HW2 Problem 2: Code correlations

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Initialize

```
fprintf('\n');
clearvars -except function_list pub_opt
close all

prn19=PRNCode(19);
prn25=PRNCode(25);
prn5=PRNCode(5);
make_delay = @(code, delay) [code(delay+1:end), code(1:delay)];
prn19_delay=350;
prn25_delay=905;
prn5_delay=75;

for i = 1:1023
    prn19.update()
    prn25.update()
    prn5.update()
end


offsets_correlation = zeros(1,1024);
```
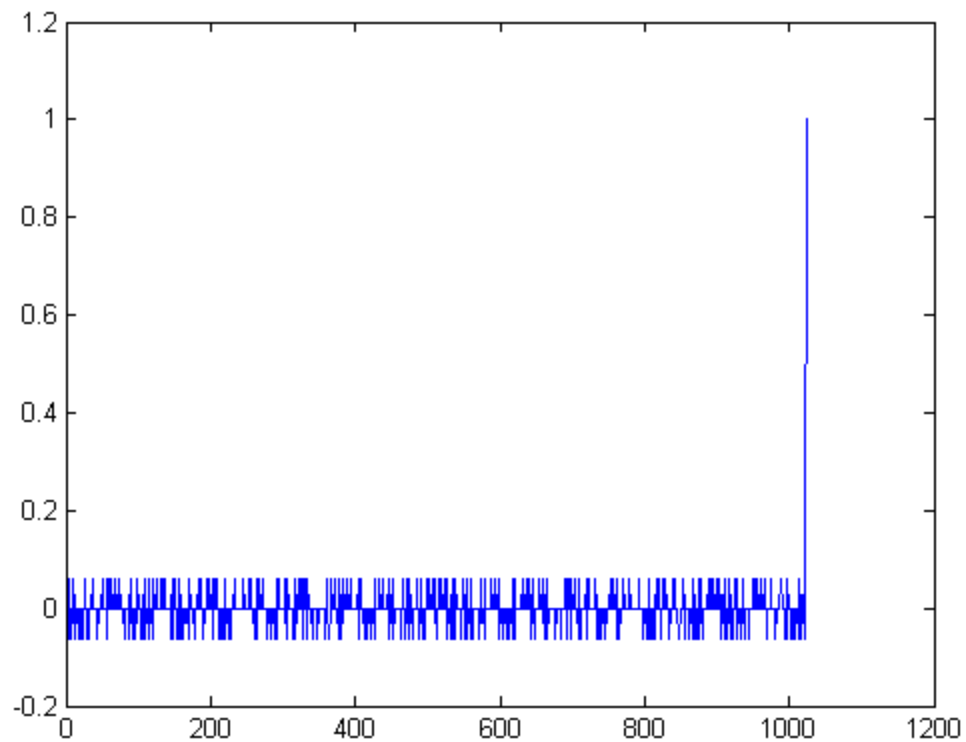
a) auto-correlation of PRN19

```
for ii = 0:1023
    offsets_correlation(ii+1) = ...
        normalized_correlation(prn19.CA_code, prn19.CA_code, ii);
end
figure
plot(offsets_correlation)
```
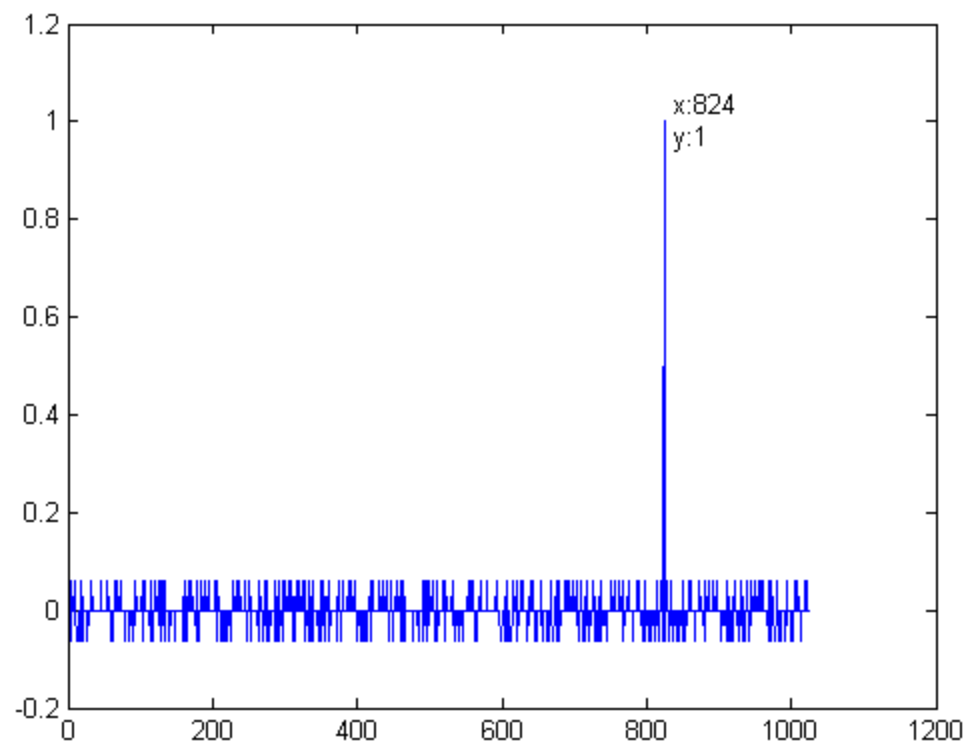
```
        C:\Users\John\Documents\ASEN5090_GNSS\tools\normalized_correlation
```

b) cross-correlation of PRN19 and PRN19 delayed by 200

The peak value's location makes sense because the 2nd code was shifted by 200, making the correlation happen 200 bits from the end.
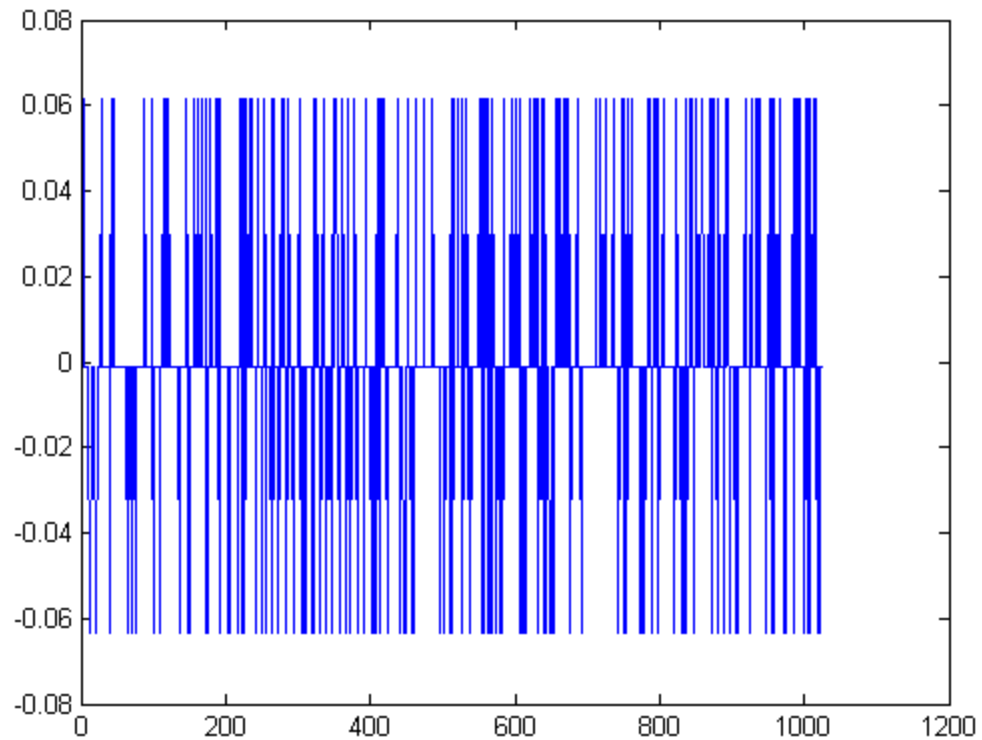
```
prn19_200delay = make_delay(prn19.CA_code, 200);
for ii = 0:1023
    offsets_correlation(ii+1) = ...
        normalized_correlation(prn19.CA_code, prn19_200delay, ii);
end
figure
plot(offsets_correlation);
[Y, I] = max(offsets_correlation);
text(I(1), Y, sprintf(' x:%d\n y:%g', I(1), Y))
```

c) cross-correlation of PRN19 and PRN25

No good correlations between PRNs 19 and 25

```
for ii = 0:1023
    offsets_correlation(ii+1) = ...
        normalized_correlation(prn19.CA_code, prn25.CA_code, ii);
end
figure
plot(offsets_correlation)
```

d) cross-correlation of PRN19 and PRN5
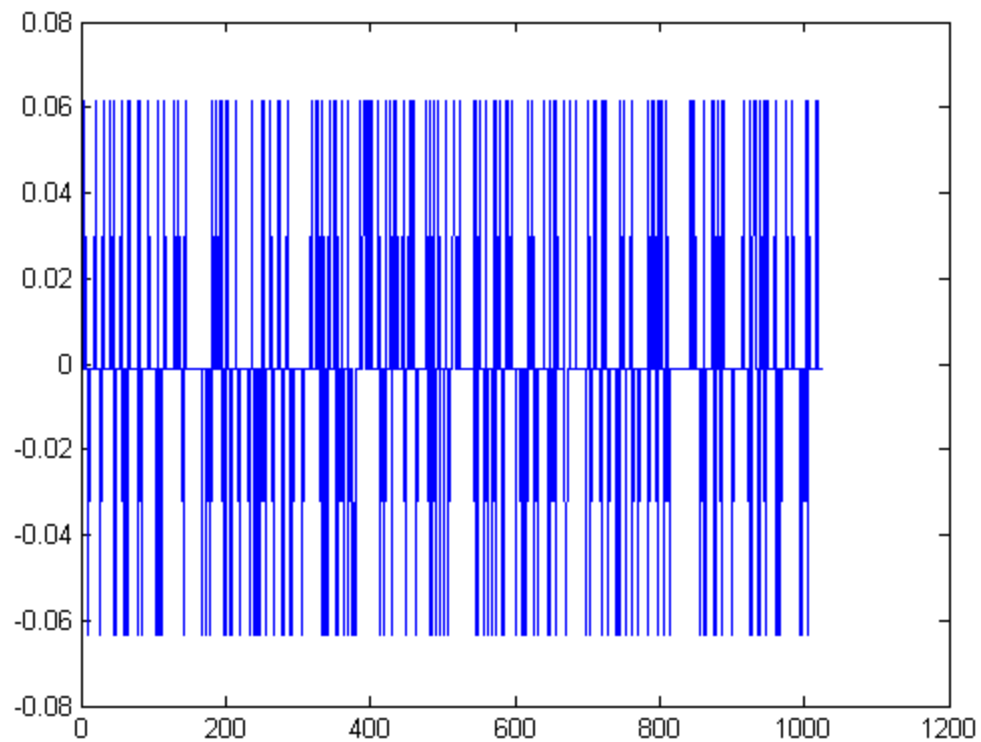
No good correlations between PRNs 19 and 5

```
for ii = 0:1023
    offsets_correlation(ii+1) = ...
        normalized_correlation(prn19.CA_code, prn5.CA_code, ii);
end
figure
plot(offsets_correlation)
```

e) cross-correlation of PRN19 and summed PRNs

The peak value's location makes sense because the 2nd code was shifted by 350, making the correlation happen 350 bits from the end. The codes correlate despite the other codes on top of PRN 19.

```
x1 = make_delay(prn19.CA_code, prn19_delay);
x2 = make_delay(prn25.CA_code, prn25_delay);
x3 = make_delay(prn5.CA_code, prn5_delay);
summed_prns = x1+x2+x3;
for ii = 0:1023
    offsets_correlation(ii+1) = ...
        normalized_correlation(prn19.CA_code, summed_prns, ii);
end
figure
plot(offsets_correlation)
[Y, I] = max(offsets_correlation);
text(I(1), Y, sprintf(' x:%d\n y:%g', I(1), Y))
```
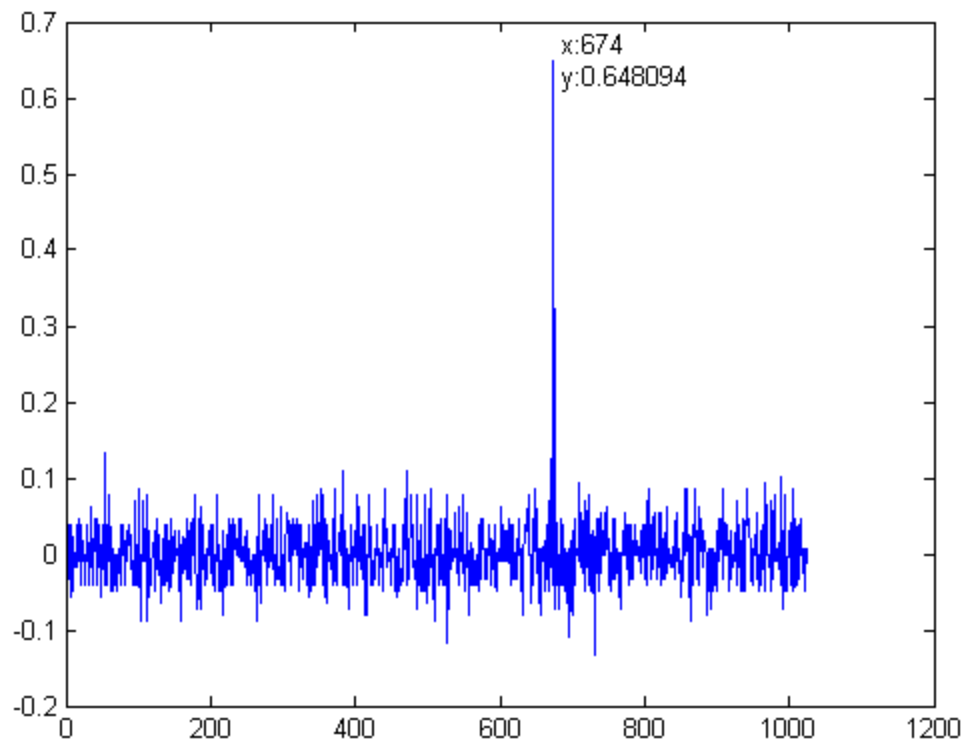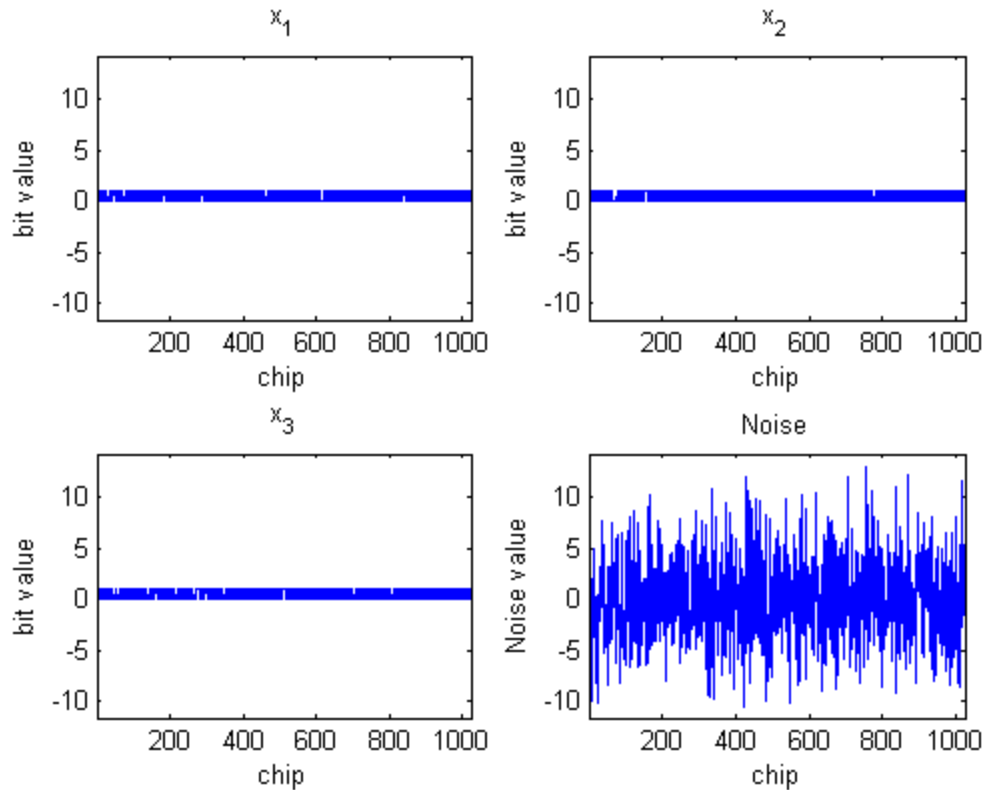
f) Noise

```
noise = 4*randn(1,1023);
figure
subplot(2, 2, 1)
plot(x1)
title('x_1')
xlabel('chip')
ylabel('bit value')
ylim([min(noise)*1.1, max(noise)*1.1])
xlim([1, 1023])
subplot(2, 2, 2)
plot(x2)
title('x_2')
xlabel('chip')
ylabel('bit value')
ylim([min(noise)*1.1, max(noise)*1.1])
xlim([1, 1023])
subplot(2, 2, 3)
plot(x3)
title('x_3')
xlabel('chip')
ylabel('bit value')
ylim([min(noise)*1.1, max(noise)*1.1])
xlim([1, 1023])
```

```
subplot(2, 2, 4)
plot(noise)
title('Noise')
xlabel('chip')
ylabel('Noise value')
ylim([min(noise)*1.1, max(noise)*1.1])
xlim([1, 1023])
```
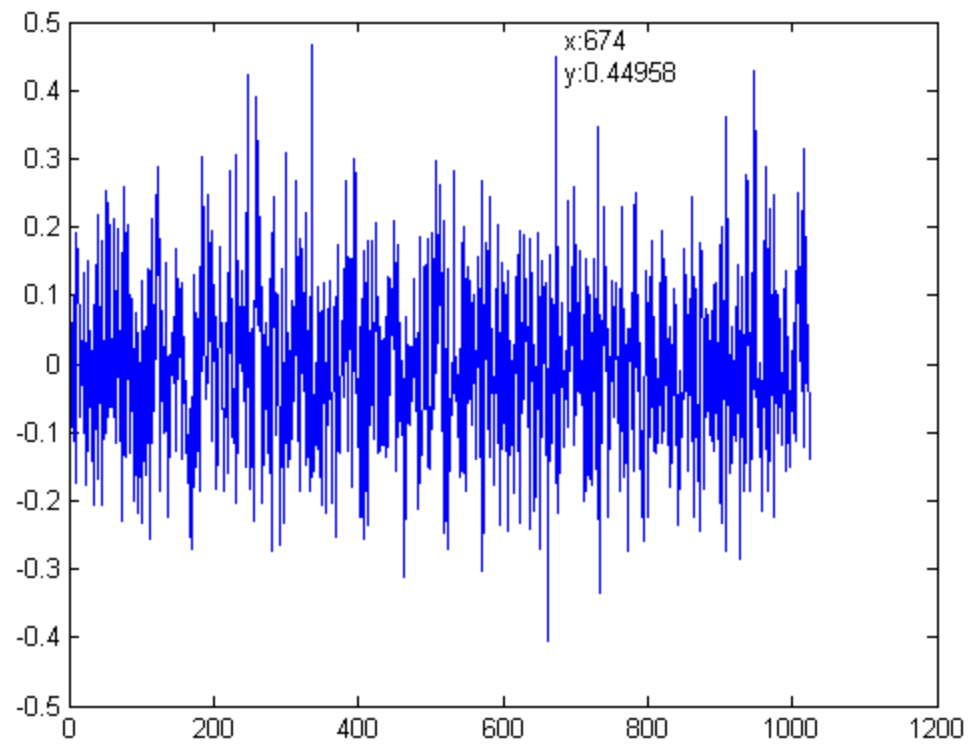

g) cross-correlation of PRN19 and summed PRNs + noise

The peak is where I expect it to be, however it's much closer in scale to other local peaks. I ran the noise function multiple times and sometimes the correlation really stood out, sometimes it didn't.

```
summed_prns = x1+x2+x3+noise;
for ii = 0:1023
    offsets_correlation(ii+1) = ...
        normalized_correlation(prn19.CA_code, summed_prns, ii);
end
figure
plot(offsets_correlation)
text(I(1), offsets_correlation(I(1)), ...
    sprintf(' x:%d\n y:%g', I(1), offsets_correlation(I(1))))
```

Published with MATLAB® R2013b