SIGNAL & DATA ANALYTICS IN IoMT
Tech-in-Med Summer Camp

PREMANANDA INDIC, PH.D.

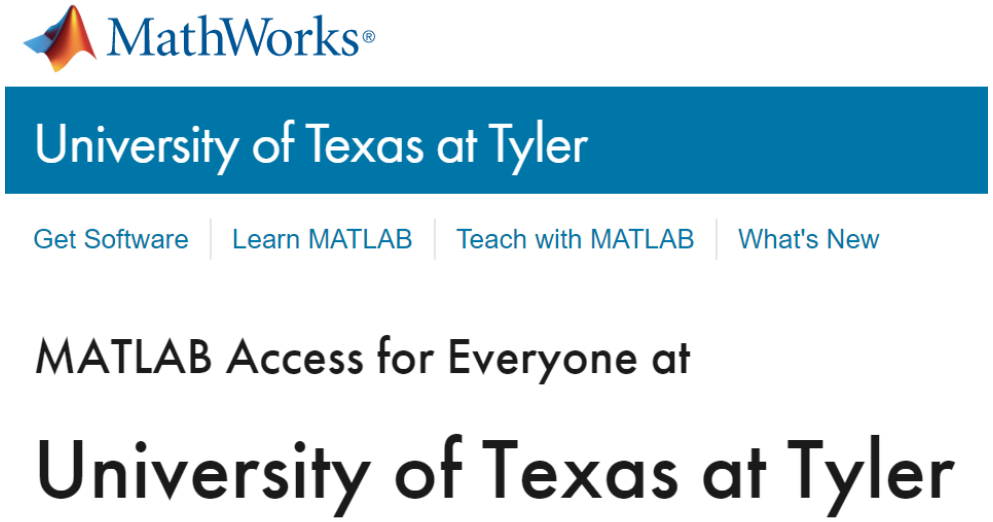
DEPARTMENT OF ELECTRICAL ENGINEERING

NSF Award OAC-1924117: Easy-Med: Interdisciplinary Training in Security, Privacy-Assured Internet of Medical Things

The University of Texas at TYLER Center for Health Informatics & Analytics

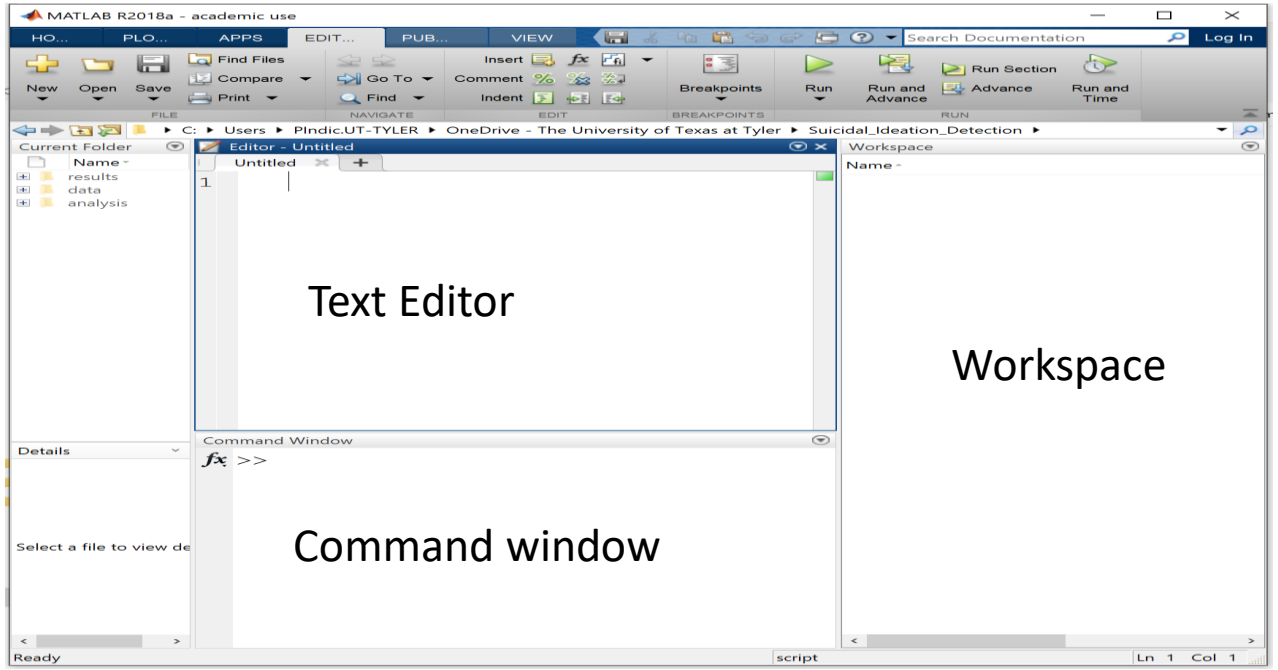
Research Design & Data Analysis Lab
Office of Research, Scholarship, and Sponsored Programs

MATLAB



https://www.mathworks.com/academia/tah-portal/university-of-texas-at-tyler-1108545.html

MATLAB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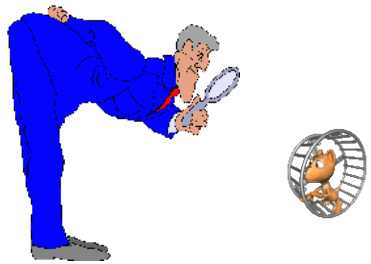
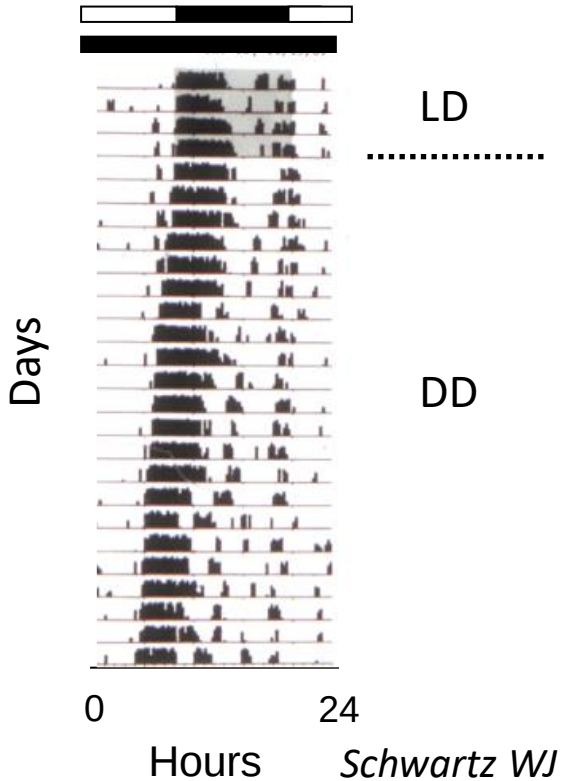
OUTLINE

1. Different physiological signals
2. Features of the signals associated with health
3. Differentiating signals and data
5. Development of algorithms
6. Processing of signals
7. Data analytics
8. Converting algorithms into software code
9. Embedding the code in the sensors.

EXAMPLE 1

- Identify the type of physiological signal ?



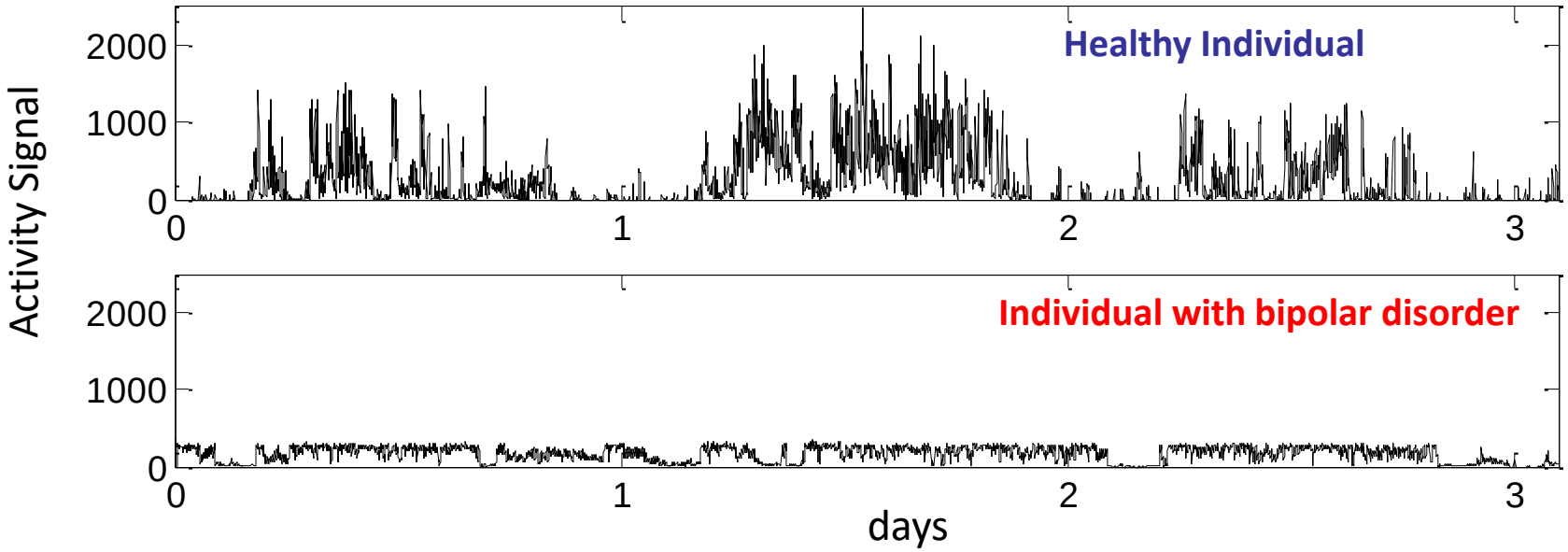


Schwartz WJ & Zimmerman P, J. Neurosci, 1990, 10, 3685-3694

Example 2

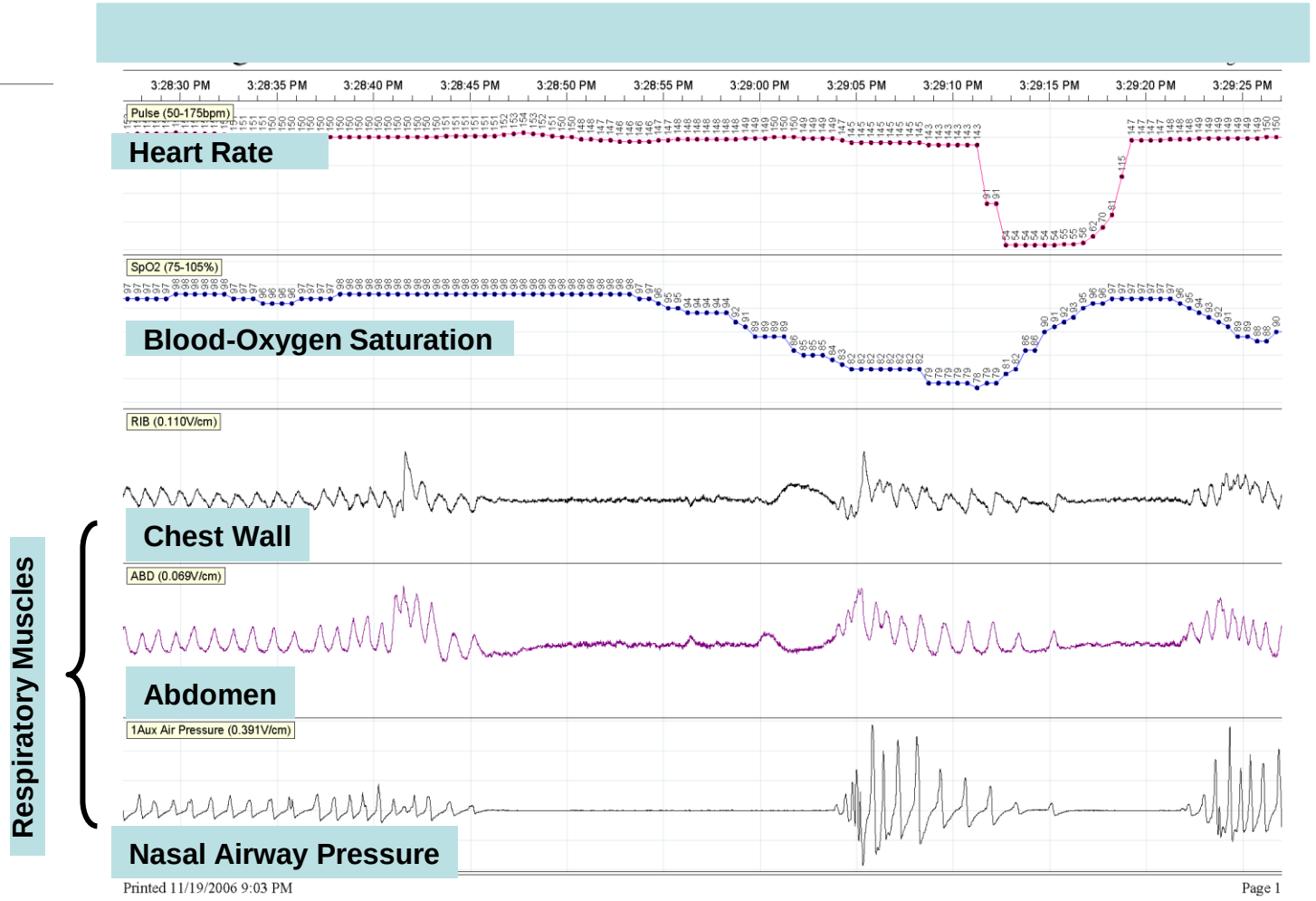
- Identify the type and characteristics of the signals ?

Philips Actiwatch 2



EXAMPLE 3

- More Physiological Signals



TYPES OF BIOMEDICAL DATA

- PHYSIOLOGICAL OR BEHAVIOURAL SIGNALS
- IMAGES
- GENOMES

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SYSTEM vs. SIGNALS

- DETERMINISTIC vs. STOCHASTIC
- STATIONARY vs. NONSTATIONARY
- TIME INVARIANT vs. TIME VARYING
- LINEAR vs. NONLINEAR

Exercise 1

The input – output relationship of a system can be represented by an equation of a straight line as

$output = m \times input + C$ where m is the slope and C is the intercept. Is the given system linear ?

Exercise 2

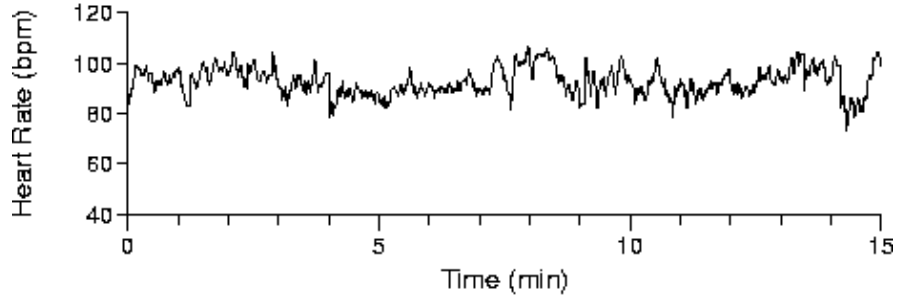
Plot in MATLAB the input – output relationship of a system can be represented by an equation of a straight line as

$output = m \times input + C$ where m is the slope and C is the intercept, with m =0.5 and C=10. consider input from a random number generator. Is the given system deterministic or stochastic ?

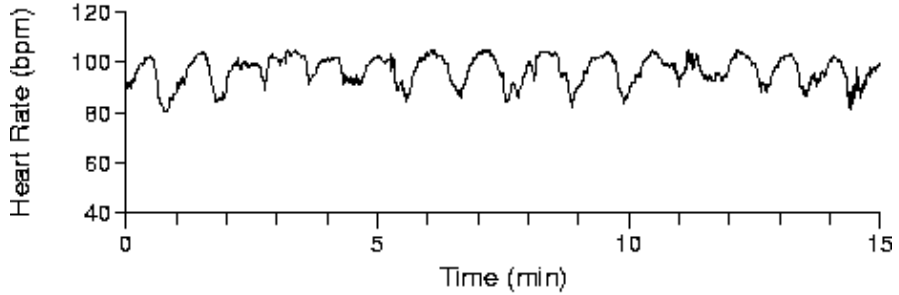
REGULAR vs. NORMAL

- Which of the given signal is regular ?
- Which of the given signal is normal?

(A)



(B)

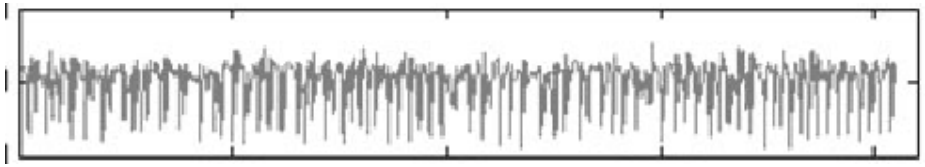


Heart Rate

REGULAR vs. NORMAL

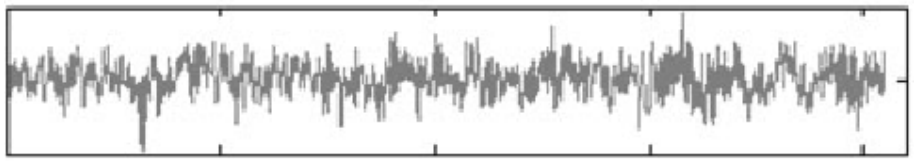
- Which of the given signal is regular ?
- Which of the given signal is normal?

(A)



EEG

(B)



REGULAR vs. NORMAL

- Which of the given signal is regular ?

- Which of the given signal is normal?

(A)

(B)

Respiration

HYPOTHESIS

Scientific hypothesis, an idea that proposes a tentative explanation about a phenomenon or a narrow set of phenomena observed in the natural world. The two primary features of a scientific hypothesis are falsifiability and testability

Source: https://www.britannica.com/science/scientific-hypothesis

Exercise 3: Hypothesis Testing

Given the preterm infant database (Preterm_Infants.xlsx), generate some hypothesis and test the hypothesis by writing codes in MATLAB

Discretization of Signals

Identify the features of the given signal $y(t) = Asin(2\pi ft)$, and explain how you will discretize the signal?

Exercise 4: Discretization of Signals

Generate the discrete version of $y(t) = Asin(2\pi ft)$, with A =1 f = 60Hz and use different sampling frequencies starting from fs = 10Hz with an increment of 10Hz. At what sampling frequency you can detect the frequency of the original analog signal of 60 Hz

Exercise 5: Discretization of Signals

Generate the discrete version of $y(t) = A1sin(2\pi f1t) + A2sin(2\pi f2t)$, with A1 =1 and A2 =0.5, f1 = 7Hz and f2 =22Hz. Choose an appropriate sampling frequency.

Exercise 6: Is the given signal stationary?

Check whether the given signal in testEEG.txt is stationary ?