Supporting the Design of Experiments for Synthetic Biology with Clotho 3.0

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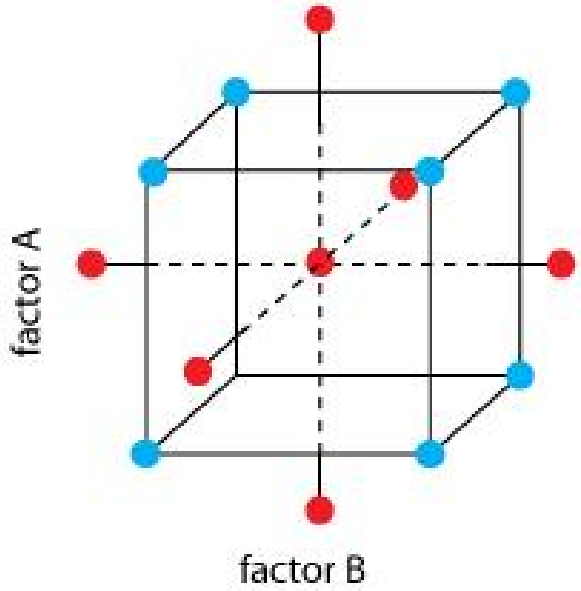
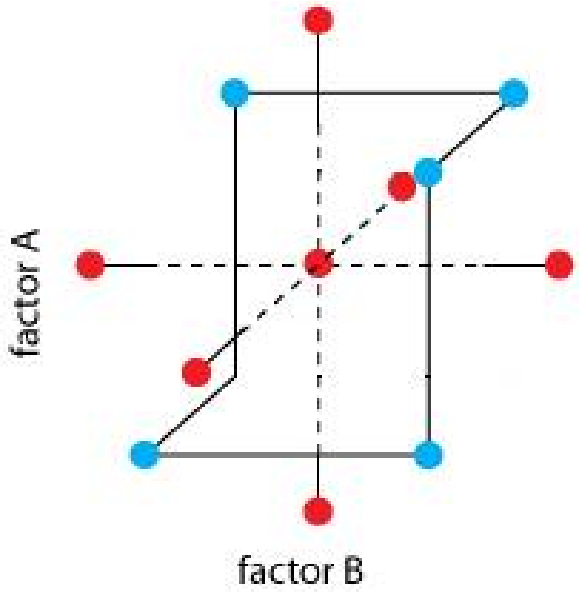
Boston University

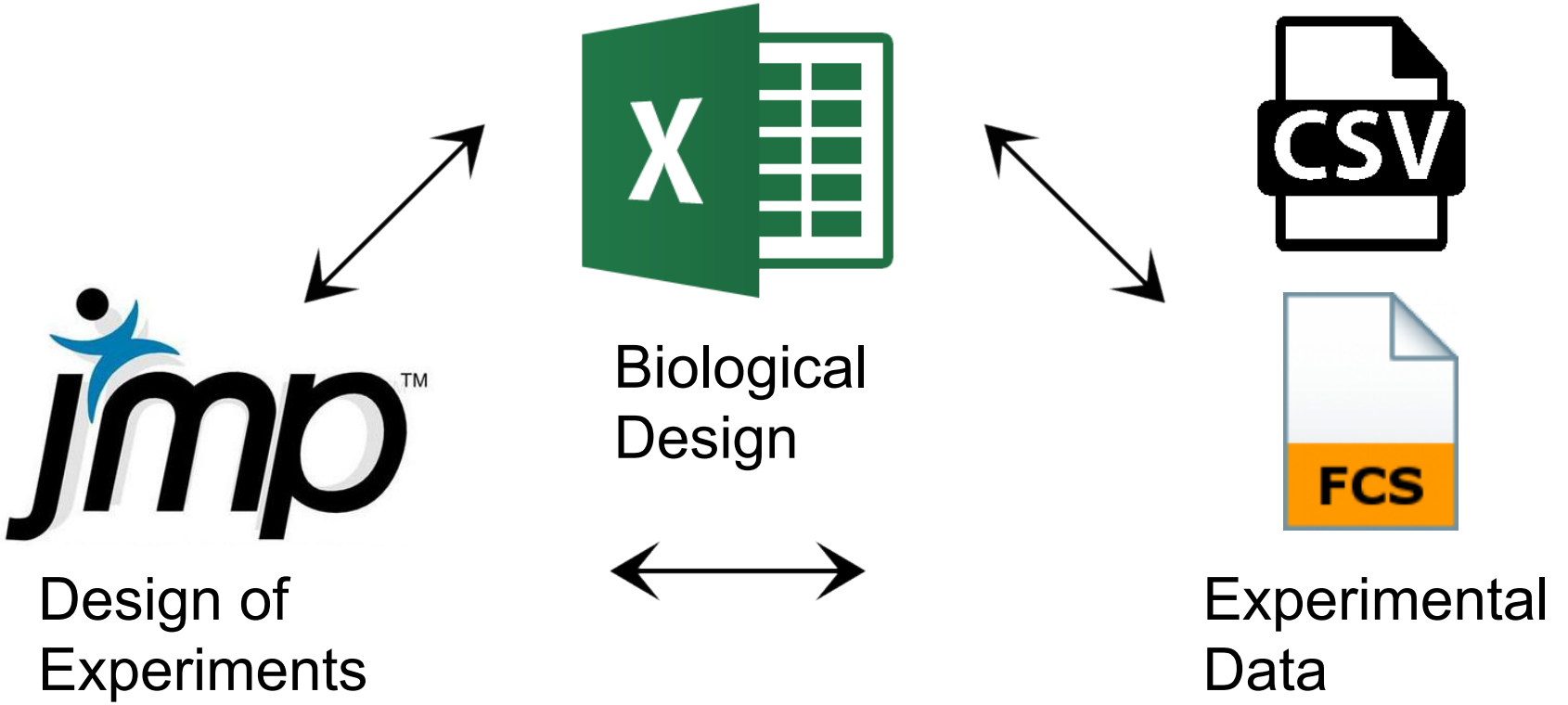
Design of Experiments (DOE)



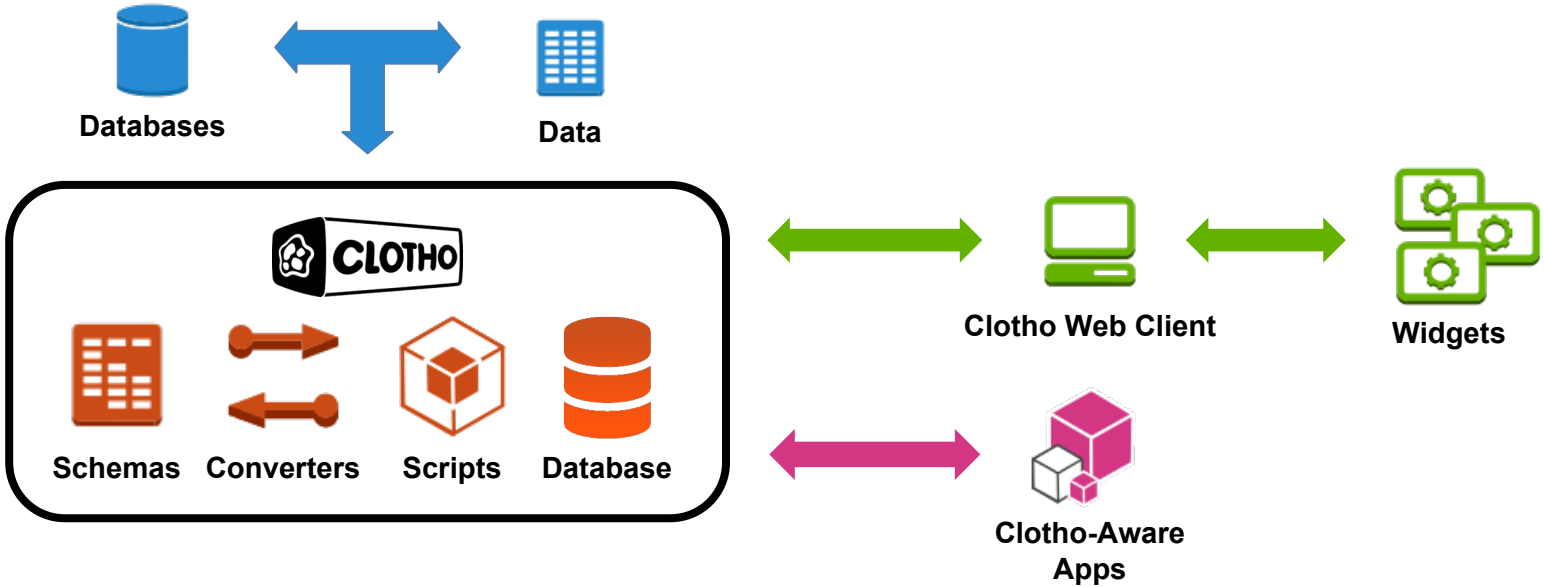
Design of Experiments (DOE)



DOE for Synthetic Biology

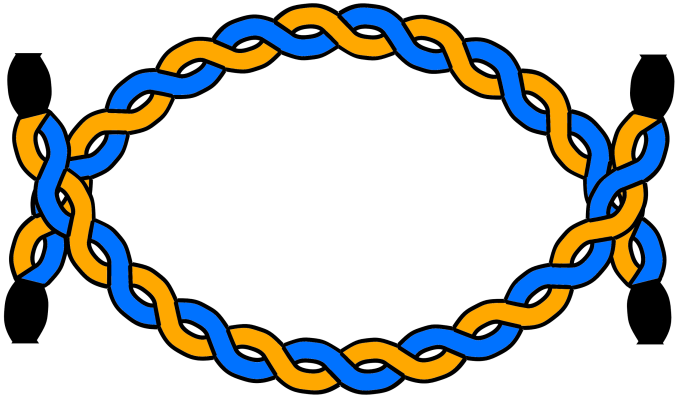


Clotho 3.0


Databases
Data
CLOTHO
Schemas
Converters
Scripts
Database
Clotho Web Client
Widgets
Clotho-Aware
Apps

DOE for Synthetic Biology w/ Double Dutch

Design of Experiments



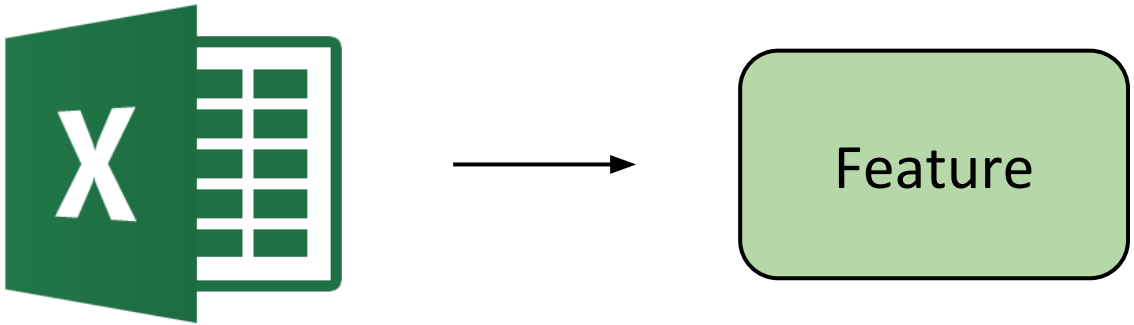
Double Dutch

Biological Design

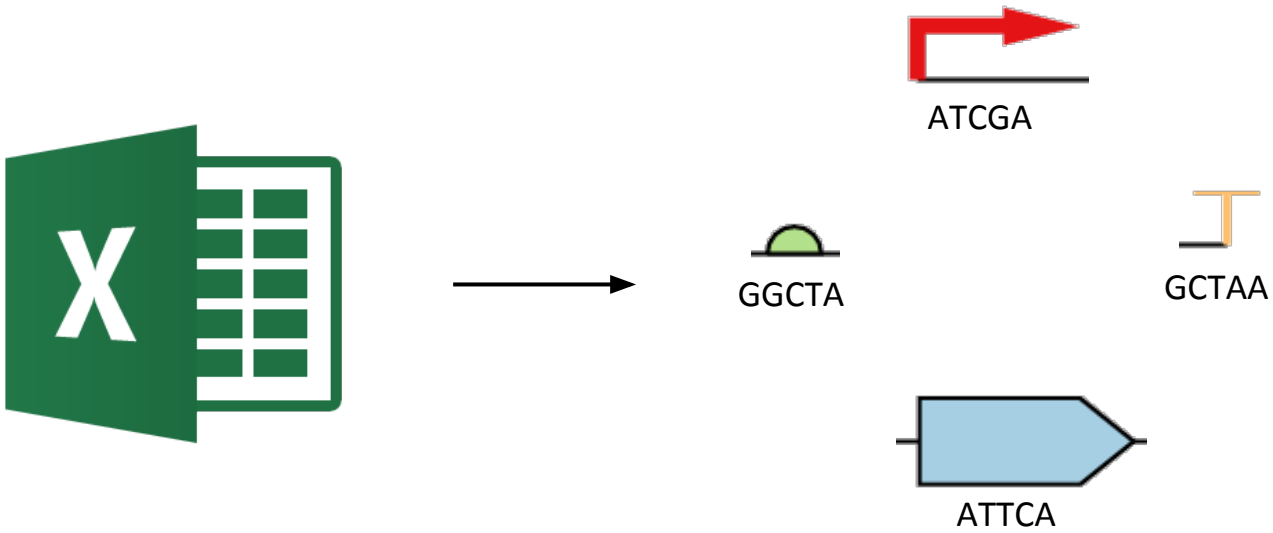
Talk Outline

- Overview of Double Dutch web app
- Double Dutch demo
- Discussion of app extensions

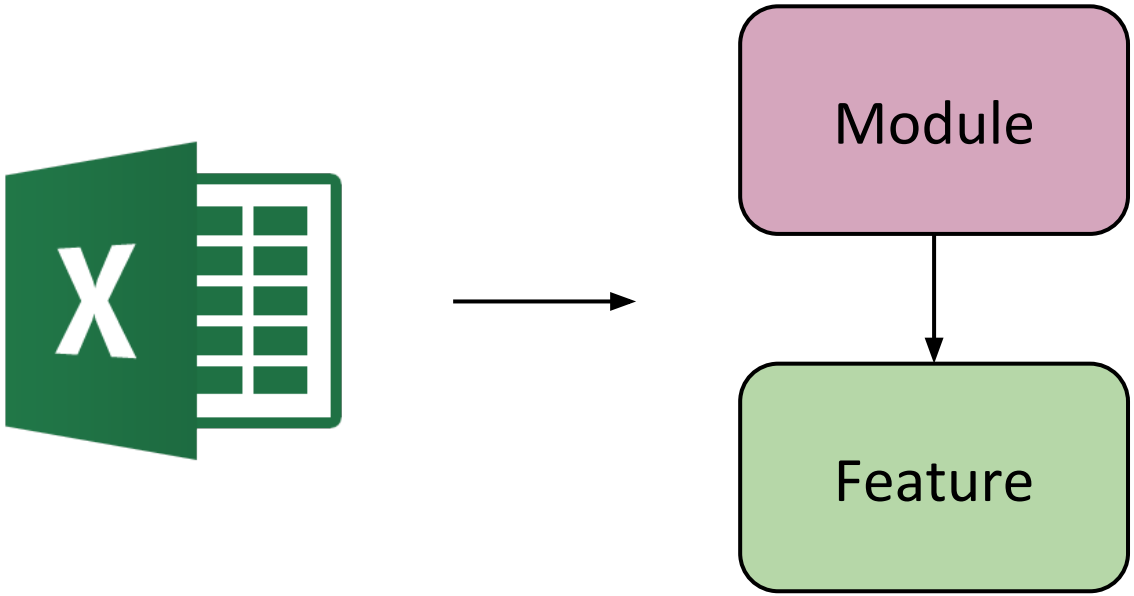
Step 1: Import Features



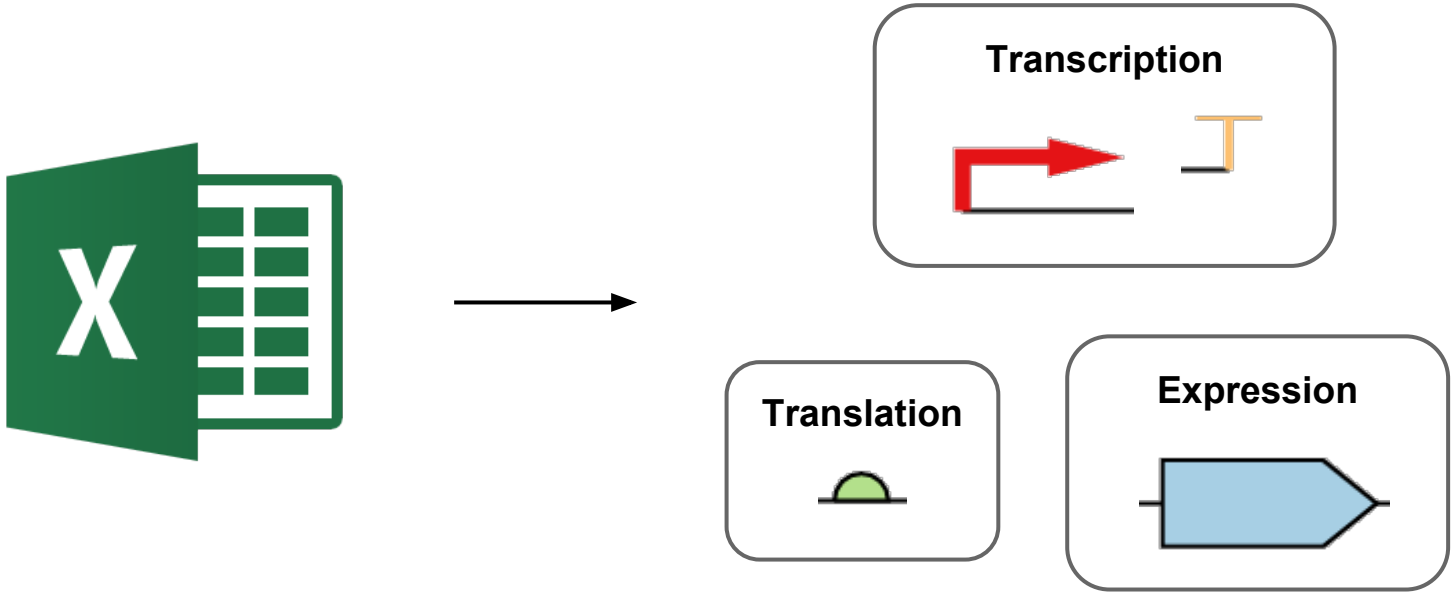
Step 1: Import Features



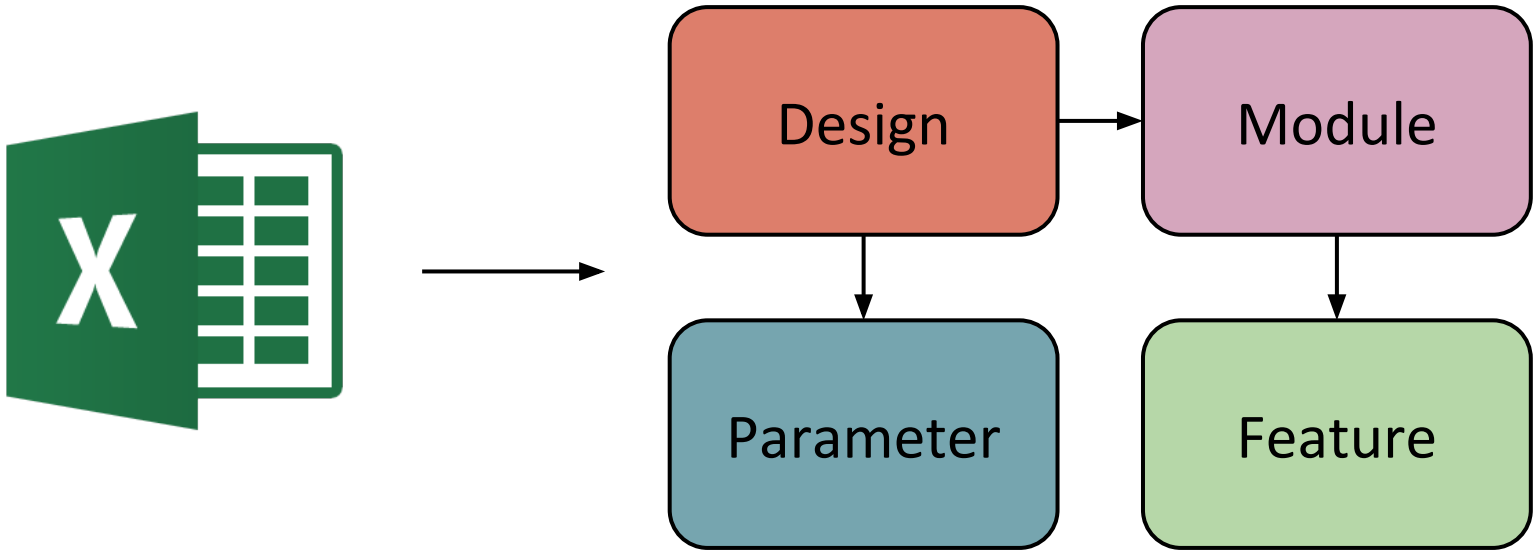
Step 2: Infer Modules



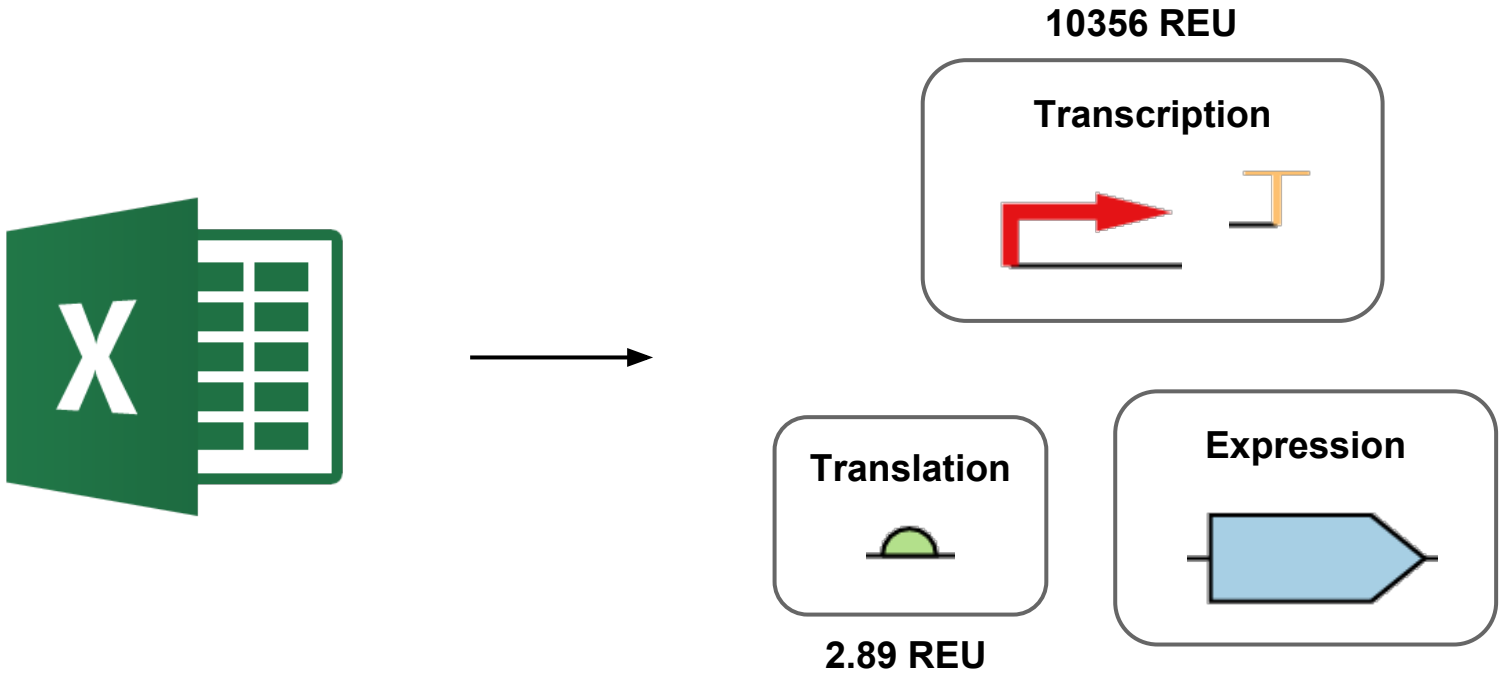
Step 2: Infer Modules



Step 3: Parameterize Modules

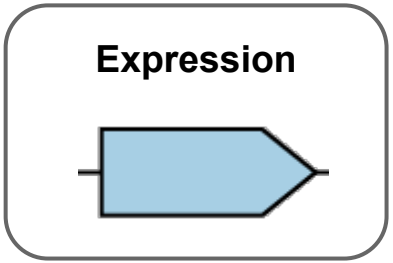


Step 3: Parameterize Module



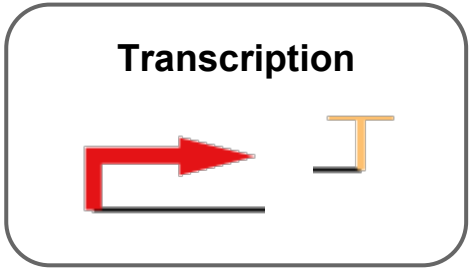
Step 4: Categorize as Factors or Levels

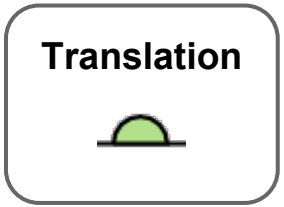
Available Factors



Available Levels

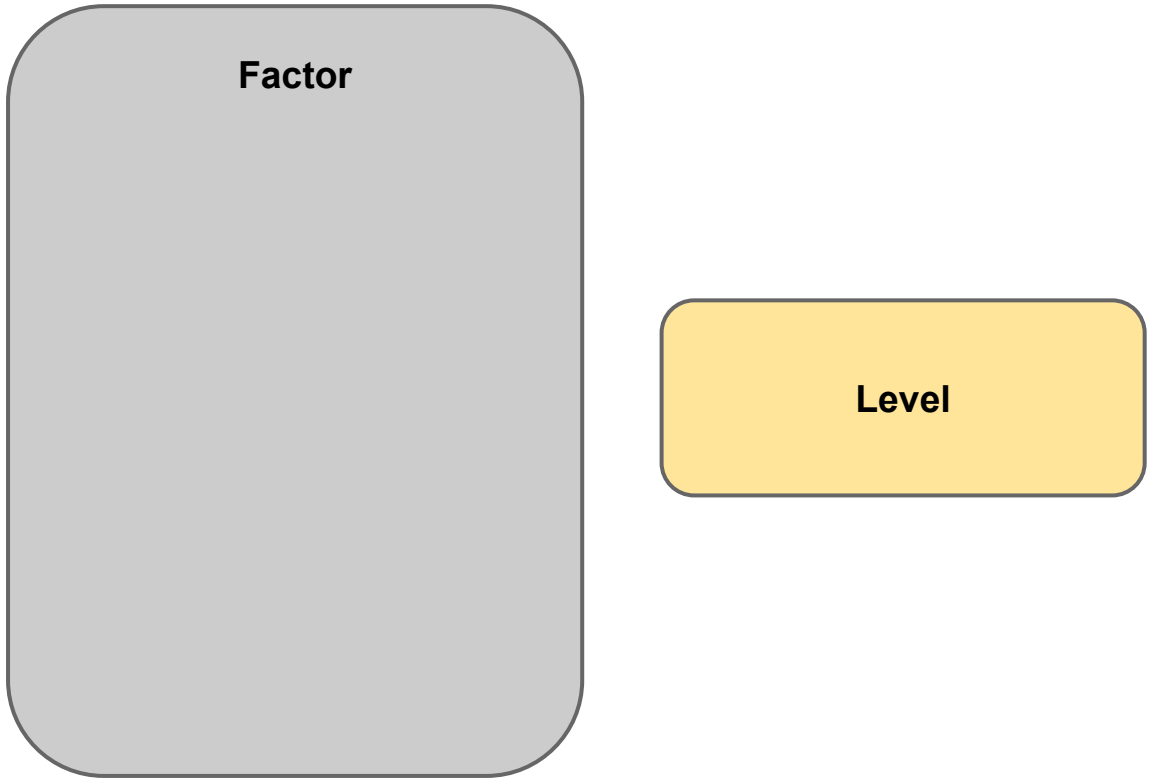
10356 REU



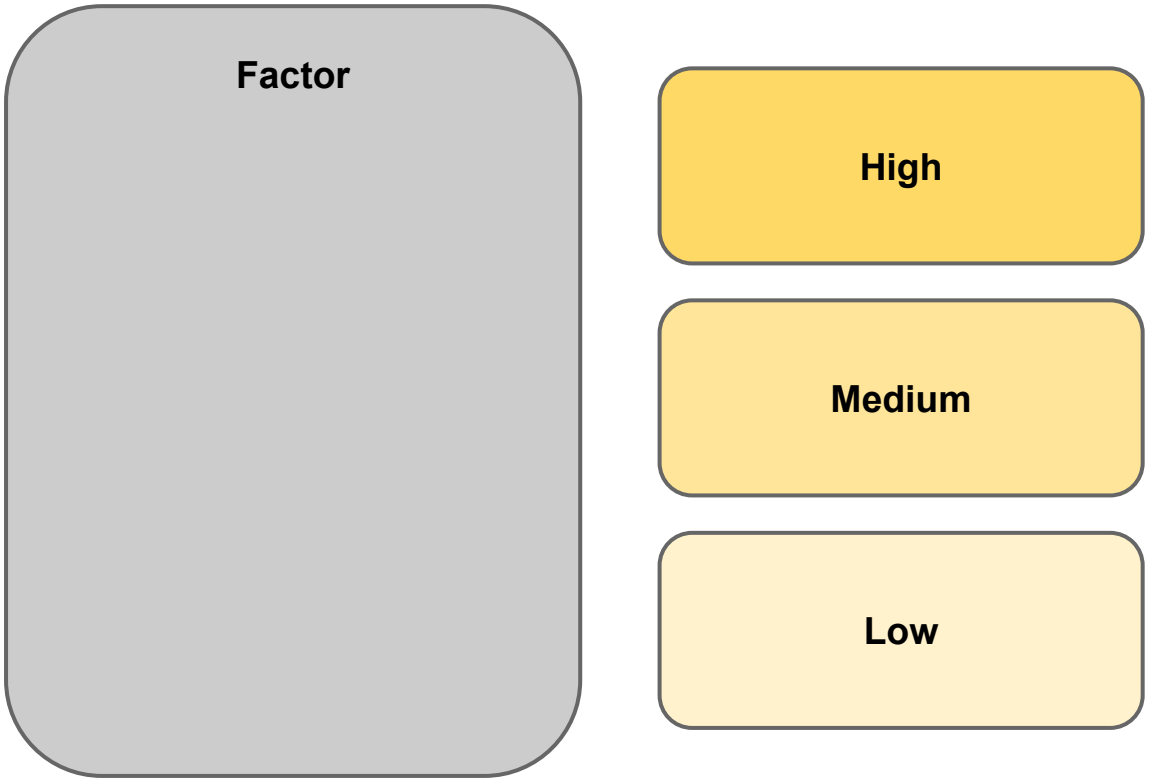


2.89 REU

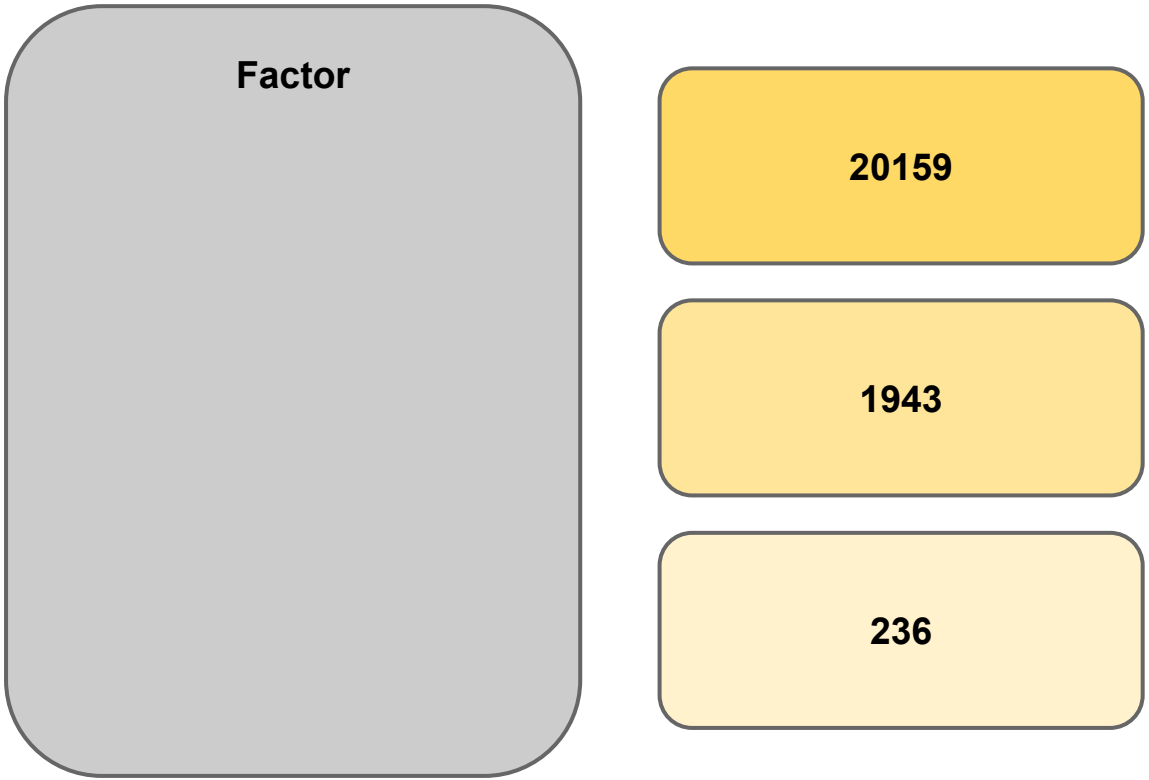
Step 5: Assign Levels to Factors



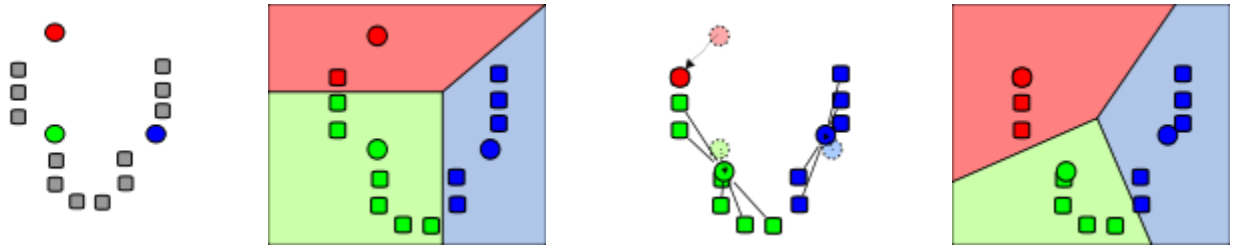
Step 5a: Choose # of Levels per Factor



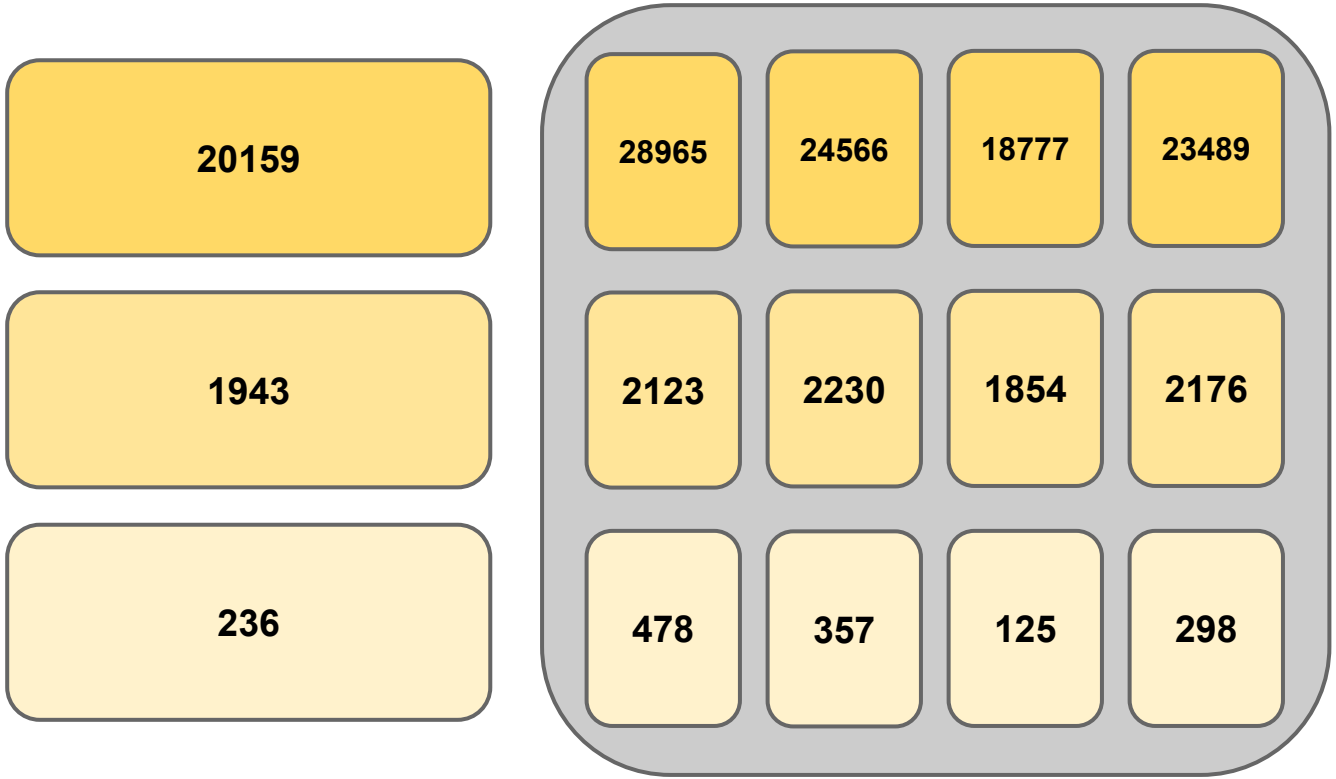
Step 5b: Quantify Target Levels



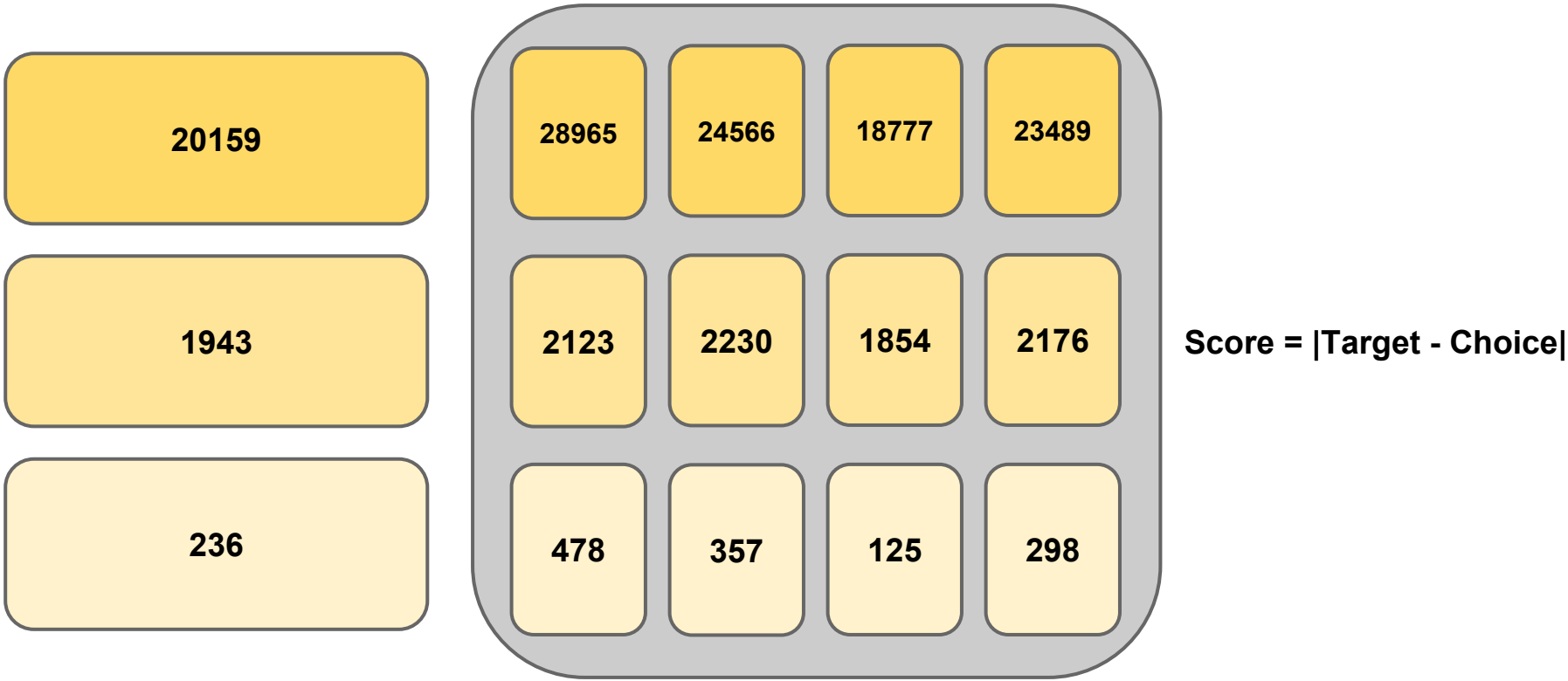
K-Means Clustering



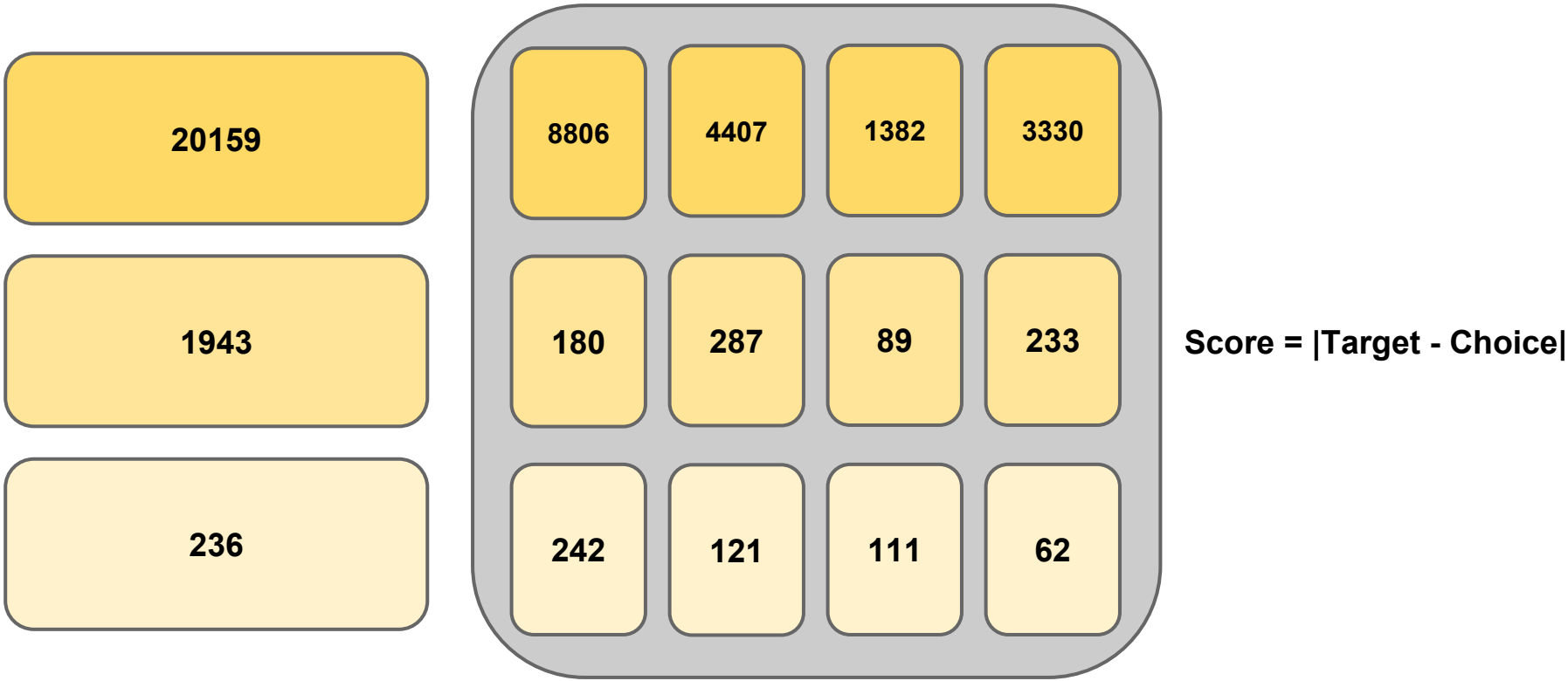
Step 5c: Partition Level Choices



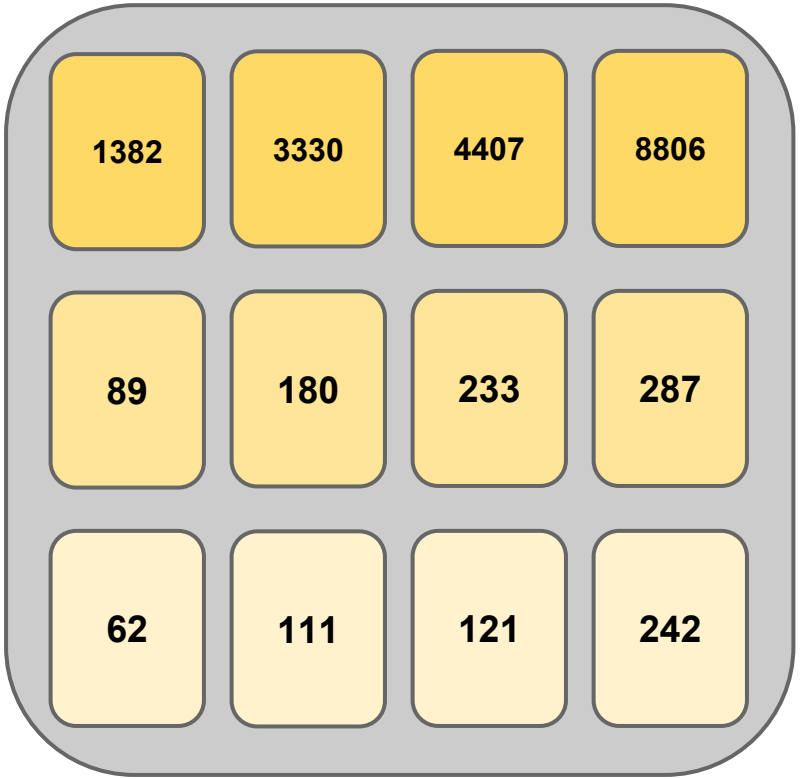
Step 5d: Score Level Choices



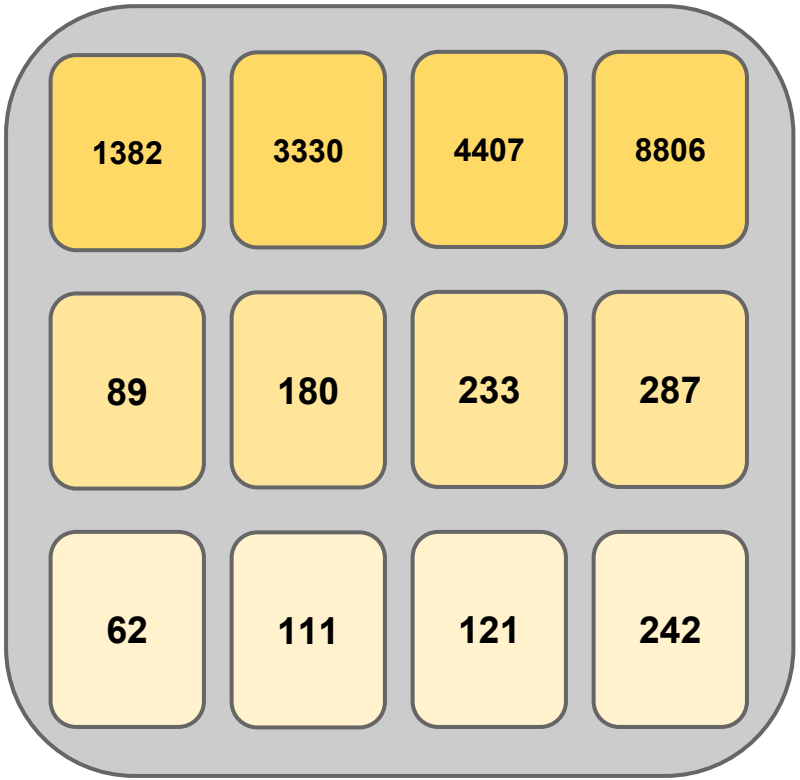
Step 5d: Score Level Choices

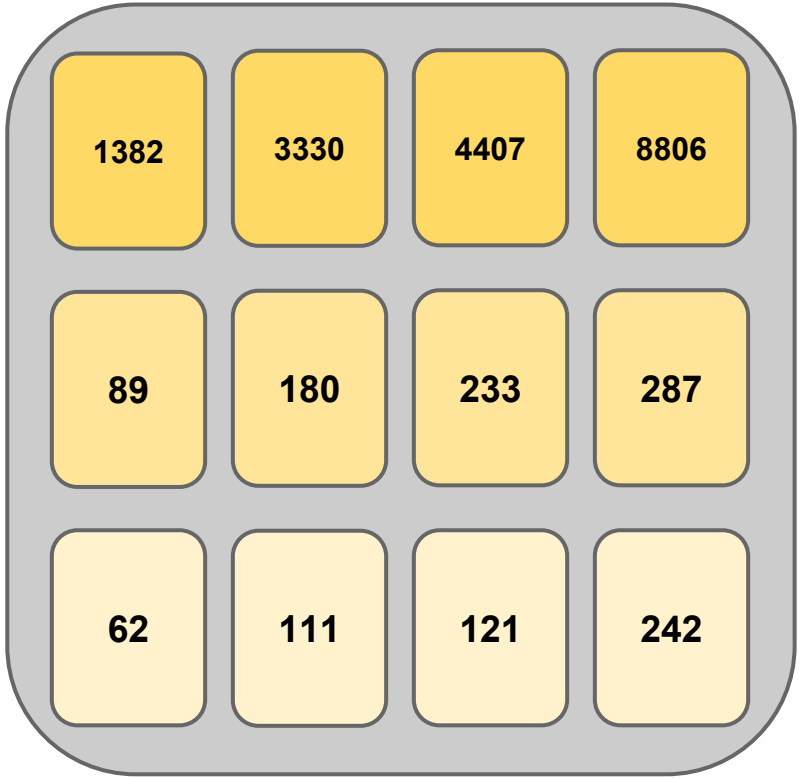


Step 5e: Sort Level Choices



Step 5f: Greedy Search





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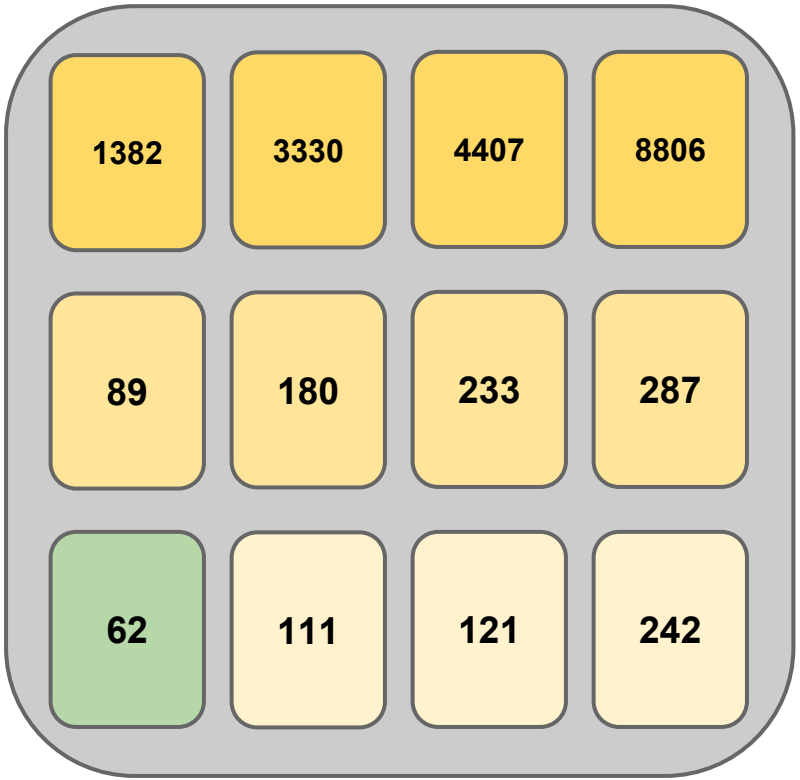

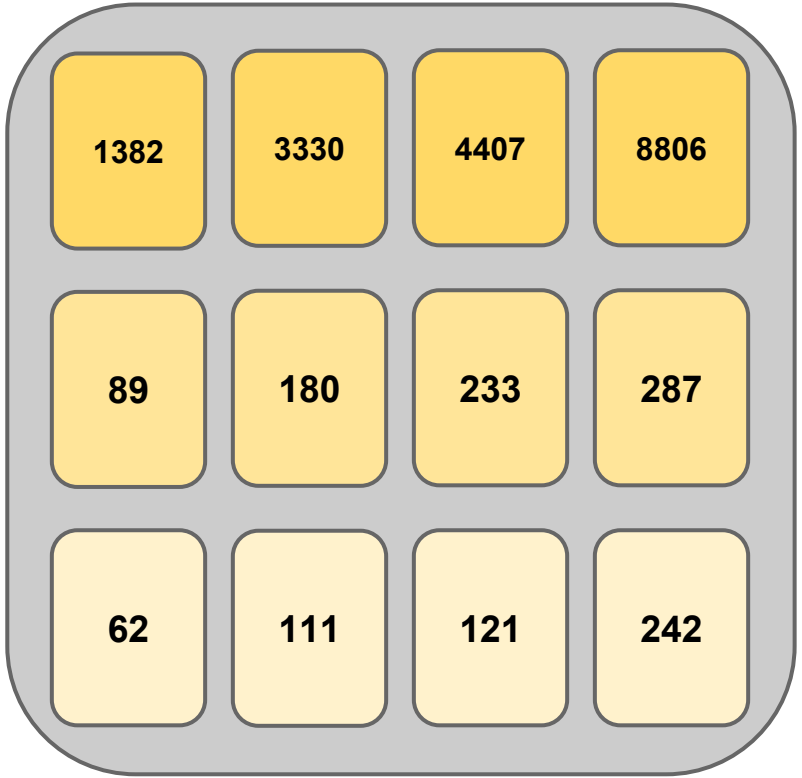

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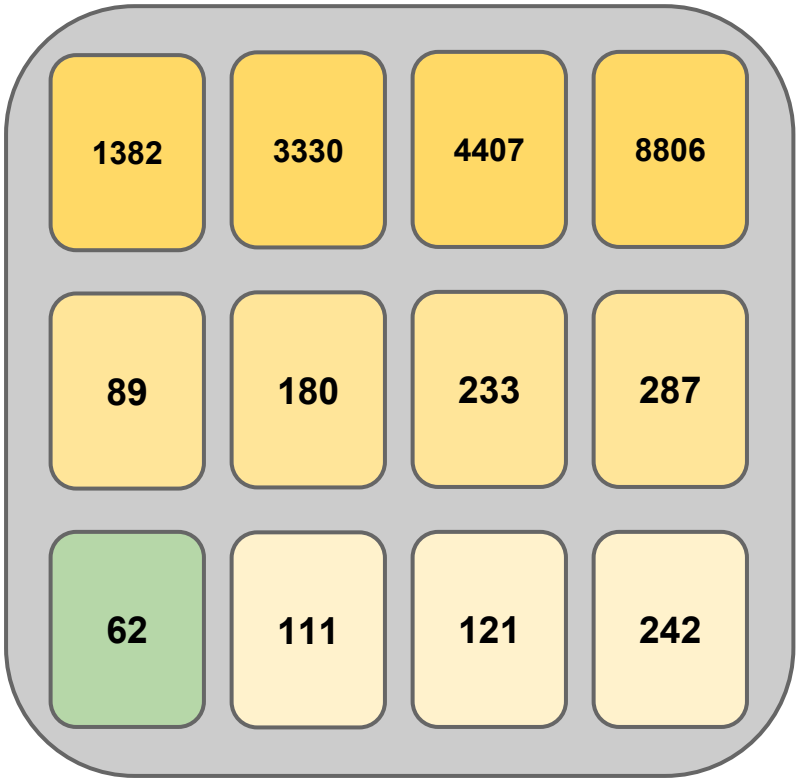

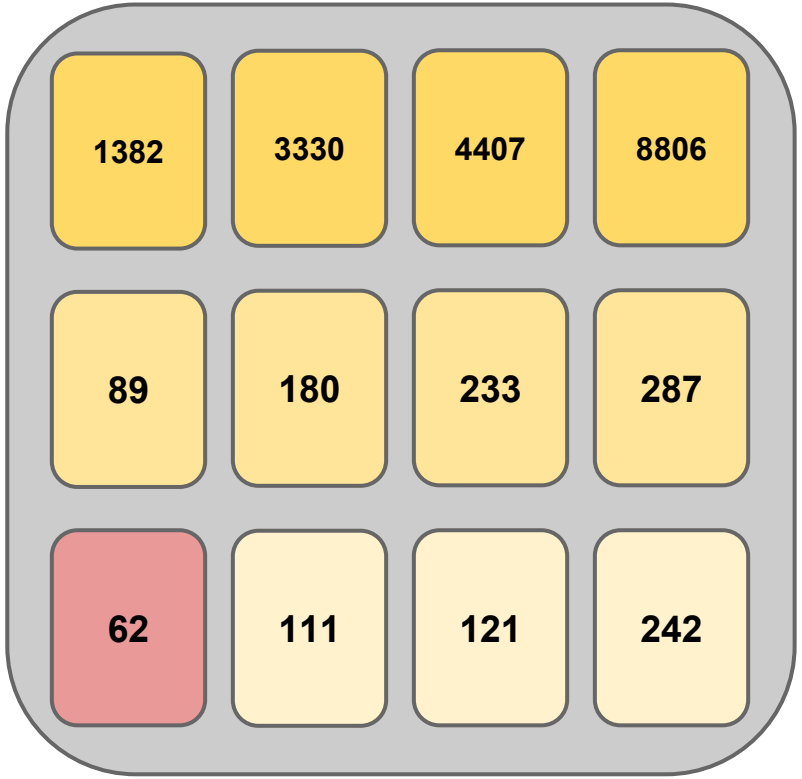

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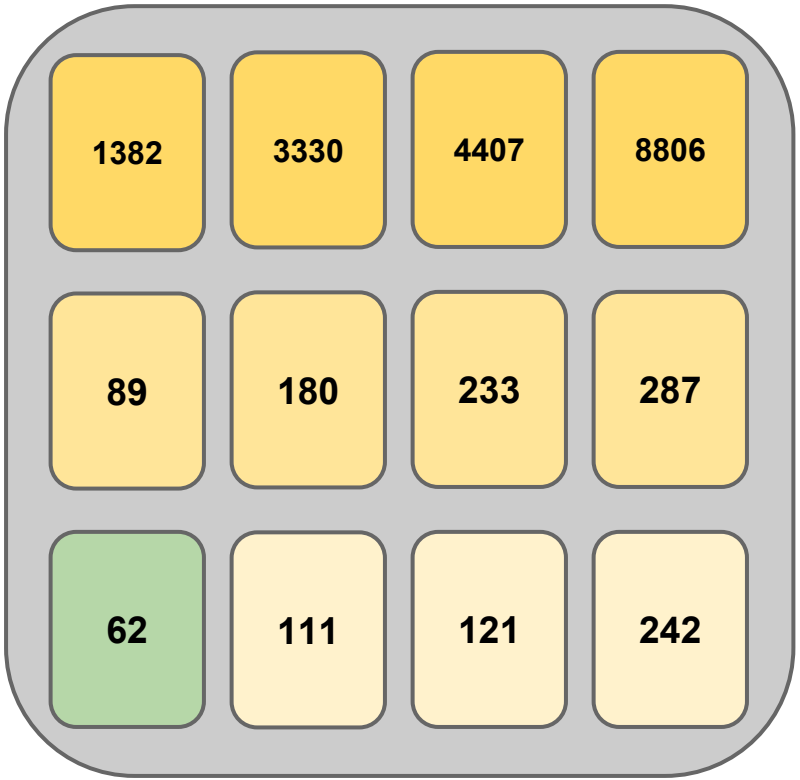

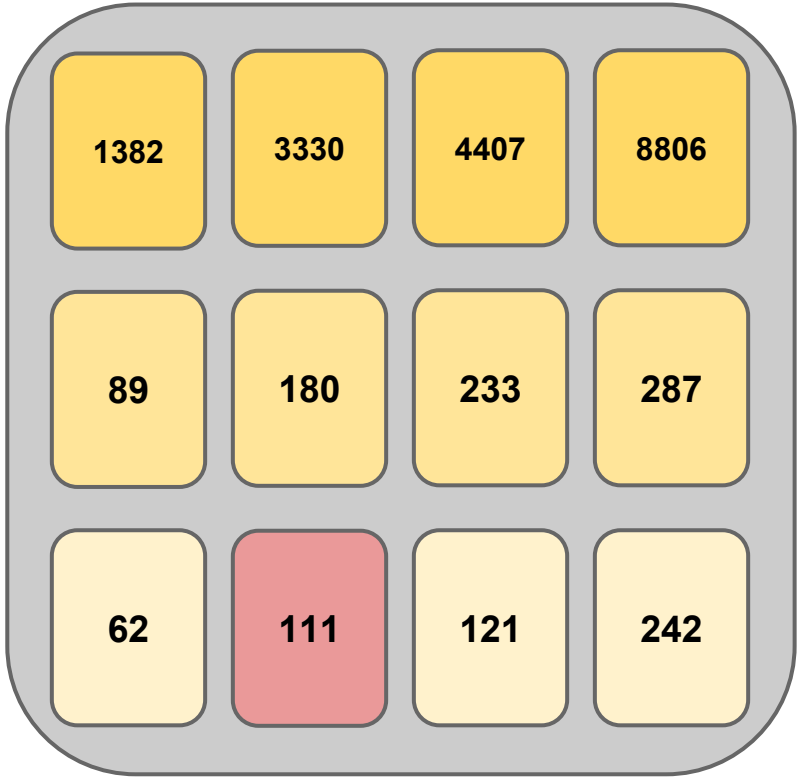

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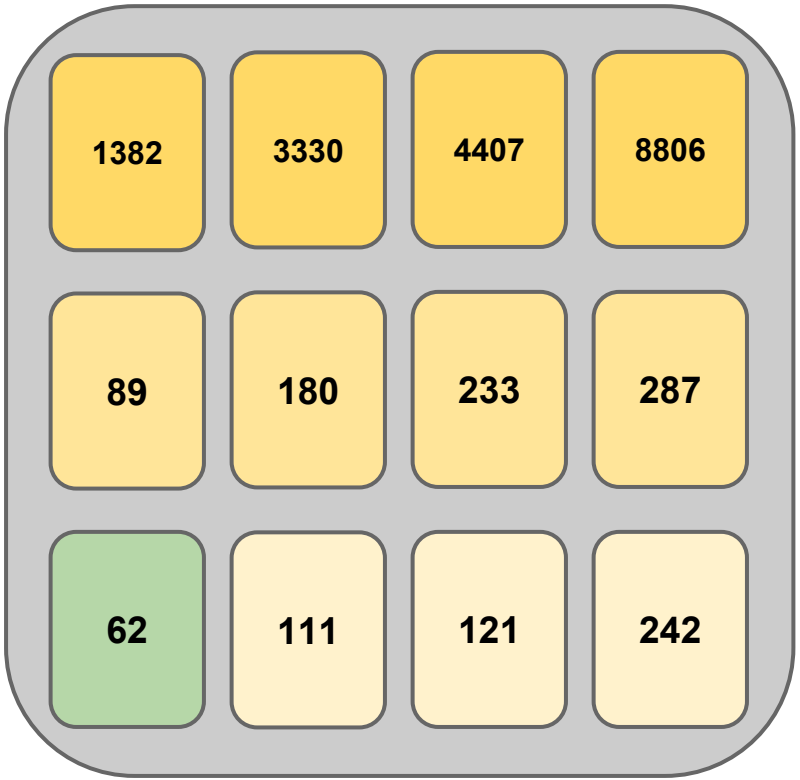

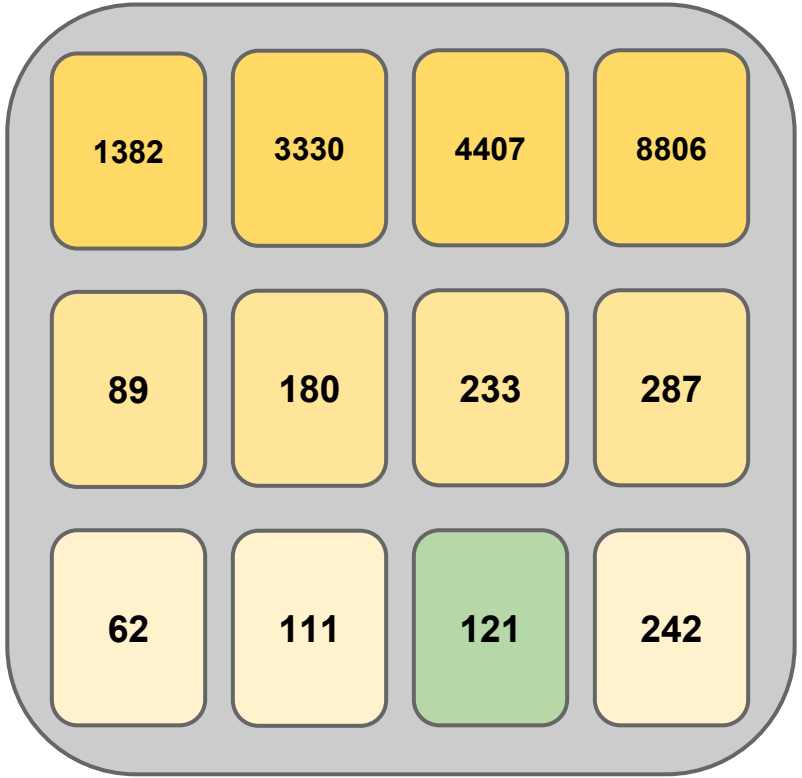

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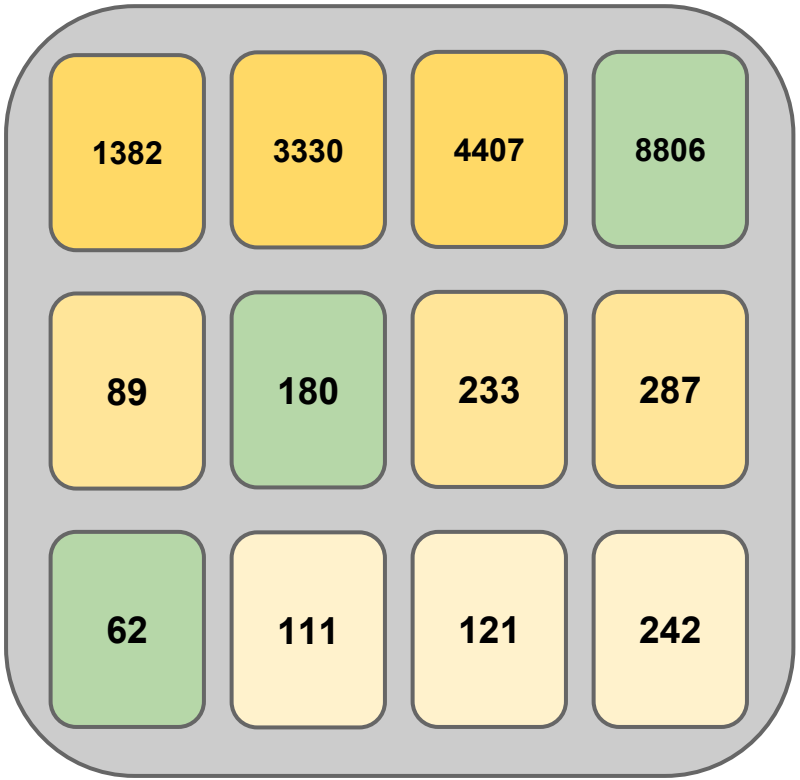
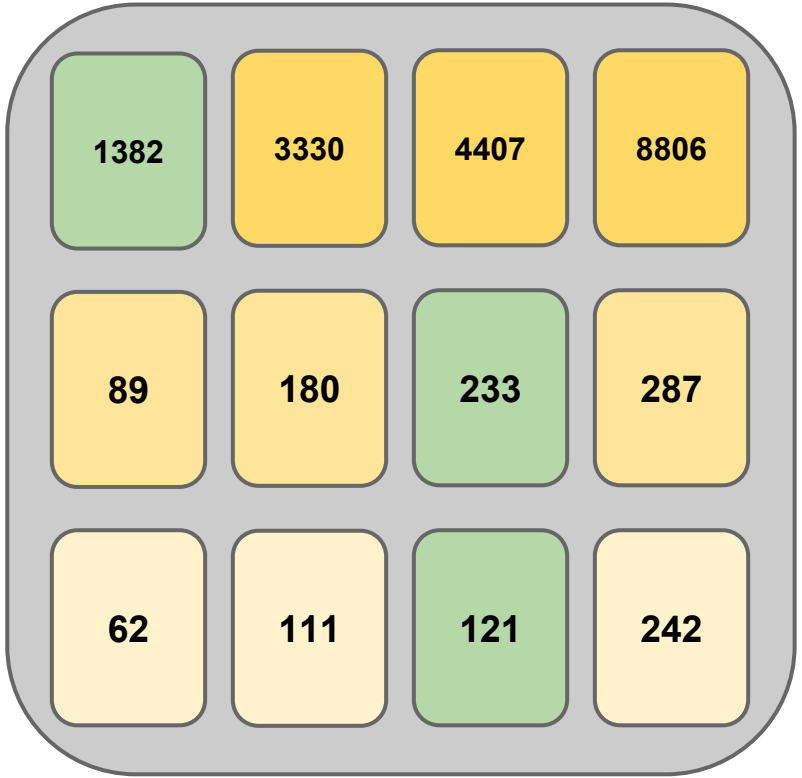
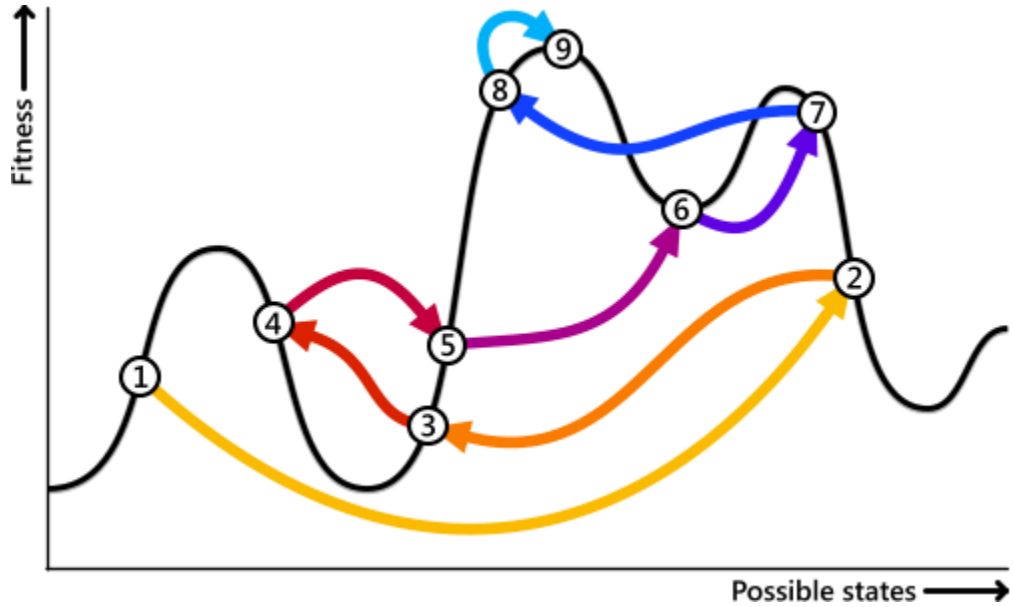
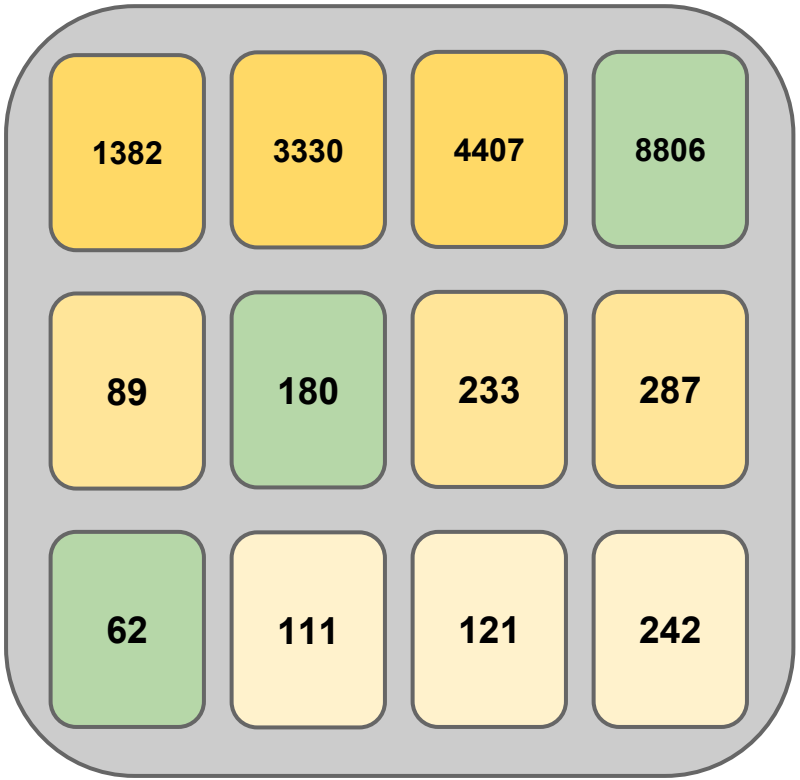


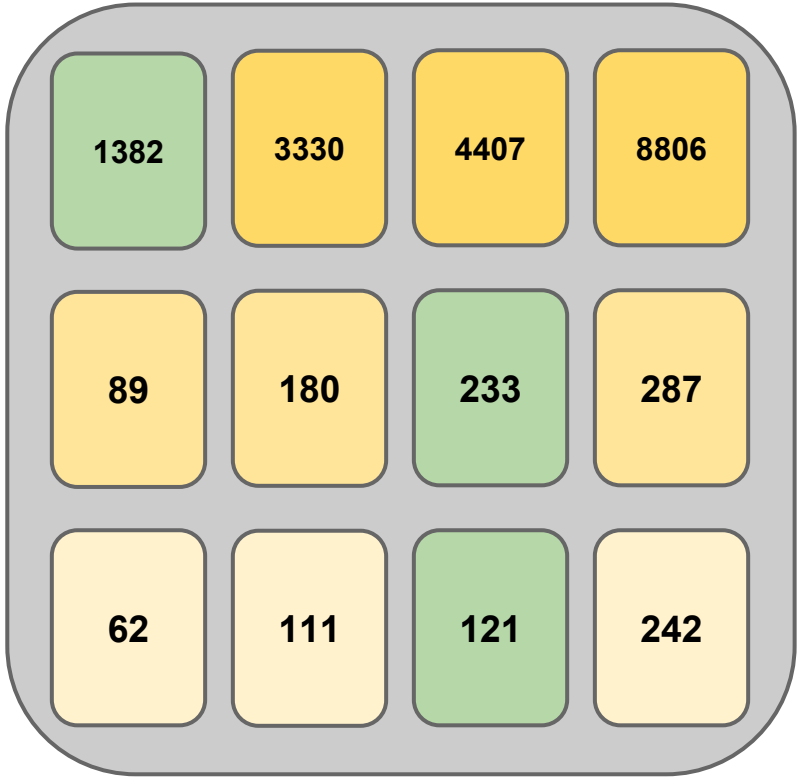


Local Optimum and Simulated Annealing

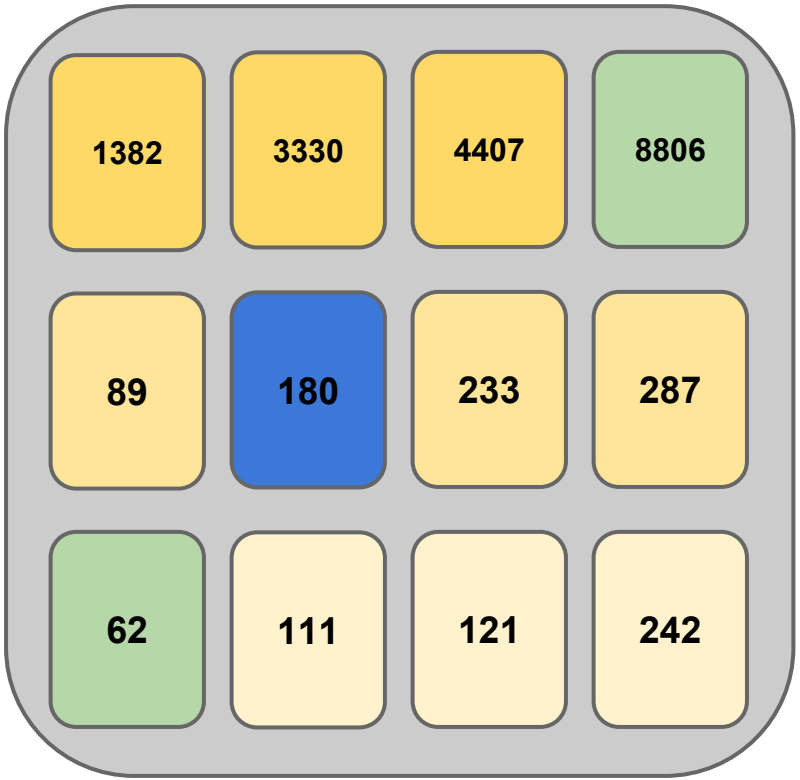


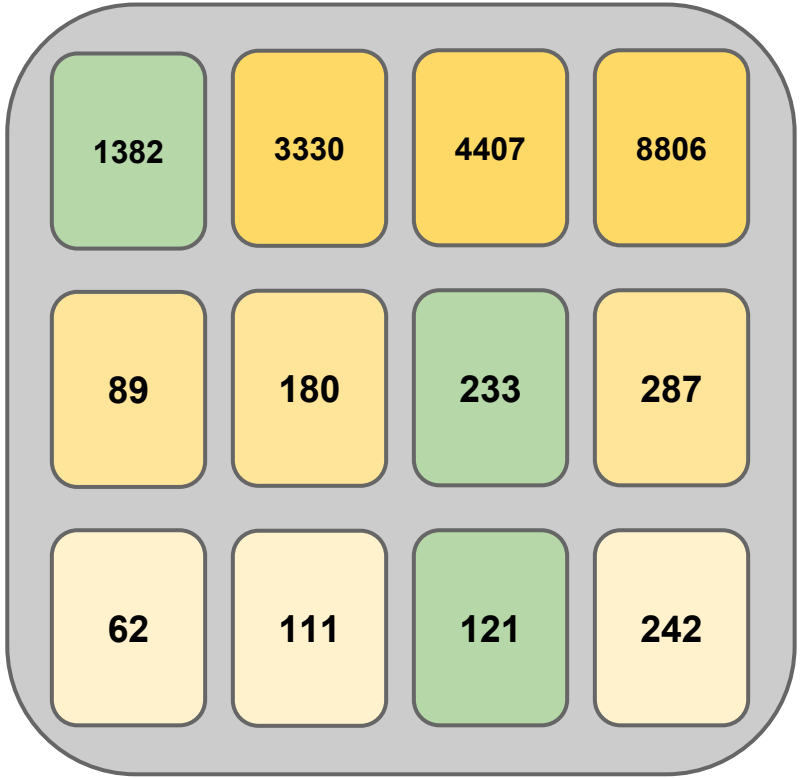
Step 5g: Simulated Annealing



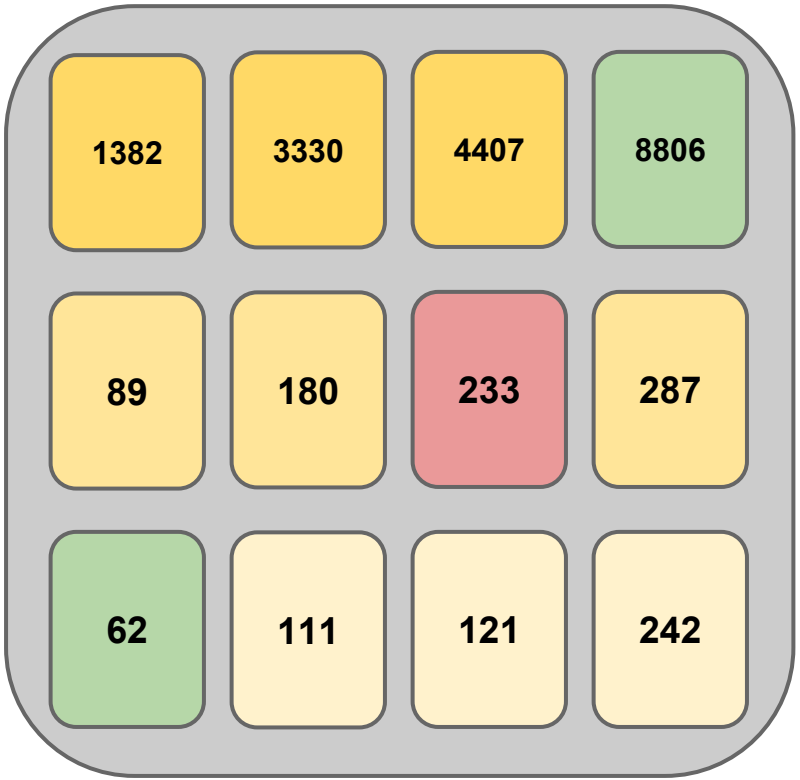


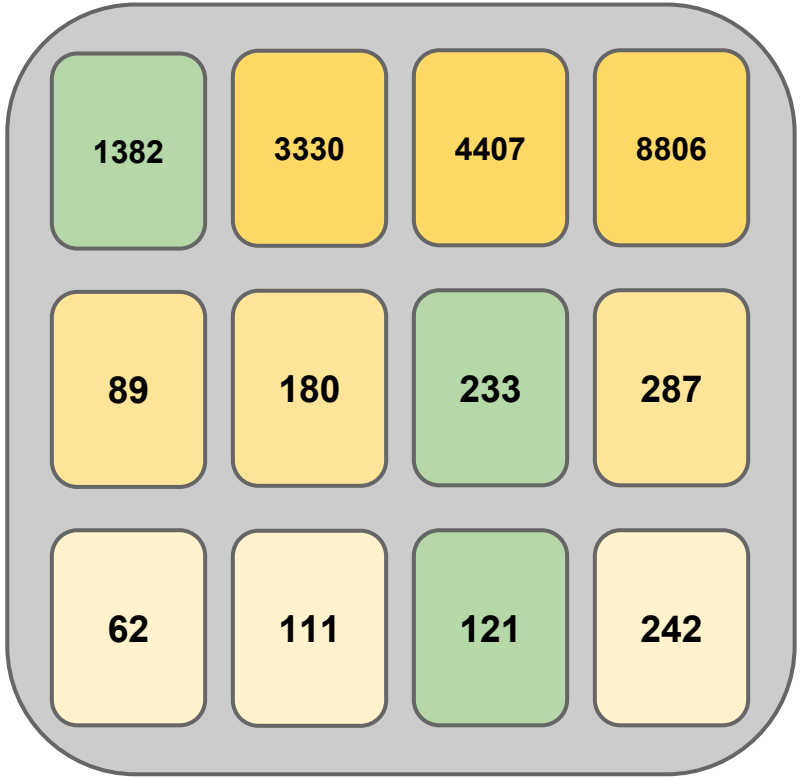
Step 5g: Simulated Annealing



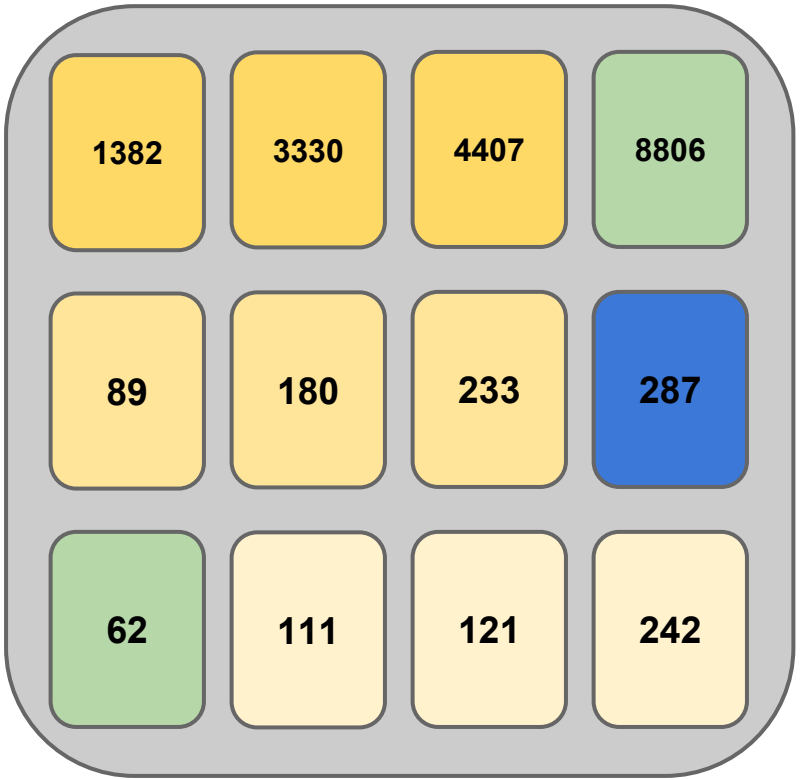


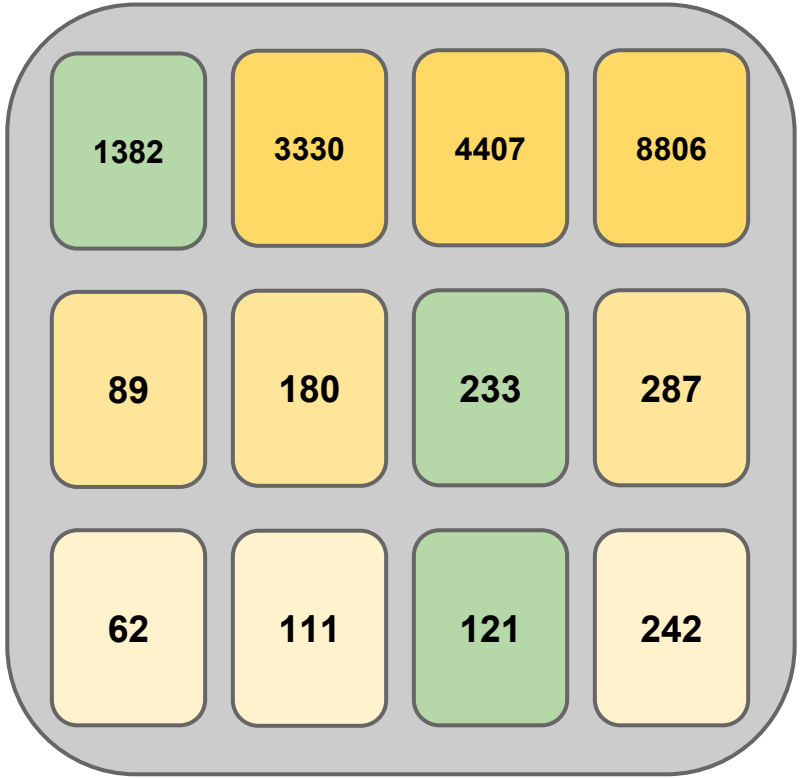
Step 5g: Simulated Annealing



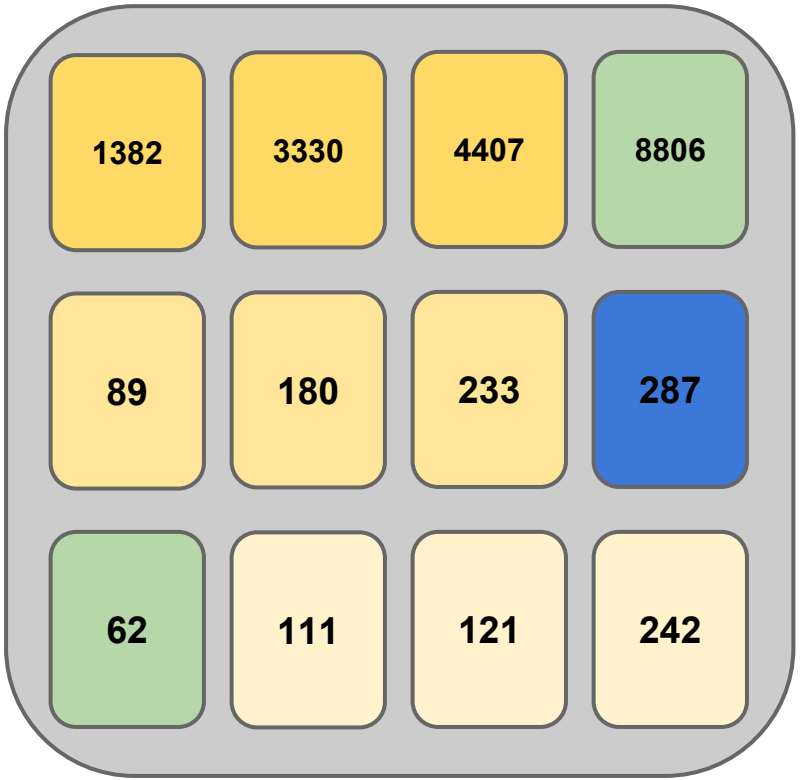


Step 5g: Simulated Annealing



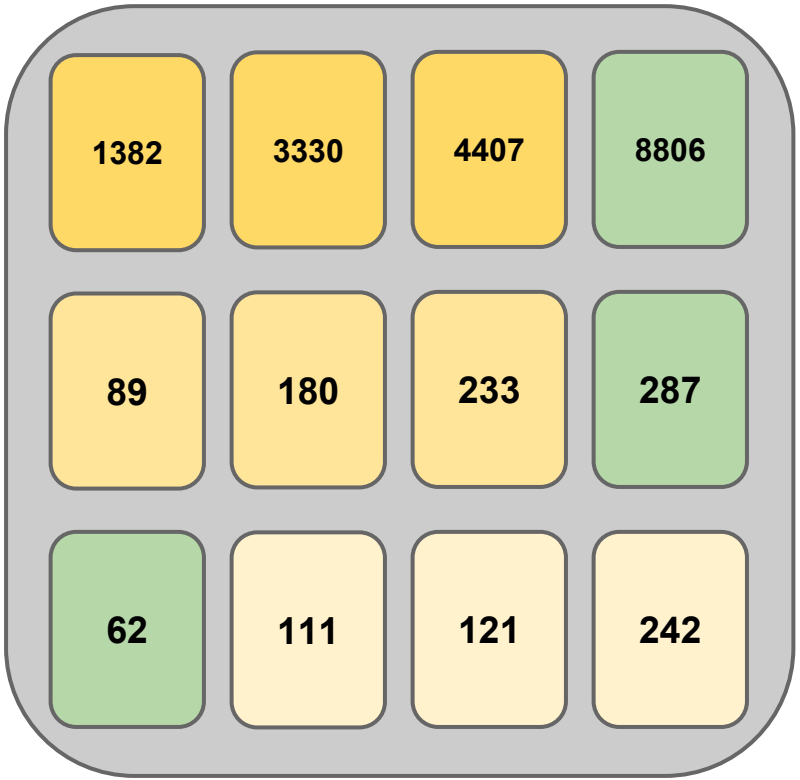


Step 5g: Simulated Annealing



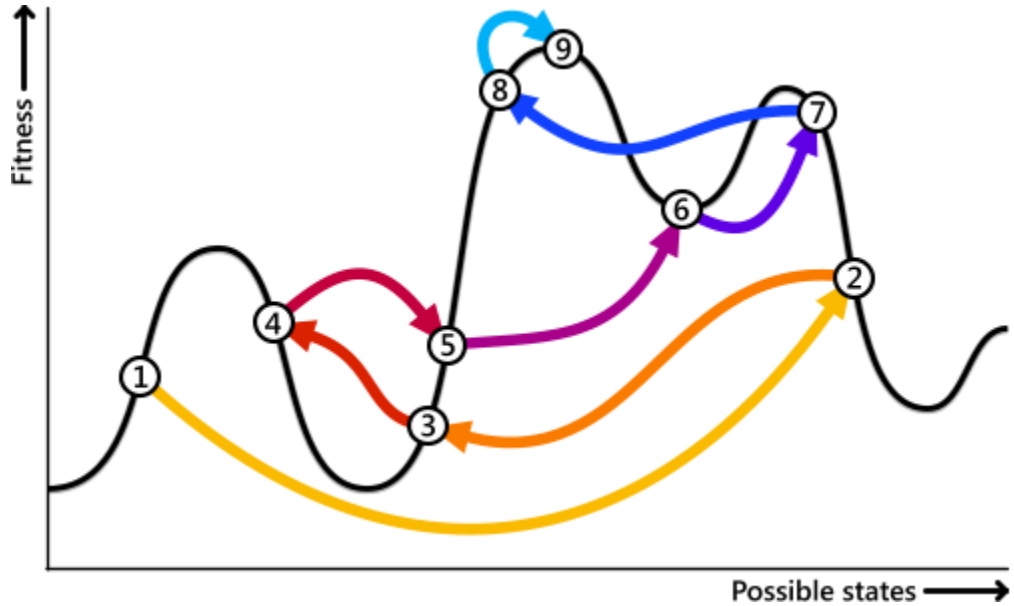
P(accept) = e^[(oldScore - newScore)/Temp]

Step 5g: Simulated Annealing

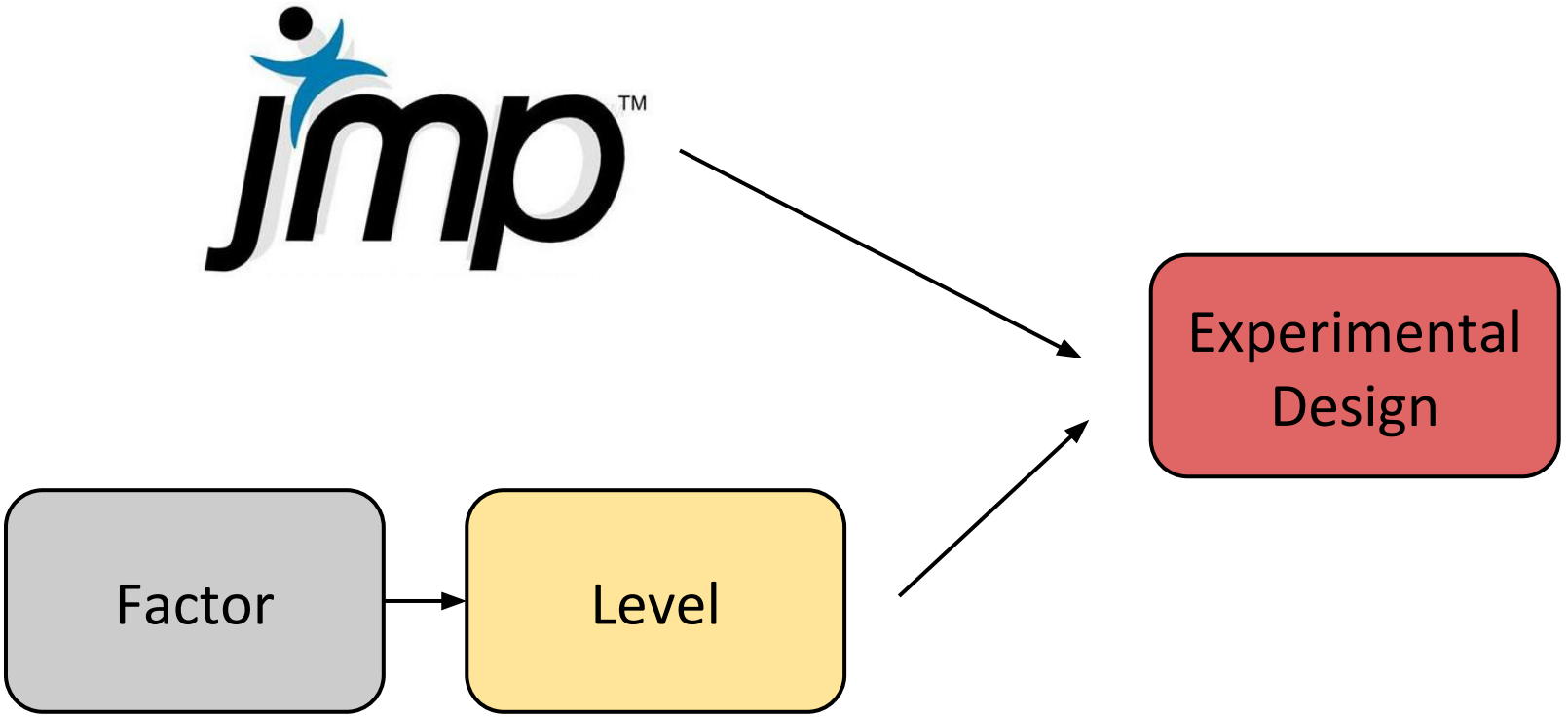


P(accept) = e^[(oldScore - newScore)/Temp]

Simulated Annealing



Step 6: Generate Experimental Design

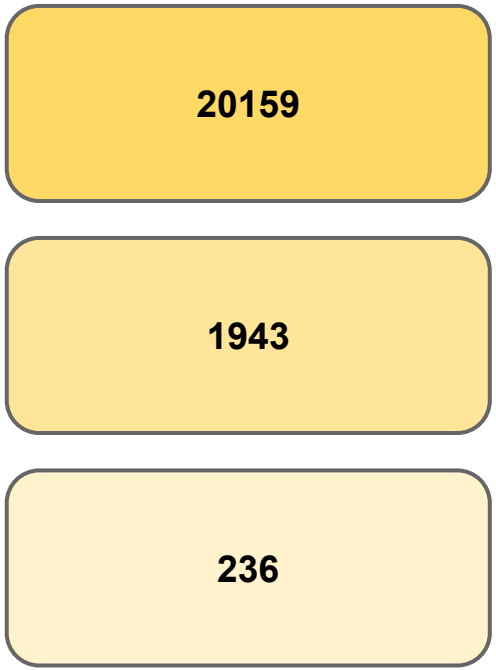


Step 6: Generate Experimental Design

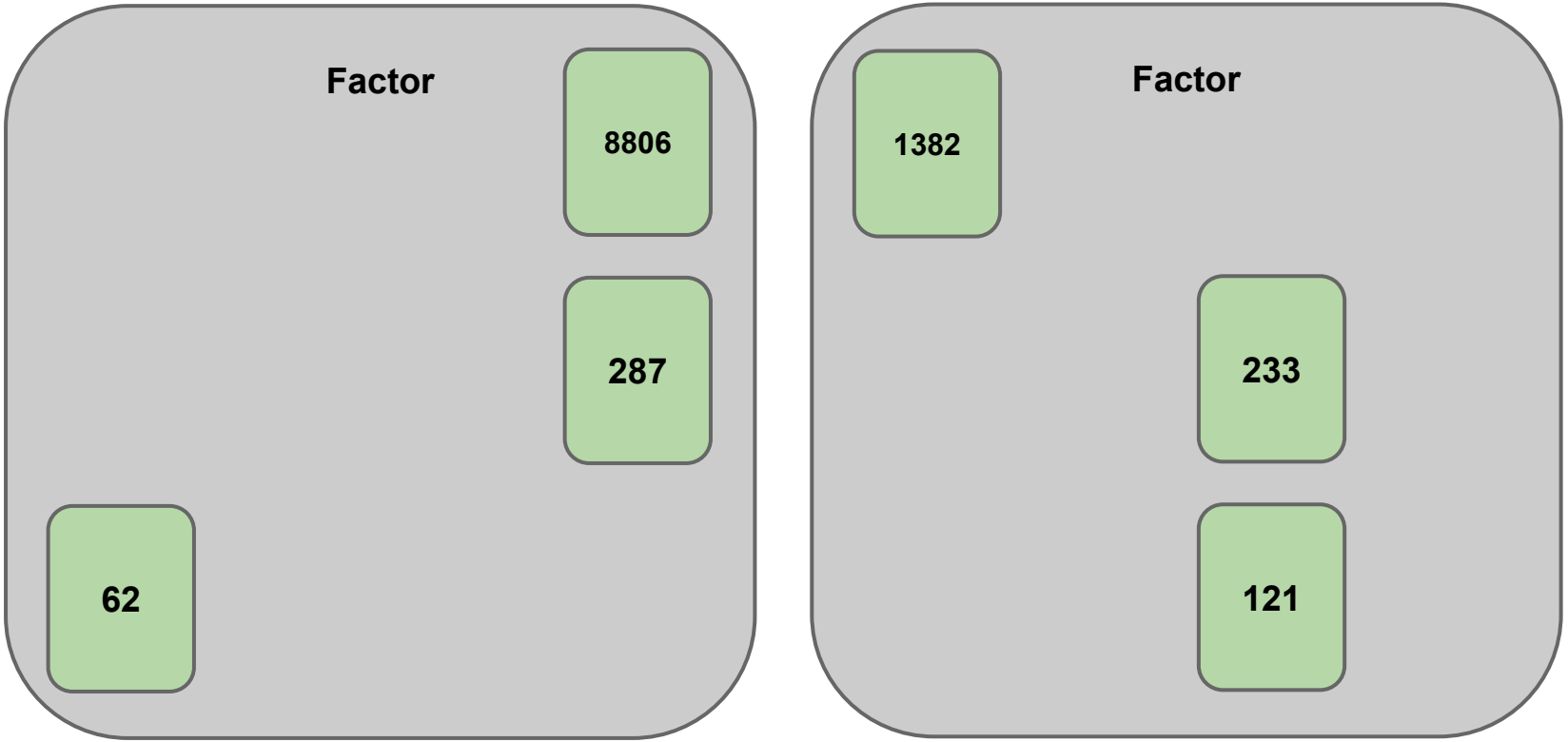
4th Order	A	B	C	D	E	F
1	0	1	1	1	-1	-1
2	0	1	0	0	0	0
3	1	1	1	1	-1	1
4	0	0	0	-1	1	0
5	-1	1	0	0	0	0
6	-1	-1	-1	1	1	0
7	0	-1	0	-1	0	0
8	1	1	-1	-1	1	-1
9	0	0	-1	0	1	-1
10	1	0	0	0	0	-1

Step 6: Generate Experimental Design

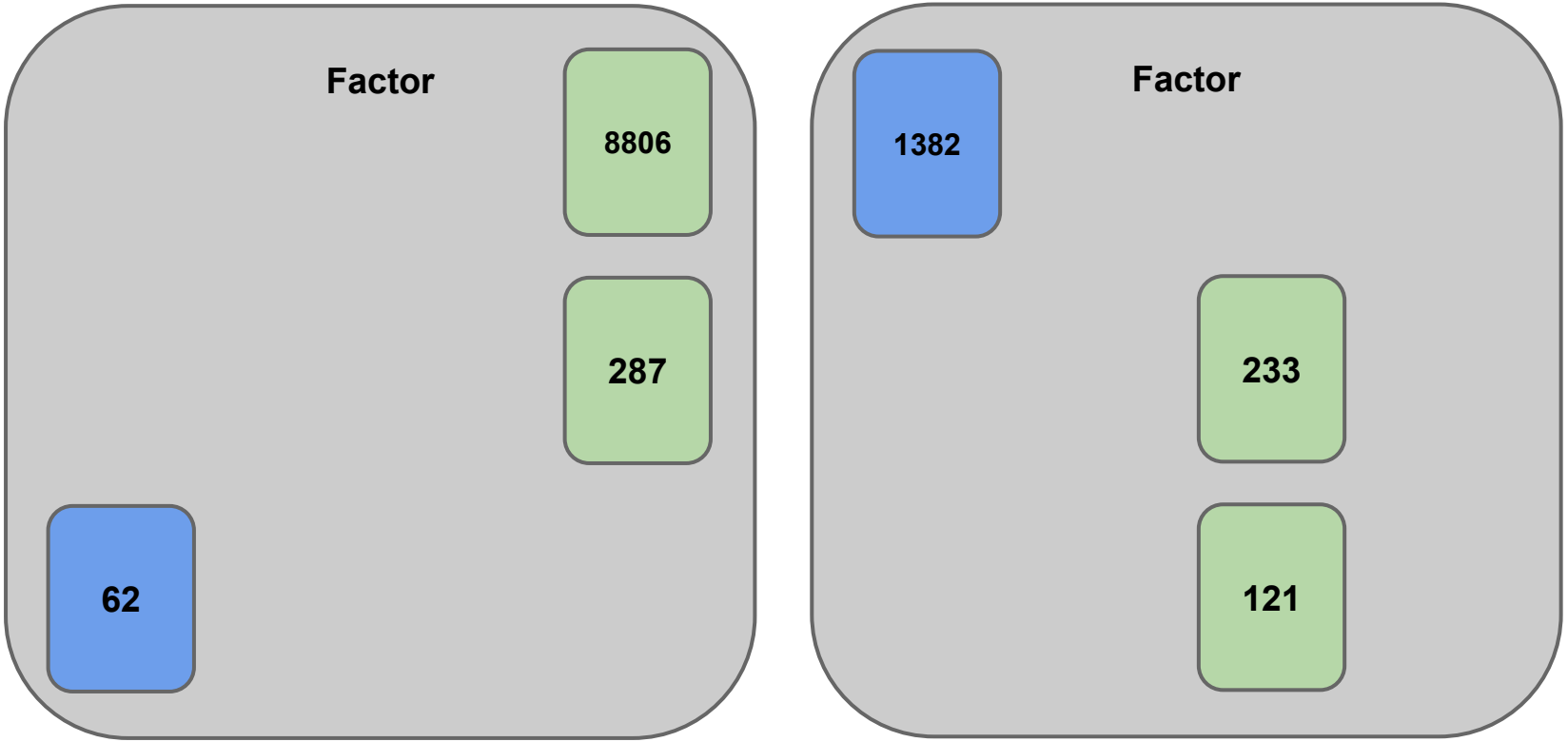
1
0
-1



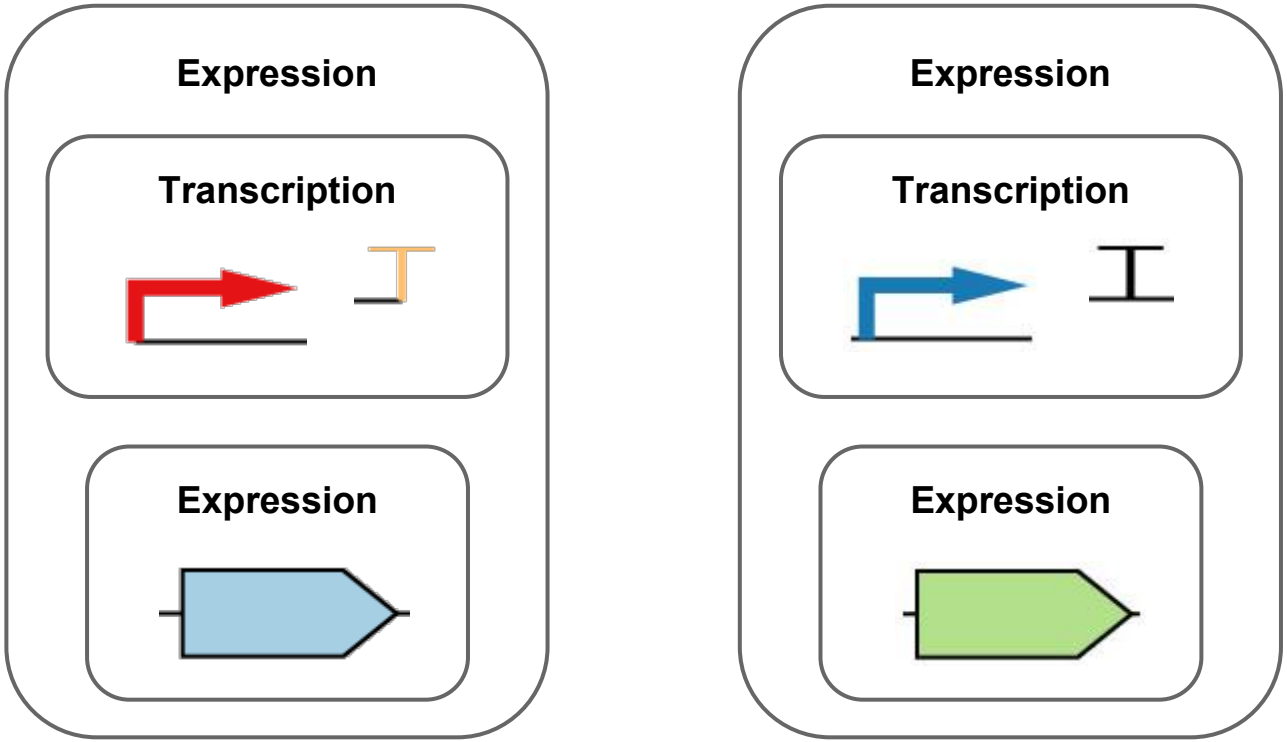
Step 6: Generate Experimental Design



Step 6: Generate Experimental Design



Step 7: Generate Biological Designs



Planned Extensions

- Validate composition of modules associated with factors and levels in experimental designs.
- Fit empirical models to experimental data.
- Incorporate Pigeon for design visualization.
- Export designs in additional file formats (Euegene, SBOL, JSON).
- Generate picklists for automated assembly.

Clotho Team

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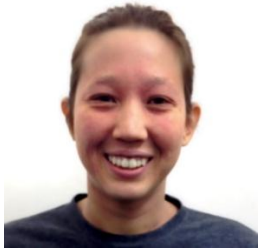
J. Christopher Anderson



Stephanie Paige

Prashant Vaidyanathan

Bill Cao

Maxwell Bates

CoSBi

synberc

Building the Future with Biology.

NSF