Artificial Intelligence for Medical Data with Python

9 SAMPLE SLIDES

6th session –
Machine learning algorithms for Image Processing and other complex medical signals

UNIVERSITY OF THE AEGEAN

SCHOOL OF ENGINEERING

DEPARTMENT OF INFORMATION AND COMMUNICATION SYSTEMS ENGINEERING

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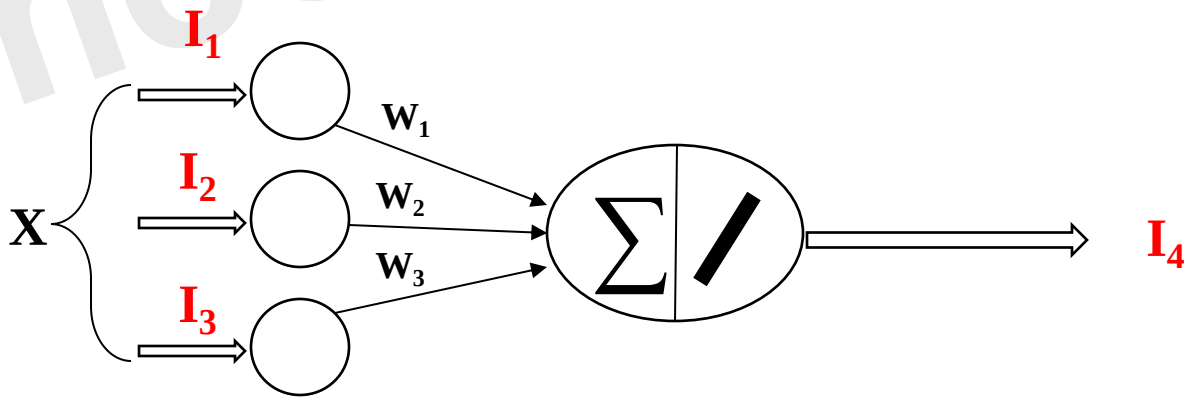
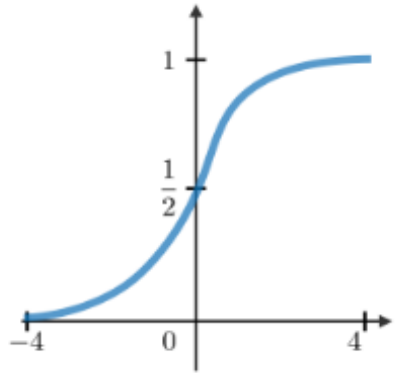
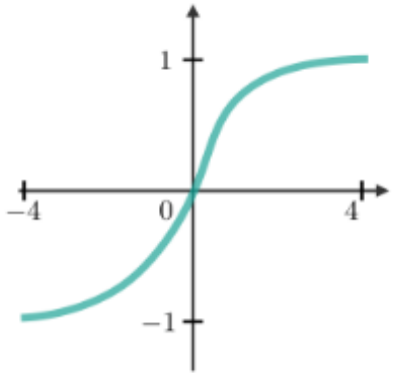
Single-Layer Perceptron for Item-based Collaborative Filtering

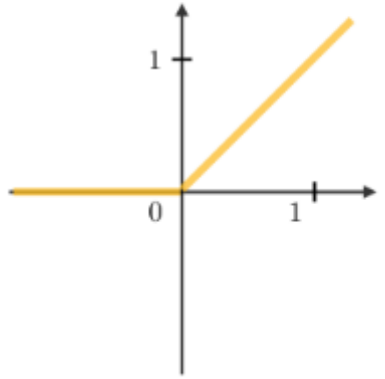
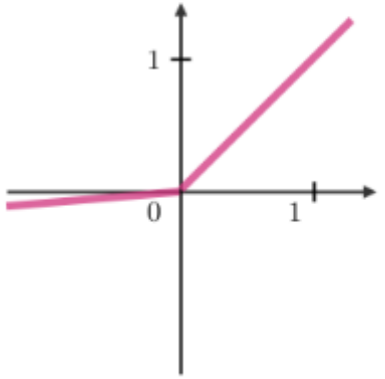
- Predict whether patient U_4 needs Drug *I4*

	I_1	I_2	I_3	I_4
U_1	4	1	1	4
U_2	1	4	2	0
U_3	2	1	4	5
U_4	1	4	1	**?**



Activation Functions

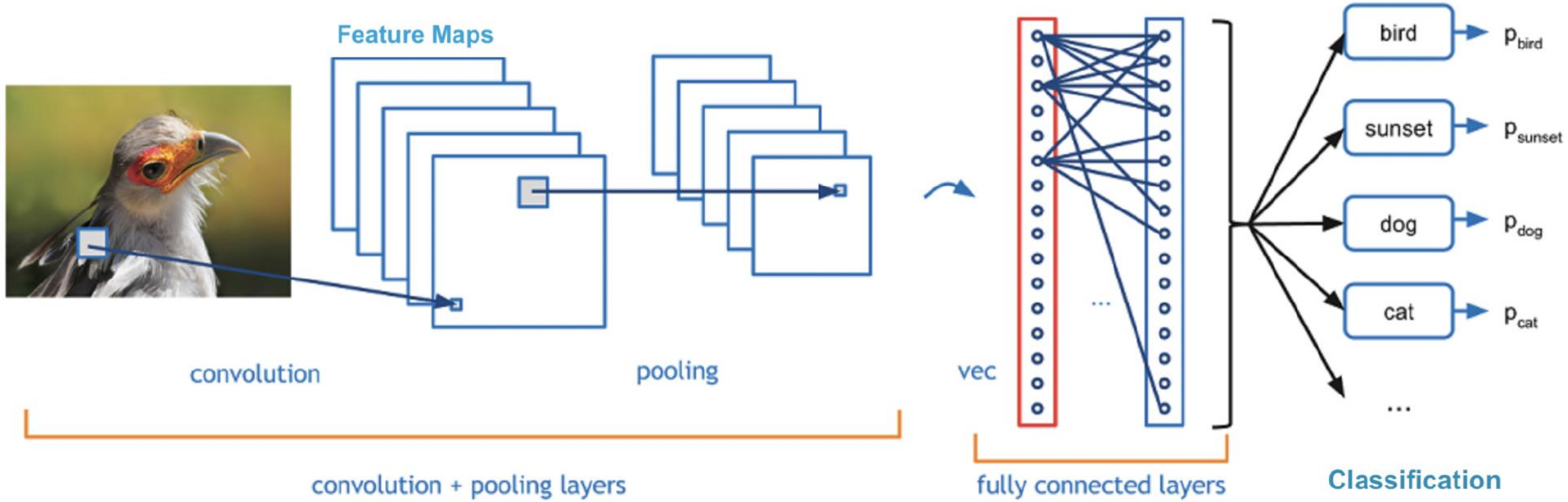
Sigmoid	Tanh
$g(z) = \frac{1}{1+e^{-z}}$	$g(z) = \frac{e^{z}-e^{-z}}{e^{z}+e^{-z}}$
	

ReLU	Leaky ReLU
$g(z) = \max(0, z)$	$g(z) = \max(\epsilon z, z)$ with $\epsilon \ll 1$
	

Pros and Cons of Activation Functions

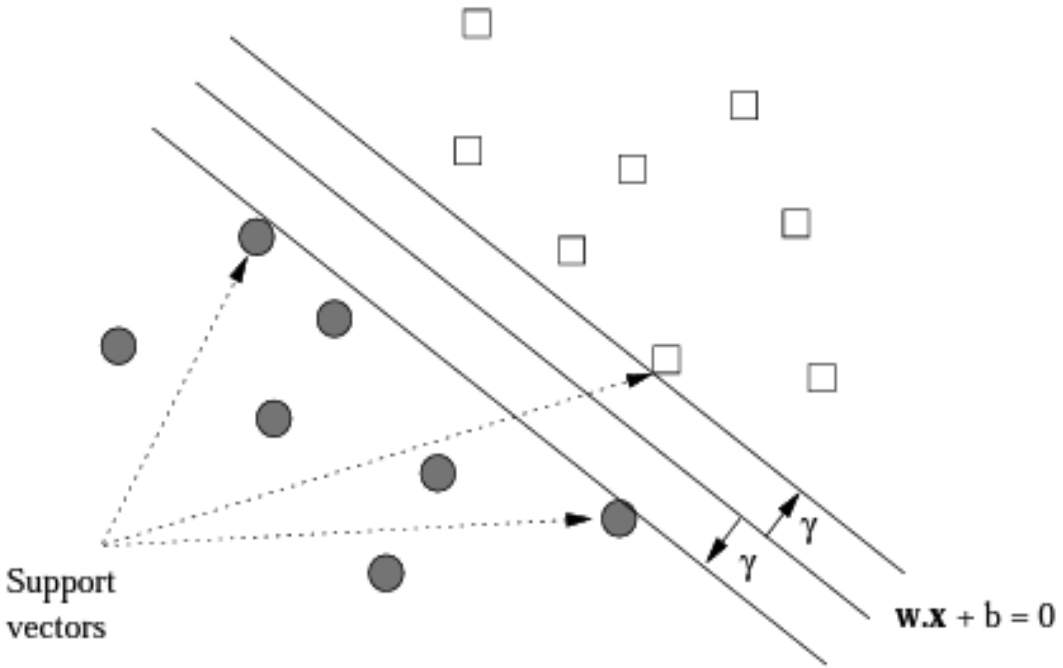
Properties	Sigmoid	Tanh	ReLU	Leaky ReLU
Continuous	**yes**	**yes**	**Except at x=0**	**yes**
Differentiable	**yes**	**yes**	**Except at x=0**	**yes**
Pros	**• Outputs in bounded range • Smooth**	**• Outputs in bounded range • Smooth • Symmetric around origin • Zero-centered output**	**• Fast • Sparsity • Avoids vanishing gradient • Ideal for deep architectures**	**• Fast • Sparsity • Allows recovery of dead neurons**
Cons	• Saturates as we move away from 0 (vanishing gradient) • Computationally expensive • Lack of zero-centered output	• Saturates as we move away from 0 (vanishing gradient) • Computationally expensive	• Unbounded output's range (exploding gradients) • Less smooth • Lack of zero-centered output • Zero gradient for very negative inputs (dying ReLU)	• Unbounded output's range • (exploding gradients) • Needs one more parameters

Example of a Convolutional Neural Network



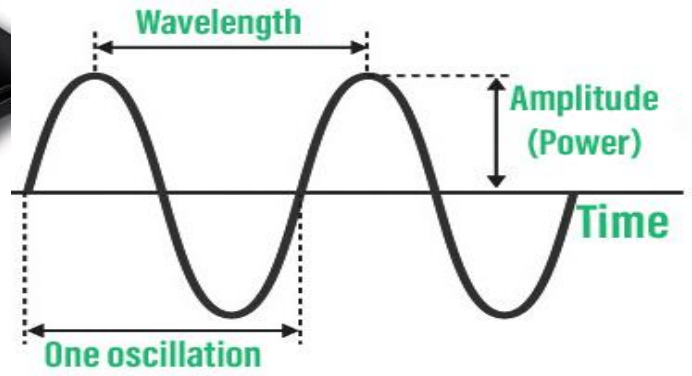
Support Vector Machines

- **The goal of a Support Vector Machine (SVM) is to select a hyperplane $w \cdot x + b = 0$ that maximizes the distance γ between the hyperplane and any point of the training set.**



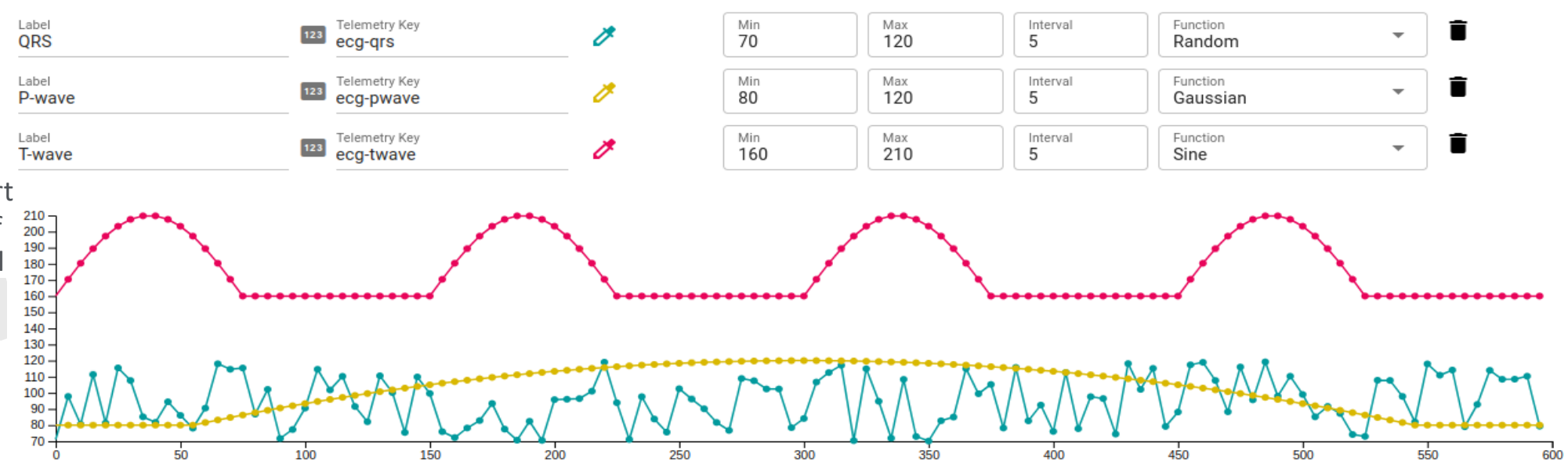
With a large margin, we are more certain to correctly classify points that are in the full data set and not only the training set

Heart Failure Prediction

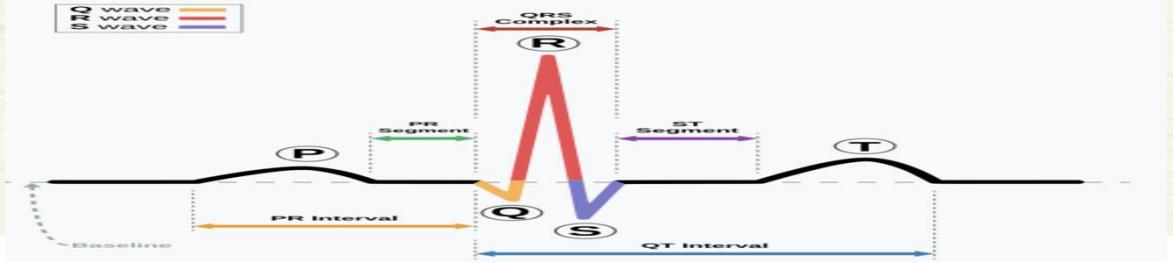


Parameter	Normal Range
ECG QRS width/amplitude	60-110msec/≤1mV
ECG P-wave width/amplitude	80-110ms/≤0.1mV
ECG T-wave width/amplitude	160-200ms/≤0.25mV

A doctor observes a graph that shows the electrical activity (in volts) of the heart of a patient over a period of time (in seconds). Each local maximum of 0.004 volts corresponds to one heartbeat.



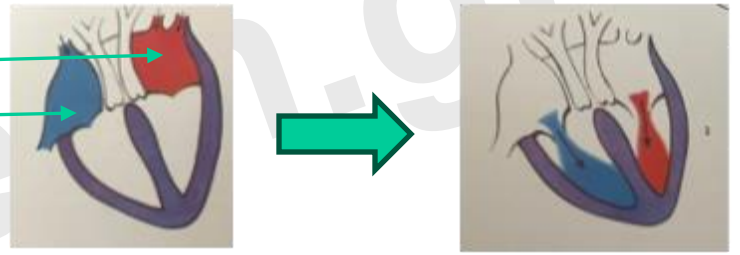
What are the main signals of ECG (Electrocardiogram)?



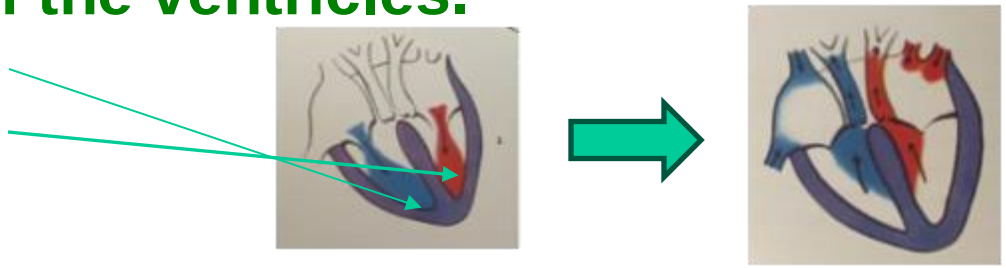
- **There are three main components to an ECG:**

Heart movements

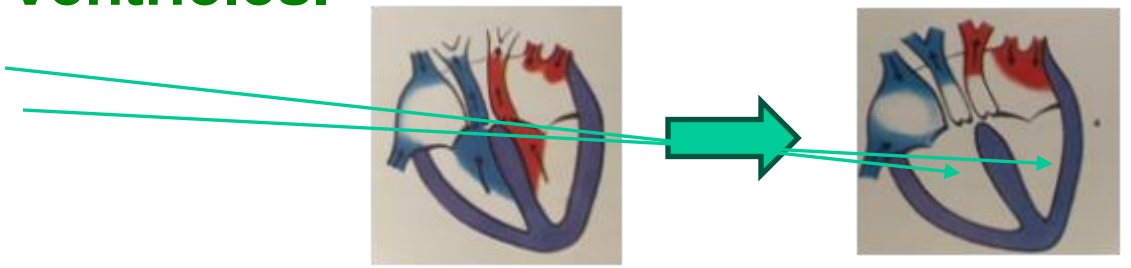
1. The P wave represents depolarization of the atria.



2. The Q R S complex represents depolarization of the ventricles.



3. The T wave represents repolarization of the ventricles.



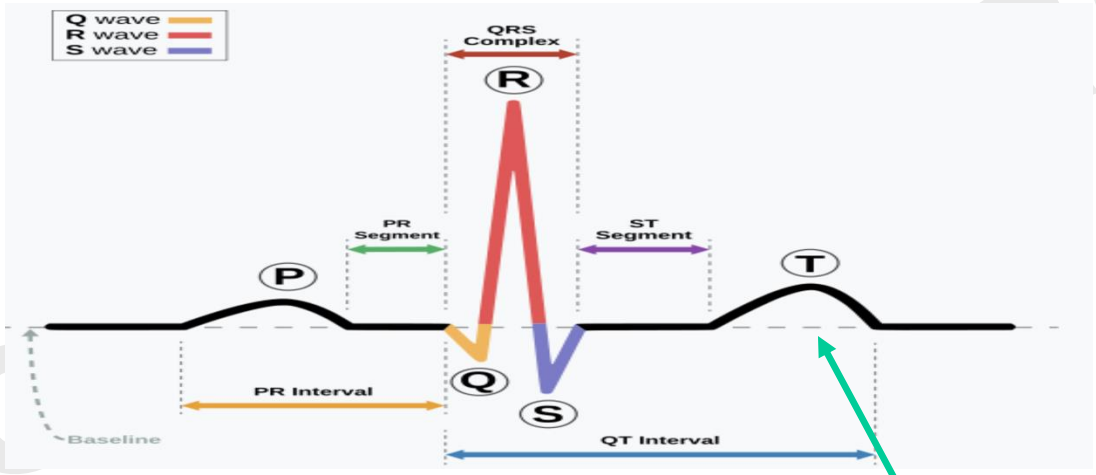
Detection Example of Ischemic Heart Failure

Heart failure:
Ischemia, heart attack and angina pectoris.

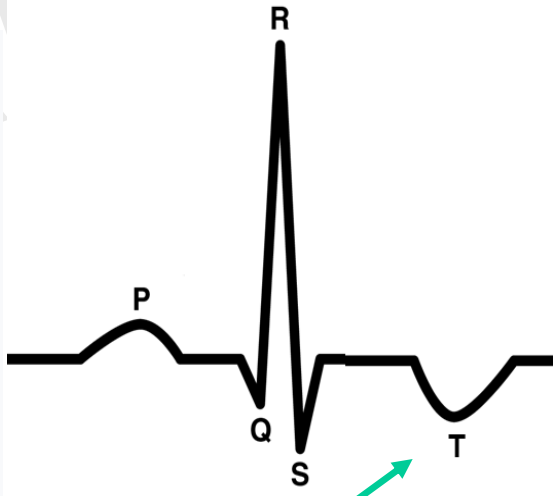
Cardiac arrhythmias: –
Tachycardia,
bradycardia,
ventricular fibrillation,
atrial fibrillation,
atrial flutter.

Cardiac arrest
arrest

Normal



Not Normal



Ischemia happens when we have a narrowing of a large coronary artery. It causes a decrease in blood flow.

Can be found by changes in T wave. T is negative and symmetrical in the leads that are normally positive.