Experiment 10: Multi-rate signal processing

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Experiment No.	10

Code :

```
clear;
clc;

% Step 1: Load the audio file
[input_signal, input_Fs] = audioread('prathamesh_rec.wav'); % Replace with actual file name
Fs = 44100; % Required sampling rate

% Convert to mono if the input signal is stereo
if size(input_signal, 2) > 1
    input_signal = mean(input_signal, 2); % Average the two channels
    disp('Input signal converted to mono.');
end

% Check if the input sampling rate matches the required rate
if input_Fs ~= Fs
    input_signal = resample(input_signal, Fs, input_Fs); % Resample to 44,100 Hz
end

% Step 2: Define the target sampling rate
Fs_target = 48000; % Target sampling frequency in Hz

% Step 3: Determine up-sampling (L) and down-sampling (M) factors
[L, M] = rat(Fs_target / Fs); % Rational fraction of the conversion ratio

fprintf('Up-sampling factor (L): %d\n', L);
fprintf('Down-sampling factor (M): %d\n', M);

% Step 4: Resample the signal
% First, upsample by L
upsampled_signal = upsample(input_signal, L);

% Design a low-pass filter to prevent aliasing
Fcutoff = min(Fs, Fs_target) / 2; % Cutoff frequency for anti-aliasing
h = fir1(128, Fcutoff / (L * Fs)); % FIR filter design
```

```
% Convolve the upsampled signal with the filter
filtered_signal = filter(h, 1, upsampled_signal); % Use 'filter' instead of 'conv'

% Then, downsample by M
output_signal = downsample(filtered_signal, M);

% Step 5: Play and save the signals
disp('Playing the original signal...');
sound(input_signal, Fs);
pause(length(input_signal) / Fs + 1);

disp('Playing the converted signal...');
sound(output_signal, Fs_target);
pause(length(output_signal) / Fs_target + 1);

% Step 6: Visualization
t_input = (0:length(input_signal)-1) / Fs;
t_output = (0:length(output_signal)-1) / Fs_target;

subplot(2, 1, 1);
plot(t_input, input_signal);
title('Original Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;

subplot(2, 1, 2);
plot(t_output, output_signal);
title('Resampled Signal');
xlabel('Time (s)');
ylabel('Amplitude');
grid on;
```