# Assignment 3—Math 668

1. Prove the convolution theorem for the discrete Fourier transform.

2. Let $y$ be an $N$-periodic sequence, and let $z$ be $y$ shifted by $\ell$; that is, $z[k] = y[k - \ell]$. Find $\hat{z}$ in terms of $\hat{y}$.

3. Aliasing. E-mail the M-file that you were asked to make in lab on 15 October.

   (a) Show that the fourier transform of $f(t) := \operatorname{sinc}^2(t)$ is the "tent function,"

   $$\hat{f}(\omega) := \begin{cases} 0 & \text{if } |\omega| > 2\pi \\ \dfrac{\omega + 2\pi}{2\pi} & \text{if } -2\pi \leq \omega < 0 \\ \dfrac{2\pi - \omega}{2\pi} & \text{if } 0 \leq \omega \leq 2\pi \end{cases}$$

   (b) Use the M-file mentioned above to reconstruct $f$ from its samples at integers; use various frequencies, $\nu = 1, 2, \frac{1}{2}, 3, \frac{1}{3}$. Make plots illustrating your results.

Due Thursday, October 27.