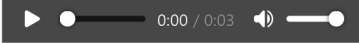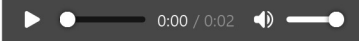```python
In [7]: import os
        import matplotlib.pyplot as plt
        import librosa, librosa.display
        import IPython.display as ipd
        import numpy as np
```

```python
In [8]: BASE_FOLDER = "audio/"
        violin_sound_file = "violin_c.wav"
        piano_sound_file = "piano_c.wav"
        sax_sound_file = "sax.wav"
        noise_sound_file = "noise.wav"
```
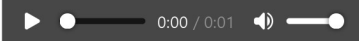
```python
In [9]: ipd.Audio(os.path.join(BASE_FOLDER, violin_sound_file))
```

Out[9]: ▶ ●━━━━━━━━ 0:00 / 0:03 🔊 ━━━●━━

```python
In [10]: ipd.Audio(os.path.join(BASE_FOLDER, piano_sound_file))
```

Out[10]: ▶ ●━━━━━━━━ 0:00 / 0:02 🔊 ━━━●━━

```python
In [11]: ipd.Audio(os.path.join(BASE_FOLDER, sax_sound_file))
```

Out[11]: ▶ ●━━━━━━━━ 0:00 / 0:01 🔊 ━━━●━━

```python
In [12]: ipd.Audio(os.path.join(BASE_FOLDER, noise_sound_file))
```

Out[12]: ▶ ●━━━━━━━━ 0:00 / 0:26 🔊 ━━━●━━

```python
In [13]: # load sounds
         violin_c4, sr = librosa.load(os.path.join(BASE_FOLDER, violin_sound_file))
         piano_c5, _ = librosa.load(os.path.join(BASE_FOLDER, piano_sound_file))
         sax_c4, _ = librosa.load(os.path.join(BASE_FOLDER, sax_sound_file))
         noise, _ = librosa.load(os.path.join(BASE_FOLDER, noise_sound_file))
```

```python
In [14]: len(violin_c4)
```

Out[14]: 59772

```python
In [15]: X = np.fft.fft(violin_c4)
         len(X)
```

Out[15]: 59772

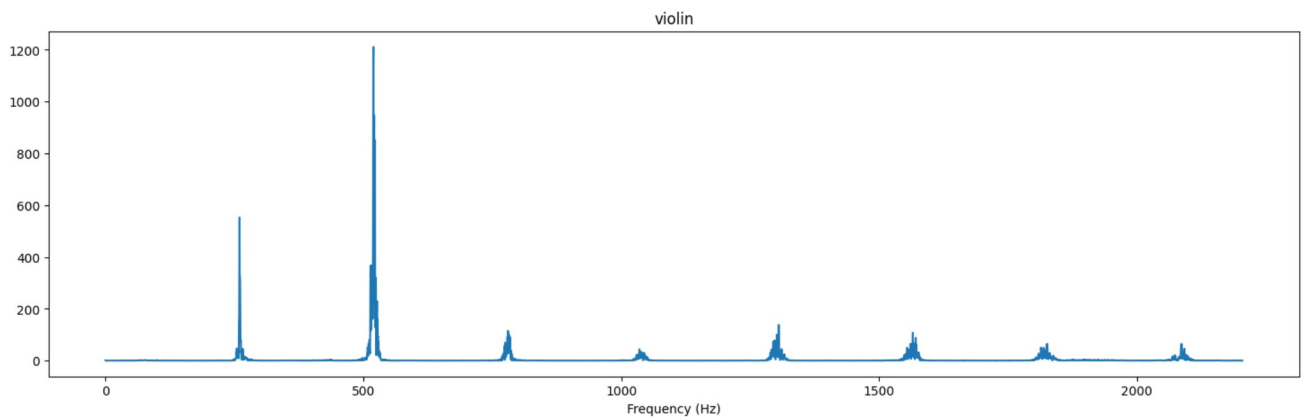```python
In [51]: def plot_magnitude_spectrum(signal, sr, title, f_ratio=1):
             X = np.fft.fft(signal)
             X_mag = np.absolute(X)

             plt.figure(figsize=(18, 5))

             f = np.linspace(0, sr, len(X_mag))
             f_bins = int(len(X_mag)*f_ratio)

             plt.plot(f[:f_bins], X_mag[:f_bins])
             plt.xlabel('Frequency (Hz)')
             plt.title(title)
```
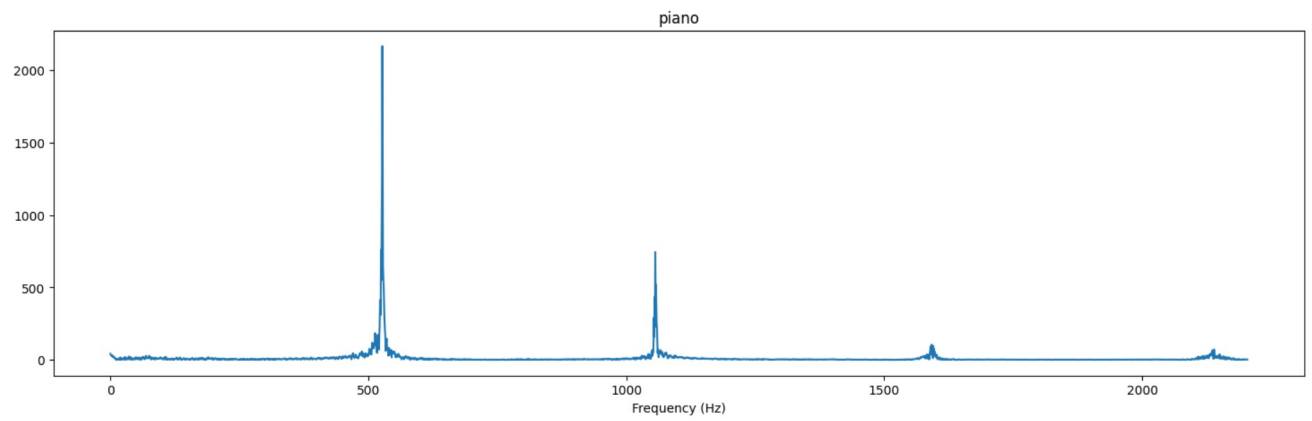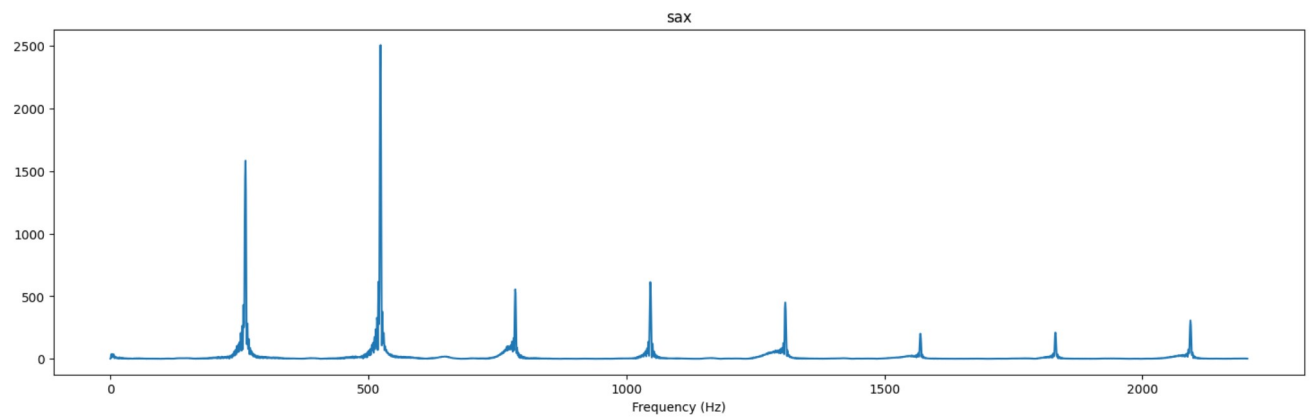
```python
In [52]: plot_magnitude_spectrum(violin_c4, sr, "violin", 0.1)
```
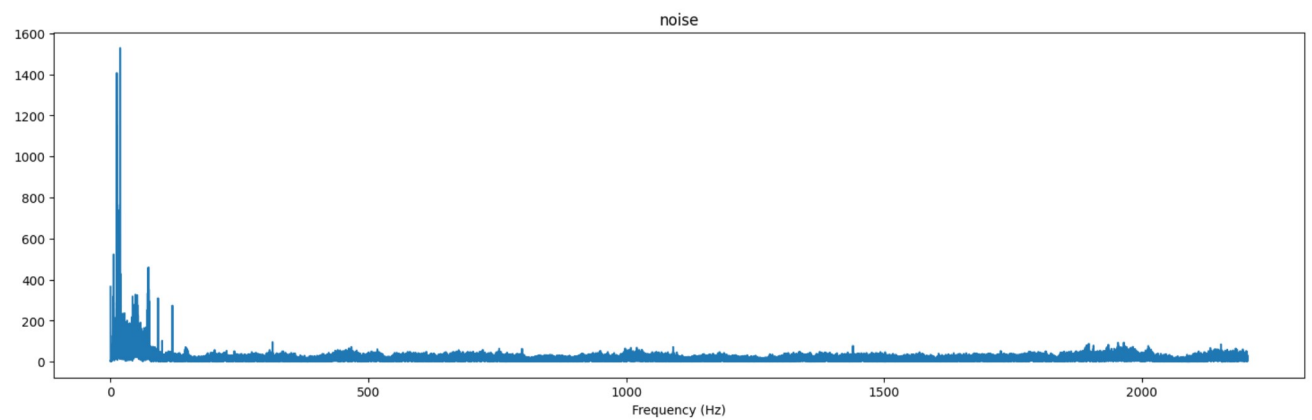


```python
In [53]: plot_magnitude_spectrum(piano_c5, sr, "piano", 0.1)
```

piano

`plot_magnitude_spectrum(sax_c4, sr, "sax", 0.1)`

sax

`plot_magnitude_spectrum(noise, sr, "noise", 0.1)`

noise