# Lab 4
# Microprocessor Architectures [ELEC-H-473]
# Tessellated Intelligence System

v1.0.0

## Introduction

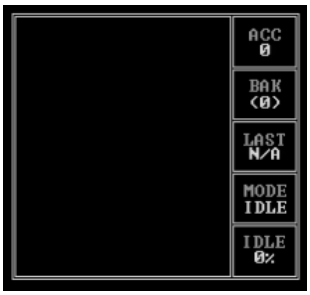
Using an exclusive architecture, we want to show you:
- how to train to quickly digest a new architecture documentation and get productive quickly;
- how to optimize your code under heavy hardware constraints;
- that it is possible to learn and play at the same time.

What you will need:
- A copy of TIS-100
  - DRM-free from the lab network drive.
  - DRM-free and Steam key from Humble Bundle.
- The TIS-100 reference manual
- RTFM

## 1 Tessellated Intelligence System: TIS-100

You are a system engineer charged with completing a set of task on an old computer: the TIS-100. Its architecture is composed of twelve interconnected nodes that can exchange data with their direct neighbours. Each node can be one out of the three possible types:
- Regular computing node
- Memory stack node
- Corrupted and unusable node

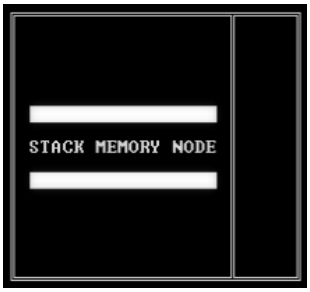
### 1.1 Computing node




The node is composed of a 15-lines programmable area surrounded by its register and various information. It has two registers: `ACC` and `BAK`, the former being directly addressable whilst the later is not and can only be modified using the `SAV` and `SWP` commands. The `LAST` register tells you which port has been used last, `MODE` what the node is doing and `IDLE` the percentage of time the node has spent doing nothing.

Using the `MOV` instruction, it can communication with the surrounding computing or memory stack nodes.

### 1.2 Memory stack




The memory stack node, as its name indicates is a stack in which the first element added is the last that can be accessed. Such a structure is also called "last in, first out", or LIFO.

The content of the node can be accessed using the `MOV` instruction.

### 1.3 Instruction set

The instruction set only contains a handful instructions such as addition, substraction and a bunch of comparison against zero. The full set is detailed in the reference manual, but the general idea is

```
<instruction> <source>, <destination>
```

Please note that although the reference manual says so, there is no "model-specific manual" nor "Tessellated Intelligence System Best Practices *" extra documents.

### 1.4 Use custom specifications

The game comes with a bunch of levels you need to solve in order to complete the game. However, you can also create your own levels using the specification editor.

You can import custom levels by copying the corresponding `.lua` files into the right folder depending on your operating system:

- `My Documents\My Games\TIS-100\<UID>\custom`
- `$HOME/.local/share/TIS-100/<UID>/custom`

where `<UID>` is either `0` if you are using the DRM-free version of the game or your Steam ID if you are playing on Steam.

For this lab, you will need to import three levels:

- "Decode the image" (`14173819.lua`)
- "Coprime detector" (`69396829.lua`)
- "Multiplication" (`73121466.lua`)

## 2 Assignment

We ask you to solve two custom levels: "Decode the image" and "Coprime detector". The grade will be based on the performance of all the submissions and weighted across the three measures: node, instruction and cycle count. If you performed better than all the other groups for at least one of the three performance measures, you will get a perfect grade for the exercise, that is two out of two. Otherwise, you will be awarded one point if the problem is solved and the second point will be weighted against all submissions (e.g. if you performed the worst in all three measures, you won't get any point, if you are right at the average, you will get half a point).

We will not disclose the performance of the submissions before the last group has sent us his submission, as you are not all synchronized.

We strongly advise you to first train on the pre-existing levels of the game before tackling the custom specifications. You should get the hang of it by the end of the fourth level: "Signal comparator".

**You will need to send us two .txt files, one for each solution.**

Those save files can be found in:

- `My Documents\My Games\TIS-100\<UID>\save\<solution_file>`

🐧 `$HOME/.local/share/TIS-100/<UID>/save/<solution_file>`

where `<solution_file>` follows this syntax: `SPEC<specification ID>.<solution number>.txt`.

For example, a solution to the "Decode the image" problem can be found under the name `SPEC14173819.0.txt`.

Do *not* change the file name when sending it to us. If you are not sure you are selecting the right file, just open it and check its content.