Importance of Dynamics

Audio Dynamics is the loudness of sound perceived by human ear. When you are listening to a classical piano piece, notice the variation in loudness of the piano creates different emotions. But, audio dynamic issue is not only restricted to the classical music, it is everywhere in rock music, pop music, hip hop, name it and its there.
Musical instruments have their own level of loudness. So, it becomes real tricky when a group of instruments are playing together.
Without digging deep into all audio engineering stuffs, I will start of with a simple example of a four piece band consisting of guitar, bass, drums, vocalists.
Mixing the four outputs is the simplest task a sound engineer has to face. Though sometimes it can get real frustrating, depends on so many several factors.

- Bad acoustics of the venue
- Noisy Microphone
- Cheap mixing consoles
- Bad drums kit
- Bass guitarist not wanting compensate his level for the fret buzz
- Mixing an acoustic guitar can be a great deal of task
- Sound engineer is drunk
- Blah Blah Blah…

Cheap mixing console does not have on board dynamic control features, and cheap opamps which lack the operational bandwidth. But then one can always have separate audio dynamic controlling equipment.
Audio Dynamics controller generally has these blocks

- Compressor
- Limiter (hard compressor)
- Noise Gate
- Expander

Guitarist using Tube amplifiers or a multi-effects pedal generally has a built in compressor. But main problems arise when mixing an Acoustic guitar, Bass guitar, Drums, and vocals.
If you happen to be a musician, then you must have noticed when you pluck a string in acoustic guitar the loudness tends to die quickly but then the string sustains with $1/8^{th}$ the initial loudness. Same for drums, when you play the snare or bass drum, the initial loudness dies much quicker than acoustic guitar.
Electric Bass guitarist tend to go direct to the mixer or though an amplifier to the mixer. Bass guitar has two very distinctive sounds which makes it so special.

- Fret Buzz
- Sound of the plectrum strumming the bass guitar.

Fret Buzz and plectrum click sound lasts for very few milliseconds. If you listen very carefully after that very few millisecond of the fret sound all that is left behind is bass frequencies which grows in energy.

Now let us do a little bit of math, very simple but important to understand the secret behind mixing.

Say a Mixer can output a maximum loudness of 1(one).

Now for mixing guitar, bass guitar, drums, and vocal together any kid will say adjust the volume fader for each channel to quarter value (1/4).

That is ¼(guitar) + ¼(bass guitar) + ¼(drums) + ¼(vocals) = 1(maximum output)

But any sound engineer will not agree with the answer. There is a very complicated underlying math going on with individual instrument loudness.
For example take acoustic guitar.
As per the kid's mixer fader setting the maximum loudness acoustic guitar can achieve is ¼ unit.
But after few milliseconds the acoustic guitar's volume dies down to 1/32 the loudness which is almost -30dBFS, which is barely audible.
So, what is the immediate solution? Turn the acoustic guitar channel fader up to 1(One)!
Then what about the other instruments? See that's exactly what sound engineers has to face.
Sending the acoustic guitar signal after preamp to the Audio Compressor with the setting of
Threshold = -18dB
Ratio = 4:1
Gain = +12dB
Attack Time = 1ms
Release Time = 10ms

This will solve the problem for acoustic guitar even if you keep the channel fader to ¼ the maximum position or in (-12dB range).
So the acoustic guitar loudness will drop to -18dB instead -30dB. (Remember every 6dB increase means double the loudness).
So, explore the same for Drums, Bass and vocals. Audio mixing is an art, not a child's play.

To understand the full operation of audio compressors check other documents.