Prelab

2022年1月15日 12:23

Pre-lab

Read the Lab 1 Background document, then complete the following exercises.

1. An audio signal y(t) is sampled with fs=32 kHz. What sampling period does that correspond to? If you mistakenly play the signal with fs=16 kHz, will it be shorter or longer than the original? How else will it sound different?

$f_{s_1} = 32kHz$

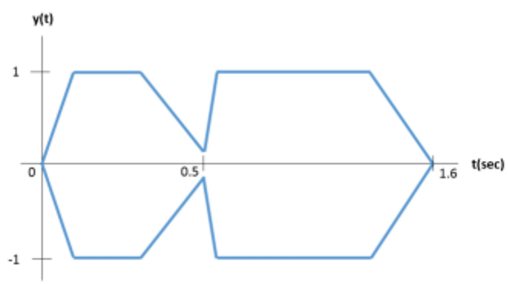
$T_1 = \frac{1}{f_s} = \frac{1}{32K} = 0.00003125 s$

$T_2 = \frac{1}{16k} = 0.0000625 s$ $T_1 < T_2$

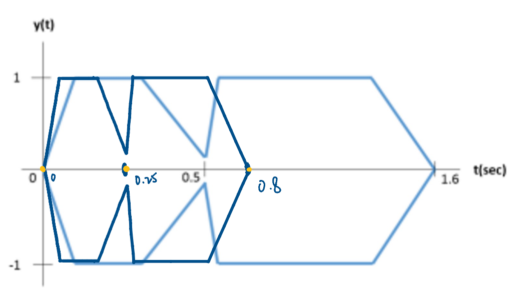
fs=16kHz is longer than original.

the pitch would decrease as fs is lower

2. The envelope of an audio signal **y(t)** (the train sound that you will work with in this lab) is approximated below:



a. Sketch the signal **y(2t).** Label the height and the time points corresponding to **t = 0**, **t = 0.5**, **t = 1.6** after the time scaling. If you played **y(2t)**, would it sound like **y(t)** has higher frequencies or lower frequencies?



y(2t) has a higher frequencies.

b. Repeat **(a)** for the signal **y(0.5t)**

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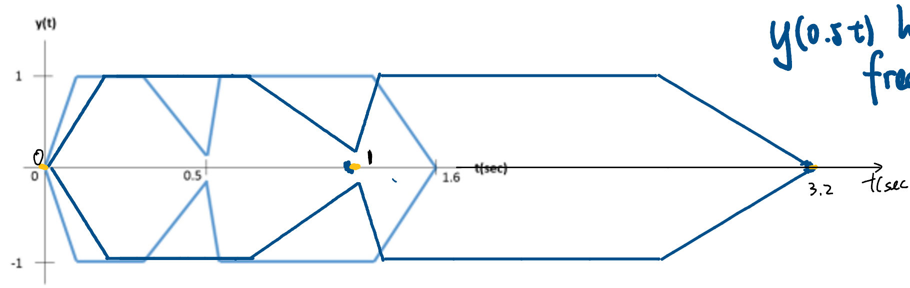
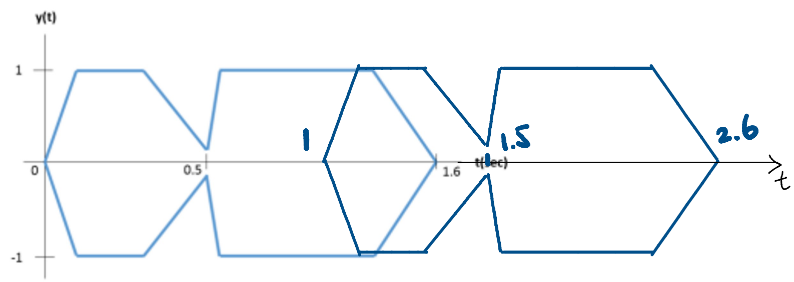
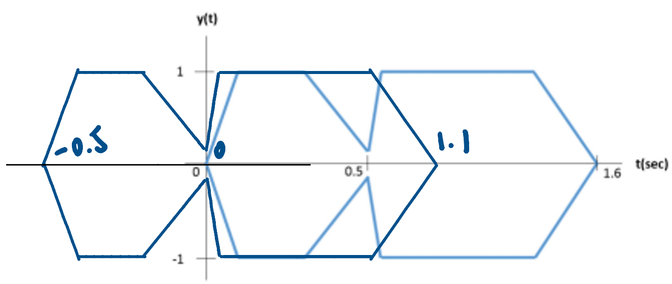


y(0.5t) has a lower frequencies.

c. Sketch the signal **y(t-1)** and **y(t+0.5),** again labeling critical time points.





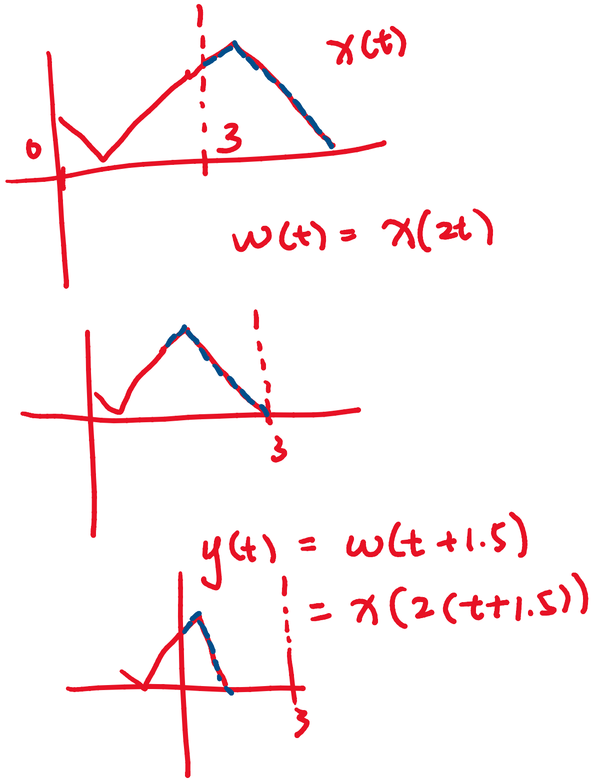
3. When the signal is digitized, you need to implement the time shift in terms of the number of samples: y[n-n1] and y[n+n2]. Find n1 and n2 (corresponding to t1=1 and t2=0.5, respectively) for the case when fs=32kHz.

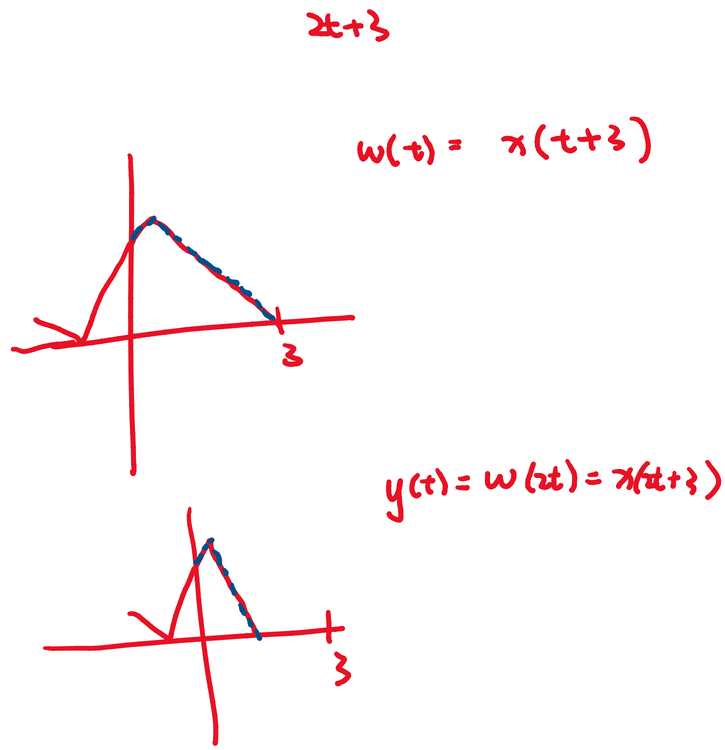
$fs = 32kHz \quad N = 0.00003125$

$$n1 = \frac{1}{0.00003125} = 32000$$

$$n2 = \frac{0.5}{0.00003125} = 16000$$

4. On a computer, we may have the constraint of keeping the time window fixed. Assuming the time window is constrained to be [0,3] sec, which of the time transformations in part 1 will require you to throw away some of the transformed signal? If you were to implement y(t)=x(2(t+1.5)) with a fixed time window, would it be better to scale first or shift first, or does it not matter?





Case1) If the data is constraint from [0,3] both of the transformation would be the same because all of the existing value will move out of the range of the time window.

Case2) if the data is not constraint, but only the time window is constrained, I would suggest to use shift and scale, because in the computer, in discrete time, it is not possible to shift data in a decimal value, such as 1.5. Therefore, we should first shift to left by 3, and scale the graph by 2, which is indicate on the right side above.