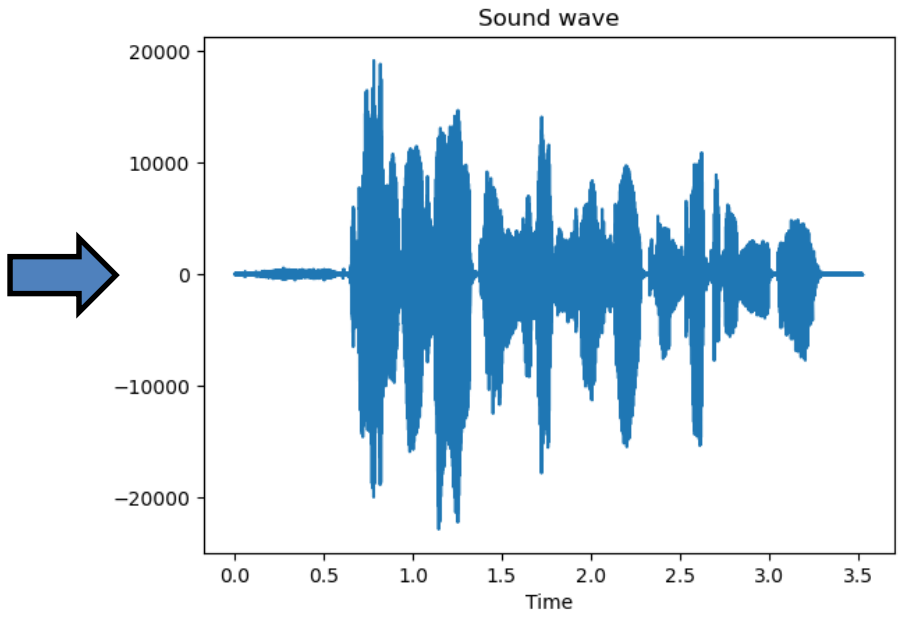
Lecture 02

신호 및 시스템 표현

신호(signal)

- 하나 이상의 독립 변수의 함수로 정의되며, 보통 어떤 현상의 성질에 관한 정보를 포함함
  - ***x*(*t*)**는 시간 ***t***의 함수로 표시되는 물리적인 양 ***x***를 나타냄
  - 예, 사람의 음성

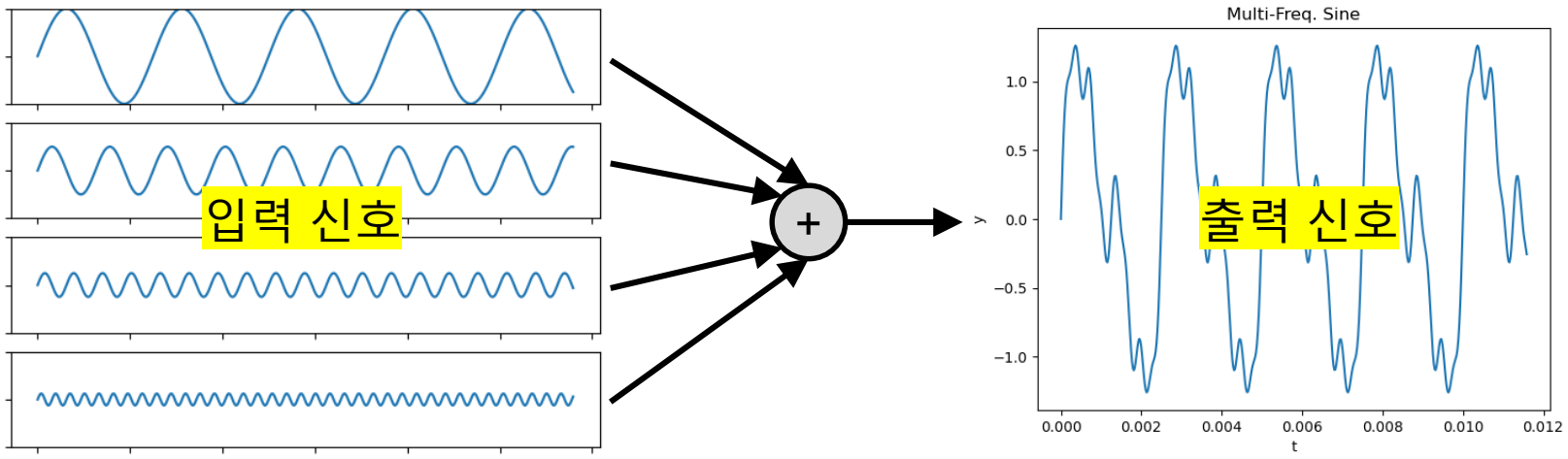
저의 회사에 방문해 주셔서 감사드립니다.



Source: Kyubyong Park, *KSS Dataset*, https://kaggle.com/bryanpark/korean-single-speaker-speech-dataset (accessed on 2024.08.06)

시스템(system)

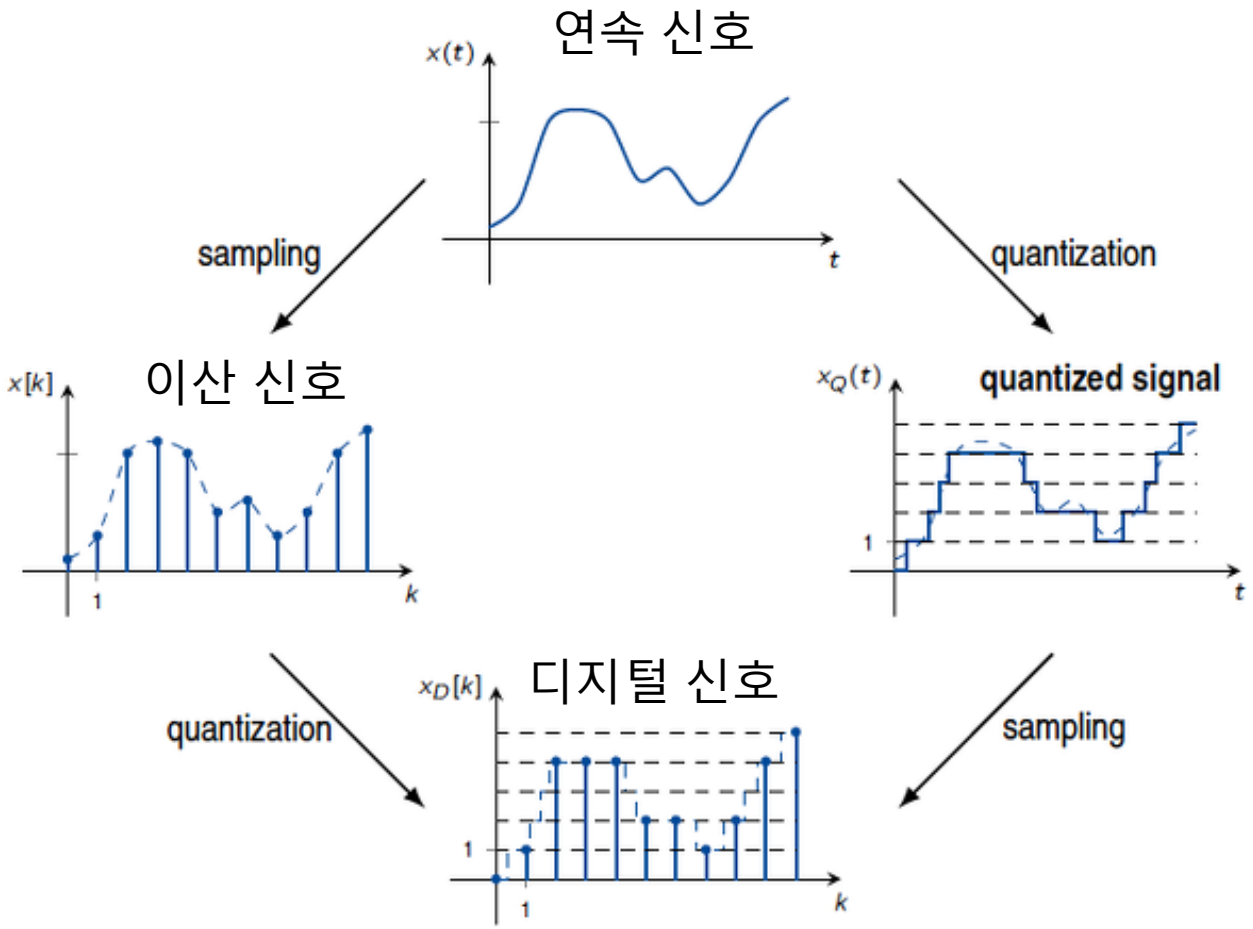
- 어떠한 목적을 달성하기 위하여 필요한 만큼의 성분과 요소들로 구성됨
- 주어진 신호에 반응하여 또 다른 신호를 발생하는 계통임
  - 신호 변형(**signal transformation**)
  - 신호 처리(**signal processing**)



연속, 이산, 디지털

연속/이산/디지털 신호

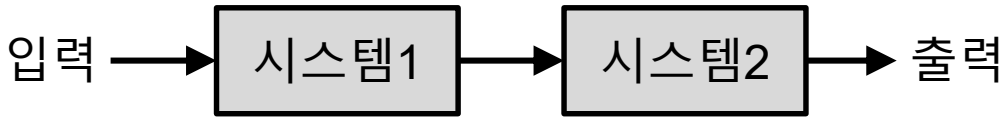
연속/이산/디지털 시스템



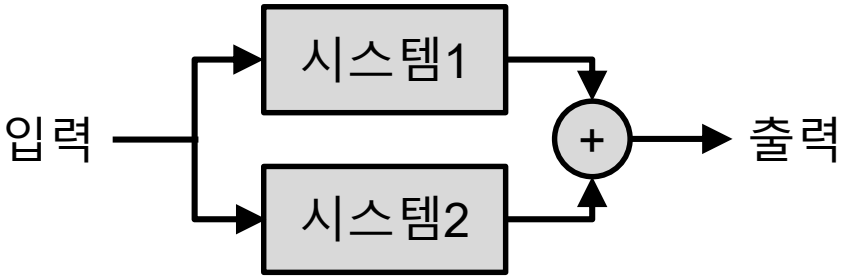
시스템

단독 시스템

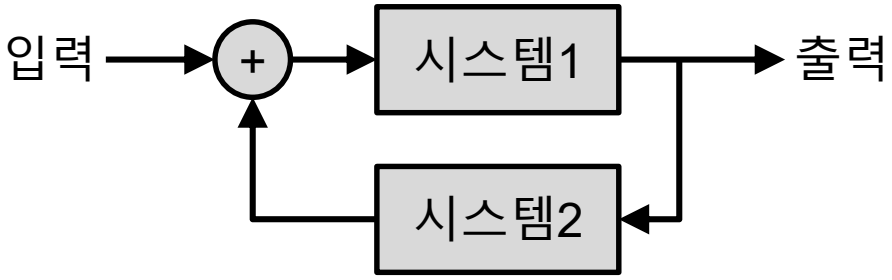
직렬 접속 시스템



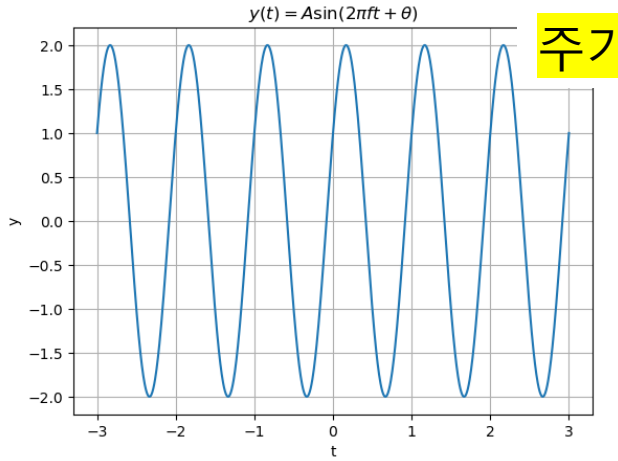
병렬 접속 시스템



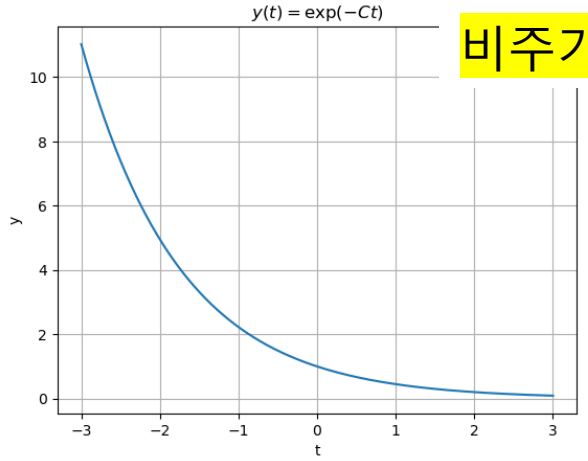
귀환 접속 시스템



연속 신호



주기 신호



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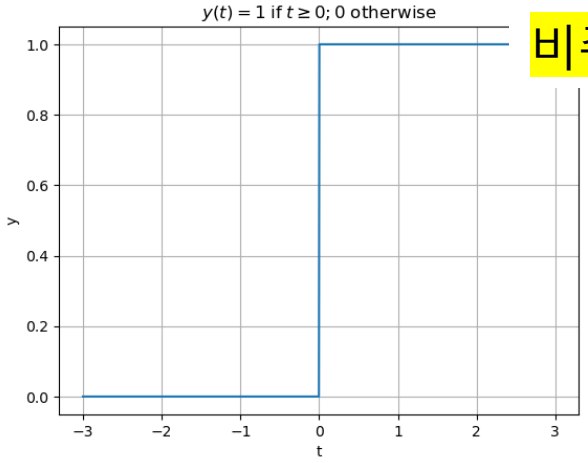

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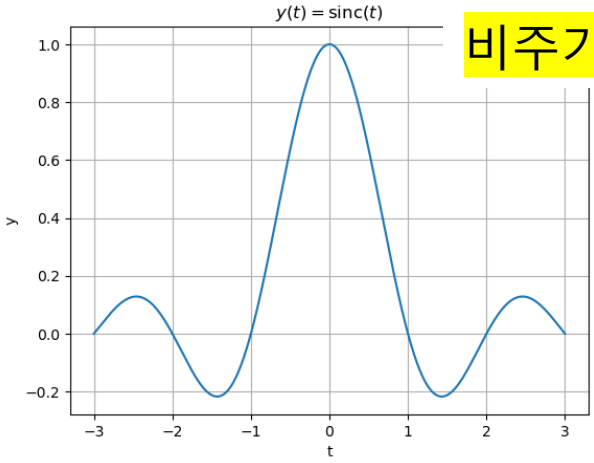
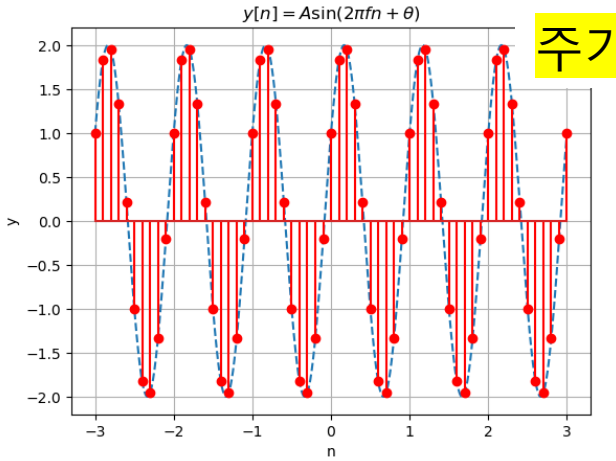
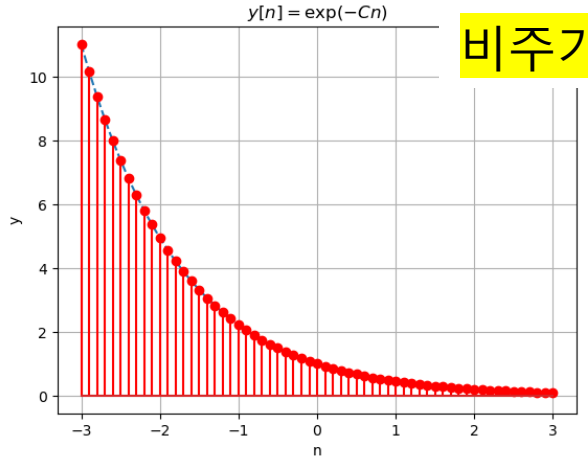


비주기 신호

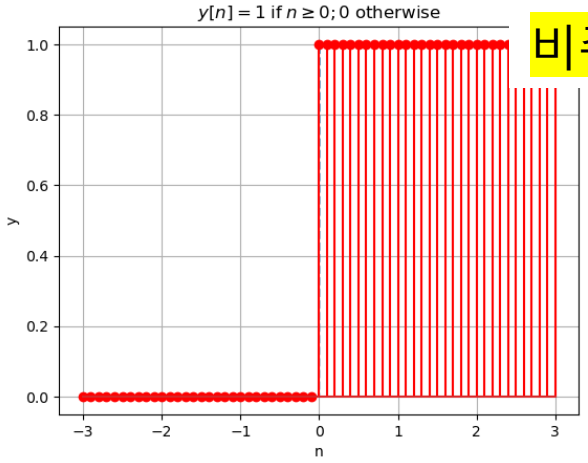
이산 신호



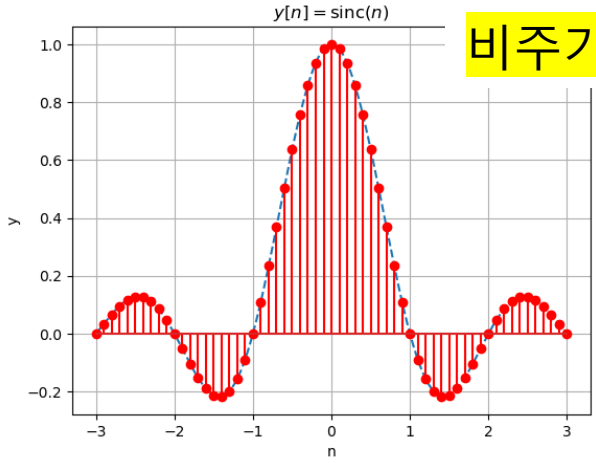
주기 신호



비주기 신호



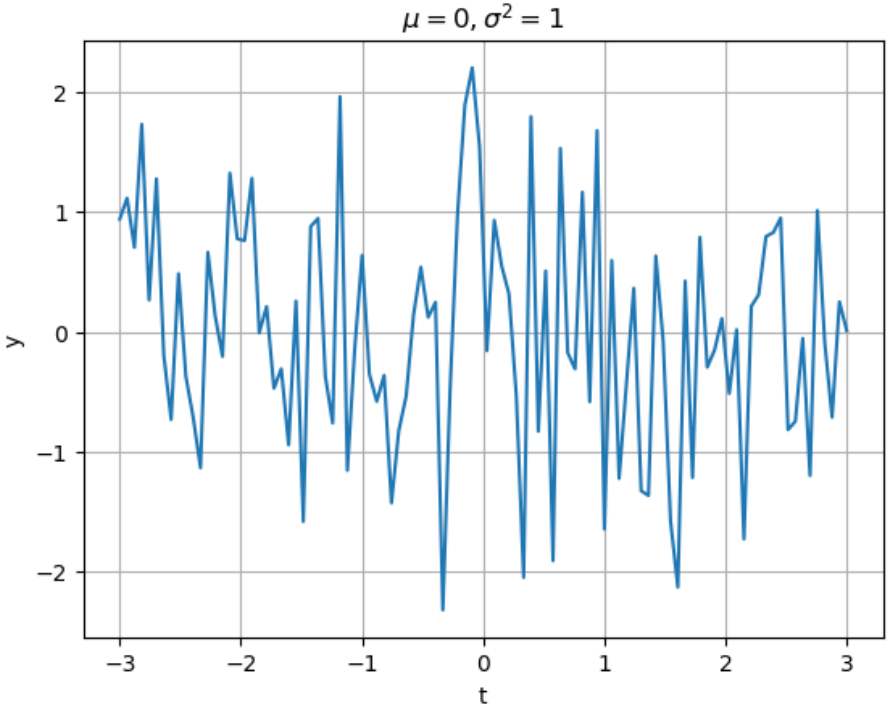
비주기 신호

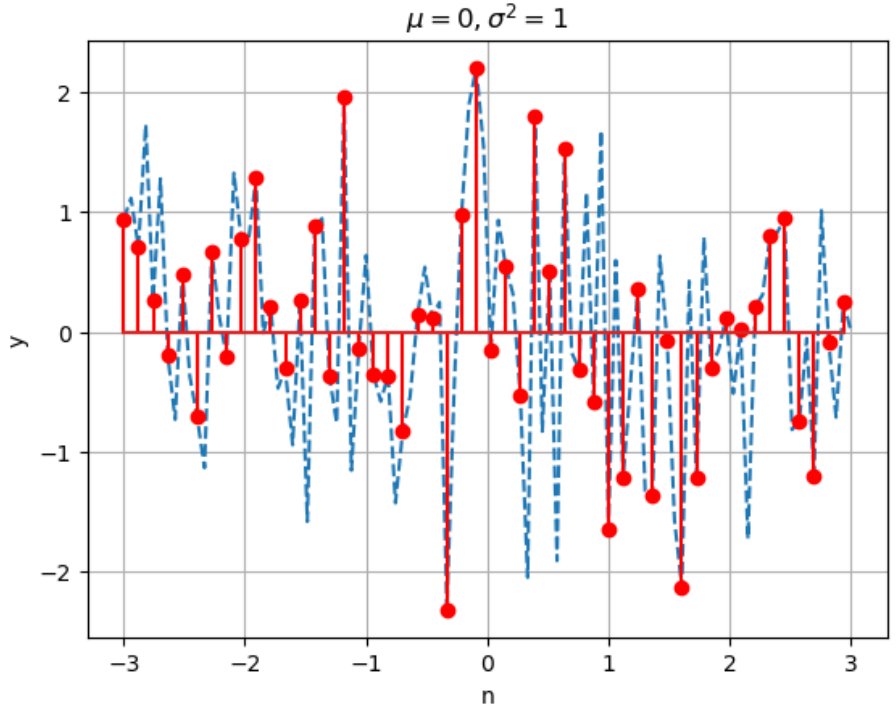


비주기 신호

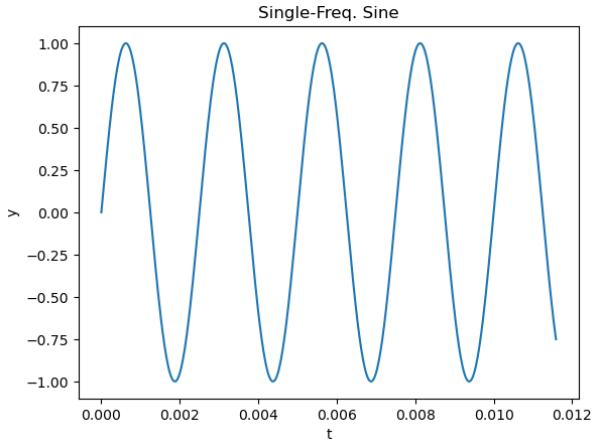
불규칙 신호

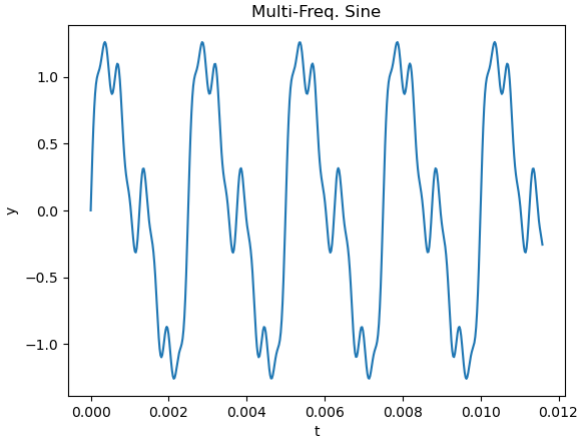
백색 가우스 잡음(**white Gaussian noise**)



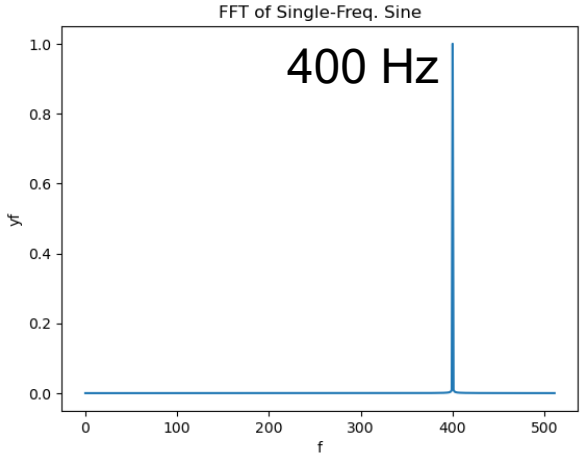


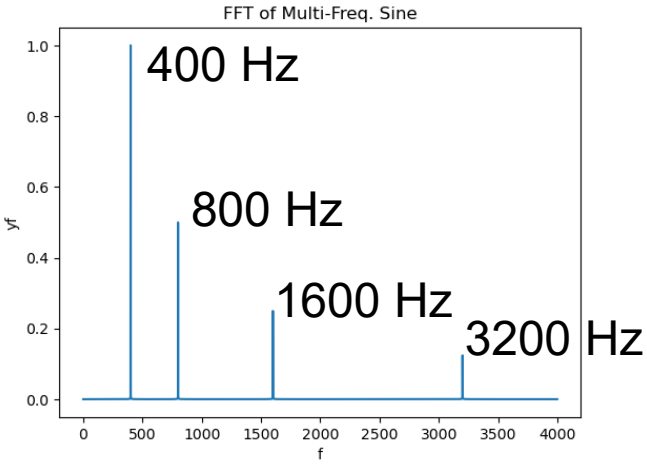
주파수 해석





푸리에 변환
(**Fourier transform**)





컨벌루션(convolution)

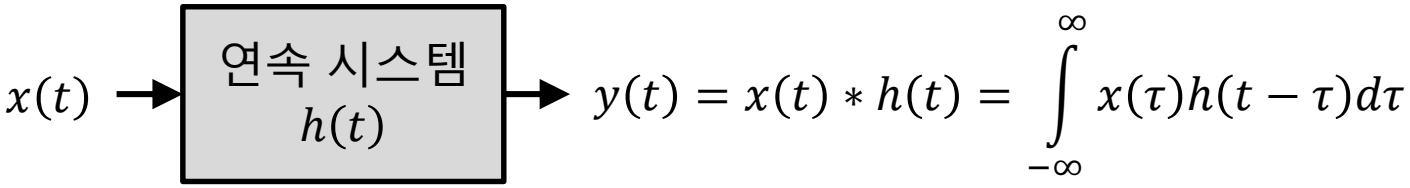
- 선형 시불편 시스템(**L**inear **T**ime-**I**nvariant System)
  - 시간에 따라 변화하지 않은 시스템
  - 중첩의 원리(**principle of superposition**)를 만족하는 시스템
    - 가산성(additivity) : $f(x_1 + x_2) = f(x_1) + f(x_2)$
    - 균일성(homogeneity) : $f(ax_1) = af(x_1)$

$$f(ax_1 + bx_2) = af(x_1) + bf(x_2)$$

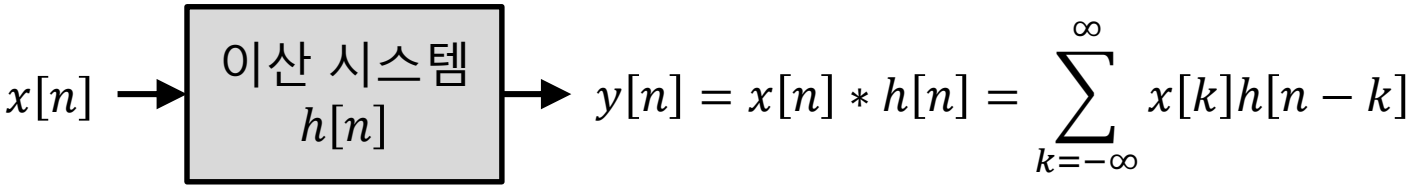
- **LTI 시스템**을 통과하는 입력 신호 ***x(t)***와 시스템의 **임펄스 응답 *h(t)*** 사이의 관계를 나타내는 수학적 컨벌루션이라고 함

컨벌루션(convolution)

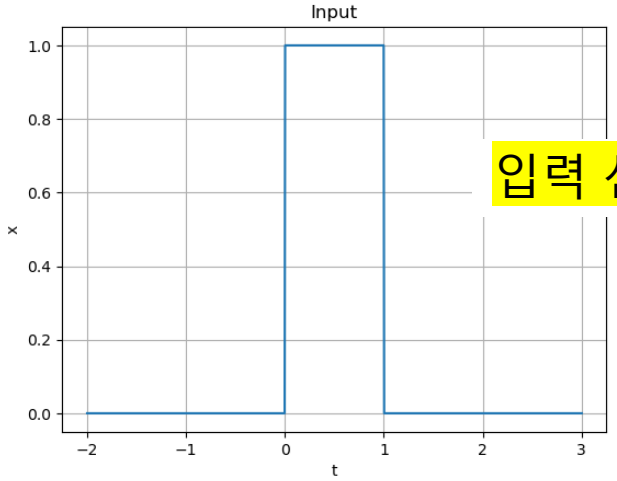
- 연속 LTI 시스템 : 컨벌루션 적분



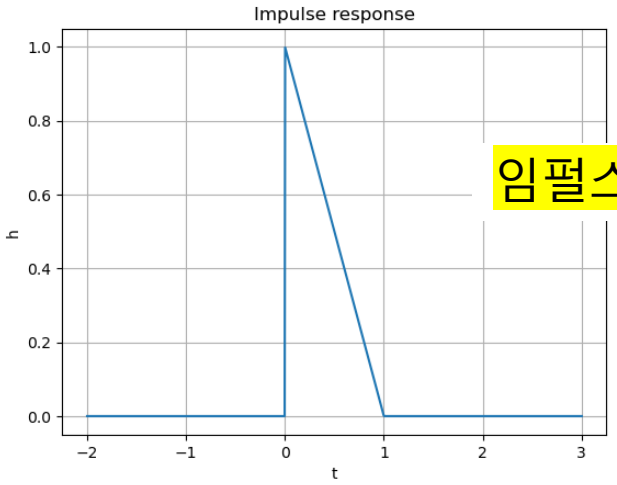
- 이산 LTI 시스템 : 컨벌루션 합



컨벌루션(convolution)

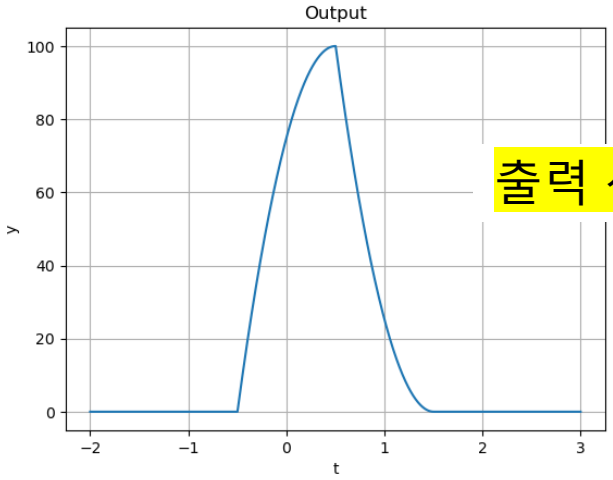


입력 신호



임펄스 응답

컨벌루션



출력 신호

상관관계(correlation)

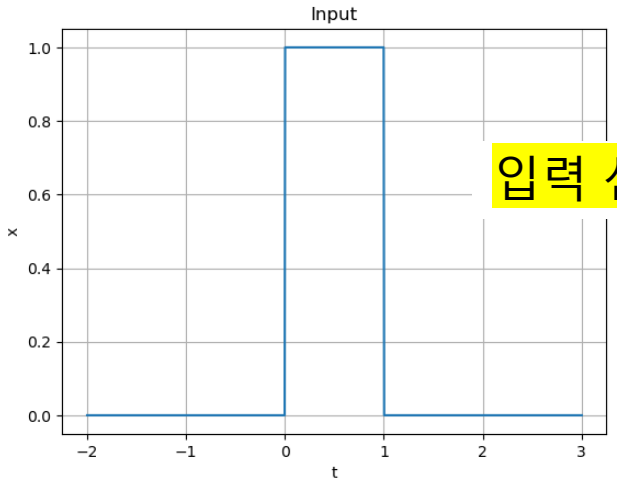
- **비주기** 신호를 처리할 때, 서로 다른 2개의 신호 사이에서 혹은 동일한 신호 내에서 신호간의 **유사성** 혹은 **상관도**를 평가함
  - 상호 상과 함수(cross-correlation function)

$$R_{12}(\tau) = \int_{-\infty}^{\infty} x_1(t)x_2(t-\tau)dt$$

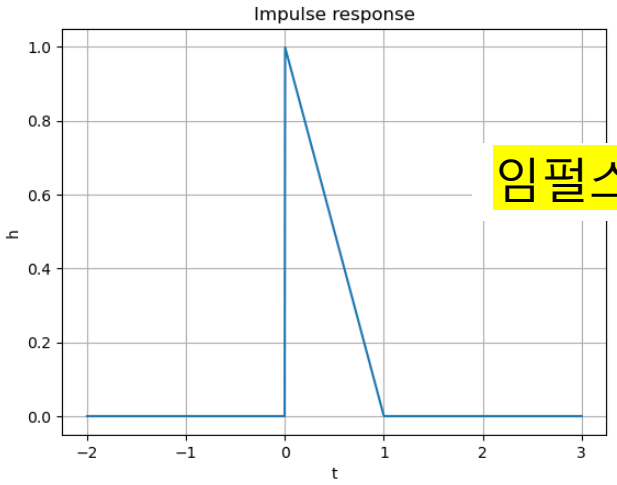
  - 자기 상관 함수(auto-correlation function)

$$R_X(\tau) = \int_{-\infty}^{\infty} x\,(t)x(t-\tau)dt$$

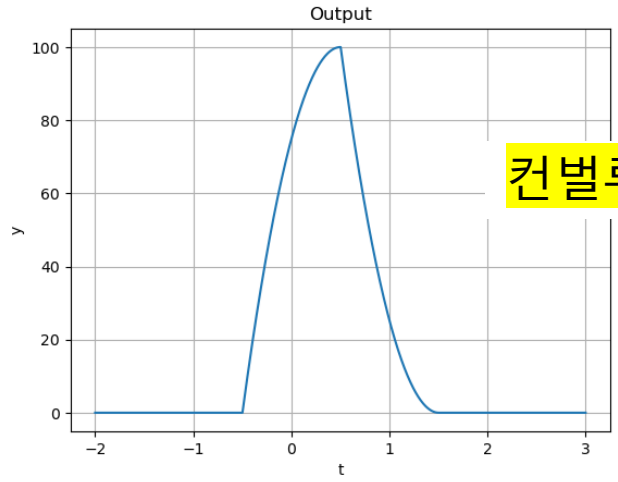
상관관계(correlation)



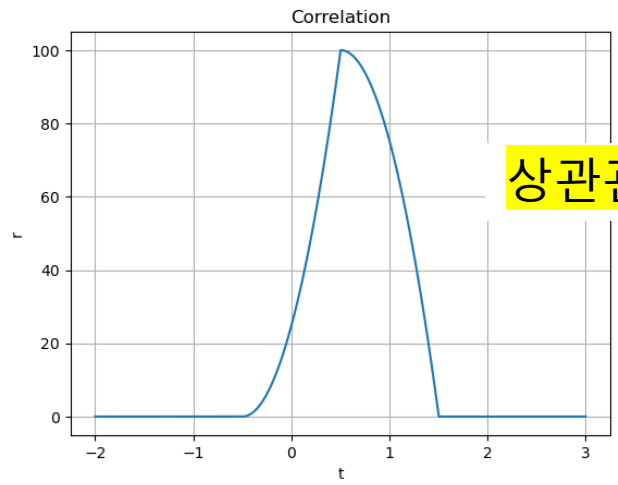
입력 신호



임펄스 응답



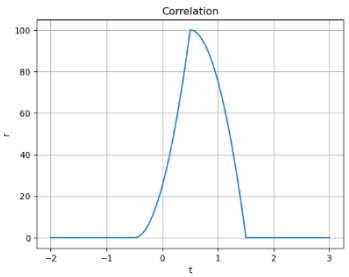
컨벌루션

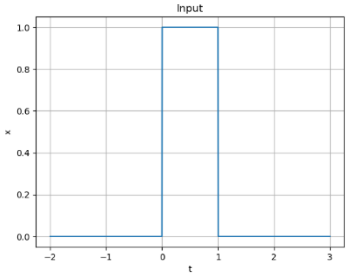


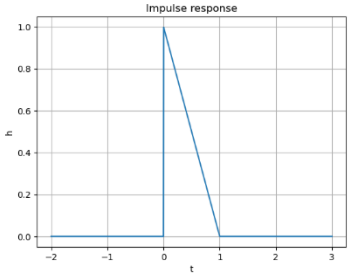
상관관계

상관관계(correlation)

출력 신호 = 입력 신호 (상관관계) 임펄스 응답

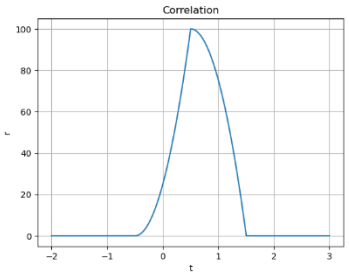


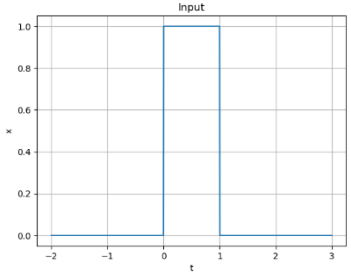


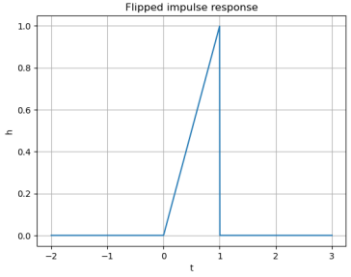


같다

출력 신호 = 입력 신호 (컨벌루션) 뒤집힌 임펄스 응답







상관관계(correlation)

- 컨벌루션의 Fourier transform

$$y(t) = x(t) * h(t)$$

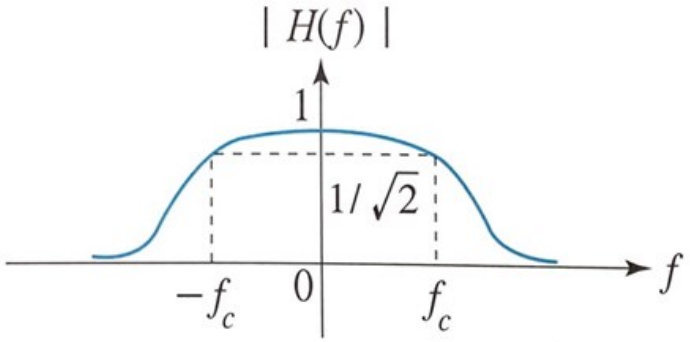
$$Y(f) = X(f)H(f)$$

- 상관관계의 Fourier transform

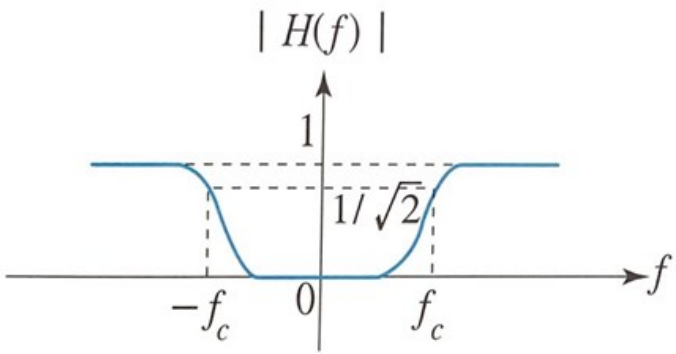
$$y(t) = x(t) * h(-t)$$

$$Y(f) = X(f)H(-f)$$

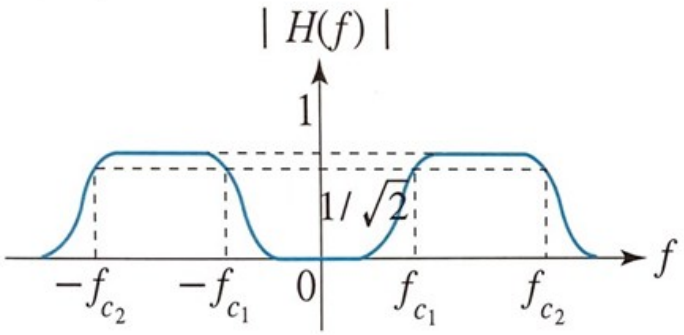
필터링(filtering)



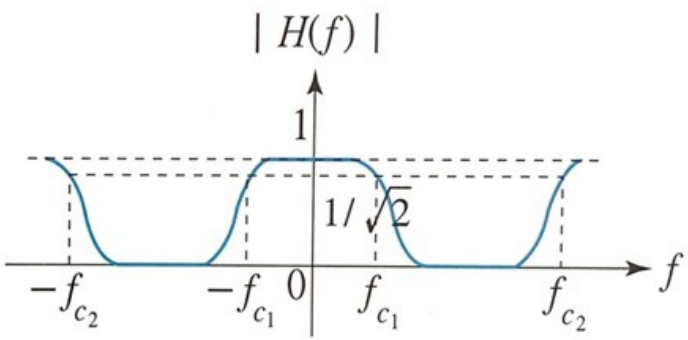
(a) 저역 통과 필터



(b) 고역 통과 필터



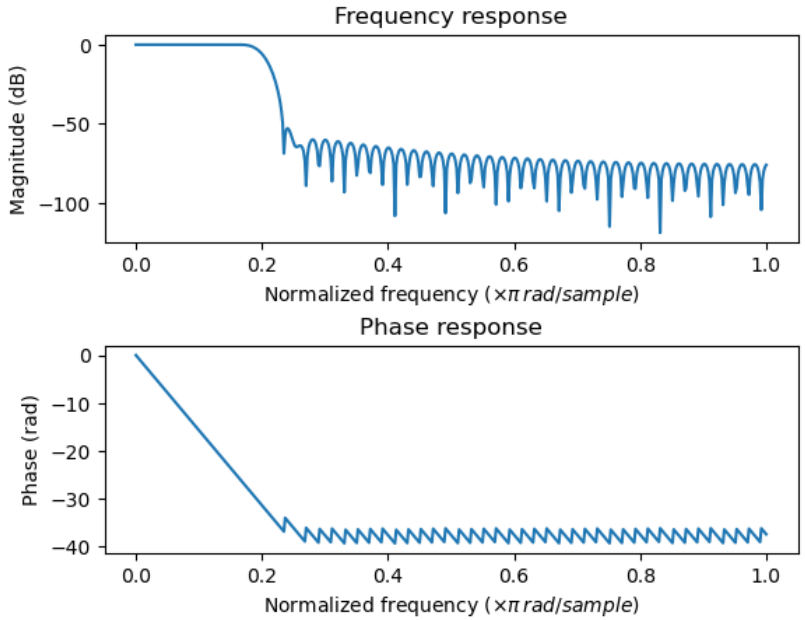
(c) 대역 통과 필터

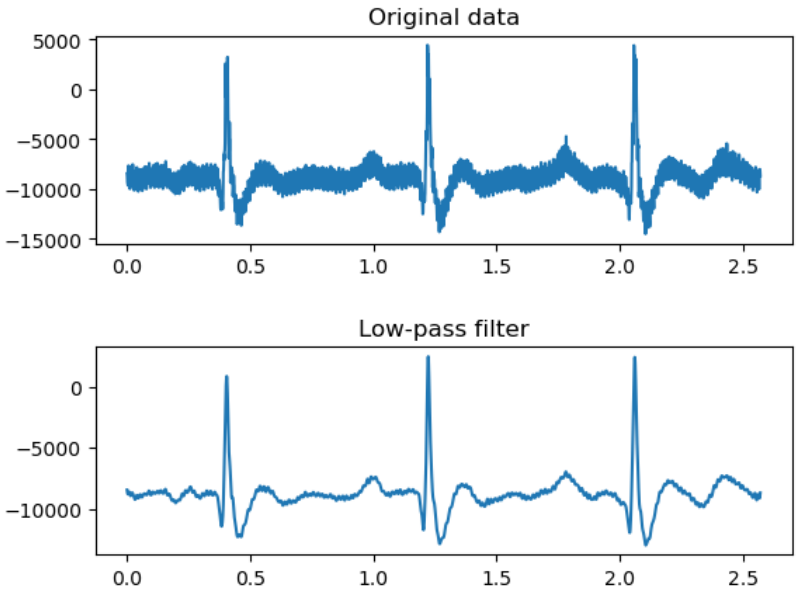


(d) 대역 차단 필터

필터링(filtering)

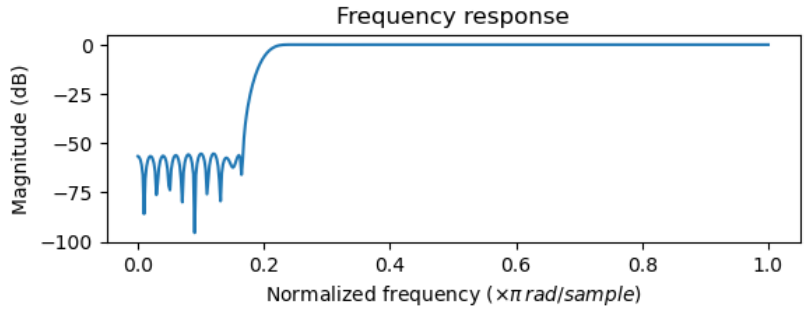
- 저역 통과 필터(low-pass filter)

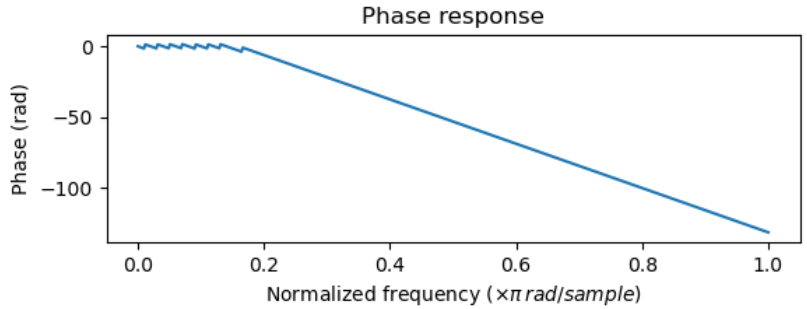


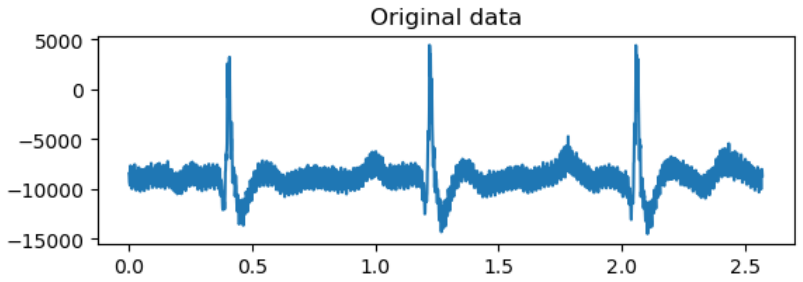


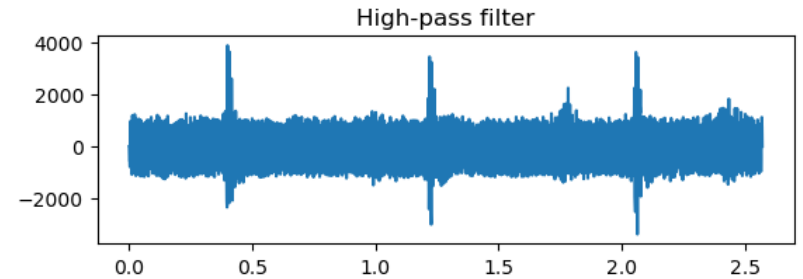
필터링(filtering)

- 고역 통과 필터(high-pass filter)



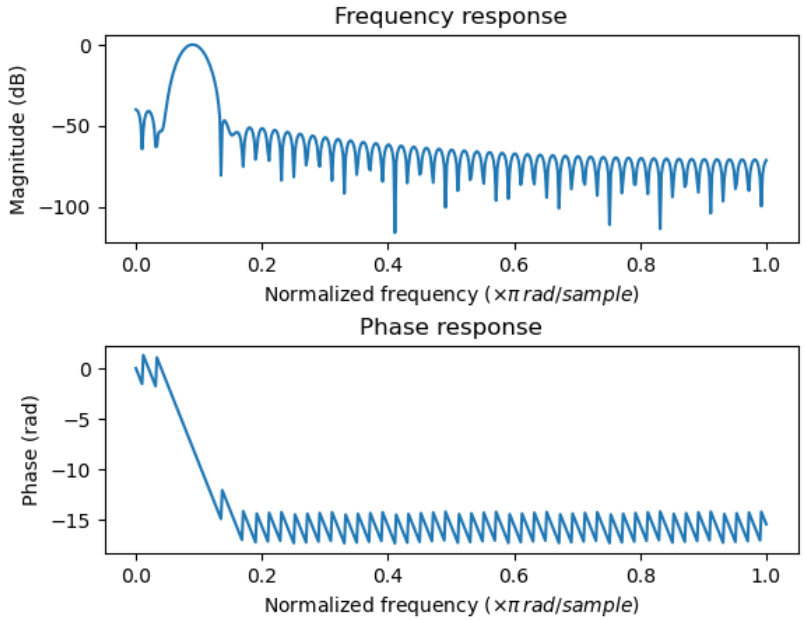


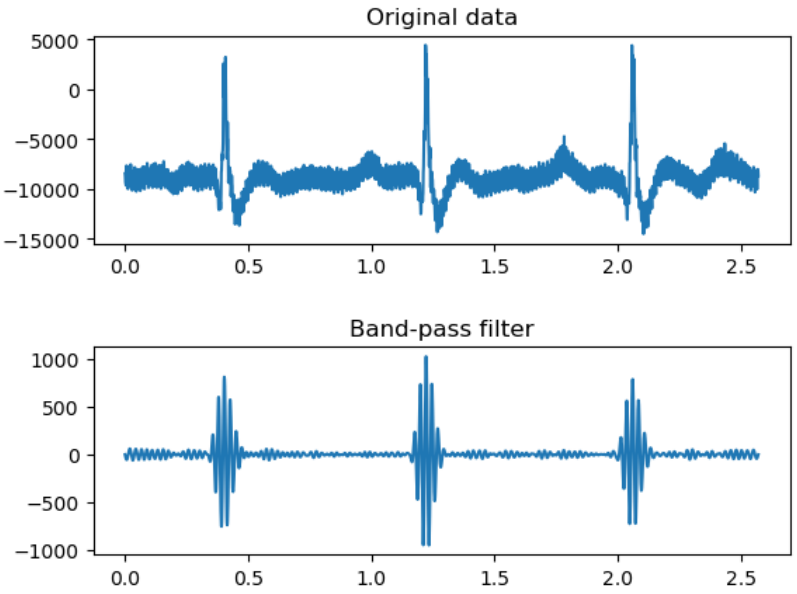




필터링(filtering)

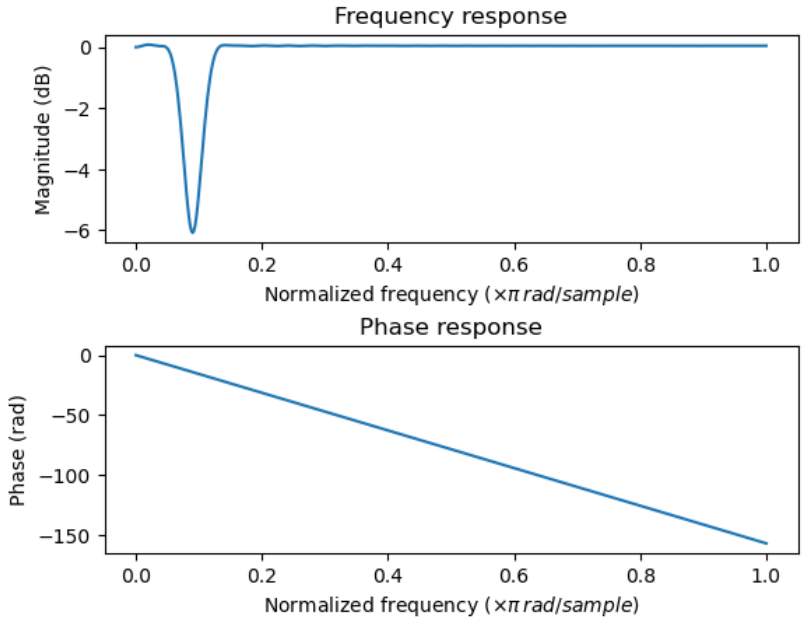
- 대역 통과 필터(band-pass filter)

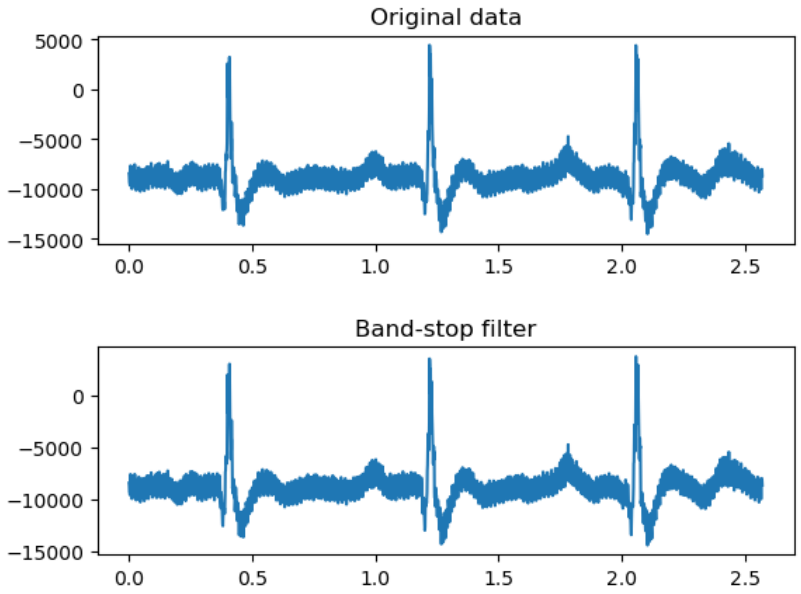




필터링(filtering)

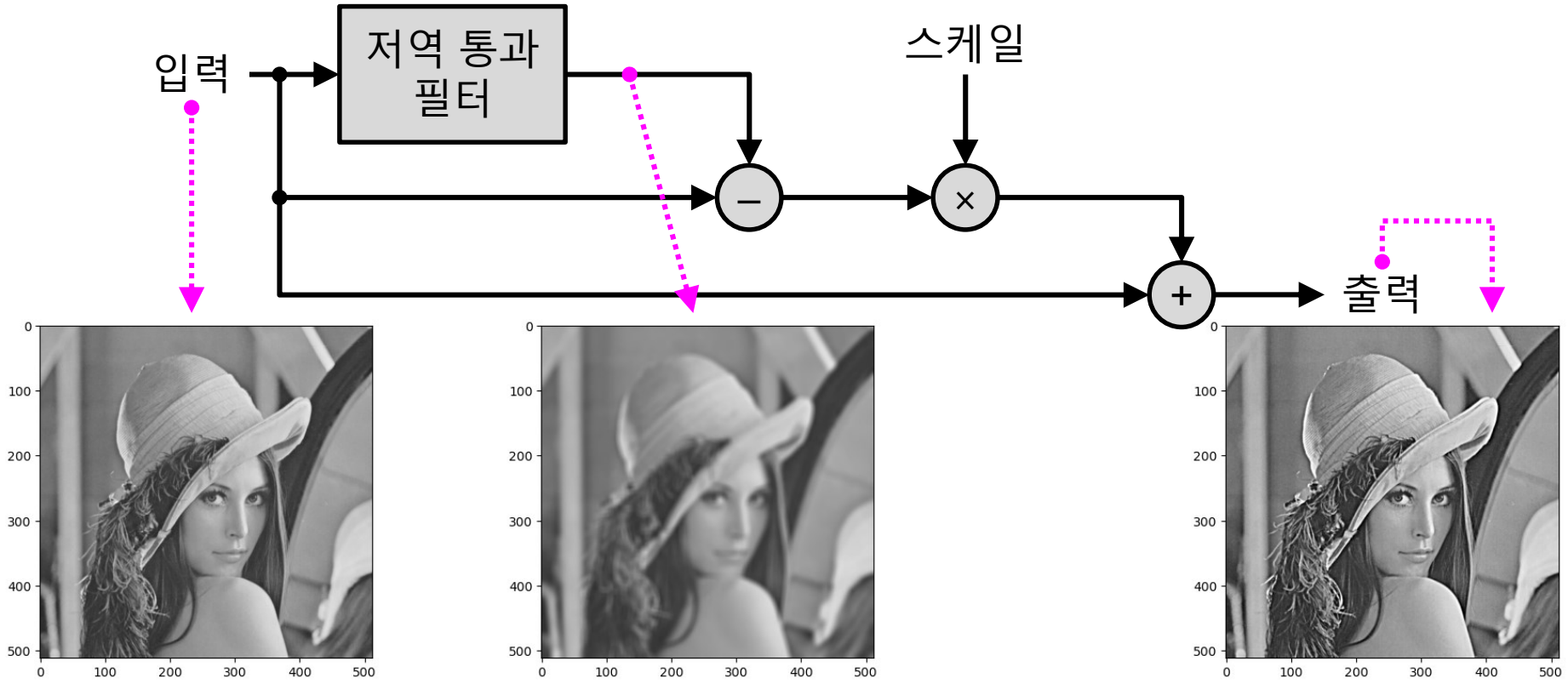
- 대역 차단 필터(band-stop filter)





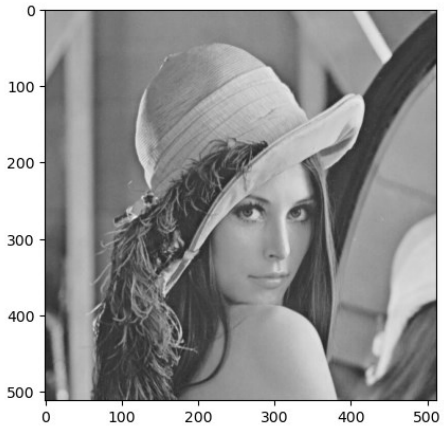
영상처리 시스템의 사례

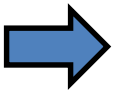
- 디테일 인핸스먼트(detail enhancement)



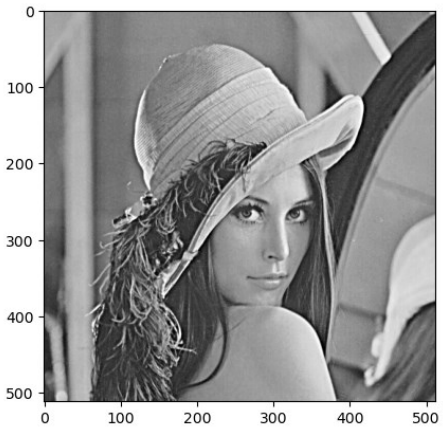
영상처리 시스템의 사례

입력

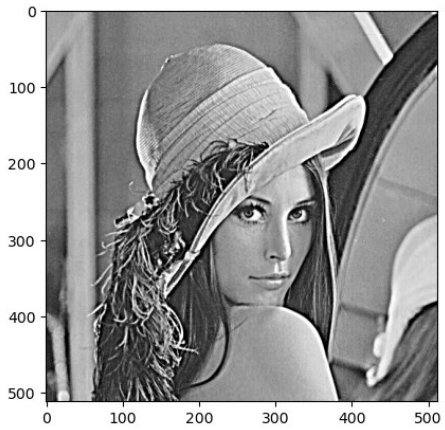




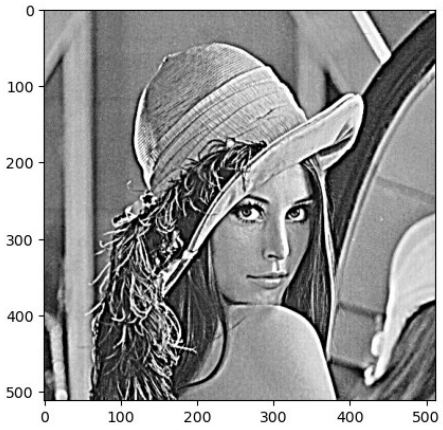
스케일 = 0.8



스케일 = 2.0



스케일 = 4.0



스케일 = 10.0