

# Project Smart House

<b>Doc. Title:</b>	<b>Project Smart House</b>
<b>Doc. reference:</b>	<b>ITT Blaise Pascal - Cesena</b>
<b>Edit by:</b>	<b>Luca Bertaccini, Enrico Brandinelli</b>
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<b>Date:</b>	<b>19/12/2025</b>
<b>Content:</b>	<b>Problem</b>

## Problem:

Create a program to manage a smart house with the use of object oriented programming in c# language.

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<b>Content:</b>	<b>Main Functions</b>

## **Main Functions:**

Classes:

## Lamp:

Class that models a lamp, with the option of changing its brightness.

## EcoLamp:

Class that models an eco friendly lamp, with the option of changing its brightness and its maximum brightness halved to save power. It also has a timer function to make sure the lamp automatically turns off after the selected timer comes to an end.

## TwoLampDevice:

Class that combines two lamps, which can also be of different types, to turn them on or off or toggle it, increase the brightness or decrease it and change the brightness in a determined lamp of a determined brightness.

## LampsRow:

Class that manages an arbitrary number of Lamps and EcoLamps from a single point. Allows to add new Lamp, new EcoLamp and a new AbstractLamp in a determined position and remove Lamp with name, with Guid and remove with name in a determined position. Allows to switch on and switch off with name and Guid and also switch all lamps on or off. Allows to change the brightness of a single lamp with the name or Guid and also change brightness of all lamps. Also allows to find the lamp with the highest or the lowest brightness, also can find all the lamps in a determined range or find all the lamps which are on or off, also can find a lamp with its Guid. Finally can sort lamps by intensity.

## Thermostat:

Class which controls temperature with range 15°-30° (default 20°), always On. Verified IncreaseTemperature raises by 0.1° up to 30° (throws at max). Verified DecreaseTemperature lowers by 0.1° down to 15° (throws at min). Verified SetTemperature accepts any value in valid range, throws outside bounds.

## Door:

Class which is a secure door controller with 4+ digit PIN, status Unknown. Verified OpenDoor works from Closed to Open, throws when Locked/Open. Verified CloseDoor works from Open to Closed, throws otherwise. Verified LockDoor works

from Closed to Locked, throws when Open. Verified UnlockDoor works from Locked to Closed with correct PIN, throws with wrong PIN or when not Locked.

## AirConditioner:

Class which is a fan speed controller (Low/Medium/High, default Medium). Verified TurnOn works when off, throws when on. Verified TurnOff works when on, throws when off. Verified SetFanSpeedLow/Medium/High work only when on, throw when off. Verified IncreaseFanSpeed cycles Low to Medium to High, throws at max or when off. Verified DecreaseFanSpeed cycles High to Medium to Low, throws at min or when off.

## CCTV:

Class which have vision change methods set Night, Thermal, or Default vision but throw if already active. Zoom setters move to min, default, or max but throw if already at that level. IncreaseZoom and DecreaseZoom adjust zoom by 0.1 but throw if already at max or min.

## LampMatrix:

Class that manages a bidimensional matrix of AbstractLamp from a single point. It allows to add a new Lamp, EcoLamp or generic AbstractLamp either in the first available position or in a specified row and column, and to remove lamps by name, by Guid, or by a specific position. It allows to switch on and switch off lamps using name or Guid, to toggle a single lamp, and to switch all lamps on, off, or toggle all at once. It also allows to change the brightness of a single lamp by name or Guid, as well as change the brightness of all lamps. Furthermore, it allows to find the lamp with the highest or lowest brightness, to retrieve all lamps within a given brightness range, to find all lamps that are on or off, to search for a lamp by Guid, and finally to sort all lamps by intensity in ascending or descending order.

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<b>Content:</b>	<b>Implementation Requirements</b>

## **Implementation Requirements:**

Lamp:

Metodo/Proprietà	Descrizione/Funzionalità
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<b>MinBrightness</b>	Returns The minimum value of Brightness(0).
<b>MaxBrightness</b>	Returns The maximum value of Brightness(100).
<b>DefaultBrightness</b>	Returns The default value of Brightness(50).
<b>Brightness</b>	The current Brightness value.
<b>SwitchOn()</b>	Turns on the lamp and sets the brightness to its default value(50). Updates LastUpdatedAtUtc.
<b>SwitchOff()</b>	Turns off the lamp and sets the brightness to its minimum value(0). UpdatesLastUpdatedAtUtc.
<b>SwitchOnOff()</b>	Switches the lamp on if it's off or turns it off if it's on. Respectively sets the brightness to either its default or minimum value. Updates LastUpdatedAtUtc.
<b>ChangeBrightness(int newbrightness)</b>	When the lamp is on and newbrightness is in the range 0 to 100, sets brightness as newbrightness. Updates LastUpdatedAtUtc.
<b>Dimmer()</b>	When lamp is on, brightness decreases by 10. Updates LastUpdatedAtUtc.
<b>Brighten()</b>	When the lamp is on, brightness increases by 10. Updates LastUpdatedAtUtc.

EcoLamp:

Metodo/Proprietà	Descrizione/Funzionalità
<b>MinBrightness</b>	Returns The minimum value of Brightness(0).
<b>MaxBrightness</b>	Returns The maximum value of Brightness(70).

<b>DefaultBrightness</b>	Returns The default value of Brightness(30).
<b>Brightness</b>	The current Brightness value.
<b>SwitchOn()</b>	Turns on the lamp and sets the brightness to its default value(50). Updates LastUpdatedAtUtc.
<b>SwitchOff()</b>	Turns off the lamp and sets the brightness to its minimum value(0). UpdatesLastUpdatedAtUtc.
<b>SwitchOnOff()</b>	Switches the lamp on if it's off or turns it off if it's on. Respectively sets the brightness to either its default or minimum value. Updates LastUpdatedAtUtc.
<b>ChangeBrightness(int newbrightness)</b>	When the lamp is on and newbrightness is in the range 0 to 100, sets brightness as newbrightness. Updates LastUpdatedAtUtc.
<b>Dimmer()</b>	When lamp is on, brightness decreases by 10. Updates LastUpdatedAtUtc.
<b>Brighten()</b>	When the lamp is on, brightness increases by 10. Updates LastUpdatedAtUtc.
<b>Status</b>	Status of the lamp: On/Off
<b>Name</b>	Name of the lamp
<b>LastUpdateAtUtc</b>	Date/Hour of the last update to the lamp's state

TwoLampDevice:

Metodo/Proprietà	Descrizione/Funzionalità
<b>Lamp1</b>	Returns an AbstractLamp
<b>Lamp2</b>	Returns an AbstractLamp

<b>SwitchOn(int selectedLamp)</b>	Turns on the selected Lamp
<b>SwitchOff(int selectedLamp)</b>	Turns off the selected Lamp
<b>Dimmer(int selectedLamp)</b>	Decreases the brightness of the selected Lamp
<b>Brighten(int selectedLamp)</b>	Increases the brightness of the selected Lamp
<b>SwitchOnOff(int selectedLamp)</b>	Turns on or off the selected Lamp
<b>ChangeBrightness(int newBrightness, int selectedLamp)</b>	Changes the brightness in a new brightness in a determined Lamp

LampsRow:

Metodo/Proprietà	Descrizione/Funzionalità
<b>Lamps</b>	Returns a list of AbstractLamp
<b>AddLamp(string name)</b>	Adds a Lamp with a determined Name
<b>AddEcoLamp(string name)</b>	Adds a EcoLamp with a determined Name
<b>AddLampInPosition(AbstractLamp lamp, int position)</b>	Adds an AbstractLamp in a determined position
<b>RemoveLamp(string name)</b>	Removes a Lamp with a determined Name
<b>RemoveLamp(Guid id)</b>	Removes a Lamp with a determined Id
<b>RemoveLampInPosition(string name, int position)</b>	Removes a Lamp with a specified name in a determined position
<b>SwitchOff(Guid id)</b>	Turns off a Lamp with its Id
<b>SwitchOn(Guid id)</b>	Turns on a Lamp with its Id



<b>SwitchOn(string name)</b>	Turns on a Lamp with its name
<b>SwitchOff(string name)</b>	Turns off a Lamp with its name
<b>AllSwitchOn()</b>	Turns on all Lamps
<b>AllSwitchOff()</b>	Turns off all Lamps
<b>SingleLampSwitchOnOff(string name)</b>	Turns on or off a determined Lamp
<b>SingleLampChangeBrightness(int newbrightness, string name)</b>	Changes brightness in a new brightness in a determined Lamp with name
<b>SingleLampChangeBrightness(int newbrightness, Guid id)</b>	Changes brightness in a new brightness in a determined Lamp with Id
<b>AllLampsSwitchOnOff()</b>	Turn on or off all Lamps
<b>AllLampsChangeBrightness(int newBrightness)</b>	Changes brightness in a new brightness in all Lamps
<b>FindLampWithMaxBrightness()</b>	Finds the Lamp which has the max brightness
<b>FindLampWithMinBrightness()</b>	Finds the Lamp which has the min brightness
<b>FindLampsByIntensityRange(int min, int max)</b>	Finds The Lamps which are in a determined range of intensity
<b>FindAllOn()</b>	Finds all the Lamps which are on
<b>FindAllOff()</b>	Finds all the lamps which are off
<b>FindLampById(Guid id)</b>	Finds a Lamp with its Id
<b>SortByIntensity(bool descending)</b>	Sort all the Lamps by intensity and returns to you false if it order growing and returns to you true if it order decreasing

LampMatrix:

Metodo/Proprietà	Descrizione/Funzionalità
<b>Lamps</b>	Returns a matrix of AbstractLamp
<b>AddLamp(string name)</b>	Adds a Lamp or an EcoLamp with a determined Name
<b>AddLampInPosition(AbstractLamp lamp, int position)</b>	Adds a Lamp or an EcoLamp in a determined position
<b>RemoveLamp(string name)</b>	Removes a Lamp with a determined Name
<b>RemoveLamp(Guid id)</b>	Removes a Lamp with a determined Id
<b>RemoveLampInPosition(string name, int position)</b>	Removes a Lamp with a specified name in a determined position
<b>SwitchOff(Guid id)</b>	Turns off a Lamp with its Id
<b>SwitchOn(Guid id)</b>	Turns on a Lamp with its id
<b>SwitchOn(string name)</b>	Turns on a Lamp with its name
<b>SwitchOff(string name)</b>	Turns off a Lamp with its name
<b>AllSwitchOn()</b>	Turns on all matrix of Lamps
<b>AllSwitchOff()</b>	Turns off all matrix of Lamps
<b>SingleLampSwitchOnOff(string name)</b>	Turns on or off a determined Lamp
<b>SingleLampChangeBrightness(int newbrightness, string name)</b>	Changes brightness in a new brightness in a determined Lamp with name
<b>SingleLampChangeBrightness(int newbrightness, Guid id)</b>	Changes brightness in a new brightness in a determined Lamp with Id
<b>AllLampsSwitchOnOff()</b>	Turn on or off all Lamps
<b>AllLampsChangeBrightness(int newbrightness)</b>	Changes brightness in a new brightness in all Lamps

<b>FindLampWithMaxBrightness()</b>	Finds the Lamp which has the max brightness
<b>FindLampWithMinBrightness()</b>	Finds the Lamp which has the min brightness
<b>FindLampsByIntensityRange(int min, int max)</b>	Finds The Lamps which are in a determined range of intensity
<b>FindAllOn()</b>	Finds all the Lamps which are on
<b>FindAllOff()</b>	Finds all the lamps which are off
<b>FindLampById(Guid id)</b>	Finds a Lamp with its Id
<b>SortByIntensity(bool descending)</b>	Sort all the Lamps by intensity and returns to you false if it order growing and returns to you true if it order decreasing

Door:

Metodo/Proprietà	Descrizione/Funzionalità
<b>PIN</b>	Returns a int
<b>DoorStatus</b>	Returns a state of DoorStatus
<b>OpenDoor()</b>	Opens the door when it's closed and throw an ArgumentException when it's locked
<b>CloseDoor()</b>	Close the door when it's open and throw an ArgumentException when is not open
<b>LockDoor()</b>	Locks the door when it's closed and throw an ArgumentException when is not closed

<b>UnlockDoor()</b>	Unlocks the door if it's locked and if the insert PIN is equal to the PIN and throw an ArgumentException when the PIN is not equal and when the door is not locked
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AirConditioner:

Metodo/Proprietà	Descrizione/Funzionalità
<b>FanSpeed</b>	Returns the FanSpeed
<b>TurnOn()</b>	Turns the device on and throw an ArgumentException when is already on
<b>TurnOff()</b>	Turns the device off and throw an ArgumentException when is already off
<b>SetFanSpeedLow()</b>	Sets the FanSpeed of device to Low and throw an ArgumentException when is not on
<b>SetFanSpeedMedium()</b>	Sets the FanSpeed of device to Medium and throw an ArgumentException when is not on
<b>SetFanSpeedHigh()</b>	Sets the FanSpeed of device to High and throw an ArgumentException when is not on
<b>IncreaseFanSpeed()</b>	Increases the FanSpeed of device and throw an ArgumentException when is not on

<b>DecreaseFanSpeed()</b>	Decreases the FanSpeed of device and throw an <code>ArgumentException</code> when is not on
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Thermostat:

Metodo/Proprietà	Descrizione/Funzionalità
<b>Temperature</b>	Returns temperature
<b>MinTemperature</b>	It's a constant
<b>DefaultTemperature</b>	It's a constant
<b>MaxTemperature</b>	It's a constant
<b>DefaultJump</b>	It's a constant
<b>IncreaseTemperature()</b>	Increases the temperature of the <code>DefaultJump</code> and when it's at maximum throw an <code>ArgumentException</code>
<b>DecreaseTemperature()</b>	Decreases the temperature of the <code>DefaultJump</code> and when it's at minimum throw an <code>ArgumentException</code>
<b>SetTemperature(double newTemperature)</b>	Sets a new temperature and throw an <code>ArgumentException</code> when the <code>newTemperature</code> is out of the range between <code>MinTemperature</code> and <code>MaxTemperature</code>

AbstractDevice:

Metodo/Proprietà	Descrizione/Funzionalità
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<b>Id</b>	Returns a Guid
<b>Name</b>	Returns name
<b>Status</b>	Returns DeviceStatus
<b>CreationTime</b>	Returns DateTime
<b>LastUpdateTime</b>	Returns DateTime
<b>SwitchOn()</b>	Turns the device on if it's off and update the LastUpdateTime to that moment
<b>SwitchOff()</b>	Turns the device off if it's on and update the LastUpdateTime to that time

CCTV:

Metodo/Proprietà	Descrizione/Funzionalità
<b>VisionType</b>	Returns CCTVVisionType
<b>MinZoom</b>	It's a constant
<b>DefaultZoom</b>	It's a constant
<b>MaxZoom</b>	It's a constant
<b>DefaultJump</b>	It's a constant
<b>SetDefaultVision</b>	Sets VisionType to DefaultVision if VisionType is not already DefaultVision
<b>SetNightVision</b>	Sets VisionType to NightVision if VisionType is not already NightVision
<b>SetThermalVision</b>	Sets VisionType to ThermalVision if VisionType is not already

	ThermalVision
<b>SetMinZoom</b>	Sets zoom to MinZoom if zoom is not already MinZoom
<b>SetDefaultZoom</b>	Sets zoom to DefaultZoom if zoom is not already DefaultZoom
<b>SetMaxZoom</b>	Sets zoom to MaxZoom if zoom is not already MaxZoom
<b>IncreaseZoom</b>	Increases zoom until it's to the max
<b>DecreaseZoom</b>	Decreases zoom until it's to the min

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<b>Content:</b>	<b>UML</b>

## UML:

Class Diagram

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<b>Content:</b>	<b>Testing</b>

## Testing:

### Lamp:

Performed 12 tests. Verified SwitchOn and SwitchOff which respectively turn on and off the lamp. Verified ChangeBrightness which cannot have negative value, the toggle which permits turning on and off and finally Dimmer and Brighten which increase or decrease the brightness. The methods that have been tested were inherited from the virtual methods in AbstractLamp.

### EcoLamp:

Performed 12 tests. Verified SwitchOn and SwitchOff which respectively turn on and off the lamp. Verified ChangeBrightness which cannot have negative value, the toggle which permits turning on and off and finally Dimmer and Brighten which



increase or decrease the brightness. Verified that the timer works. The methods that have been tested were inherited from the virtual methods in AbstractLamp.

## TwoLampDevice:

Performed 39 tests.

Verified SwitchOn and SwitchOff which respectively turn on and off a determined lamp. Verified ChangeBrightness which cannot have negative value, the toggle which permits turning on and off and finally Dimmer and Brighten which increase or decrease the brightness.

## LampsRow:

Performed 42 tests.

Verified SwitchOn and SwitchOff which respectively turn on and off a determined lamp with its name or Guid. Verified SingleChangeBrightness with name or Guid which cannot have negative value, the toggle which permits turning on and off and finally Dimmer and Brighten which increase or decrease the brightness of a determined lamp with name or Guid.

Verified AddLamp and AddEcoLamp, also tested RemoveLamp with name or Guid or simply with the position. Verified AllLampSwitchOn and Off. Verified finding a lamp by intensity, the status or the Guid.

## Thermostat:

Performed 10 tests.

Verified constructor throws ArgumentException for null, empty string, or whitespace-only names. Verified SetTemperature throws ArgumentException when temperature exceeds max or below min, and correctly sets valid temperatures.

Verified IncreaseTemperature throws ArgumentException when already at max, and correctly increases by 0.1° when valid. Verified DecreaseTemperature throws ArgumentException when already at min, and correctly decreases by 0.1° when valid.

## Door:

Performed 12 tests.

Verified constructor throws `ArgumentException` for null, empty string, or whitespace-only names, and for PIN under 4 digits. Verified `OpenDoor` works when closed but throws when locked. Verified `CloseDoor` works when open. Verified `LockDoor` works when closed but throws when open. Verified `UnlockDoor` throws when open or with wrong PIN, but correctly unlocks when locked with correct PIN (1234).

## AirConditioner:

Performed 17 tests.

Verified constructor throws `ArgumentException` for empty name. Verified `TurnOn` works when off but throws when already on. Verified `TurnOff` works when on but throws when off. Verified `SetFanSpeedLow/Medium/High` work only when on, throw when off. Verified `IncreaseFanSpeed` cycles Medium to High, throws at max or when off. Verified `DecreaseFanSpeed` cycles High to Medium to Low, throws at min or when off.

## CCTV:

Performed 17 tests.

Verified constructor rejects empty name. Verified each vision mode switches correctly but throws if already active. Verified zoom modes update correctly, while re-setting or exceeding min/max zoom triggers exceptions.

## LampMatrixTest:

Performed 42 tests.

Verified `AddLamp` and `AddEcoLamp`, both in the first available position and in a specific position, including the correct handling of a full matrix. Verified `RemoveLamp` by name, by Guid, and by position. Verified `SwitchOn` and `SwitchOff` methods using both name and Guid, as well as toggling a single lamp and toggling all lamps. Verified `AllSwitchOn` and `AllSwitchOff`. Verified brightness management, including changing the brightness of a single lamp by name or Guid and changing the brightness of all lamps. Verified search and query functionalities, including finding the lamp with maximum or minimum brightness, finding lamps within a given brightness range, finding all lamps that are on or off, and finding a lamp by its Guid. Finally, verified sorting lamps by intensity in both increasing and decreasing order.