

DAILY ASSESSMENT FORMAT

Date:	May 27 2020	Name:	Apeksha S Shetty
Course:	Digital signal processing	USN:	4AL16EC006
Topic:	Fourier transform	Semester & Section:	8 TH SEM A
Github Repository:	Apeksha-97		

FORENOON SESSION DETAILS

Image of session

The image shows handwritten notes on a piece of paper titled "FOURIER TRANSFORMS". The notes define the Fourier Transform $F(s)$ as:

$$F(s) = \int_{-\infty}^{\infty} f(x) \cdot e^{isx} dx$$

is called Fourier Transform of $f(x)$

Also, the function $f(x)$, defined by

$$f(x) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(s) \cdot e^{-isx} ds$$

Below the notes is a screenshot of a MATLAB code editor. The code defines a function `fft` that takes a signal `x` and its length `N` as inputs. It calculates the sampling frequency `Fs=1000`, the sampling period `Ts=1/Fs`, and the signal duration `dt=0.1`. It then defines the time axis `t=0:Ts:(T-dt)` and the frequency axis `f=0:Fs/2:(Fs/2-dt)`. The code uses `fftshift` and `plot` to visualize the signal and its spectrum. The workspace window shows the variables `dt`, `Ts`, `Fs`, `dt2`, `Fs2`, `dt3`, `Fs3`, `dt4`, `Fs4`, `dt5`, `Fs5`, `dt6`, `Fs6`, `dt7`, `Fs7`, `dt8`, `Fs8`, `dt9`, `Fs9`, `dt10`, `Fs10`, `dt11`, `Fs11`, `dt12`, `Fs12`, `dt13`, `Fs13`, `dt14`, `Fs14`, `dt15`, `Fs15`, `dt16`, `Fs16`, `dt17`, `Fs17`, `dt18`, `Fs18`, `dt19`, `Fs19`, `dt20`, `Fs20`, `dt21`, `Fs21`, `dt22`, `Fs22`, `dt23`, `Fs23`, `dt24`, `Fs24`, `dt25`, `Fs25`, `dt26`, `Fs26`, `dt27`, `Fs27`, `dt28`, `Fs28`, `dt29`, `Fs29`, `dt30`, `Fs30`, `dt31`, `Fs31`, `dt32`, `Fs32`, `dt33`, `Fs33`, `dt34`, `Fs34`, `dt35`, `Fs35`, `dt36`, `Fs36`, `dt37`, `Fs37`, `dt38`, `Fs38`, `dt39`, `Fs39`, `dt40`, `Fs40`, `dt41`, `Fs41`, `dt42`, `Fs42`, `dt43`, `Fs43`, `dt44`, `Fs44`, `dt45`, `Fs45`, `dt46`, `Fs46`, `dt47`, `Fs47`, `dt48`, `Fs48`, `dt49`, `Fs49`, `dt50`, `Fs50`, `dt51`, `Fs51`, `dt52`, `Fs52`, `dt53`, `Fs53`, `dt54`, `Fs54`, `dt55`, `Fs55`, `dt56`, `Fs56`, `dt57`, `Fs57`, `dt58`, `Fs58`, `dt59`, `Fs59`, `dt60`, `Fs60`, `dt61`, `Fs61`, `dt62`, `Fs62`, `dt63`, `Fs63`, `dt64`, `Fs64`, `dt65`, `Fs65`, `dt66`, `Fs66`, `dt67`, `Fs67`, `dt68`, `Fs68`, `dt69`, `Fs69`, `dt70`, `Fs70`, `dt71`, `Fs71`, `dt72`, `Fs72`, `dt73`, `Fs73`, `dt74`, `Fs74`, `dt75`, `Fs75`, `dt76`, `Fs76`, `dt77`, `Fs77`, `dt78`, `Fs78`, `dt79`, `Fs79`, `dt80`, `Fs80`, `dt81`, `Fs81`, `dt82`, `Fs82`, `dt83`, `Fs83`, `dt84`, `Fs84`, `dt85`, `Fs85`, `dt86`, `Fs86`, `dt87`, `Fs87`, `dt88`, `Fs88`, `dt89`, `Fs89`, `dt90`, `Fs90`, `dt91`, `Fs91`, `dt92`, `Fs92`, `dt93`, `Fs93`, `dt94`, `Fs94`, `dt95`, `Fs95`, `dt96`, `Fs96`, `dt97`, `Fs97`, `dt98`, `Fs98`, `dt99`, `Fs99`, `dt100`, `Fs100`, `dt101`, `Fs101`, `dt102`, `Fs102`, `dt103`, `Fs103`, `dt104`, `Fs104`, `dt105`, `Fs105`, `dt106`, `Fs106`, `dt107`, `Fs107`, `dt108`, `Fs108`, `dt109`, `Fs109`, `dt110`, `Fs110`, `dt111`, `Fs111`, `dt112`, `Fs112`, `dt113`, `Fs113`, `dt114`, `Fs114`, `dt115`, `Fs115`, `dt116`, `Fs116`, `dt117`, `Fs117`, `dt118`, `Fs118`, `dt119`, `Fs119`, `dt120`, `Fs120`, 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Outline Introduction Frequency Response Digital Filters

Filter Types

An FIR Filter

- Consider System Described By The Transfer Function

$$H(z) = \frac{b_3 z^3 + b_2 z^2 + b_1 z + b_0}{z^3}$$
- The Corresponding Difference Equation

$$y[k] = b_3 f[k] + b_2 f[k-1] + b_1 f[k-2] + b_0 f[k-3]$$
 shows the current output is a function of current/past inputs
- Once The Input Is Off For A Sufficient Amount of Time, The Output Is Off
- A Single Impulse Applied at $k = 0$ Will Yield A Finite Length Impulse Response
- FIR Filters Only Have Poles At The Origin

Dr. Adam Panagos
Analytical Methods for Multivariable and Discrete-Time Systems

AP

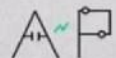
Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) Filters

Digital Filter Design Part 1



<http://www.adampanagos.org>

Playlist Video # 6 of 8



Outline Introduction Frequency Response Digital Filters

Filter Types

An IIR Filter

- Consider System Described By The Transfer Function

$$H(z) = \frac{b_3 z^3 + b_2 z^2 + b_1 z + b_0}{z^3 + a_2 z^2 + a_1 z + a_0}$$

- The Corresponding Difference Equation

$$y[k] = -a_2 y[k-1] - a_1 y[k-2] - a_0 y[k-3] + b_3 f[k] + b_2 f[k-1] + b_1 f[k-2] + b_0 f[k-3]$$

shows the current output is a function of current/past inputs and past outputs. It is a *recursive* structure

- A Unit Impulse Applied at $k = 0$ Will Last "Forever"
- IIR Filters Can Have Poles At Arbitrary Locations



Dr. Adam Panagos

Analytical Methods for Multivariable and Discrete-Time Systems

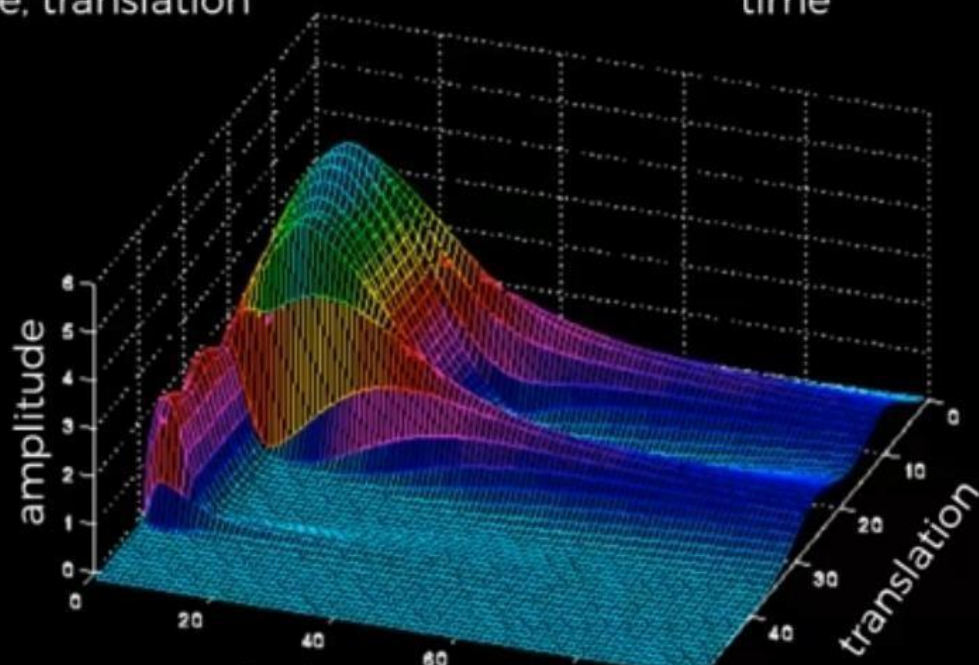
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WAVELET TRANSFORM

$$X(a, b) = \int_{-\infty}^{\infty} x(t) \psi_{a,b}^*(t) dt$$

scale, translation

time



Day 8

Day -8 Digital Signal processing

Fourier transforms

The function $F(s)$, defined by

$$F(s) = \int_{-\infty}^{\infty} f(x) \cdot e^{isx} \cdot dx \text{ is called Fourier transform of } f(x)$$

Also, the function $f(x)$, defined by

$$f(x) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(s) \cdot e^{-isx} \cdot ds$$

is called Inverse Fourier transform of $F(s)$
Inversion Formula

① Find the Fourier transform of

$$f(x) = \begin{cases} 1, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$$

hence evaluate $\int_{-\infty}^{\infty} \frac{\sin x}{x} dx$

② Find the Fourier transform of

$$f(x) = \begin{cases} 1-x, & |x| \leq 1 \\ 0, & |x| > 1 \end{cases}$$

FFT \rightarrow Fast Fourier transform

$$\text{DFT } X_p = \sum_{n=0}^{N-1} x_n \cdot w_N^{np}$$

$$0 \leq p \leq N-1$$

$$w_N = e^{-j\frac{2\pi}{N}}$$

$$X_0 = x_0 e^{-j2\pi(0)(0)/4} + x_1 e^{-j2\pi(1)(0)/4} + x_2 e^{-j2\pi(2)(0)/4} + x_3 e^{-j2\pi(3)(0)/4}$$

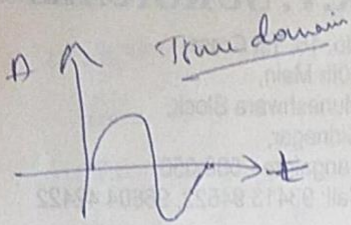
$$X_0 = x_0 + x_1 + x_2 + x_3$$

$$X_1 = x_0 e^{-j2\pi/4} + x_1 e^{-j2\pi(1)(1)/4} + x_2 e^{-j2\pi(2)(1)/4} + x_3 e^{-j2\pi(3)(1)/4}$$

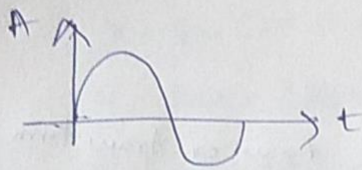
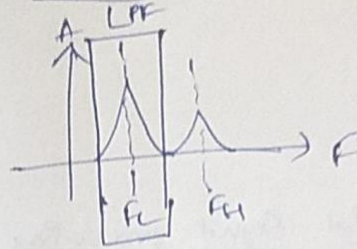
$$X_1 = x_0 e^{-j\pi/2} + x_1 - x_2 + x_3$$

Fast fourier transform

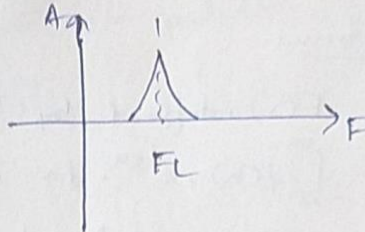
Matlab



FFT



IFFT



$f_s = 1000$; # Sampling Frequency

$T_s = 1/f_s$; # sampling period or time step

$dt = 0:T_s:2-T_s$; # Signal duration

$f_1 = 10$;

$f_2 = 30$;

$f_3 = 70$;

$y = A \sin(2\pi f t + \theta)$;

$y_1 = 10 \times \sin(2\pi f_1 \times dt)$;

$y_2 = 10 \times \sin(2\pi f_2 \times dt)$;

$y_3 = 10 \times \sin(2\pi f_3 \times dt)$;

$y_4 = y_1 + y_2 + y_3$

subplot(3,1,1);

plot(dt, y1, 'red');

subplot(3,1,2)

plot(dt, y2, 'red');

subplot(3,1,3)

plot(dt, y3, 'red');

subplot(4,1,4)

plot(dt, y4, 'red');

$N = \text{length}(y_4)$;

length of time domain signal

$Nfft = 2 \times \text{nextpow2}(N)$;

length of signal in power

Study And Analysis FIR and IIR using FPA for in matlab

• filter Design

$$f_s = 500$$

$$T = 1/f_s;$$

$$t = 0:T:1-T;$$

$$x = \sin(2\pi \cdot 10 \cdot t) + 0.2 \cdot \text{randn}(\text{size}(t));$$

$$y = \text{filter}(\text{BzNum}, 1, x);$$

$$\text{plot}(t, x, t, y);$$

d = LPF

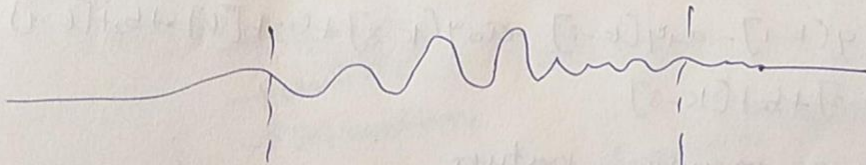
Introduction to wt (wavelets).

→ Fourier transform $\Rightarrow X(f) = \int_{-\infty}^{\infty} x(t) e^{j2\pi f t} dt$



wavelet transform.

$$\text{Area 1} = \text{Area 2}$$



$$X(a,b) = \int_{-\infty}^{\infty} x(t) \psi_{a,b}^*(t) dt$$

→ translation and scale.

→ high-frequency scale

→ low-frequency scale

→ Resolution.

→ Correlation.

$$X(a,b) = \int_{-\infty}^{\infty} x(t) \psi_{a,b}^*(t) dt$$

→ Vanishing moments.

$$m_k = \int_{-\infty}^{\infty} f(x) x^k dx$$

→ higher No. of Vanishing moments = more complex wavelet representation of complex signal

FIR AND IIR filters

By the transfer function

$$H(z) = \frac{b_3 z^3 + b_2 z^2 + b_1 z + b_0}{z^3}$$

Digital filter classified as Recursive or Non-recursive

Also called IIR & FIR

IIR

$$H(z) = \frac{b_3 z^3 + b_2 z^2 + b_1 z + b_0}{z^3 + a_2 z^2 + a_1 z + a_0}$$

Difference Equation

$$y(k) = -a_2 y(k-1) - a_1 y(k-2) - a_0 y(k-3) + b_3 x[k] + b_2 x[k-1] + b_1 x[k-2] + b_0 x[k-3]$$

→ It has a recursive nature.

→ A unit impulse applied at $k=0$ will last "forever".

→ IIR filters can have poles at arbitrary locations.

FIR filter

$$H(z) = \frac{b_3 z^3 + b_2 z^2 + b_1 z + b_0}{z^3}$$

$$y(k) = b_3 x[k] + b_2 x[k-1] + b_1 x[k-2] + b_0 x[k-3]$$

→ Once the input is off for a sufficient amount of time, the output is off.

→ Single impulse applied at $k=0$ will yield a finite length impulse response.

→ FIR filters only have poles at the origin.

require 0 vanishing moments - longer support.

→ Regularity

→ Selectivity in Frequency

Heisenberg uncertainty.

more selective wavelet = less compact support.

CWT & DWT →

→ 20-20000 Hz is the range of hearing

Fourier Series.

$$f(t) = \frac{1}{2} a_0 + \sum_{k=1}^{\infty} (a_k \cos 2\pi k t + b_k \sin 2\pi k t)$$

Fourier transform.

$$X(f) = \int_{-\infty}^{\infty} x(t) e^{-j 2\pi f t} dt.$$

Discrete Fourier transform.

$$\text{Continuous } X(f) = \int_{-\infty}^{\infty} x(t) e^{-j 2\pi f t} dt.$$

Discrete

Continuous wavelet transform $\psi(t)$

$$f(t) * \psi(2^k t)$$

→ study of $f(t)$ at various resolution.

$$CWT(\tau, s) = \int \left\langle f(t), \psi\left(\frac{t-\tau}{s}\right) \right\rangle$$

$$STFT \left(\left\langle f(t), g(t-u) e^{j 2\pi f t} \right\rangle \right)$$

$$\langle f(t)g \rangle = \int f \cdot g^* dt$$

IMPLEMENTATION OF SIGNAL FILTERING SIGNAL USING WT IN MATLAB

Clear all

```
[K,FS]audioread("man_voice.wav");  
K=k*0.5/RMS(k);  
K=awgn(k,2,'measured');  
B=wthresh(c,s,0.25);  
Y=waverec(b,l,'db');  
Y=y*0.5/RMS(y);  
Sound(y,FS);
```

SHORT TIME FOURIER TRANSFORM AND THE SPECTOGRAM

-analysis of time varying special characteristics

Speech

Music

Seismology

-increases : bandwidth decreases and impulses response duration increases

WELCH'S METHOD AND WINDOWING

- Power spectrum estimation
- Pwelch(MATLAB) calculates spectral density =multiply by fs/2 to get spectrum
- Example power spectrum estimates in db
 - Hammming window
 - No overlap(R=L)
 - Effect of averaging on variance

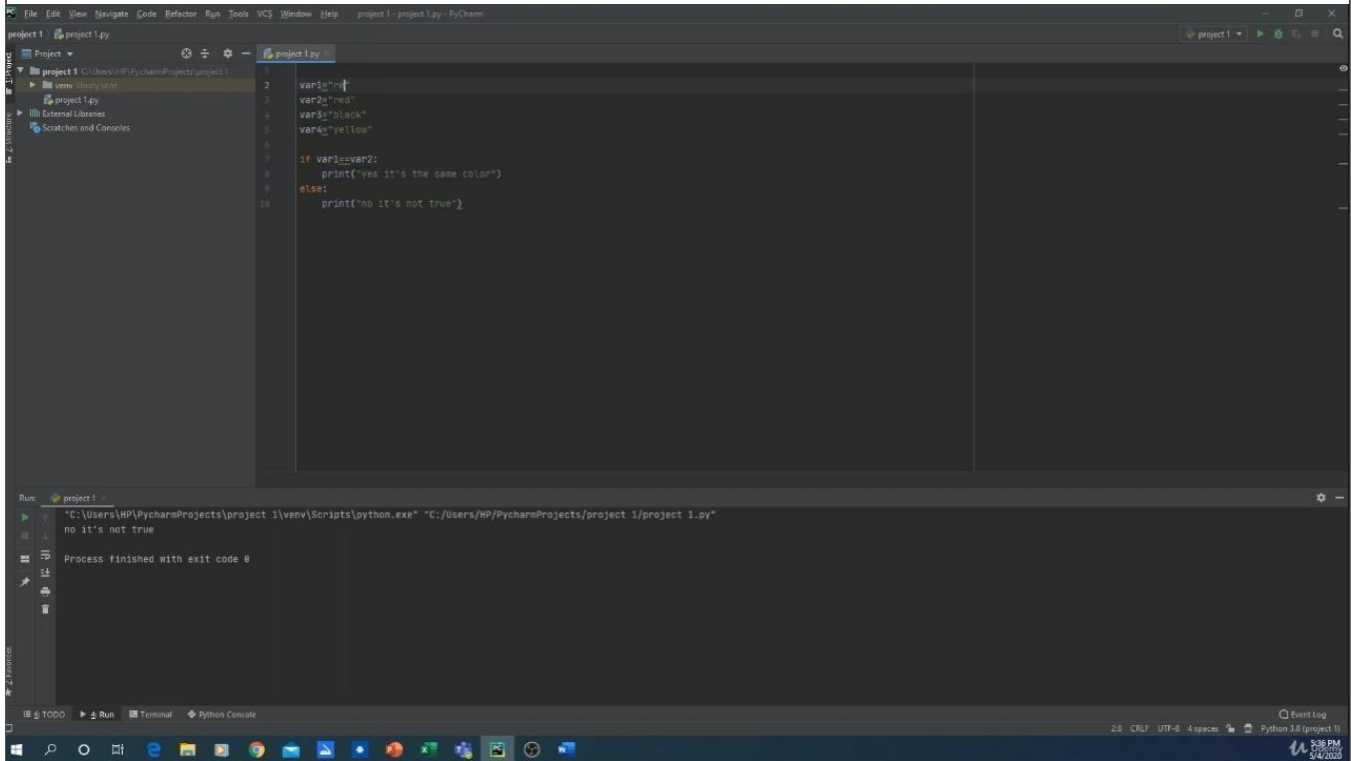
ECG SIGNAL ANALYSIS USING MATLAB

- Electrical activity of heart

```
Sig=load('ecg txt');  
Plot(Sig)  
Xlabel('samples');  
Ylabel('electrical activity');  
Title ('ecg signal sampled at 100hz ');  
Hold on  
Plot(sign,'r0');  
Edit
```

Date:	May 27 2020	Name:	Apeksha S Shetty
Course:	Python	USN:	4AL16EC006
Topic:		Semester & Section:	8TH SEM A
Github Repository:	Apeksha-97		

Image



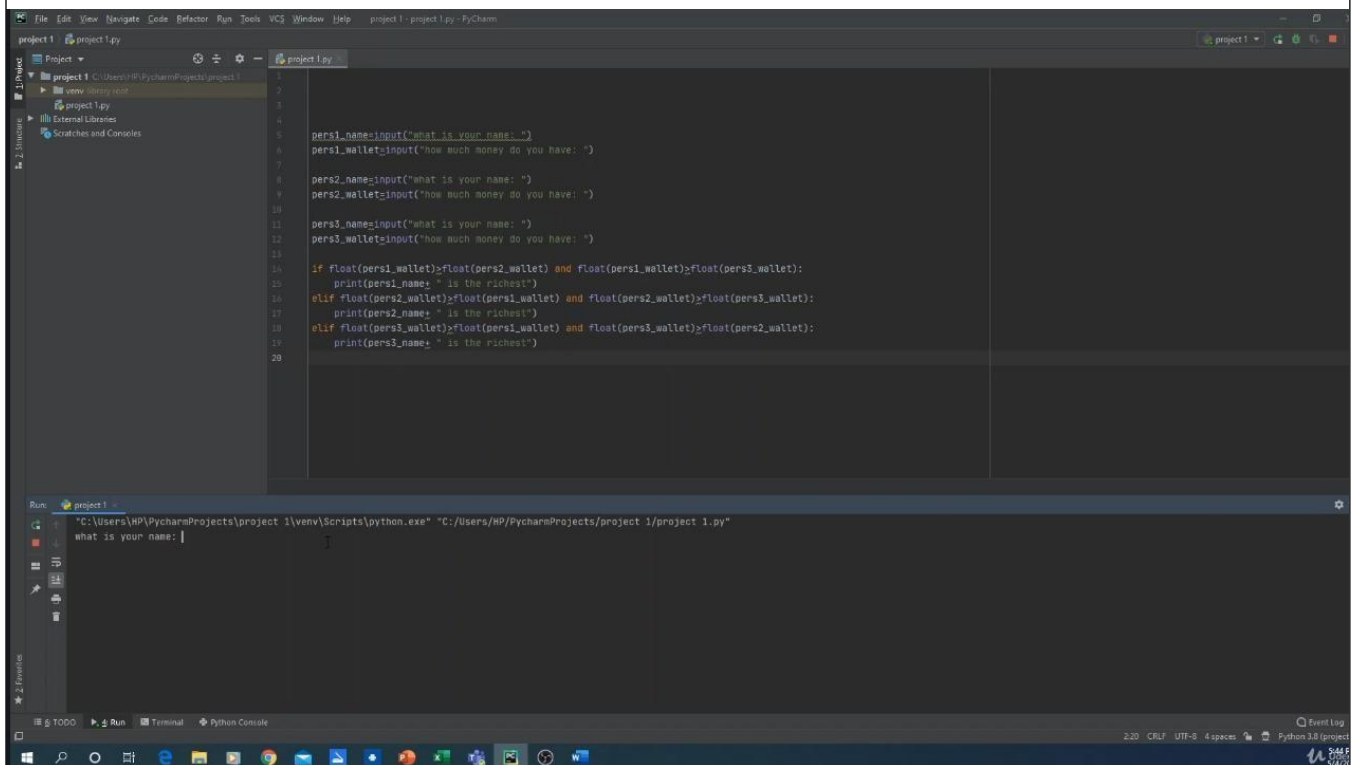
The screenshot shows the PyCharm IDE interface. The main editor window displays a Python script named `project 1.py` with the following code:

```
1
2 var1="n"
3 var2="red"
4 var3="black"
5 var4="yellow"
6
7 if var1==var2:
8     print("yes it's the same color")
9 else:
10    print("no it's not true")
```

The Run window at the bottom shows the execution output:

```
Run: project 1
"C:\Users\HP\PycharmProjects\project 1\venv\Scripts\python.exe" "C:\Users\HP\PycharmProjects\project 1\project 1.py"
no it's not true
Process finished with exit code 0
```

The status bar at the bottom indicates the file encoding is UTF-8, the line length is 4 spaces, and the Python version is 3.8 (project 1). The system clock shows 5:36 PM on 5/4/2020.



The screenshot shows the PyCharm IDE interface. The main editor window displays a Python script named `project 1.py` with the following code:

```
1
2
3
4
5 pers1_name=input("what is your name: ")
6 pers1_wallet=input("how much money do you have: ")
7
8 pers2_name=input("what is your name: ")
9 pers2_wallet=input("how much money do you have: ")
10
11 pers3_name=input("what is your name: ")
12 pers3_wallet=input("how much money do you have: ")
13
14 if float(pers1_wallet)>float(pers2_wallet) and float(pers1_wallet)>float(pers3_wallet):
15     print(pers1_name, " is the richest")
16 elif float(pers2_wallet)>float(pers1_wallet) and float(pers2_wallet)>float(pers3_wallet):
17     print(pers2_name, " is the richest")
18 elif float(pers3_wallet)>float(pers1_wallet) and float(pers3_wallet)>float(pers2_wallet):
19     print(pers3_name, " is the richest")
20
```

The Run window at the bottom shows the execution output:

```
Run: project 1
"C:\Users\HP\PycharmProjects\project 1\venv\Scripts\python.exe" "C:\Users\HP\PycharmProjects\project 1\project 1.py"
what is your name: |
```

The status bar at the bottom indicates the file encoding is UTF-8, the line length is 4 spaces, and the Python version is 3.8 (project 1). The system clock shows 5:44 PM on 5/4/2020.

Day8

Report can be typed or handwritten of upto two pages

Use of if statement with numericals

```
Var1="red";  
Var2="orange";  
Var3="black";  
Var4="yellow";
```

If var1== var2:

Print("yes it's the same colour ")

Else:

Print("no it's not true")

- If statement for the decision making
- Without the use of the boolean functions
- With string to string

Data manipulation

In variables and in strings

```
Variable_1="apple"  
List_1=["apple","banana","anas","melon"]  
List_1[3]="anas"  
List_1[2]="tomato"  
Print(list_1)
```