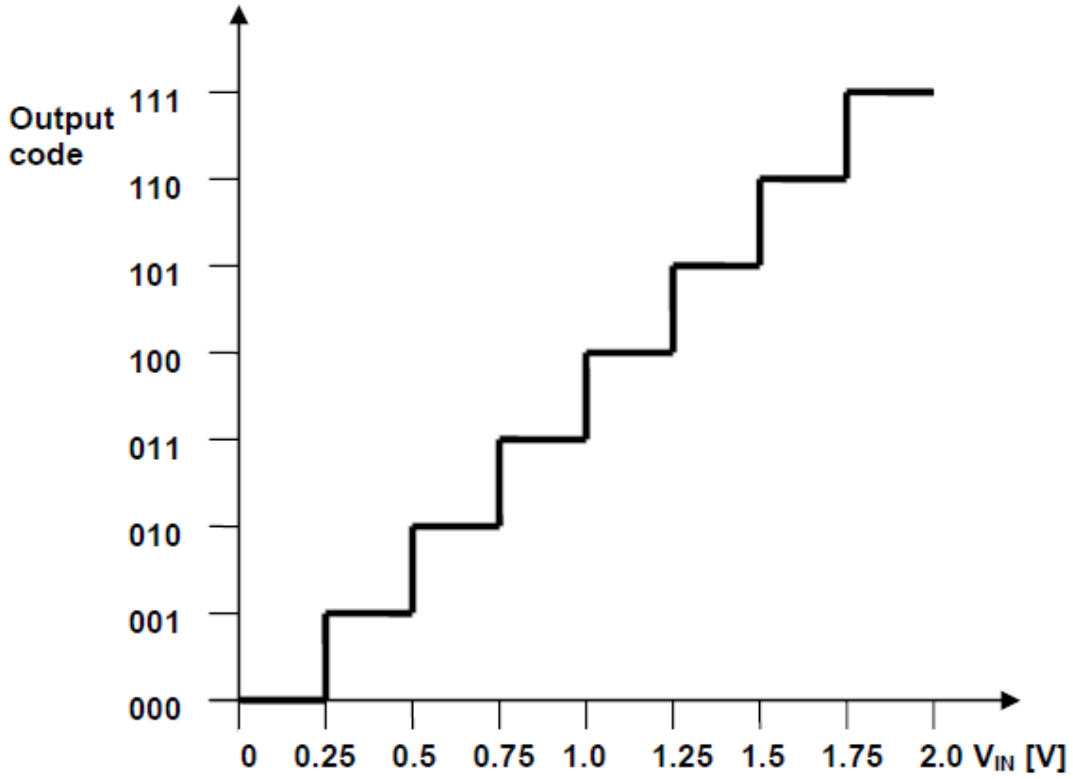
Balloon Satellite – Lesson 3

ADC & PWM

Analog to Digital Converters (ADC)

- Some sensor's output is an Analog Voltage
  - HIH-4030 Humidity Sensor
  - LDR
- In the digital world, everything is binary
- Analog signals go through a conversion process to represent analog voltages in digital world

3 bit resolution digitisation



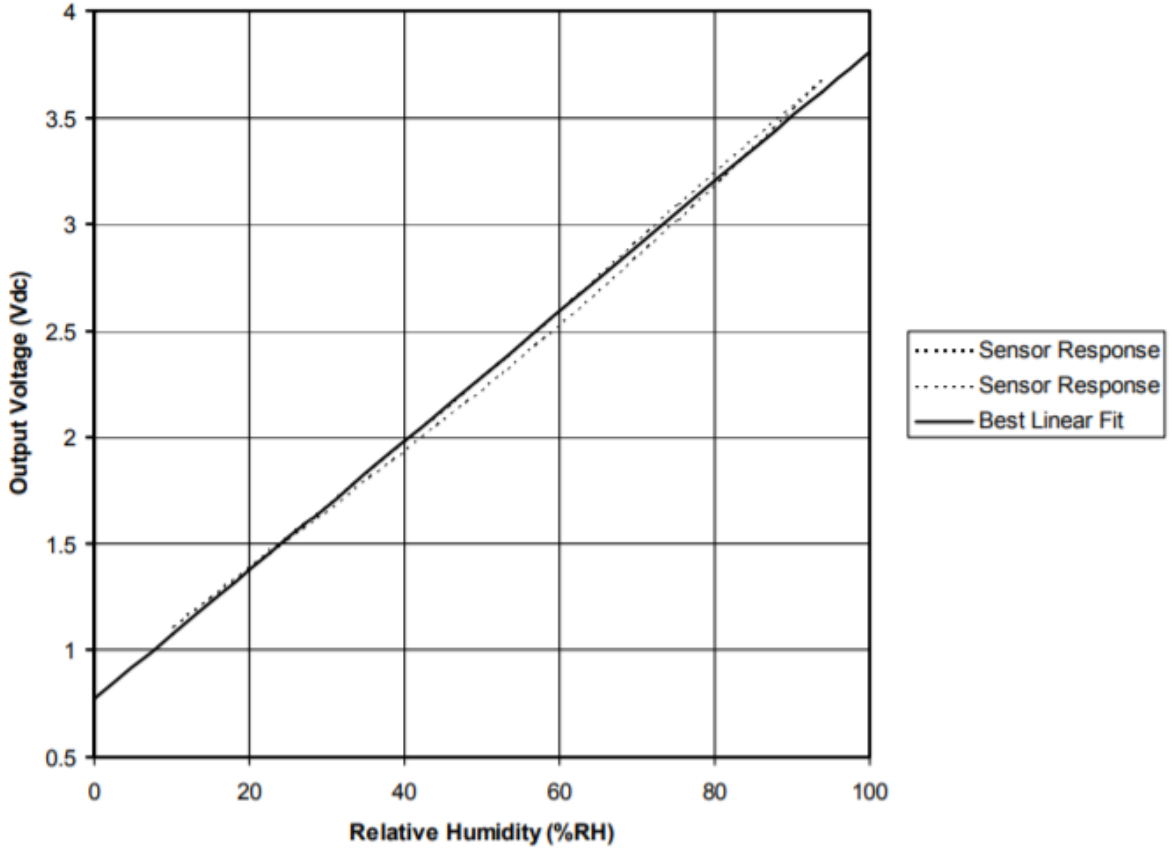
ADC [cont]

- Arduino Mega contains 16 channels for analog inputs (A0 – A15)
- Each channel has a 10bit ADC
- Each channel is able to read voltages between 0V – 5V
  - 10 bit = 1024 steps
  - Hence resolution of ADC is 5V/1024 = 4.8828 mV per step
- Use function analogRead() to read the voltage from the specified analog pins
- Typical sampling rate (rate at data is refreshed) on an Arduino is 10KHz

- Exercise: If an ADC has a 12 bit resolution and it is able to read voltages between 0V – 8V, what is the voltage per step?

ADC [cont]

- Humidity Sensor: HIH-4030
- https://www.sparkfun.com/datasheets/Sensors/Weather/SEN-09569-HIH-4030-datasheet.pdf
- Operation Voltage: 4V – 5.8V
- Exercise: Go through datasheet to find the equations to convert analog reading from Arduino to RH readings

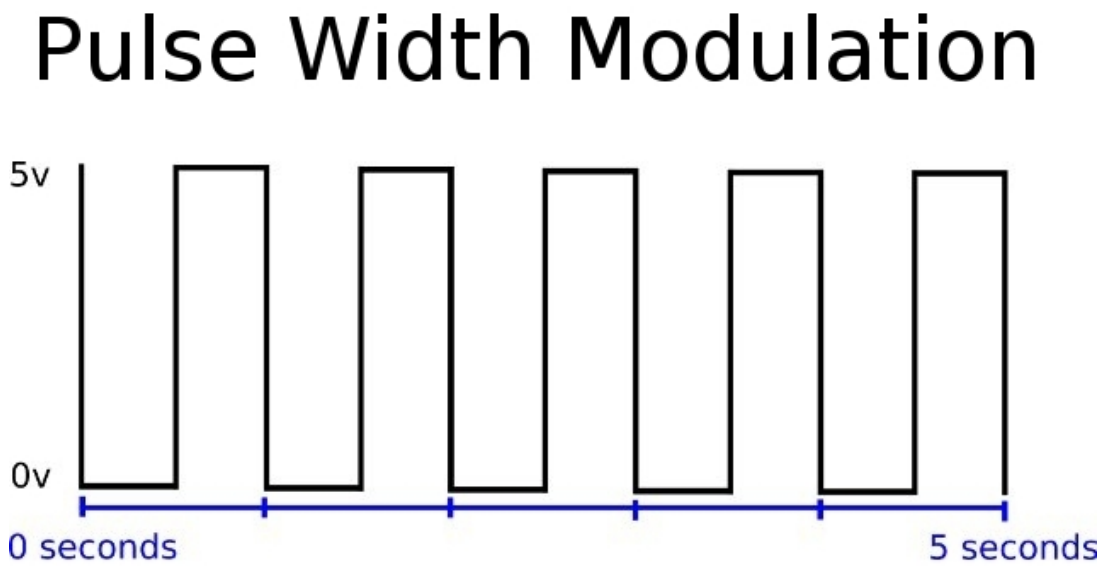


Task 1

- You are provided with a HIH-4030 sensor and an Arduino Mega. Your customer has requested for a system that prints out on the computer the RH value of the surrounding every 30s.

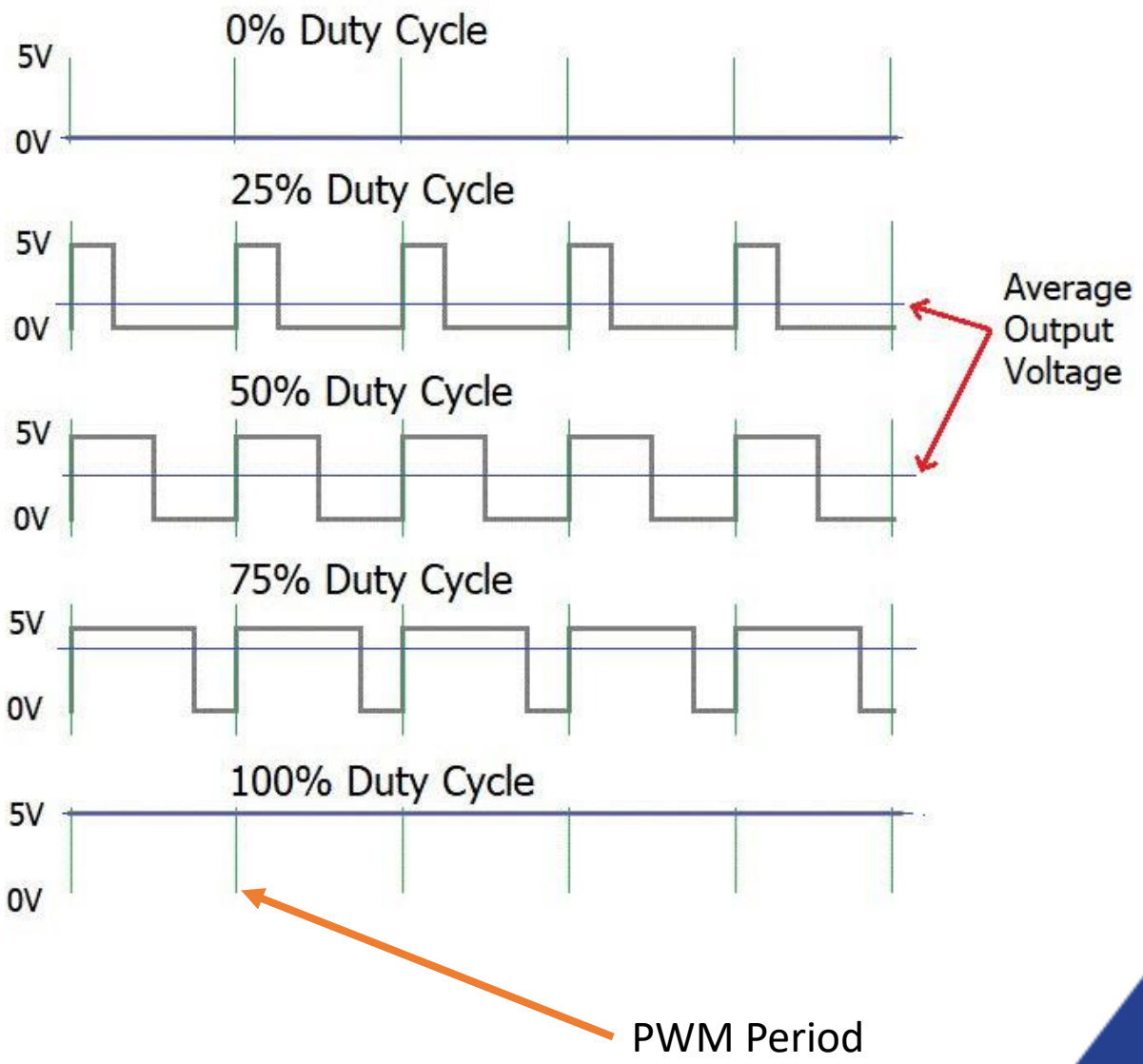
Pulse Width Modulation

- Pulse Width Modulation (PWM) is a method of reducing average power delivered by an electrical signal by chopping it up into discrete parts
- It is an efficient way of providing intermediate amounts of power to a device by varying its duration of High (on) and Low (off) cycles
- Applications: Dimming of lights, Servo Control



Pulse Width Modulation (cont)

- PWM Period (Tp) is defined as the regular interval or period of time of the PWM waveform
  - PWM frequency = _____
- Duty Cycle describes the proportion of On time within the PWM period
  - Low duty cycle = ____ power

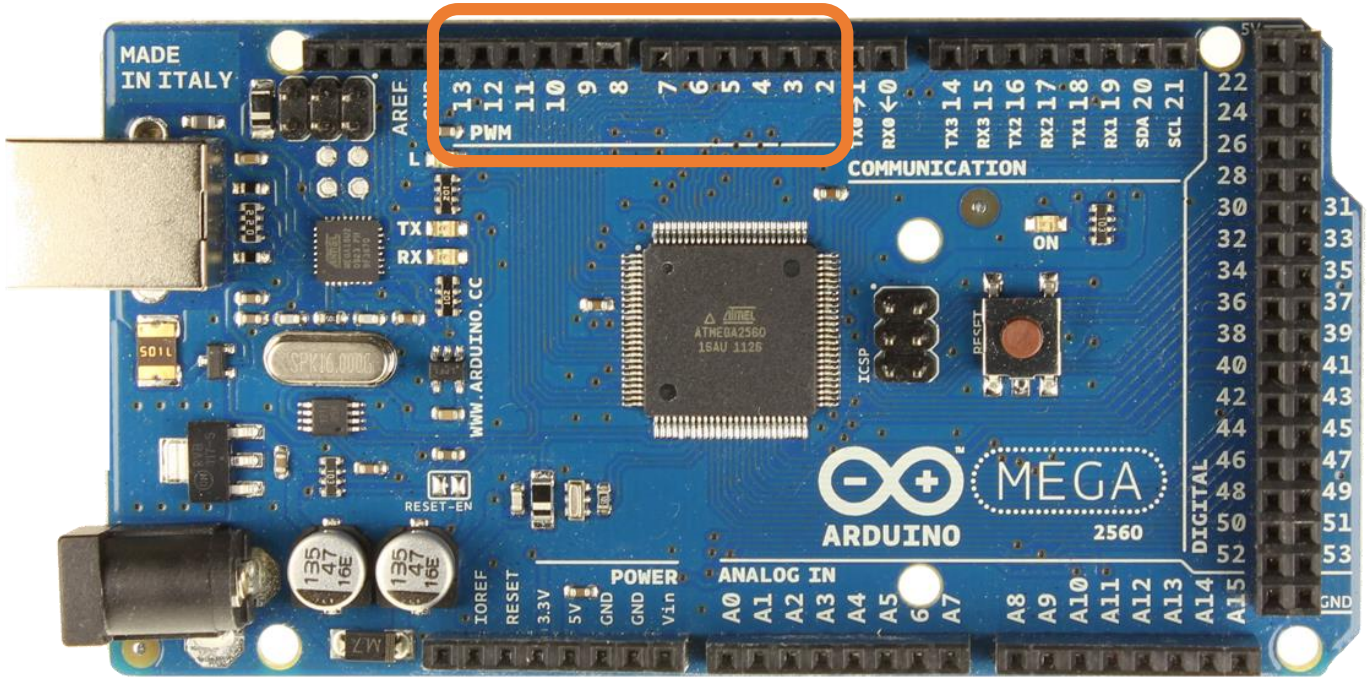


Pulse Width Modulation (cont)

- Duty cycle is represented in percentages; 0-100%,100% is fully on
- PWM Resolution gives the number of steps between 0-100% duty cycle
  - Arduino Mega has a PWM resolution of _____ steps
- Generally, PWM frequency is fixed and duty cycle is varied to effectuate a change to external systems

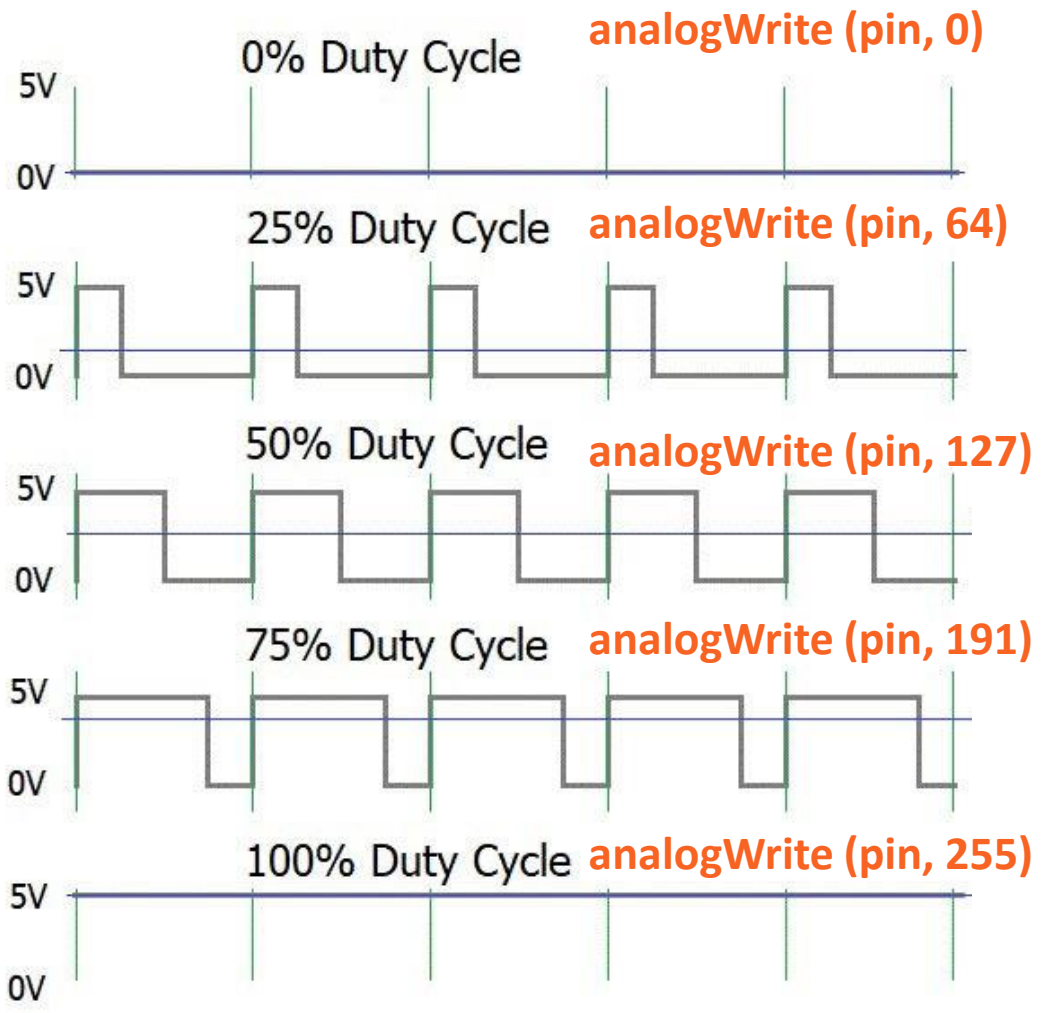
PWM Output Pins

- The operating voltage of PWM Output Pins on the Mega is _____V



Arduino – analogWrite()

- Write a PWM value to a digital pin. It can be used to light a LED at varying brightness or to drive a motor at different speeds or positions
- Upon calling analogWrite(), the output will be a steady square wave based on the specified duty cycle till next call of analogWrite()
- PWM Frequency is fixed
- analogWrite(pin, value)
  - Pin: which PWM pin to command
  - Value: 0(off) – 255(on)

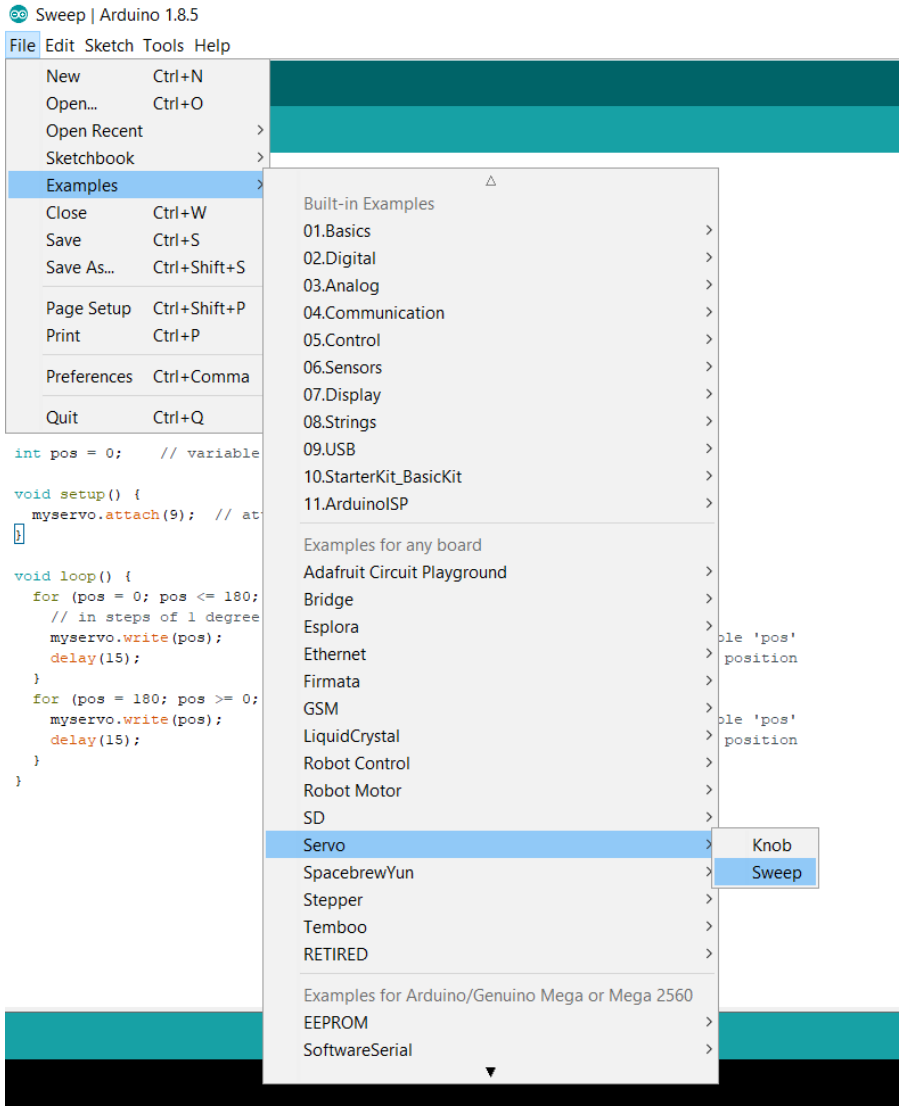


Arduino – Servo Library

- Included in distributions of Arduino IDE
- 2 types of servos
  - Continuous Rotation, Speed Controlled
  - Position Controlled Servo
- Servo Part: https://www.sgbotic.com/index.php?dispatch=products.view&product_id=2844
- Servo Library: https://www.arduino.cc/en/Reference/Servo
- attach() function attaches the servo variable to the pin
- write() function commands the servos to a desired angle

Task 2

- Play with the servo library and a physical servo. Understand how the functions and commands work.



Thank You

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