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"""
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"""
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```
class Controller:
```

```
    ''' This class implements a generic proportional gain controller'''
```

```
    def __init__(self, Kp, Ki, Kd, saturation):
```

```
        '''
```

```
        Initializes the proportional gain and defines the  
        initial setpoint for the controller.
```

```
        @param Kp: Sets proportional gain value
```

```
        @param Ki: Sets integral gain value
```

```
        @param saturation: The anti-wind up integration saturation limit
```

```
        '''
```

```
        print('Creating a controller')
```

```
        ## Proportional gain for a control loop
```

```
        self.Kp = Kp
```

```
        ## Integral gain for a control loop
```

```
        self.Ki = Ki
```

```
        ## Derivative gain for a control loop
```

```
        self.Kd = Kd
```

```
        ## Desired output target variable
```

```
        self.setpoint = 0
```

```
        self.saturation = saturation
```

```
        ## Actuation signal sent to the plant
```

```
        self.__actuate_signal = 0
```

```
        ## Current output value of feedback from plant
```

```
        self.__current_value = 0
```

```
        ## Set the start variable to true to begin integral gain term
```

```
        self.__start = True
```

```
        self._esum = 0
```

```
        self._perror = 0
```

```
        self._deriv = 0
```

```
        print('Controller sucessfully created')
```

```
    def set_setpoint(self, new_setpoint):
```

```
        '''
```

```
        Method to enable the user to define a new setpoint that the  
        control loop will use as a reference value.
```

```
        @param new_setpoint: User-defined setpoint that the controller us
```

```
        '''
```

```
        self.setpoint = new_setpoint
```

```

def set_Kp(self, new_Kp):
    """
    Method to enable the user to define a new proportional gain
    that the control loop will use to multiply the error signal
    and output an actuation signal.
    @param new_Kp: User-defined propotional gain that is multiplied b
    """
    self.Kp = new_Kp

def set_Ki(self, new_Ki):
    """
    Method to enable the user to define a new integral gain
    that the control loop will use to multiply the error sum signal
    and output an actuation signal.
    @param new_Ki: User-defined integral gain that is multiplied by e
    """
    self.Ki = new_Ki

def set_newSat(self, new_Sat):
    """
    Method to enable the user to define a integral saturation
    and output a saturated error signal if saturated
    @param newSat: User-defined saturation that is used to prevent in
    """
    self.saturation = new_Sat

def set_Kd(self, new_Kd):
    """
    Method to enable the user to define a new derivative gain
    that the control loop will use to multiply the error signal
    and output an actuation signal.
    @param new_Kd: User-defined derivative gain that is multiplied by
    """
    self.Kd = new_Kd

def repeatedly(self, current_value):
    """
    Method that repeatedly runs the control algorithm. Compares
    setpoint to actual signal value. This error is multiplied by
    the proportional gain and sent to the plant.
    @param current_value: Received current value from feedback loop
    @return actuate_signal: % duty cycle sent to device driver
    """
    #Define current value variable to be used in control algorithm
    self.__current_value = current_value

```

```

self._error = self.setpoint - self.__current_value

# Calculate integral of error (Esum)
self._esum += self._error

if self._esum > self.saturation:
    self._esum = self.saturation
elif self._esum < -self.saturation:
    self._esum = -self.saturation

#Calculate Derivative of Error
self._deriv = self._error - self._perror
self._perror = self._error

#Creates actuation signal from the proportional gain mulitplied b
self.__actuate_signal = self._error*self.Kp + self._esum*self.Ki+
return self.__actuate_signal

def percent_completion(self):
    ''' Returns the completion calculation for the controlled path.
    @return error The error from the desired position and current pos
    '''
    try:
        percent = (self._error/self.setpoint)*100
    except ZeroDivisionError:
        return 0
    else:
        return percent

def clear_controller(self):
    ''' Clears the esum for a new target location.
    '''
    self._esum = 0
    self._error = 0
    self.__actuate_signal = 0
    self._perror = 0
    self._deriv = 0

```