

PROBLEM SOLVING

[BACK](#)

Pólya's approach to problem-solving

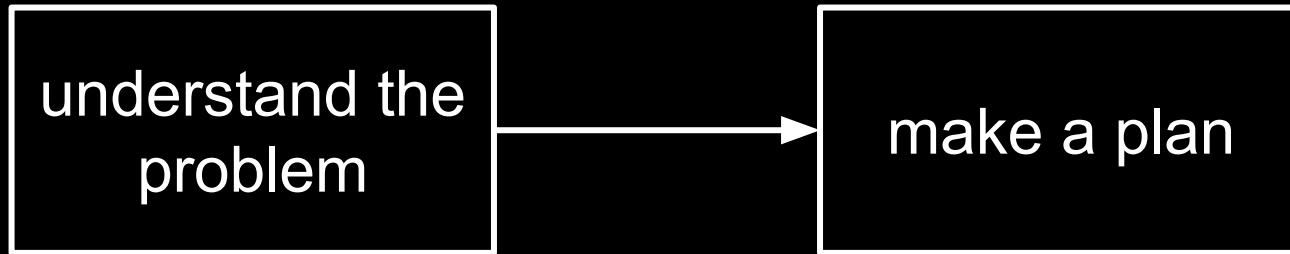


image source: <http://doi.org/10.3932/ethz-a-000099441>

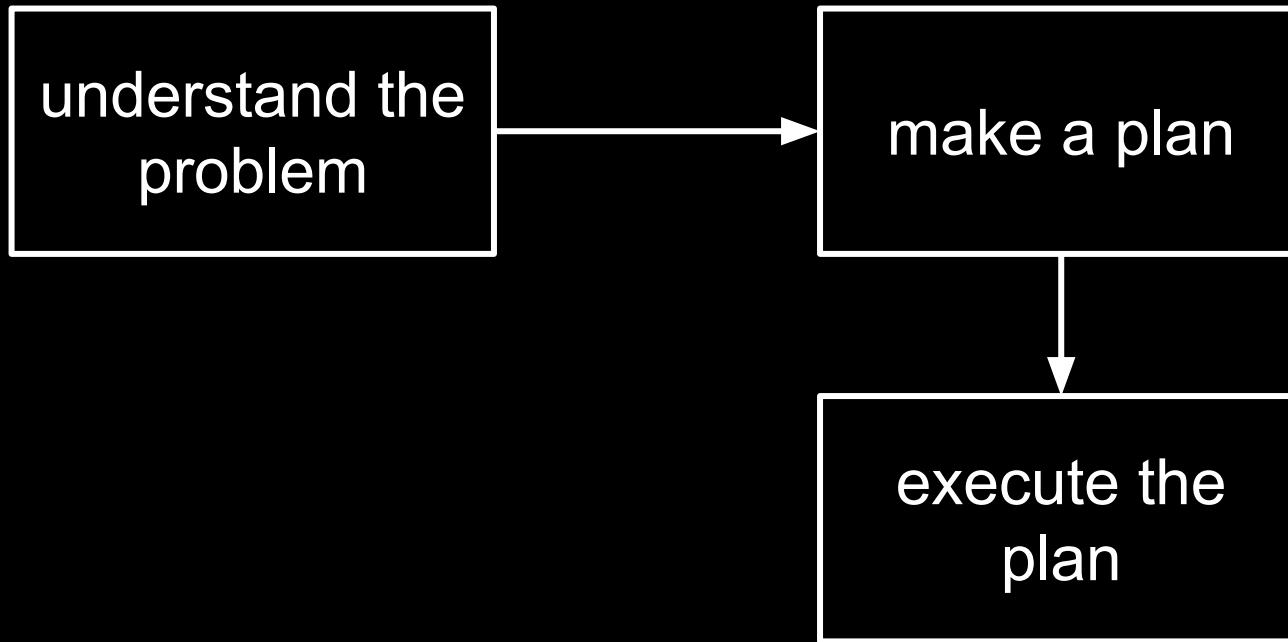
Pólya's approach to problem-solving

understand the
problem

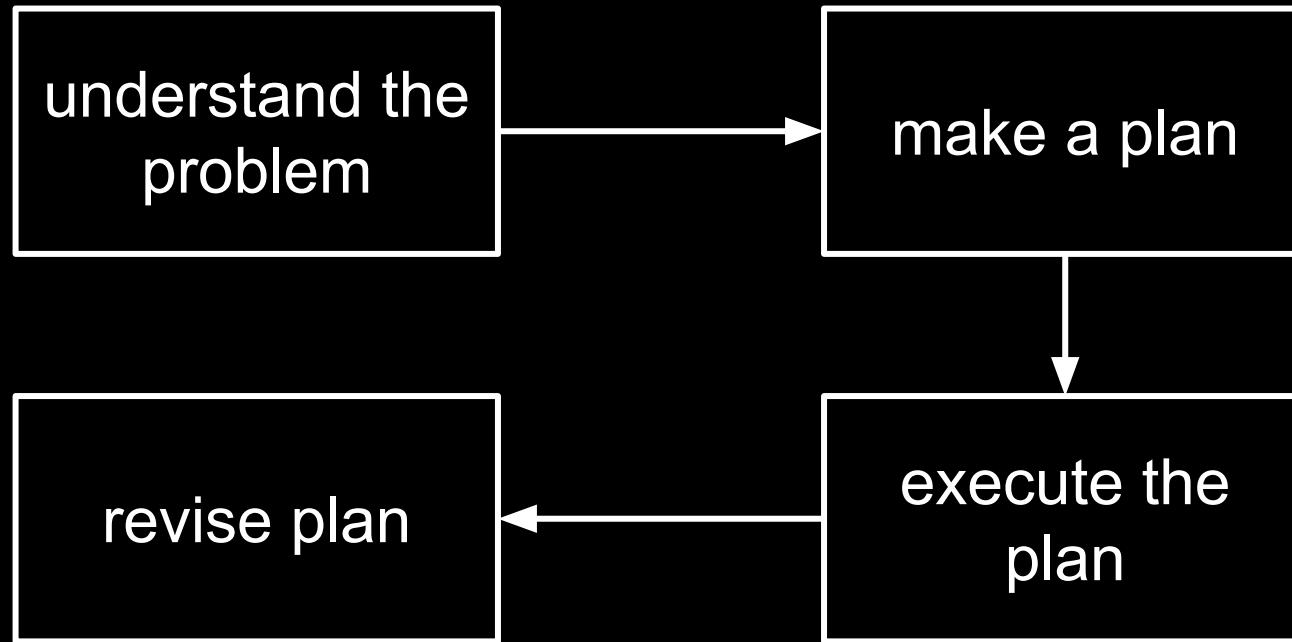
Pólya's approach to problem-solving



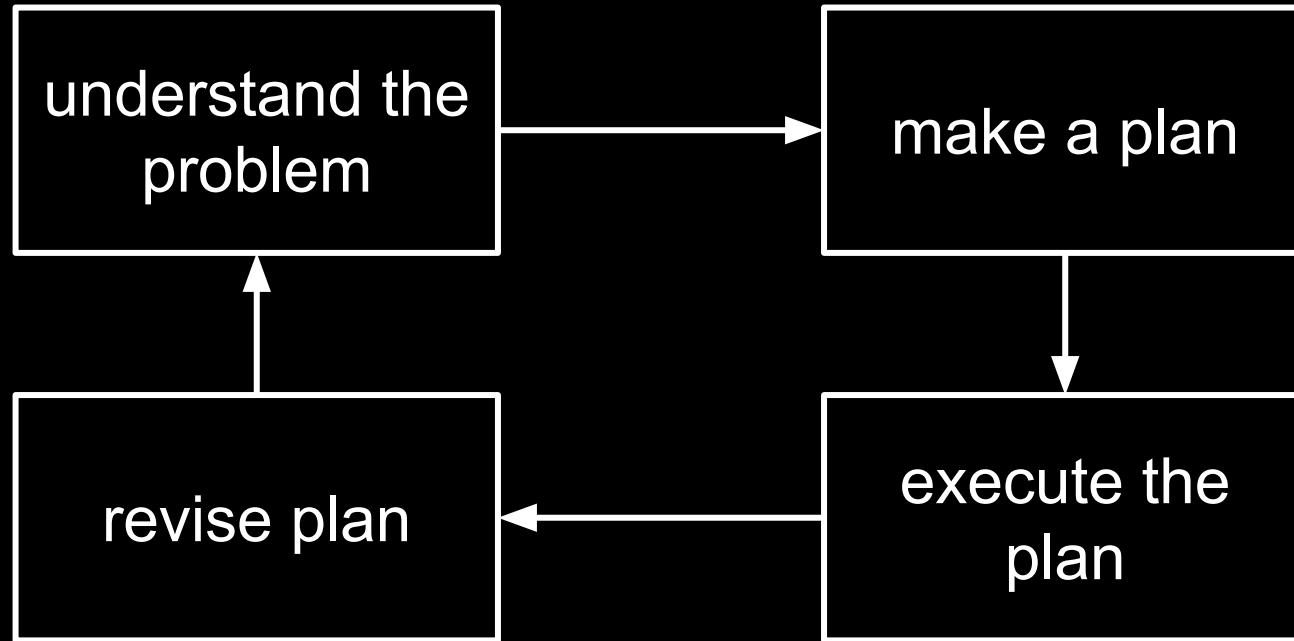
Pólya's approach to problem-solving



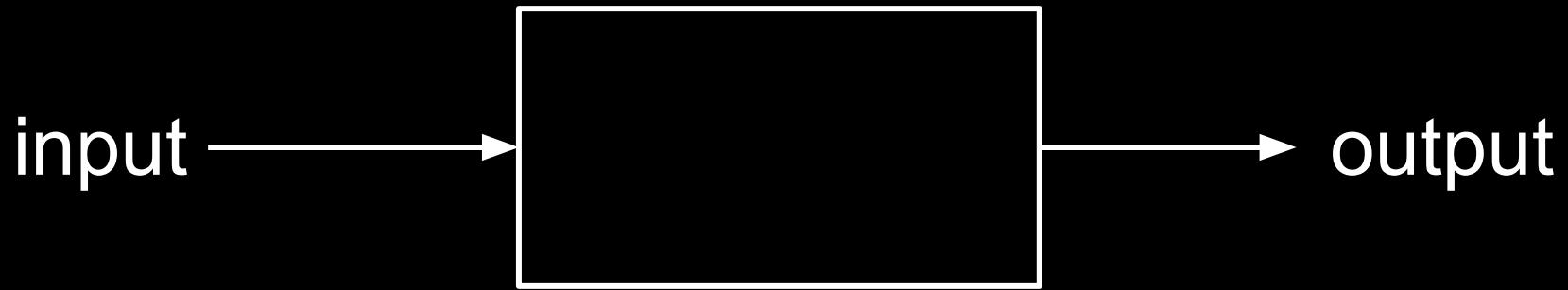
Pólya's approach to problem-solving



Pólya's approach to problem-solving



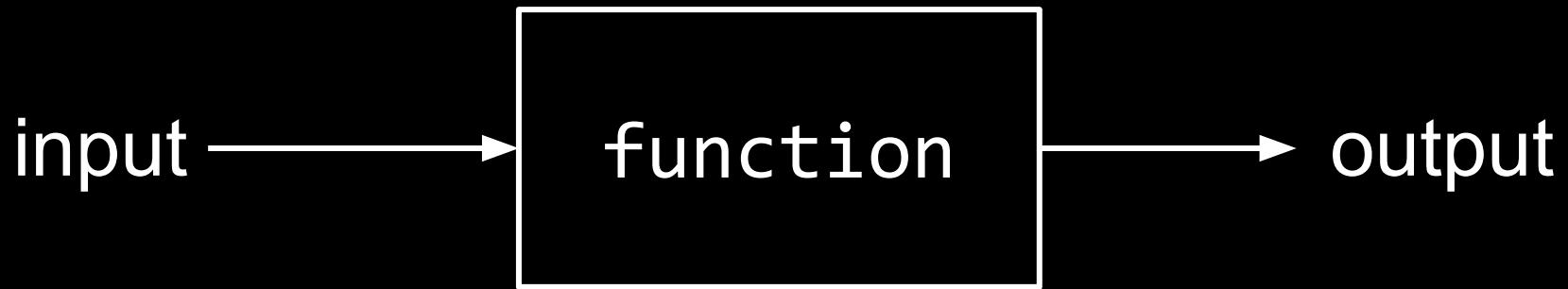
a model to represent problems



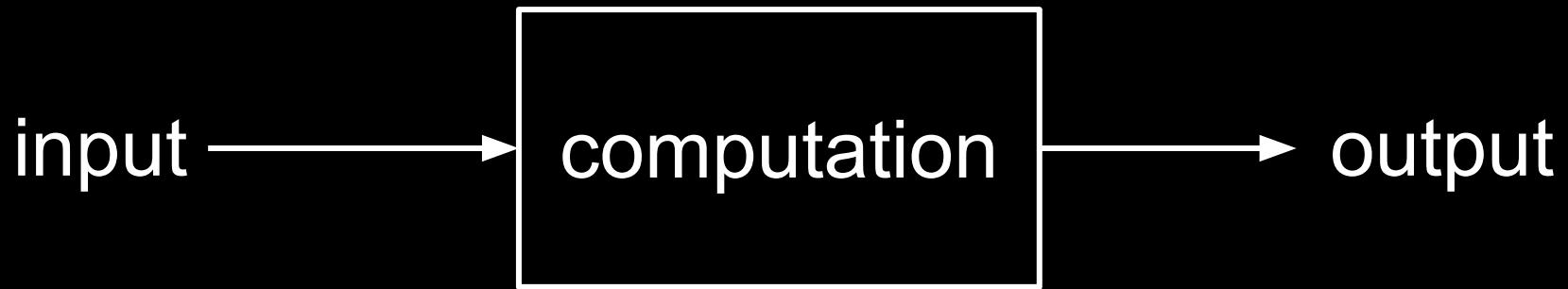
a model to represent problems



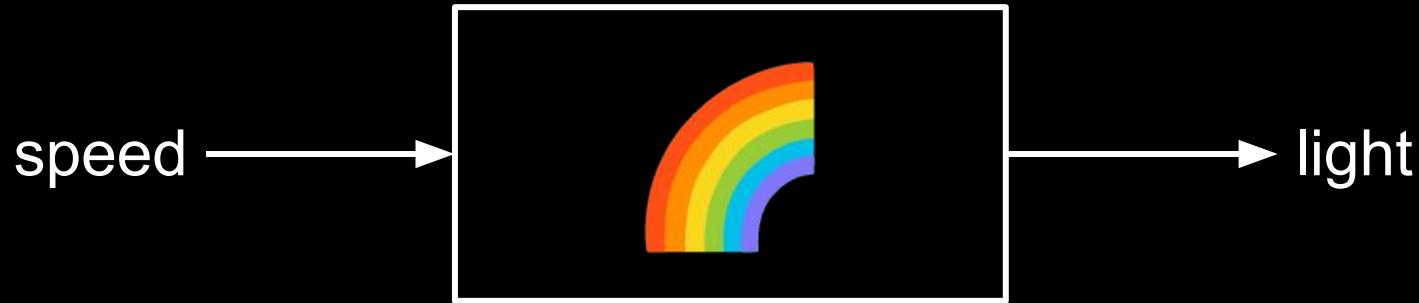
a model to represent problems

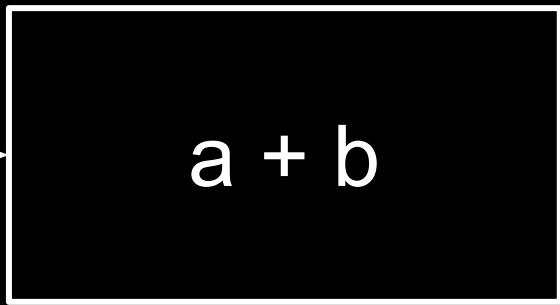


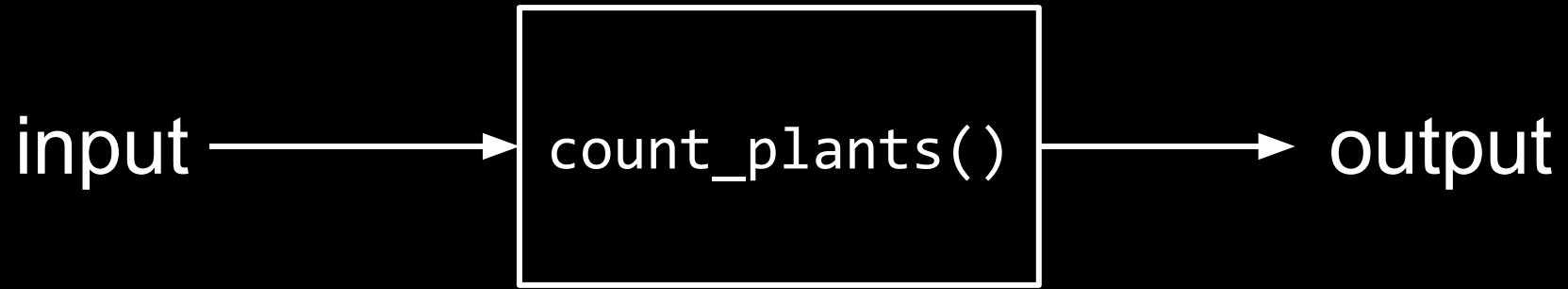
a model to represent problems



the rainbow experiment as an input - processing - output - problem



$\{a, b\}$  s





count_plants()

output



count_plants()

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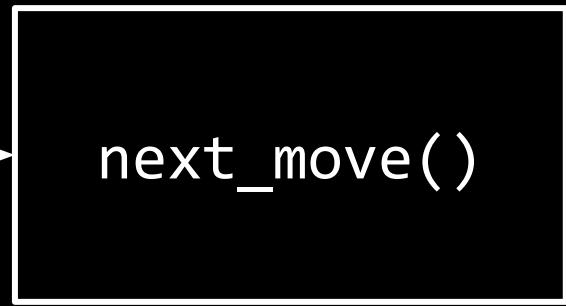
processing of
information



count_plants()

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representation of
information



E2 → E4



1: 0R	9: 0P	57: 1R
2: 0N	10: 0P	58: 1N
3: 0B	11: 0P	59: 1B
4: 0K	12: 0P	60: 1K
5: 0Q	13: 0P	...
6: 0B	14: 0P	62: 1B
7: 0N	15: 0P	63: 1N
8: 0R	16: 0P	64: 1R

representation of information



problem solving strategies

problem decomposition

large and complex problem

less complex
subproblem

less complex
subproblem

less complex subproblem

less complex
subproblem

less complex
subproblem

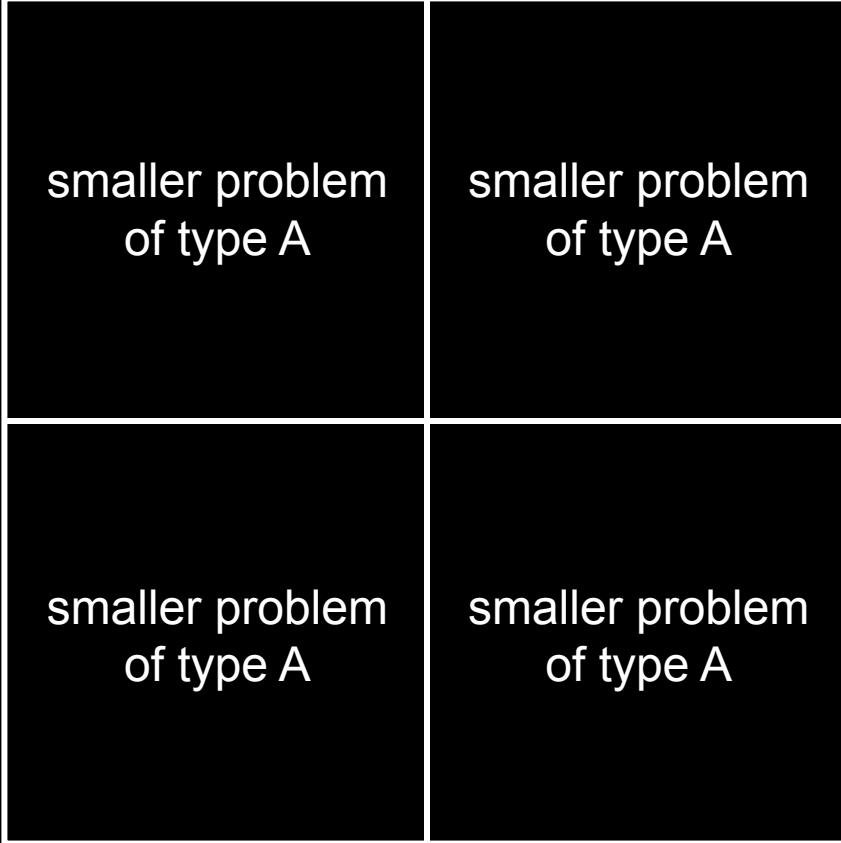
less complex subproblem

less complex subproblem

less complex subproblem

divide and conquer

large and complex problem of type A



smaller problem
of type A

even smaller problem of type A	even smaller problem of type A
even smaller problem of type A	even smaller problem of type A
even smaller problem of type A	even smaller problem of type A
even smaller problem of type A	even smaller problem of type A

sorted list +
element



is 67 a prime number?

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

linear search



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

linear search



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

linear search



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

linear search



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

linear search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



19 steps... can't we do better?

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



large and complex
problem

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

large and complex problem

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

smaller problem

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41

smaller problem

43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

binary search

67 != 41



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

binary search

$67 > 41$



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, **41**,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

binary search

$67 > 41$



2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



67 != 71

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



67 != 71

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



$$67 < 71$$

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



67 != 59

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



$$67 > 59$$

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



$$67 = 67$$

binary search

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



$$67 = 67$$

3 splits → much better

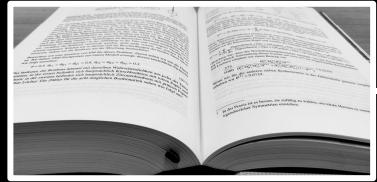
2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,
43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97



$$67 = 67$$



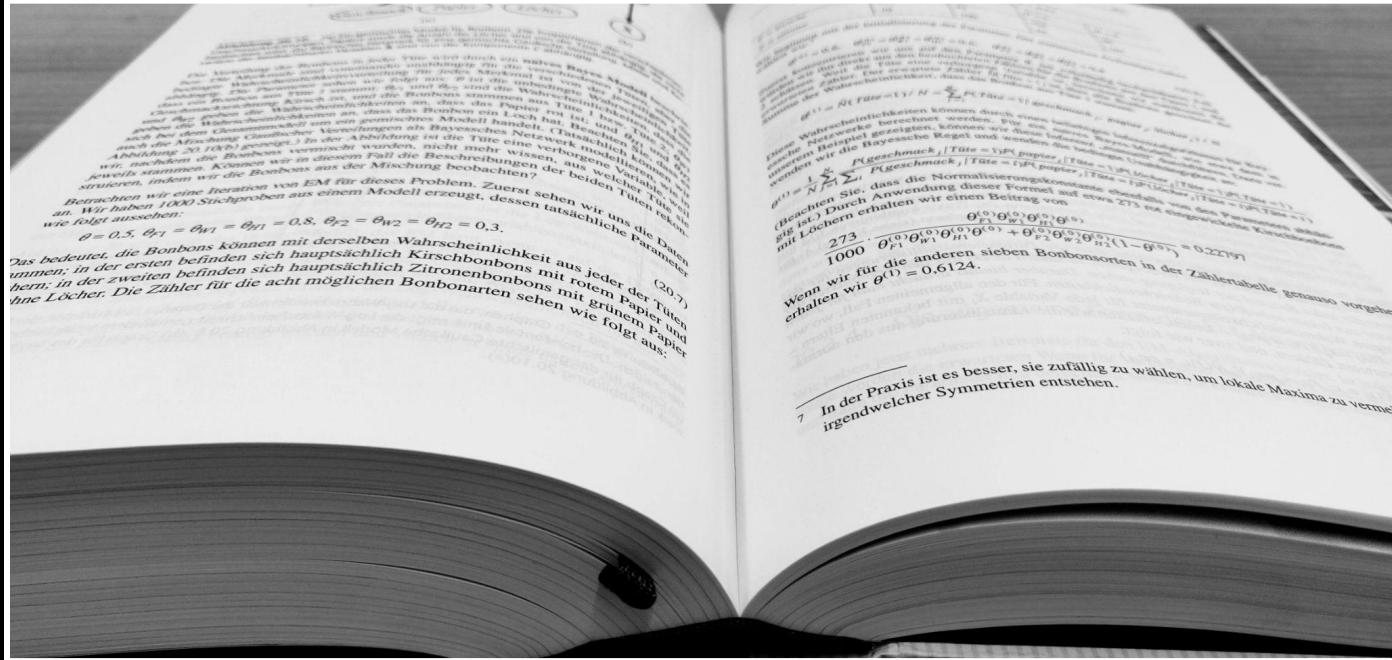
how efficient are linear and
binary search in general?



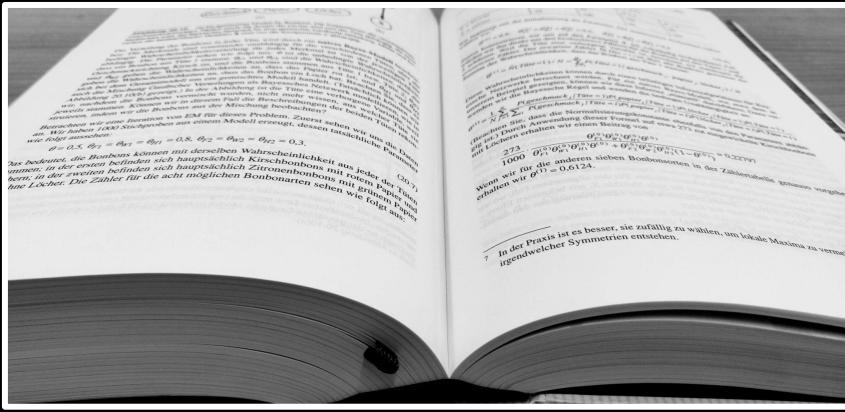
count_words()

word count

how many words are in the book?



strategies, anyone?

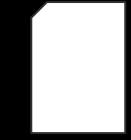
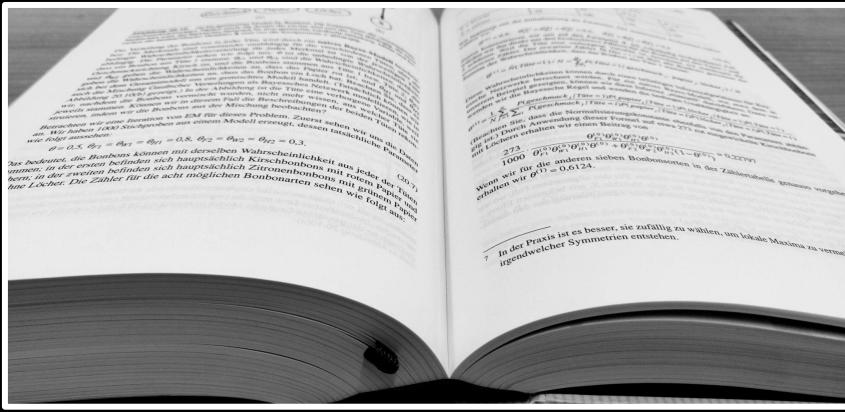


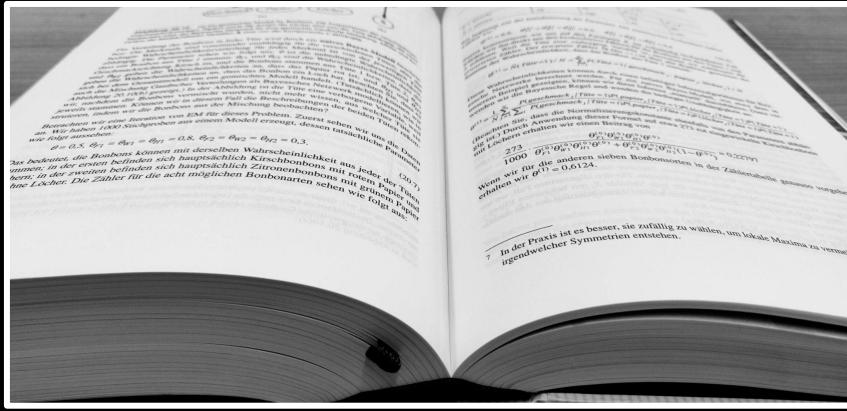
... und somit ist die Wahrscheinlichkeit, dass ein Bonbon aus einer Zuckertüte ein Karamellbonbon ist, gleich der Wahrscheinlichkeit, dass es ein Zitronenbonbon ist. Also ist $\theta_{11} = \theta_{12} = \theta_{21} = \theta_{22}$.
Betrachten wir die Beobachtung, dass ein Bonbon aus einer Zuckertüte ein Karamellbonbon ist. Dann ist die Wahrscheinlichkeit, dass ein Bonbon aus einer Zuckertüte ein Karamellbonbon ist, gleich der Wahrscheinlichkeit, dass es ein Zitronenbonbon ist. Also ist $\theta_{11} = \theta_{12} = \theta_{21} = \theta_{22}$.

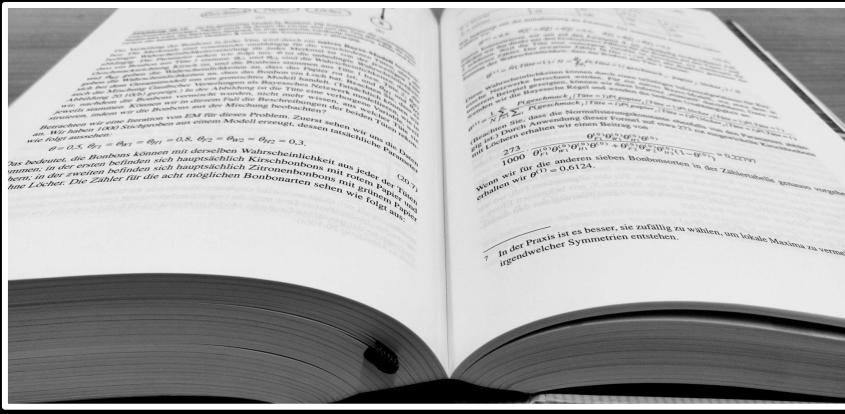
Was bedeutet, die Bonbons können mit derselben Wahrscheinlichkeit aus jeder der Tüten entnommen werden. In der ersten Tüte befinden sich hauptsächlich Zitronenbonbons mit einem kleinen Prozentsatz Karamellbonbons. Die Zähler für die acht möglichen Bonbonarten seien wie folgt ange-

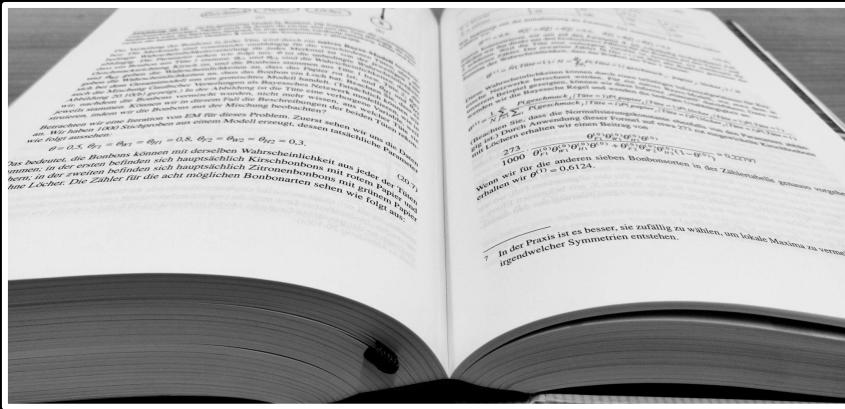
7. In der Praxis ist es besser, sie zufällig zu wählen, um lokale Maxima zu vermeiden.

Wenn wir für die anderen sieben Bonbonarten in der Zähltabelle gewählt haben, erhalten wir $\theta^* = 0.6124$.









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page 1

212

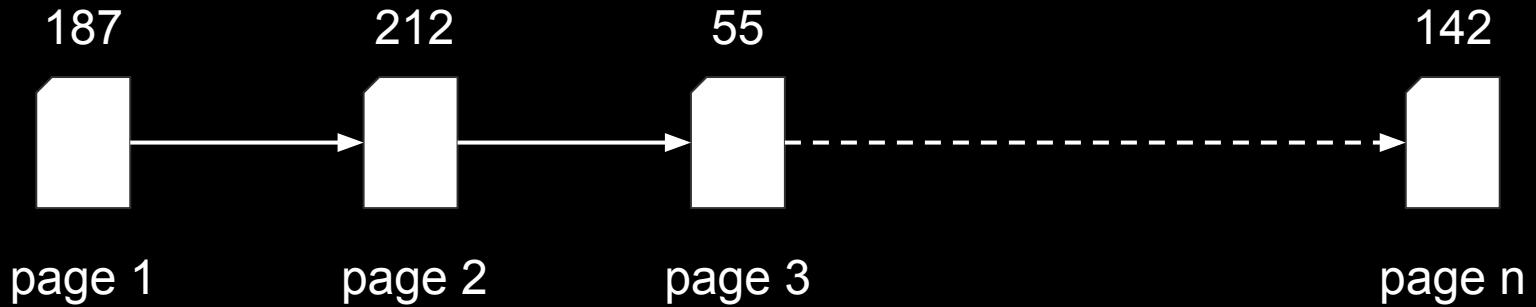
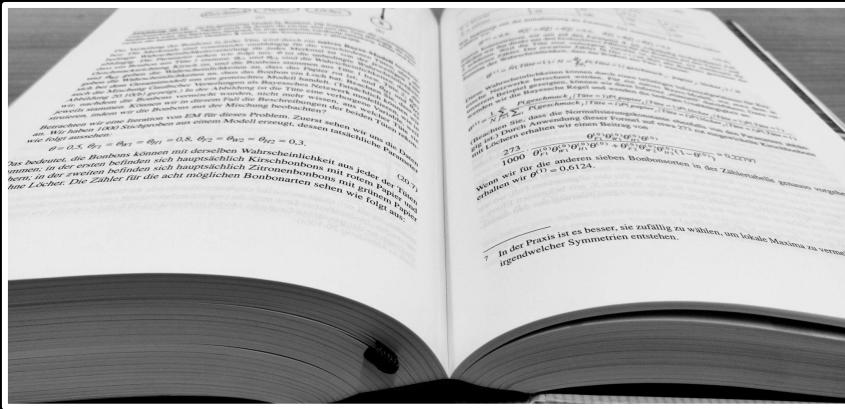


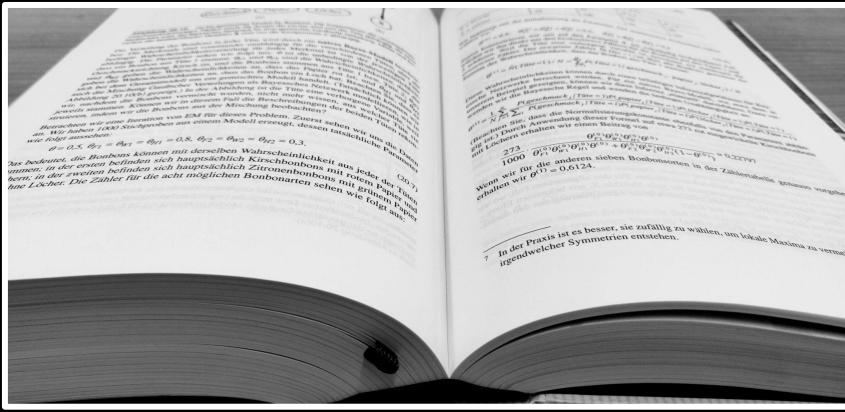
page 2

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page 3





$n = 1327$ pages

$\varnothing 2:23$ minutes per page

~ 52.34 hours

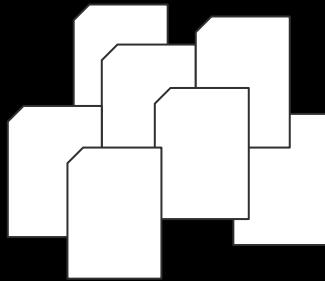


divide and conquer

+

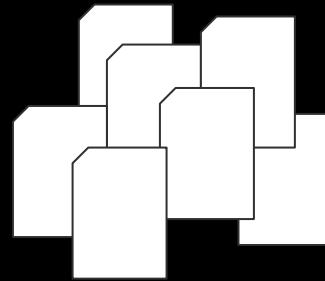
?

pages 1 - 700



student 1

pages 701 - 1327



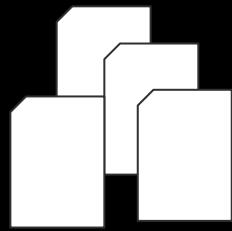
student 2

pages 1 - 350

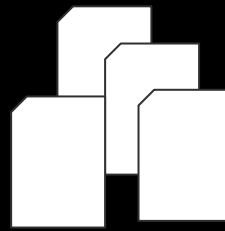
pages 351 - 700

pages 701 - 1050

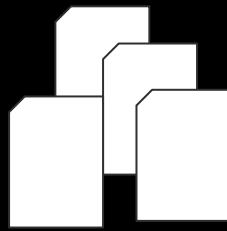
pages 1051- 1327



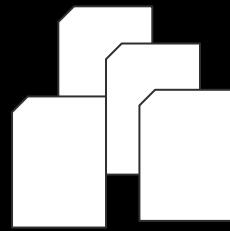
student 1



student 2



student 3



student 4

divide and conquer

+

distribution and parallelization

