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Report: LAB 01

Task 1:

Model-based desing is a development process that enables fast and cost-effective development of dynamic systems. In this process, a system model is at the center of the development process, from requirements development through design, implementation, and testing.
Model-based design provides a common design environment, which facilitates general communication, data analysis and system verification between development groups. Engineers can also locate and correct errors early in system design and, another important advantage, is the facilitation of design reuse.
In model-based design of control systems, development is manifested in these four steps:

1. **Plant modelling**: it can be data-driven or based on first principles and consists in choosing a mathematical algorithm with which to identify a mathematical model of processed raw data of a real-world.
2. **Controller analysis and synthesis**: the mathematical model obtained in the previous step is used to identify dynamic characteristics of the plant model. A controller can then be synthesized based on these characteristics.
3. **Simulation**: Simulation allows specification, requirements, and modeling errors to be found immediately and to be fixed as soon as possible. Simulation usually is offline and real-time.
4. **Deployment**: an iterative debugging process is carried out by analyzing results on the actual target and updating the controller model after which the deployment is done.

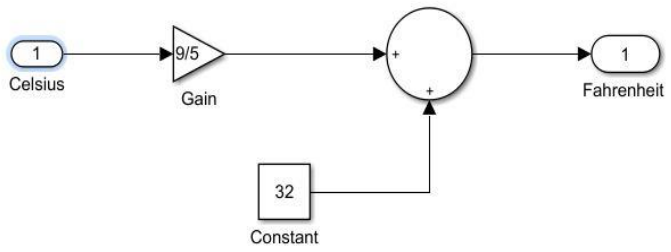
Task 2:

Given the formula used to convert temperature from Celsius to Fahrenheit

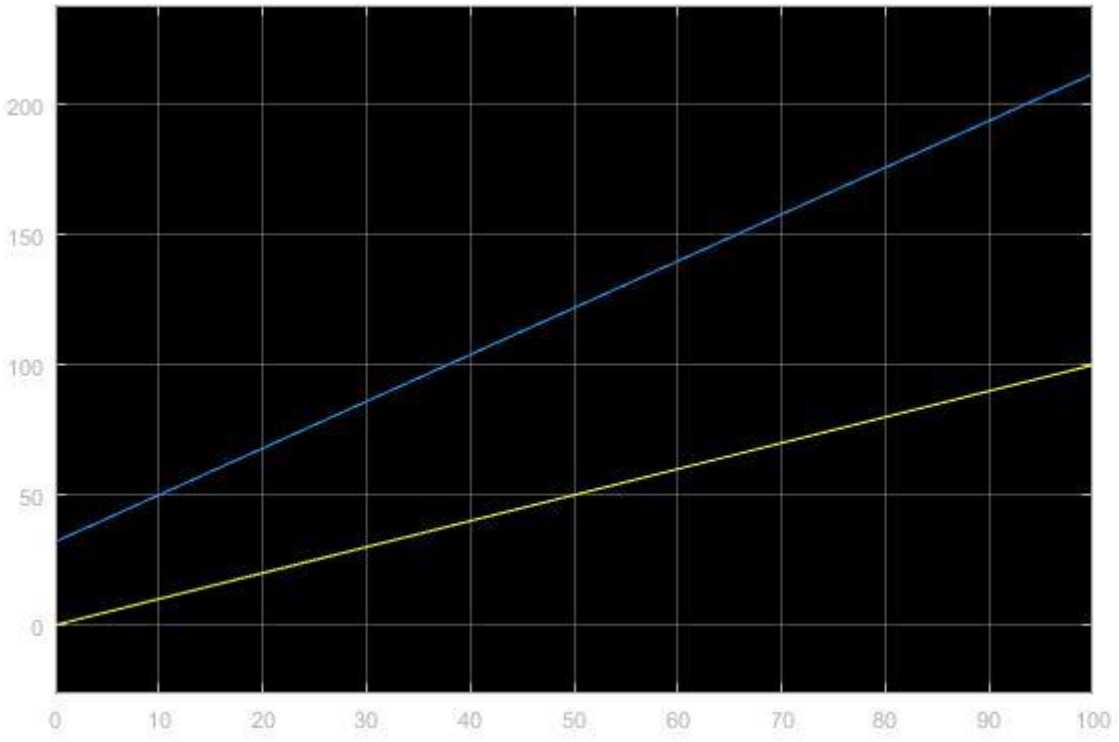
$$T(°F) = T(°C) \times 9/5 + 32$$

I need these blocks from Simulink:

- In1: an input port for the Celsius temperature;
- Out1: an output port for the Fahrenheit temperature;
- Constant: output the constant value 32;
- Gain: to multiply the input value by the value (9/5);
- Sum: to sum 32 by the output of the Gain block.



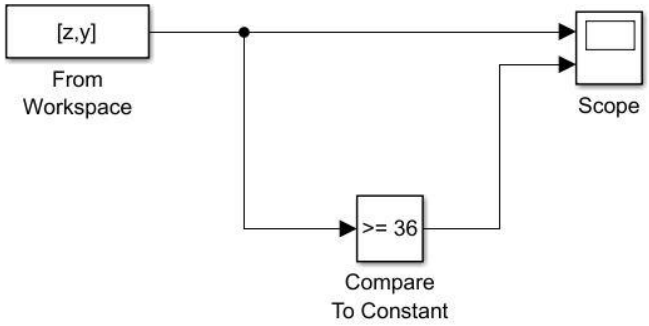
Here the simulation of the model using the Scope block connected to the output port and, as input, a Ramp block. The blue line is, as expected, the conversion to Fahrenheit temperature given the yellow line as input.



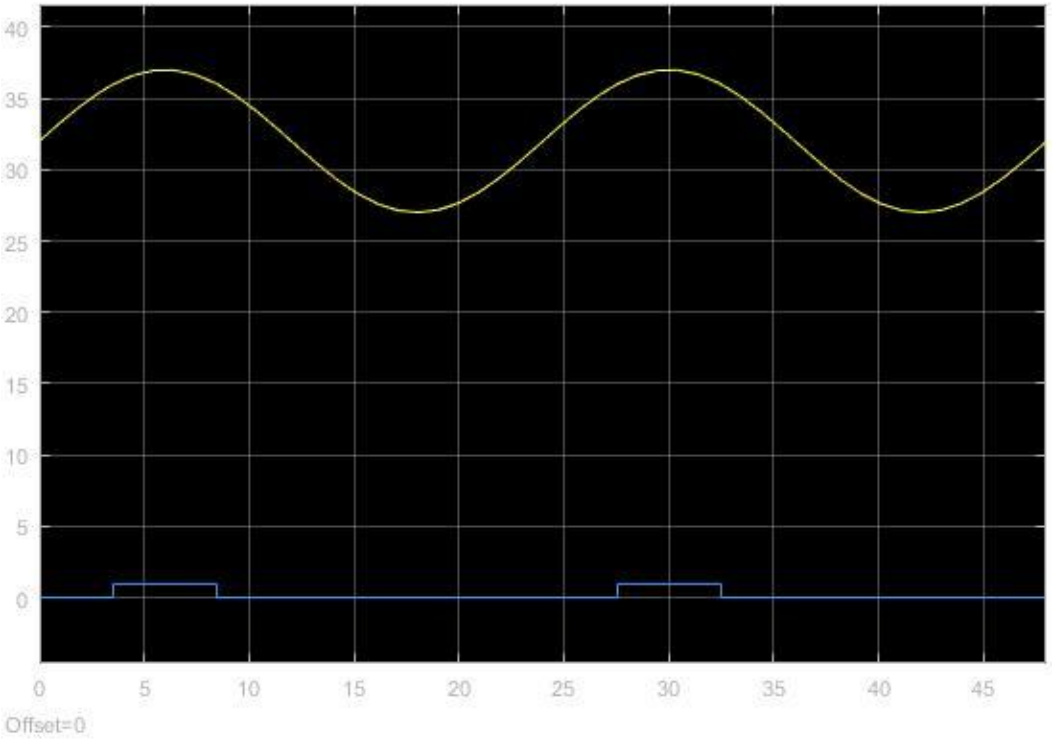
Task 3:

I need these blocks from Simulink:

- From workspace: is able to read 2 columns-array from the workspace(one column representing time (z) and the other one representing temperature data (y));
- Compare to constant: used to compare the data with the constant value 36;



This is the plot of the output (blue line) with the input data (yellow line). The blue line is 1 when the input is bigger than 36.

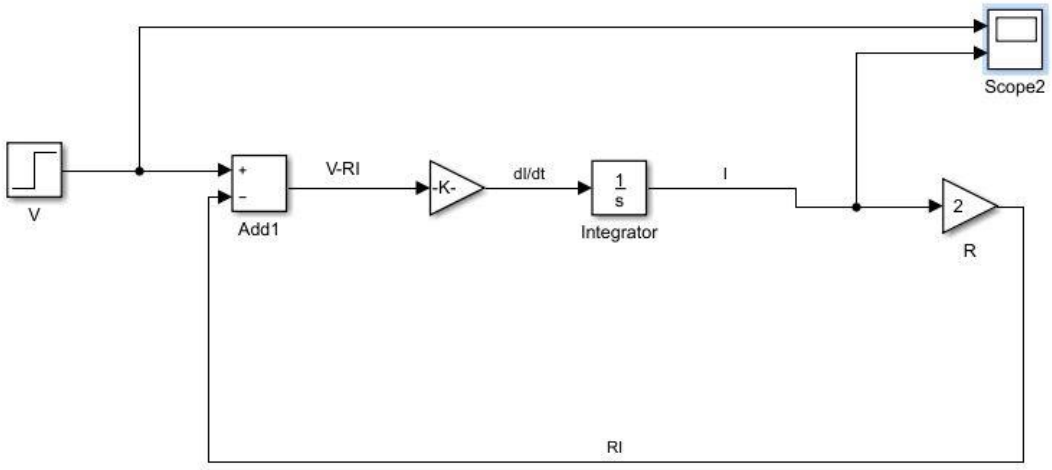


Task 4:

I avoid to use a Derivative block for the inductor´s voltage calculation, that can introduce discontinuities into your system. The inductor voltage is the sum of the voltage source and the resistor voltage.

$$V_L = L\frac{di}{dt}$$

$$L\frac{di}{dt} = V_{AC} - Ri$$



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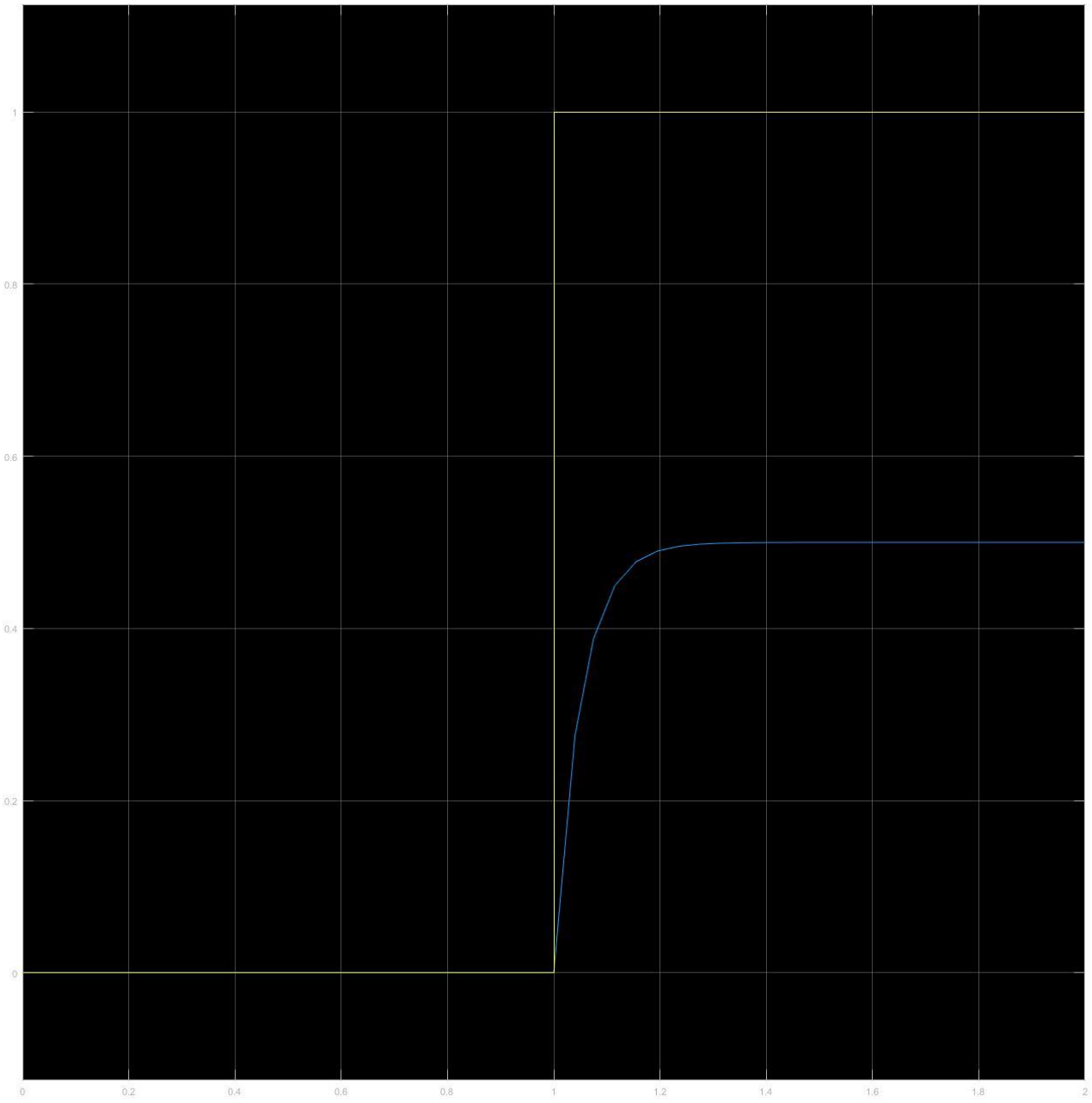
This is the plot where the yellow line is the input (a step function) and the blue line is the current.



References

https://en.wikipedia.org/wiki/Model-based_design
https://se.mathworks.com/help/simulink/ug/best-form-mathematical-models.html