#### SMARTCOFFEEMACHINE™

The SmartCoffeeMachine™ can be set to brew coffee at specific temperatures, ranging from 60°C to 95°C. By default, the machine is off. The machine can hold a maximum of six coffee pods at a time.

When the machine is turned on using the turnOn function, the brewing temperature and the type of coffee (Espresso, Cappuccino, Latte) must be specified.

#### COFFEEPOD

Different types of coffee pods can be placed in the machine. For the machine, the following characteristics of the coffee pod are essential:

* **Current brew percentage** (0% - ∞%)
* **Type of coffee** (Espresso, Cappuccino, Latte)
* **Flavor intensity** (Mild, Medium, Strong)

The coffee pod includes a toString() method that returns the name of the coffee type and its flavor intensity.

### Incorporating **Flavor Intensity**

**Flavor intensity** is a measure of how strong or bold the coffee tastes, and it depends on the brewing **time** (t), **temperature** (T), and the specific pod's characteristics. Different flavor intensities affect the coffee brewing process as follows:

**Mild**: Brewed faster, with a lower temperature, resulting in a lighter flavor profile.

Formula for brew rate:

Brew Percentage = 0.5 × (0.08 × T) ×t (Lower multiplier results in lighter extraction of flavors.)

**Medium**: Balanced brewing time and temperature, producing a standard coffee flavor.

Formula for brew rate:

Brew Percentage = (0.1 × T) × t

**Strong**: Brewed longer at higher temperatures, extracting more oils and compounds from the pod for a bold flavor.

Formula for brew rate:

Brew Percentage=1.5 × (0.12 × T) × t (Higher multiplier increases flavor extraction and intensity.)

For example:

* A **Mild Espresso** at T =70 degree Celsius for 10 seconds results in: Brew Percentage = 0.5 × (0.08 × 70) × 10 = 28%
* A **Strong Espresso** at T =90 degree Celsius for the same 10 seconds results in: Brew Percentage = 1.5 × (0.12 × 90) × 10 = 162%

This difference reflects how the flavor intensities modify the brewing dynamics.

### Brew Percentage by Flavor Intensity

| **Flavor Intensity** | **Base Brew Multiplier** | **Brew Percentage Formula** | **Suggested** T​ **(°C)** |
| --- | --- | --- | --- |
| **Mild** | 0.08 | 0.5 x (0.08 x T) x t | 60–75 |
| **Medium** | 0.1 | 0.1 x T x t | 75–85 |
| **Strong** | 0.12 | 1.5 x (0.12 x T) x t | 85–95 |

#### MILK

The machine can also prepare milk-based coffee beverages. Milk has the following characteristics:

* **Current froth percentage** (0% - ∞%)
* **Temperature** (0°C to 100°C)

The milk includes a toString() method that returns the current froth percentage.

#### DRINK FORMULAS

Each coffee drink is prepared using a scientific formula, based on its type, the brewing temperature (T), and time elapsed (t, in seconds). During brewing:

1. **Temperature Increase:** The temperature of the drink increases by 0.5 × t (°C per second).
2. **Brew Percentage Increase:** The brew percentage of the coffee pod increases at a fixed rate per second, depending on the coffee type.
3. **Froth Percentage (for milk-based drinks):** The froth percentage increases linearly over time.

The parameters for each coffee type are as follows:

| **Coffee Type** | **Brew Percentage Increase/Second** | **Froth Percentage Increase/Second** | **Formula for Brew Percentage** | **Formula for Temperature** |
| --- | --- | --- | --- | --- |
| **Espresso** | 0.1 x T​ |  | 0.1 x T x t | 25 + 0.5 x t |
| **Cappuccino** | 0.08 x T​ | 0.05 x T | 0.08 x T x t | 30 + 0.5 x t |
| **Latte** | 0.06 x T | 0.04 x T | 0.06 x T x t | 35 + 0.5 x t |

#### POD HOLDER

The coffee machine includes a pod holder (singleton) to store and retrieve coffee pods. The pod holder can hold an unlimited number of coffee pods. Users can select a pod based on the coffee type. The pod holder retrieves the first available pod of the selected type.

If no pods of the selected type are available, an exception is raised: NoMorePodsException. The pod holder's temperature defaults to 20°C but can be adjusted.

#### ASSIGNMENTS

##### ASSIGNMENT 1

Build the application based on the provided class diagram and the text above.

##### ASSIGNMENT 2

The turnOn feature starts a timer that triggers the coffee machine to brew the drink. This is implemented using a Timer and TimerTask (see Appendix 1: Timer and TimerTask class information). The timer simulates one second of the brewing process for the coffee machine. Implement this functionality in the SmartCoffeeMachine™ class.

##### ASSIGNMENT 3

After testing the coffee machine and pod holder for some time, it happens frequently that the pod holder runs out of pods unnoticed. The manufacturer requests a notification to the user through an exception: the PodHolderEmptyException. This exception is thrown as soon as you attempt to retrieve a pod from an empty pod holder. Implement this.

##### ASSIGNMENT 4

The SmartCoffeeMachine™ comes with a thermometer. You must use this thermometer to measure the temperature of various entities, including the coffee machine, the pod holder, and the drinks. Create a Thermometer class with a method that:

* Accepts one of the mentioned elements as input.
* Returns a string: “I measured a temperature of xx degrees Celsius”, along with a temperature classification: Cold (<10°C), Warm (10°C - 50°C), Hot (>50°C).

##### ASSIGNMENT 5

1. Due to a past incorrect implementation, the coffee machine did not always retrieve the correct pod from the pod holder. Provide a meaningful unit test that tests the getNextPod method.

b) Some drinks occasionally reach undesired froth percentages. Create a meaningful unit test to verify the froth percentage of the milk during the brewing process.

##### ASSIGNMENT 6

Create a Main class with a static main method that:

* Creates a SmartCoffeeMachine™;
* Places three Espresso pods and two Cappuccino pods in the pod holder;
* Places one Latte pod in the pod holder;
* Places three pods in the coffee machine;
* Turns on the coffee machine to brew at 85°C for Cappuccino;
* Measures the temperature of a brewed drink;
* Increases the brewing temperature to 90°C;
* Measures the temperature of a brewed drink again.

