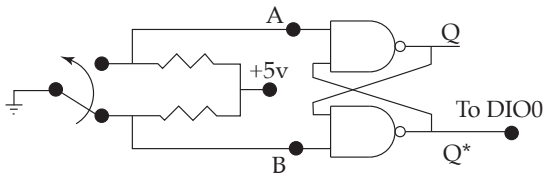
05.4 Debouncing circuits for switches

When a mechanical switch is thrown via a button, toggle, or some other interface, the new contact between the two conductors is not immediately seamless. In fact, over a few milliseconds, contact is made and broken dozens of times[2]. This phenomenon is called switch contact bounce.

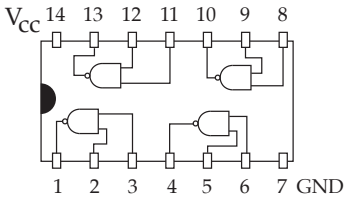
Often, we mitigate switch bounce with a circuit—called a debouncing circuit—between the switch and the microcontroller. Debouncing circuits yield a single transition of the digital signal, low-to-high or high-to-low.

Consider in detail the debouncing circuit of Fig. 05.1. For the outputs to switch, both inputs must switch, effectively mitigating bounce.

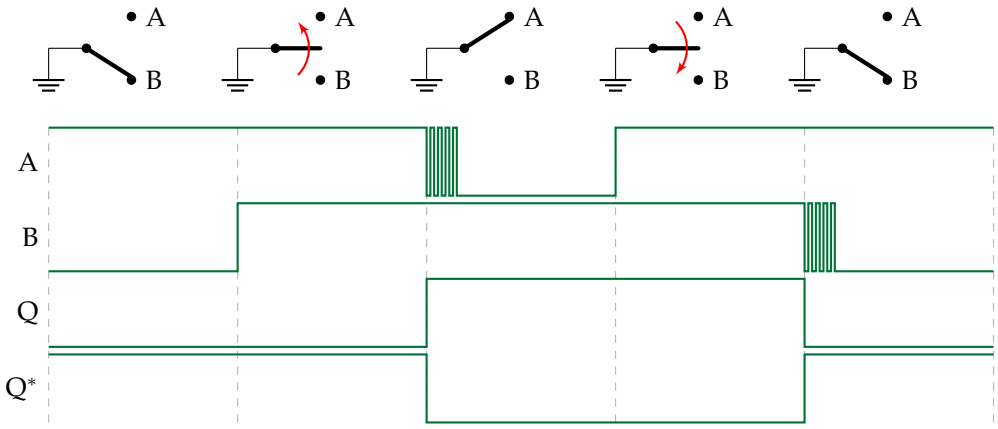
2. Horowitz and Hill, 2015.



(a) a debouncing circuit for a mechanical switch.



(b) 7401 quad nand, open-collector outs.



(c) logic levels corresponding different switch states through time.

Figure 05.1: an illustration of the operation of a debouncing circuit. With the switch initially drawing B low, Q* must be high and Q low. The loss of contact with B does not affect Q* or Q. Initial contact with A draws a low and therefore Q high and Q* low. The ensuing bounce doesn't affect Q because it doesn't affect Q* being low, so Q is high, regardless of A. This logic is then mirrored in the transition from contact with A to B, with its ensuing bounce. A TTL IC, shown in (b), can be used to instantiate this circuit.