



DISCRETE MATHEMATICS IN COMPUTER SCIENCE

**HSIEN-CHIH CHANG
MARCH 7, 2022**

ADMINISTRIVIA

- **Final exam**
 - Mar 13 (Sun) 8—11AM
 - LSC 100 (this room)
- **SAS/Conflict/COVID**
 - Come talk to me
- **Homework 9 is optional**
- **Closed-book written exam**
- **Scope: Module C on counting**
- **One-page two-sided cheatsheet**
 - Must be hand-written





GOTTA CATCH 'EM ALL

HOW MANY DIFFERENT POKÉMON DO WE HAVE
AFTER BUYING n CARDS, GIVEN THERE ARE
 n POKÉMON IN TOTAL?

GOTTA
CATCH 'EM ALL



**HOW CARDS WE EXPECTED TO BUY TO COLLECT
ALL THE POKÉMON?**

**GOTTA
CATCH 'EM ALL**



**HOW CARDS WE EXPECTED TO BUY TO COLLECT ALL
THE DIFFERENT POKÉMON?**

**GOTTA
CATCH 'EM ALL**



DRAWLOTS(L):

$n \leftarrow |L|$

for $i \leftarrow 1$ to n

 remove a random lot x from L

$R[i] \leftarrow x$

return $R[1..n]$

GENERATE RANDOM PERMUTATIONS



FISHERYATES($L[1..n]$):

for $i \leftarrow 1$ down to n

$Chosen[i] \leftarrow \text{FALSE}$

for $i \leftarrow n$ down to 1

 repeat

$r \leftarrow \text{RANDOM}(n)$

 until $\neg Chosen[r]$

$R[i] \leftarrow L[r]$

$Chosen[r] \leftarrow \text{TRUE}$

return $R[1..n]$

FISHER-YATES ALGORITHM



SELECTIONSHUFFLE($A[1..n]$):

for $i \leftarrow n$ down to 1

swap $A[i] \leftrightarrow A[\text{RANDOM}(i)]$

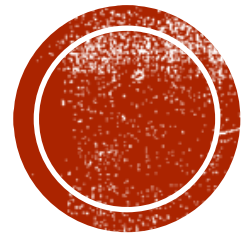
**DURSTENFELD
SHUFFLE**



INSERTIONSHUFFLE($A[1..n]$):
for $i \leftarrow 1$ to n
 swap $A[i] \leftrightarrow A[\text{RANDOM}(i)]$

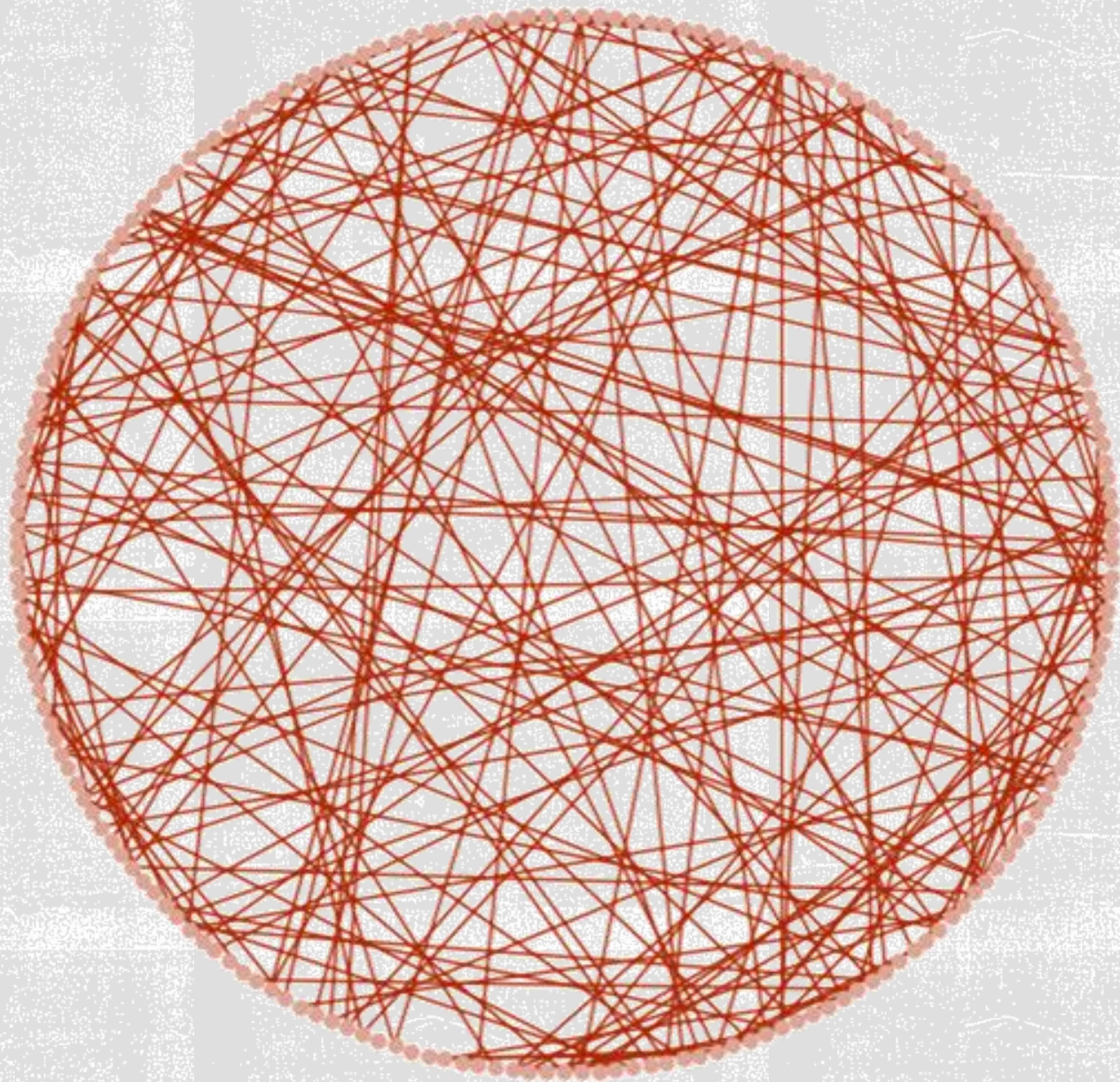
**DURSTENFELD
SHUFFLE**





PROBABILISTIC METHODS





RANDOM GRAPH
 $G(n,p)$



**HOW MANY VERTICES DO WE NEED IN ORDER TO
GET A TRIANGLE OR AN ANTI-TRIANGLE?**

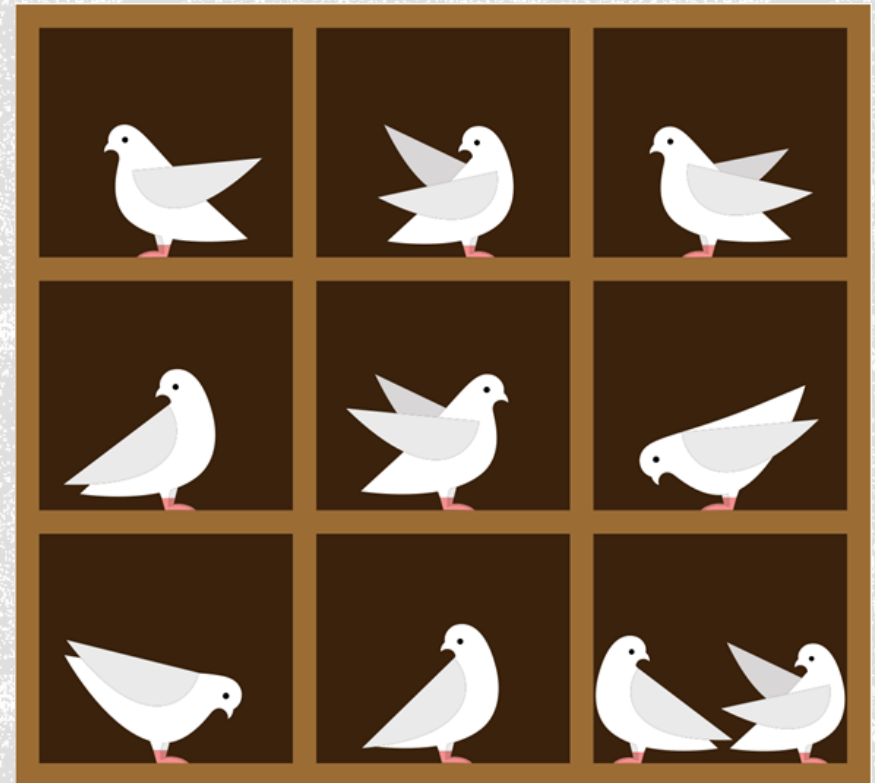
RANDOM GRAPH

How many



OPTIMISM PRINCIPLE

- If $\text{Pr}[\text{good event}] > 0$,
then good event will happen.
- If $\text{Pr}[\text{bad things}] < 1$,
then good things will happen.



**HOW MANY VERTICES DO WE NEED IN ORDER TO
GET A COMPLETE K -SUBGRAPH OR AN ANTI-
COMPLETE K -SUBGRAPH?**

RANDOM GRAPH

How many

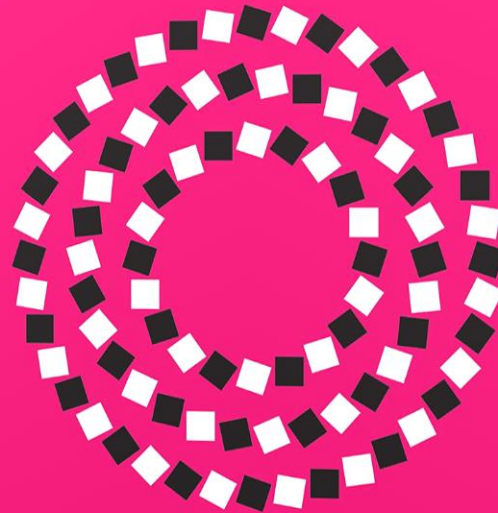




*"This book may well be the best collection of mind-stretching
teasers ever assembled." – Donald E. Knuth*

Mathematical Puzzles

Peter Winkler



Illustrations by Jess Johnson

 **CRC Press**
Taylor & Francis Group
AN A K PETERS BOOK

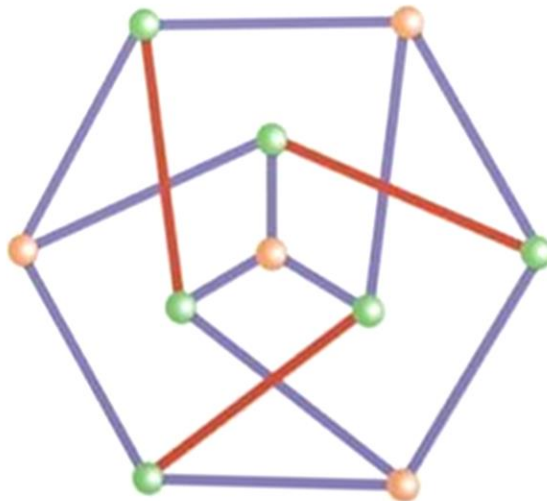
Algorithms



Jeff Erickson

INTRODUCTION TO GRAPH THEORY

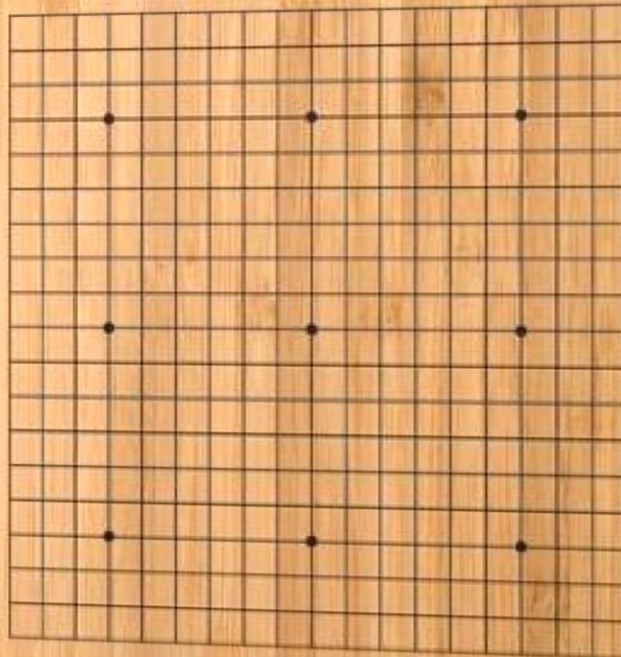
SECOND EDITION



DOUGLAS B. WEST

COMBINATORIAL MATHEMATICS

DOUGLAS B. WEST



Introduction to the Theory of
COMPUTATION
THIRD EDITION



MICHAEL SIPSER

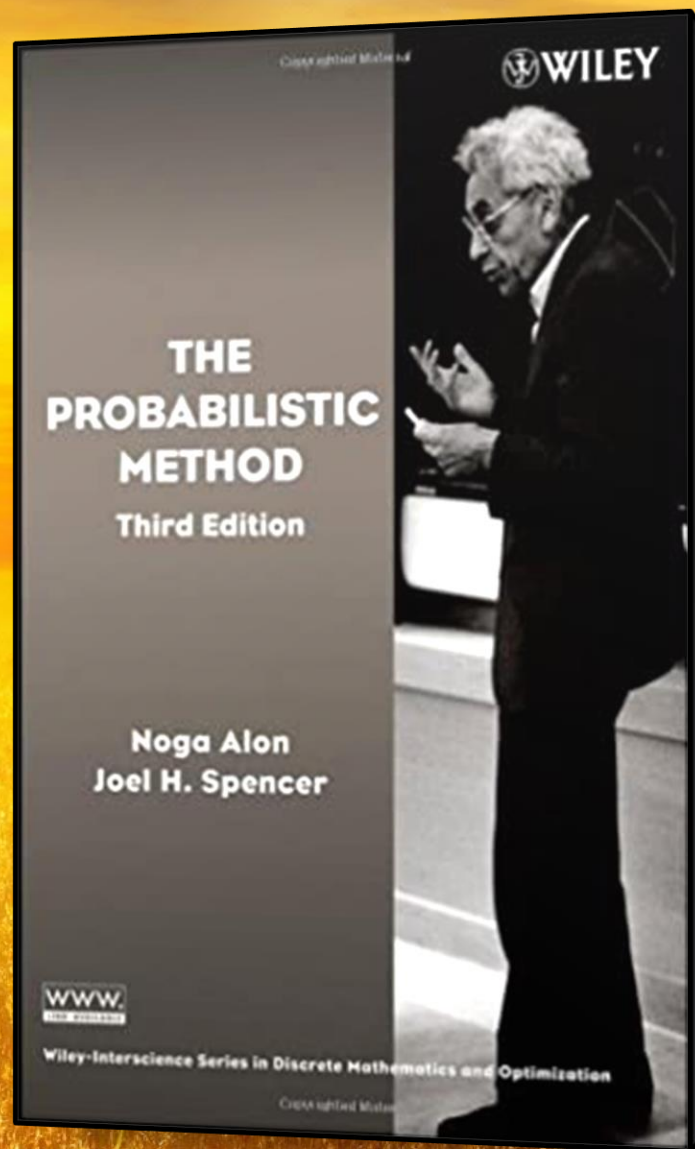
CONCRETE MATHEMATICS

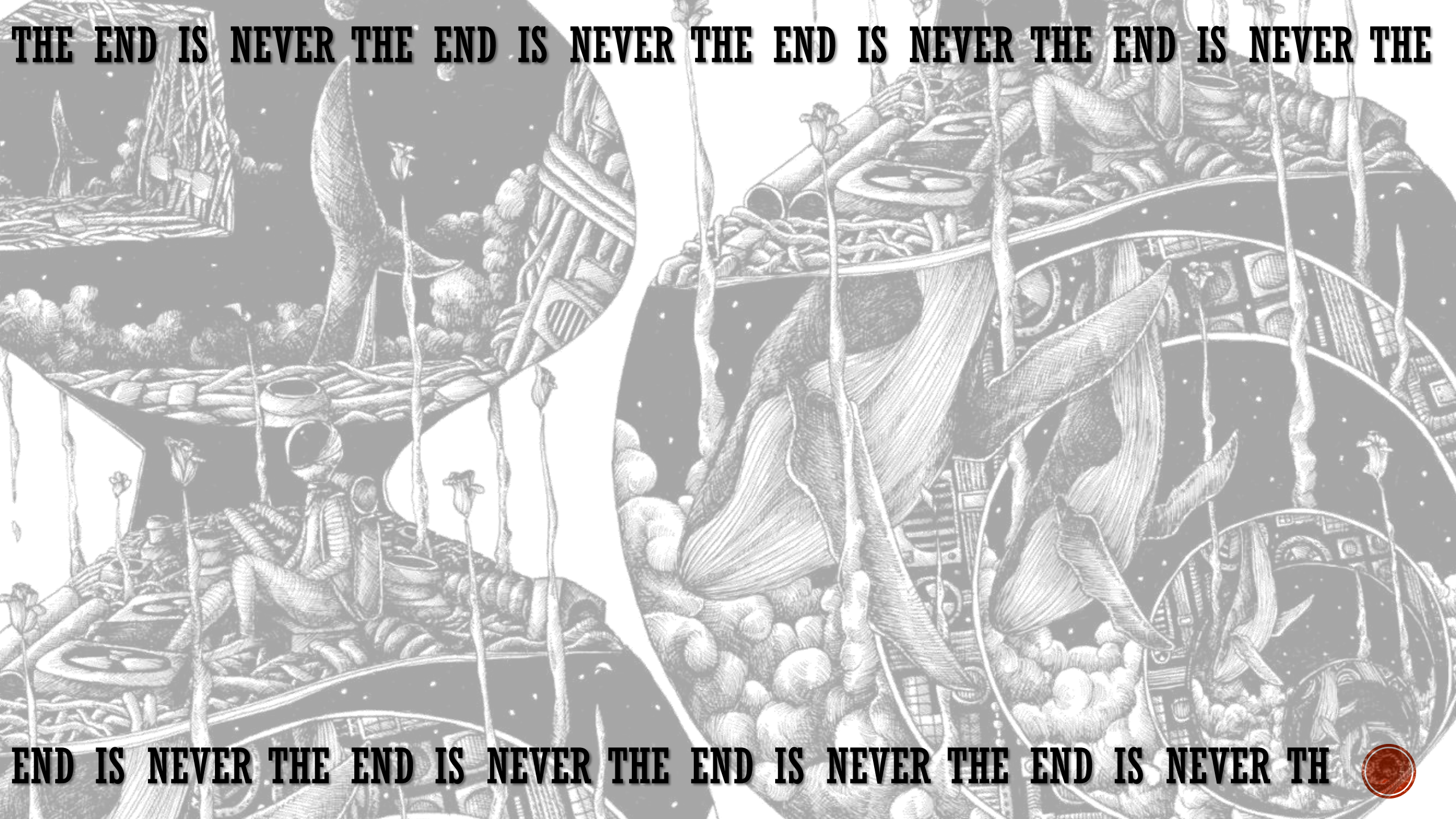
A FOUNDATION FOR COMPUTER SCIENCE

GRAHAM ○ KNUTH ○ PATASHNIK

SECOND EDITION







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