Name: Mian Usman Naeem Kakakhel

Id: 21701015

Section: 02

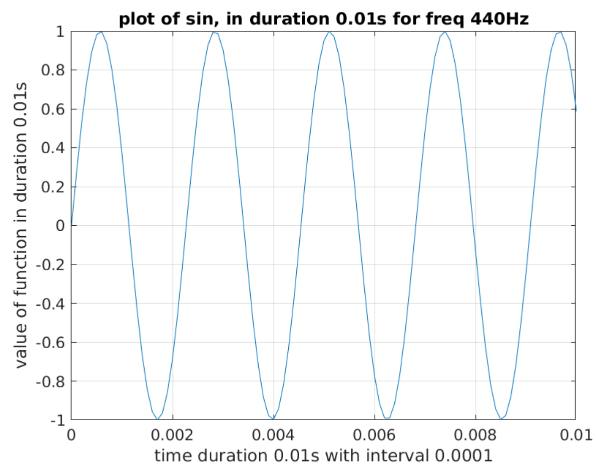
HW 1

29/02/2020

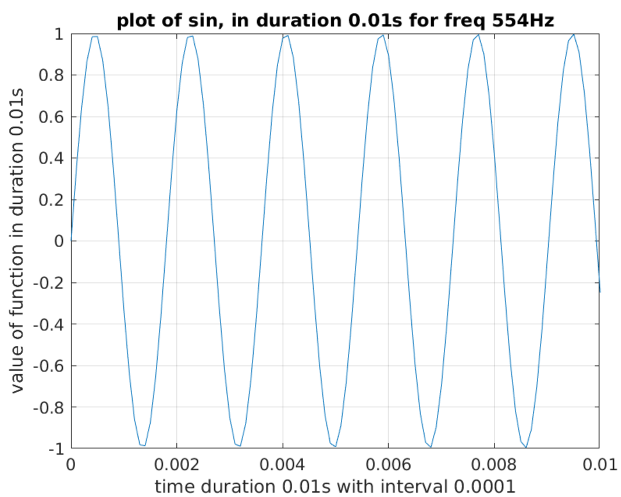
Note: All code is given at the end.

PART 1)

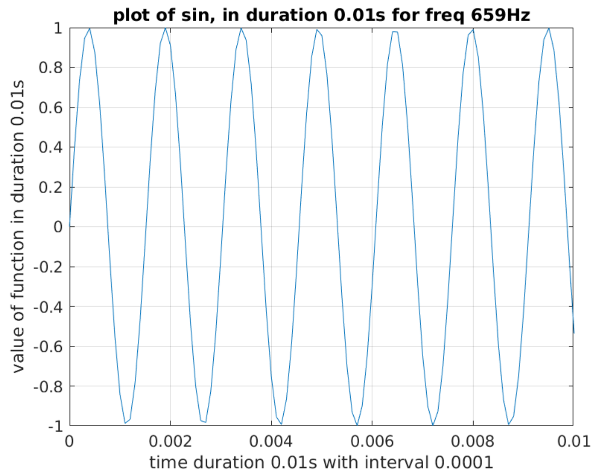
Listening to f0 = 440 Hz, 2f0 = 880 Hz, and 4f0 = 1760 Hz, the frequency was doubled and the sound went one octave up.



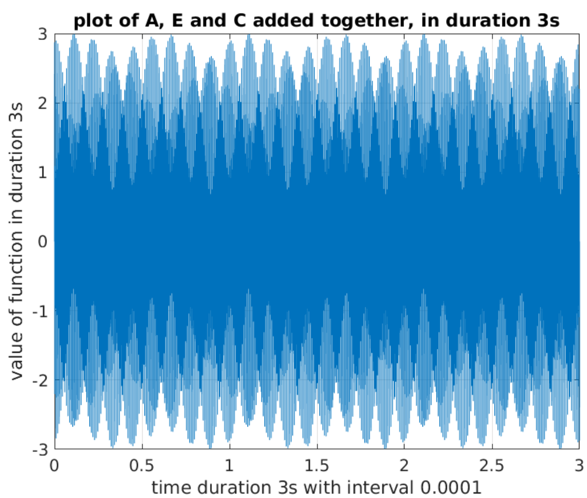
Listening to f0 = 554 Hz, 2f0 = 1108 Hz, and 4f0 = 2216 Hz, the frequency was doubled and the sound went one octave up.

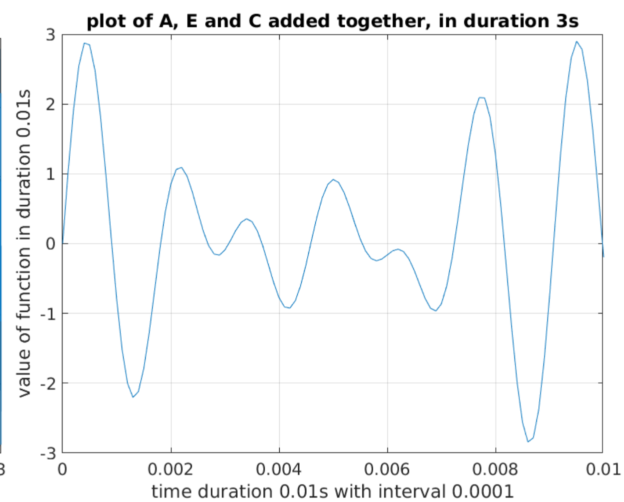


Listening to f0 = 659 Hz, 2f0 = 1318 Hz, and 4f0 = 2636 Hz, the frequency was doubled and the sound went one octave up.



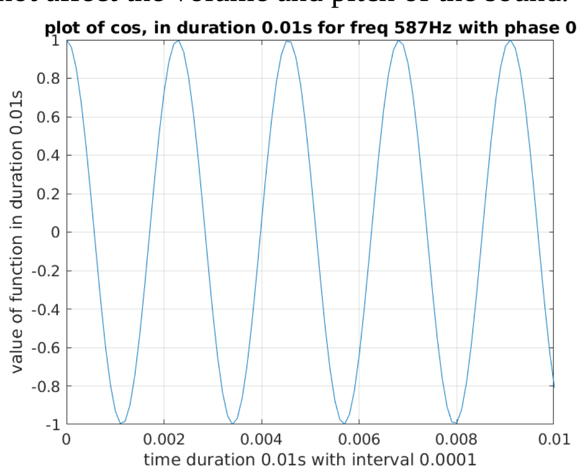
This is a combo of A, C# and E notes

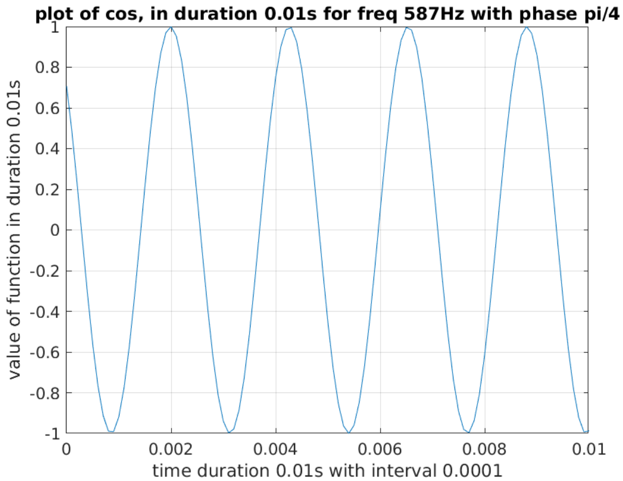


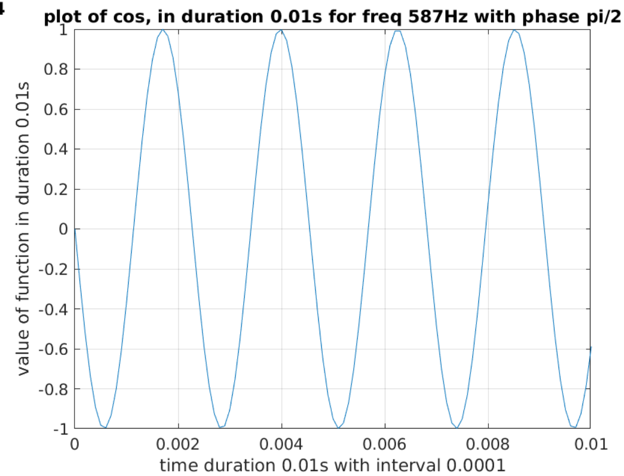


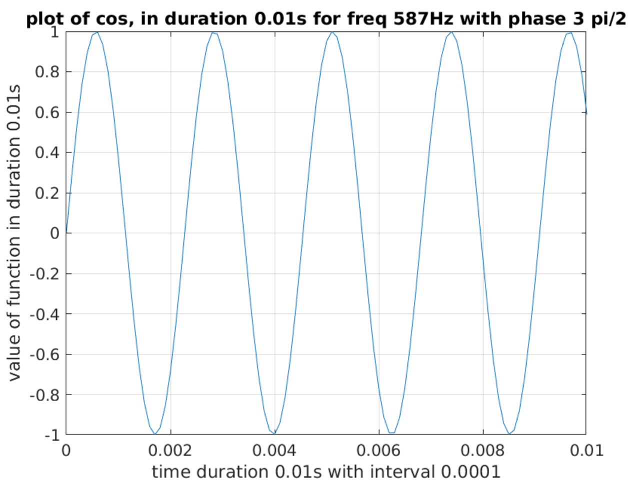
PART 2)

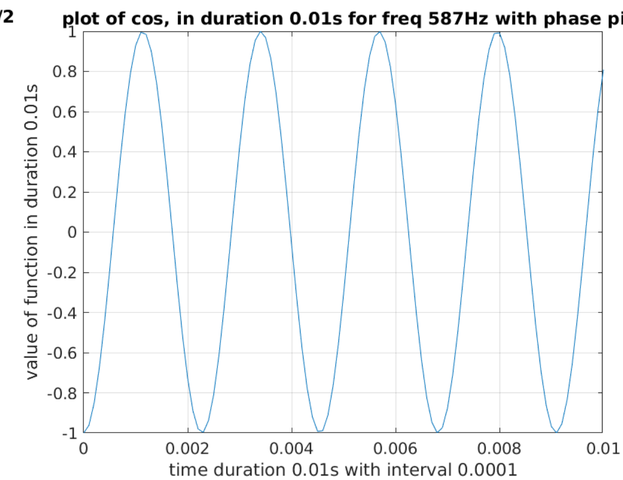
Changing the phase does not affect the volume and pitch of the sound.





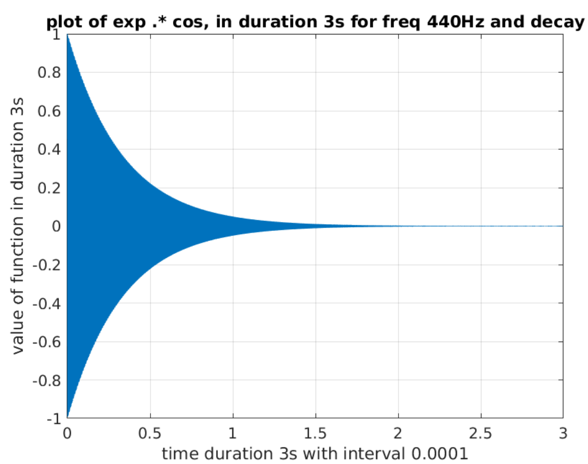






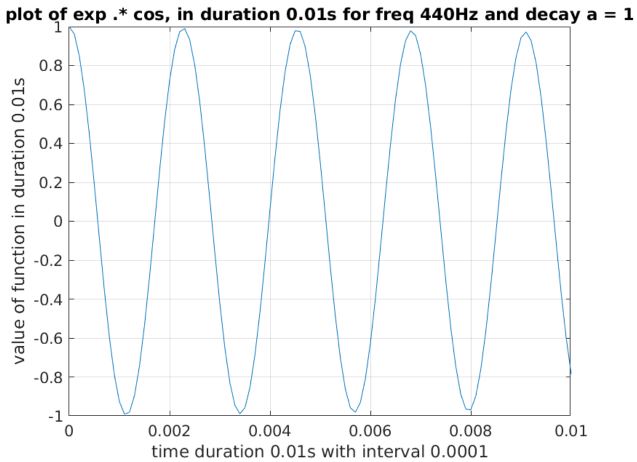
PART 3)

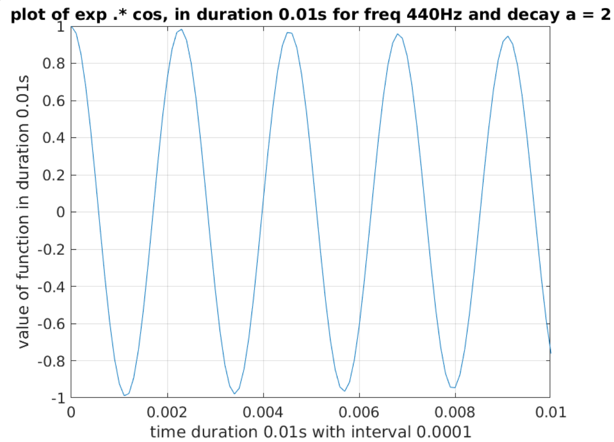
X3 with decay:

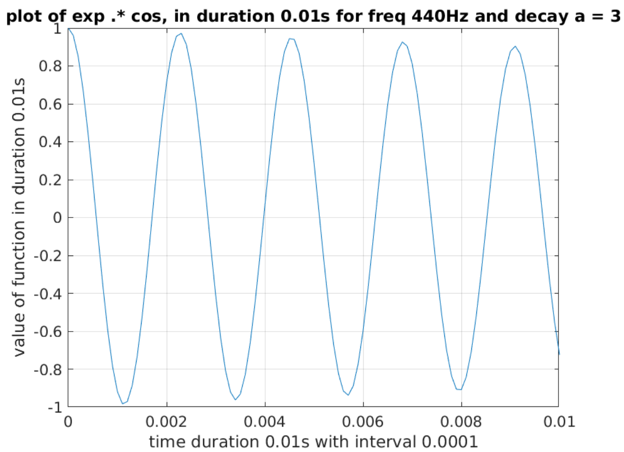


The amplitude of X1 is constant while the amplitude of X3 is decreasing exponentially thus the volume of the sound also decreases exponentially in X3. The sound of X1 remains constant due to the constant amplitude of X1.

X1 sounds more like a piano but X3 sounds more like a flute.

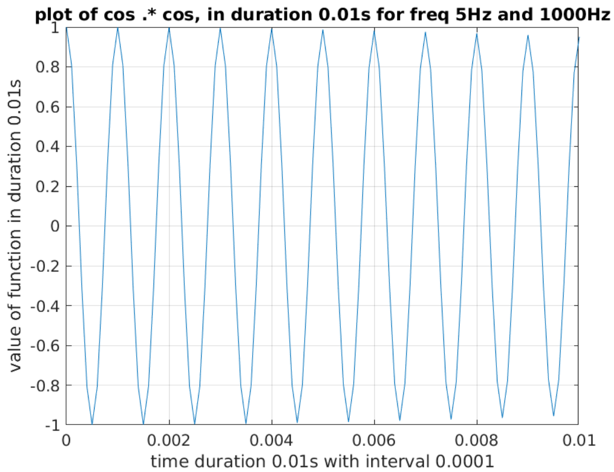


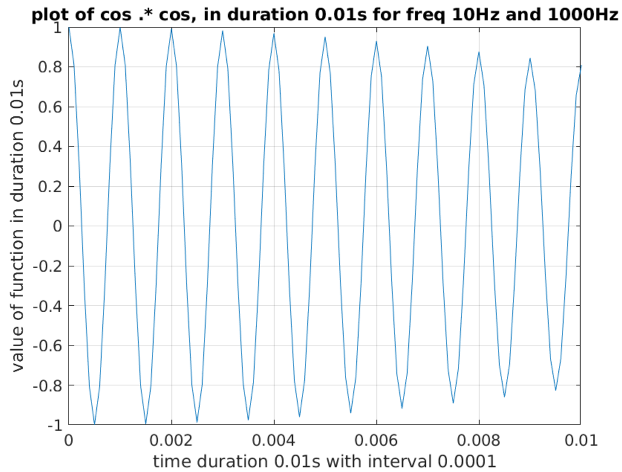


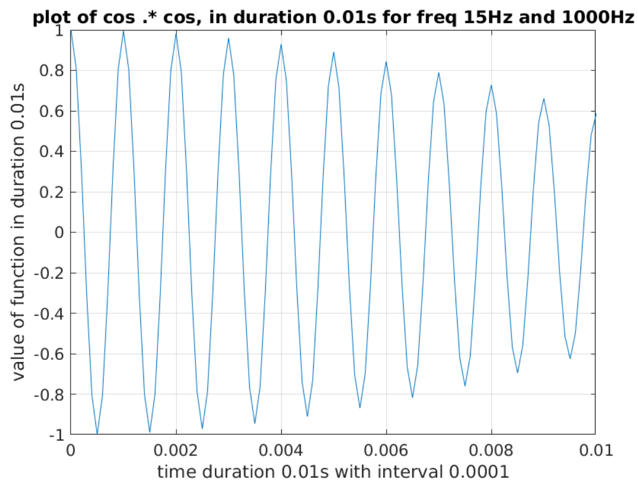


Here we can see that the exponential decrease factor of the decrease increases as we increase a thus it could be related to a tuning fork system which produces exponentially decreasing sounds.

PART4)







Comparing X1 and X4, we can see that X1 is very smooth around the edges and all the way but X4 is very pointy on the peaks. When increasing f1, it can be seen that the pulsating effect increases in the sound.

The beat note is heard because 2 sins with very close frequencies are played and summed together.

PART 5)

The sample freq according to rule should be 2 times the maximum frequency and the maximum frequency is 2500 in this case. So the sampling freq should be greater than 5000. 0.01 as instructed in the question is not enough for this and I took 0.0001 in the question due to this reason.

μ is calculated from $fi(t) = 2\mu t + f0$. With t=0 we get f0=2500 and then with t=2 we get μ=-500.

When we reverse the starting and ending frequencies we get f0=500 μ=500.

When the X5 is run on the first values, we hear a sound dropping from high pitch to low pitch and when the values are reversed, the sound is increasing from low pitch to high pitch.

With a double μ, the rate with which the pitch increases, increases and when the μ is halved, the increasing pitch decreases.

For the second part we first hear a chirp down and then we hear a chirp up.

PART6)

The composed song is given below.

```
notename = ["A", "C","B", "D", "E", "F", "F#", "G", "G#"];

song = ["F#", "F#","A", "A", "E", "E", "F#", "F#","D","D", "E", "E", "B", "B", "A", "A", "G#",
"G#"];
for k1 = 1:length(song)
   idx = strcmp(song(k1), notename);
   songidx(k1) = find(idx);
end
dur = 0.3*8192;
songnote = [ ];
for k1 = 1:length(songidx)
songnote = [songnote; [notecreate(songidx(k1),dur) zeros(1,75)]'];
end
soundsc(songnote, 8192)
```

Code for all parts:

PART1)

```
T = 0.0001;
fA = 440;
fC = 554;
fE = 659;
t = (0:T:3.0);
x1 = sin(2 * pi * fA * t);

yAxis = (x1(1:(0.01/T) + 1));
times = (0:T:0.01);

plot(times, yAxis);
xlabel('time duration 0.01s with interval 0.0001');
ylabel('value of function in duration 0.01s');
```

```
title('plot of sin, in duration 0.01s for freq 440Hz');
grid ON;

soundsc(x1, 1/T);

s = sin(2 * pi * fA * t) + sin(2 * pi * fC * t) + sin(2 * pi * fE * t);
times1 = (0:T:3);

plot(times1, s);
xlabel('time duration 3s with interval 0.0001');
ylabel('value of function in duration 3s');
title('plot of A, E and C added together, in duration 3s');
grid ON;

soundsc(s, 1/T);
```

PART2)

```
T = 0.0001;
phi = pi;
fD = 587;
t = (0:T:3.0);
x2 = cos((2 * pi * fA * t) + phi);

yAxis = (x2(1:(0.01/T) + 1));
times = (0:T:0.01);

plot(times, yAxis);
xlabel('time duration 0.01s with interval 0.0001');
ylabel('value of function in duration 0.01s');
title('plot of cos, in duration 0.01s for freq 587Hz with phase pi');
grid ON;

soundsc(x2, 1/T);
```

PART3)

```
T = 0.0001;
a = 1;
fD = 440;
t = (0:T:3.0);
```

```
x3 = exp(-((a * a) + 2) * t) .* cos(2 * pi * fA * t);

yAxis = (x3(1:(0.01/T) + 1));
times = (0:T:0.01);

plot(t, x3);
xlabel('time duration 0.01s with interval 0.0001');
ylabel('value of function in duration 0.01s');
title('plot of exp .* cos, in duration 0.01s for freq 440Hz and decay');
grid ON;

soundsc(x3, 1/T);
```

PART4)

```
T = 0.0001;
f1 = 15;
f2 = 1000;
t = (0:T:3.0);
x4 = cos(2 * pi * f2 * t) .* cos(2 * pi * f1 * t);

yAxis = (x4(1:(0.01/T) + 1));
times = (0:T:0.01);

plot(times, yAxis);
xlabel('time duration 0.01s with interval 0.0001');
ylabel('value of function in duration 0.01s');
title('plot of cos .* cos, in duration 0.01s for freq 15Hz and 1000Hz');
grid ON;

soundsc(x4, 1/T);

trig = 0.5 * (cos((2 * pi * f2 * t) + (2 * pi * f1 * t)) + cos((2 * pi * f1 * t) - (2 * pi * f2 * t)));

soundsc(trig, 1/T);
```

PART5)

```
T = 0.0001;
f0 = 2500;
mew = -500;
```

```
fnew = 500;
mewnew = 500;
t = (0:T:2.0);
phi = 0;
x5 = cos((2 * pi * mewnew * t .* t) + (2 * pi * fnew * t) + phi);

yAxis = (x5(1:(0.01/T) + 1));
times = (0:T:0.01);

plot(times, yAxis);
xlabel('time duration 0.01s with interval 0.0001s');
ylabel('value of function in duration 0.01s');
title('chirp signal with mew = -500 and f0 = 2500 and phi = 0');
grid ON;

soundsc(x5, 1/T);
```