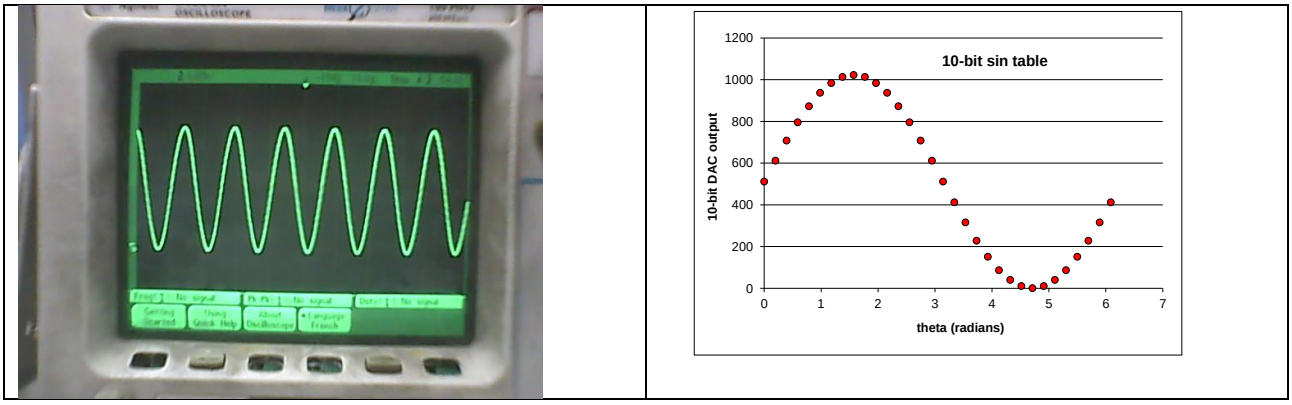
Computer Architectures **02GOLOV [AA-LZ]**	Delivery date: Wednesday 4/11
Laboratory **6**	Expected delivery of lab_06.zip must include: - zipped project folder of the exercises 1 and 2 - this document compiled possibly in pdf format.

Starting from the *ASM_template* project, solve the following 2 exercises.

Exercise 1) In a digital system, the sound can be obtained by repeatedly feeding a speaker component with a sampled sinusoid.

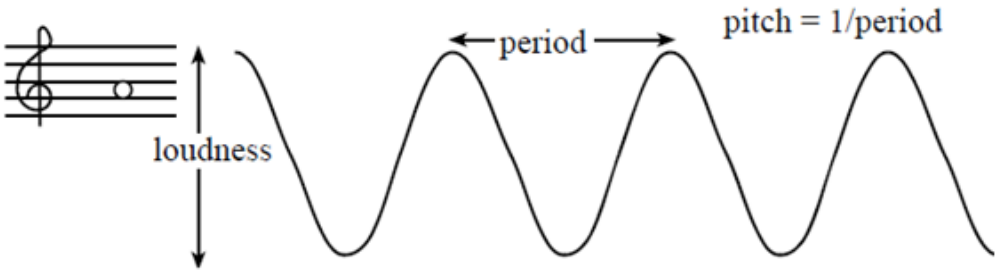


The sinusoid shown on the left-hand side above is continuous and recorded by an oscilloscope from an analogue source. In processor-based systems, as they process digital information, a sinusoid can be only stored per discrete points. The digitization of analog signals involves the rounding off of the values which are approximately equal to the analog values. The method of sampling chooses few points on the analog signal, and then these points are merged to round off the value to a near stabilized value. A kind of digitalization process is show on the right-hand portion of the picture above.

A digitalised sinusoid can be memorized as a set of unsigned constant values on 16 bits in the code section (as a part of the code itself). These values could be then used later, for example by sending them to a speaker at a regular interval. A given note is determined by the frequency of the sinusoid: for example, the Middle A note is obtained **by sending the whole set of values** within a period of 2.27ms.

```
Sin0  DCW    512,  612,  708,  796,  873,
             937,  984, 1013, 1023, 1013,
             984,  937,  873,  796,  708,
             612,  512,  412,  316,  228,
             151,   87,   40,   11,    1,
              11,   40,   87,  151,  228,
             316,  412
```

While the note (or tone) is determined by the frequency, the loudness is related to the amplitude of the wave.



Write an assembly program that is able to identify the maximum and minimum values of the sinusoid. Please respond to questions in the following box.

Report your reasoning and formulas for both questions

Q1: Determine the volume (or loudness level) with respect to the 100% that can be reached by the sampled sinusoid, assuming a codification with 12 bits.

Rapporto=2^{12}-1 /1022=4 → volume Massimo con 12 bit è il 400% del volume dell'onda di partenza
→ l'onda di partenza ha un volume pari al 25% del volume massimo

Q2: At which frequency **every single sampled value** needs to be sent to the speaker to emit the Middle A note?
1/2,27ms=440,52Hz

Exercise 2) Create a new project by starting from the previous exercise.

The extended program has to manipulate the samples provided in exercise 1), by scaling them in order to reach a 50% volume when the range is described with 10 bits. The resulting alternative sinusoid have to be stored in a proper *readwrite* area.

Report the requested values in the table below.

	Execution time @12MHz	Code size	Data size
Exercise 1)	0.00004	564	204
Exercise 2)	0.000033	564	268

Respond to the following open questions.

Q1: what section have you used to store the new sequence?
I've used data readwrite section

```
AREA dati,DATA,READWRITE
```

Q2: Which address range is assigned to this section and which memory of the system is used?
Address range [0x10000000,0x,1000003F]
Memory used: CODE memory