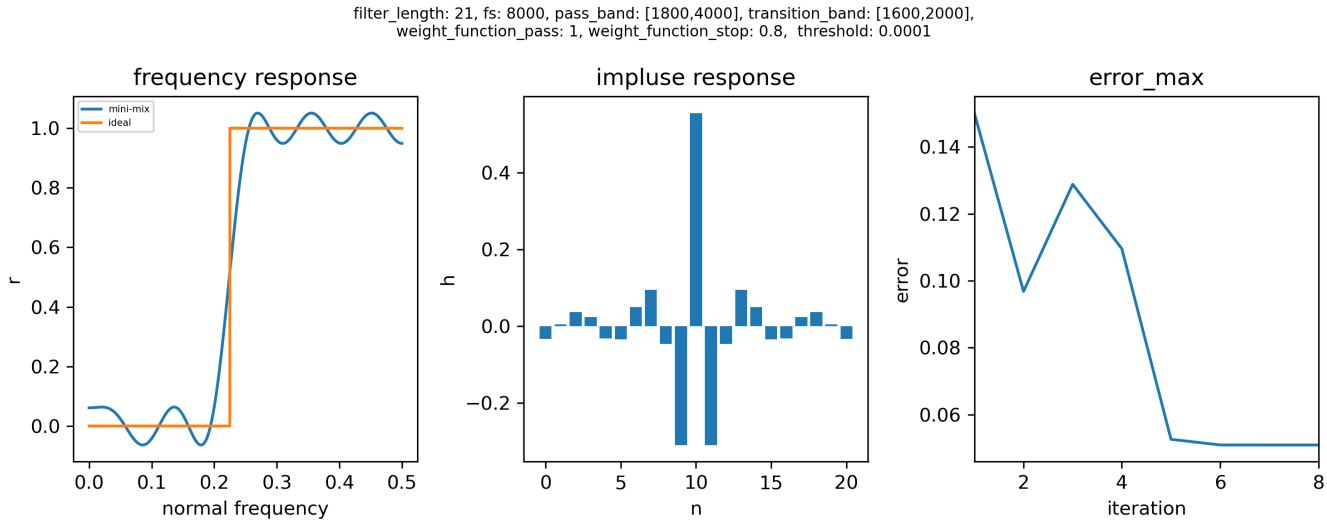
ADSP 2023 Spring HW1

Mini-Max FIR Filter

- step1:
  - Initialize values of Fm (avoid the transition band).
- step2:
  - Find the vecter S with the equation: A * S = B.
- step3:
  - Compute the error with the equation: err(F) = [R(F) - Hd(F)] * W(F), R(F) is sum of s[n] * cos(2n * pi * F) , n = 0, 1,..., k.
- step4:
  - Find new extreme points Fm with err(F).
- step5:
  - Let E0 = max(err(F)), E1 = max(err_last_iteration(F))
  - If E1 - E0 > threshold or E1 - E0 < 0 then go back to step2, else go to step6.
- step6:
  - h[k] = s[0], h[k+n] = h[k-n] = s[n]/2, n = 1, 2,..., k.
  - Plot the graphs of frquency response, impulse response, and the max error of each iteration.

Results of default parameters

- filter length = 21
- fs = 8000 Hz
- pass band = [1800,4000]
- transtion band = [1600,2000]
- pass band weight function = 1
- stop band weight function = 0.8
- threshold = 0.0001



Run the code

- Environment: Python 3.8
- Install packages:

```
pip3 install -r requirements.txt
```

- Use default parameters:

```
python3 main.py
```

- Use custom parameters:

```
python3 main.py --filter_length {filter_length} \
                --fs {fs} \
                --pass_band_L {pass_band_L} \
                --pass_band_H {pass_band_H} \
                --transition_band_L {transition_band_L} \
                --transition_band_H {transition_band_H} \
                --WFP {WFP} \
                --WFS {WFS} \
                --threshold {threshold}
```

- Output:
    1. Graph of frequency response.
    2. Graph of impulse response.
    3. Graph of iteration error_max.
    4. Show values of iteration error_max on terminal.
- Graph of results:
    - results.png