Solutions to Assignment 10
Adaptive Filtering

The square wave training signal composed of 100 samples of a square wave of frequency $F_s/10$ can be generated by first generating a sine wave of the same frequency and then "clipping" (by using the sign() function or comparing to 0) to obtain a square wave:

```
y = sin(2*pi*0.1*[0:99]) ;
y = y > 0 ;
```

We can filter the square wave through a channel with impulse response $h(n) = \{0.1, 0.3, 1, -0.2, -0.3,\}$ by using the filter function:

```
x=filter([0.1 0.3 1 -0.2 -0.3],[1],y) ;
```

We then generate a vector of initial weights (`w`) of length 10 (twice the channel impulse response duration) initialized to zero, and set the value of μ to half of the value given by the equation $\mu < 1/(3NE\{x^2\})$ using `sum(x.^2)/N` as an estimate for $E\{x^2\}$:

```
w=zeros(1,10);
mu=1/(3*length(w)*sum(x.^2)/length(x))*0.5;
```

The `lms()` function is then used to compute the error as the filter adapts and the original, distorted, and equalized signals are plotted:

```
e=lms(x,y,w,mu);
plot(y);
print -deps sol10.q1a.eps
plot(x);
print -deps sol10.q1b.eps
plot(y-e);
print -deps sol10.q1c.eps
```

Plots of the original (training) signal, the signal distorted by the channel and received by the modem, and the signal as equalized by the adaptive filter are shown below: