BE 521 - Homework 3

Spring 2015

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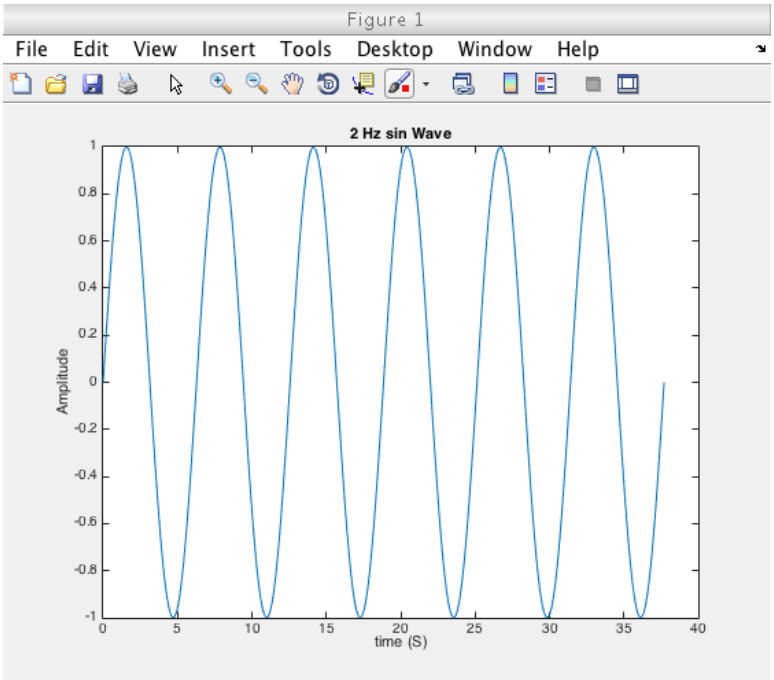
Objective: Computational modeling of neurons.

```
close all; clear all; clc;
```

1.1a Basic Membrane and Equilibrium Potentials (5 pts)

```
time = 3;              % S
wave_f = 2;            % Hz
sample_f = 100;        % Hz

s= 0;
e = 2 * pi * wave_f * time;      % rad
steps = time * sample_f;

x = linspace(s, e, steps);
y = sin(x);

figure(1)
plot(x,y)
title('2 Hz sin Wave');
ylabel('Amplitude');
xlabel('time (S)')
```



1.1b Like length computation

```
LL = @(x) sum(abs(diff(x)));
```

1.1c Like length of sign wave

```
lls = LL(y) % line lenght computation
```

```
lls =

  23.984216311421108
```

1.2a Number of full windows

```
windows = @(xlen, fs, winLen, winDisp) (...
    ((xlen / fs) - winLen) / winDisp + 1 ...
);
```

1.2b Windows in a sin wave

```
window_len = 0.5;     % S
win_disp = 0.25;       % S
windows_s = windows(length(x), sample_f, window_len, win_disp)
```

```
windows_s =

    11
```

1.2c Windows in a sin wave. 500ms displacement

```
win_disp = .5;      % s
windows_s = windows(length(x), sample_f, window_len, win_disp)
```

```
windows_s =

     6
```

1.2c Windows in a sin wave. 100ms displacement

```
win_disp = .1;      % s
windows_s = windows(length(x), sample_f, window_len, win_disp)
```

```
windows_s =

    26
```

1.3a Moving Win Features

```
function [feature] = MovingWinFeats(x, fs, winLen, winDisp, featFn)
    windows = @(xLen, fs, winLen, winDisp) ...
        ((xLen/fs)-winLen)/winDisp + 1;

    windows = windows(length(x), fs, winLen, winDisp);

    feature = zeros(windows, 1);

    stp = winDisp*fs;
    len = winLen*fs;

    for i=1:windows
        s= (i-1) * stp + 1;
        e = (i-1) * stp + len;
        feature(i) = featFn(x(s:e));
    end
end
```

1.3b Windowed LL from 1.1

```
win_len = .5;
win_d = .25;
moving_LL = MovingWinFeats(y, sample_f, win_len, win_d, LL )
```

```
moving_LL =

   3.889549524421202
   3.891483740328599
   3.892988351961849
   3.894063193217832
   3.894708145438365
   3.894923137423294
   3.894708145438366
   3.894063193217838
   3.892988351961849
   3.891483740328595
   3.889549524421203
```

1.3c

```
time = 3;
sample_f = 100;
steps = time * sample_f;

wave_f_1 = 2;
wave_f_2 = 5;

s = 0;
e1 = 2 * pi * wave_f_1 * time;
e2 = 2 * pi * wave_f_2 * time;

x1 = linspace(s,e1,steps);
x2 = linspace(s,e2,steps);

y1 = sin(x1);
y2 = sin(x2);

y = y1 + y2;

win_len = .5;
win_d = .25;

moving_LL = MovingWinFeats(y, sample_f, win_len, win_d, LL)
```

```
moving_LL =

  10.215693178229969
  11.541338604412854
  10.035631811767006
   8.972801954378578
  10.126639055919377
  11.568020746303253
  10.126639055919368
   8.972801954378589
  10.035631811767008
  11.541338604412838
  10.215693178229980
```

1.4a area

```
area = @(x) sum(abs(x));
```

1.4b energy

```
energy = @(x) sum(x.^2);
```

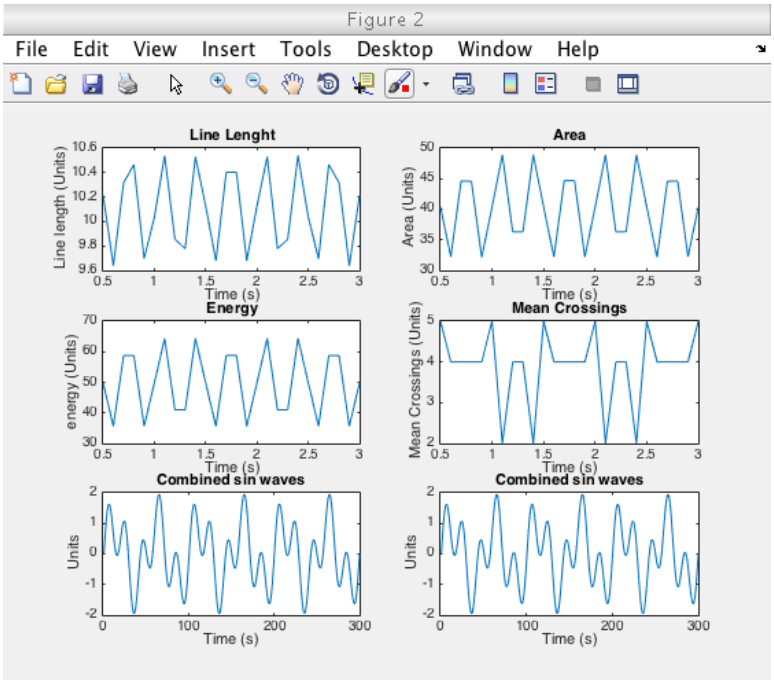
1.4c Zero-crossings

```
z_crossings = @(x) sum(abs(diff(sign(x-mean(x)))))/2;
```

1.4d All 4 with right allignment

```
win_len = .5;
win_d = .1;

y_a = MovingWinFeats(y, sample_f, win_len, win_d, area);
y_eng = MovingWinFeats(y, sample_f, win_len, win_d, energy);
y_x = MovingWinFeats(y, sample_f, win_len, win_d, z_crossings);
y_LL = MovingWinFeats(y, sample_f, win_len, win_d, LL);
y_nwindows = windows(length(y), sample_f, win_len, win_d);

x =linspace(win_len, time, y_nwindows);

figure(2)

subplot(3,2,1)
plot(x, y_LL);
title('Line Lenght')
xlabel('Time (s)')
ylabel('Line length (Units)')

subplot(3,2,2)
plot(x, y_a);
title('Area')
xlabel('Time (s)')
ylabel('Area (Units)')

subplot(3,2,3)
plot(x, y_eng);
title('Energy')
xlabel('Time (s)')
ylabel('energy (Units)')

subplot(3,2,4)
plot(x, y_x);
title('Mean Crossings')
xlabel('Time (s)')
ylabel('Mean Crossings (Units)')


subplot(3,2,5)
plot(1:length(y), y);
title('Combined sin waves')
ylabel('Units')
xlabel('Time (s)')
```

```
subplot(3,2,6)
plot(1:length(y), y);
title('Combined sin waves')
ylabel('Units')
xlabel('Time (s)')
```



2.1

```
dataset = 'I521_A0003_D001';
me = 'mlautman';
pass_file = 'mla_ieeglogin.bin';
[T,session] = evalc('IEEGSession(dataset, me, pass_file)');
data=session.data;
sample_rate = data.sampleRate ;
durration = data.channels(1).get_tsdetails.getDuration;
vals = session.data(1).getvalues(1:976078,1);

ms = floor(mod(durration/1e3,1000));
s = floor(mod(durration/1e6,60));
m = floor(mod(durration/1e6,3600)/60);
h = floor(mod(durration/1e6,3600*24)/3600);

mmss = num2str(ms);
ss = num2str(s);
mm = num2str(m);
hh = num2str(h);
[hh ':' mm ':' ss ':' mmss ' HH:MM:SS:MS']

msec = durration
time = '1:21:20:390' % from the IEEG explorer.
```

```
ans =

1:21:20:390 HH:MM:SS:MS
```

```
msec =

     4.880390000000000e+09


time =

1:21:20:390
```

2.2

```
e = (h*3600 + m*60 + s)*sample_rate
vals = vals(1:e);
```

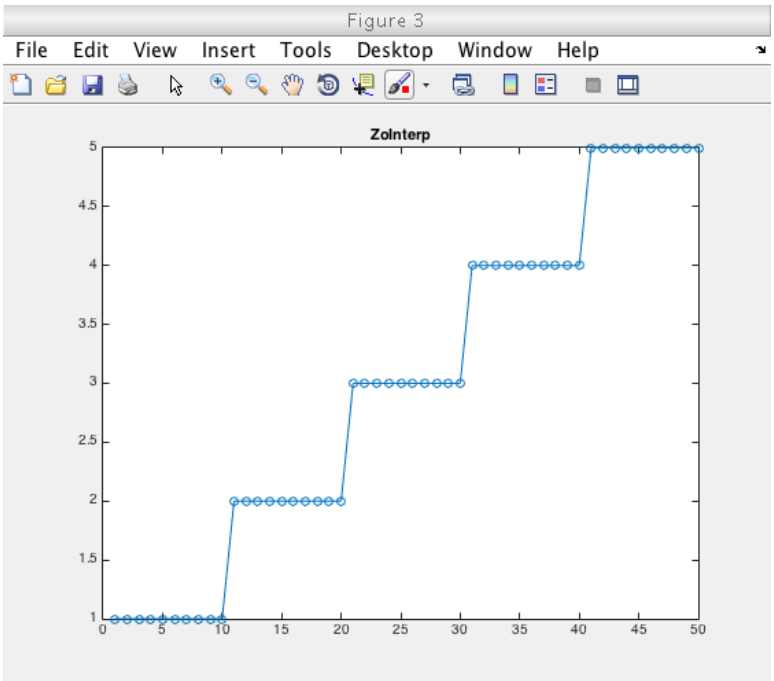
```
e =

      976000
```

2.3a

```
zoInterp = @(x, numInterp) reshape(repmat(x,numInterp,1),1,[]);
```

2.3b

```
figure(3)
plot(zoInterp(1:5,10), '-o')
title('ZoInterp');
```



2.4