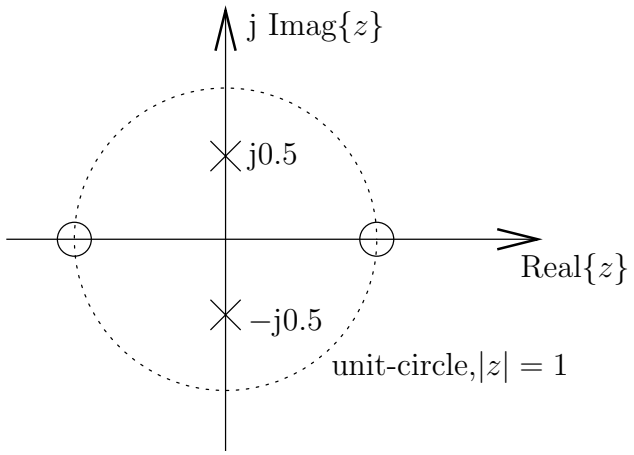
Exercise 22:

Given is the following pole-zero-diagram:



representing $H_z(z)$ of a digital filter. Further on it is known that $H_z(z = j) = 1$.

1. Determine the system function $H_z(z)$ of the filter.
2. Is the filter stable? Justify your answer!
3. Determine the difference equation of the digital filter.
4. Draw the structure of the filter.
5. Determine the values of $|H_z(z = j)|$ and $|H_z(z = -j)|$.
6. Sketch the magnitude of the frequency response $|H_N(\Omega)| = |H_z(z = e^{j\Omega})|$ in the range $-\pi$ to π, with $\Omega = \omega \cdot T_a$ and T_a the sampling period.
7. Which kind of filter is described by the given pole-zero diagram (e.g. low-pass, high-pass, band-pass, band-stop, all-pass, etc.)?
8. Using the difference equation, determine the output $g(k)$ in the range $k = 0(1)3$ for the input sequence $s(k) = \gamma_0(k)$.
9. Determine the impulse response $h(k)$ from the system function $H_z(z)$.
10. Calculate $h(k)$ in the range $k = 0(1)3$ and compare it with 22.8.