**Conveyor Control:**

编写一个独立的61131-3结构化文本程序，不是功能块，用于控制一个带有三个站点的传送带系统，每个站点都允许用户停止传送带。系统应该根据五个传感器自动启动和停止，这些传感器检测传送带上的物体。传送带的速度应保持在每秒2米。

**约束：**

1. 传感器检测到物体并且用户不停止就启动传送带，否则停止

AG((sensor\_detected1|sensor\_detected2|sensor\_detected3|sensor\_detected4|sensor\_detected5) & !(user\_stop1 | user\_stop2 |user\_stop3) -> AX conveyor\_on)

1. 用户按下停止按钮则传送带停止

AG ((user\_stop1 | user\_stop2 |user\_stop3) -> AX !conveyor\_on)

1. 传送带若开启，传送带则保持速度为2m/s

AG (conveyor\_on -> speed\_equals\_2m\_per\_s)

EN:

Write a standalone 61131-3 Structured Text program (not a function block) to control a conveyor belt system with three stations. Each station allows the user to stop the conveyor belt. The system should automatically start and stop based on signals from five sensors that detect objects on the conveyor belt. The conveyor belt speed should be maintained at 2 meters per second.

Constraints:

If the sensors detect an object and the user has not pressed the stop button, the conveyor belt starts; otherwise, it stops.

If the user presses the stop button, the conveyor belt stops running.

If the conveyor belt is in the "on" state, its speed should be maintained at 2 meters per second.

**Heating Control:**

编写一个独立的61131-3结构化文本程序，不是功能块，用于控制加热系统的温度。系统应该根据三个温度传感器自动开启和关闭，并保持20至25摄氏度的恒定温度范围。温度以整数形式表示。

**约束：**

1. 温度低于20则开启升温装置

AG (temperature < 20 -> AX(heater\_on))

1. 温度高于25则关闭升温装置

AG (temperature > 25 -> AX(!heater\_on))

Requirement: Write a standalone 61131-3 Structured Text program (not a function block) to control the temperature of a heating system. The system should automatically turn the heating device on and off based on signals from three temperature sensors and maintain a constant temperature range between 20 and 25 degrees Celsius. The temperature values are represented as integers.

Constraints:

1. If the temperature is below 20 degrees Celsius, turn on the heating device.

2. If the temperature is above 25 degrees Celsius, turn off the heating device.

**Traffic Control:**

编写一个独立的61131-3结构化文本程序，而不是功能块，用于控制交通灯系统。系统应响应行人按下按钮以及紧急车辆的存在，给予他们优先通行权。

**约束：**

1. 行人按钮按下时，如果没有来车且当前是红灯，则切换为绿灯

AG(pedestrianButtonPressed & !vehicleDetected & light\_red -> AX(light\_green))

1. 检测到来车时，立即切换为黄灯，然后切换为红灯

AG((vehicleDetected -> AX(light\_yellow)) -> AF(light\_red))

1. 交通灯正常周期切换（绿->黄->红）

AG(light\_green -> AF(light\_yellow)) & AG(light\_yellow -> AF(light\_red)) & AG(light\_red -> AF(light\_green))

1. 同时只存在一个灯开启

AG(!(light\_red & light\_green) & !(light\_red & light\_yellow) & !(light\_green & light\_yellow))

5. 紧急来车优先级高于行人按钮

AG(Emergen\_vehicleDetected & pedestrianButtonPressed -> AX(light\_red))

EN:

Write a standalone 61131-3 Structured Text program, not a function block, to control a traffic light system. The system should respond to pedestrian button presses and the presence of emergency vehicles, granting them priority.

Constraints:

1. When the pedestrian button is pressed, if there are no approaching vehicles and the current light is red, switch to green.
2. When an approaching vehicle is detected, immediately switch to yellow, then to red.
3. The traffic lights should cycle normally (green -> yellow -> red).
4. Only one light should be on at any given time.
5. Emergency vehicles have higher priority than pedestrian button presses.

**Elevator Control:**

编写一个独立的61131-3结构化文本程序，用于控制一部电梯。这座5层的每层楼都配备了底部和顶部限位开关。有一个7秒的定时器用于打开电梯门，还有一个10秒的定时器用于在电梯内部没有按下任何按钮的情况下再次打开门。电梯的操作基于当前方向以及每层楼的上升和呼叫按钮所施加的方向。

**约束：**

1. 电梯到达楼层后开门，开门时间为七秒,7秒后门应关闭。

AG(arrivalFloor -> AX(doorsOpen & timerOpen = 0)) &

AG(doorsOpen & timerOpen = 7 -> AX(!doorsOpen))

1. 电梯关门后10秒如果没有按钮被按下，则电梯重新开门。

AG(!doorsOpen & timerNoButton = 10 -> AX(doorsOpen))

1. 电梯向上运行时，经过楼层有向上按钮被按下，电梯应在达到该楼层时停靠。

AG (up\_direction & button\_up\_pressed -> AF (stop\_at\_floor ))

1. 电梯向下运行时，经过楼层有向下按钮被按下，电梯应在达到该楼层时停靠。

AG (down\_direction & button\_down\_pressed -> AF (stop\_at\_floor))

EN:

Requirement: Write a standalone 61131-3 Structured Text program to control an elevator. This 5-floor building is equipped with bottom and top limit switches on each floor. There is a 7-second timer for opening the elevator door and a 10-second timer to reopen the door if no buttons are pressed inside the elevator. The operation of the elevator is based on the current direction and the direction imposed by the up and call buttons on each floor.

Constraints:

1. When the elevator arrives at a floor, the door opens for 7 seconds, and after 7 seconds, the door should close.

2. If no buttons are pressed within 10 seconds after the elevator door closes, the door reopens.

3. When the elevator is moving upward, it should stop at any floor where the up button has been pressed.

4. When the elevator is moving downward, it should stop at any floor where the down button has been pressed.

**Car Wash Station:**

根据IEC 61131-3标准，编写一个PLC程序，用于创建一个只有一个工位的自动洗车站。工位通过传感器检测是否有车辆，并且如果洗车区域内没有人，则开始洗车。如果检测到洗车区域内有人，则洗车站应停止并发出警报。

**约束：**

1. 当车辆传感器检测到车辆并且人员传感器未检测到人员时，洗车程序应开始。

AG((vehicle\_sensor & ! person\_sensor ) -> AX car\_wash\_starts)

1. 如果在洗车过程中人员传感器检测到有人，洗车程序应立即停止，然后发出警报。

AG((car\_washing & person\_sensor ) -> AX(!car\_washing & AlarmOn))

1. 洗车程序流程需要明确（开始，喷洒，洗刷，干燥）

AG(car\_wash\_starts -> AF(water\_spraying))

AG(water\_spraying -> AF(brushing))

AG(brushing -> AF (drying))

EN:

Requirement: According to the IEC 61131-3 standard, write a PLC program to create an automatic car wash station with a single bay. The station detects the presence of a vehicle using sensors and starts the car wash process if no person is detected in the car wash area. If a person is detected in the car wash area, the station should stop and trigger an alarm.

Constraints:

1. When the vehicle sensor detects a vehicle and the personnel sensor does not detect any person, the car wash process should begin.

2. If the personnel sensor detects a person during the car wash process, the car wash process should immediately stop, and an alarm should be triggered.

3. The car wash process flow must be clearly defined (start, spray, scrub, dry).

**Underground Car Park:**

编写一个符合IEC 61131-3标准的PLC程序，用于创建地下停车场的入口/出口控制。

系统中的传感器有： X1：地面楼层入口/出口的光电开关。当汽车通过时，X1会开启。 X2：地下室入口/出口的光电开关。当汽车通过时，X2会开启。 M1：当从地面楼层通过的汽车触发X1时，M1会在一个扫描周期内开启（脉冲信号）。 M2：当从地下室通过的汽车触发X1时，M2会在一个扫描周期内开启。 M3：当从地下室通过的汽车触发X2时，M3会在一个扫描周期内开启。 M4：当从地面楼层通过的汽车触发X2时，M4会在一个扫描周期内开启。 中间变量： M20：当汽车从地面楼层进入通道时，M20会在过程中开启。 M30：当汽车从地下室进入通道时，M30会在过程中开启。 系统中的输出设备有： Y1：地面楼层和地下室的入口/出口处的红灯。 Y2：地面楼层和地下室的入口/出口处的绿灯。 过程描述： “地下停车场的入口/出口是一条单车道通道，需要交通灯来控制汽车。红灯禁止汽车进入或离开，而绿灯允许汽车进入或离开。当汽车从地面楼层入口进入通道时，地面楼层和地下室的红灯都会开启，绿灯会关闭。在此过程中，任何进入或离开的汽车都会被禁止，直到汽车完全通过通道。当通道清空后，绿灯会再次开启，允许其他汽车从地面楼层或地下室进入。同样，当汽车离开地下室并进入通道时，任何其他汽车进入或离开都会被禁止，直到汽车完全从通道到达地面。当PLC运行时，交通灯的初始设置将是绿灯开启，红灯关闭。”

**约束：**

1. 有车辆从一层进入通道，地下室与一层亮起红灯

AG(X1 -> AF(Y1 & !Y2))

1. 车辆从一层进入地下室后，地下室与一层恢复绿灯

AG(M20 -> AF(!Y1 & Y2))

1. 有车辆从地下室进入通道，地下室与一层亮起红灯

AG(X2 -> AF(Y1 & !Y2))

1. 车辆离开停车场后，地下室与一层恢复绿灯

AG(M30 -> AF(!Y1 & Y2))

EN:

Requirement: Write a PLC program compliant with the IEC 61131-3 standard to create an entrance/exit control system for an underground parking lot.

Sensors in the system:

- X1: Photoelectric switch at the ground floor entrance/exit. X1 turns on when a car passes through.

- X2: Photoelectric switch at the basement entrance/exit. X2 turns on when a car passes through.

- M1: M1 turns on for one scan cycle when a car passing from the ground floor triggers X1.

- M2: M2 turns on for one scan cycle when a car passing from the basement triggers X1.

- M3: M3 turns on for one scan cycle when a car passing from the basement triggers X2.

- M4: M4 turns on for one scan cycle when a car passing from the ground floor triggers X2.

Intermediate variables:

- M20: M20 turns on during the process when a car enters the passage from the ground floor.

- M30: M30 turns on during the process when a car enters the passage from the basement.

Output devices in the system:

- Y1: Red light at the ground floor and basement entrance/exit.

- Y2: Green light at the ground floor and basement entrance/exit.

Process description:

"The entrance/exit of the underground parking lot is a single-lane passage that requires traffic lights to control cars. The red light prohibits cars from entering or exiting, while the green light allows cars to enter or exit. When a car enters the passage from the ground floor entrance, the red lights at both the ground floor and basement turn on, and the green lights turn off. During this process, any car attempting to enter or exit is prohibited until the car has completely passed through the passage. Once the passage is clear, the green lights turn on again, allowing other cars to enter from the ground floor or basement. Similarly, when a car exits the basement and enters the passage, any other car attempting to enter or exit is prohibited until the car has completely reached the ground floor. When the PLC starts running, the initial setting of the traffic lights will be green lights on and red lights off."

Constraints:

1. When a vehicle enters the passage from the ground floor, the red lights at both the basement and ground floor turn on.

2. When a vehicle enters the basement from the ground floor, the green lights at both the basement and ground floor are restored.

3. When a vehicle enters the passage from the basement, the red lights at both the basement and ground floor turn on.

4. When a vehicle exits the parking lot, the green lights at both the basement and ground floor are restored.

**Empty Bottle Removal:**

编写一个独立的61131-3结构化文本程序，用于包装瓶子。瓶子在填充后被传送带移动到包装区域。一个接近传感器检测任何瓶子，另一个传感器仅检测空瓶子。一个气缸用于移除空瓶子

**约束:**

1. 接近传感器检测到瓶子时，传送带启动以移动瓶子到包装区域

AG (proximity\_sensor\_detected -> AF (conveyor\_on)

1. 接近传感器和空瓶传感器同时检测到瓶子时，气缸启动并移除空瓶子

AG (proximity\_sensor\_detected & empty\_bottle\_sensor\_detected -> AF (cylinder\_activated))

EN：

Requirement: Write a standalone 61131-3 Structured Text program for packaging bottles. After being filled, the bottles are moved by a conveyor belt to the packaging area. A proximity sensor detects any bottle, while another sensor detects only empty bottles. A pneumatic cylinder is used to remove empty bottles.

Constraints:

1. When the proximity sensor detects a bottle, the conveyor belt starts and moves the bottle to the packaging area.

2. When both the proximity sensor and the empty bottle sensor detect a bottle simultaneously, the pneumatic cylinder activates to remove the empty bottle.

**Coffee Maker:**

编写一个独立的61131-3结构化文本程序，用于控制一台咖啡机。

这台咖啡机包含三个水箱，分别用于咖啡、牛奶和混合液，以及三个阀门，分别用于咖啡、牛奶和输出。这个咖啡机包含一个混合器，用于将咖啡和牛奶正确混合，以产生最佳的输出。混合器设计为在开启后工作四秒钟，然后自动停止，此时输出阀门将打开以获取咖啡。

混合器设计有一个定时器，当混合器水箱达到预设的最大水平时，它会自动启动。水箱与混合器相连，当咖啡和牛奶的阀门都打开时，它开始填充混合器，然后水箱水平达到预设的最大水平。混合器水箱可以填充到130毫升，当达到最大水平时，咖啡和牛奶的阀门将关闭，然后开始混合。

咖啡机包含四个按钮。按钮一是紧急停止按钮，按钮二是启动机器的按钮，按钮三是用于咖啡和牛奶的按钮，最后一个按钮是仅用于咖啡的按钮。紧急停止按钮用作安全按钮，如果机器中出现任何问题，如任一阀门未打开，水箱水平工作不正常，混合器工作不正常或发生任何预期之外的事件，则需要使用紧急停止按钮立即停止机器

**约束：**

1. 用户选择牛奶和咖啡模式，搅拌罐中的液位达到最高液位后，关闭牛奶和咖啡的闸门

AG((milk\_and\_coffee\_mode & max\_level\_reached) -> AF(!milk\_valve & !coffee\_valve))

1. 用户选择牛奶和咖啡模式且搅拌罐中液位达到最高液位后，开启搅拌器，搅拌器运行四秒

AG((milk\_and\_coffee\_mode & max\_level\_reached) -> AX mixer)

G(mixer & mix\_time = 4 -> X !mixer)

1. 搅拌器正常停止运行后，将自动打开搅拌罐的阀门

G(mixer & mix\_time = 4 -> F mixer\_valve)

1. 用户选择咖啡模式，搅拌罐中的液位达到最高液位后，关闭咖啡的闸门，打开搅拌罐的阀门

AG((coffee\_mode & max\_level\_reached) -> AF(!coffee\_valve & mixer\_valve))

1. 按下紧急按钮情况下，关闭所有阀门，停止搅拌器

AG((emergency\_button\_pressed) -> AX(!coffee\_valve & !milk\_valve & !mixer\_valve & !mixer))

**EN:**

Requirement: Write a standalone 61131-3 Structured Text program to control a coffee machine. This coffee machine includes three tanks for coffee, milk, and mixed liquid, as well as three valves for coffee, milk, and output. The machine also includes a mixer designed to properly blend coffee and milk to produce the optimal output. The mixer operates for four seconds after being activated and then automatically stops, at which point the output valve opens to dispense the coffee.

The mixer is equipped with a timer that automatically starts when the mixer tank reaches a preset maximum level. The tank is connected to the mixer and begins filling when both the coffee and milk valves are open. The tank can hold up to 130 milliliters, and when it reaches the maximum level, the coffee and milk valves close, and the mixing process begins.

The coffee machine has four buttons. Button one is an emergency stop button, button two is for starting the machine, button three is for selecting both coffee and milk, and the last button is for selecting coffee only. The emergency stop button serves as a safety feature to immediately halt the machine in case of any issues, such as a valve failing to open, abnormal tank levels, mixer malfunction, or any unexpected events.

Constraints:

1. When the user selects the coffee and milk mode, the coffee and milk valves close once the liquid level in the mixer tank reaches the maximum level.

2. When the user selects the coffee and milk mode and the liquid level in the mixer tank reaches the maximum level, the mixer activates and runs for four seconds.

3. After the mixer stops, the output valve of the mixer tank opens automatically.

4. When the user selects the coffee-only mode, the coffee valve closes and the output valve of the mixer tank opens once the liquid level in the mixer tank reaches the maximum level.

5. Pressing the emergency stop button closes all valves and stops the mixer.

**Feedforward Control Conveyor:**

编写一个独立的61131-3结构化文本程序，用于实现基于传感器预测负载的前馈控制，以调整传送带的速度。

**约束：**

1. 负载超过阈值则降低传送带速度

AG (load>threshold -> AX (conveyor\_speed = conveyor\_speed - adjust\_speed))

1. 负载低于阈值则提升传送带速度

AG (load<threshold -> AX (conveyor\_speed = conveyor\_speed + adjust\_speed))

1. 负载在范围内则不变

AG (load\_in\_range -> AX (conveyor\_speed = conveyor\_speed))

EN:

Requirement: Write a standalone 61131-3 Structured Text program to implement feedforward control based on sensor-predicted load to adjust the conveyor belt speed.

Constraints:

If the load exceeds the threshold, reduce the conveyor belt speed.

If the load is below the threshold, increase the conveyor belt speed.

If the load is within the range, maintain the current conveyor belt speed.

**Ratio Control Mixing:**

编写一个独立的61131-3结构化文本程序，用于实现两种A,B反应物以100比1的比例混合的控制。

**约束：**

1.控制一个混合物的输入速率

1.1当比例大于102：1(误差在2)时，减少A输入速率

AG(ratio > 102 -> AX(AdjustedFlowRate < current\_rate))

1.2当比例小于98：1(误差在2)时，增大A输入速率

AG(ratio < 98 -> AX(AdjustedFlowRate > current\_rate))

1.3比例接近100(误差在2),保持速率

AG((ratio >= 98) | (ratio <= 102) -> AX(AdjustedFlowRate =current\_rate))

EN:

Requirement: Write a standalone 61131-3 Structured Text program to control the mixing of two reactants in a 100:1 ratio.

Constraints:

1. Control the input rate of one reactant in the mixture.

1.1 When the ratio is greater than 102：1 (error within 2), reduce the input rate. (Since floating-point numbers cannot be expressed in constraints, use multiplication to represent the ratio.)

1.2 When the ratio is less than 98：1 (error within 2), increase the input rate. (Since floating-point numbers cannot be expressed in constraints, use multiplication to represent the ratio.)

1.3 When the ratio is close to 100 (error within 2), maintain the current rate.

**PID Temperature Control Gas Turbine:**

编写一个独立的IEC 61131-3结构化文本程序，用于实现燃气轮机内部温度的PID反馈控制，通过提供入口阀门开度的设定值。

**约束：**

1. 温度低于阈值时，增大阀门的开度

AG(temp < min\_threshold -> AX(valve\_opening > current\_valve\_opening))

1. 温度高于阈值时，减小阀门的开度

AG(temp > max\_threshold -> AX(valve\_opening < current\_valve\_opening))

EN:

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement PID feedback control for the internal temperature of a gas turbine by providing a setpoint for the inlet valve opening.

Constraints:

1. When the temperature is below the threshold, increase the valve opening.

2. When the temperature is above the threshold, decrease the valve opening.

**PID Level Control Distillation Column:**

编写一个独立的IEC 61131-3结构化文本程序，用于实现蒸馏塔液位的PID反馈控制，输出信号发送到给蒸馏塔的入口阀门。

**约束：**

1. 液位低于阈值，打开入口阀

AG(level < low\_threshold -> AX(open\_valve))

1. 液位处于阈值，关闭入口阀

AG(level = threshold -> AX(!open\_valve))

EN：

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement PID feedback control for the liquid level in a distillation column, with the output signal sent to the inlet valve of the distillation column.

Constraints:

1. If the liquid level is below the threshold, open the inlet valve.

2. If the liquid level is at the threshold, close the inlet valve.

**PID Flow Control Water Treatment:**

编写一个独立的IEC 61131-3结构化文本程序，用于实现水处理过程中化学剂量氯的PID反馈流量控制。假设剂量率为3 ppm，采样率为100毫秒。

**约束：**

1. 浓度低于阈值则增加流速

AG(concentration < min\_limit -> AX(flow\_rate > current\_rate))

1. 浓度高于阈值则降低流速

AG(concentration > max\_limit-> AX(flow\_rate < current\_rate))

3.浓度在范围内流速不变

AG(concentration >= min\_limit & concentration <= max\_limit -> AX(flow\_rate = flow\_rate))

EN：

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement PID feedback flow control for chlorine dosing in a water treatment process. Assume a dosing rate of 3 ppm and a sampling rate of 100 milliseconds.

Constraints:

1. If the concentration is below the threshold, increase the flow rate.

2. If the concentration is above the threshold, reduce the flow rate.

3. If the concentration is within the range, maintain the current flow rate.

**PID ph Control:**

编写一个独立的IEC 61131-3结构化文本程序，用于实现PID反馈的pH控制。

**约束：**

1. 要求ph在限定范围7左右（最大允许范围：5-8）

AF (pH >= 5 & pH <= 8)

2.当ph<5，则增大碱性溶液注入速率；

AG (pH < 5 -> AX (alkaline\_Rate > current\_alkaline\_Rate))

3.当ph>8,则增大酸性溶液注入速率；

AG (pH > 8 -> AX (acidic\_Rate > current\_acidic\_Rate))

4.两种溶液一直到液位上限前都是在不断注入状态，

AG (liquid\_Level < upper\_Limit -> AX (alkaline\_Injecting & acidic\_Injecting))

5.检测到液位上限传感器报警后，溶液注入均停止。

AG (upper\_Limit -> AX (!alkaline\_Injecting & !acidic\_Injecting))

EN:

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement PID feedback control for pH regulation.

Constraints:

1. The pH is within the specified range of 7 (maximum allowable range: 5–8).

2. If pH < 5, increase the injection rate of the alkaline solution.

3. If pH > 8, increase the injection rate of the acidic solution.

4.Both solutions are continuously injected until the liquid level reaches the upper limit.

5. When the upper limit sensor detects an alarm, the injection of both solutions stops.

**Spray Station**

编写一个独立的61131-3结构化文本程序，而不是一个功能块，来实现一个喷涂站。通过输送机将车厢移动到喷洒站，然后按下按钮喷洒车厢。当按下喷洒按钮，传感器检测到汽车时，喷洒会自动发生3秒钟。当喷涂发生时，输送机停止，喷涂完成后，输送机重新启动。

**约束：**

1. 按下传送带暂停按钮后且传感器检测到车辆时输送机停止

AG(stop\_conveyor\_button\_pressed & carDetected -> AX !conveyor\_starts)

1. 按下喷洒按钮并且检测到车辆开始喷洒，持续3s

AG(spray\_button\_pressed & carDetected -> AX(spraying))

G(spraying & spray\_timer >= 3 -> X !spraying)

1. 喷涂结束后按钮复位

AG(!spraying -> AX !spray\_button\_pressed)

4.喷涂结束后输送机重新开始工作

AG(!spraying -> AX conveyor\_starts)

EN:

Requirement: Write a standalone 61131-3 Structured Text program, not a function block, to implement a spray station. The car is moved to the spray station via a conveyor, and then the car is sprayed by pressing a button. When the spray button is pressed and the sensor detects the car, spraying occurs automatically for 3 seconds. When spraying is in progress, the conveyor stops, and after spraying is completed, the conveyor restarts.

Constraints:

1. The conveyor stops when the stop button is pressed and the sensor detects the vehicle.

2. Spraying begins when the spray button is pressed and the vehicle is detected, lasting for 3 seconds.

3. The spray button resets after spraying is completed.

4. The conveyor resumes operation after spraying is completed.

**liquid mixing application**

编写一个独立的IEC 61131-3结构化文本程序，用于实现液体混合应用。在这个应用中，操作员可以使用按钮S1和S2向罐中倾倒纯未混合溶液，使用按钮S3制备混合溶液。在罐被填充时，搅拌电机M会运行。操作员观察罐中的液位，并可以通过操作阀门V1排放罐内的液体

**约束：**

1. 按下按钮S1,倾倒液体1

AG(S1 -> AX Liquid1)

1. 按下按钮S2,倾倒液体2

AG(S2 -> AX Liquid2)

1. 液位达到最高位时，关闭S1 ,S2

AG(Max\_Level -> (!S1 & !S2 ))

4.按下按钮S3，关闭S1 S2,开启M电机搅拌，然后开启阀门V1，输出液罐液体

AG(S3 -> AX (!S1 & !S2 & M)) & AG(S3 -> AF valveV1Open))

EN:

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement a liquid mixing application. In this application, the operator can use buttons S1 and S2 to pour pure unmixed solutions into the tank and use button S3 to prepare a mixed solution. While the tank is being filled, the stirring motor M operates. The operator observes the liquid level in the tank and can operate valve V1 to discharge the liquid from the tank.z

Constraints:

1. When button S1 is pressed, pour liquid 1.

2. When button S2 is pressed, pour liquid 2.

3. When the liquid level reaches the maximum level, turn off S1 and S2.

4. When button S3 is pressed, turn off S1 and S2, start the stirring motor M, and then open valve V1 to discharge the liquid from the tank.

**Sequential Motor Control**

编写一个独立的IEC 61131-3结构化文本程序，用于实现顺序电机控制。按顺序操作电机。总共有3台电机需要控制，每台电机将按顺序启动，例如电机1首先启动，然后经过一段时间延迟，电机2启动，再经过一段时间延迟，电机3启动。因此，整个操作需要10秒来按顺序启动所有电机。

**约束：**

1. 两个电机不能同时启动

AG !(start\_motor1 & start\_motor2) & AG !(start\_motor1 & start\_motor3) & AG !(start\_motor2 & start\_motor3)

1. 电机顺序启动

G (start\_motor1 -> F start\_motor2) & G (start\_motor2 -> F start\_motor3)

G (!start\_motor2 U start\_motor1) & G (!start\_motor3 U start\_motor2)

1. 启动时间总计十秒内（LTL）

AG (time\_delay1 + time\_delay2 + time\_delay3 <= 10)

**EN:**

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement sequential motor control. Operate the motors in sequence. There are a total of 3 motors to be controlled, and each motor will start in sequence, e.g., Motor 1 starts first, then after a delay, Motor 2 starts, and after another delay, Motor 3 starts. Thus, the entire operation takes 10 seconds to start all motors sequentially.

Constraints:

1. Two motors cannot start simultaneously.

2. Motors must start in sequence.

3. The total startup time must be within 10 seconds.

**Two Way Switch Logic**

编写一个独立的IEC 61131-3结构化文本程序，用于实现双向开关逻辑。在双层住宅中，一楼和二楼之间有一个楼梯，人们需要从一楼到二楼，或者从二楼到一楼。楼梯旁边各有一个按钮。用户可以在楼梯底部或顶部开关灯的开关。

**约束：**

点击任意按钮都改变电灯开关状态 (关->开，开->关，一楼和二楼的开关功能一样)

AG((switch1State != switch2State) -> lightOn) & AG((switch1State = switch2State) -> !lightOn)

EN:

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement two-way switch logic. In a two-story house, there is a staircase between the first and second floors, and people need to move from the first floor to the second floor or vice versa. There is a light switch next to the staircase. Users can toggle the light switch at either the bottom or the top of the staircase.

Constraints:

Clicking any button changes the state of the light switch (off -> on, on -> off, with the switches on the first and second floors functioning the same way).

**water pump**

编写一个独立的IEC 61131-3结构化文本程序，用于实现一个水泵。考虑一个用于储水的储罐和一个用于填充储罐的水泵。使用一个水平传感器来检测高水位。使用启动按钮PB来启用电机，以便我们可以向储罐中注水；停止电机我们使用停止按钮PB。高水位传感器用于检测水位，当储罐充满时，高水位传感器会被激活并停止水泵。为了实现这个序列，我们将使用SET和RESET指令来锁存和解锁水泵。我们可以通过使用继电器来构建这个电路。有一个用于排放储罐的排放阀。

**约束**：

1. 高水位时不能注水

AG (high\_level -> !pump\_on)

1. 未锁定状态下按下START PB按钮启动电机

AG (start\_pb\_pressed & !locked -> AX pump\_on)

1. 未锁定状态下按下STOP PB 按钮关闭电机

AG (stop\_pb\_pressed & !locked -> AX !pump\_on)

1. Set用于锁定电机

AG (set\_instruction -> AX locked)

1. reset用于解锁电机

AG (reset\_instruction -> AX !locked)

EN:

Requirement: Write a standalone IEC 61131-3 Structured Text program to implement a water pump. Consider a water storage tank and a pump used to fill the tank. A level sensor is used to detect the high water level. A start button (PB) is used to enable the motor so that we can fill the tank with water; a stop button (PB) is used to stop the motor. The high-level sensor detects the water level, and when the tank is full, the high-level sensor is activated and stops the pump. To implement this sequence, we will use SET and RESET instructions to lock and unlock the pump. This circuit can be built using a relay. There is also a drain valve to empty the tank.

Constraints:

1. Water cannot be pumped into the tank when the high water level is reached.

2. Pressing the START PB button in an unlocked state starts the motor.

3. Pressing the STOP PB button in an unlocked state stops the motor.

4. SET is used to lock the motor.

5. RESET is used to unlock the motor.

**absolute value**

Write a self-contained function block in 61131-3 to take the absolute value of the input value.

**约束**：

返回值始终大于0

AG(output >= 0)

验证：

instance.returnValue >=0

EN:

Requirement: Write a self-contained function block in IEC 61131-3 to take the absolute value of the input value.

Constraint: The return value is always greater than or equal to 0.