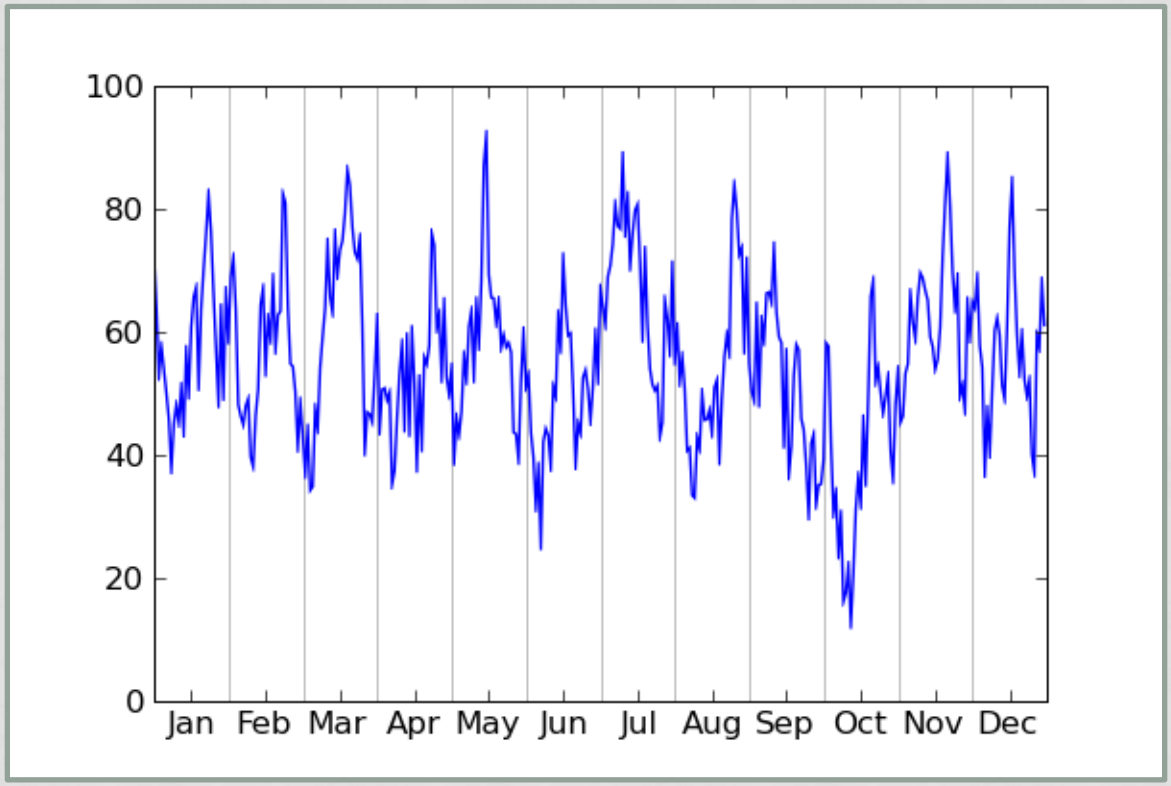
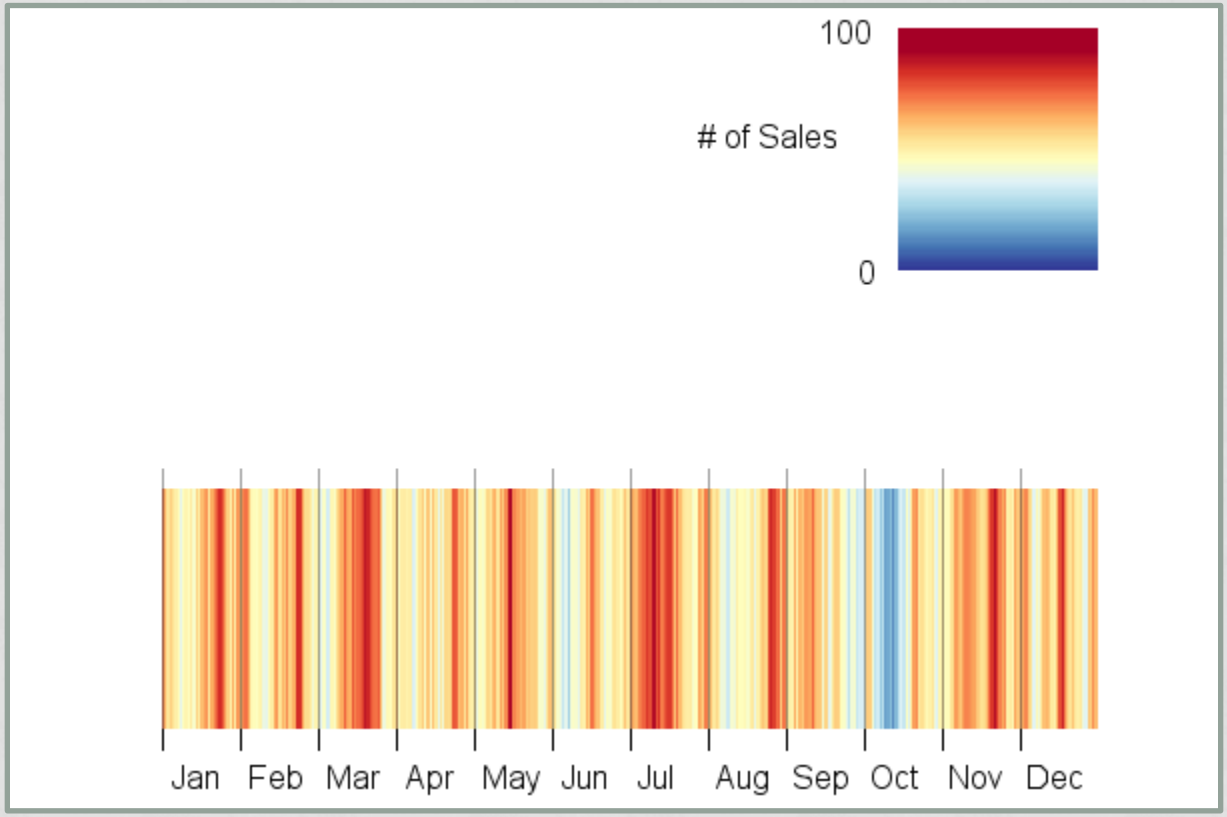
COMPARING AVERAGES IN TIME SERIES DATA

MICHAEL CORRELL, DANIELLE ALBERS,
STEVE FRANCONERI, MICHAEL GLEICHER

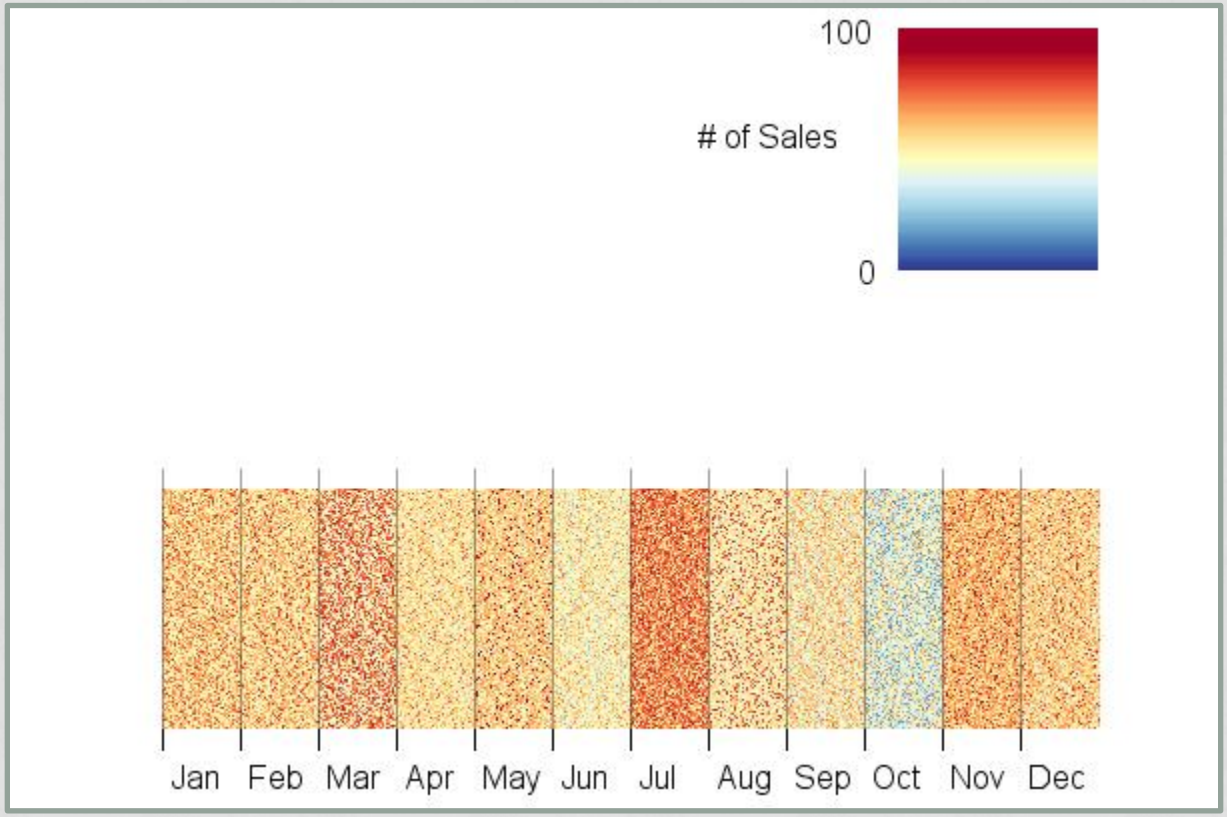
INTRODUCTION



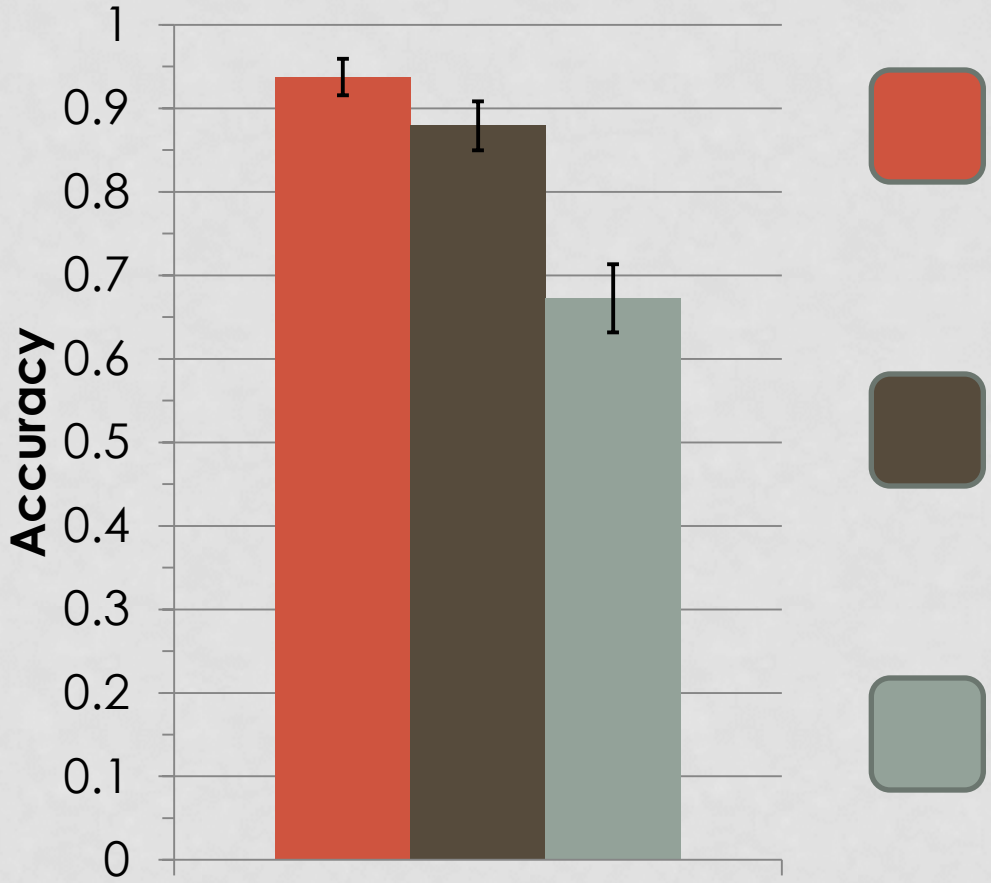
INTRODUCTION

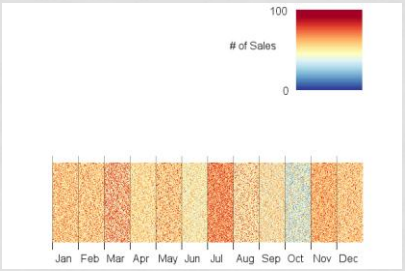


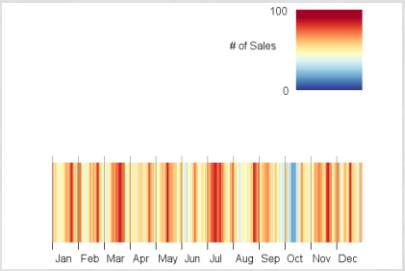
INTRODUCTION

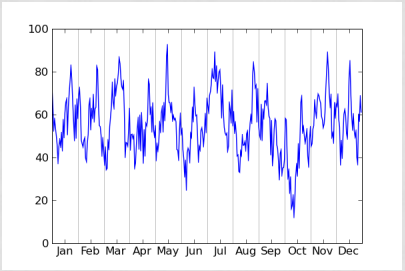


INTRODUCTION









INTRODUCTION

OUTLINE

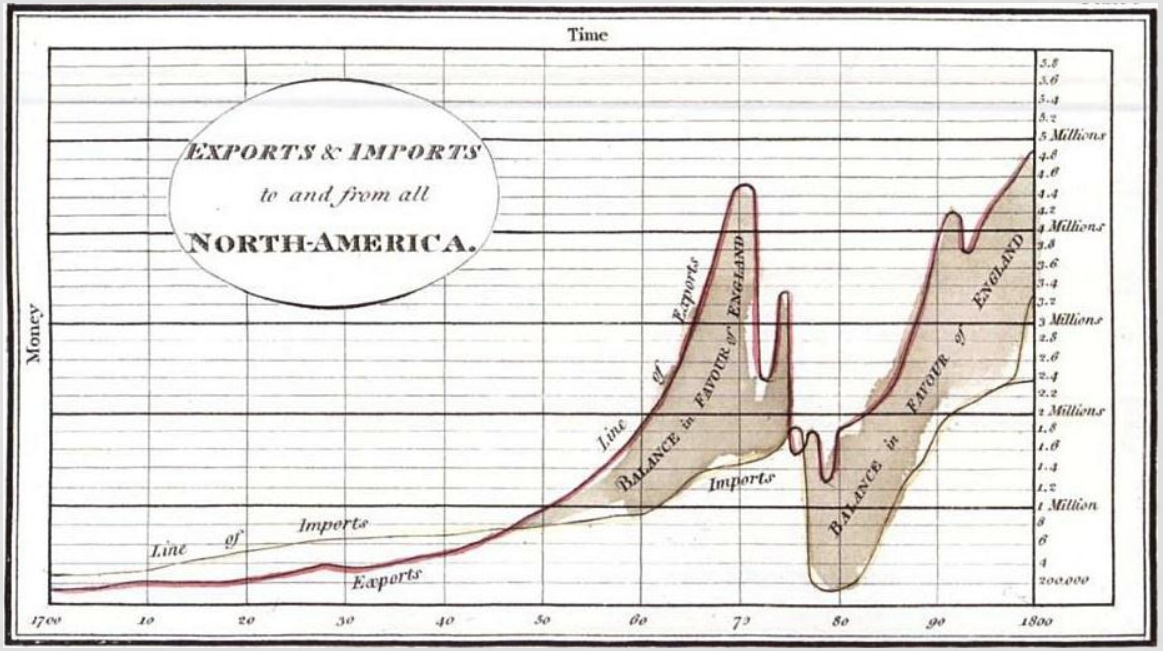
Motivation

Visual Design

Experiment

Discussion

MOTIVATION


Time
Money
EXPORTS & IMPORTS
to and from all
NORTH-AMERICA.
Line of Exports
BALANCE in FAVOUR of ENGLAND
Line of Imports
Exports
Imports
BALANCE in FAVOUR of ENGLAND
1700
10
20
30
40
50
60
70
80
90
1800

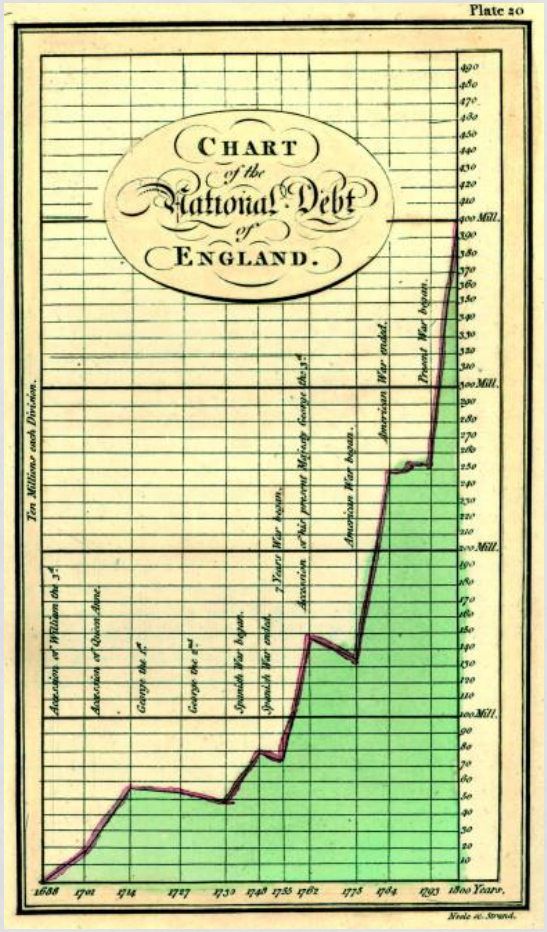
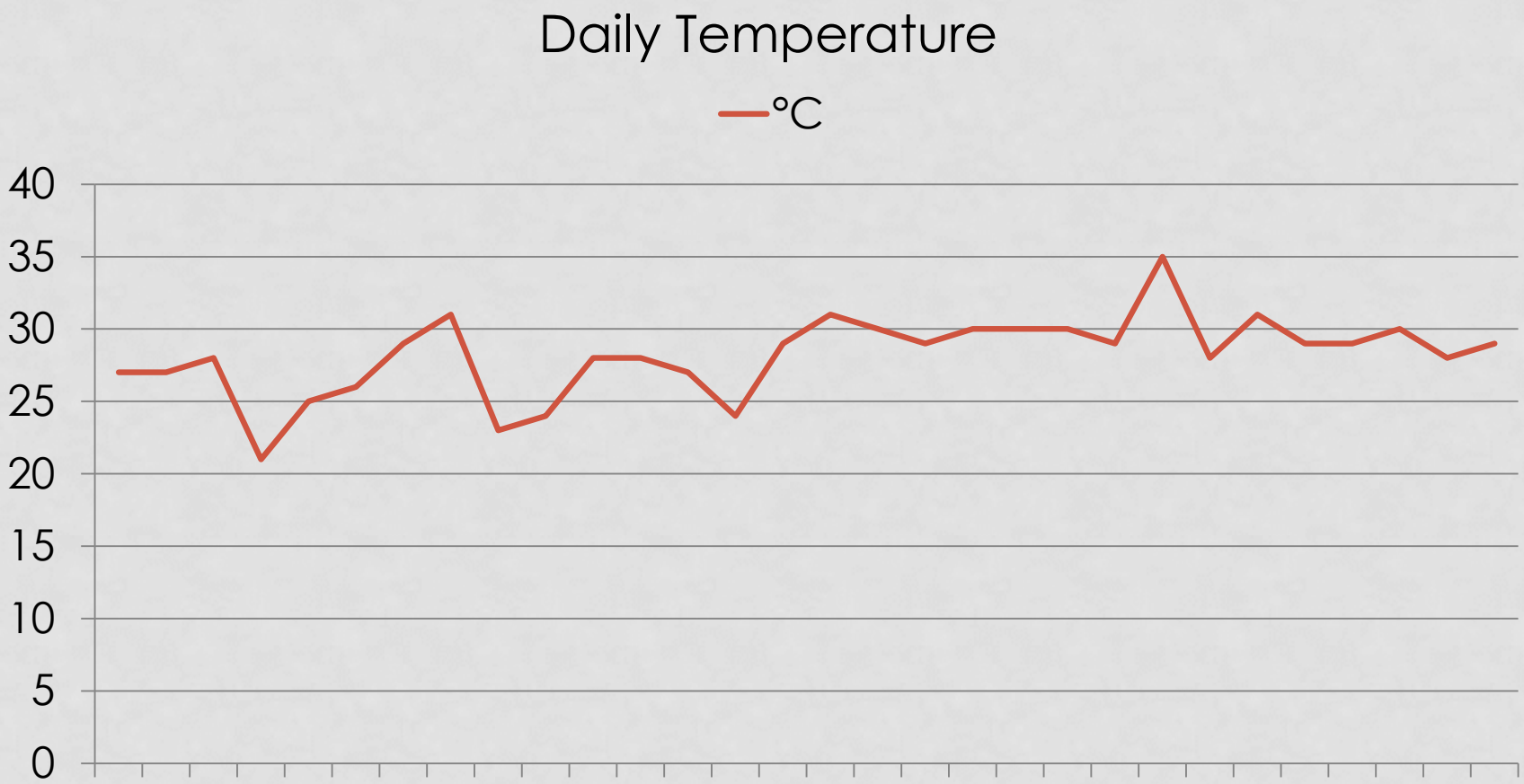


Plate 20
CHART
of the
National Debt
of
ENGLAND.
Ten Millions each Division.
Accession of William the 3d.
Accession of Queen Anne.
George the 1st.
George the 2nd.
Spanish War begun.
Spanish War ended.
7 Years War begun.
Accession of his present Majesty George the 3d.
American War begun.
American War ended.
French War begun.
1688
1701
1714
1727
1739
1748
1756
1762
1775
1784
1793
1800 Years.

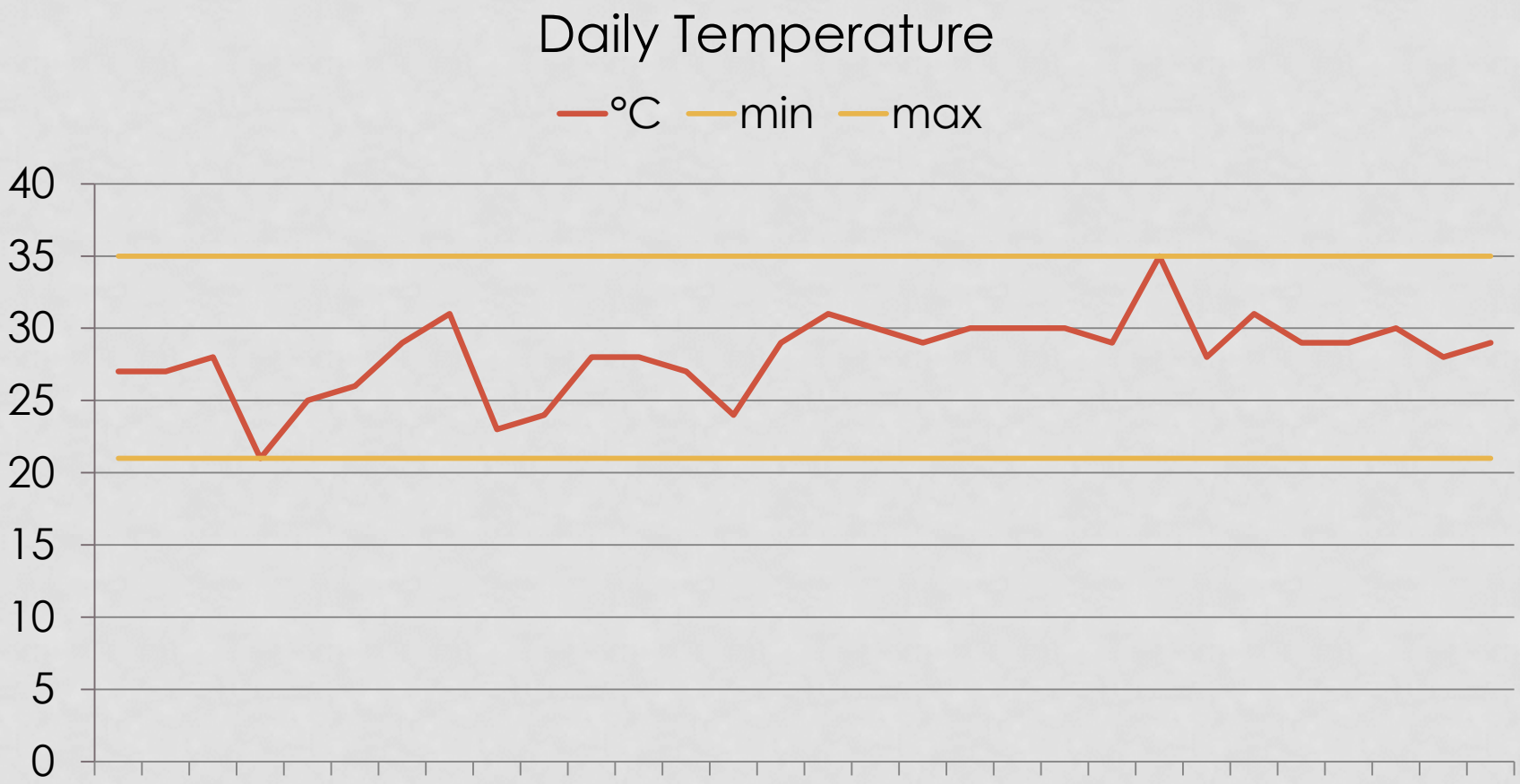
INFOVIS MANTRA

1. **Overview**
2. Zoom & Filter
3. Details on Demand

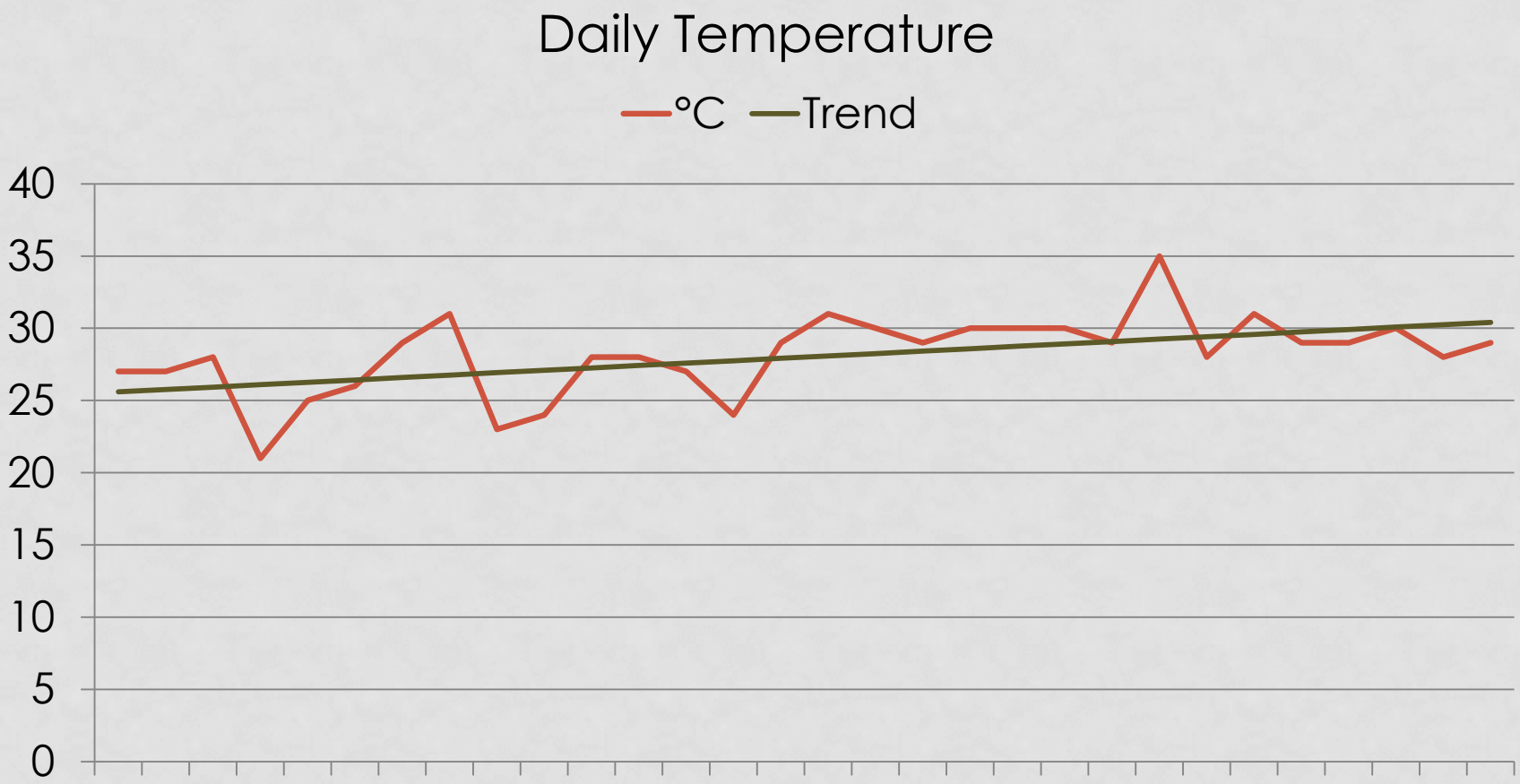
MOTIVATION



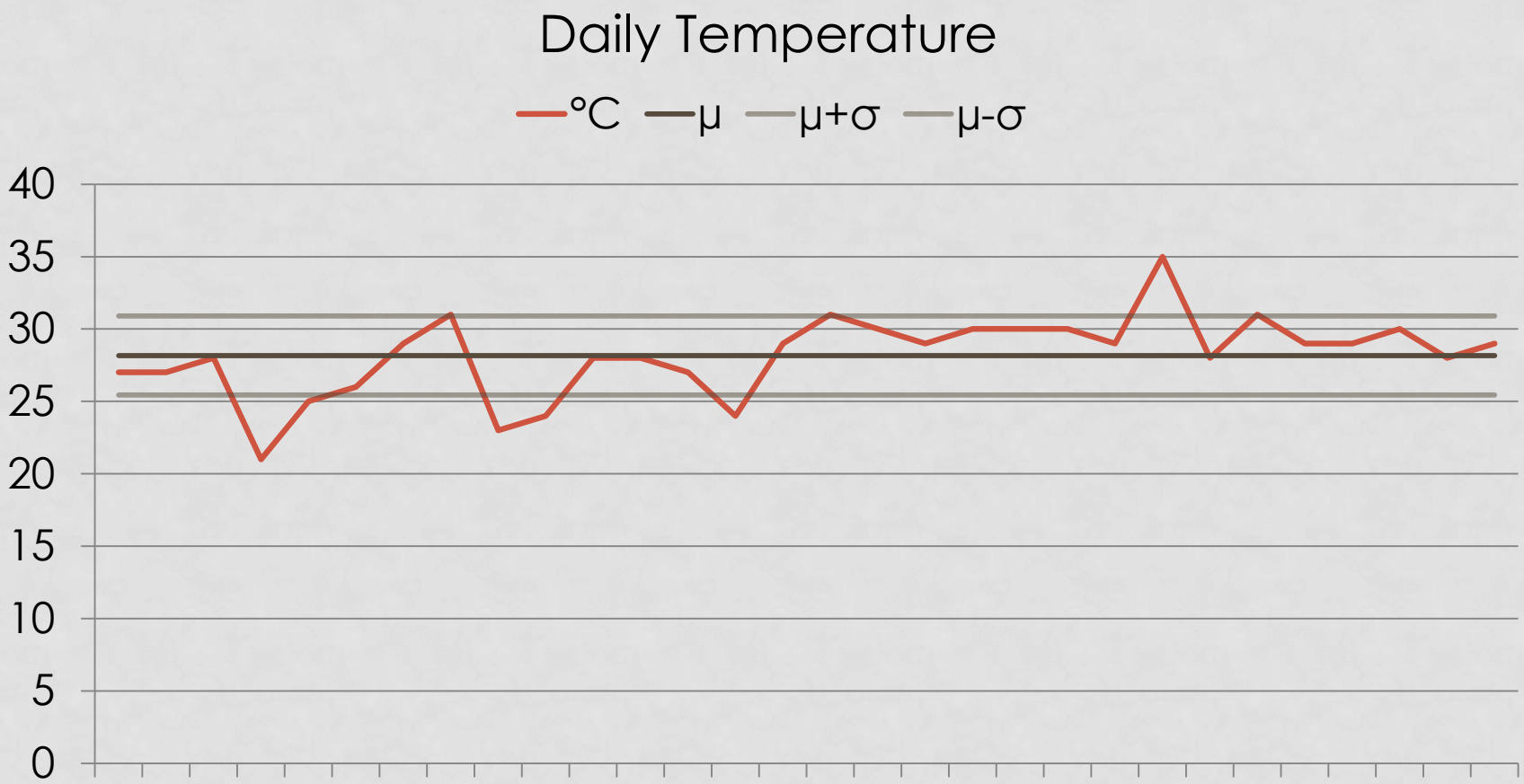
MOTIVATION



MOTIVATION



MOTIVATION



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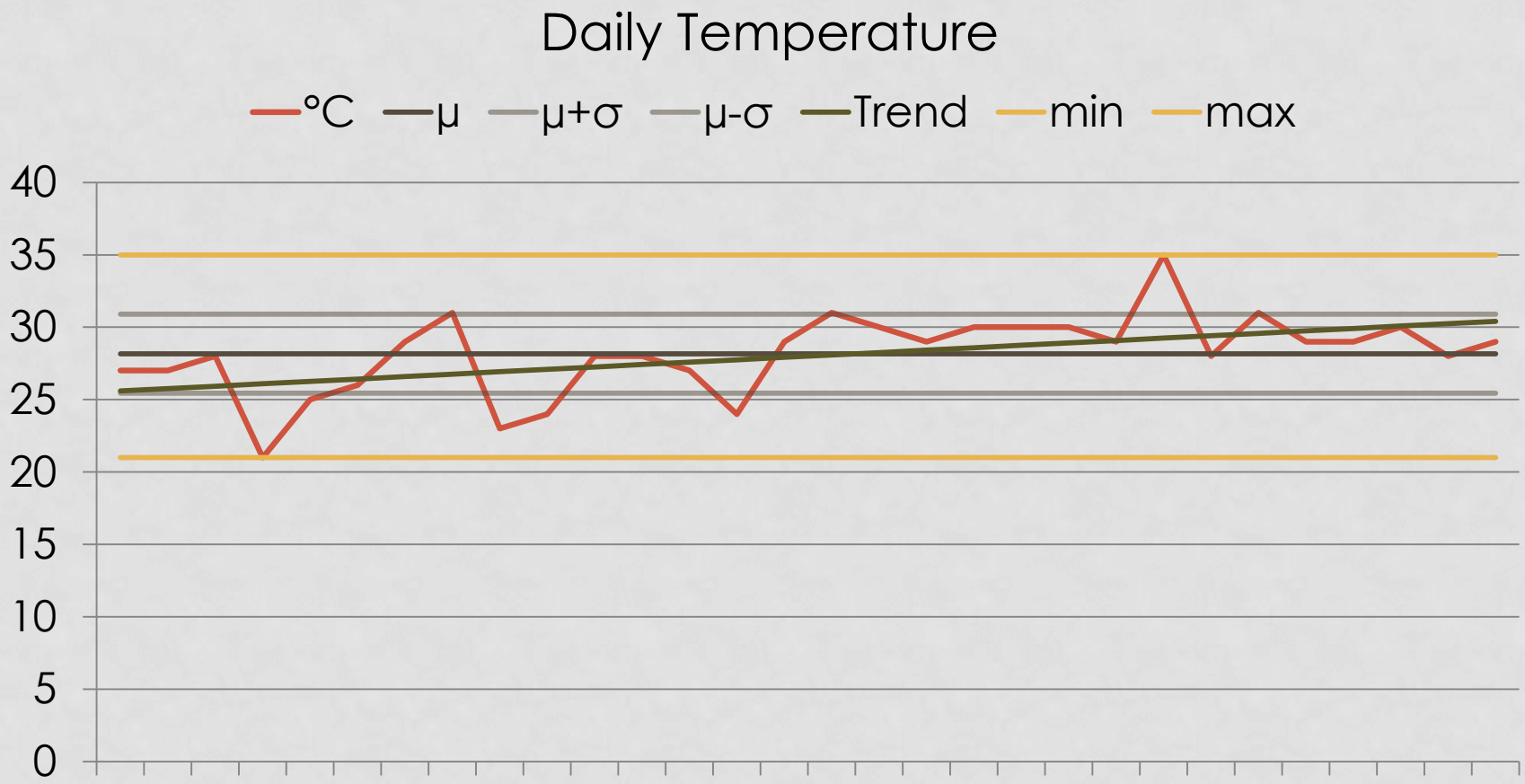

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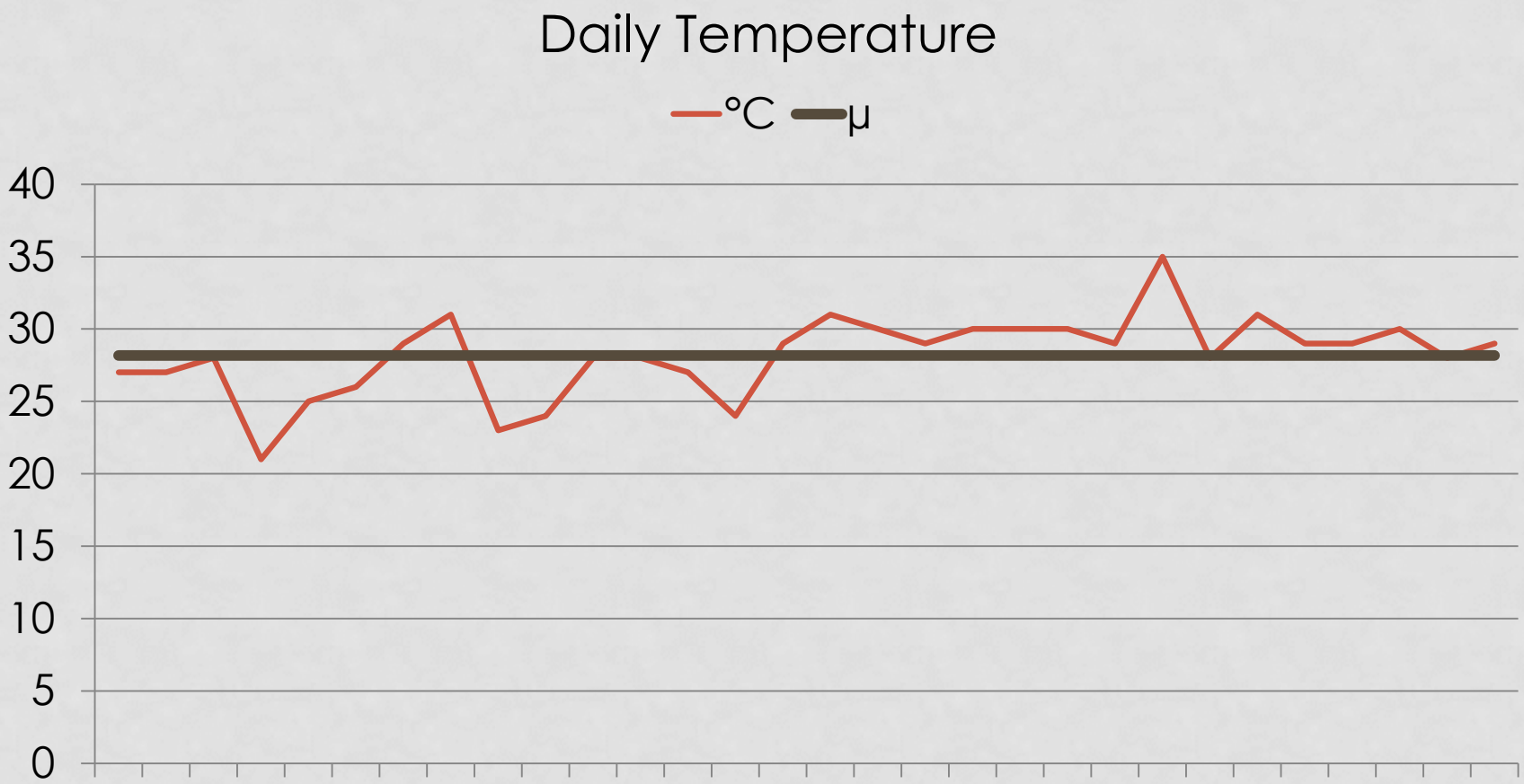
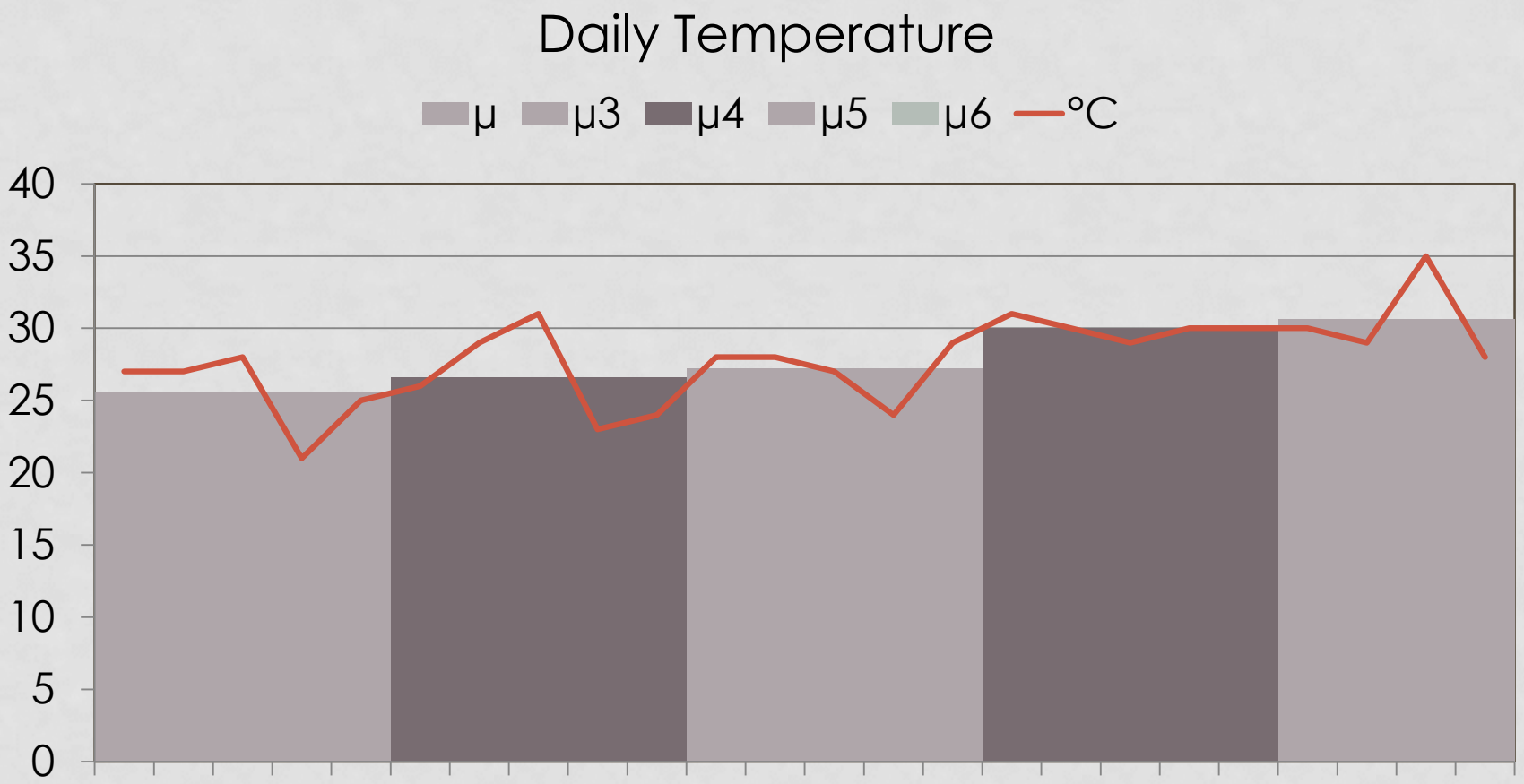
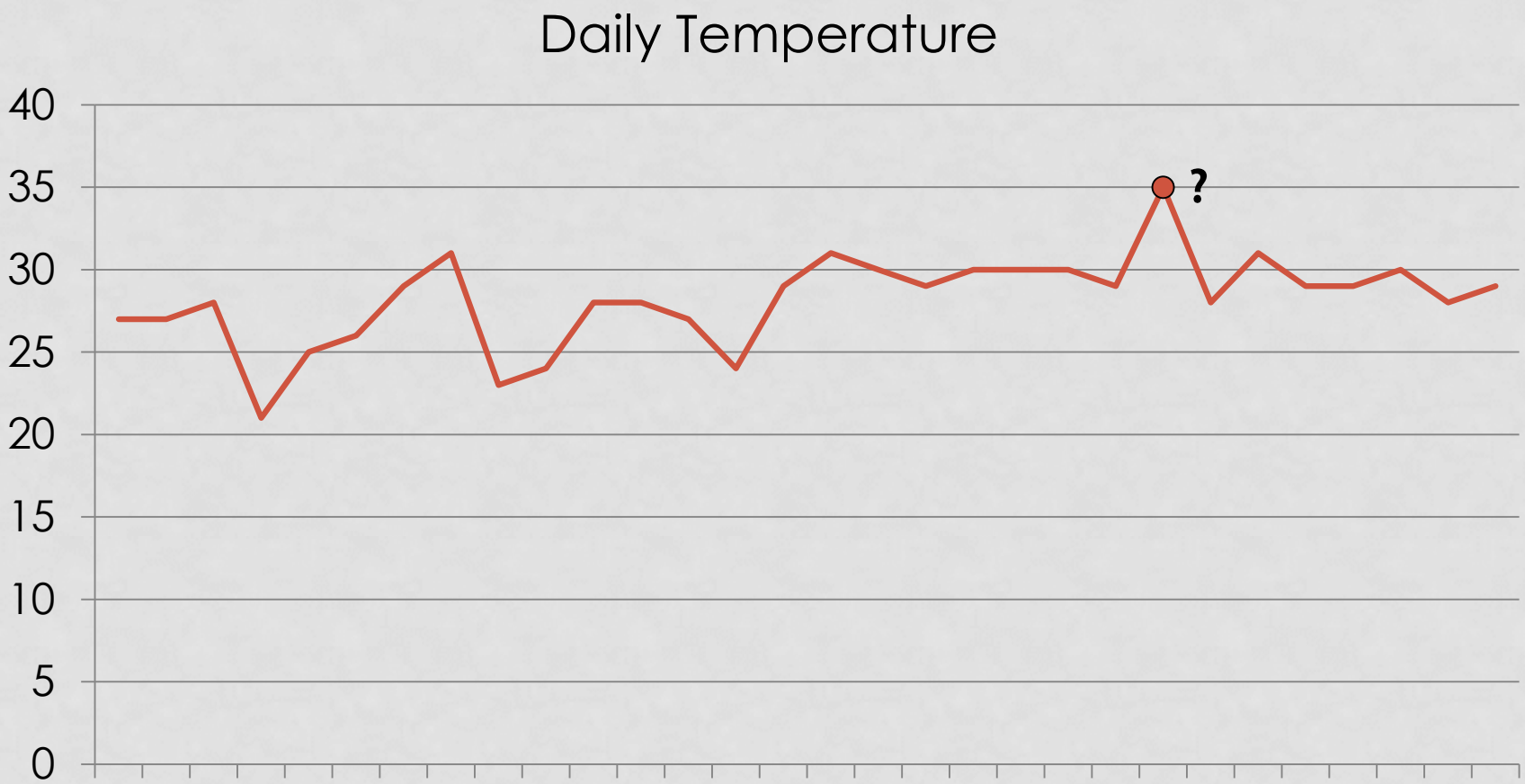


MOTIVATION

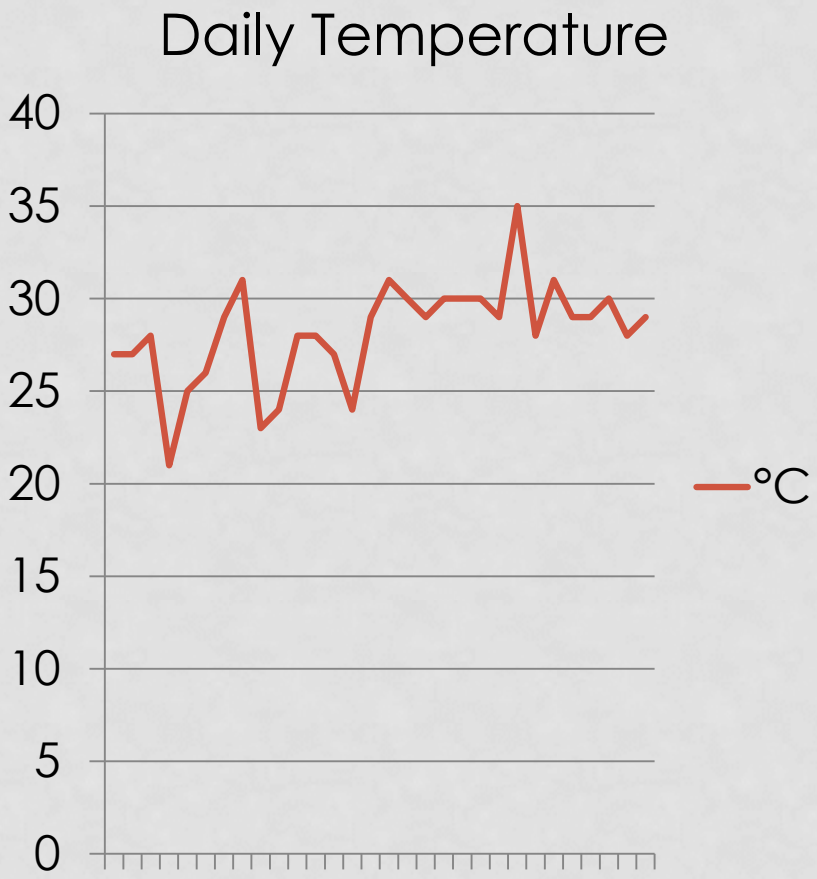


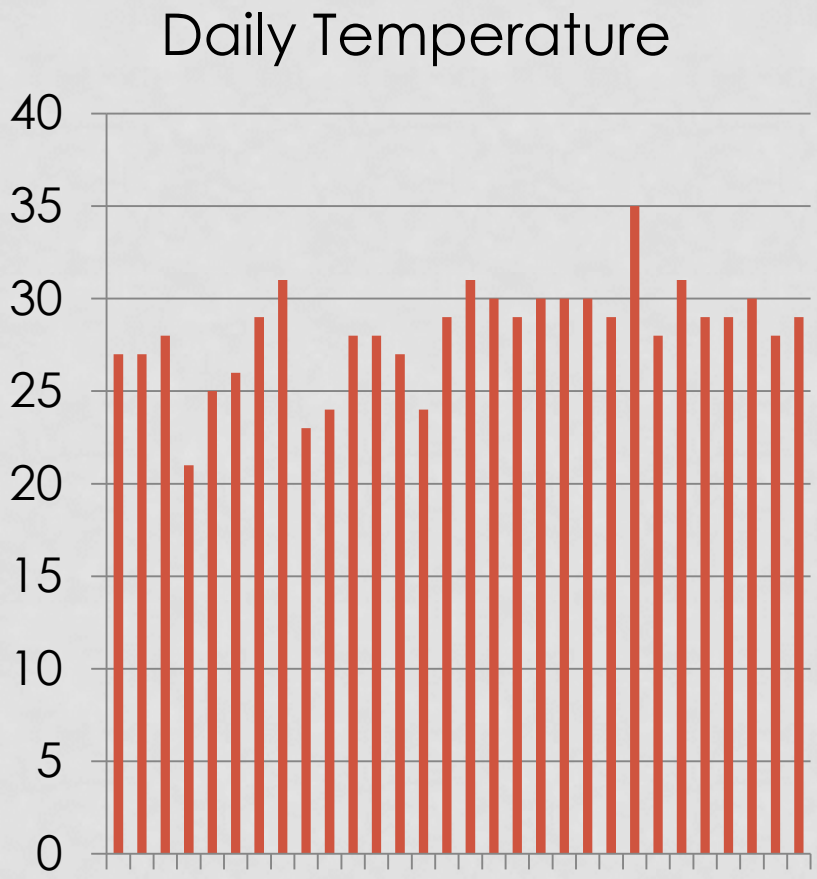
MOTIVATION



Cleveland & McGill 1984

MOTIVATION





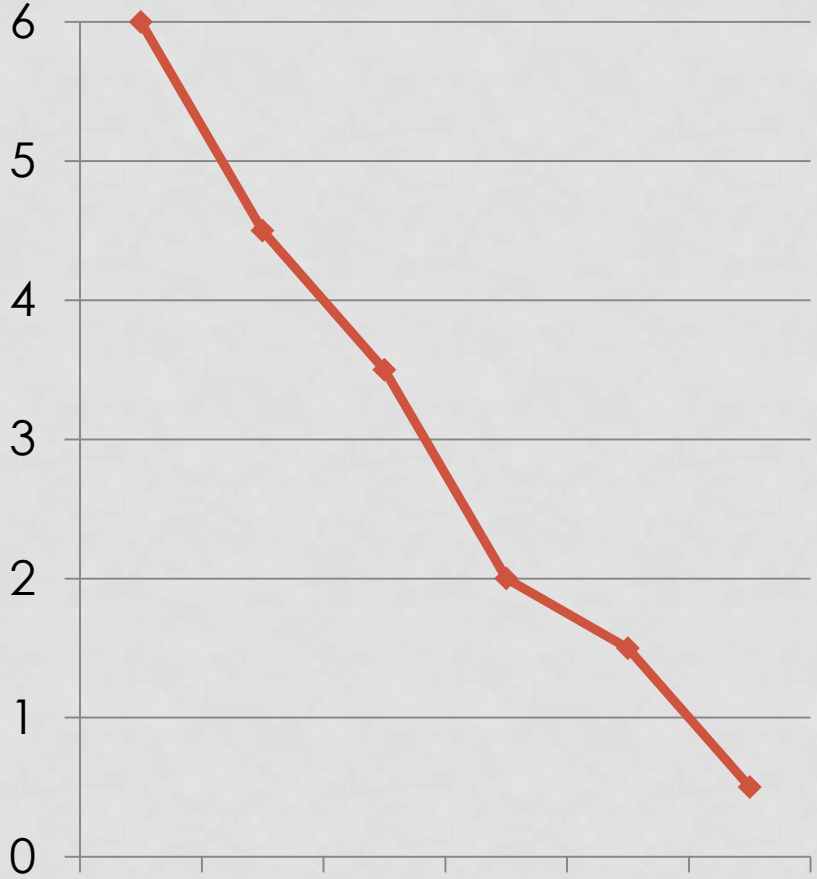
Shah, Mayer, Hegarty 1999

RESEARCH QUESTIONS

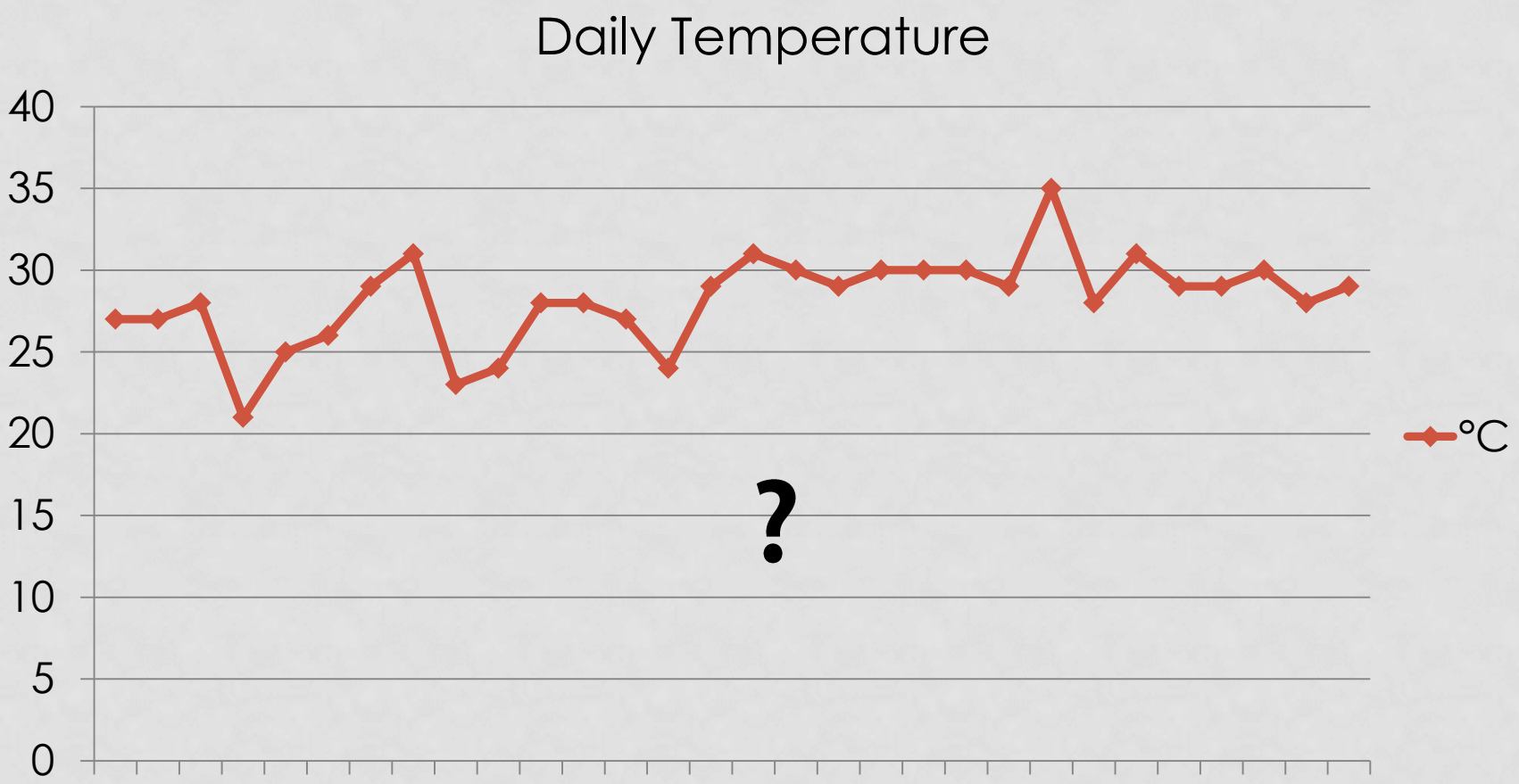
Can users extract aggregate statistics from time series data?

Can different encodings improve performance at this task?

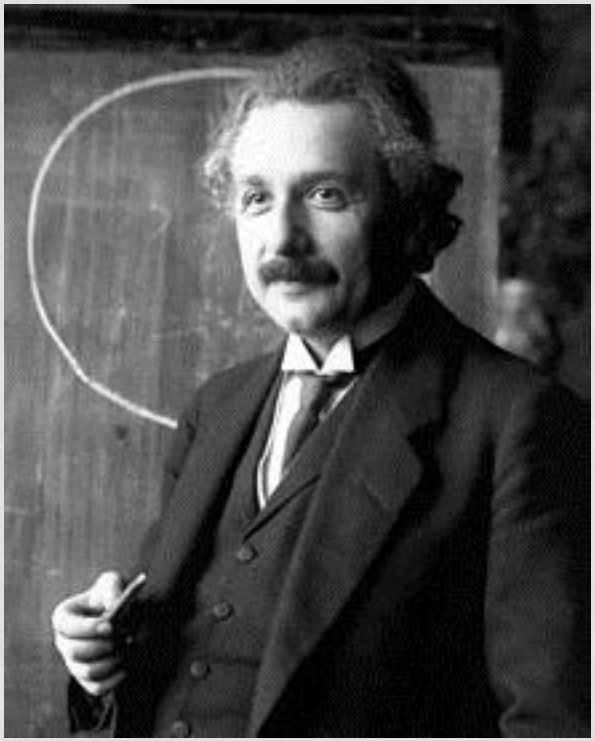
SHAPE AVERAGING



SHAPE AVERAGING



COLOR AGGREGATION



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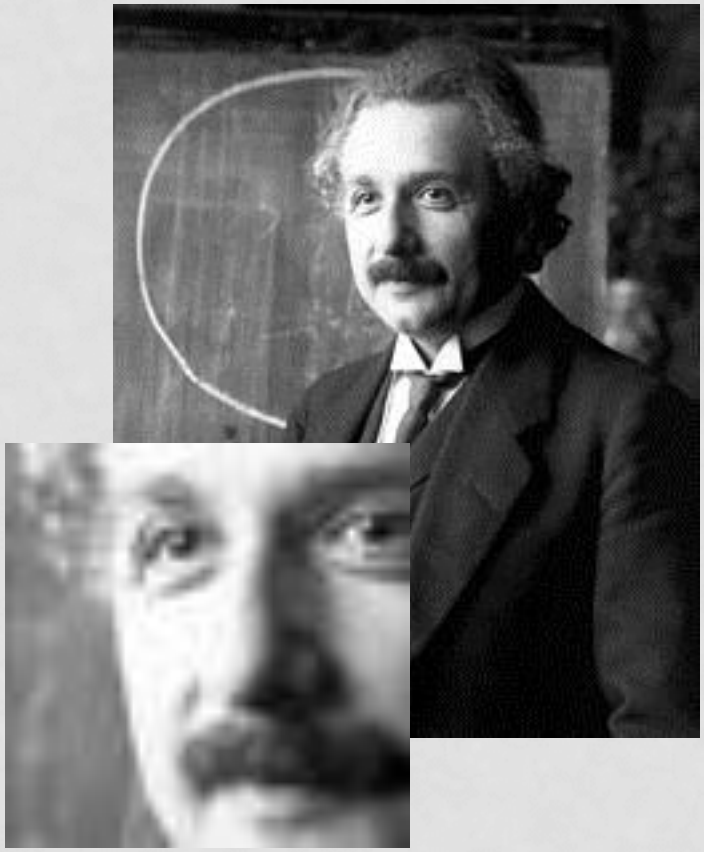

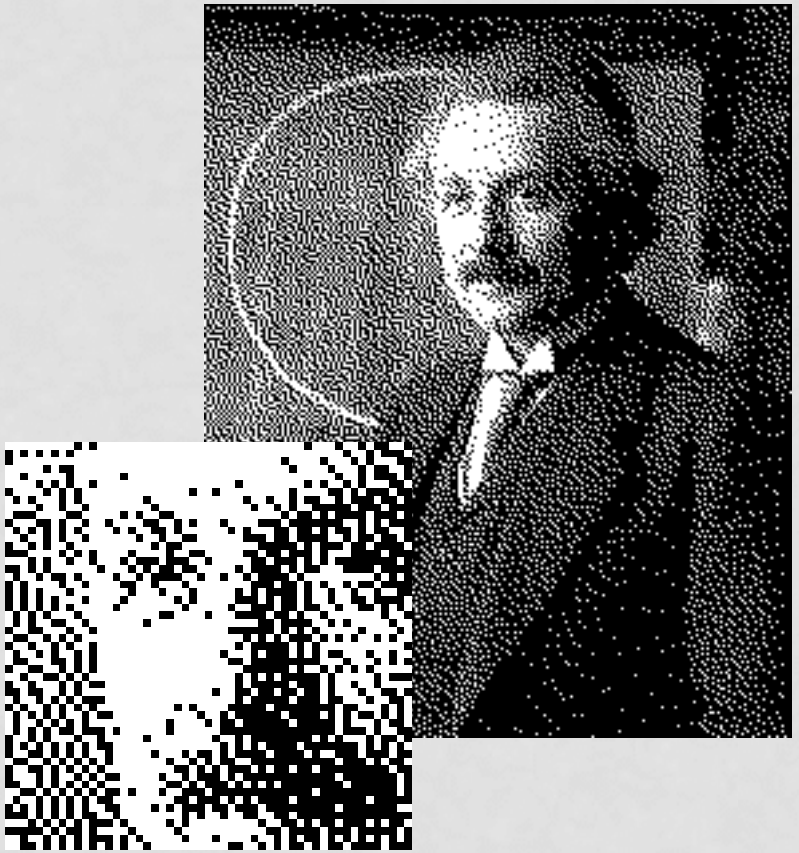

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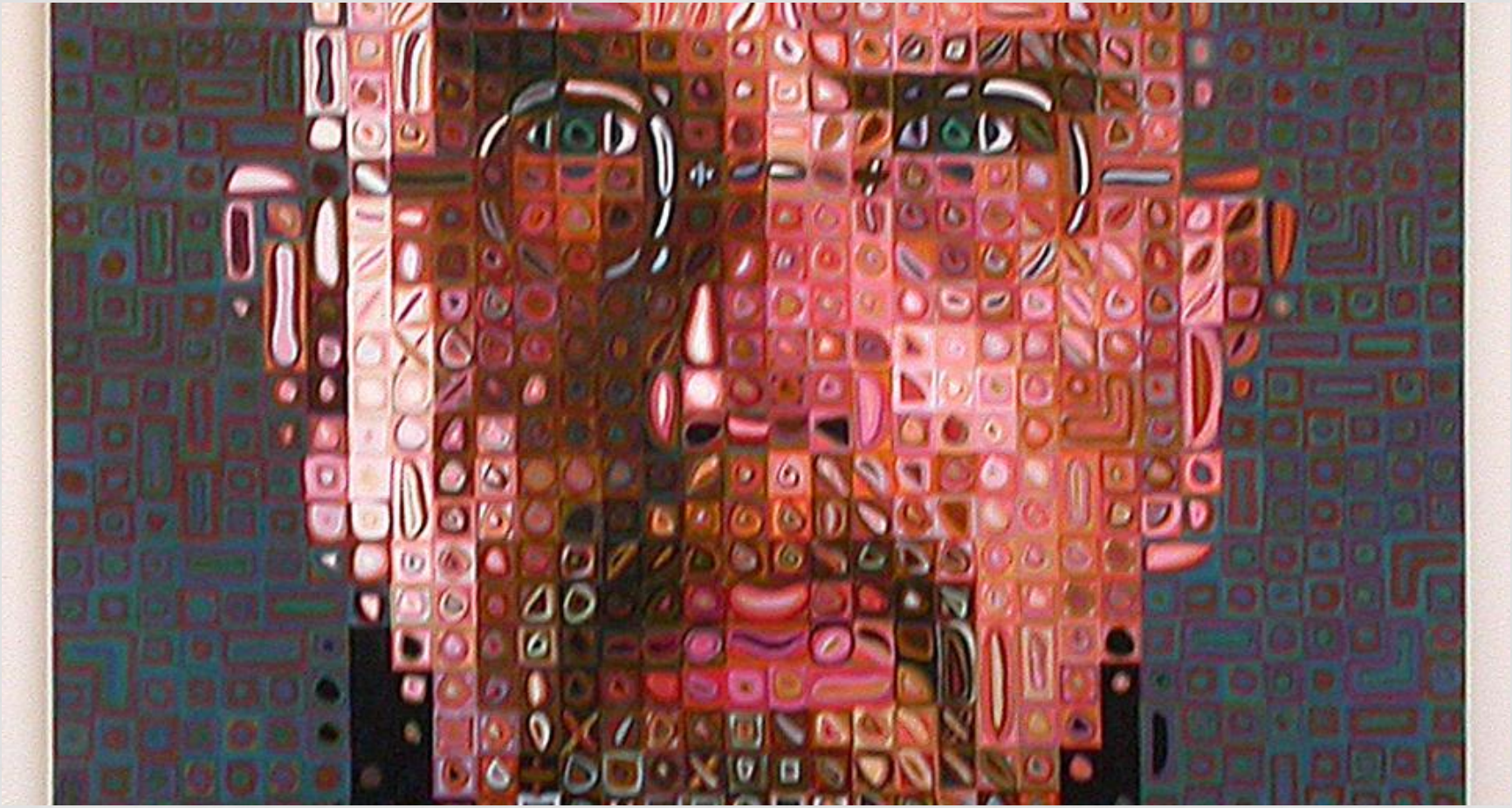

COLOR AGGREGATION

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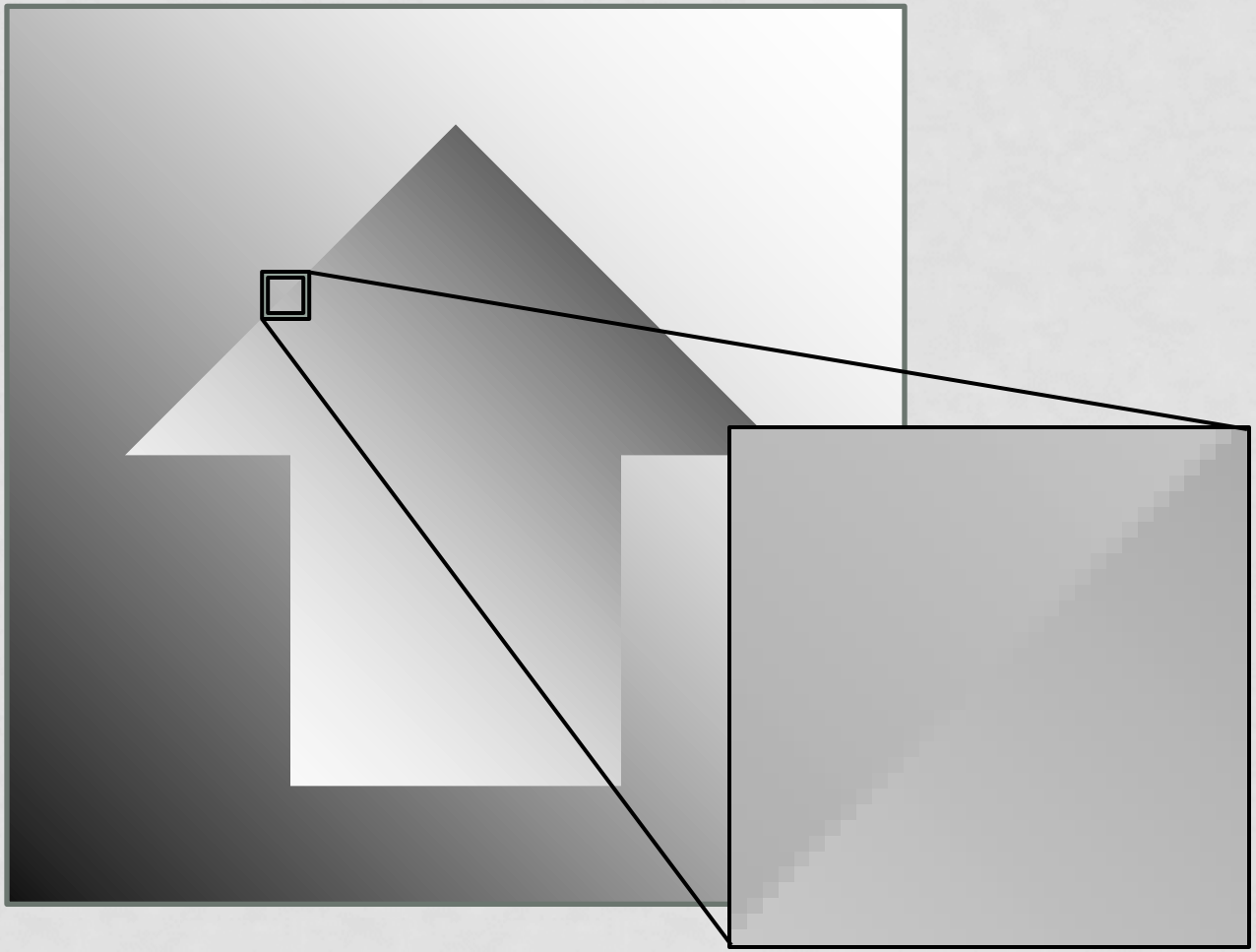

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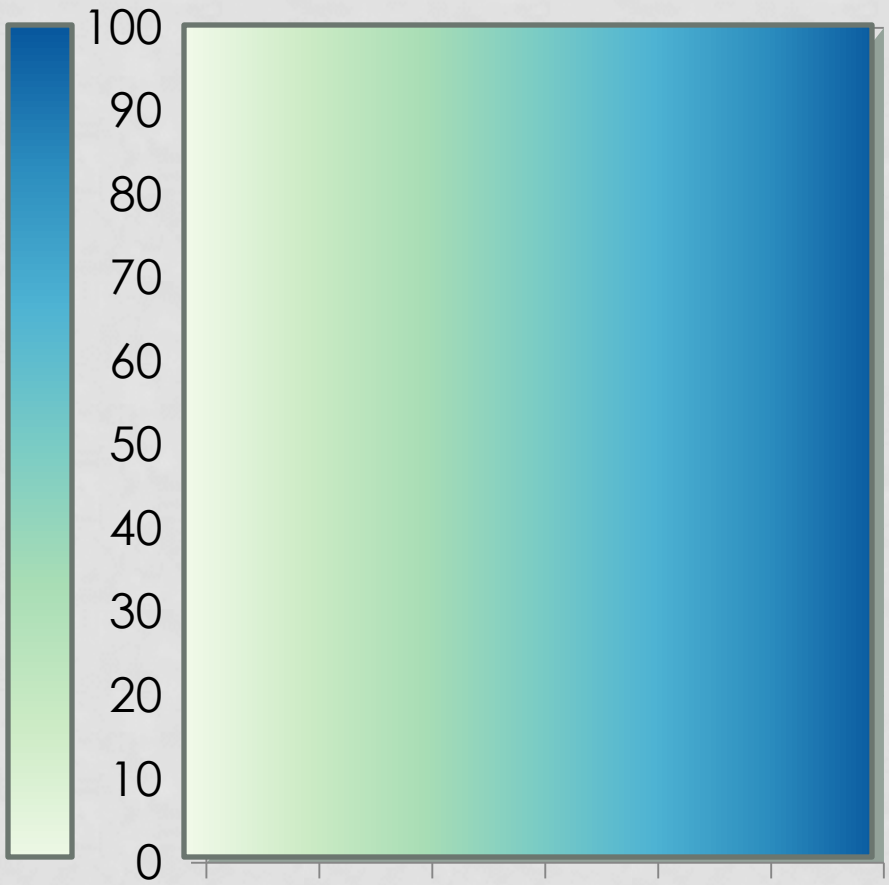

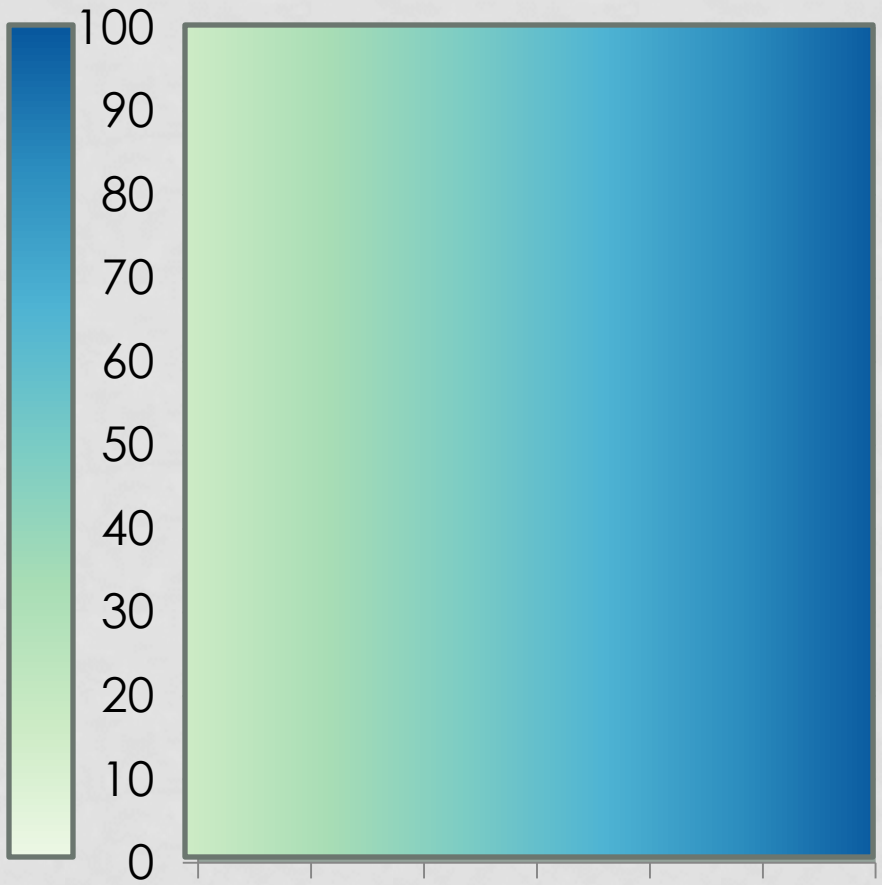

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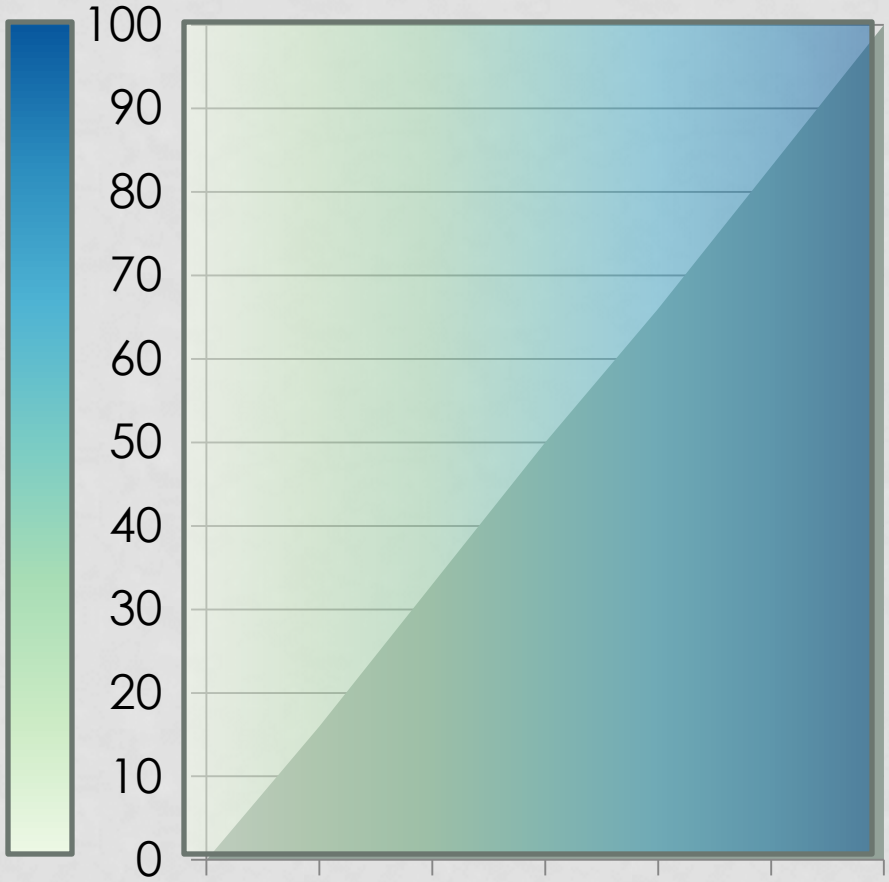

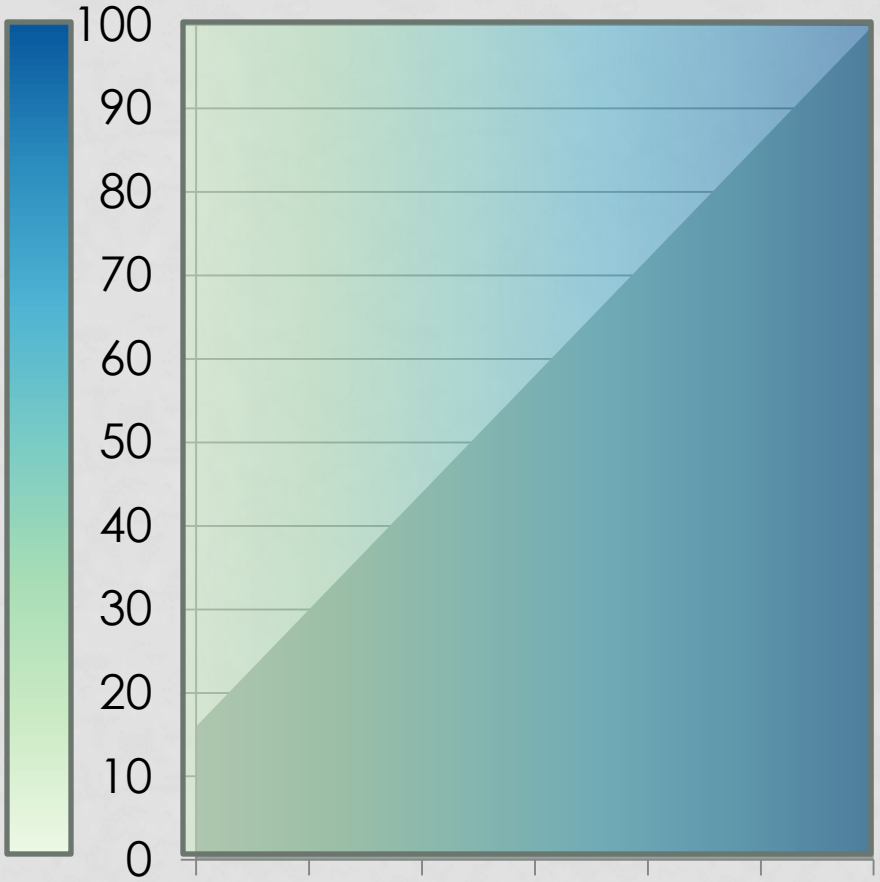

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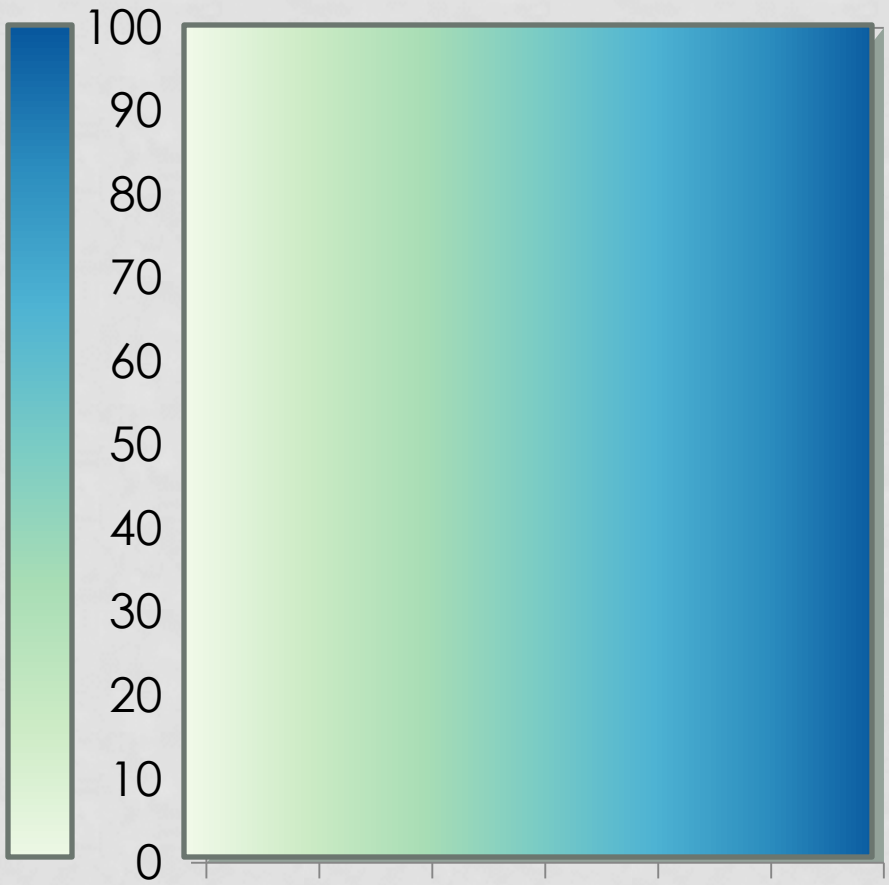

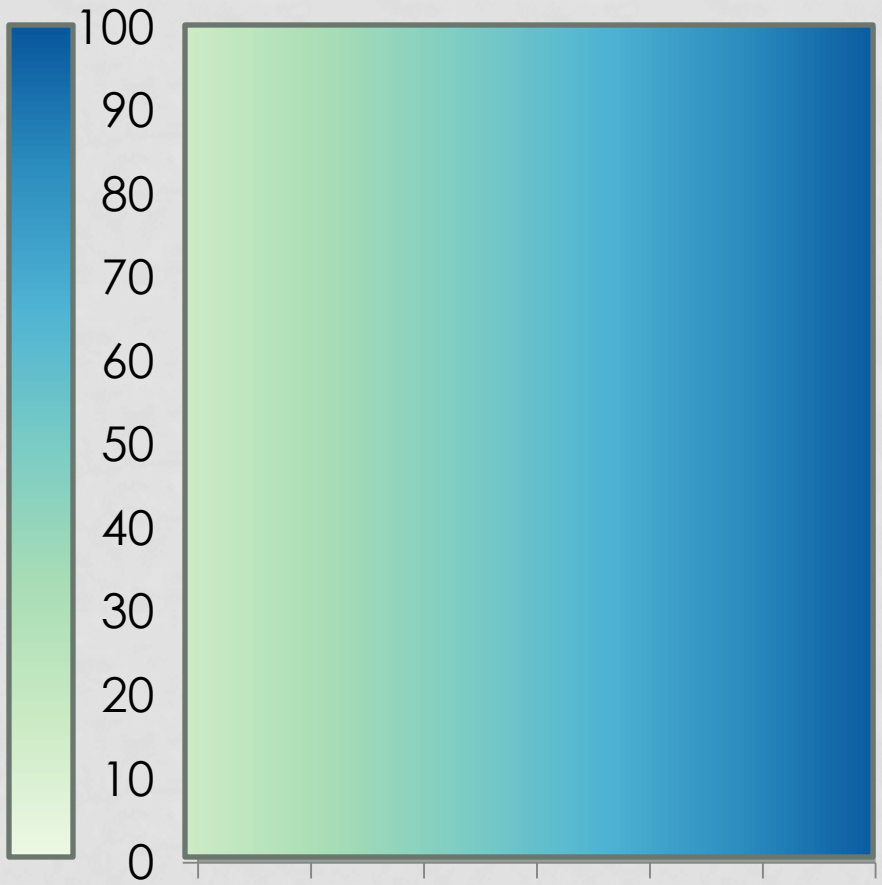

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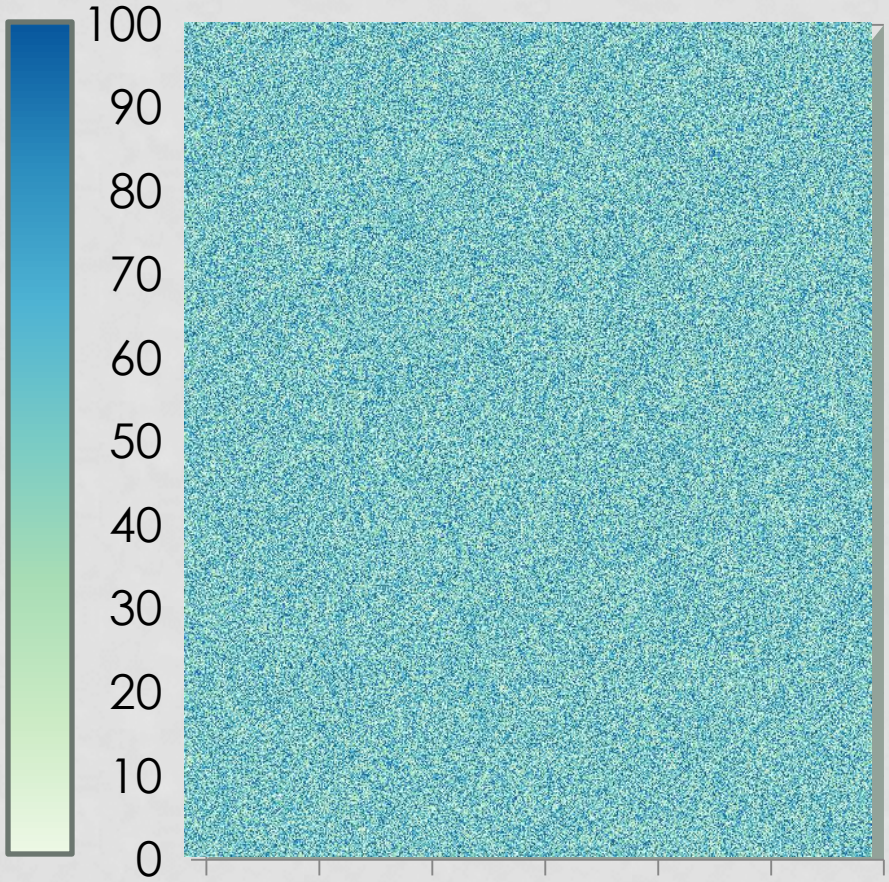
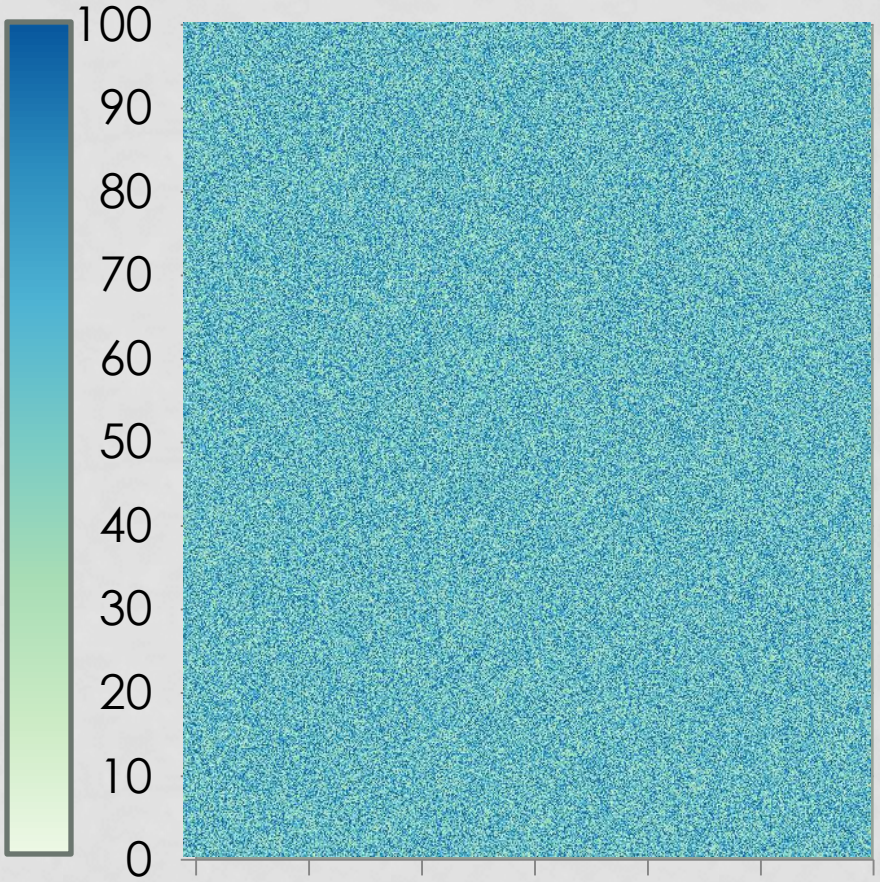
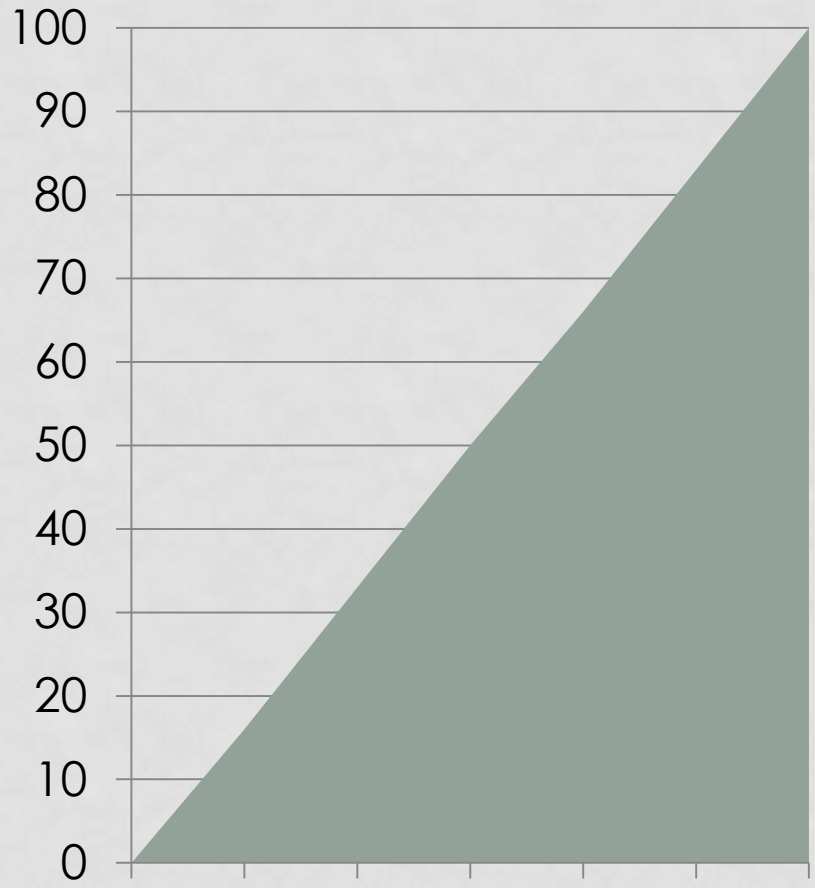
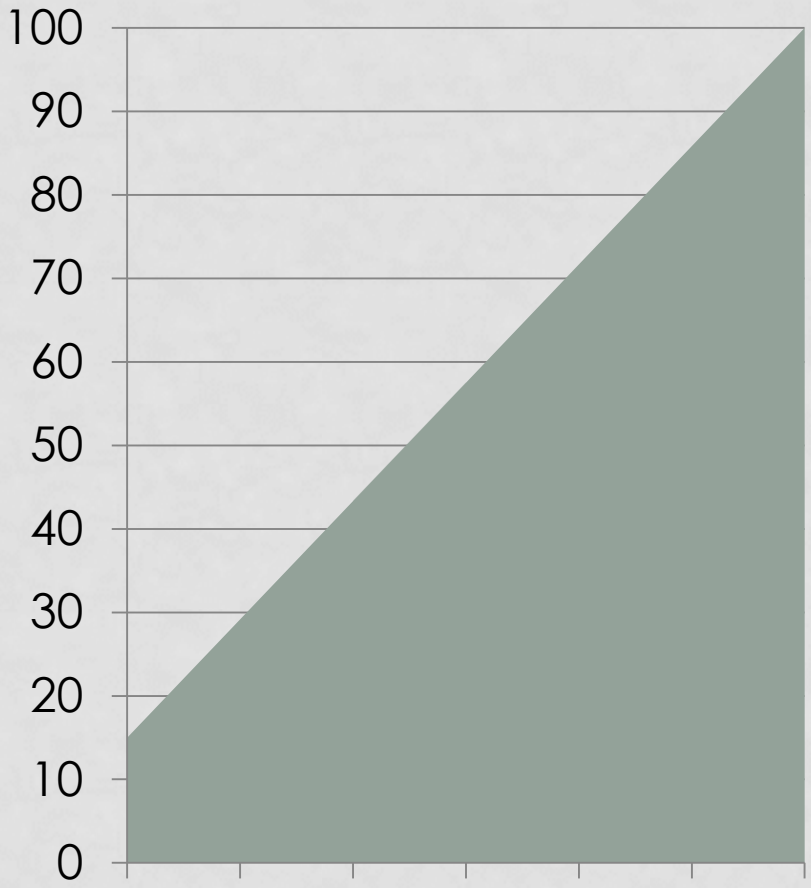


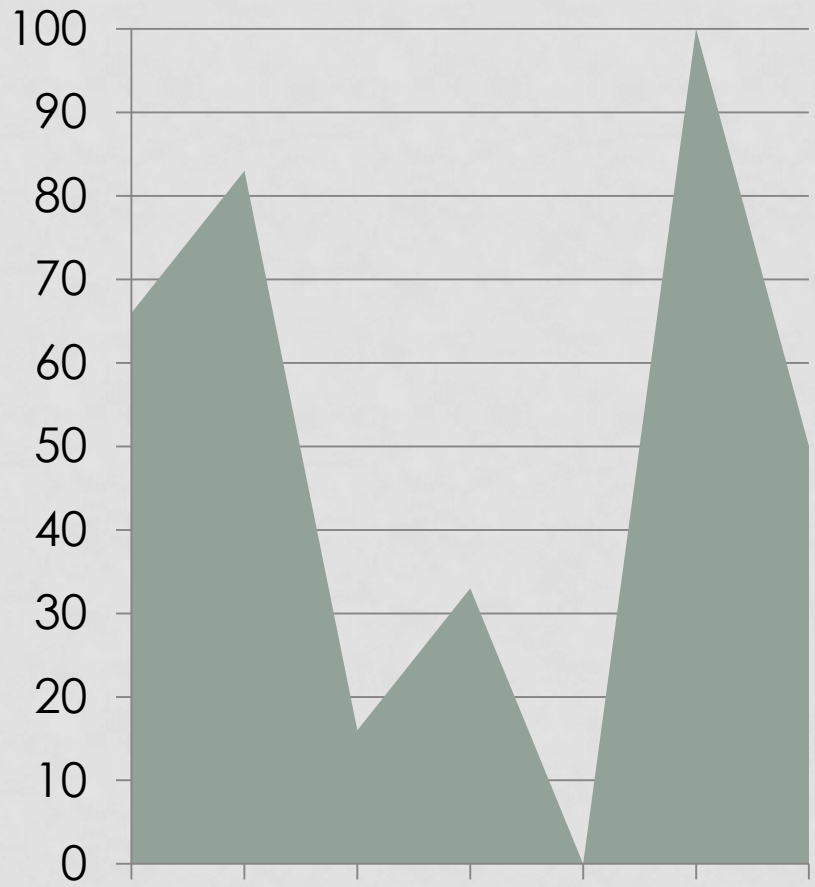


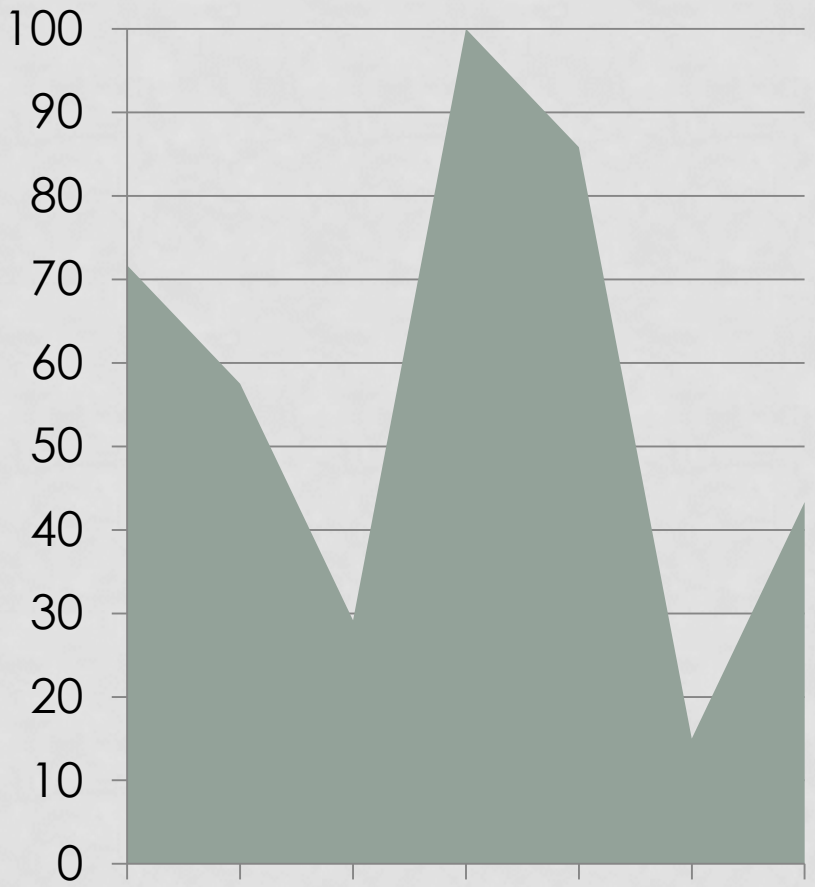
SHAPE PERMUTATION?





SHAPE PERMUTATION?





OUTLINE

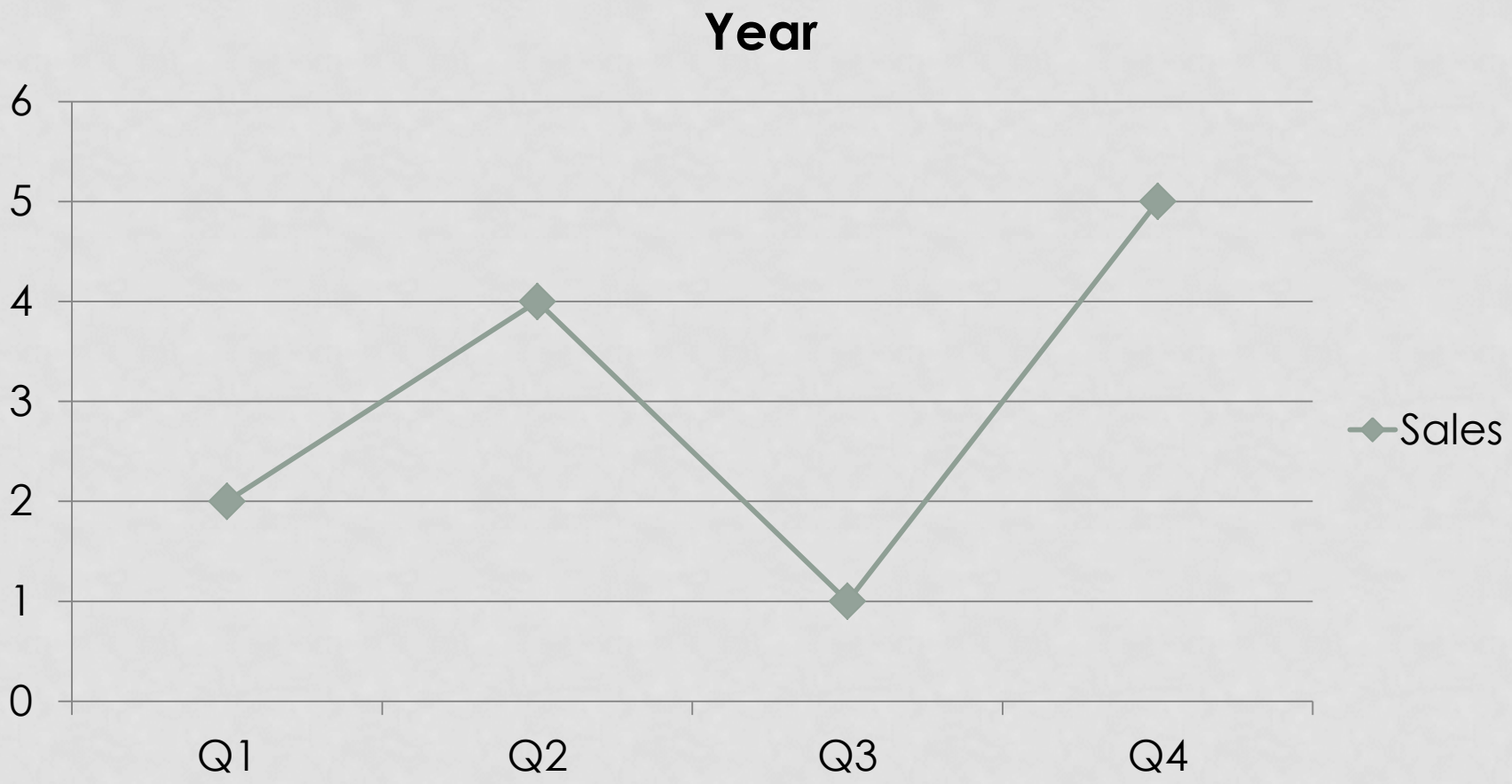
Motivation

Visual Design

Experiment

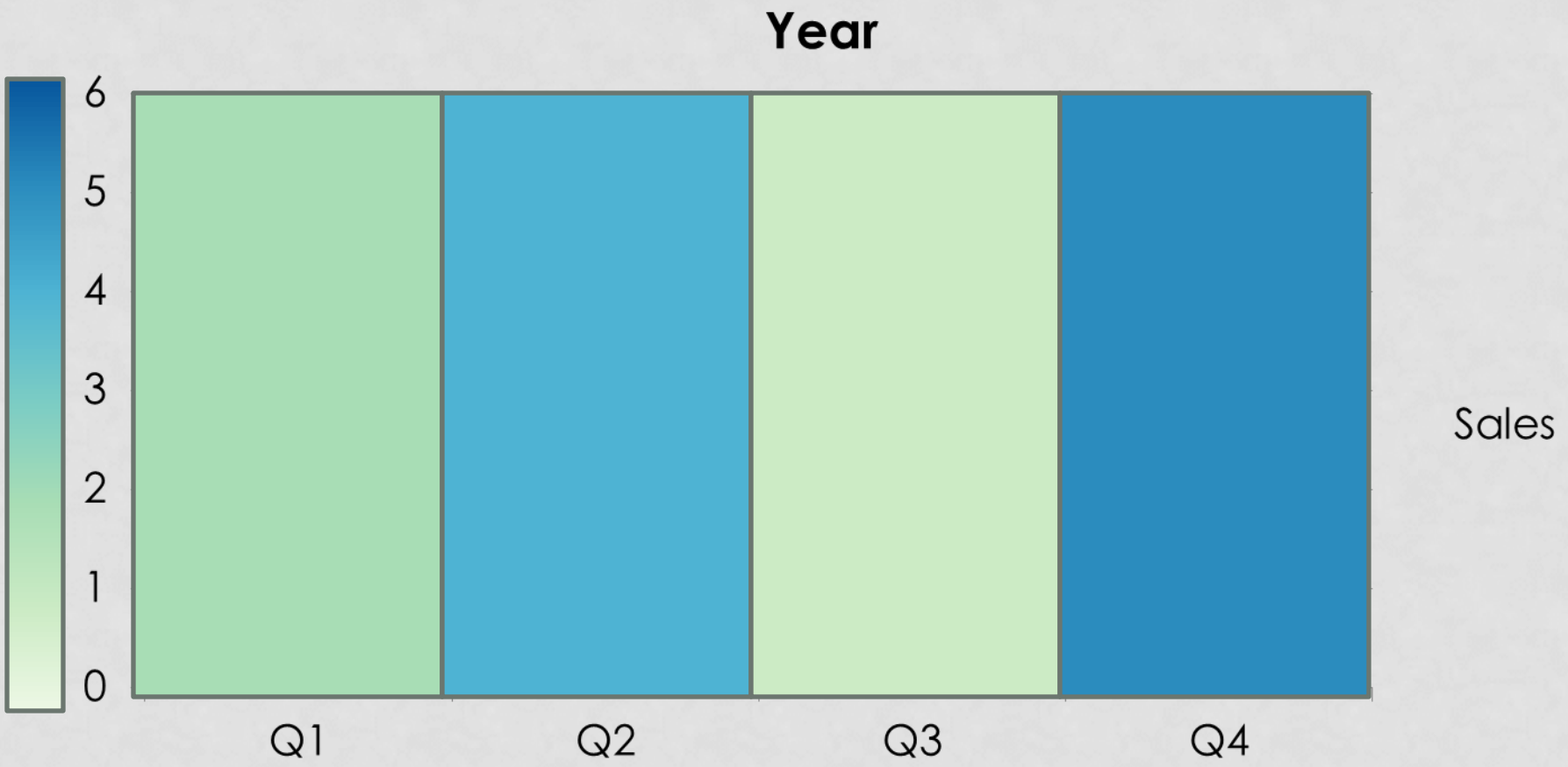
Discussion

DESIGN

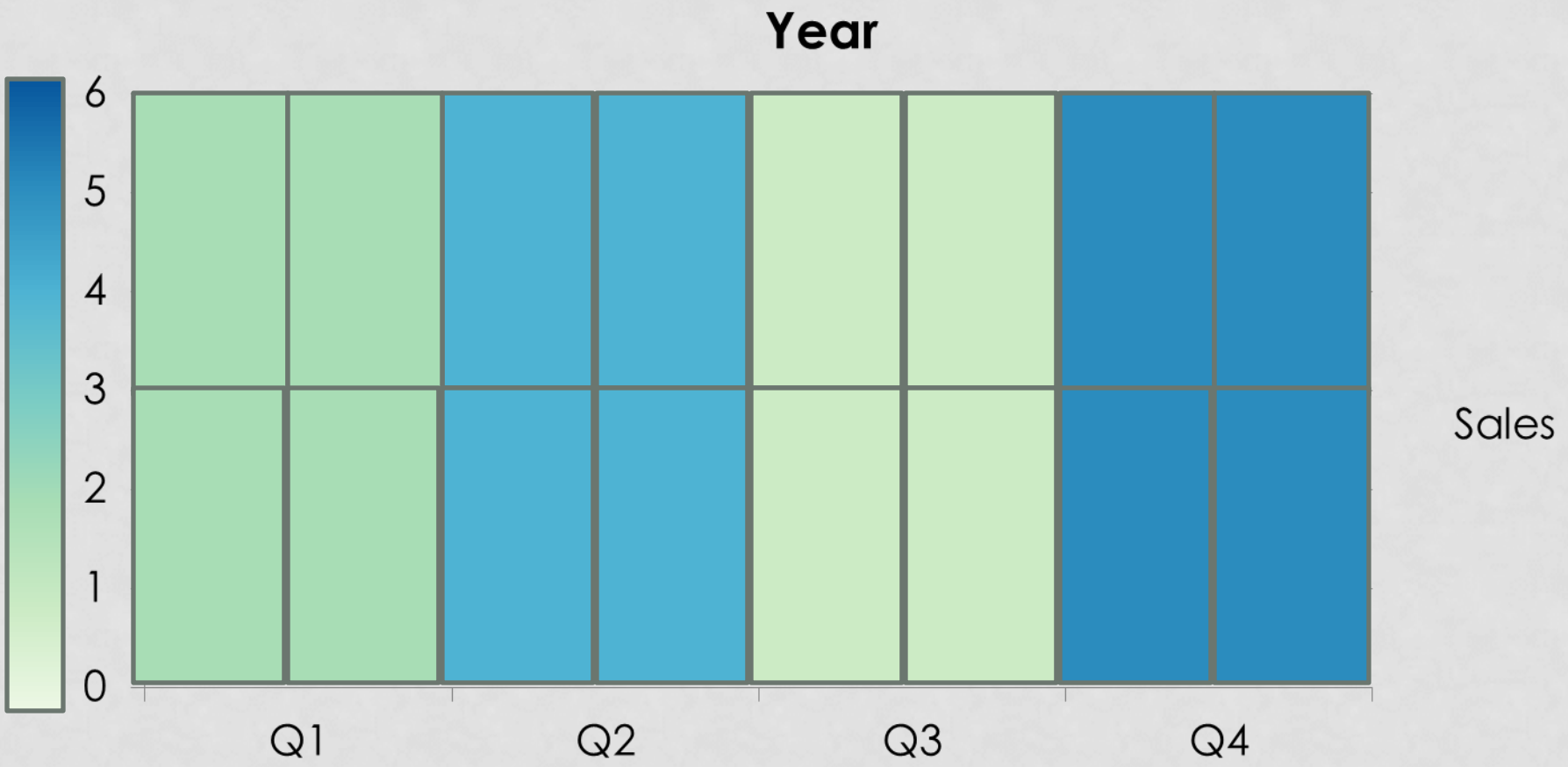


DESIGN

DESIGN



WEAVING



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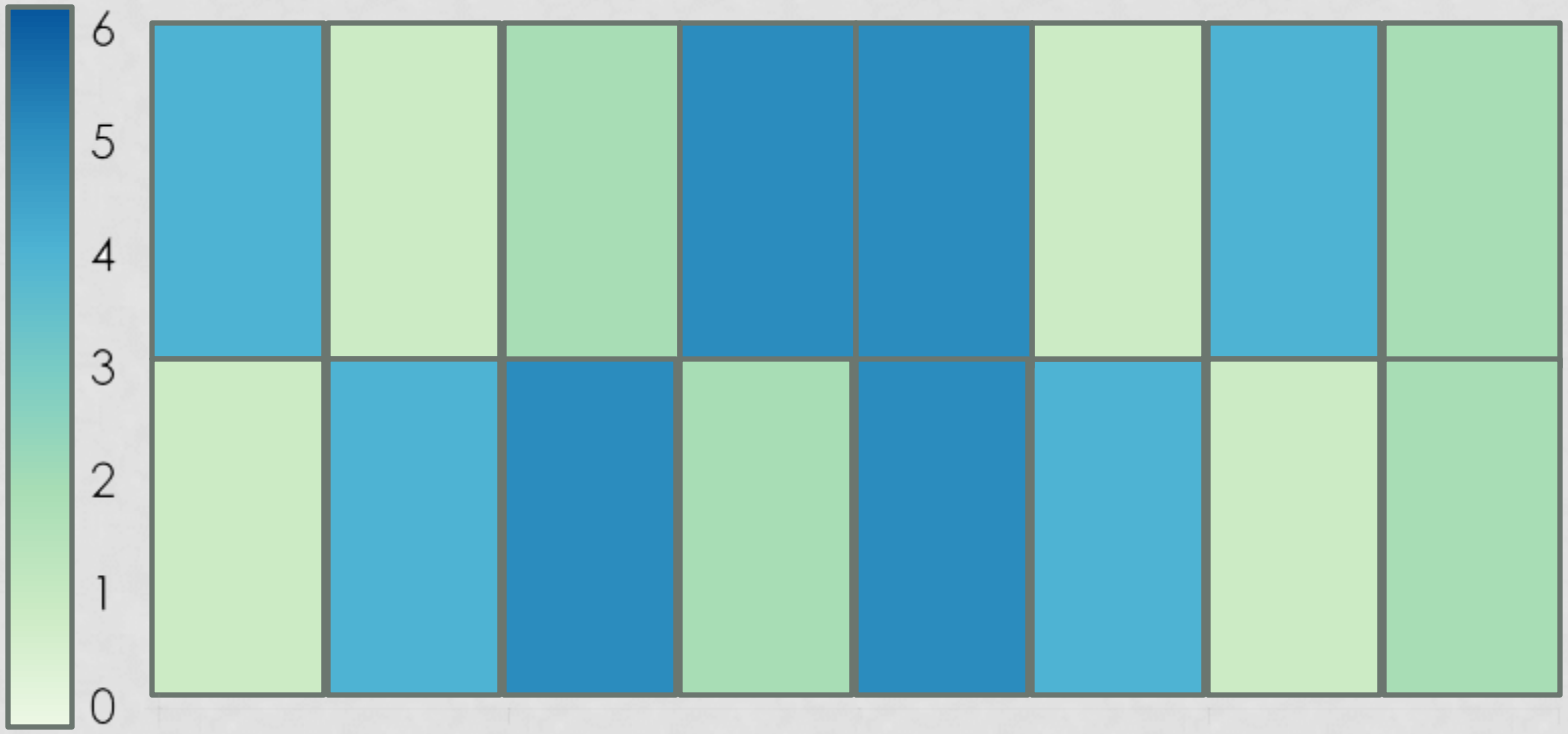

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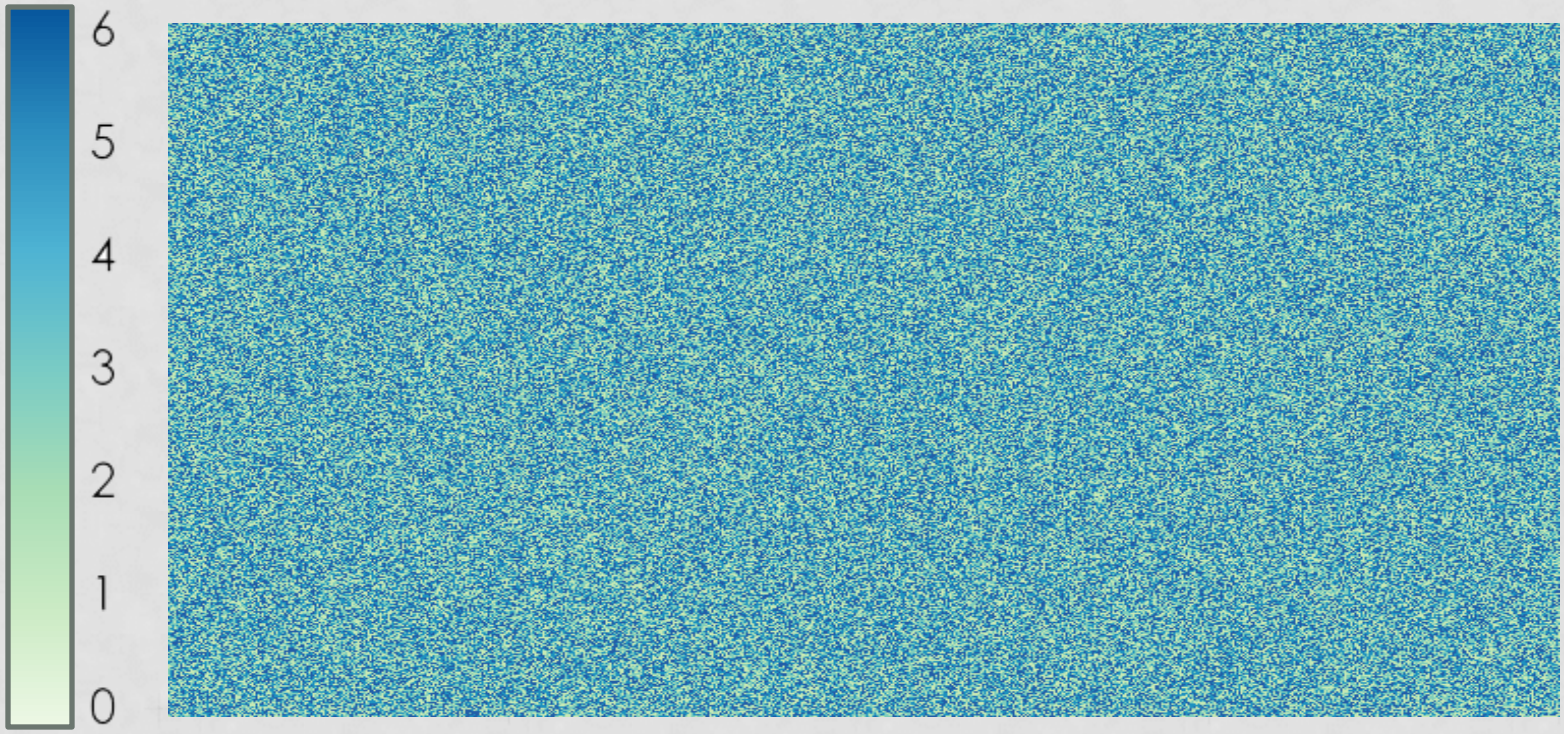

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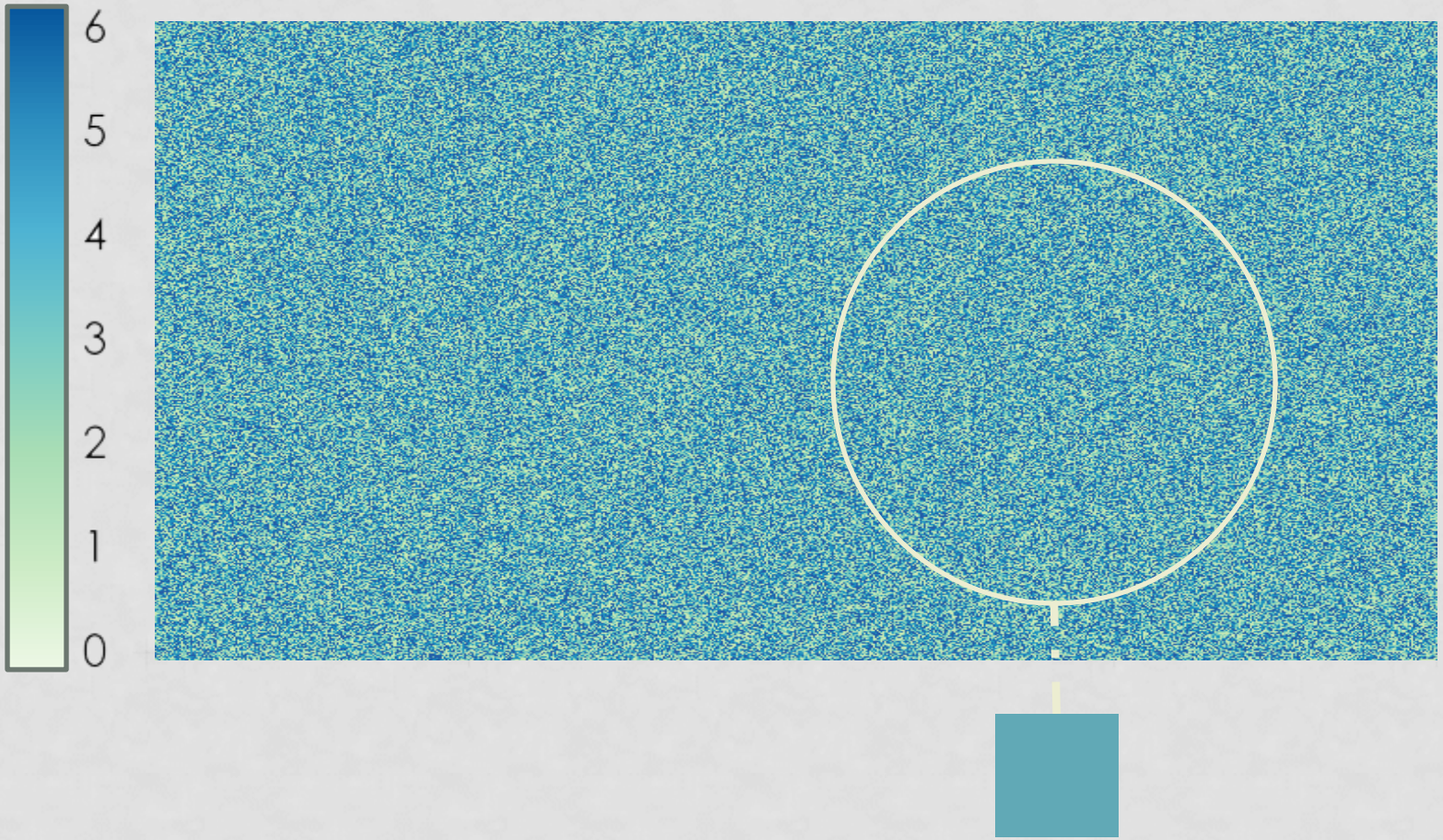

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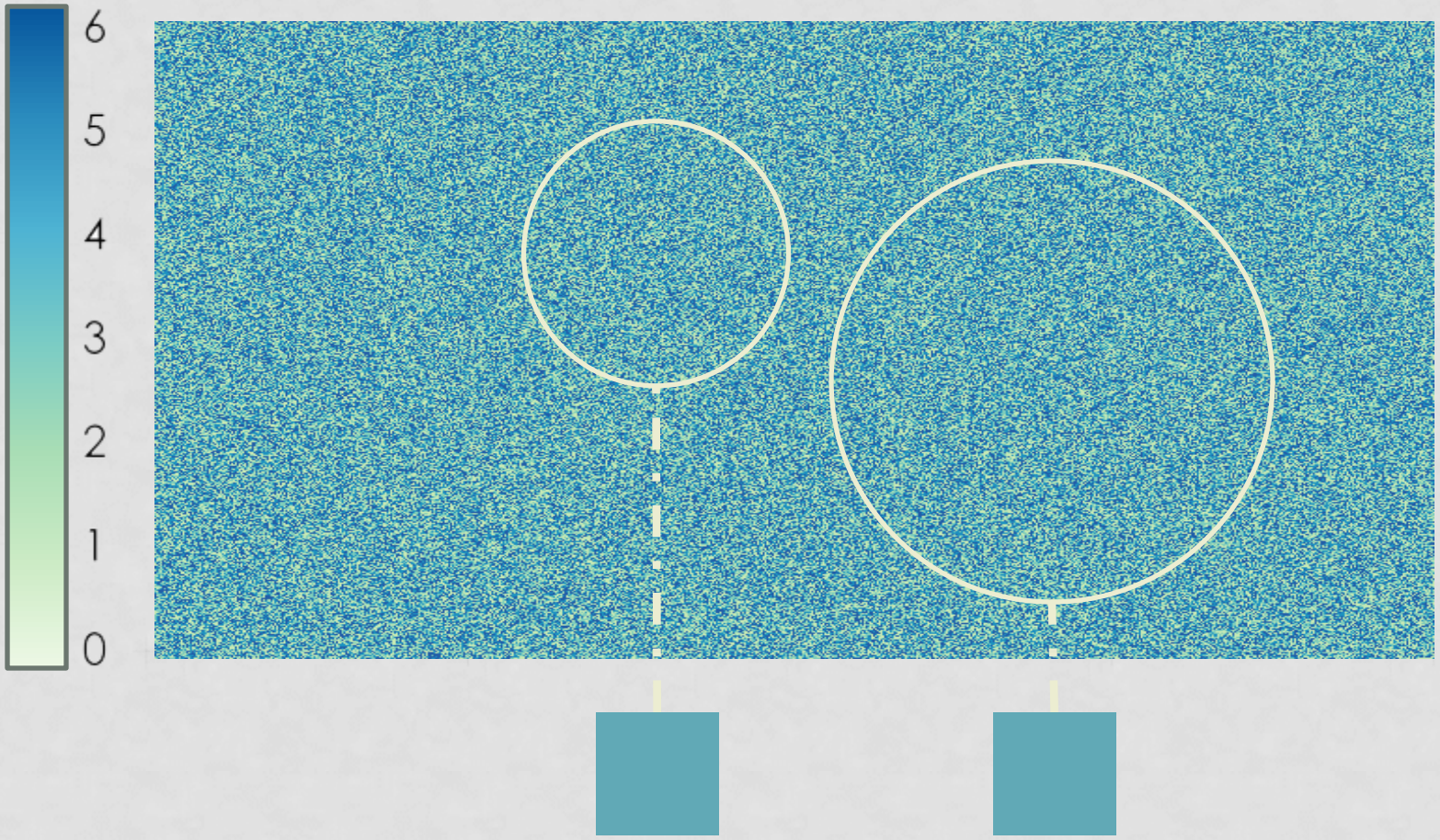

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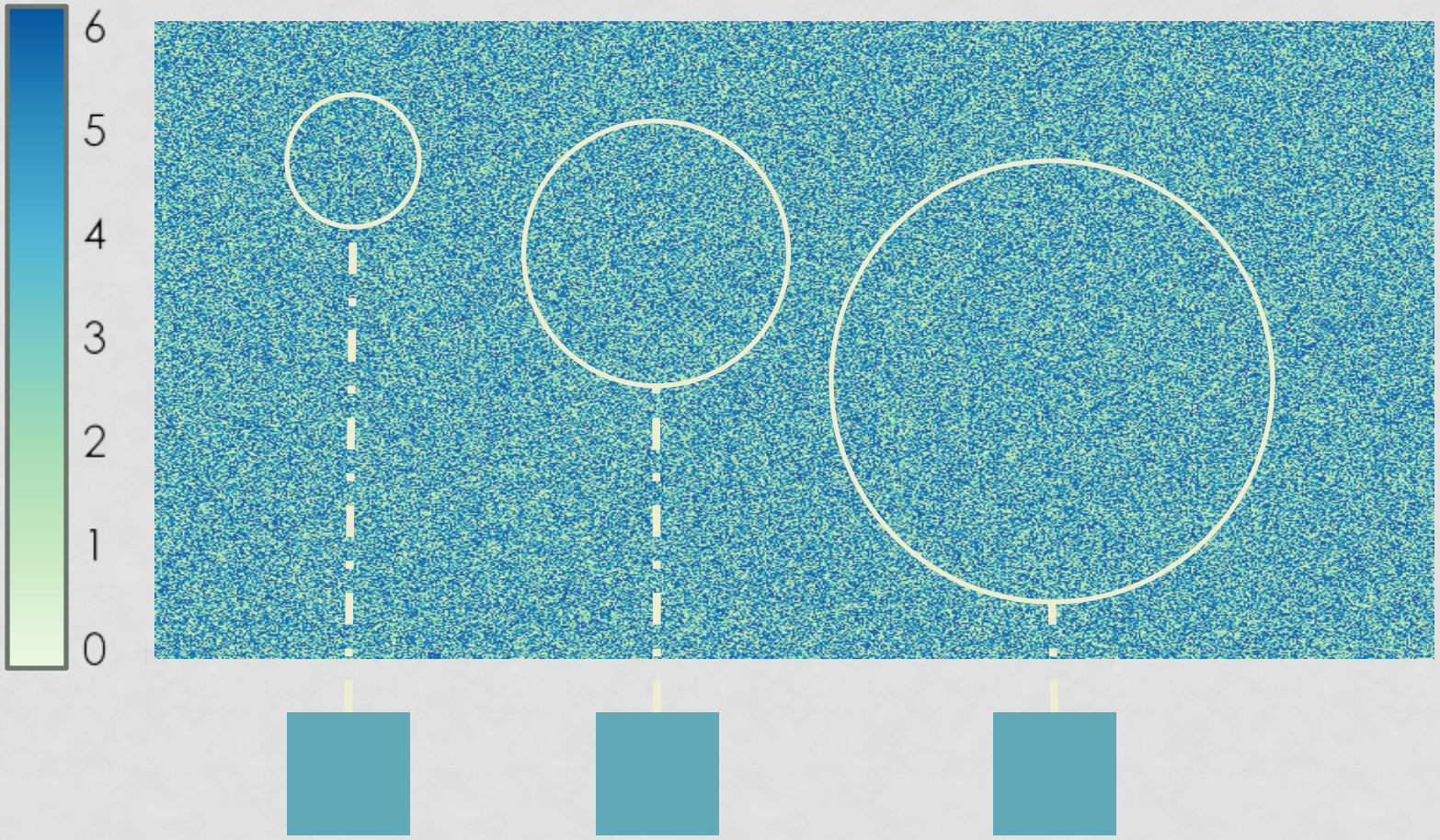


OUTLINE

Motivation

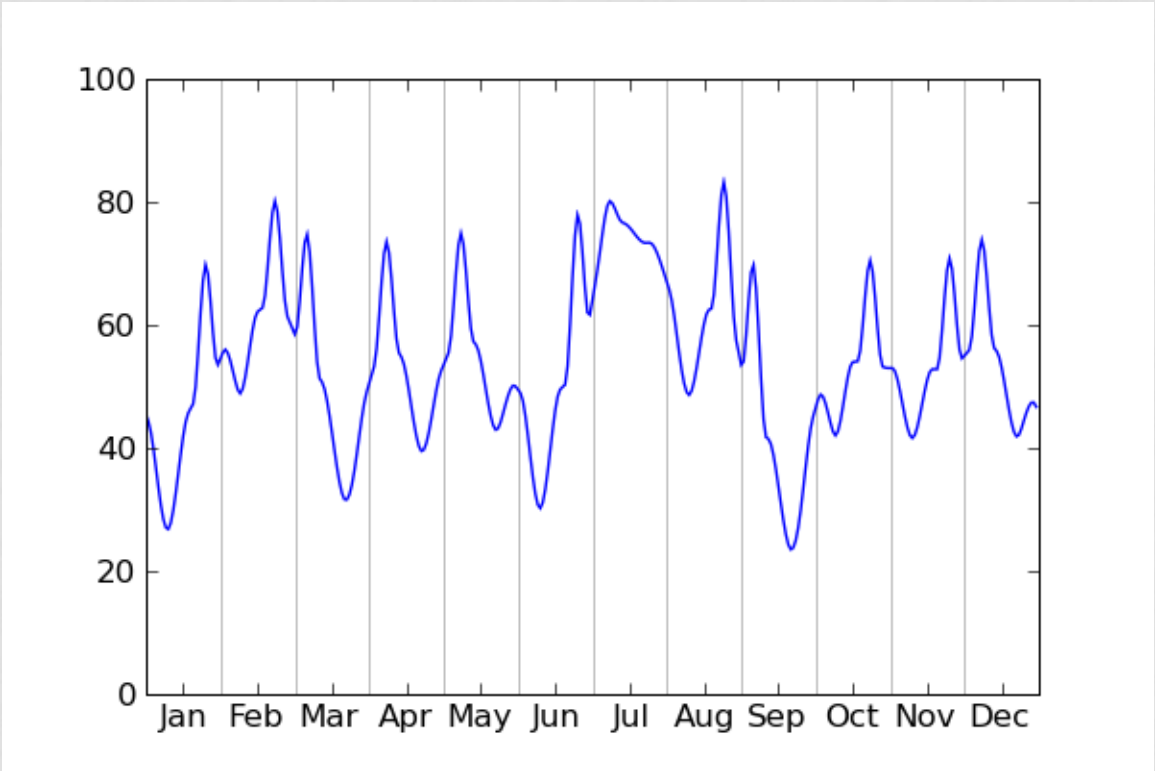
Visual Design

Experiment

Discussion

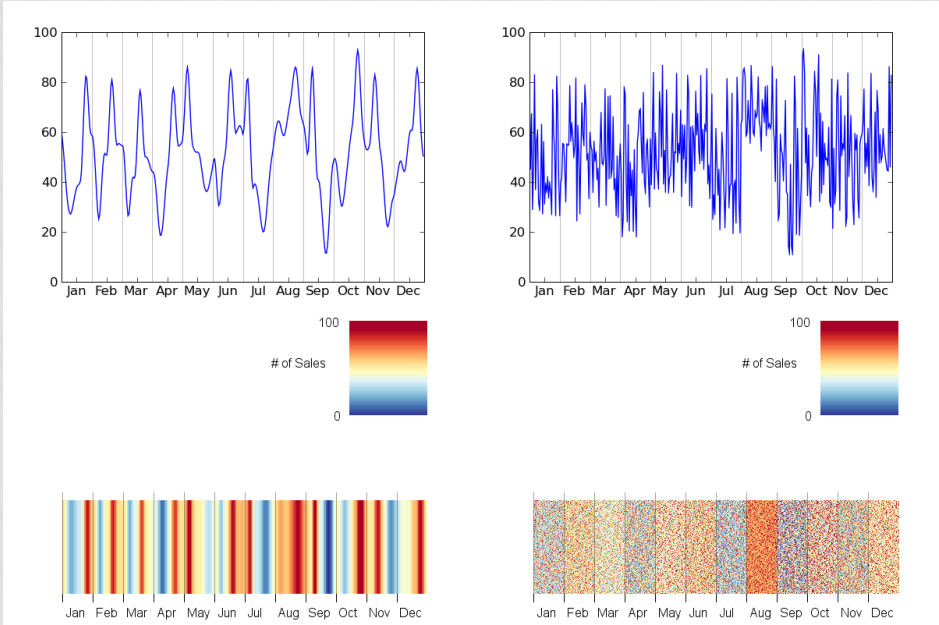
TASK

- Which month had the highest average sales?



CONDITIONS

- Linegraphs:
  - Regular or 1D permuted
- Colorfields:
  - Regular or woven



HYPOTHESES

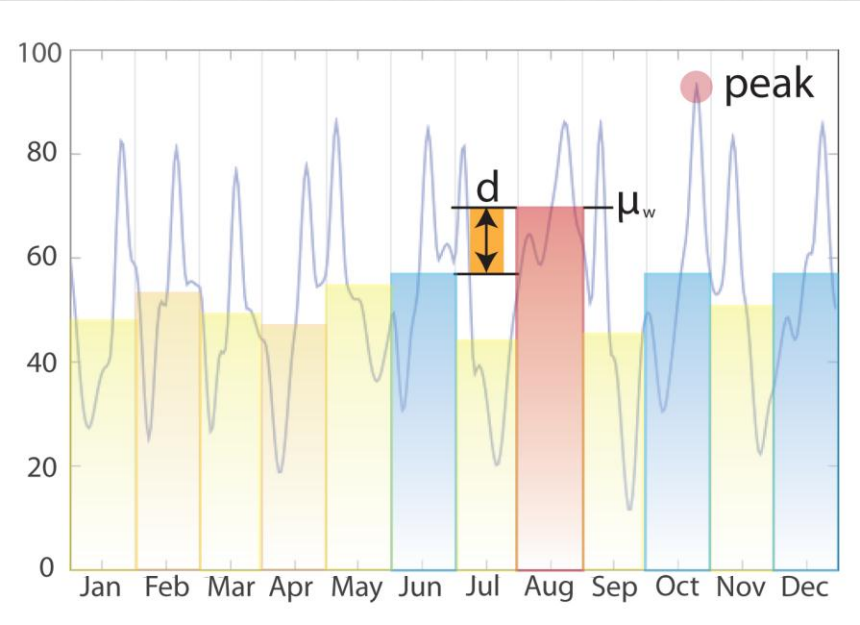
1. Colorfields outperform linegraphs.
2. Woven colorfields outperform standard colorfields.
3. Permutation doesn't help in the linegraph case.

CONDITIONS

Noise of signal

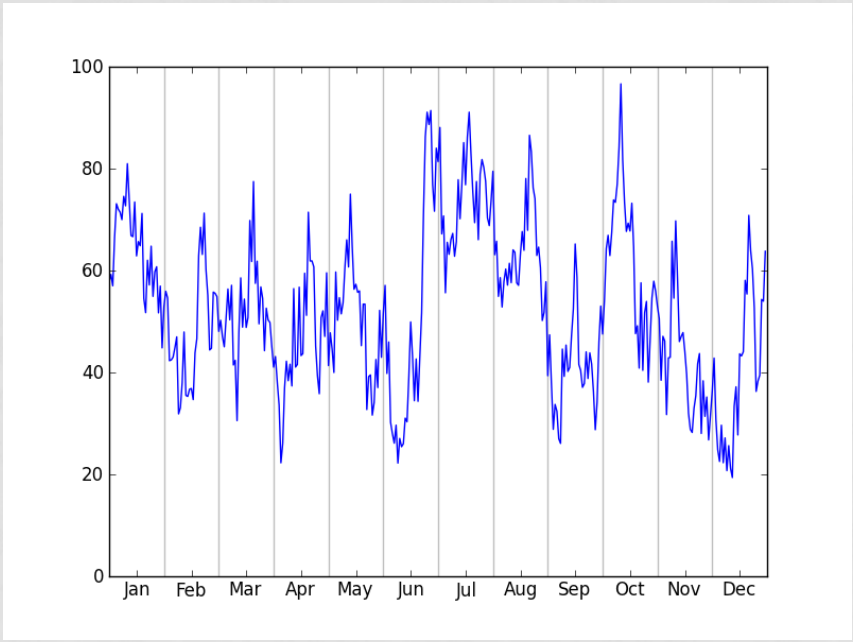
Gap between winner and distractor

Number of distractor months

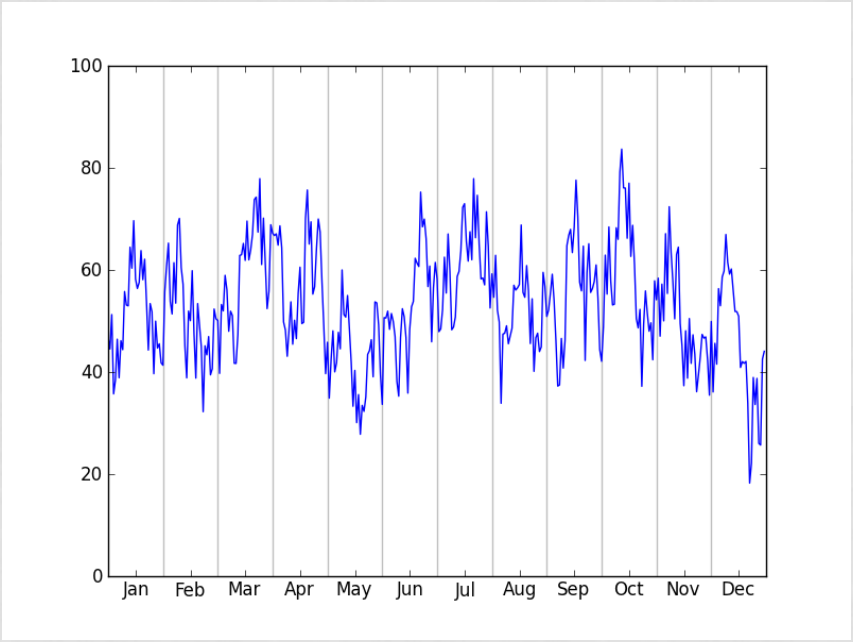


CONDITIONS

d = 10

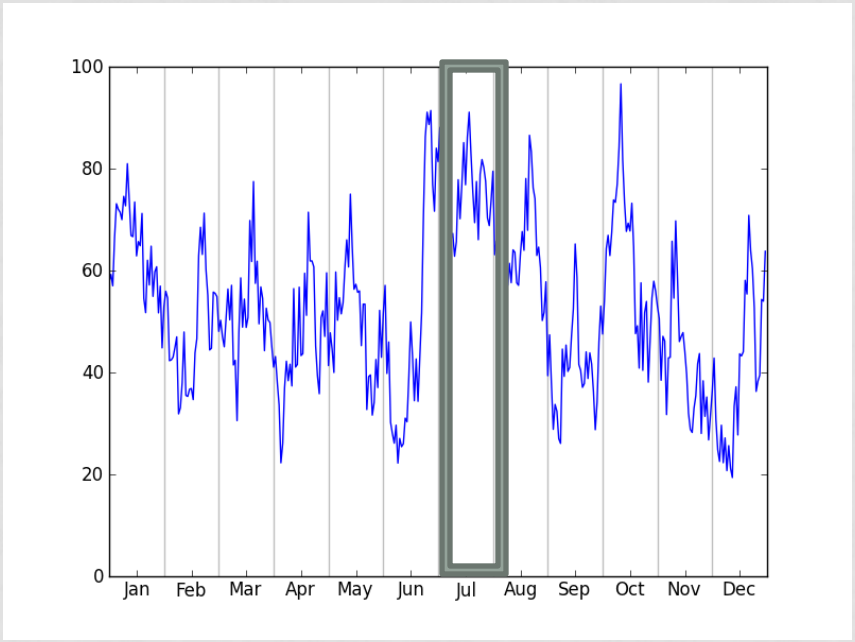


d = 2

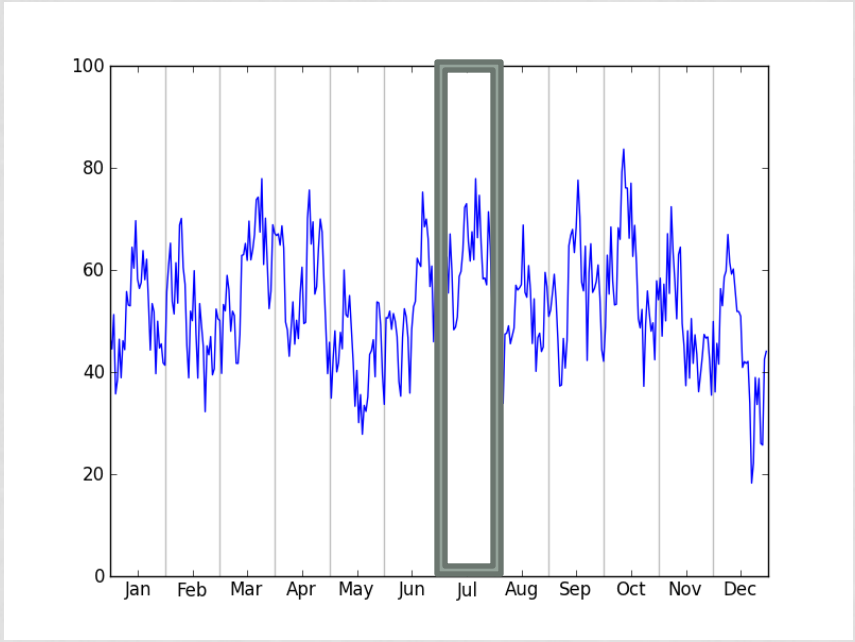


CONDITIONS

d = 10



d = 2



PARTICIPANTS

- Recruited using Amazon's Mechanical Turk
- Ishihara plates used to exclude color blind users
- Task time used to detect "click through" behavior

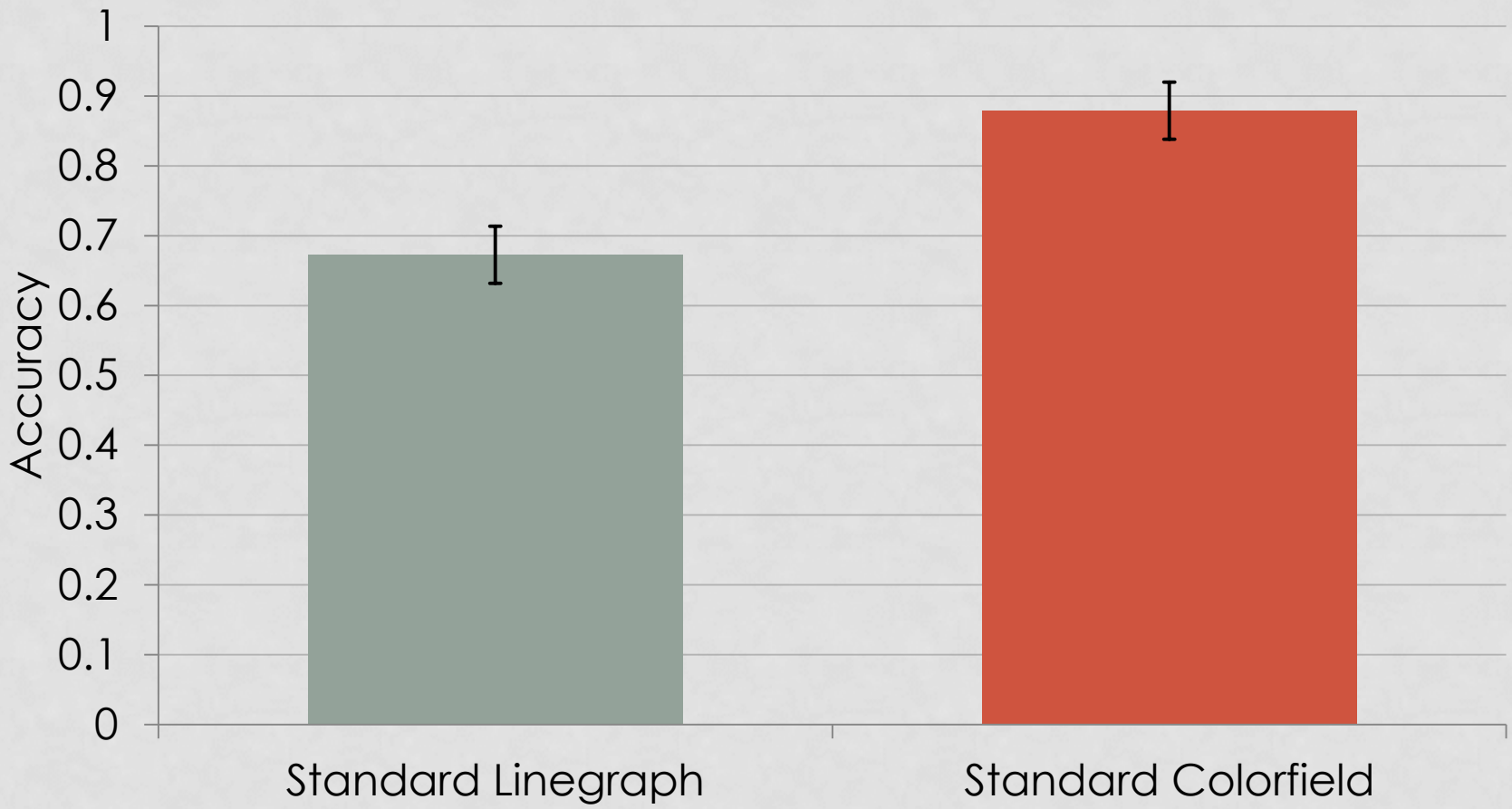
PARTICIPANTS

- 30 questions each
- 74 participants:
  - North Americans
  - 42 female
  - 32 male
  - Ages 18-62

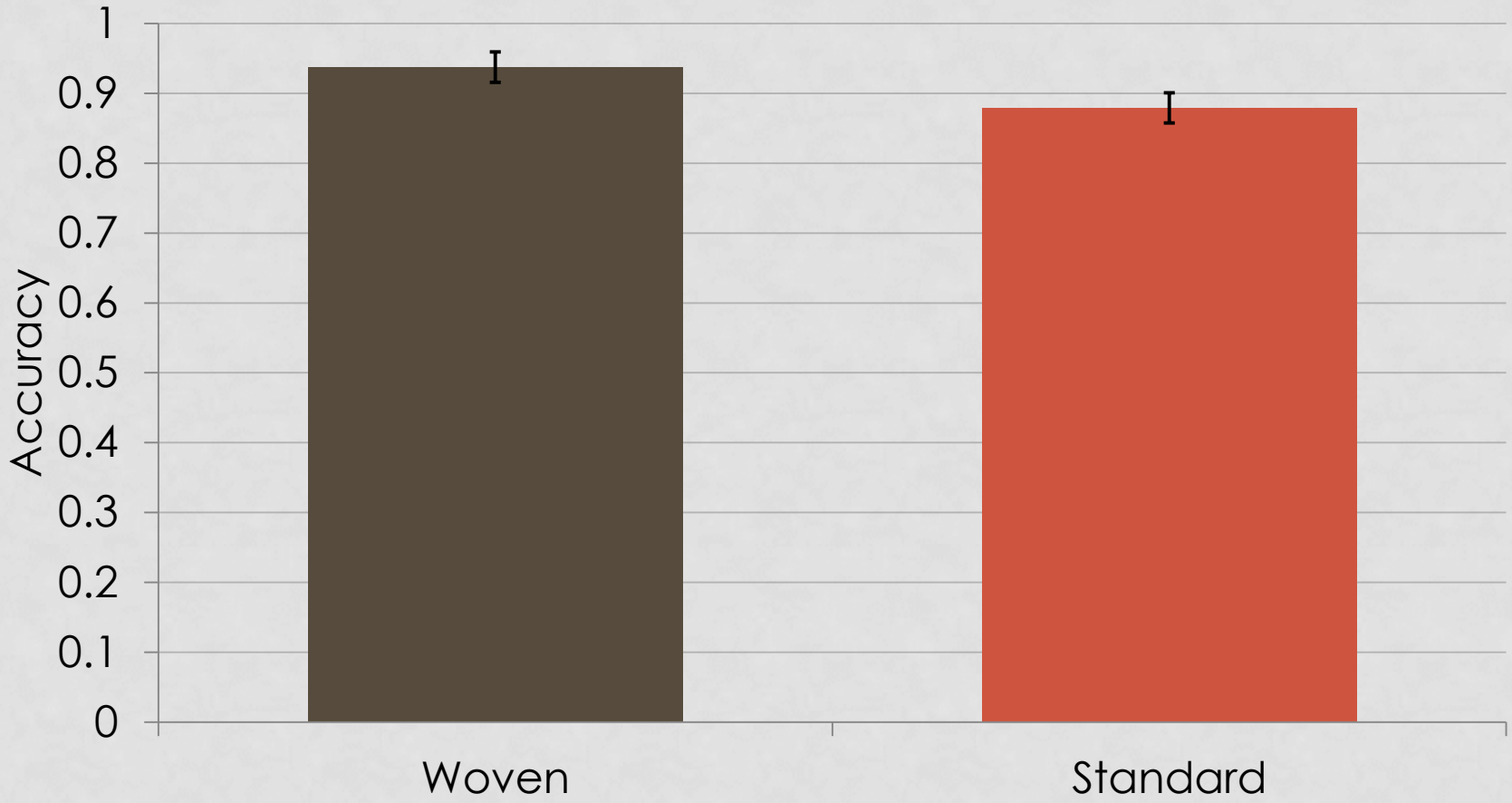
HYPOTHESES

1. Colorfields outperform linegraphs.
2. Woven colorfields outperform standard colorfields.
3. Permutation doesn't help in the linegraph case.

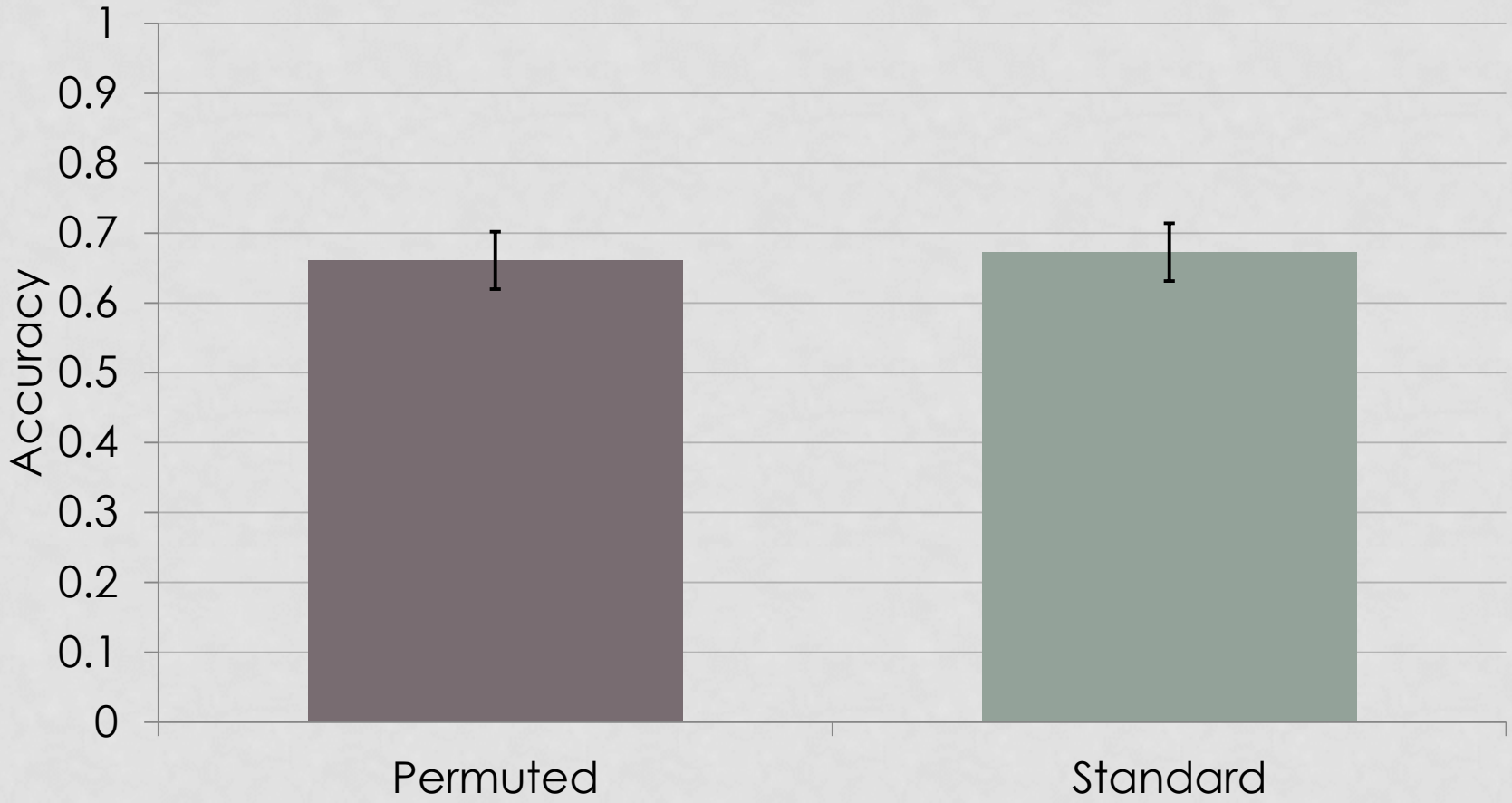
RESULTS


Accuracy
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Standard Linegraph
Standard Colorfield

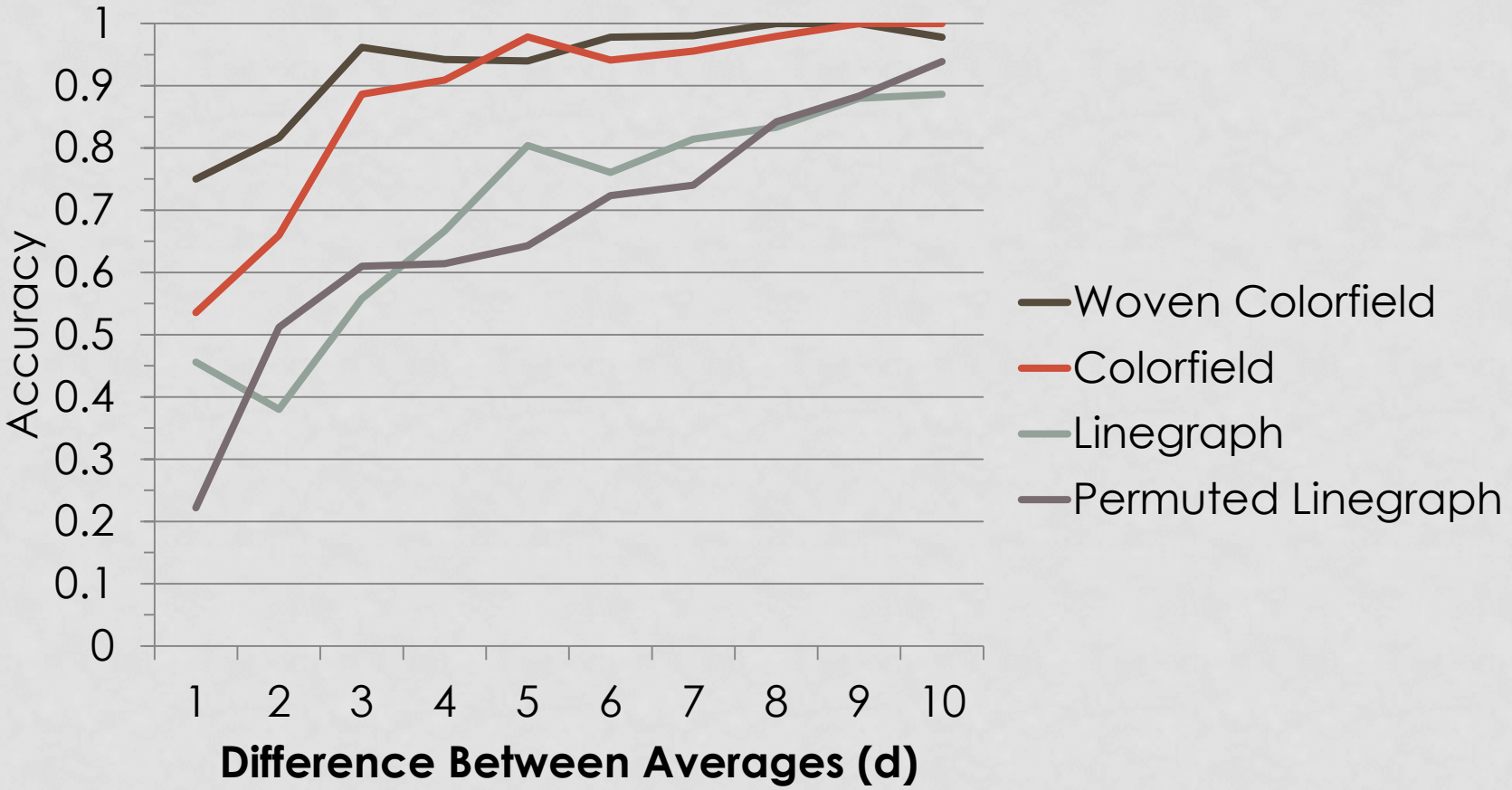
COLORFIELD



LINEGRAPH



RESULTS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0.1
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2
3
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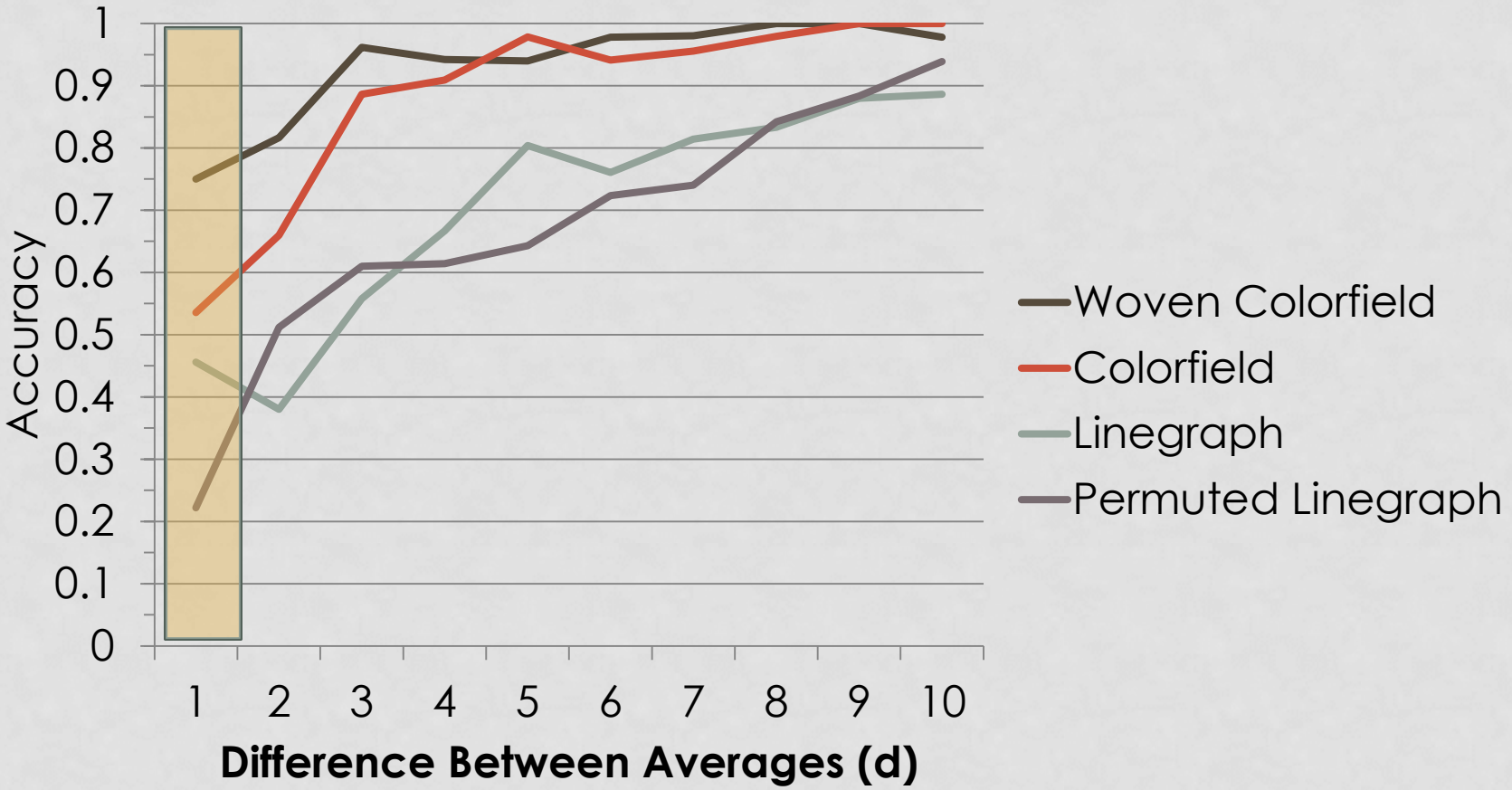
6
7
8
9
10
Difference Between Averages (d)
Woven Colorfield
Colorfield
Linegraph
Permuted Linegraph

RESULTS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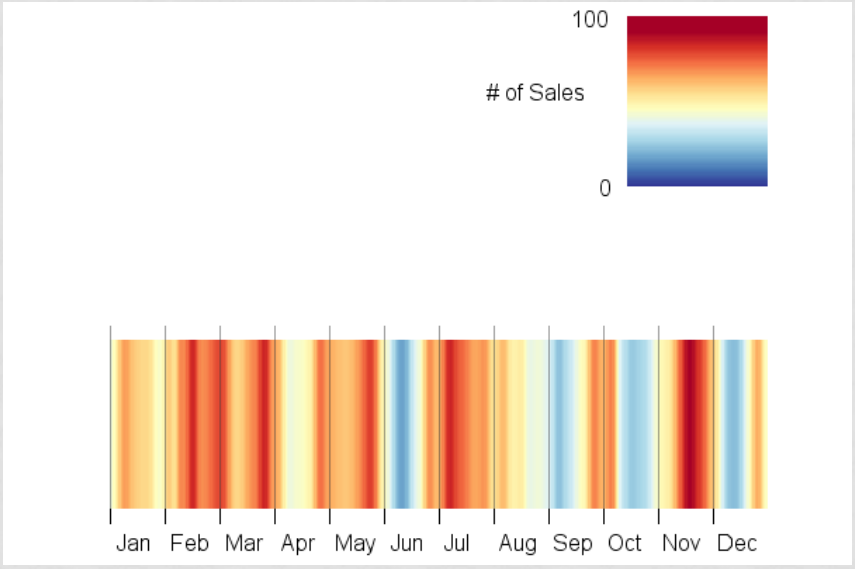
10
Difference Between Averages (d)
Woven Colorfield
Colorfield
Linegraph
Permuted Linegraph

D=1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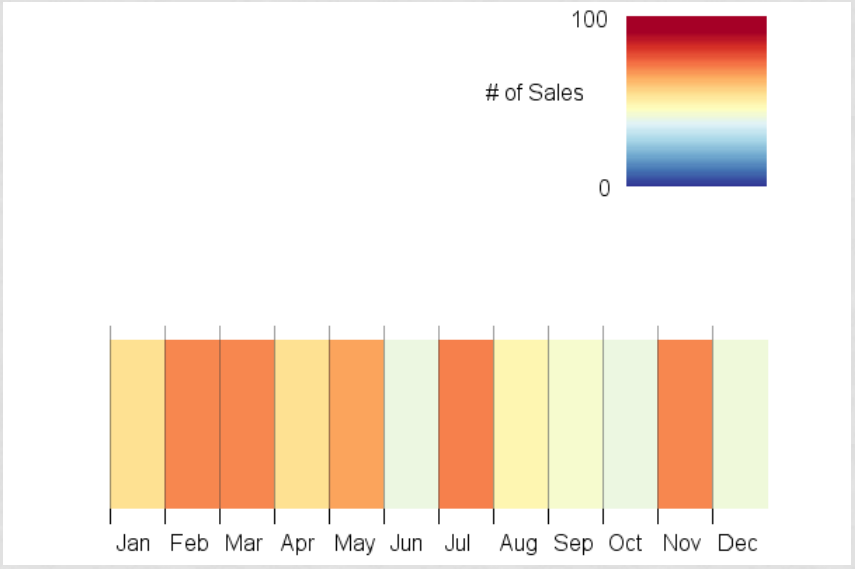
# of Sales
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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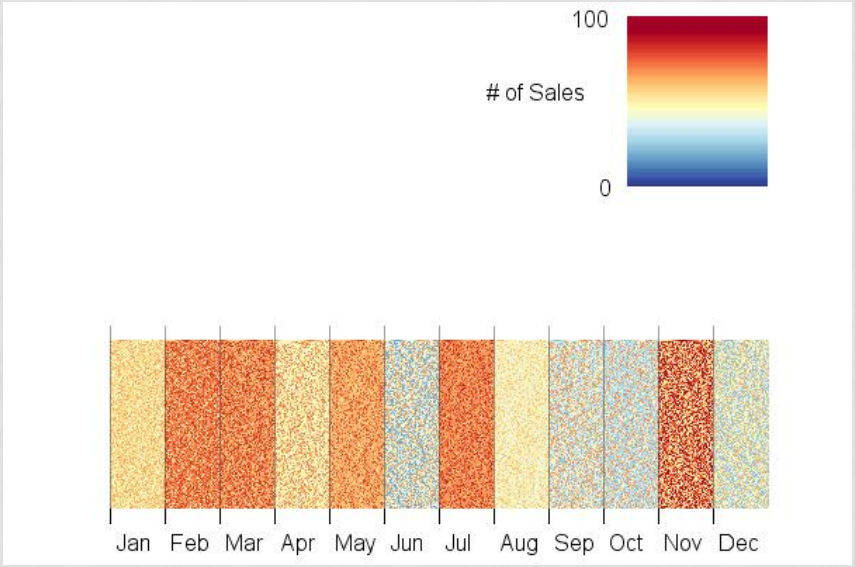
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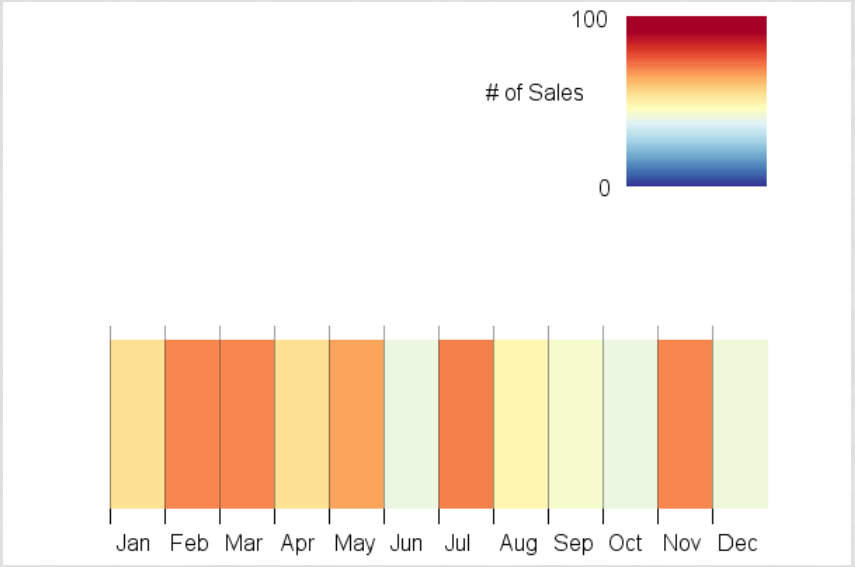

100
# of Sales
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

OUTLINE

Motivation

Visual Design

Experiment

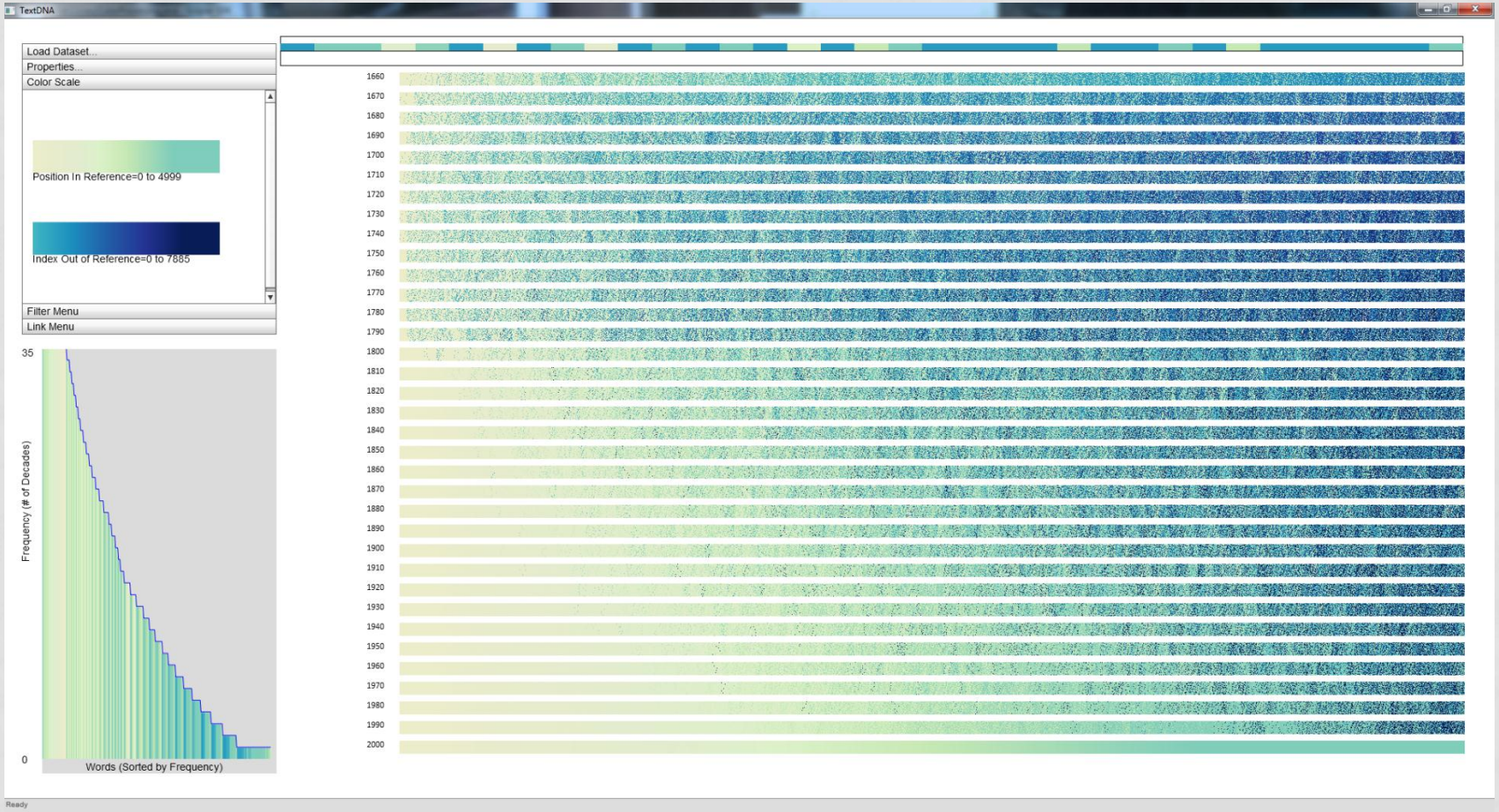
Discussion

RESEARCH QUESTIONS

Can users extract aggregate statistics from time series data?

Can different encodings improve performance at this task?

SEQUENCE SURVEYOR



Albers, Dewey, Gleicher 2011

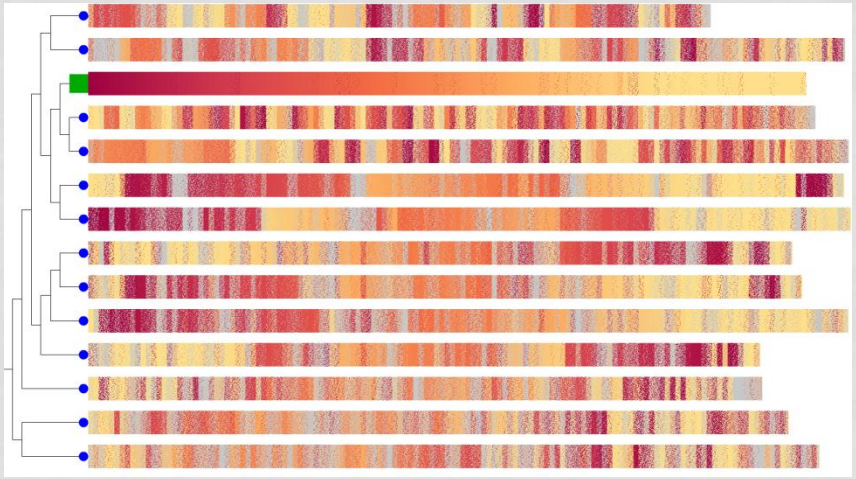
FUTURE WORK

Exploring limits of aggregation ability

Exploring different kinds of aggregate statistics

Exploring tradeoffs in weaving

Deploying more systems



ACKNOWLEDGMENTS

Thanks for listening!

Contact me at mcorrell@cs.wisc.edu

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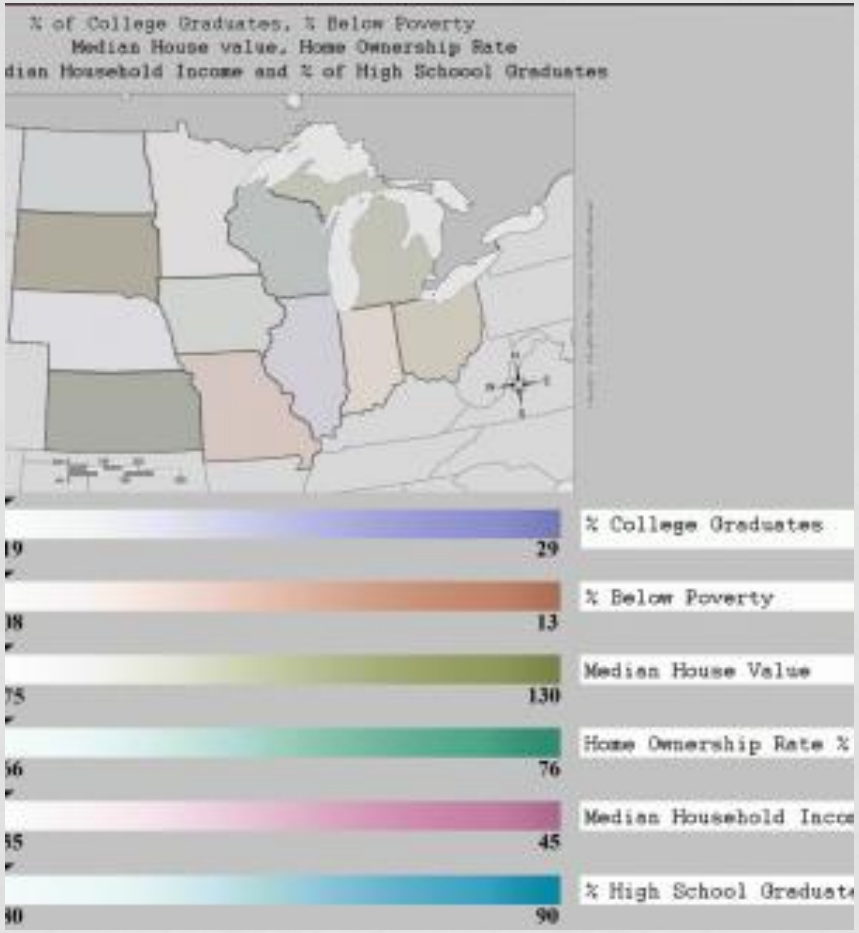
Albers was supported in part through DoE Genomics:GTL and Sci-DAC Programs (DE-FG02-04ER25627).

COLOR WEAVING

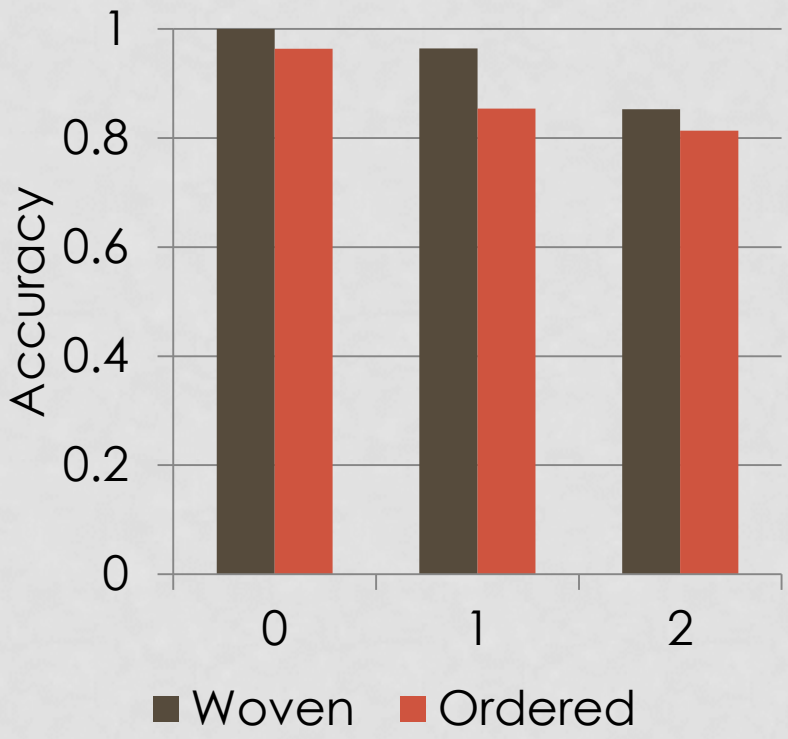


Hagh-Shenas et al., 2007

COLORFIELD

Difference between avgs.

Noise level



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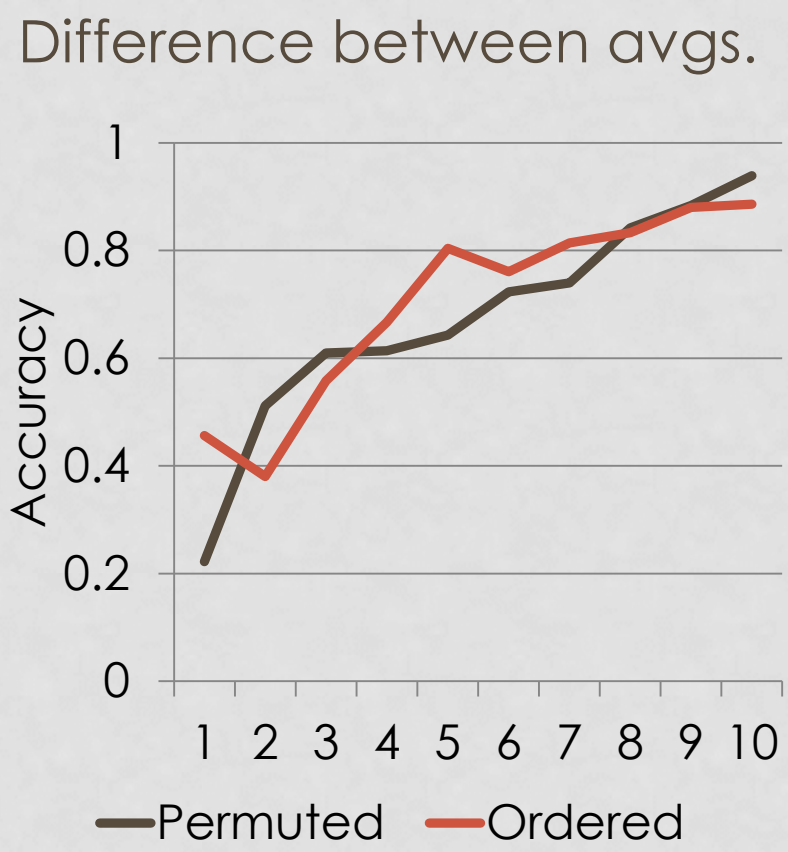
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0
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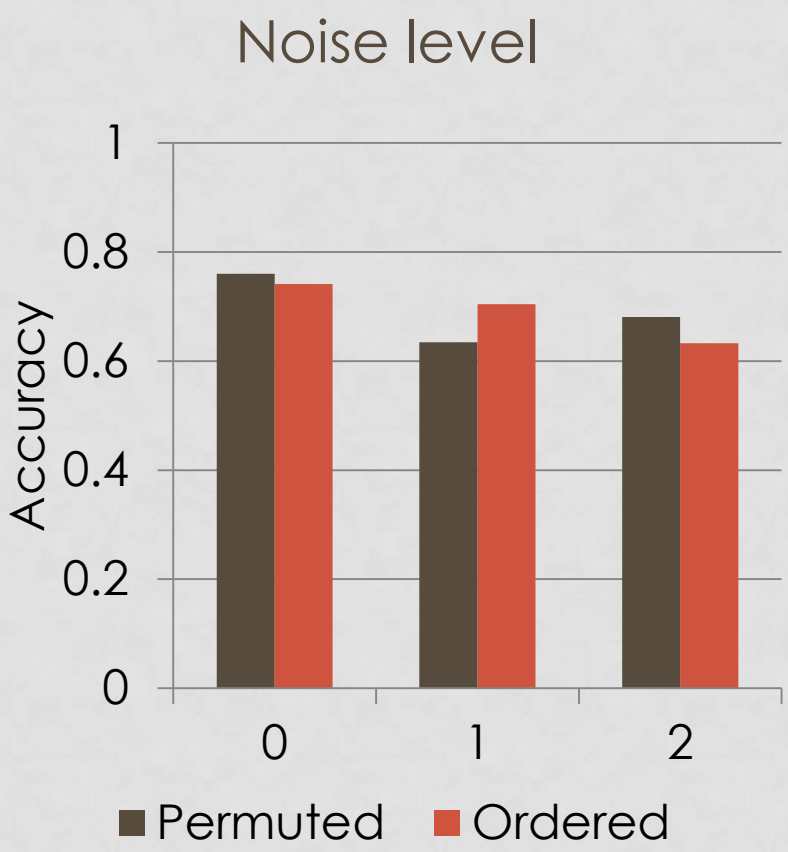
Permuted
Ordered


Noise level
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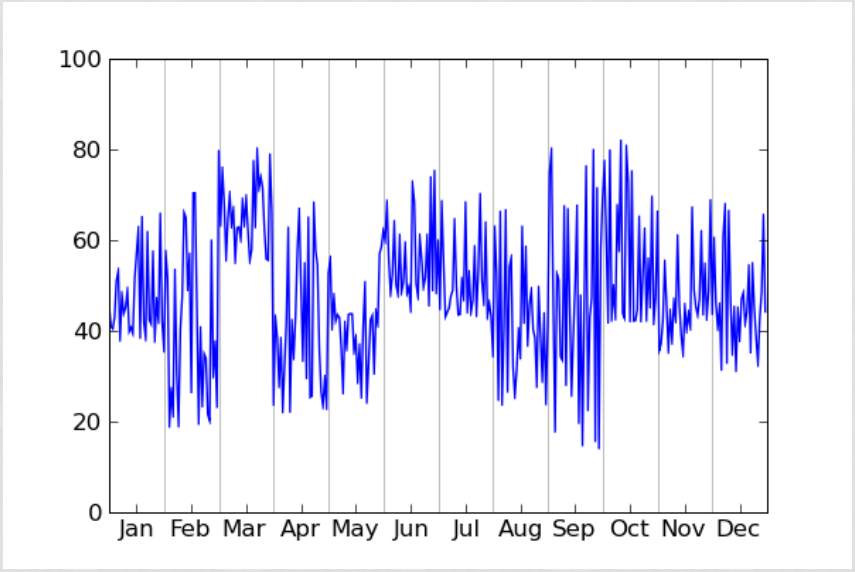
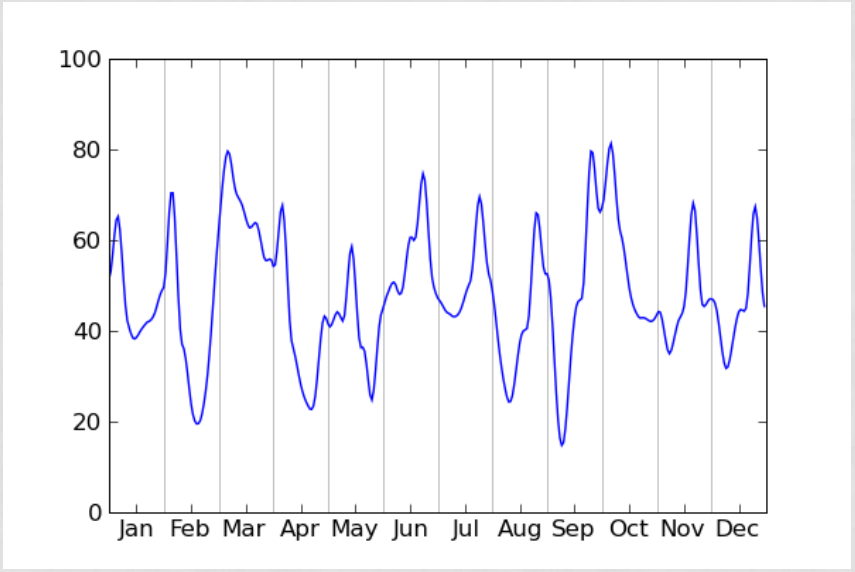
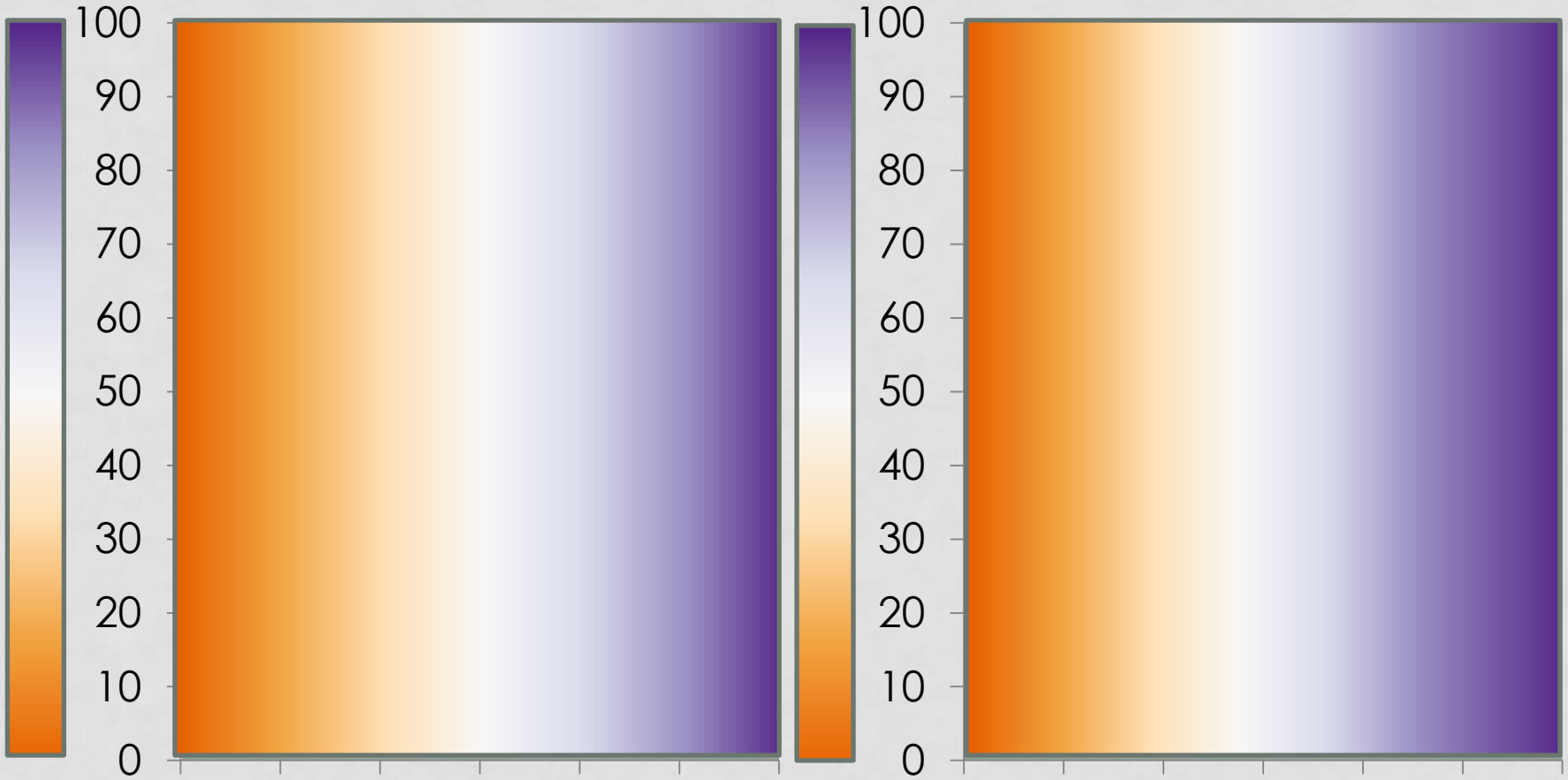
Permuted
Ordered

LINEGRAPH PERMUTATION





COLOR AGGREGATION



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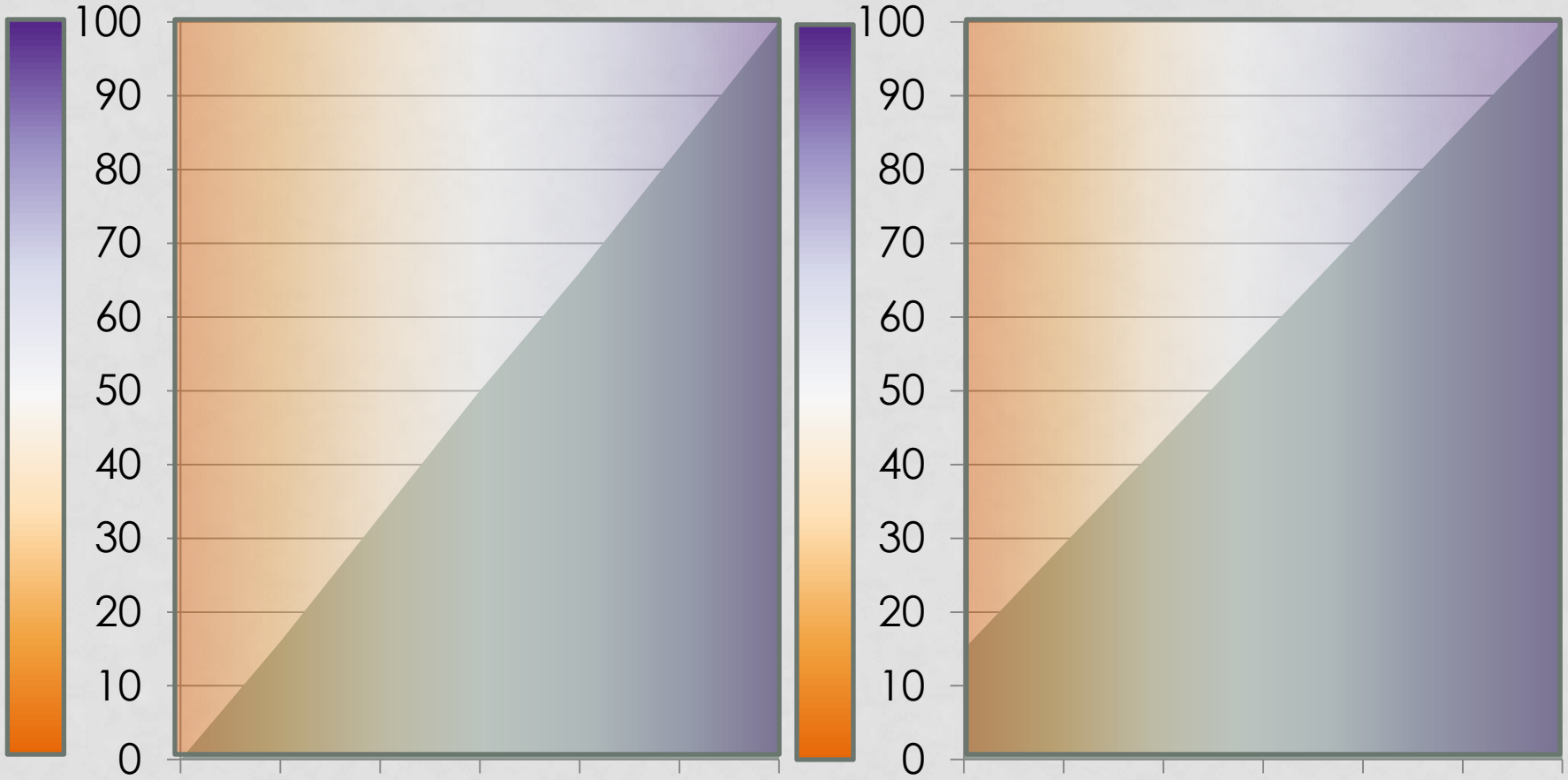

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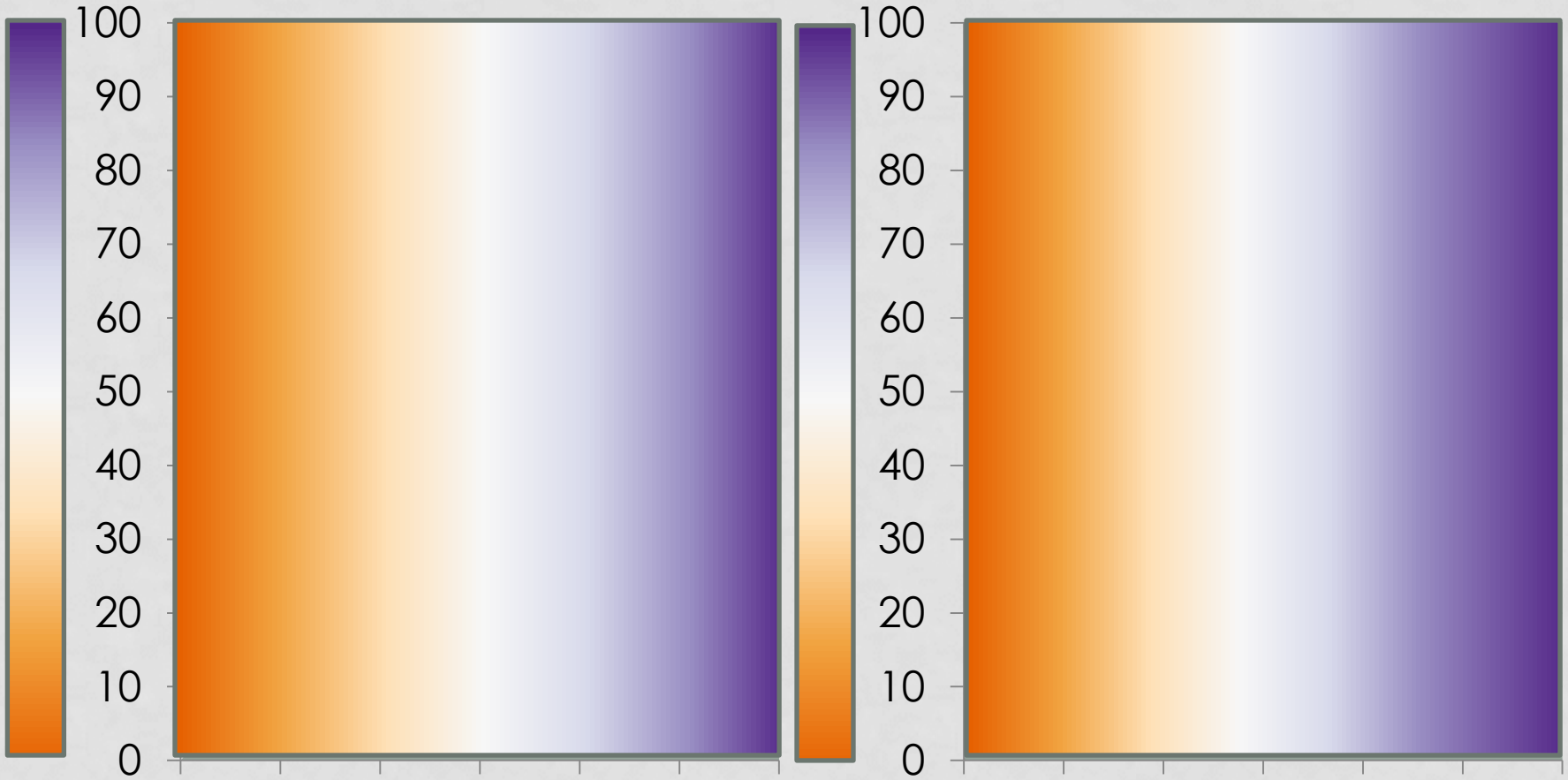

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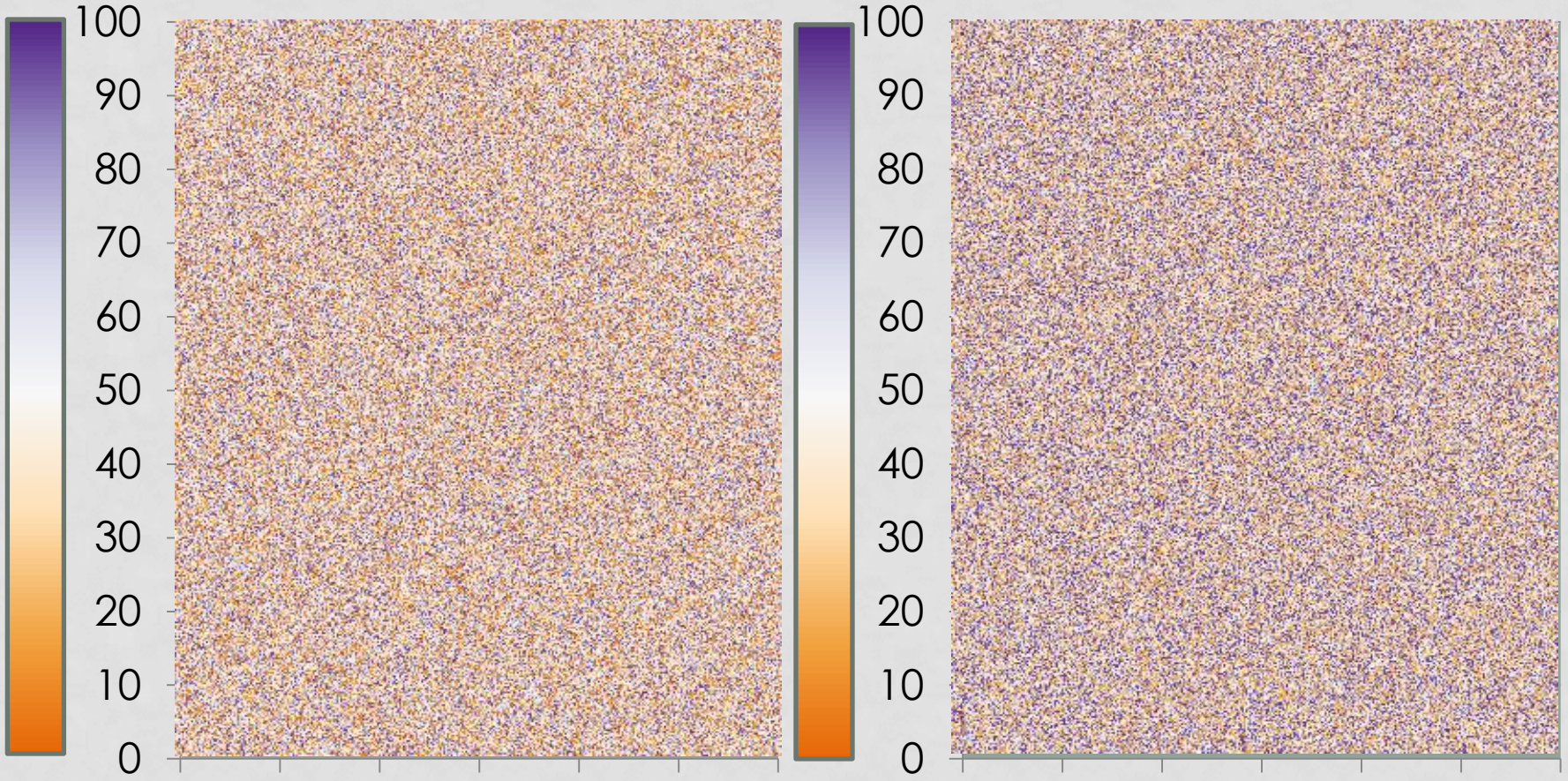

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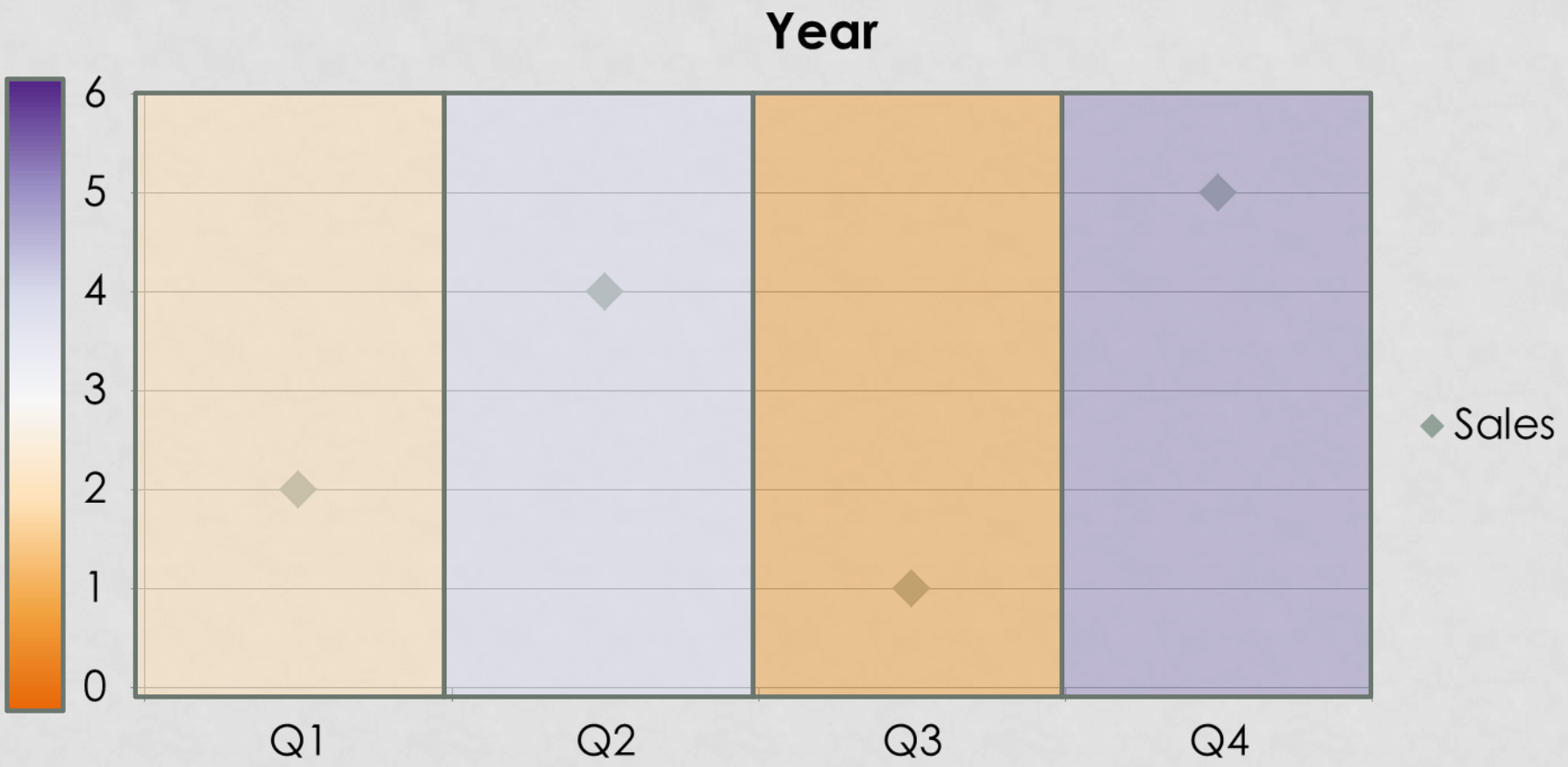

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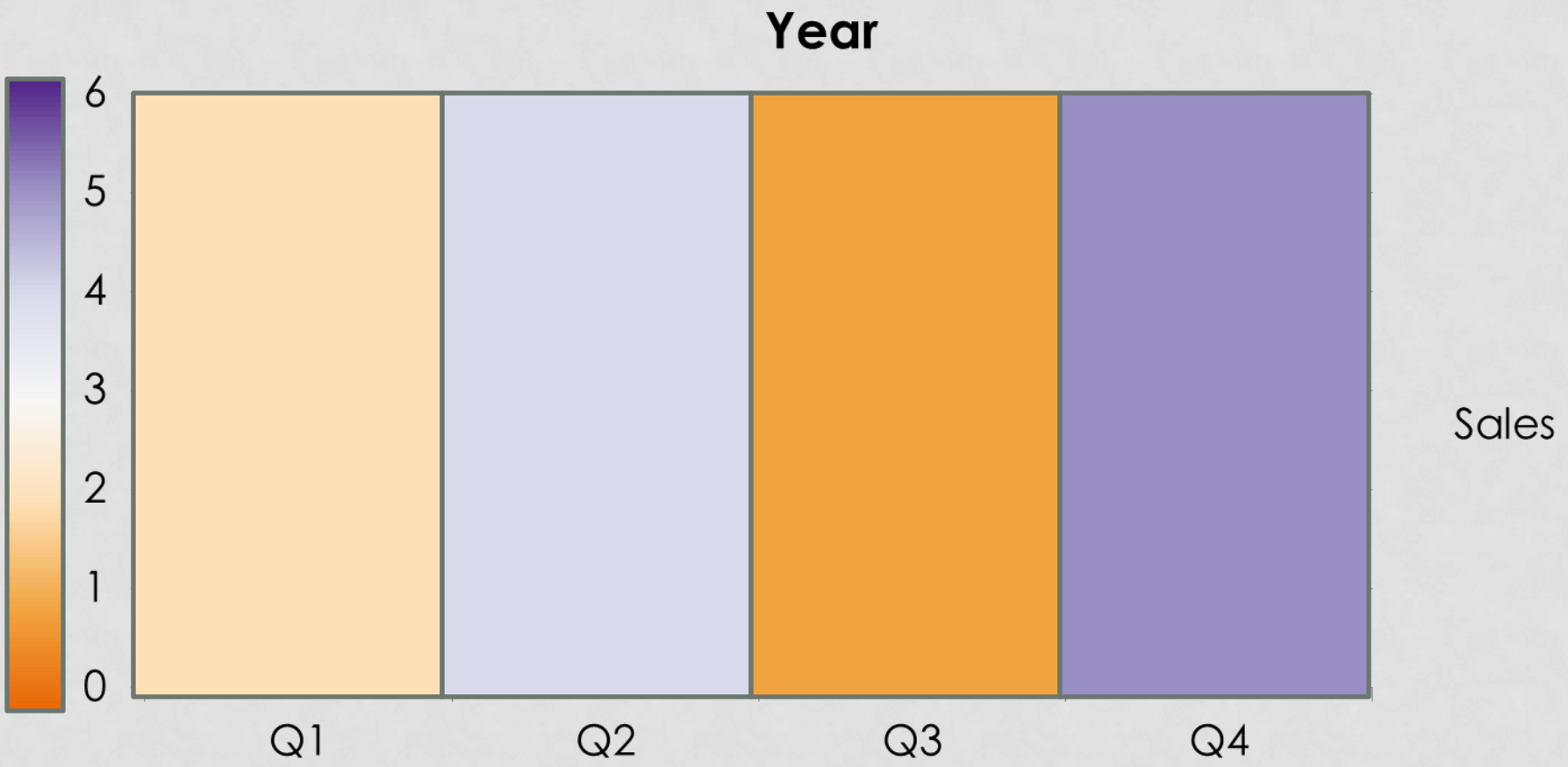
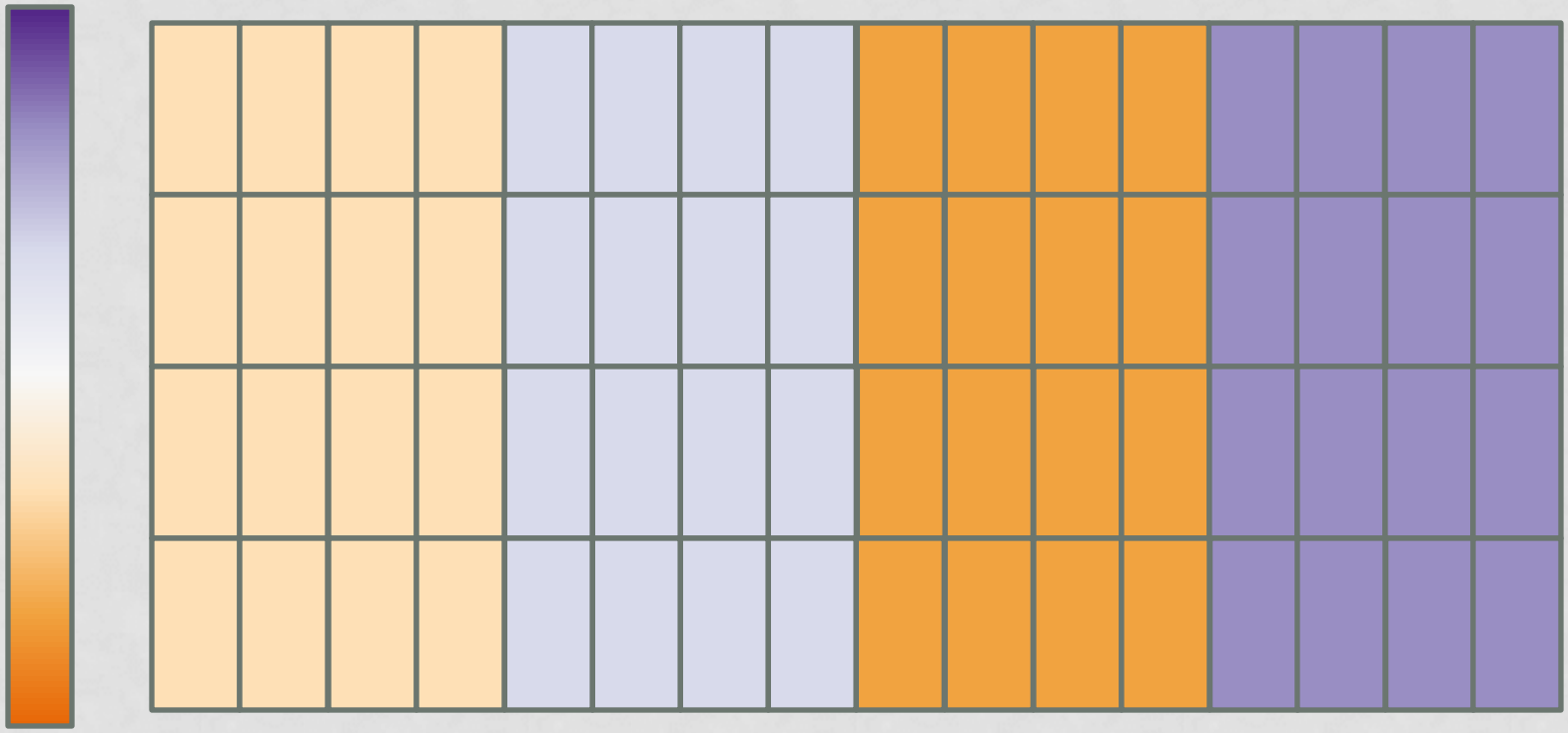


DESIGN

Year at a glance



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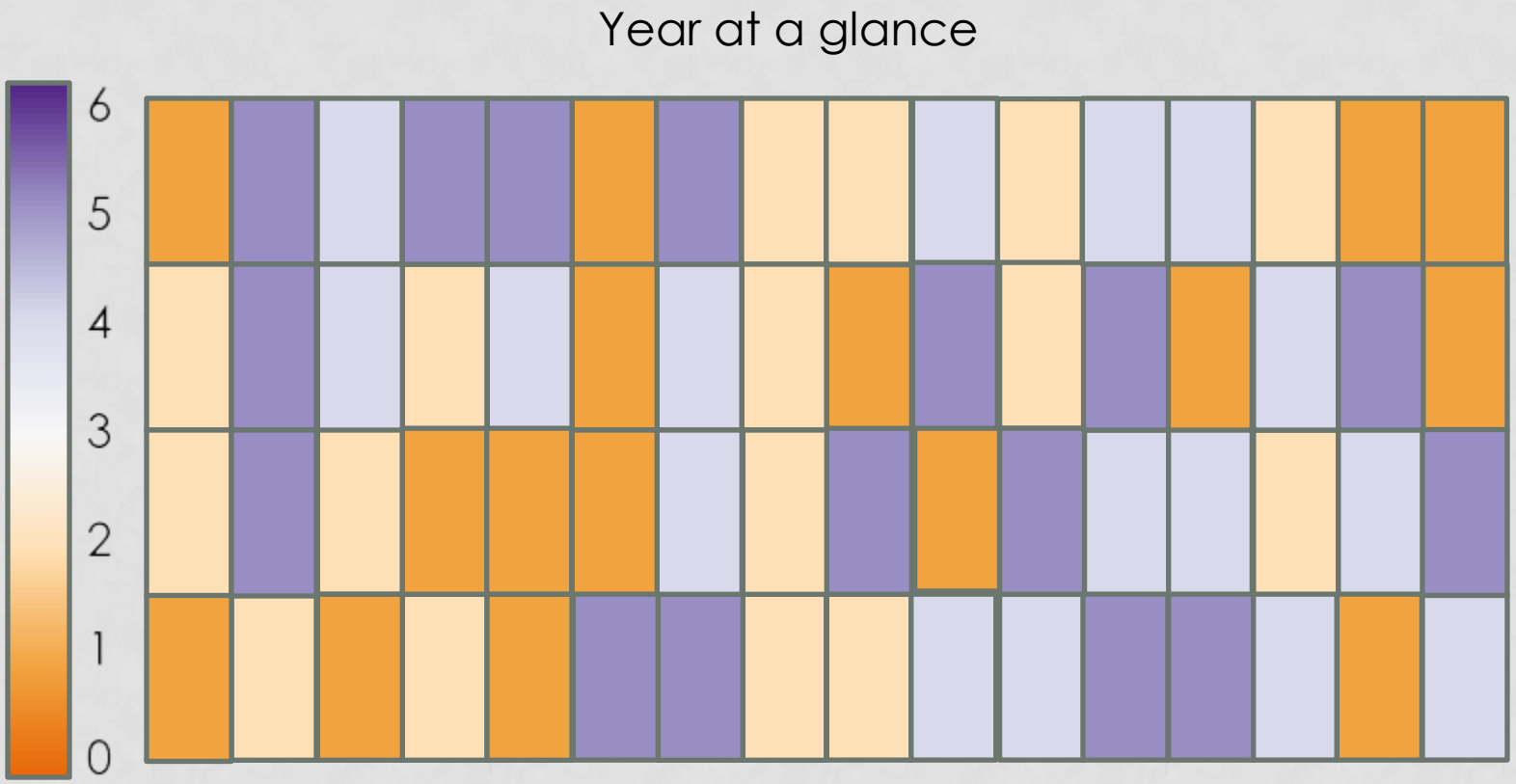

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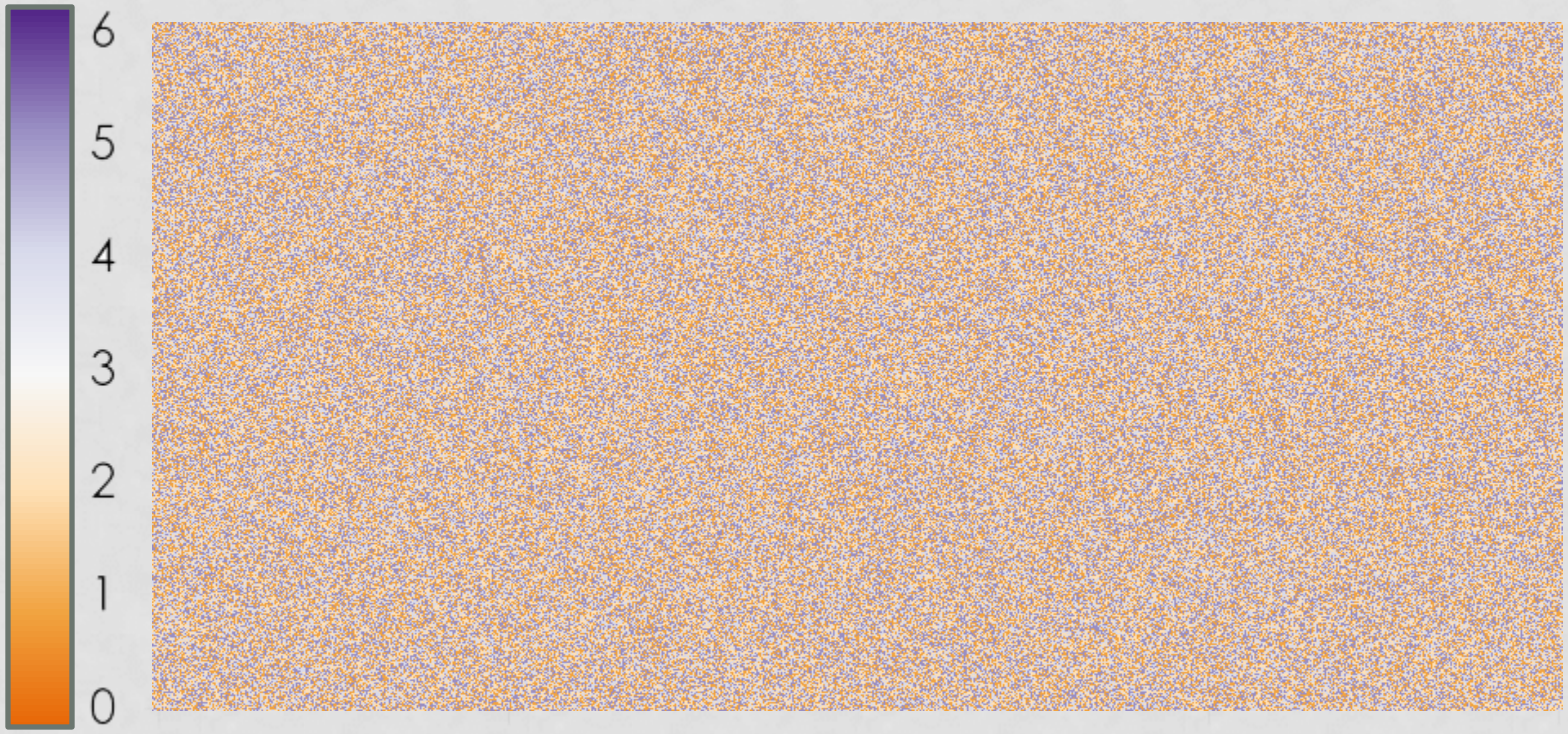

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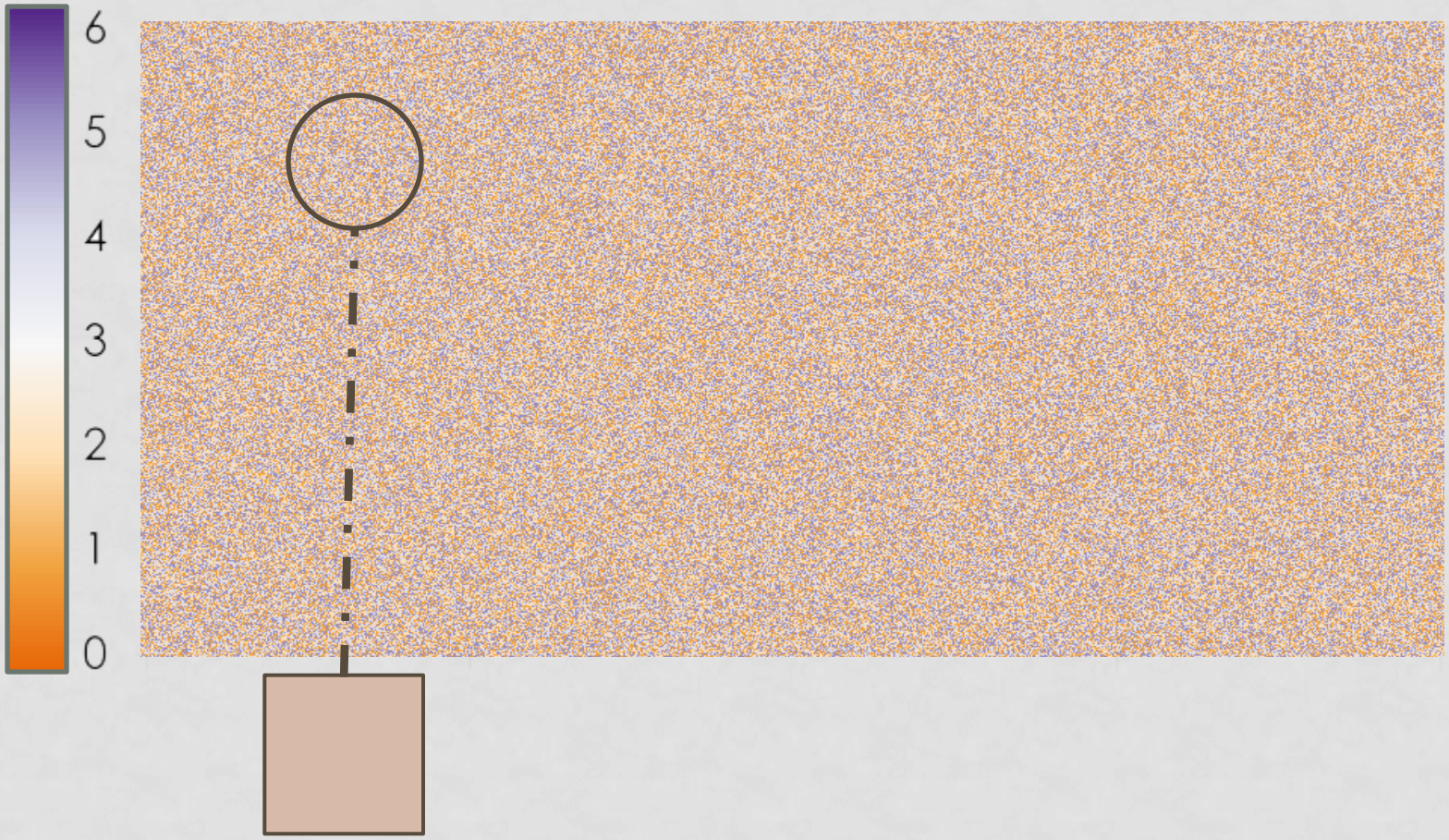

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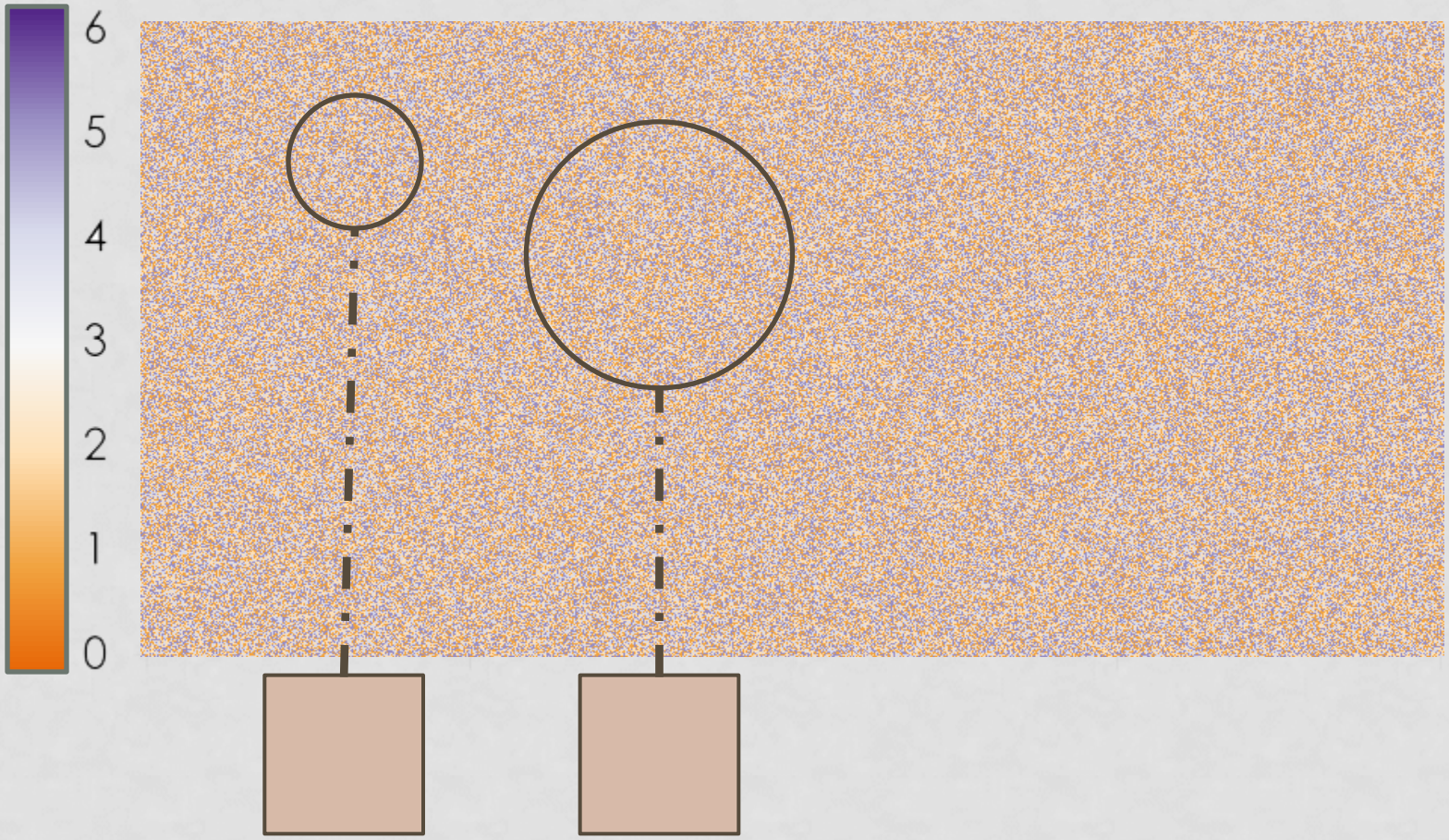

DESIGN