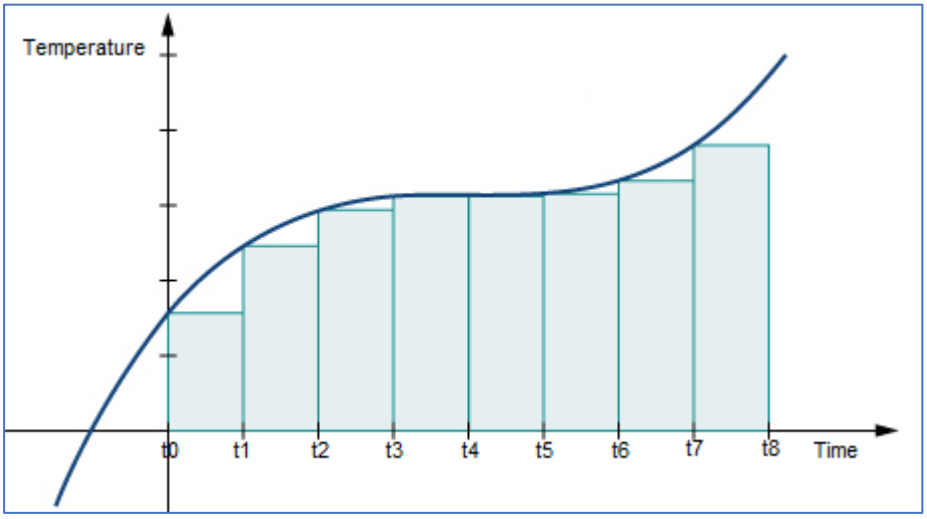
ES T3, Applying Queues

Extend the program of last week:
In the previous version of your program, a new thread is created, every time when a Scene is started, and that thread reads the steps of the Scene directly from the array in which the Scene is stored. This has as a consequence that a Scene can not be redefined while it is being executed.
In the Mutex assignment, we fixed that problem with a Mutex.
In this assignment, we will fix that same problem by using a Queue:

1. When a new thread is created to execute a Scene, the steps of that Scene should be sent to that thread through a Queue (so the thread will not access the Scene-array directly anymore, but get the steps from the Queue).
   Don't forget to delete the Queue when it is not needed anymore.
2. Is your program now completely thread safe? In other words: will it always work well, no matter at which moment the Scene is being redefined?

The following is optional:
Next, we want Scenes to be started when it has been warm for a longer time during a day; so we use the input from a temperature sensor.

3. Make a timer that generates an interrupt in a regular rate.
   In each interrupt, the ISR must read the current temperature from a temperature sensor, and put that value in a Queue.
4. Also make a thread that reads the temperature values from this Queue.
   As long as there is no value to be read, this thread must be Blocked (in a call to osMessageQueueGet).
   Every value must be processed, in such a way, that we calculate the integral of the temperature over the day, like shown in the figure below.



   So we take a temperature sample at times t0, which is T(t0), a sample at time t1, which is T(t1), a sample at time t2, which is T(t2), etc. If we assume that the time between 2 samples is 1 minute, then the integral can be approximated by calculating:
   Integral = T(t0)*60 + T(t1)*60 + T(t2)*60 + …
   The calculation of this Integral should be reset every day at midnight (for testing purposes, you might want to do that faster, like every 5 minutes).
5. Make it such that this thread starts a specific Scene, as soon as the value of the Integral reaches some predefined value.

This is the final version of your program, so this will be graded.

Extend your document with the following:

- Explain how you applied the Queue in step 1 (and optionally that for step 2).
- Answer the question in step 2.
- Explain how you did steps 3, 4 and 5.
- How did you test the extra functionality?
- Explain how the work for these 3 assignments was divided in the group.
- Any special problems you had, and how you solved them.
- If there are things that you could not implement, or that did not work well, mention that also.
- Optional: describe any special things that you added to the application, which were not mentioned above.