Schmitt Trigger

An operational amplifier (op amp) can create a square wave output when a voltage reference (e.g., 2.5V) is connected to its inverting input and a triangle voltage (0-5V) to its non-inverting input.
The first golden rule of op amps states that they will do anything to achieve a zero-volt difference between their inputs, leading to output swings based on the input voltages.
Without feedback, the op-amp acts as a comparator: it outputs high if the non-inverting input is higher and low if the inverting input is higher. Comparators are useful for monitoring voltages but can produce noisy outputs with multiple transitions when crossing threshold values. Schmitt triggers solve noise-related issues by introducing two threshold values—high and low—allowing for stable output transitions. The hysteresis voltage between these thresholds prevents oscillation during noise interference, ensuring clean signal transitions.
Non-inverting Schmitt triggers maintain the same output state for high and low thresholds while inverting ones reverse this behavior.
By connecting monitored voltage to an input pin, one can observe corresponding output signals which may require cascading two ICs for inversion correction.

In projects using push buttons as inputs, adding an RC network helps mitigate mechanical bounce before applying a Schmitt trigger for sharp transitions.
For Arduino circuits, only an RC network suffices since digital inputs already provide necessary high/low thresholds similar to those of a Schmitt trigger. A simple relaxation oscillator can be built using capacitors and resistors with a Schmitt trigger; hysteresis allows continuous charging/discharging resulting in square wave outputs.