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Reading and Criticizing an Article

Algorithmic Self-Assembly of DNA: Theoretical Motivations and 2D Assembly Experiments by Erik Winfree, J. of Biomolecular Structures & Dynamics, 2000.

Final assignment of the PhD course
"Biomolecular Computing: Theory and Experiments"

Instructor: Natasha Jonoska

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Outline

Contents

- **Target:** Biochemists and Biotechnologists, not Computer Scientists.
- **Content:** Experimental implementation of a simple controlled self-assembly process by biochemical structures.
- **Motivation:** (Potentially) The process can be used to perform any computation (Turing-equivalent model).
- It is a review of the author's previous work with an additional characterization.

Abstract

The author points out:

- the context of the work (DNA based computing);
- the theoretical model that will be implemented (Wang's tiles);
- the mechanism used to implement it (branched DNA constructions);
- the experiments that have been done;
- the relevance of the work in its context.

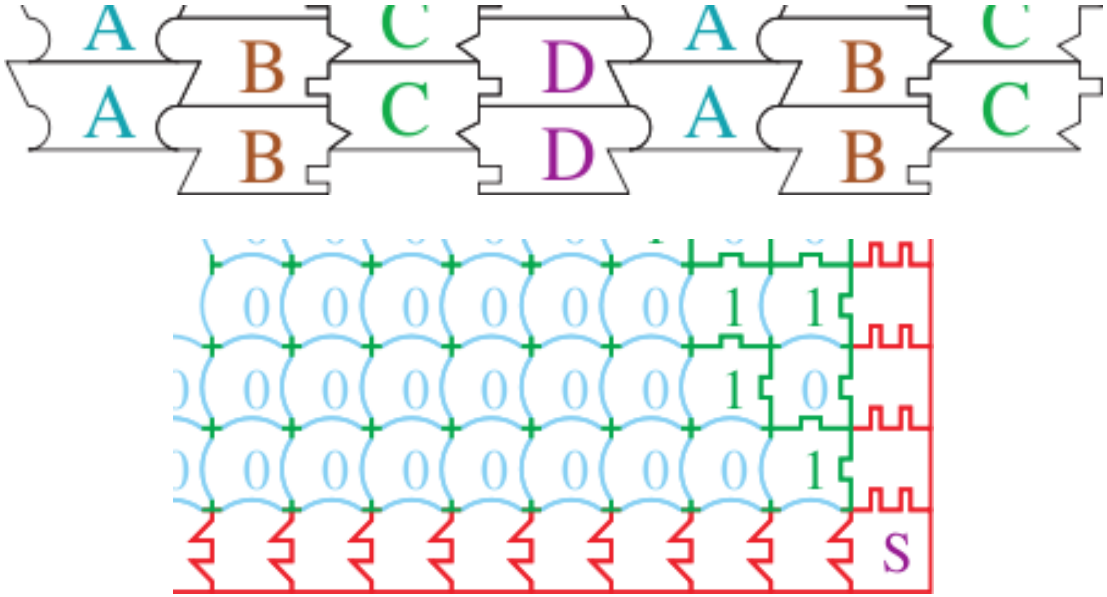
$\Rightarrow$ it is well-written!

Introduction

- The editors require a fixed article structure!
  $\Rightarrow$ the author has little choice.
- Elements:
  - the big "challenge" (to make nano-sized computational devices);
  - retro-perspective of the research achievements (e.g. the Adleman experiment);
  - future applications hypotheses;
  - other possible biological mechanisms.
- Lack of:
  - comparison with other models/methods (pros and cons);
  - explanation of the article structure;
  - anticipation of the results.

Examples

- The *tiling problem* is accurately explained by examples.
- However:



Main Results and Conclusions

Results:

- The description of the experiments and the analyses of the results seem very accurate (at least to a not-expert reader!).
- There is not a clear *interpretation* of the quality of the results (is the mechanism feasible for a more complex simulation?).

Conclusions:

- he presents the aim of the work;
- but he does not discuss the problems that must be addressed in order to perform (useful) computations.

References and Technical Delivery

- **References:** adequate and refer to (quite) recent publications.
- **Technical Delivery:** the style of the document does not facilitate the navigability. Example:

Figure 7: Formation gels for the **A** and **B** double-crossover molecules, run at1°C by 5% non-denaturing PAGE. Every strand is radiolabelled so that

3 Results and Discussion

3.1 Results of Characterization by Gel Electrophoresis

A prerequisite for lattice self-assembly is the formation of the DX units from their component strands. A thorough investiga-

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(My) Conclusions

- The article was written for a particular target audience.
- Because of this, it contains:
  - a extensive description of the experiments (reproducibility);
  - a detailed analyses of the results.
- But it lacks of:
  - a clear interpretation of the results;
  - a comparison with other models/techniques/mechanisms.