

PROBLEM SOLVING

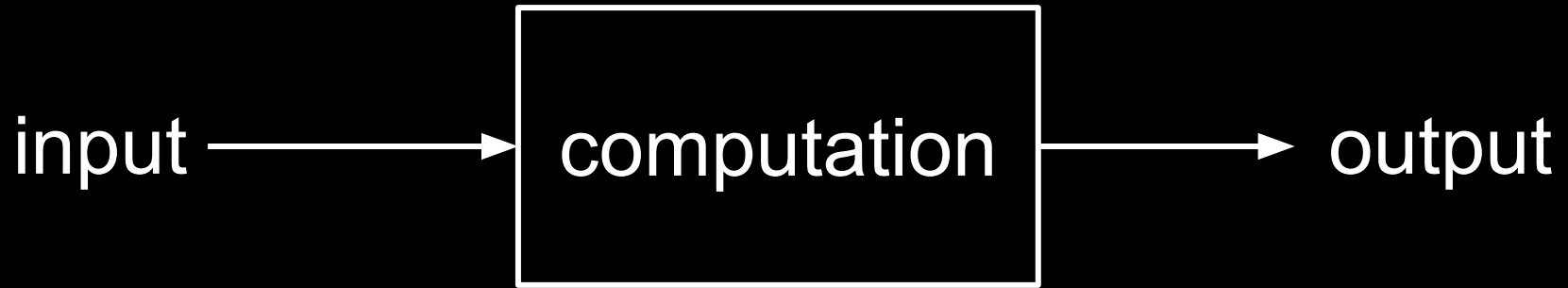
a model for solving problems



a model for solving problems



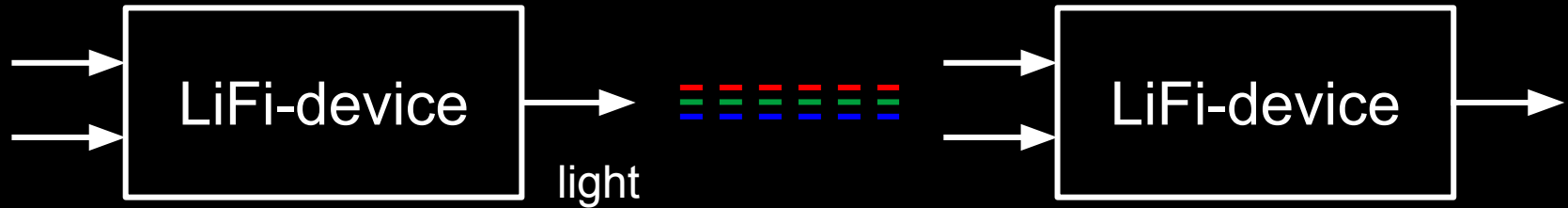
a model for solving problems

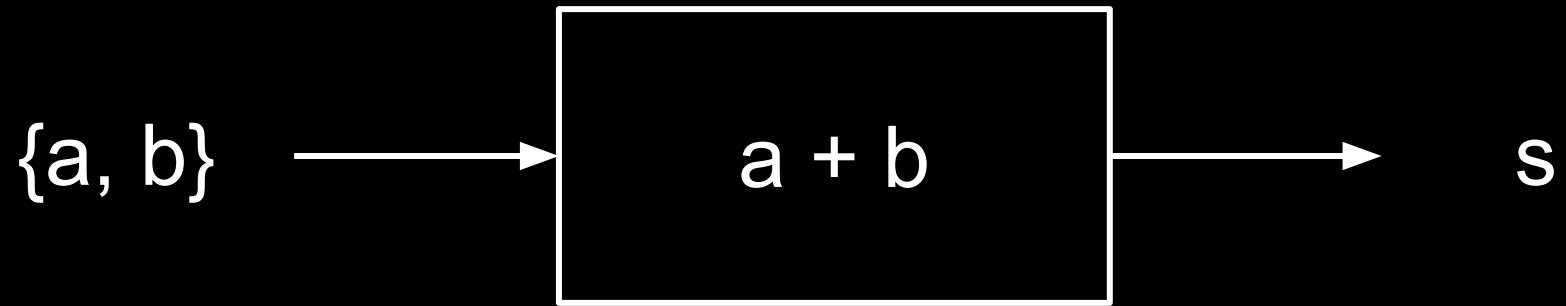


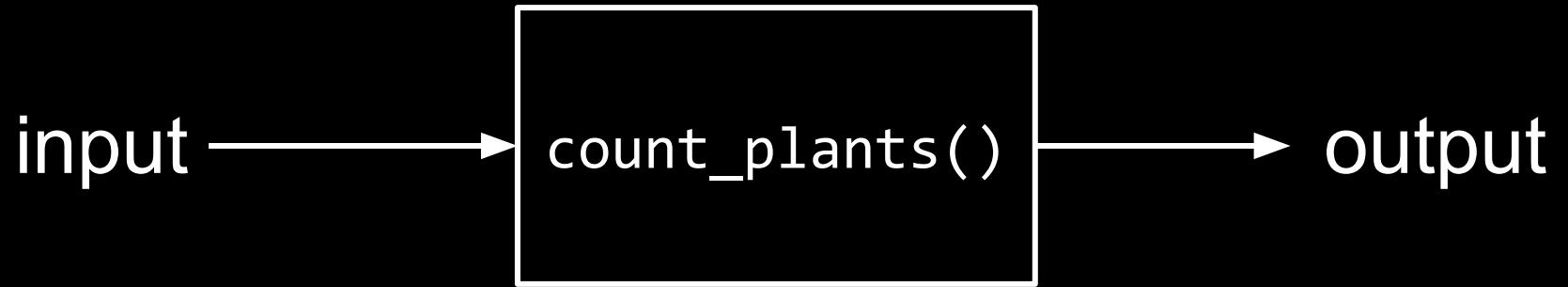
the LiFi-project as an input-processing-output problem

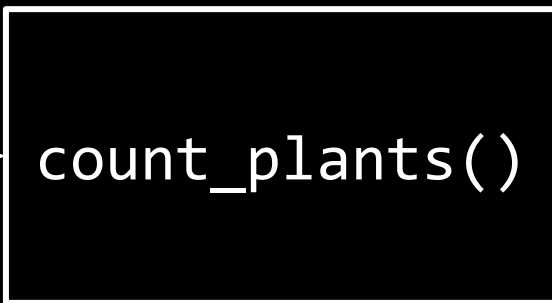
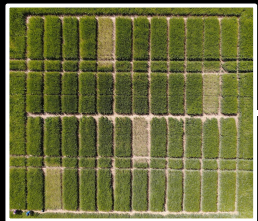


the LiFi-project as an input-processing-output problem

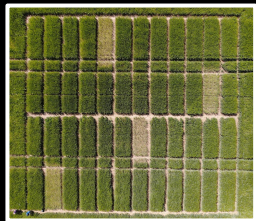






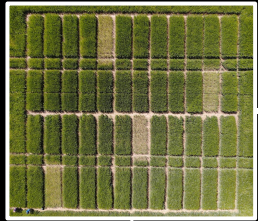


output



42

processing of
information



count_plants()

42

representation of
information



next_move()

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	61: 1Q
6: 0B	14: 0P	62: 1B
7: 0N	15: 0P	63: 1N
8: 0R	16: 0P	64: 1R

...

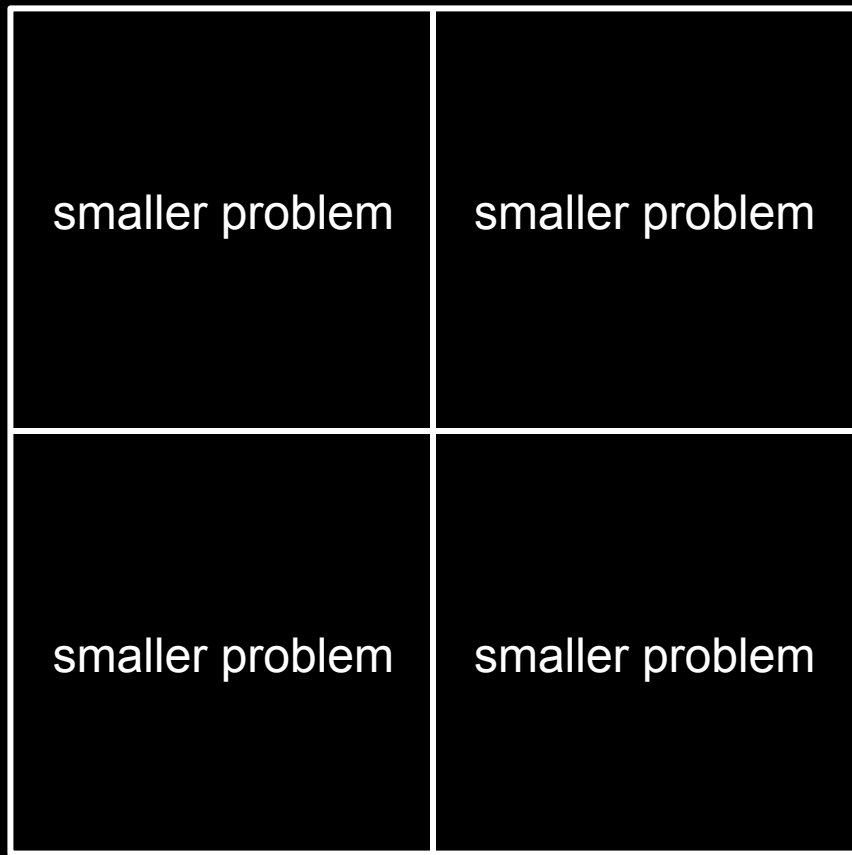
representation of information

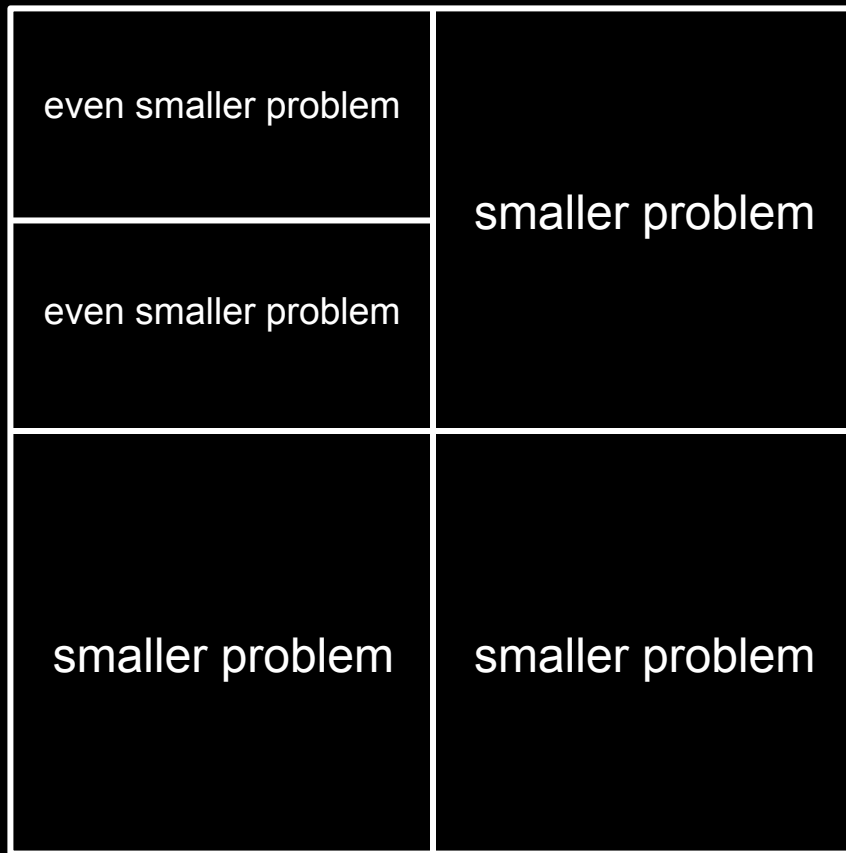


problem solving strategies

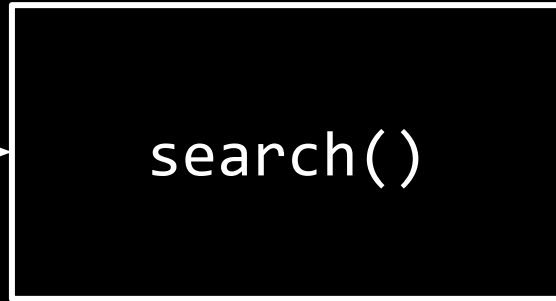
divide and conquer

large and complex problem





sorted list +
element



yes / no

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

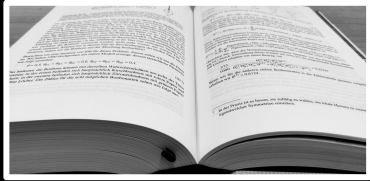
2, 3, 5, 7, 11, ~~13~~, 17, 19, ~~23~~, 29, 31, 37, 41,
~~43~~, 47, ~~53~~, 59, ~~61~~, 67, ~~71~~, ~~73~~, 79, ~~83~~, ~~89~~, 97



67 = 67



how efficient are linear and
binary search in general?



`count_words()`

word count

Die Abweichung der Beobachtung im letzten Tüte wird durch ein wahres Bayes'sches Modell beschrieben. Die Beobachtung ist die Farbe des Bonbons, das gezogen wurde. Das Modell ist eine Wahrscheinlichkeitsverteilung für die Farbe des Bonbons, gegeben die Farbe des Papiers. Die Parameter sind die Wahrscheinlichkeiten, dass ein Bonbon einer bestimmten Farbe ist, gegeben die Farbe des Papiers.

Das Problem besteht darin, diese Parameter zu schätzen. Wir haben nur eine Stichprobe von Bonbons gesehen. Wir können die Maximum-Likelihood-Schätzung verwenden, aber dies ist nicht unbedingt die beste Schätzung. Eine bessere Schätzung ist die Bayesianische Schätzung, die die Unsicherheit über die Parameter berücksichtigt.

Wir betrachten hier eine Iteration von EM für dieses Problem. Zuerst sehen wir uns die Daten an. Wir haben 1000 Stichproben aus einem Modell erzeugt, dessen tatsächliche Parameter wie folgt aussehen:

$$\theta = 0.5, \theta_1 = \theta_{H1} = \theta_{V1} = 0.8, \theta_2 = \theta_{H2} = \theta_{V2} = 0.3.$$

Dies bedeutet, dass die Bonbons kommen mit derselben Wahrscheinlichkeit aus jeder der Tüten ummen; in der ersten befinden sich hauptsächlich Zitronenbonbons mit rotem Papier und in der zweiten befinden sich hauptsächlich Zitronenbonbons mit grünem Papier ohne Löcher. Die Zähler für die acht möglichen Bonbonarten sehen wie folgt aus:

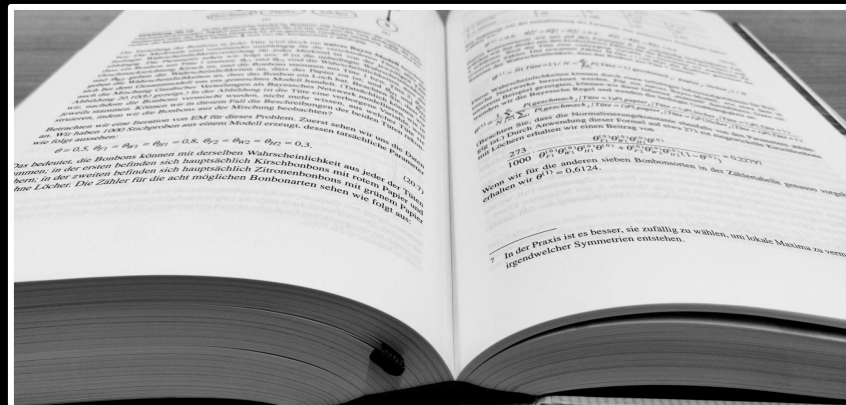
Bonbonart	Zähler
Rotes Papier, ohne Loch	400
Rotes Papier, mit Loch	600
Grünes Papier, ohne Loch	300
Grünes Papier, mit Loch	700

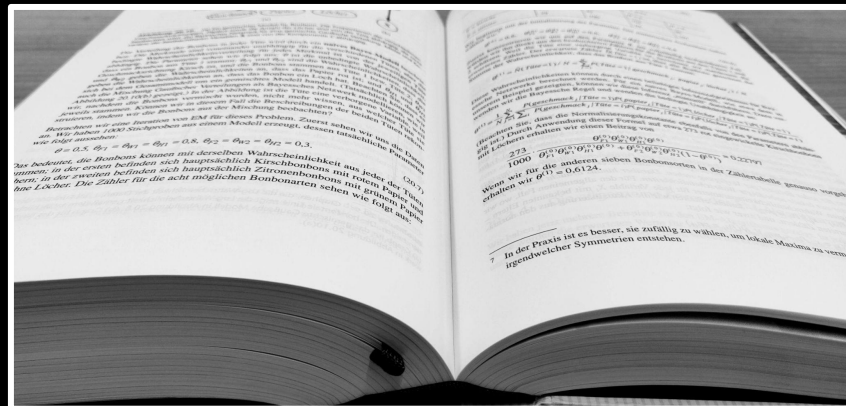
(20.7)

Wenn wir für die anderen sieben Bonbonsorten in der Zählertabelle genauso vorgehen erhalten wir $\theta^{(1)} = 0.6124$.

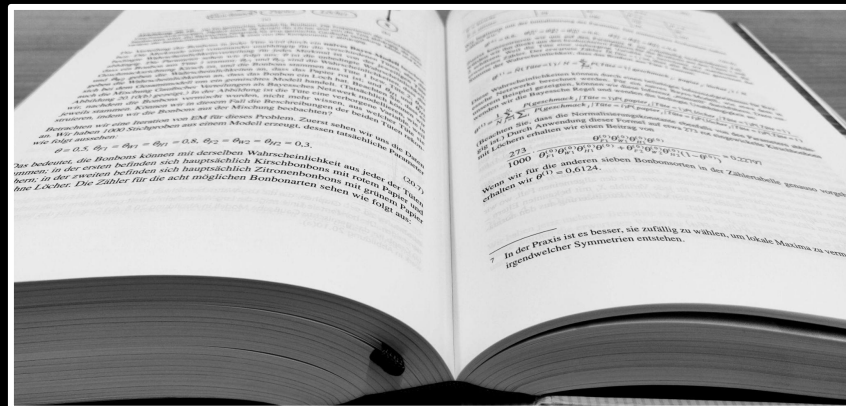
In der Praxis ist es besser, sie zufällig zu wählen, um lokale Maxima zu vermeiden, wenn Symmetrien entstehen.

strategies, anyone?





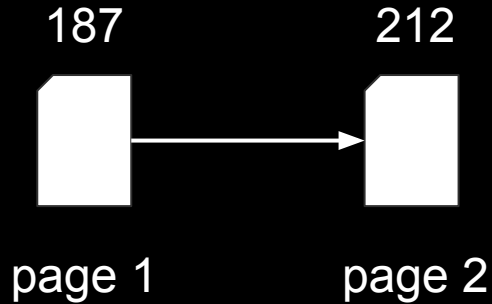
page 1

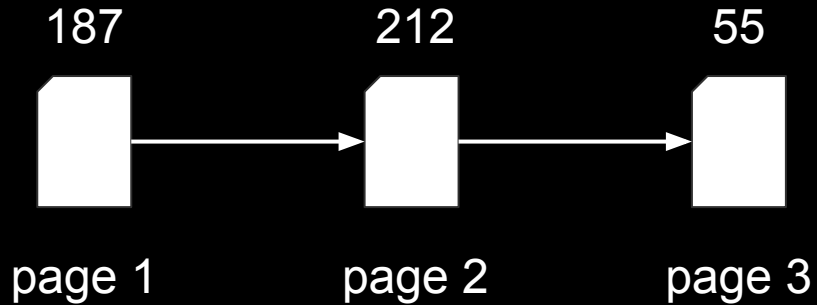
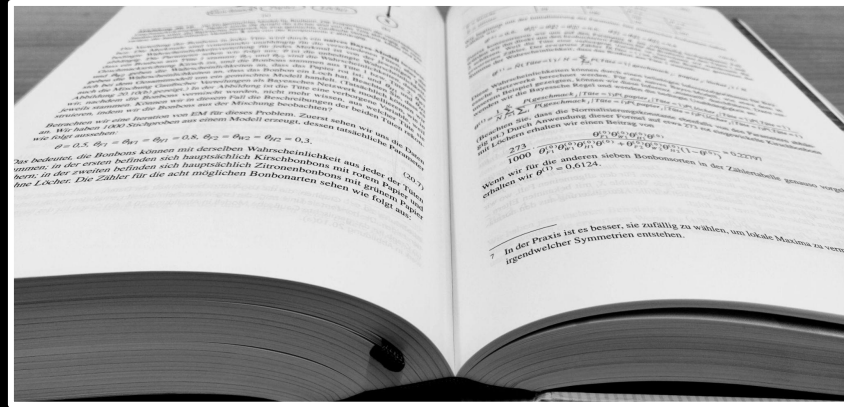


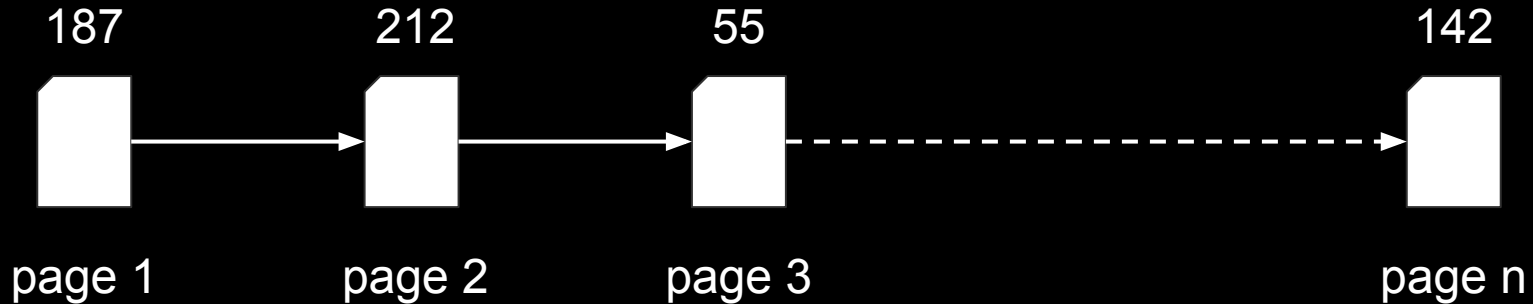
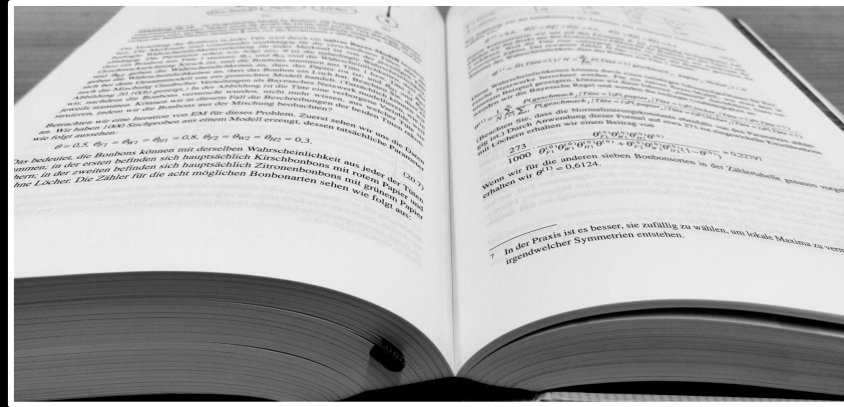
187

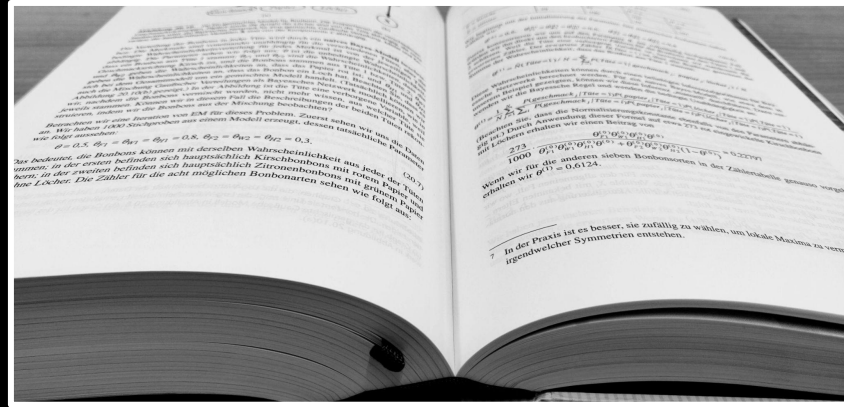


page 1









$n = 1327$ pages

\varnothing 2:23 minutes per page

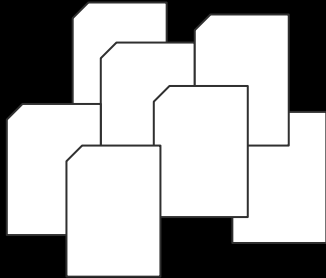
~ 52.34 hours

divide and conquer

+

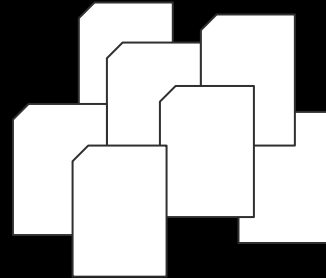
?

pages 1 - 700



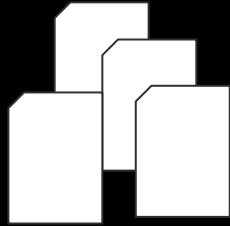
student 1

pages 701 - 1327



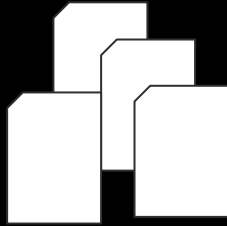
student 2

pages 1 - 350



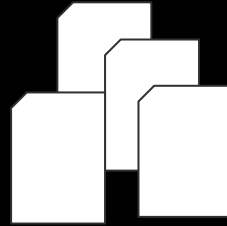
student 1

pages 351 - 700



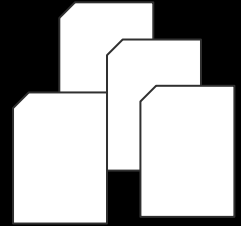
student 2

pages 701 - 1050



student 3

pages 1051- 1327



student 4

divide and conquer
+
distribution and parallelization

