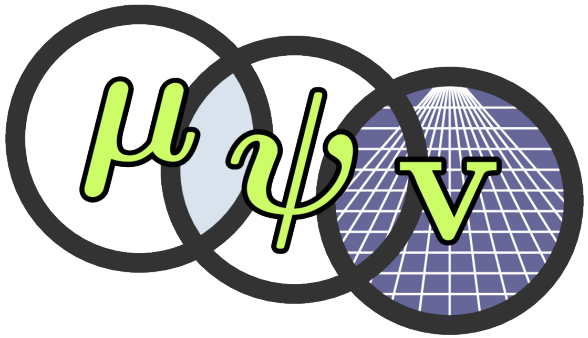

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Predicting algorithmic complexity for individuals

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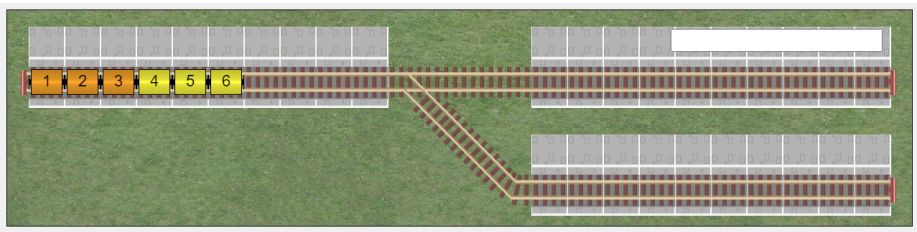
Introduction

- Interest: Simulation of algorithms
- Question: How can we use complexity metrics to predict an individual's difficulty solving a task?
- Experiment - Railway environment
- Move, While, Repeat
- 8 tasks - 4 and 6 wagons



Three train tracks with 6 wagons on the *Top Left* track

Reverse

```
While track Top-Left has wagons:
    Move wagon from Top-Left to Bottom-Right
While track Bottom-Right has wagons:
    Move wagon from Bottom-Right to Top-Left
    Move wagon from Top-Left to Top-Right
```

Palindrome

```
While first wagon on Top-Left has color blue:
    Move wagon from Top-Left to Bottom-Right
While track Bottom-Right has wagons:
    Move wagon from Bottom-Right to Top-Left
    Repeat 2 times:
        Move wagon from Top-Left to Top-Right
```

Parity Sort

```
While track Top-Left has wagons:
    Move wagon from Top-Left to Top-Right
    Move wagon from Top-Left to Bottom-Right
While track Bottom-Right has wagons:
    Move wagon from Bottom-Right to Top-Left
While track Top-Left has wagons:
    Move wagon from Top-Left to Top-Right
```

Faro Shuffle

```
While not solved:
    Move wagon from Top-Left to Top-Right
    While first wagon on Top-Left has color orange:
        Move wagon from Top-Left to Bottom-Right
    Move wagon from Top-Left to Top-Right
    While track Bottom-Right has wagons:
        Move wagon from Bottom-Right to Top-Left
```

Four rearranging algorithms

Complexity Metrics

1. Depth
   Based on nested loops
2. Structure
   Based on length of code
3. Moves
   # performed moves
4. Commands
   # times each block is executed
5. Contexts
   Switching between tracks
6. Signature
   Repetition Effect
7. Entropy
   Chaotic distribution of wagons

Metric	ρ	p-value
Depth	-0.145	**.016**
Structure	-0.008	.149
Moves	0.078	.202
Commands	0.019	.751
Contexts	0.086	.152
Signature	-0.133	**.027**
Entropy	-0.123	**.041**

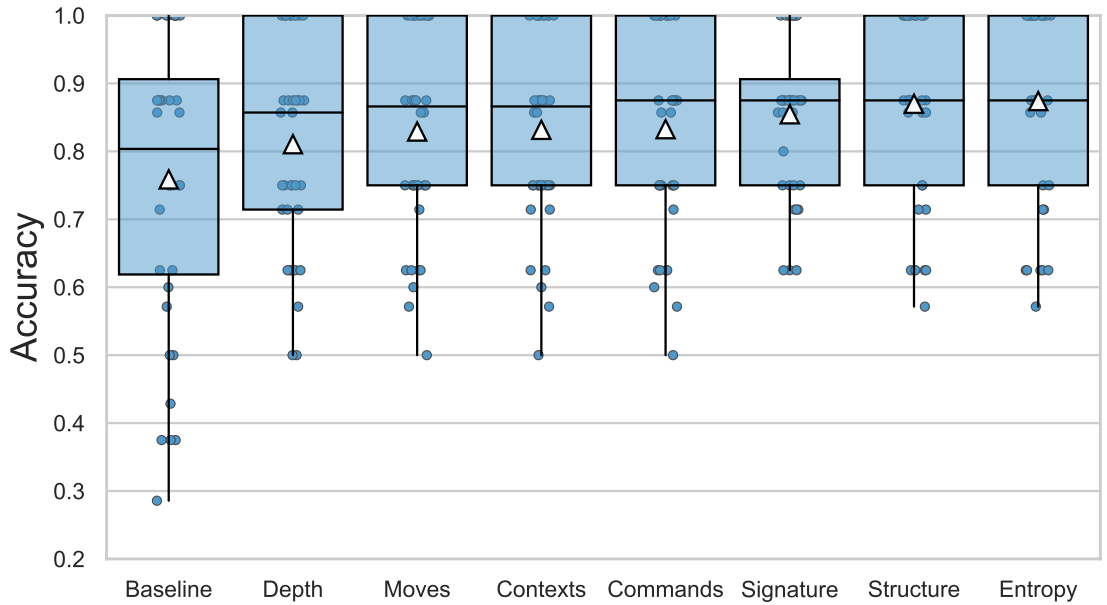
Pearson's ρ

Predictive Modeling Task

- Are the metrics good predictors of task difficulty for each individual?
- Cognitive Computation for Behavioral Reasoning Analysis (CCOBRA) framework
  - Easy model evaluations
  - Focus on modeling reasoning behavior on the individual level
- Models: Equip each metric with a complexity threshold
- Maximum complexity that an individual can handle
- Prediction: Compare the individual's threshold to the task complexity
- Lower-bound baseline: Individuals always give an incorrect answer

Results

Metric Model	Accuracy
Entropy	87%
Structure	87%
Signature	86%
Contexts	83%
Commands	83%
Moves	83%
Depth	81%
Baseline	76%



Benchmark evaluation results

Thank you for your attention!