EE700 HW#4 SOLUTIONS PHIL SCHNITER

1) The code implements the procedure outlined in the lecture. Perhaps the only thing not covered in lecture is calculation of the CTFT from the FFT.

$$X(\Omega) = \int_{-\infty}^{\infty} x(t) e^{-j\Omega t} dt = \lim_{T \to 0} \sum_{n=-\infty}^{\infty} x(nT) e^{-j\Omega nT} \cdot T$$

If $x(nT) = 0$ for $n \notin \{0, 1, 2, \ldots N-1\}$ and T small,

$$X\left(\frac{2\pi}{N}\frac{k}{T}\right) \approx T \cdot \underbrace{\sum_{n=0}^{N-1} x(nT) e^{-j\frac{2\pi}{N}kn}}_{FFT}$$

2) The given coefficients $h[n] = [\,1/\sqrt{2}\ \ 0\ \ 0\ \ 1/\sqrt{2}\,]$ satisfy $\delta[m] = \sum_n h[n]\, h[n-2m]$ thus yield an orthonormal set $\{\phi(t-n), n \in \mathbb{Z}\}$. So they would appear to make fine wavelet filter coefficients. Yet iterating the scaling function via the cascade algorithm, we see that the scaling function $\phi(t)$ will not converge in a useful sense. (See Vetterli book p.249 for more details.) Hence more restrictions must be placed on $\{h[n]\}$ to yield a continuous $\phi(t)$...

3) For the "steps" waveform, the Haar basis is ideal because it captures the "shape" of the clean waveform (which lies in V_5). For the chirp waveform, a smoother basis (like db10.mat) is more effective. Thresholds chosen roughly by examining noisy coefficients.