1. Load the data correctly.

```
load('data6.mat');
```

You already have the necessary parameters...

```
% The ECG sampling rate is 1000 Hz
FS = 1000;
% QRS detector operates on 200 Hz signals
FS_QRS = 200;
% The number of subjects
N = numel(data);
% Windowing length
window = 50;
% Number of overlapped samples
nbroverlap = 45;
% Specify nfft parameter as empty.
nfft = [];
% Minimum spectrogram threshold
th = -30;
```

2. First you will use the cycles variable from the data file. Check the data you have!

```
cycles
```

```
cycles = 1×5 struct
```

Fields	t	ECG	PCG
1	1×1800 double	1×1800 double	1×1800 double
2	1×2500 double	1×2500 double	1×2500 double
3	1×1350 double	1×1350 double	1×1350 double
4	1×900 double	1×900 double	1×900 double
5	1×1450 double	1×1450 double	1×1450 double

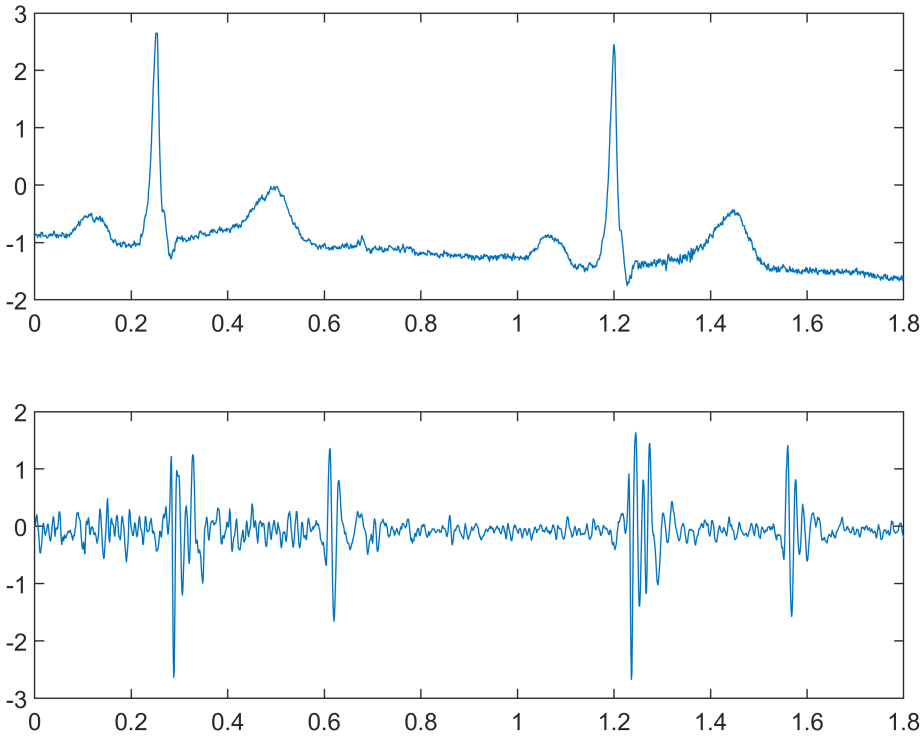
```
class(cycles)
```

```
ans =
'struct'
```

```
cycles(1)
```

```
ans = struct with fields:
      t: [1×1800 double]
    ECG: [1×1800 double]
    PCG: [1×1800 double]
```

```
figure
subplot(2,1,1), plot(cycles(1).t, cycles(1).ECG)
subplot(2,1,2), plot(cycles(1).t, cycles(1).PCG)
```



You need to calculate the PCG spectrogram for each subject save the results in a structure called "SPCs"

Check these resources/examples:

1. https://se.mathworks.com/help/matlab/ref/struct.html
2. https://se.mathworks.com/help/signal/ref/spectrogram.html
3. **openExample('signal/SpectrogramReassignmentAndThresholdingExample')**
4. **openExample('signal/TrackChirpsInAudioSignalExample')**

Struct examples:

```
S = struct('Var1','a', 'Var2',[], 'Var3',[1,2,3,4,5])
```

```
S = struct with fields:
    Var1: 'a'
    Var2: []
    Var3: [1 2 3 4 5]
```

```
S.Var4 = 1:1:10
```

```
S = struct with fields:
    Var1: 'a'
    Var2: []
    Var3: [1 2 3 4 5]
    Var4: [1 2 3 4 5 6 7 8 9 10]
```

```
S(1).Var4 = 1:1:10
```

```
S = struct with fields:
    Var1: 'a'
    Var2: []
    Var3: [1 2 3 4 5]
    Var4: [1 2 3 4 5 6 7 8 9 10]
```

```
S(2).Var4 = 11:1:20
```

S = 1×2 struct

Fields	Var1	Var2	Var3	Var4
1	'a'	[ ]	[1,2,3,4...	[1,2,3,4...
2	[ ]	[ ]	[ ]	[11,12,1...

3. Then you need to use the variable "data" from the data file. Again check your data!

```
data
```

data = 1×5 struct

Fields	t	ECG	PCG	subject
1	1×21500 dou...	1×21500 dou...	1×21500 dou...	'normal'
2	1×20500 dou...	1×20500 dou...	1×20500 dou...	'normal'
3	1×16500 dou...	1×16500 dou...	1×16500 dou...	'ventricula...
4	1×19900 dou...	1×19900 dou...	1×19900 dou...	'ventricula...
5	1×22000 dou...	1×22000 dou...	1×22000 dou...	'aortic ste...

The syntax for the QRSDetection function is given as follows:

- `[QRSOnsets, QRSOffsets] = QRSDetection(data);`

`You only need to save the onsets in a cell array called "onsets".`

- [onset with some indexing, ~] = QRSDetection(The resampled data); -----> **do not forget mapping the output afterwards!!!!**

Example for mapping:

```
onset_times = [1,2,3,4,5]
```

```
onset_times = 1×5
     1     2     3     4     5
```

```
onsets_200Hz = onset_times * FS_QRS
```

```
onsets_200Hz = 1×5
         200         400         600         800        1000
```

```
onsets_1000HZ = onset_times * FS
```

```
onsets_1000HZ = 1×5
        1000        2000        3000        4000        5000
```

Cell examples:

```
A = cell(5)
```

A = 5×5 cell

	1	2	3	4	5
1	[]	[]	[]	[]	[]
2	[]	[]	[]	[]	[]
3	[]	[]	[]	[]	[]
4	[]	[]	[]	[]	[]
5	[]	[]	[]	[]	[]

```
A = cell(2,5)
```

A = 2×5 cell

	1	2	3	4	5
1	[]	[]	[]	[]	[]
2	[]	[]	[]	[]	[]

```
A{1} = 5
```

A = 2×5 cell

	1	2	3	4	5
1	5	[]	[]	[]	[]
2	[]	[]	[]	[]	[]

```
A{2,5} = [10:10:100]
```

A = 2×5 cell

	1	2	3	4	5
1	5	[]	[]	[]	[]
2	[]	[]	[]	[]	[10,20,3...

```
A = {1,2,3; 'text', rand(5,10,2),{11; 22; 33}}
```

A = 2×3 cell

	1	2	3
1	1	2	3
2	'text'	5×10×2 double	3×1 cell

4. At the end you need to use the "pwelch" function to estimate the power spectral density of PCG

Use these resources:

1. https://se.mathworks.com/help/signal/ref/pwelch.html
2. **openExample('signal/VerifyOrderOfFIRFilterExample')**