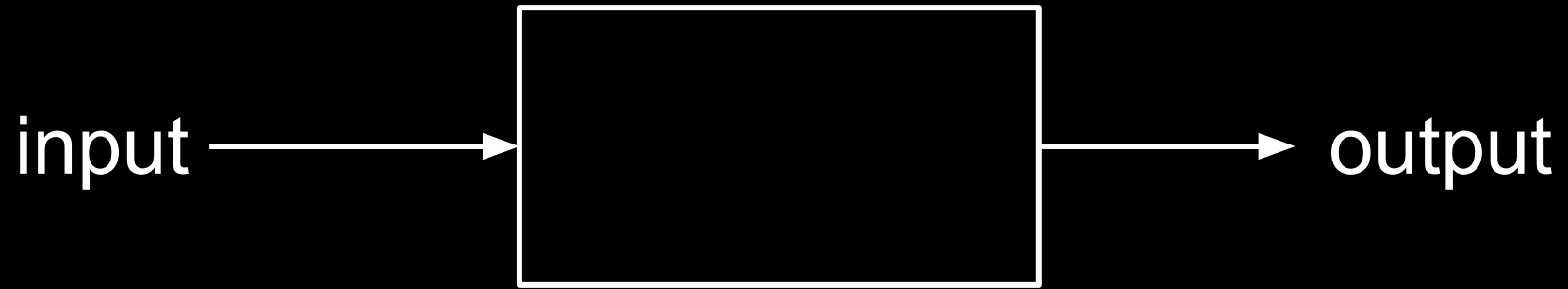


# PROBLEM SOLVING

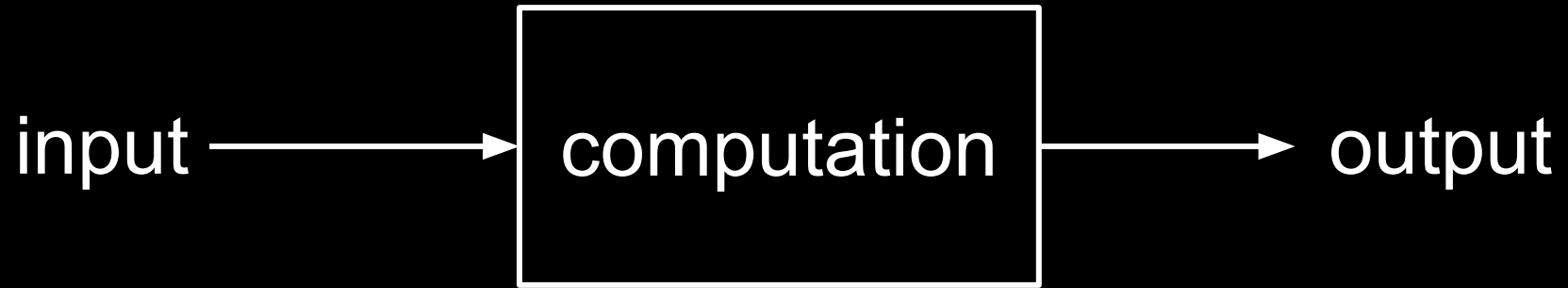
# a model for solving problems

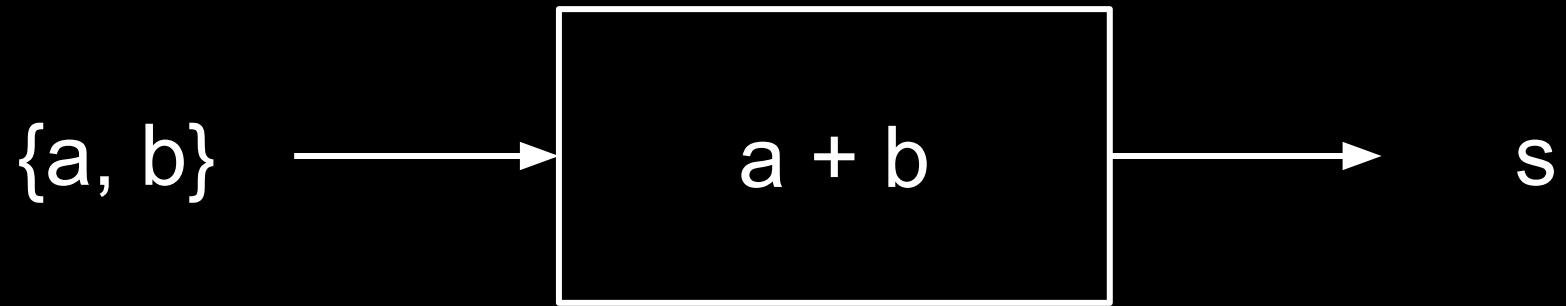


# a model for solving problems

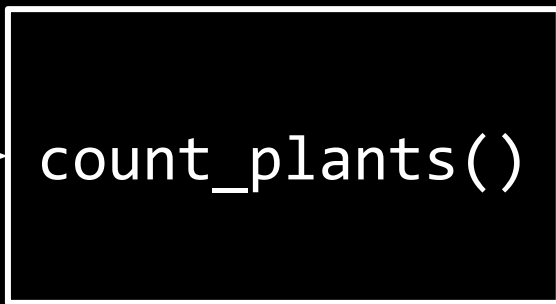


a model for solving problems









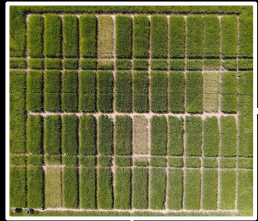
output



42



processing of  
information

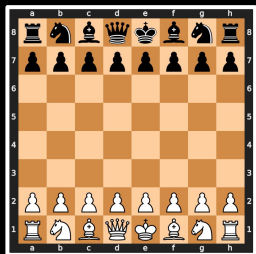


`count_plants()`

42

representation of  
information





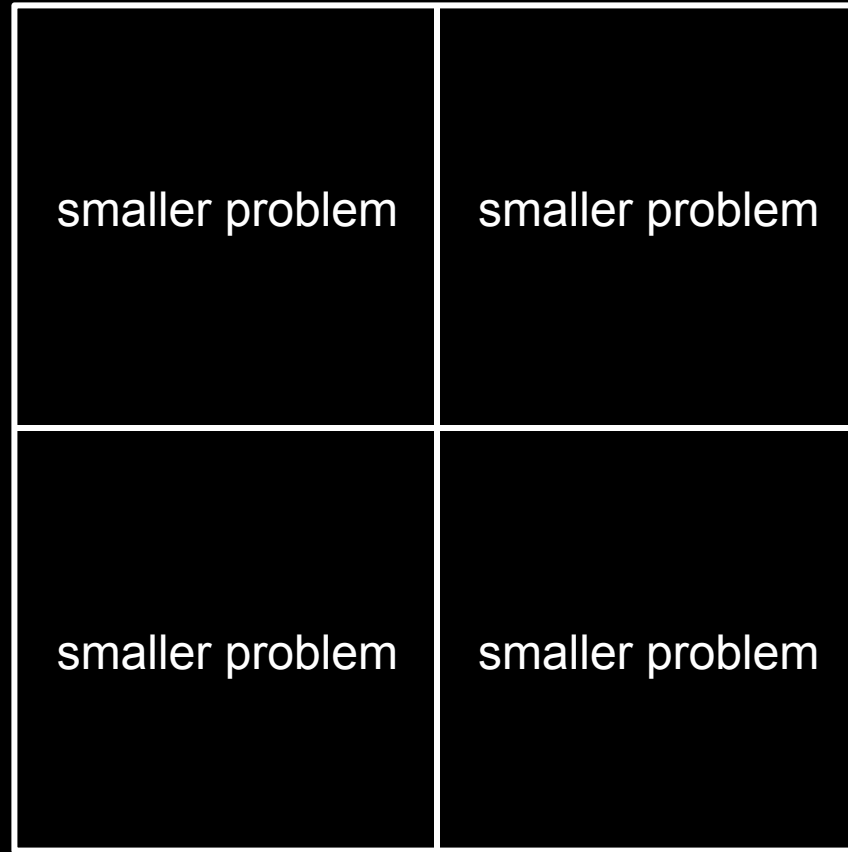
next\_move()

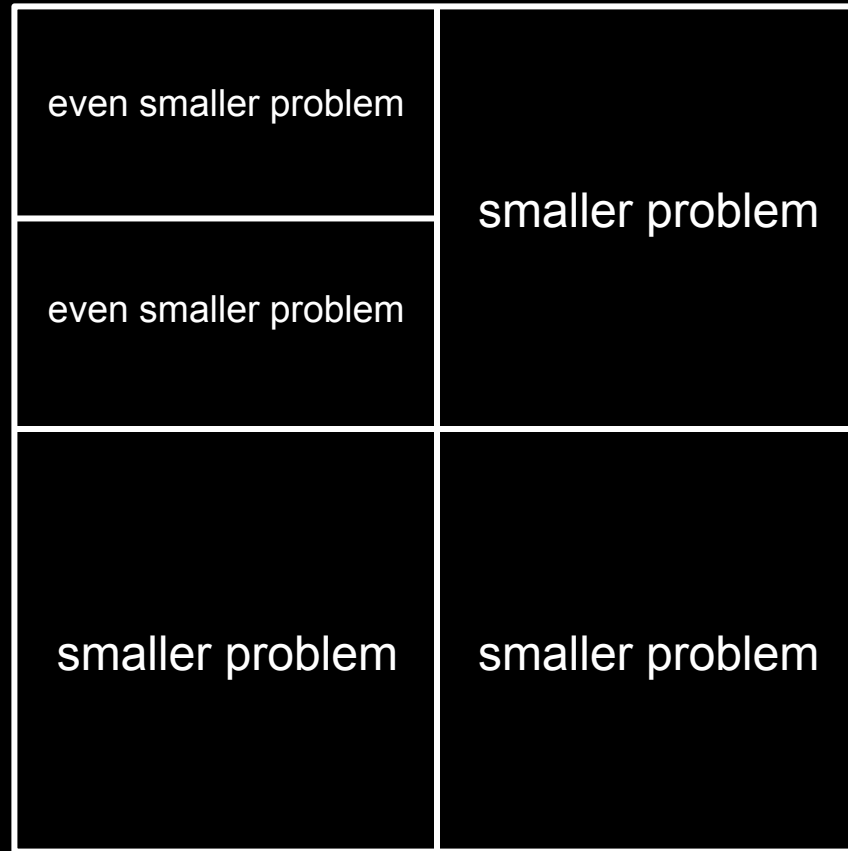
E2 → E4

problem solving strategies

divide and conquer

large and complex problem







sorted list +  
element



search()



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

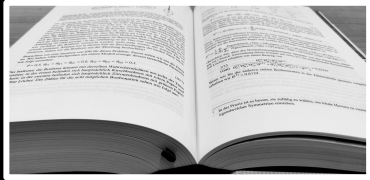
2, 3, 5, 7, 11, ~~13~~, 17, 19, ~~23~~, ~~29~~, 31, 37, 41,  
~~43~~, 47, ~~53~~, 59, ~~61~~, 67, ~~71~~, ~~73~~, 79, ~~83~~, ~~89~~, 97



67 = 67



how efficient are linear and  
binary search in general?

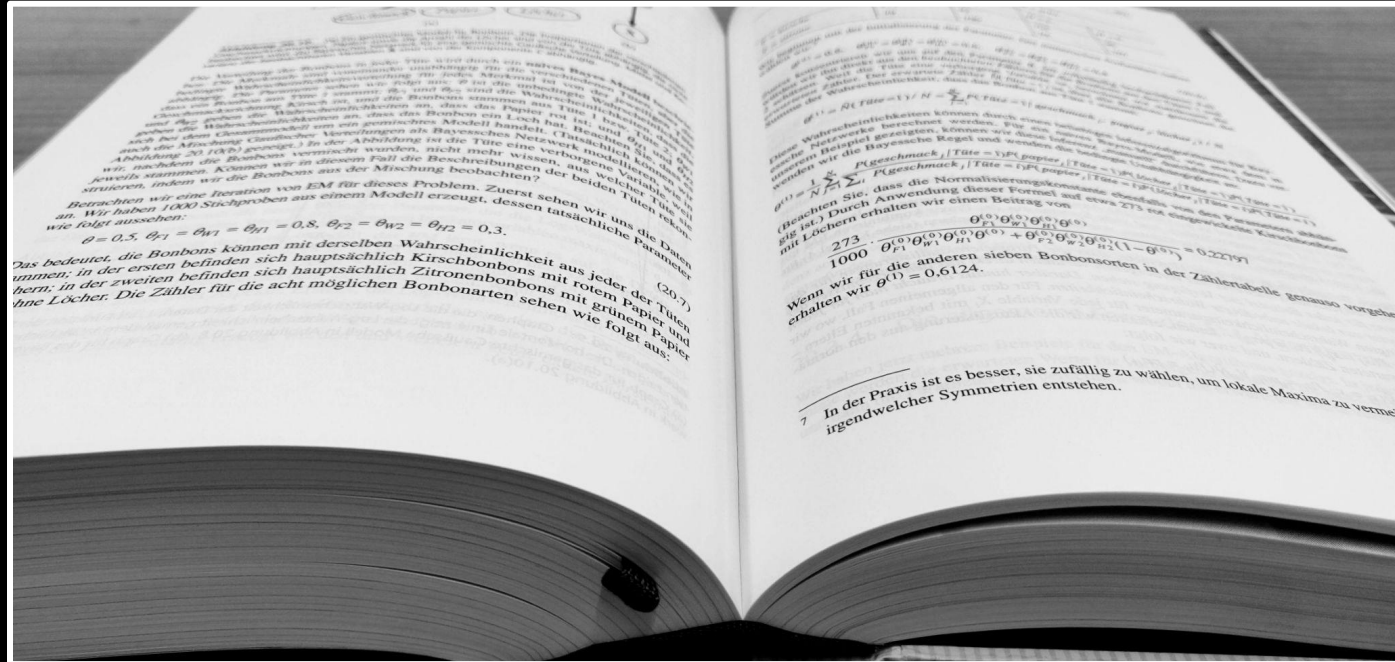


`count_words()`

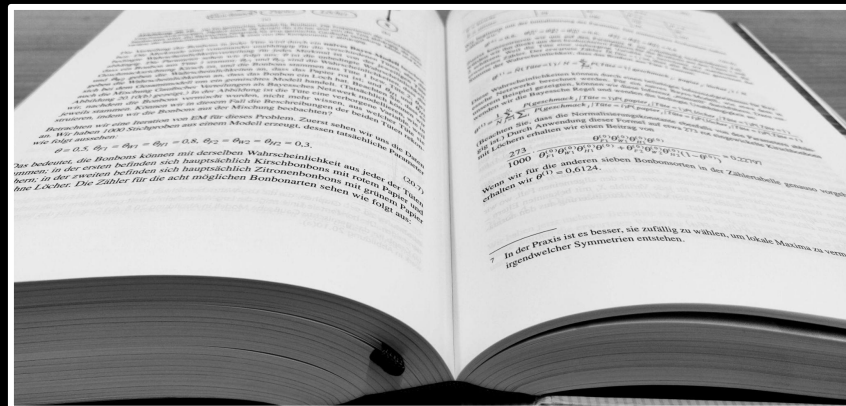
word count

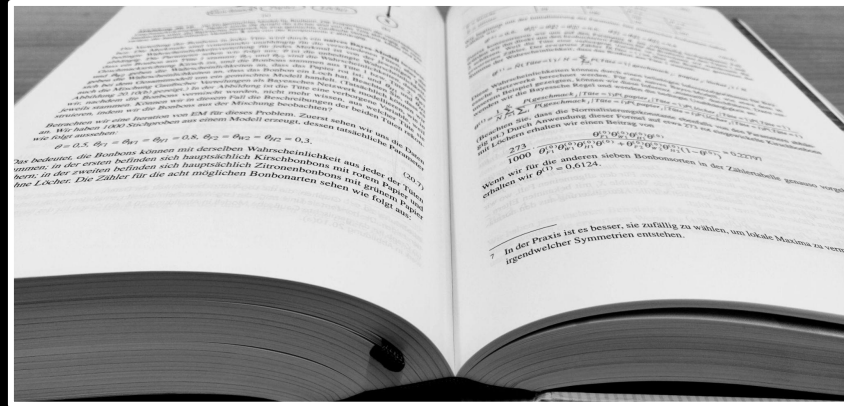


# how many words are in the book?

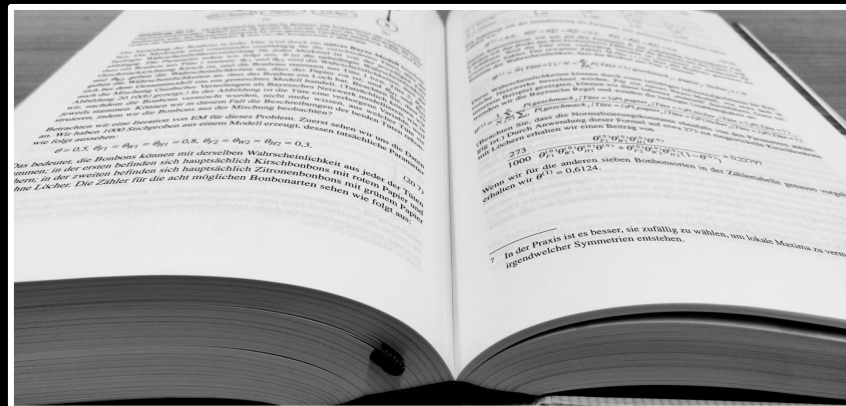


strategies, anyone?





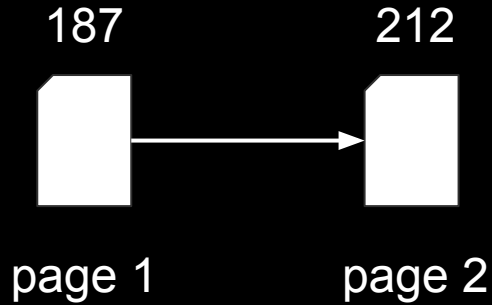
page 1

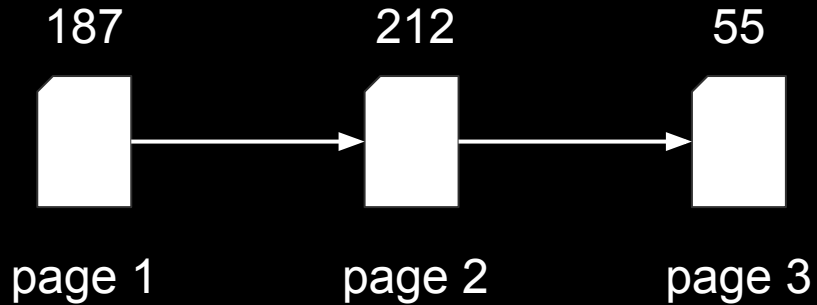
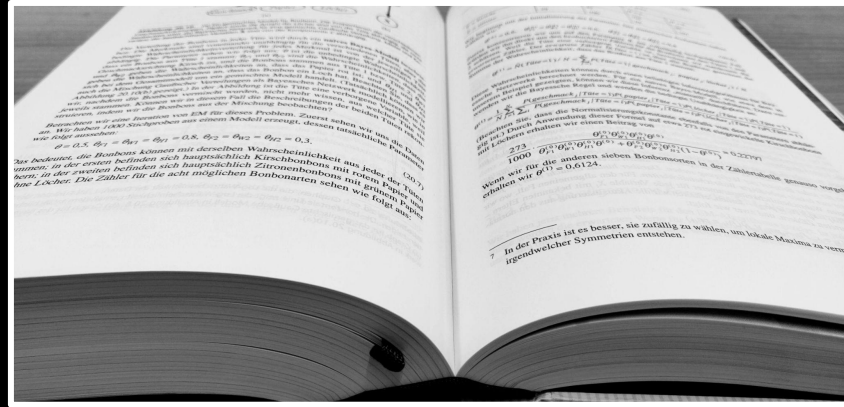


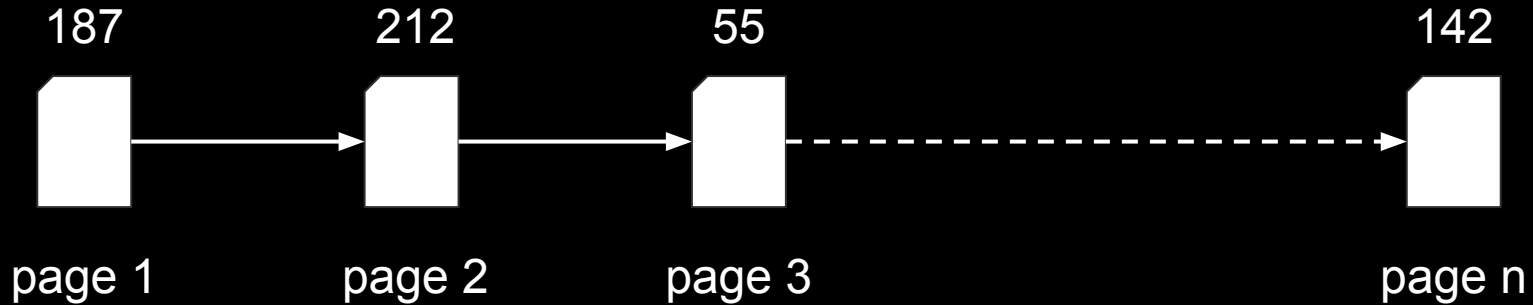
187



page 1











$n = 1327$  pages

$\varnothing$  2:23 minutes per page

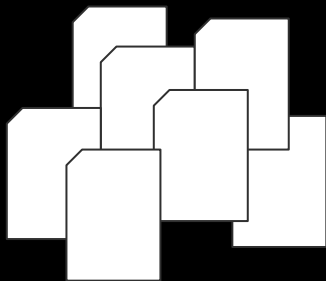
$\sim 52.34$  hours

divide and conquer

+

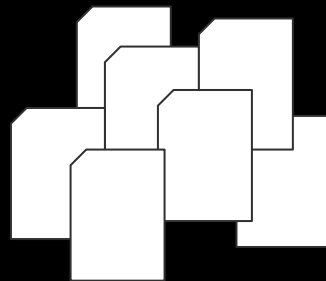
?

pages 1 - 700



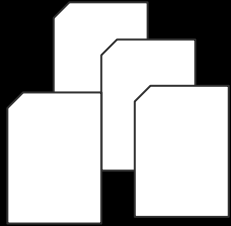
student 1

pages 701 - 1327



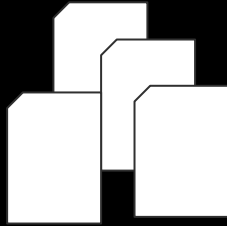
student 2

pages 1 - 350



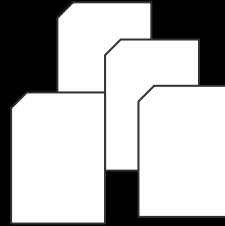
student 1

pages 351 - 700



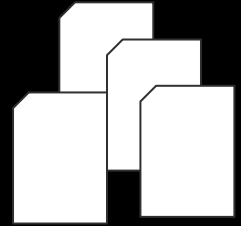
student 2

pages 701 - 1050



student 3

pages 1051- 1327



student 4

divide and conquer  
+  
distribution and parallelization

