ABSTRACT
We overview the basis of Elementary Cellular Automata and Wolfram’s Classes, subsequently we show a technique known as Memory Based Rule Analysis, to extract complex systems from a family of chaotic discrete dynamical system. Cases of study rules 30 and 126.

KEYWORDS: Cellular automata, elementary cellular automata, memory, complex dynamic, chaos, rule 30, rule 126.

CELLULAR AUTOMATA
Elementary Cellular Automata (CA): Computing model which provides a good platform for studying emergent collective behaviour, complexity, randomness and interaction between order and chaotic systems.

Defined by a four tuple \((G, Z, N, F)\), where:
- \(G\rightarrow\) Grid (Set of cells)
- \(Z\rightarrow\) Set of possible cell states
- \(N\rightarrow\) Set which describes cells neighbourhoods
- \(F\rightarrow\) Transition function (Rules of automata)

Basic characteristics:
- Locality: Each cell can communicate with adjacent cells.
- Parallelism: CA performs computations in a distributed fashion on a spatially extended grid.
- Simplicity: A cell has a simple structure. If \(i^{th}\) cell has to make a transition, it has to depend on own state, left neighbour and right neighbour either.

\[ q_i(t + 1) = f(q_{i-1}(t), q_i(t), q_{i+1}(t)) \]

ECAM, UECAM AND COMPLEX ECAM
Elementary Cellular Automata with Memory (ECAM): A ECA composed with a memory function, i.e. act in a historical mode.
Memory function (MF): Help to discover hidden information in dynamical systems from simple functions (majority, minority, parity) or rules and transform simple and chaotic rules to complex rules or vice versa.

chaotic ECA \(\rightarrow\) complex ECA

Classification:
- **Strong**: MF are unable to transform one class to another.
- **Moderate**: MF can transform the rule to another class and conserve the same class as well.
- **Weak**: MF do most transformations and the rule changes to another different class quickly.

Properties:
- **UECAM**: Able to reach every different class called universal.
- **Complex-ECAM**: Yield a complex ECAM but with elements of the original ECA rule.

WOLFRAM’S CLASSIFICATION

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Homogeneous behaviour</td>
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<tr>
<td>II</td>
<td>Periodic behaviour</td>
</tr>
<tr>
<td>III</td>
<td>Chaotic behaviour</td>
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<tr>
<td>IV</td>
<td>Complex behaviour</td>
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</tbody>
</table>

**TRANSLATION DYNAMICS TO COMPLEX RULES IN ELEMENTARY CELLULAR AUTOMATA FROM WOLFRAM CLASSES**

Estephania Molina Delgado\(^1\) molinaestephania@gmail.com, Genaro J. Martínez\(^1,2\), Andrew Adamatzky\(^2\)

\(^1\)Instituto Politécnico Nacional, \(^2\)University of the West of England