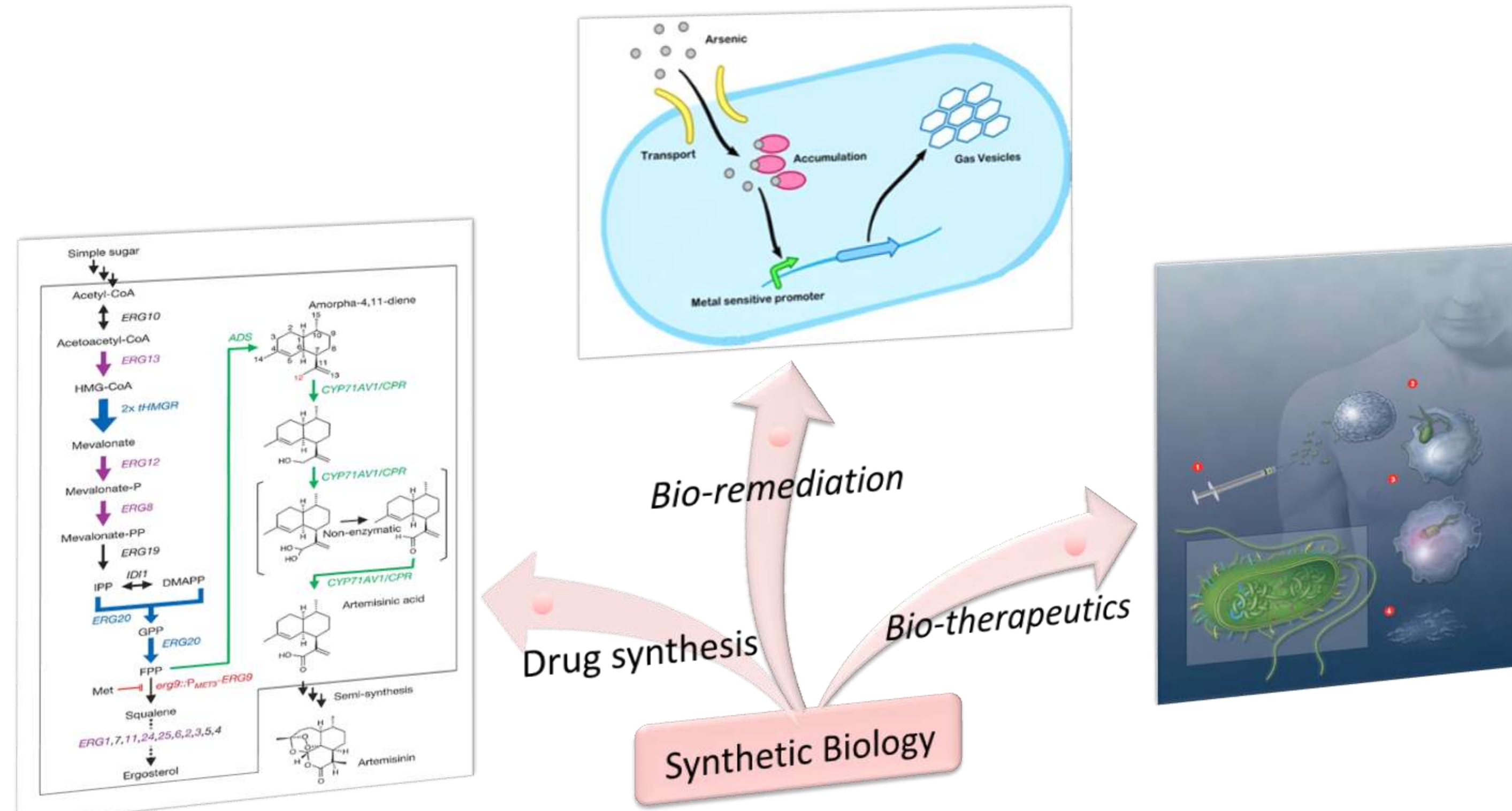


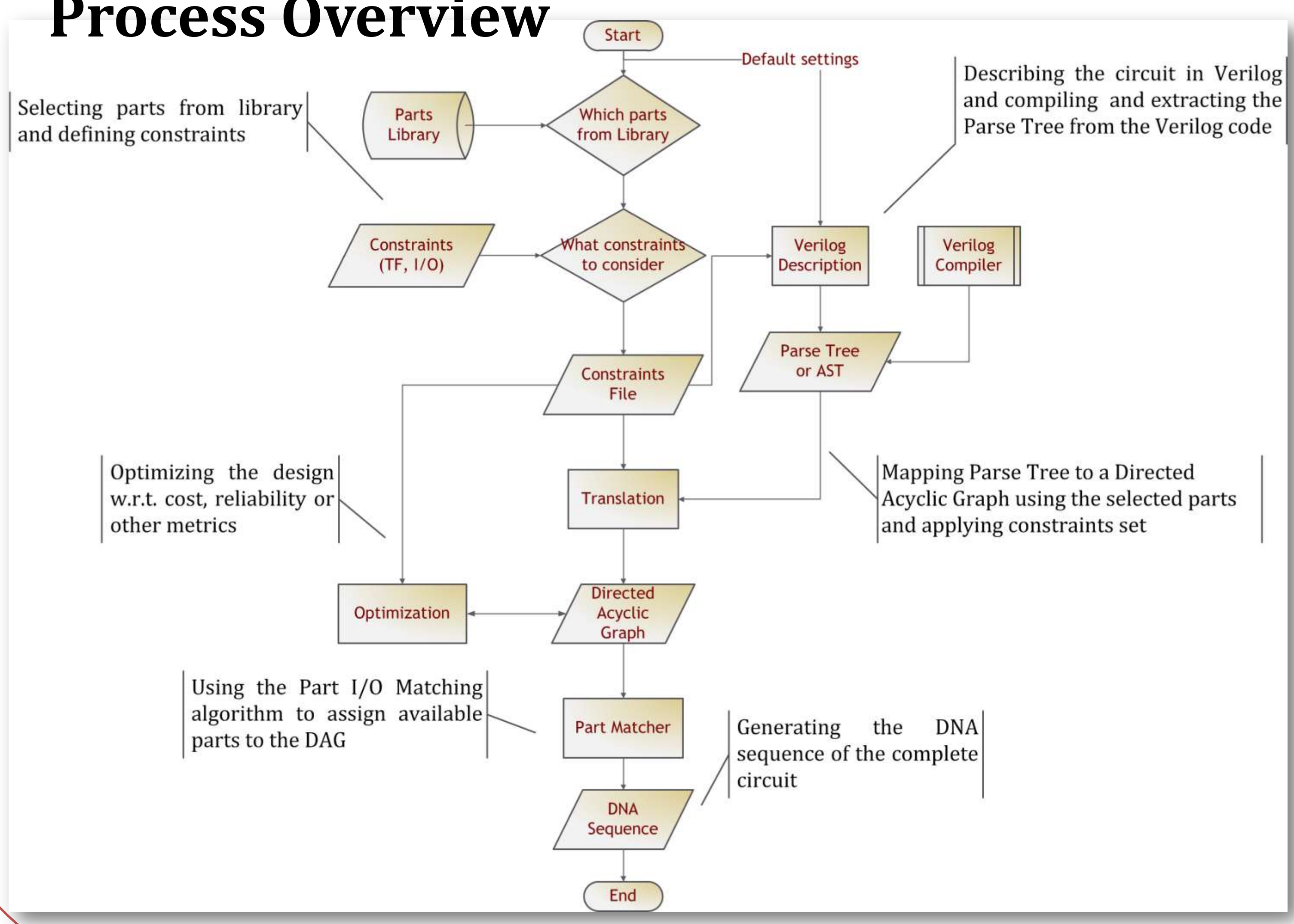
Introduction

Synthetic biology is an emerging field in which biologists engineer complex artificial living systems to investigate natural biological phenomena and implement a variety of applications. Synthetic organisms can be engineered for bio-therapeutic applications, such as to seek out and destroy cancerous tumors, to execute pathways for manufacturing molecules with drug applications that are otherwise difficult or expensive to synthesize, or to produce antibodies with specific targets.



Such applications require the implementation of complex decision-making modules. In electronic circuits, such decision-making is implemented using combinational logic: a network of basic logic gates that can distinguish a particular subset of inputs. The goal of the Cello project is to enable the use of combinational logic, and many of the existing tools to specify the desired behavior, but allow it to be implemented in biological circuits instead of electronic ones. Thus, Cello aims to splice an existing logic circuit design workflow with an existing biological assembly workflow.

Process Overview



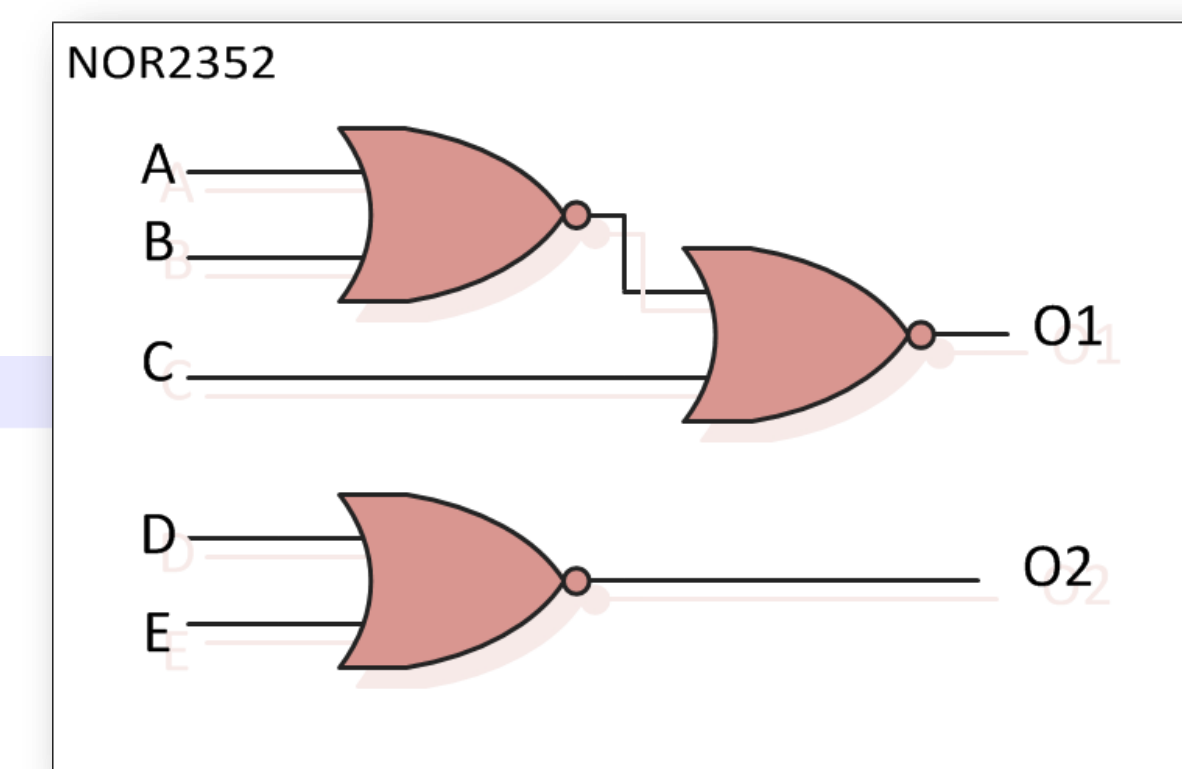
Cello

The proposed methodology is named Cello (Cell Logic). The example case here illustrates a simple circuit with 5 inputs and 2 outputs.

```

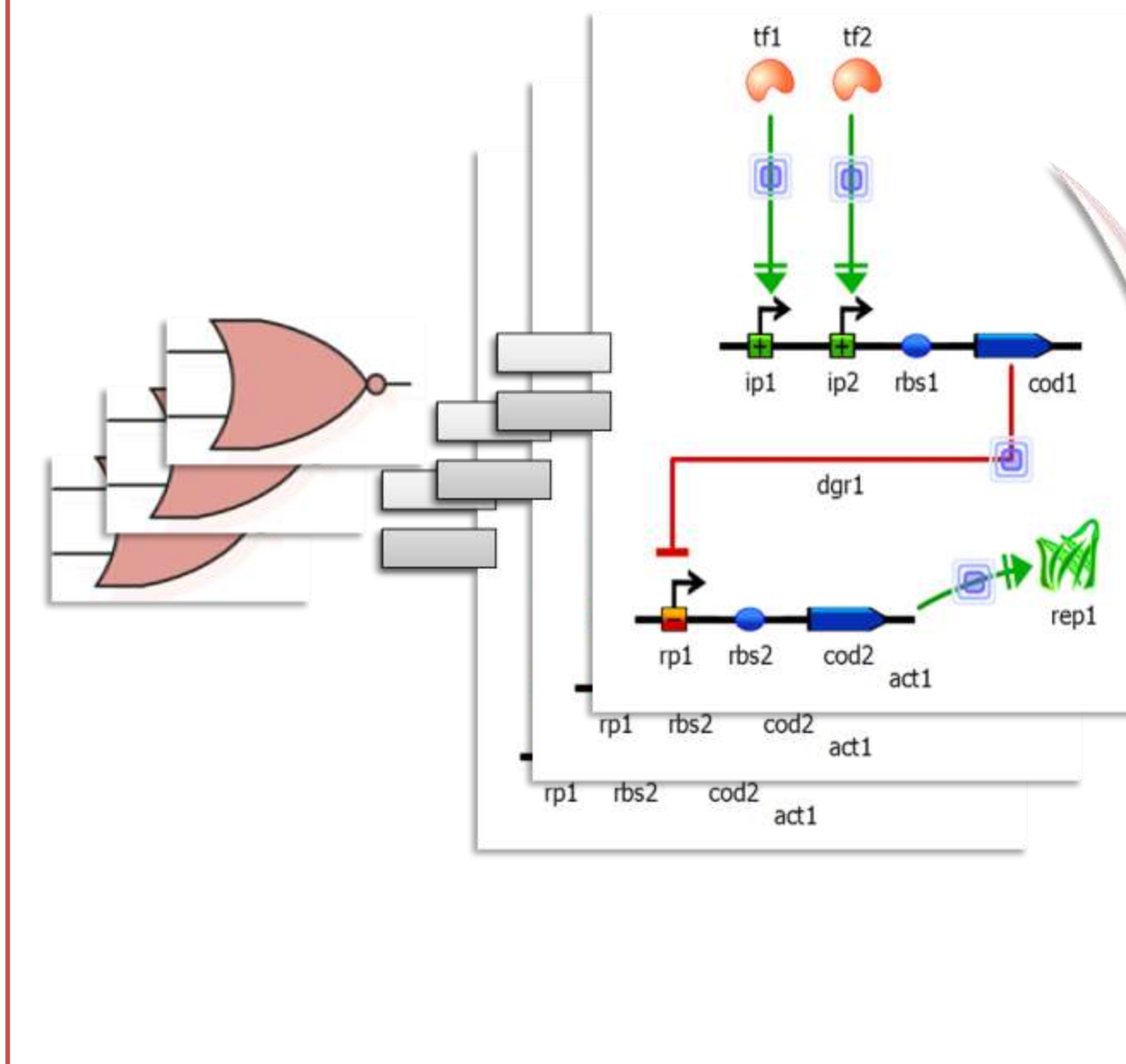
1 module NOR2352 (
2   input A,
3   input B,
4   input C,
5   input D,
6   input E,
7   output O1,
8   output O2
9 );
10
11 assign O1 = ~( ~( A | B ) | C );
12
13 assign O2 = ~( D | E );
14
15 endmodule

```



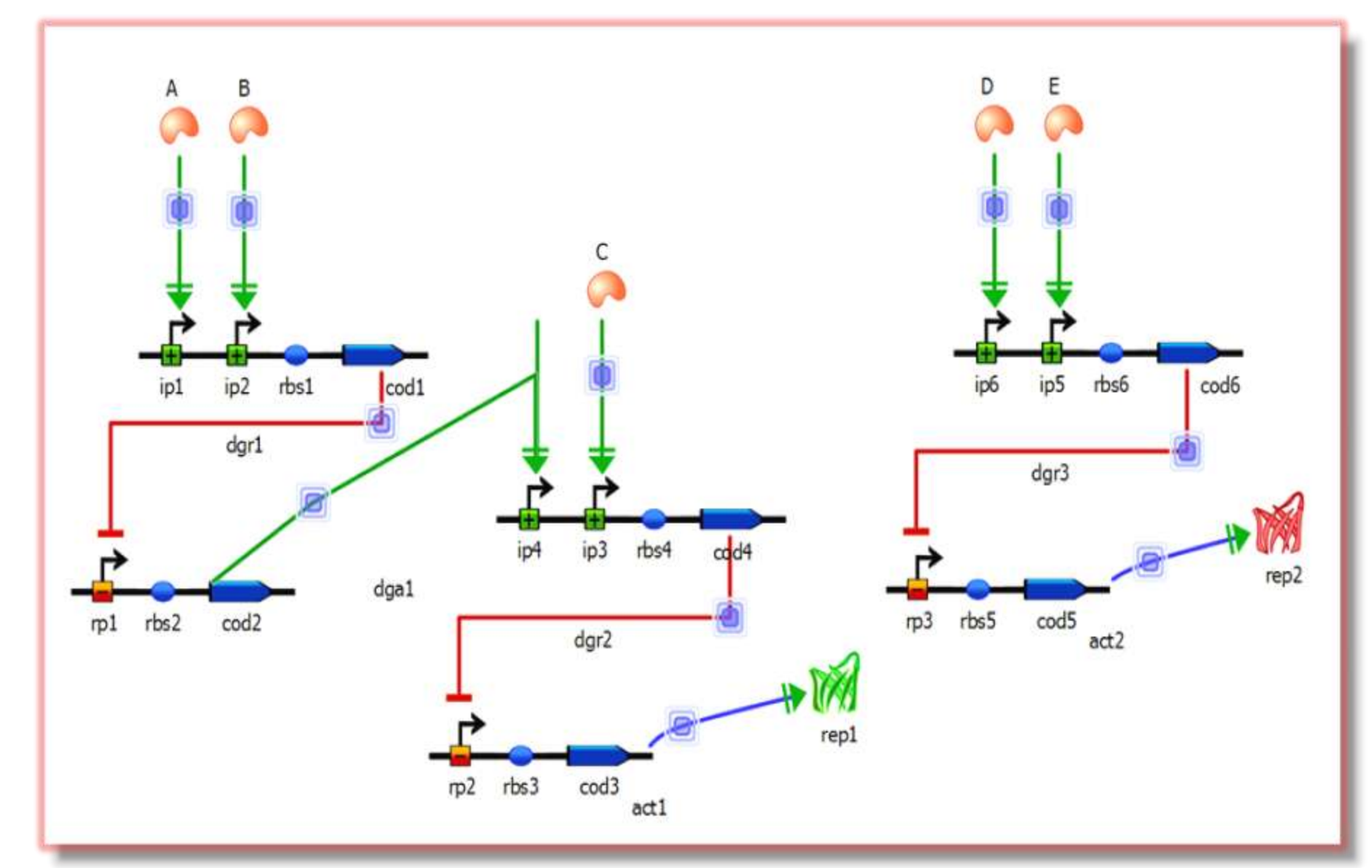
❖ The Verilog description concisely captures the properties of circuit.

❖ Selection of three NOR parts from library

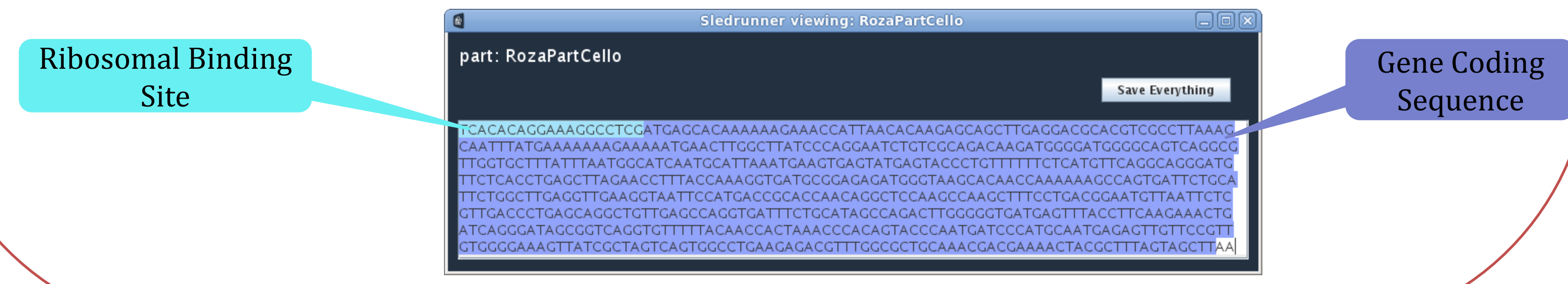


A	B	C	D	E	O1	O2
0	0	0	0	0	0	1
0	0	0	0	1	0	0
0	0	0	1	0	0	0
0	0	0	1	1	0	0
0	0	1	0	0	0	1
0	0	1	0	1	0	0
0	0	1	1	0	0	0
0	0	1	1	1	0	0
0	1	0	0	0	1	1
0	1	0	0	1	1	0
0	1	0	1	0	0	0
0	1	0	1	1	0	0
0	1	1	0	0	0	1
0	1	1	0	1	0	0
0	1	1	1	0	0	0
0	1	1	1	1	0	0
1	0	0	0	0	1	1
1	0	0	0	1	1	0
1	0	0	1	0	1	0
1	0	0	1	1	1	0
1	0	1	0	0	0	1
1	0	1	0	1	0	0
1	0	1	1	0	0	0
1	0	1	1	1	0	0
1	1	0	0	0	1	1
1	1	0	0	1	1	0
1	1	0	1	0	1	0
1	1	0	1	1	0	0
1	1	1	0	0	0	1
1	1	1	0	1	0	0
1	1	1	1	0	0	0
1	1	1	1	1	0	0

❖ The generated abstract Genetic Regulatory Network

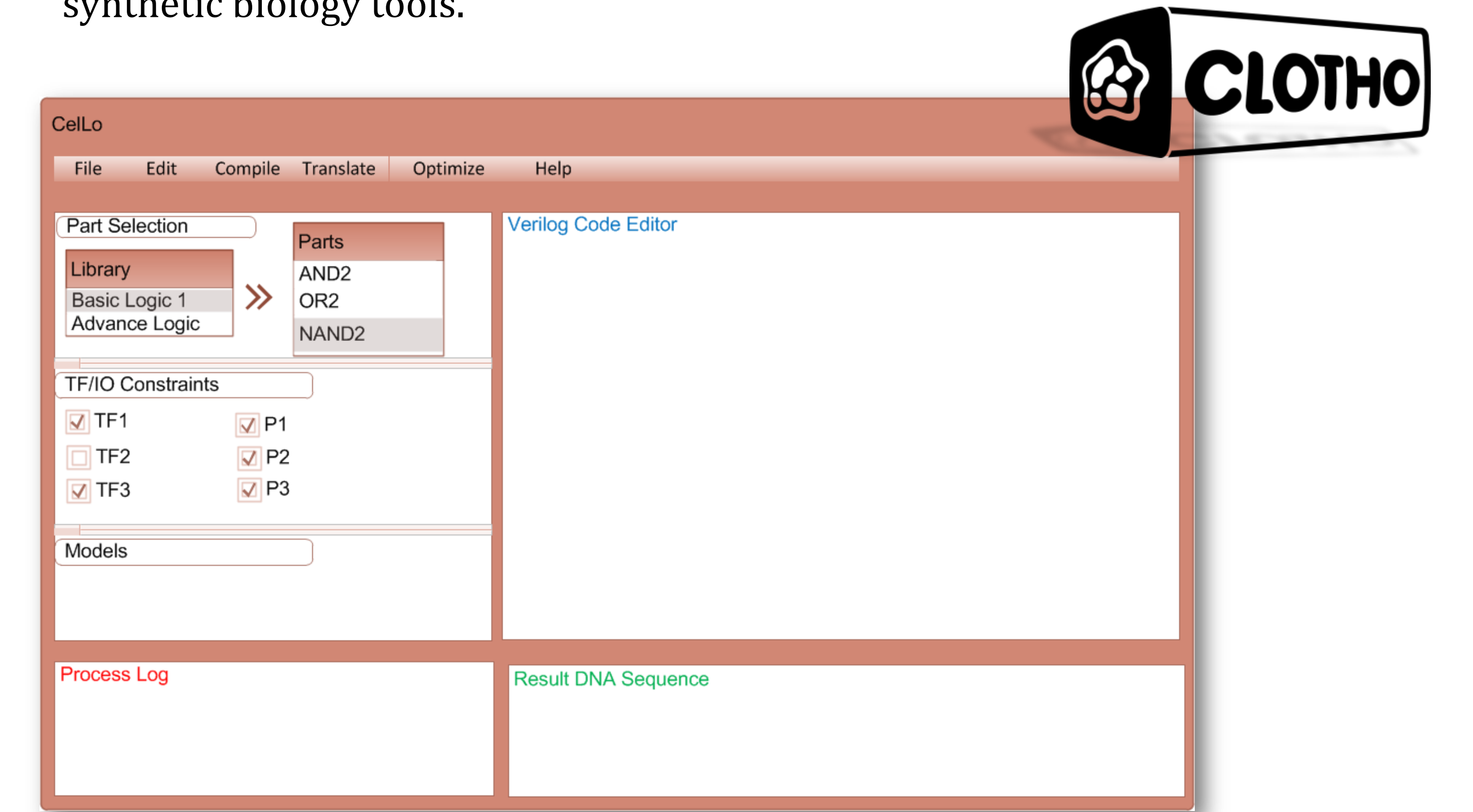


❖ A part of the final network's DNA sequence



Cello GUI

The Cello workflow is implemented as a Clotho app. Clotho (www.clothocad.org) is a portable Java-based open-source software platform, data-model, and API for synthetic biology tools.



Future Work

- Formalizing the "Tech mapping" process
- Constructing circuits using our liquid handling robot and testing their functional behavior
- Creating larger circuits
- Determining Transcription Factor limitations and graph partitioning for inter-cellular communication



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We thank Traci Haddock and Brynne Stanton for their advice and help in the biological lab. We also thank Arthur Sun and James DiCarlo for their help in planning and performing the biological construction and assembly experiments on the robot.

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Heavy Metal Scavengers <http://2009.igem.org/Team:Groningen>

Tumor Killing Bacteria <http://openwetware.org/wiki/SynBERG:TKB>