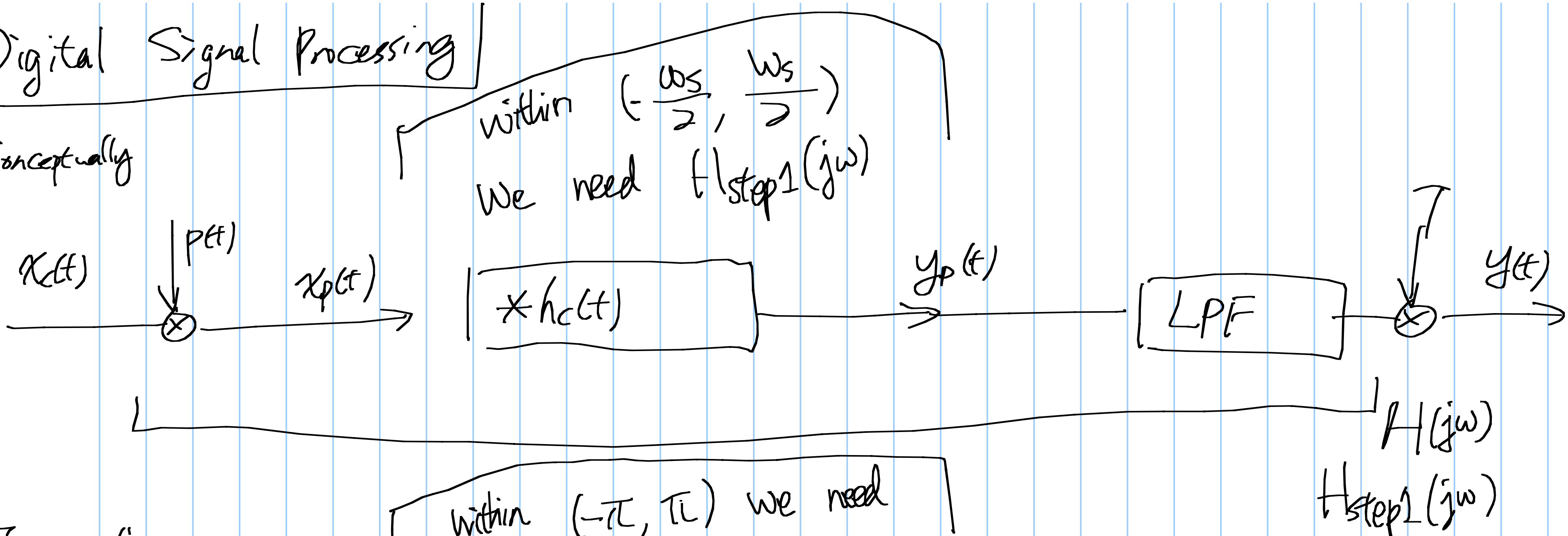
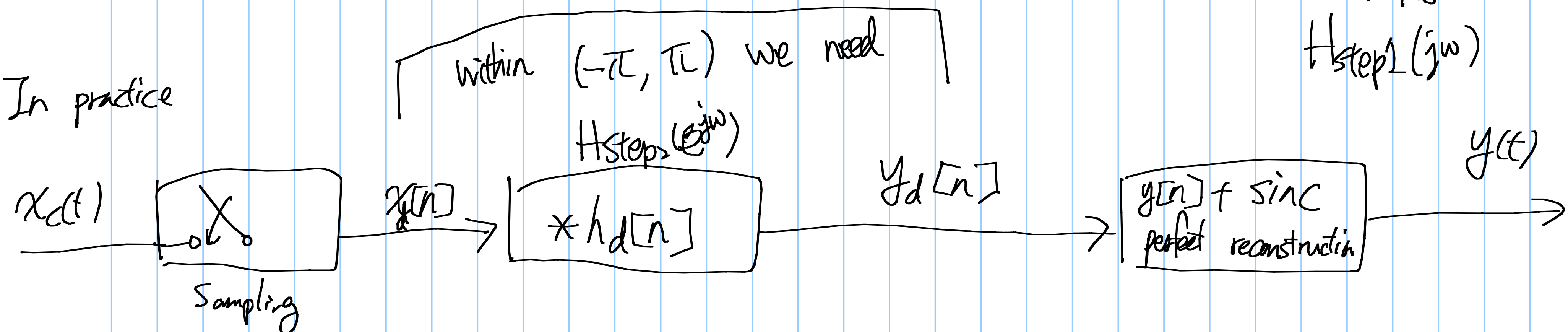
Digital Signal Processing

Conceptually



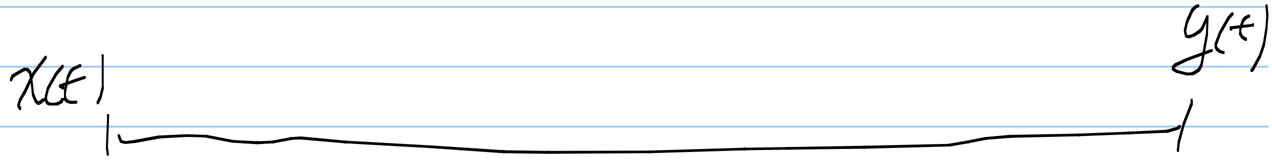
In practice



Goal: the input/output relationship between $x(t)$ & $y(t)$ fits the given design goal $h(t)$. or equivalent $H(j\omega)$

Example: digital differentiator:

End to End



$y(t) = \frac{d}{dt} x(t)$

Step 1: Everything outside $\left(-\frac{\omega_s}{2}, \frac{\omega_s}{2}\right)$ does not matter.

Step 2: Strech to fit $(-\pi, \pi)$

Step 3:

Q: How to compute $y_d[n]$?

* Ex: CT delay component

$$\xrightarrow{x(t)} \boxed{\text{delay } \Delta} \xrightarrow{y(t) = x(t-\Delta)}$$

Delay is difficult to implement in conti-time

Q: How to achieve it using sampling + DT processing

Ans: Our goal is to

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Note Title 4/21/2010

$$y(t) = x(t-\Delta) \Longleftrightarrow Y(j\omega) = \underbrace{e^{-j\omega\Delta}}_{\text{target } H(j\omega)} X(j\omega)$$

Step 1: Truncate anything outside $\left(-\frac{\omega_s}{2}, \frac{\omega_s}{2}\right)$

Step 2: Stretch $H_{step1}(j\omega)$ to fit $(-\pi, \pi)$

Step 3: Inverse DTFT

ex: Half-sample delay $\Delta = \frac{T}{2}$

$$y[n] = \sum_{k=-\infty}^{\infty} h[k]\, x[n-k]$$

We can implement any desired conti-time delay.