Introduction

Equation discovery for integer sequences with probabilistic grammars

- Equation discovery
- Probabilistic grammars
- Integer sequences

Experimental Evaluation (*linrec*)

Algorithm 1 For experimental evaluation of SINDy for *linrec* case

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Input: Matrix $M = [X|\mathbf{y}]$ of observations $X = [\mathbf{a}_{n-1}|...|\mathbf{a}_{n-19}]$ and target $\mathbf{y} = \mathbf{a}_n$

Output: Equation $a_n = \sum_{i=1}^{19} c_i a_{n-i}$ or Failed

1: **function** SINDy's linrec(M)
2:     **for** $p = 1, 2, ..., 19$ **do**
3:         Add $col_p(X)$ to M (i.e. $X = [X|M_p]$)
4:         **if** SINDy_grid($M, d_{max} = 1$) is not Failed **then**
5:             **return** SINDy_grid($M, d_{max} = 1$)
6:         **end if**
7:     **end for**
8:     **return** Failed
9: **end function**

Experimental Evaluation (*linrec*)

Algorithm 2 For experimental evaluation of Diofantos for *linrec* case

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Input: Matrix $M = [X|\mathbf{y}]$ of observations $X = [\mathbf{a}_{n-1}|...|\mathbf{a}_{n-19}]$ and target $\mathbf{y} = \mathbf{a}_n$

Output: Equation $a_n = \sum_{i=1}^{19} c_i a_{n-i}$ or Failed

1: **function** Diofantos's linrec(M)
2:     **for** $p = 1, 2, ..., 19$ **do**
3:         Add $col_p(X)$ to M (i.e. $X = [X|M_p]$)
4:         **if** Diofantos$(M, d_{max} = 1)$ is not Failed **then**
5:             **return** Diofantos$(M, d_{max} = 1)$
6:         **end if**
7:     **end for**
8:     **return** Failed
9: **end function**

Experimental Evaluation (*linrec*)

Algorithm 3 For experimental evaluation of SINDy for *linrec* case

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Input: Matrix $M = [X|\mathbf{y}]$ of observations $X = [\mathbf{a}_{n-1}|...|\mathbf{a}_{n-19}]$ and target $\mathbf{y} = \mathbf{a}_n$

Output: Equation $a_n = \sum_{i=1}^{19} c_i a_{n-i}$ or Failed

1: **function** SINDy's linrec(M)
2:     **for** $p = 1, 2, ..., 19$ **do**
3:         Add $col_p(X)$ to M (i.e. $X = [X|M_p]$)
4:         **if** SINDy_grid$(M, d_{max} = 1)$ is not Failed **then**
5:             **return** SINDy_grid$(M, d_{max} = 1)$
6:         **end if**
7:     **end for**
8:     **return** Failed
9: **end function**

Experimental Evaluation (*core*)

Algorithm 4 For experimental evaluation of Diofantos for *core* case

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Input: Matrix $M = [X|\mathbf{y}]$ of observations $X = [\mathbf{n}|\mathbf{a}_{n-1}|...|\mathbf{a}_{n-10}]$ and target $\mathbf{y} = \mathbf{a}_n$

Output: Equation $a_n = f(n, a_{n-1}, ... a_{n-10})$ or Failed

 1: **function** Diofantos's core(M)
 2:     M = [**y**]
 3:     **for** $p = 1, 2, ..., 10$ **do**
 4:         Add $col_p(X)$ to M (i.e. $X = [X|M_p]$)
 5:         **for** $d_{max} = 1, 2, 3$ **do**
 6:             **if** Diofantos(M, d_{max}) is not Failed **then**
 7:                 **return** Diofantos(M, d_{max})
 8:             **end if**
 9:         **end for**
10:     **end for**
11:     **return** Failed
12: **end function**

Experimental Evaluation (*core*) with SINDy

Algorithm 5 For experimental comparison of SINDy for *core* case

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Input: Matrix $M = [X|\mathbf{a}_n]$ of observations $X = [\mathbf{n}|\mathbf{a}_{n-1}|...|\mathbf{a}_{n-10}]$
Output: Equation $a_n = f(n, a_{n-1}, ...a_{n-10})$ or Failed

1: **function** SINDy's core(M)
2:      M = [**n**|**y**]
3:      **for** $p = 1, 2, ..., 10$ **do**
4:          Remove column **n** and add column $\mathbf{a}_{n-p}$ to M
5:          **if** SINDy_grid(M, d_{max}) is not Failed **then**
6:              **return** SINDy_grid($M, d_{max} = 1$)
7:          **end if**
8:          Add column of observations corresponding to n to M
9:          **if** SINDy_grid(M, d_{max}) is not Failed **then**
10:             **return** SINDy_grid($M, d_{max} = 1$)
11:         **end if**
12:     **end for**
13:     **return** Failed