

COMBINATORIAL OPTIMIZATION ALGORITHMS

WHAT IS AN ALGORITHM?

A problem solving technique

A 'recipe' to solve the problem

Recipe

1. Boil water
2. Throw eggs in it
3. Wait 10 mins
4. Remove the eggs

Algorithm

1. Step1
2. Step2
3. Step3
4. Step4

A CLASSIFICATION

1. Exact algorithms

Other names: deterministic,
iterative, ...

2. Heuristic algorithms

Other names: stochastic,
approximate, ...

A CLASSIFICATION

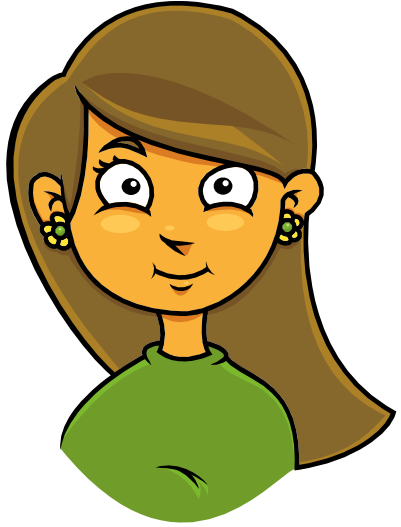
Exact algorithms

Such algorithms guarantee (**100%**) to produce an optimal (the best) solution for a given problem if we **DO NOT** limit time or memory

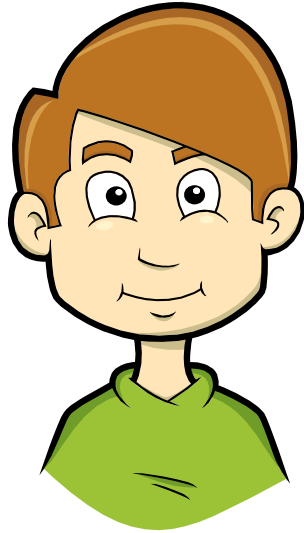
Heuristic algorithms

Such algorithms **DO NOT** guarantee finding the best solution. However, they produce good answers **quickly**.

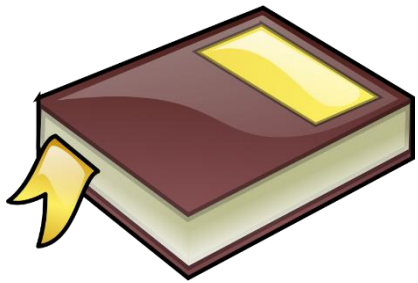
LET'S CONSIDER AN ANALOGY



Jennifer



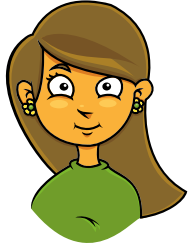
Bob



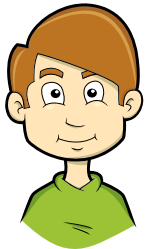
EXAM

LET'S CONSIDER AN ANALOGY

1 month to prepare for the exam



Read and memorize all pages

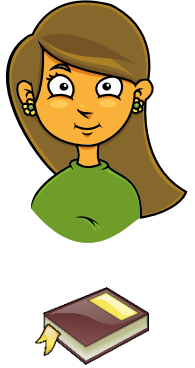


**Read and memorize pages
recommended by his juniors**



LET'S CONSIDER AN ANALOGY

Results



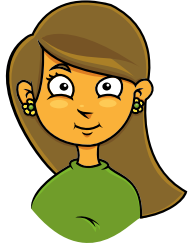
Exacts



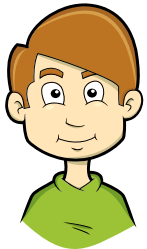
Heuristic

LET'S CONSIDER AN ANALOGY

5 days to prepare for the exam



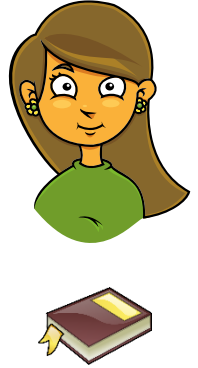
Attempt to read and memorize all pages!!!
She managed to read only 20% of the book



**Read and memorize pages recommended
by his juniors**
**He managed to read all the pages
recommended**

LET'S CONSIDER AN ANALOGY

Results



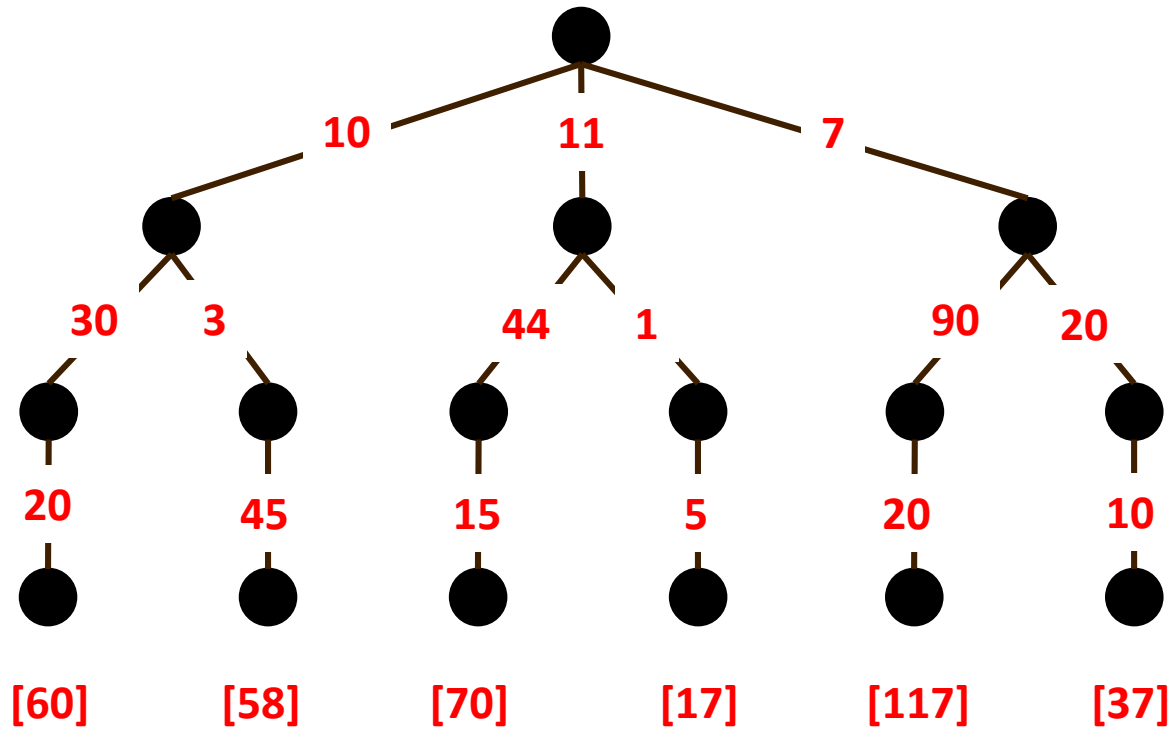
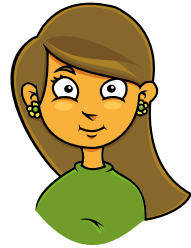
Exact (failed)



Heuristic (passed)

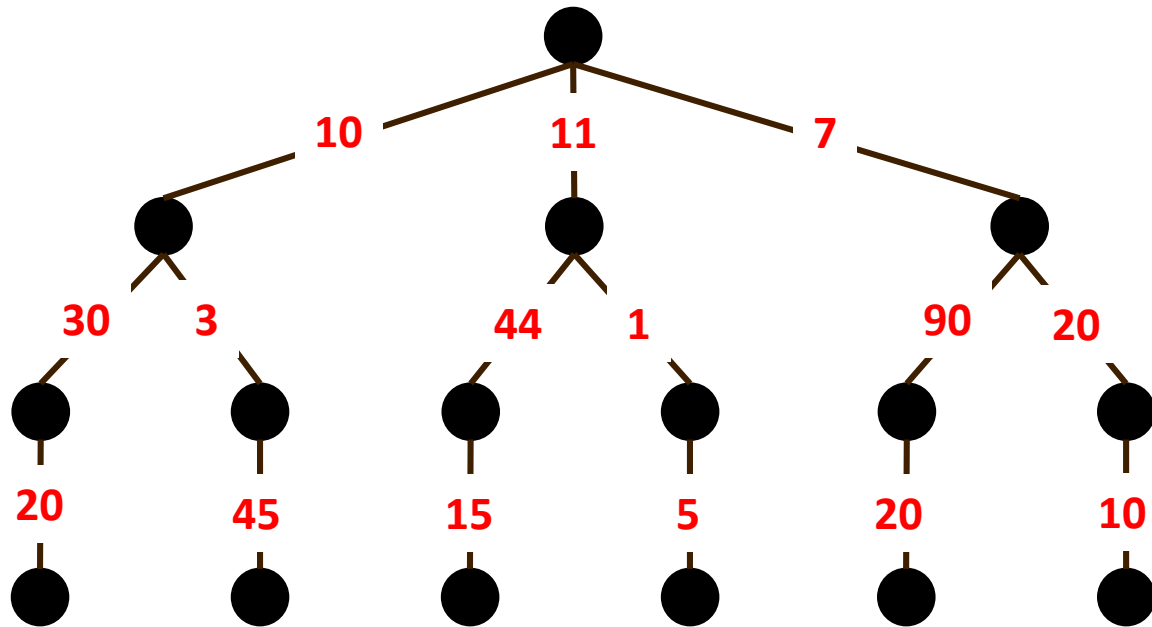
FINDING THE MINIMUM SUM

Exact



FINDING THE MINIMUM SUM

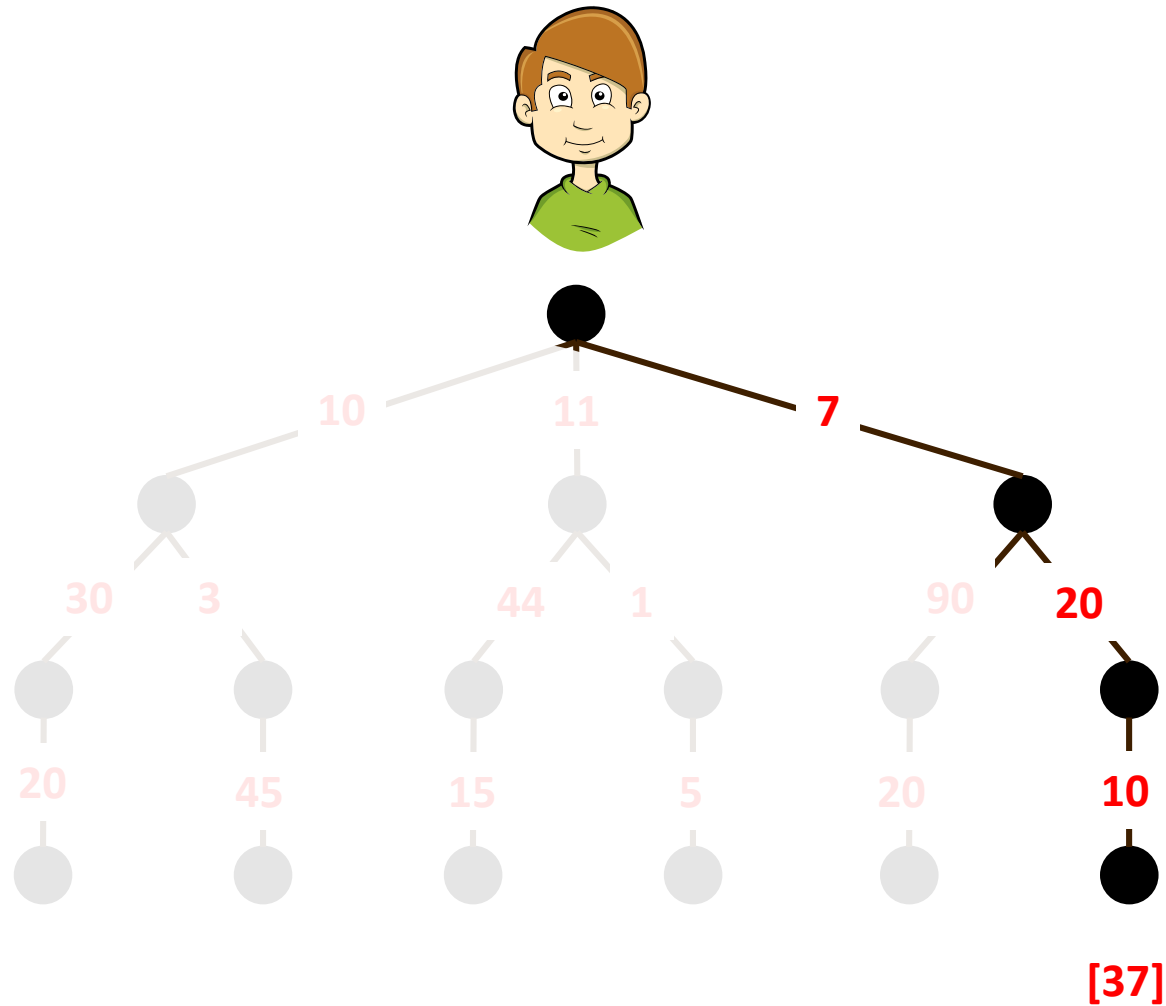
Exact



[17]

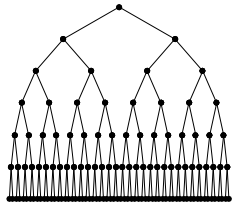
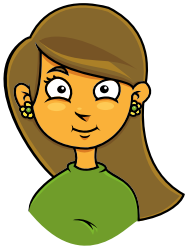
EXACT AND HEURISTIC ALGORITHMS FOR CARD GAME

Heuristic



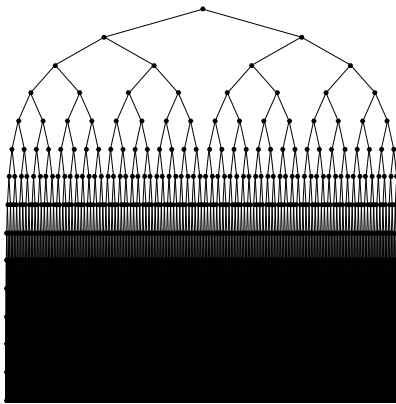
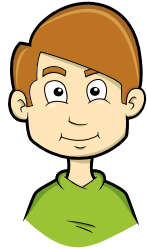
WHICH ONE IS BETTER?

Exact



64 leaves

Heuristic



16384 leaves

SOME EXAMPLES IN EACH CLASS

1. Exact methods

- a) Brute Force search
- b) Branch and bound
- c) ...

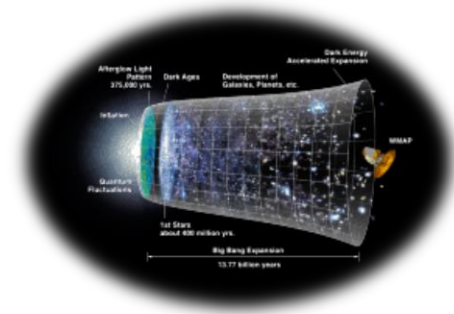
2. Heuristic methods

- a) Nearest Neighbour algorithm
- b) Ant colony optimization
- c) ...

COBINATORIAL PROBLEMS?

$n = 20 \approx 77\text{B years}$

Big Bang



14 billion years old

