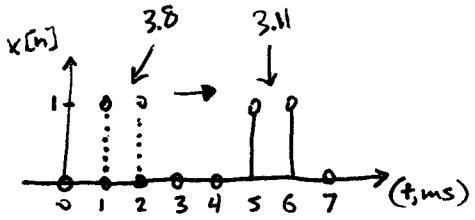
3.11 Use the time-shifting property of the DFT and the solution to Problem 3.8 to obtain the amplitude and phase spectra of the time series {0, 0, 0, 0, 0, 1, 1, 0} for data sampled at the instants $t = 0, 1, 2, \ldots, 7$ ms.



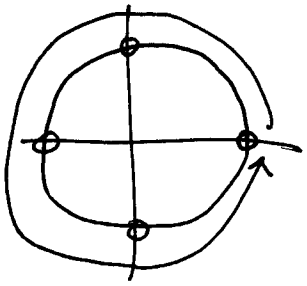
Time Shift

time → freq

$h(n+k) \Leftrightarrow H(e^{j\varnothing})\, e^{j\varnothing k}$

in this case the shift = 4 samples

from problem 3.8, we had N = 4, so shifting the phasor by 4 ends up back in the same place!



So those freq. bins will remain the same.

However, the case in 3.11 has N = 8 so we have 4 more freq. bins.

Looking at the Matlab FFT, we see the 4 original bins didn't change values:

```
>> x = [0 0 0 0 0 1 1 0]

x =

     0     0     0     0     0     1     1     0

>> fft(x)

ans =

  Columns 1 through 5

   2.0000                  -0.7071 + 1.7071i  -1.0000 - 1.0000i   0.7071 - 0.2929i   0

  Columns 6 through 8

   0.7071 + 0.2929i  -1.0000 + 1.0000i  -0.7071 - 1.7071i
```

k=0 same

was k=1, now k=2 — same

was k=2, now k=4 — same

was k=3, now k=6 — same