The Audible Frequency Range of Human Hearing (when young):

$$20\ Hz < f < 20\ KHz \qquad (\simeq 3 \text{ orders of magnitude})$$

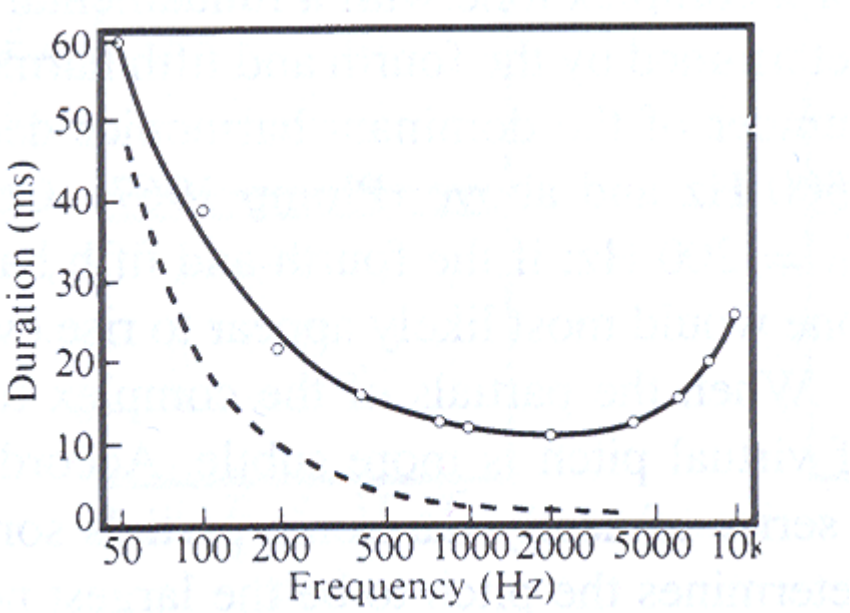
As we grow older, the ange of frequencies that we can hear decreases (both high and low frequencies – mostly on the high frequency end…)

Frequency ranges of musical instruments typically $\sim 100\ Hz$ to $\sim$ few KHz

e.g. guitar Low E = 82 *Hz*
High E = 330 *Hz*

Piano highest note is ~ 4200 *Hz*
Very little above ~ 10 *KHz* (squeals & scrapes)

The human ear needs to be able to perceive a sound for minimum length of time Δt. In order to determine a pitch – *i.e.* pure/single-frequency tone – the minimum duration time Δt of the pure tone depends on its frequency:



For $f \sim 100\ Hz$ $(\tau \sim 10\ msec)$: $t_{\min} \sim 40\ msec$ $(\sim 4 \text{ cycles})$

For $f \sim 1000\ Hz$ $(\tau \leq 1\ msec)$: $t_{\min} \sim 13\ msec$ $(\sim 13 \text{ cycles})$

The minimum duration time Δt for human perception of a pitch is certainly in part due our ear & brain processing, but for low frequencies especially, minimum time duration is ***also*** due to the ***uncertainty principle*** $\Delta f \Delta t = 1$, which tells us that a pure tone/single-frequency sine wave signal of ***finite*** duration Δt in fact has a ***finite*** frequency spread Δf ! Only as the time duration $\Delta t \to \infty$ does $\Delta f \to 0$.