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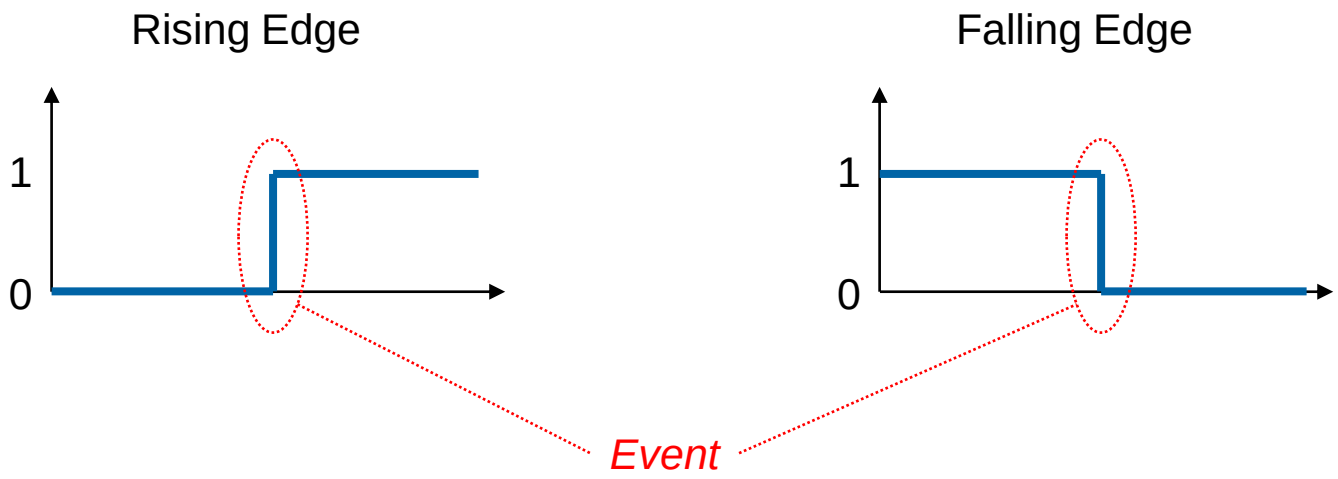
Lab 1
Edge Detection and Debouncing

Microcomputer Systems 1

Juan Gruber and Andreas Rüst

Edge Detection

- **Change of status -> event**



Edge Detection

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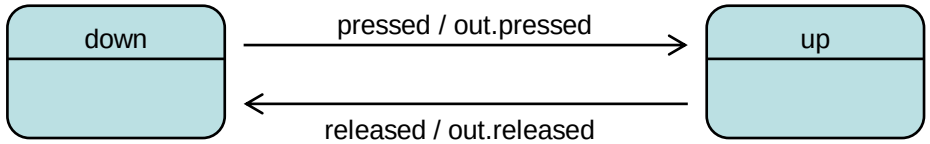
- **Software solution**



Edge Detection

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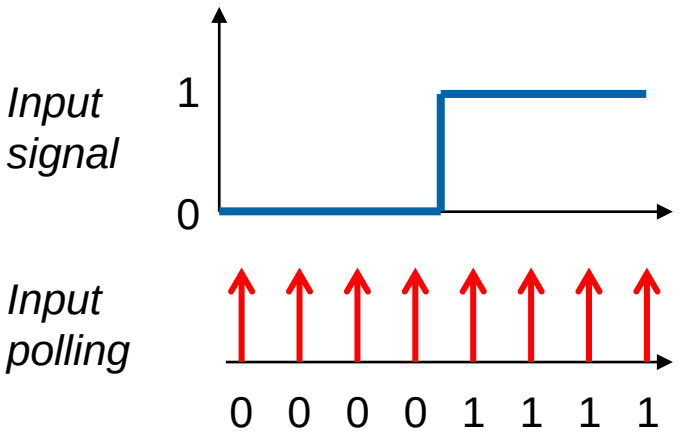
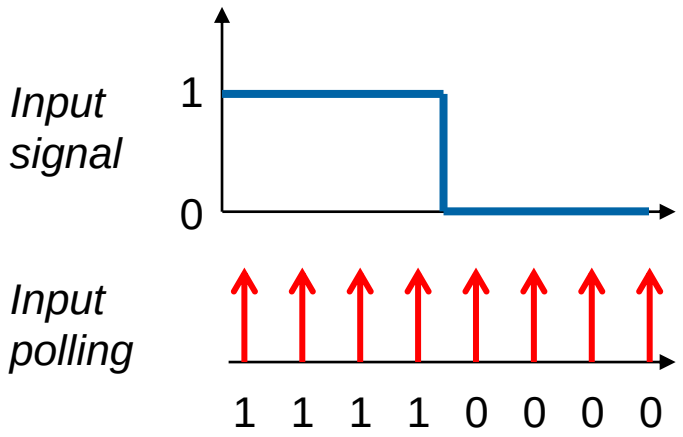
- **Simple software solution**
  - Read input
  - Compare with last value → edge detected when change in value
  - Store new value





Edge Detection

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- **Simple Software Solution**
  - Example: Detect rising edge

```
// buttons_state contains current state of buttons
// return value: buttons with rising edge
uint8_t detect_rising(uint8_t buttons_state)
{
    static uint8_t last_buttons_state = 0;
    uint8_t buttons_rising;

    // detect edges
    buttons_rising = buttons_state & ~last_buttons_state;

    // store button state for next detection.
    last_buttons_state = buttons_state;

    return buttons_rising;
}
```

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- **Simple Software Solution**
  - Example: Detect falling edge

```
// buttons_state contains current state of buttons
// return value: buttons with falling edge
uint8_t detect_falling(uint8_t buttons_state)
{
    static uint8_t last_buttons_state = 0;
    uint8_t buttons_falling;

    // detect edges
    buttons_falling = ~buttons_state & last_buttons_state;

    // store button state for next detection.
    last_buttons_state = buttons_state;

    return buttons_falling;
}
```

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- **Simple software solution**
  - Use static variable to store last state
    → Only one instance possible (static variable)

- **Software solution for multiple instances**
  - Solution: Using pointers
  - Memory allocation in calling function

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- **Software solution for multiple instances**
  - Example: Detect rising edges

Pointers to variables

Dereferencing

```
// input: current and last state of buttons
// return value: buttons with rising edge
uint8_t detect_rising(uint8_t *buttons_state,
                      uint8_t *last_buttons_state)
{
  uint8_t edges;

  // detect rising edge
  edges  = (*buttons_state) & ~(*last_buttons_state);

  // store button state for next detection
  *last_buttons_state = *buttons_state;

  return edges;
}
```

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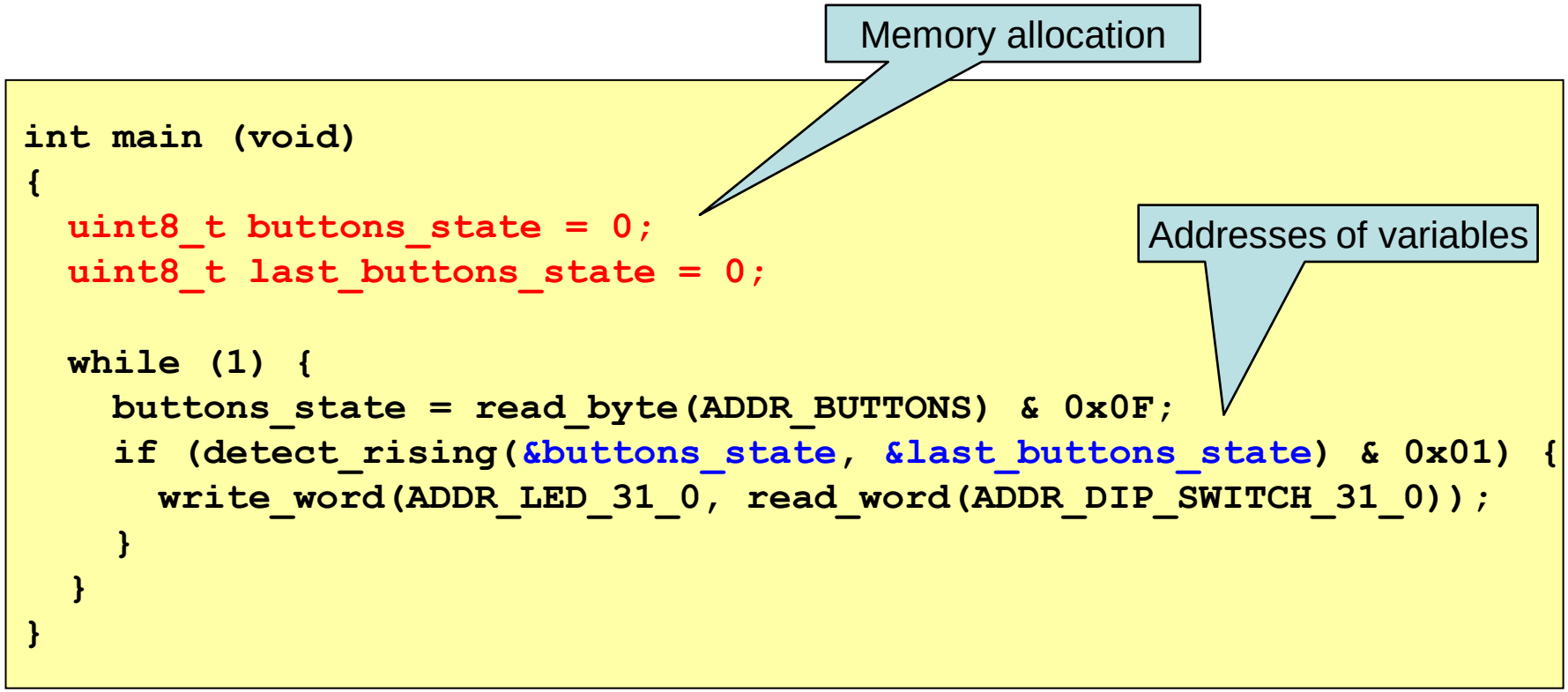
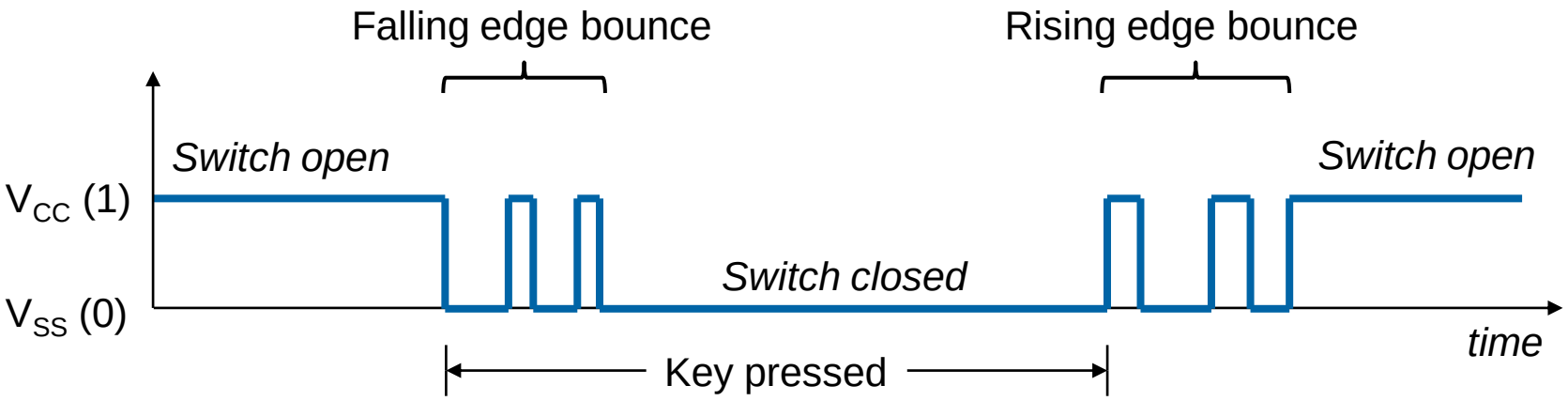
- **Software solution for multiple instances**
  - Example: Detect button 1 rising



Debouncing

- **What is bouncing?**
  - Every bounce is seen as input change



Debouncing

- **What is bouncing?**
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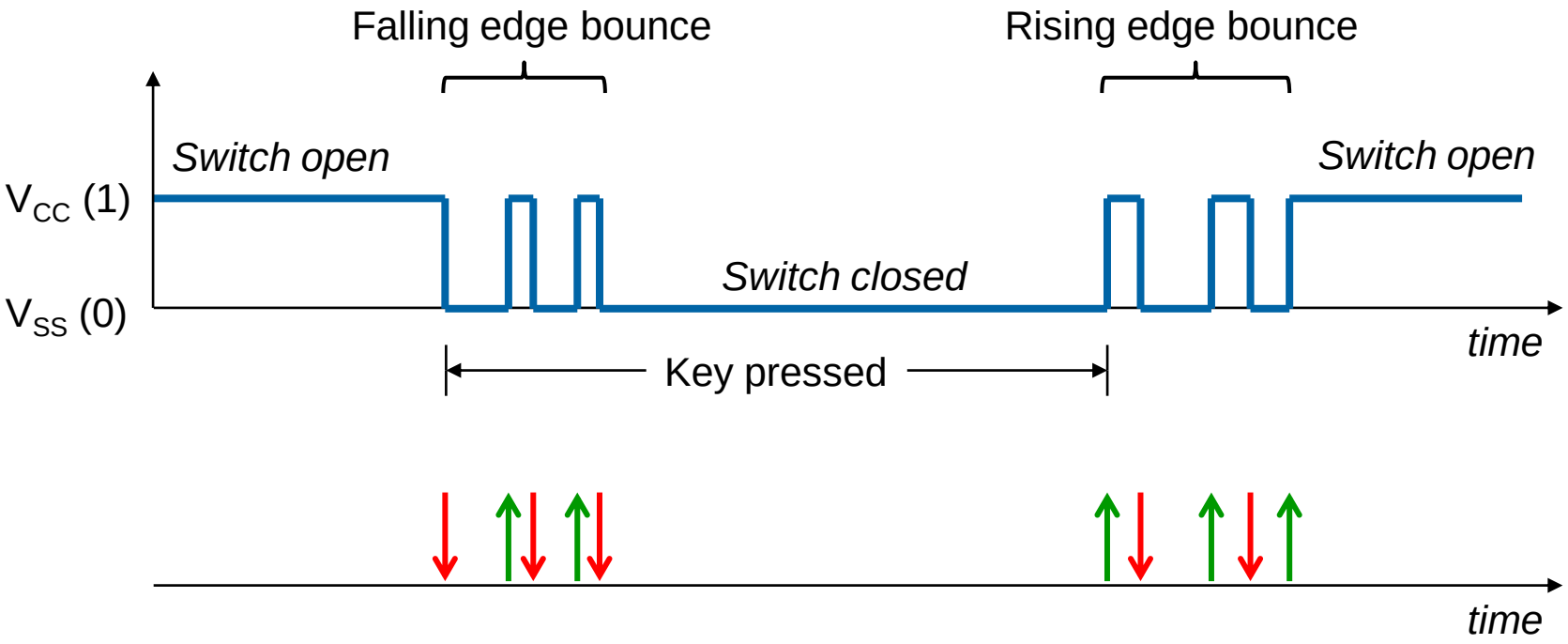

Debouncing

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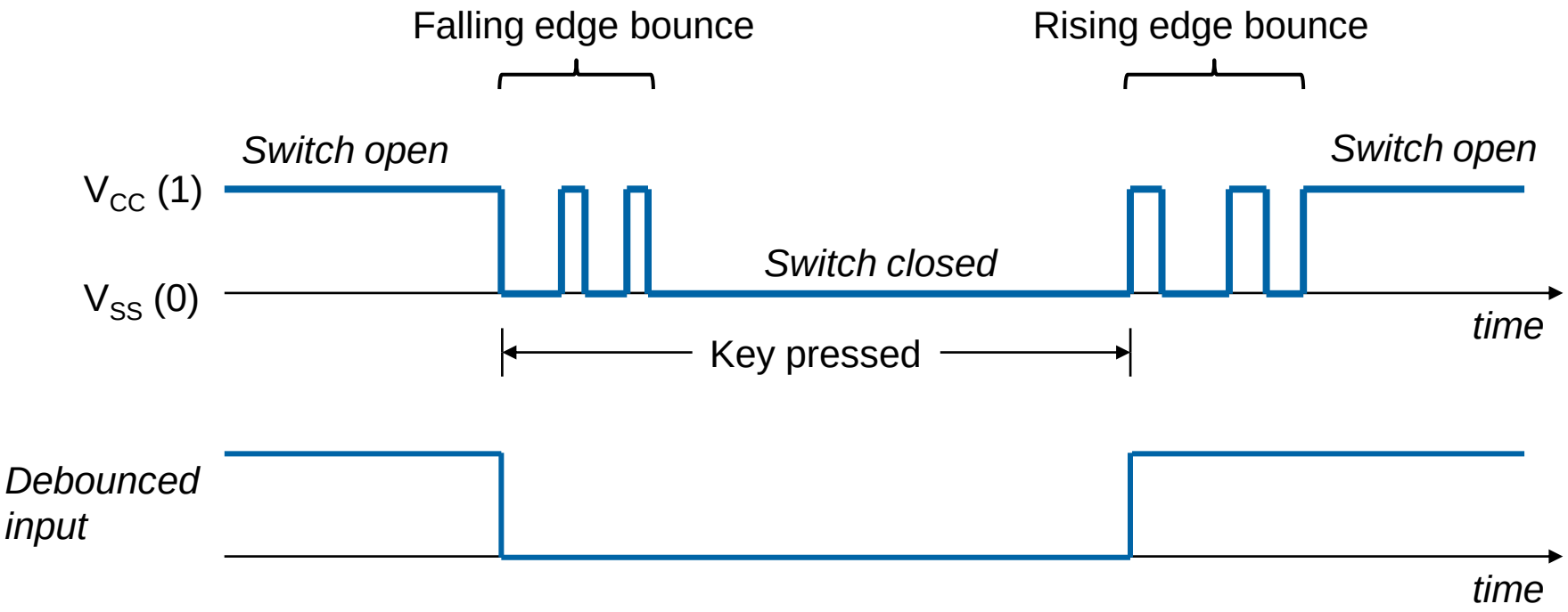
- **What is bouncing?**



Software Debouncing

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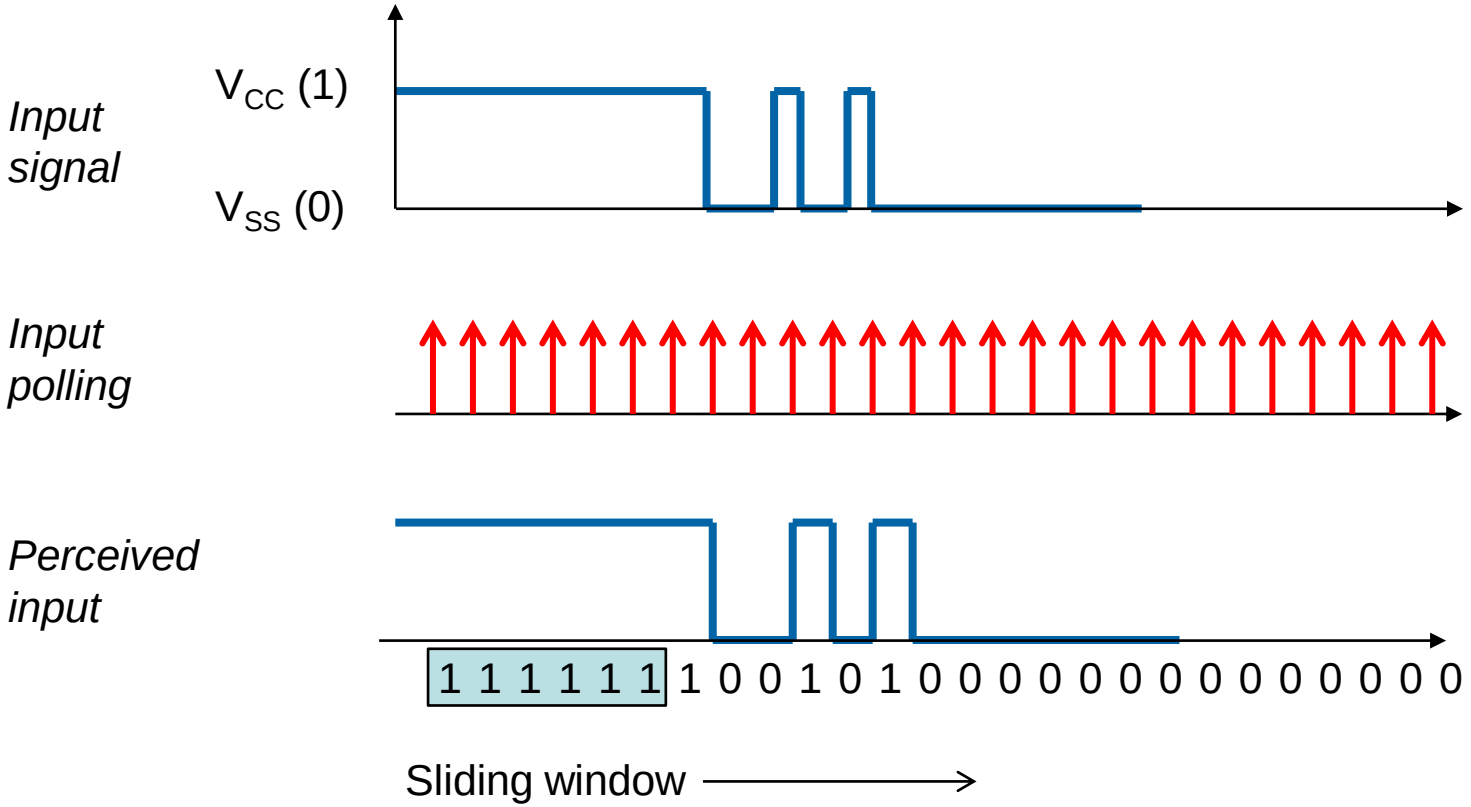
- **Sliding window filter**



Software Debouncing

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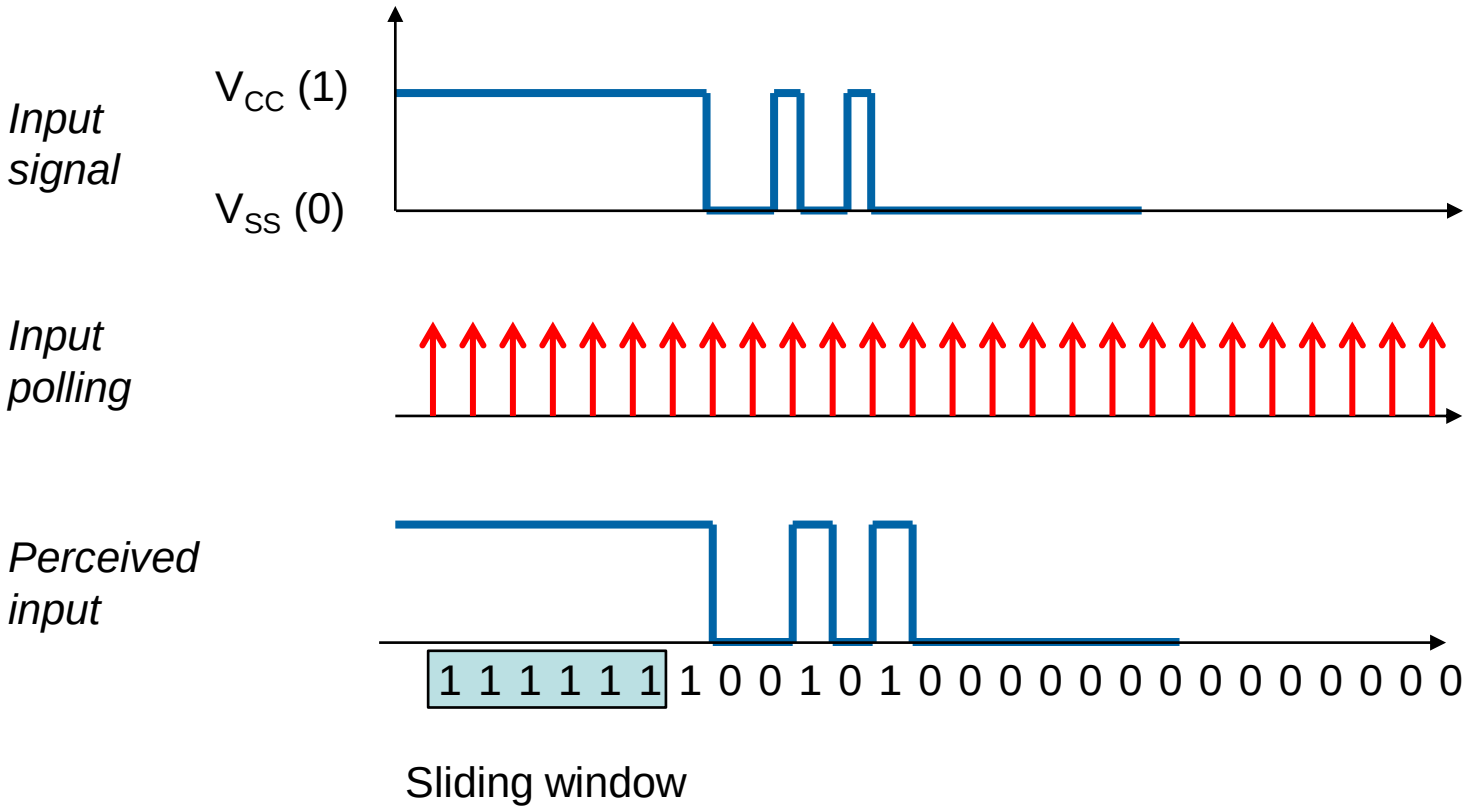
- **Sliding window filter**



Software Debouncing

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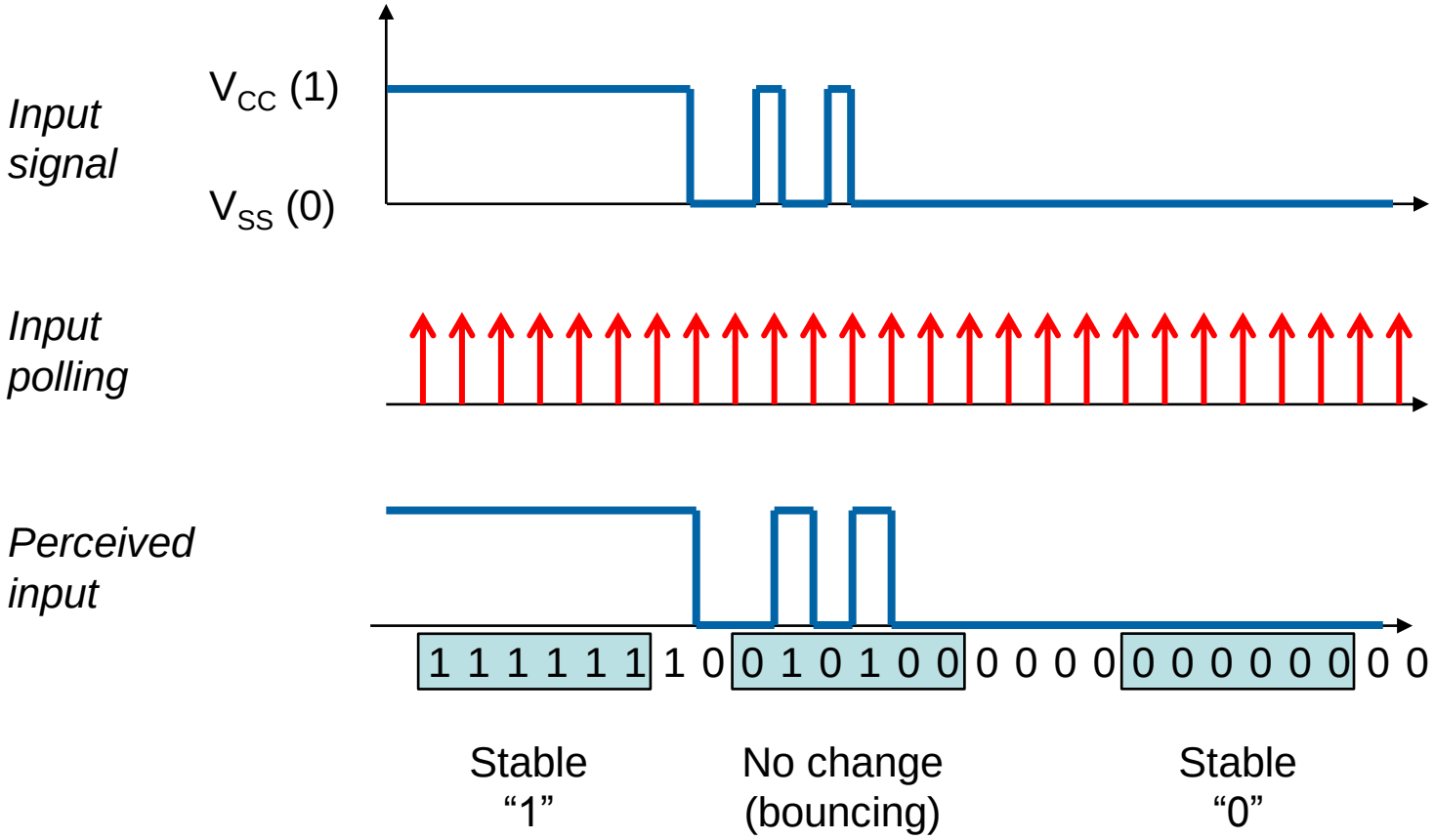
- **Sliding window filter**



Software Debouncing

- **Detecting falling edge with sliding window filter**