LAST NAME(s) *(Capital letters)*			
FIRST NAME *(Capital letters)*			
NIA		DNI	

INSTRUCTIONS FOR THE EXAM.

- Read these instructions carefully before starting the exam.
- Do not forget to write your name in every answer sheet.
- Pay attention to what it is asked in each question and/or problem, given that it is not the same: to explain, to list, to describe, to define, etc., always, sometimes, at least.
- You can use two sheets including notes, algorithms, equations, etc.
- **The duration of the exam (Test + problems) is 3 hours.**

Problem 1 (2.5 points)

Recommendations:

- Read the formulations of the problem in detail before answering.
- You must include a detailed justification of your answers.

Given the following grammar:

G = (Σ_T, Σ_N, S, P) with Σ_T = {0, 1}; Σ_N = {S, A, B, C, D, E, F}
P = {
S ::= λ | 0S | 1A
A ::= 1F | 0B
B ::= 0S | 1F | 0C
C ::= 0C | 1D
D ::= 0D | 1E
E ::= 0DD | 11D
F ::= 1A| 0B
}

1. Apply the necessary minimum changes to the grammar (i.e. to clean, to well-form, to transform into a right-linear G3) to obtain an equivalent Deterministic Finite Automaton (this is required in the following section).
2. Obtain this Deterministic Finite Automaton based on the grammar obtained in the previous section.

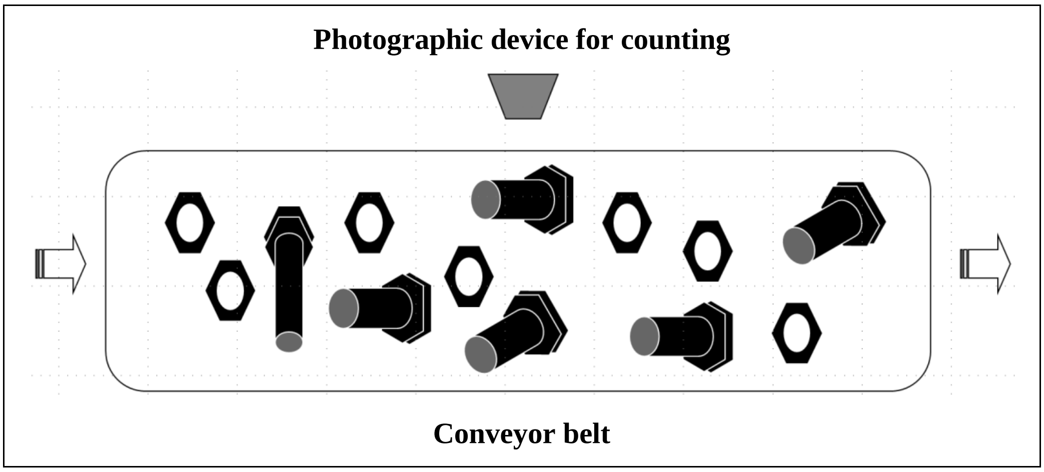
    Note: The DFA must be specified by means of the transitions diagram (i.e., a graph, and not through the transition function or table). In addition, the diagram must include all the states and transitions. If not, the answer will be considered wrong.

3. Minimice the DFA obtained.
4. Indicate the set of words of length less or equal to 4 recognized by the DFA.
5. Describe the language generated by the grammar of this problem. Justify your answer.

Problem 2 (2 points)

A factory produces a kit for mounting bookshelves that contains screws and each screw has its corresponding nut.

This factory has decided to develop a photographic device that ensures that informs that there is an **excess** of nuts (with regard the number of screws) before the packaging process starts.



1. Formalize and explain the problem, setting it in the Chomsky Hierarchy, from the point of view of the language and the corresponding automaton to build the described device. Indicate the alphabet, describe the language, indicate the type of grammar (of the most restricted level) that would generate the language, and what type of Automata/Machine would recognize this language.

2. Design the Automaton/Machine, corresponding with the most restricted level of the Chomsky Hierarchy, which provides its approval when the number of nuts is in excess.

Problem 3 (2.5 points)

a. Given the following grammar G= ({a,b},{S,A,B}, S, P) with P:

S ::= Aba

A ::= a

Ab ::= AAbA | ABb | AbB

B ::= A | AB

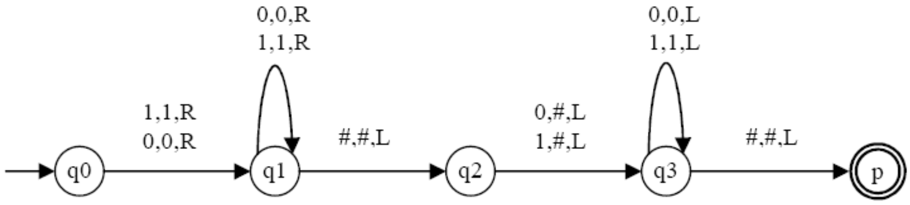
a.1. Which is the type of grammar? Explain in detail.

a.2. Define the language generated by means of a regular expression.

a.3. Prove that it is an ambiguous grammar.

a.4. Explain in detail if it is possible to represent this language by means of the following formal machines and structures: a Pushdown Automaton, a Deterministic Finite Automaton, a Turing Machine, a Type-3 grammar.

b. Given the following Turing Machine



TM = $(\{q_0,q_1,q_2,q_3\},\{0,1\},\{0,1,\#\},\delta,q_0,\{p\})$

b.1. Write the transition table.

b.2. Which is the function that the TM carries out? Explain in detail.

b.3. Show the sequence of movements to process the input string “1110”.