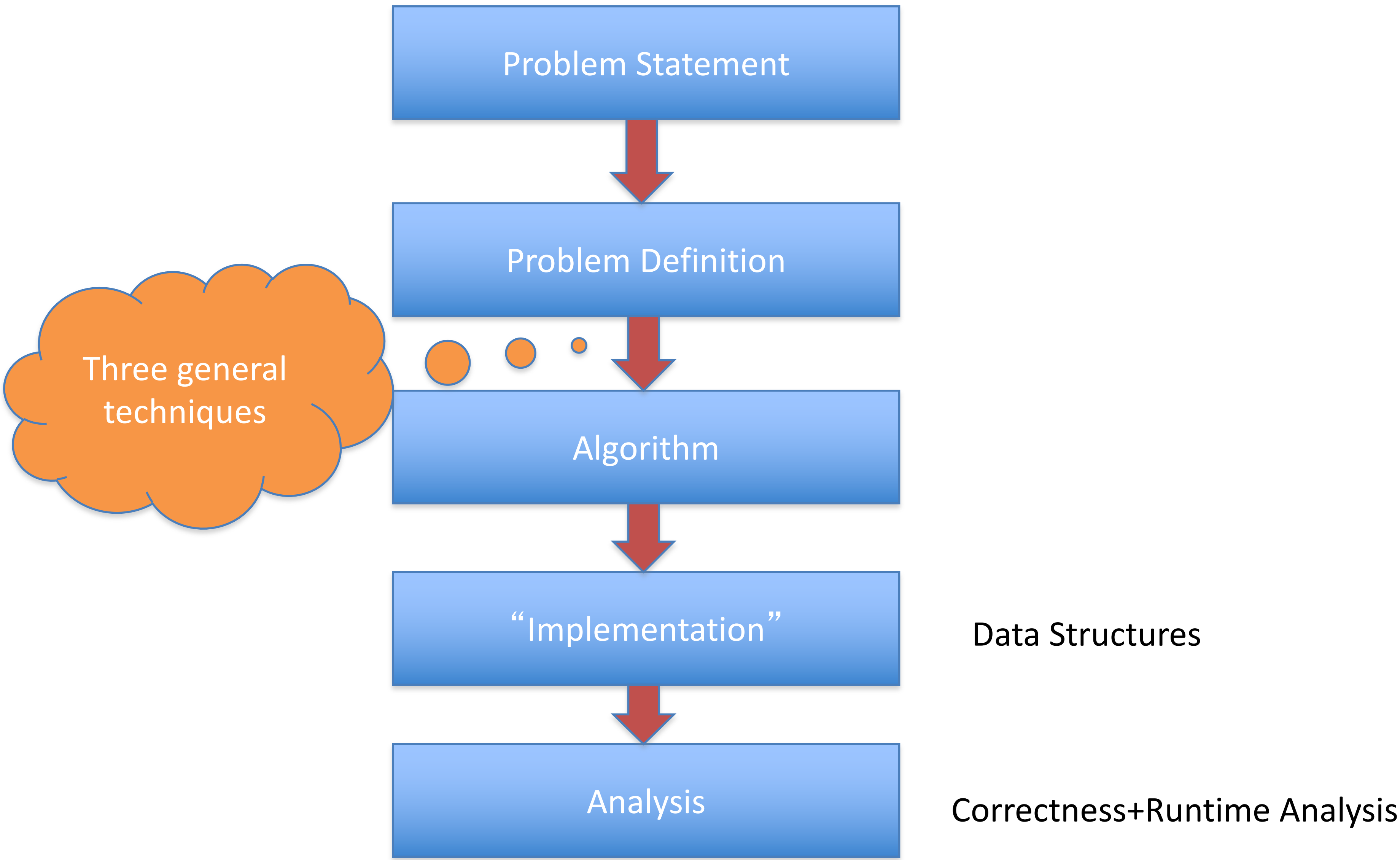
Lecture 28

CSE 331

Apr, 10 2020

High level view of CSE 331



Greedy Algorithms

Natural algorithms

Reduced exponential running time to polynomial

Divide and Conquer

Recursive algorithmic paradigm

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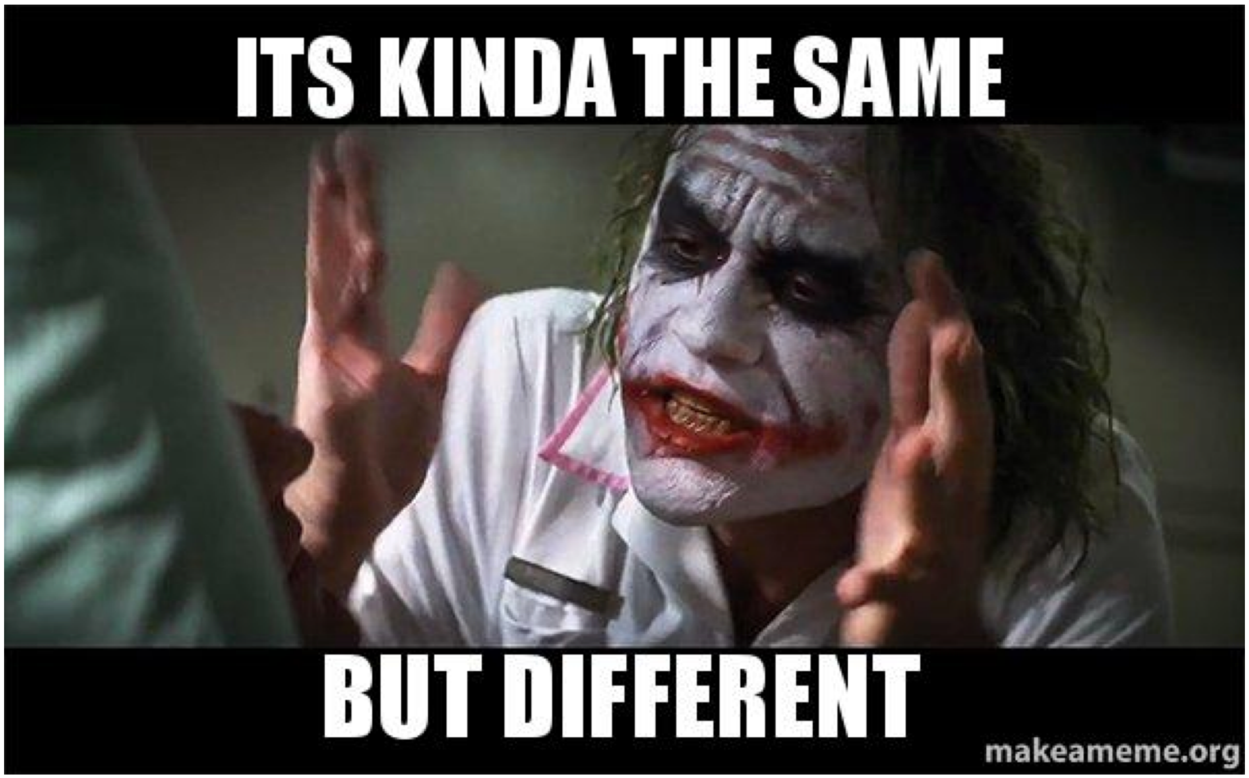
Reduced large polynomial time to smaller polynomial time

A new algorithmic technique

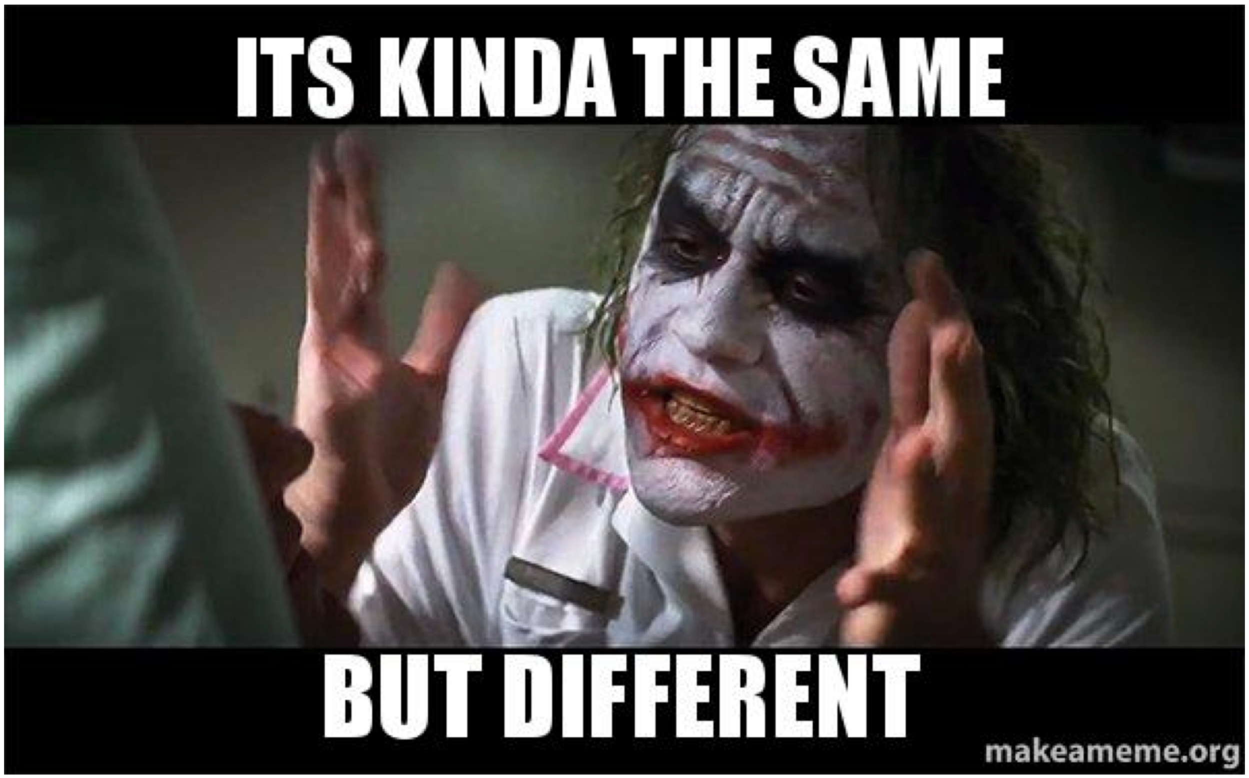
Dynamic Programming

Dynamic programming vs. Divide & Conquer



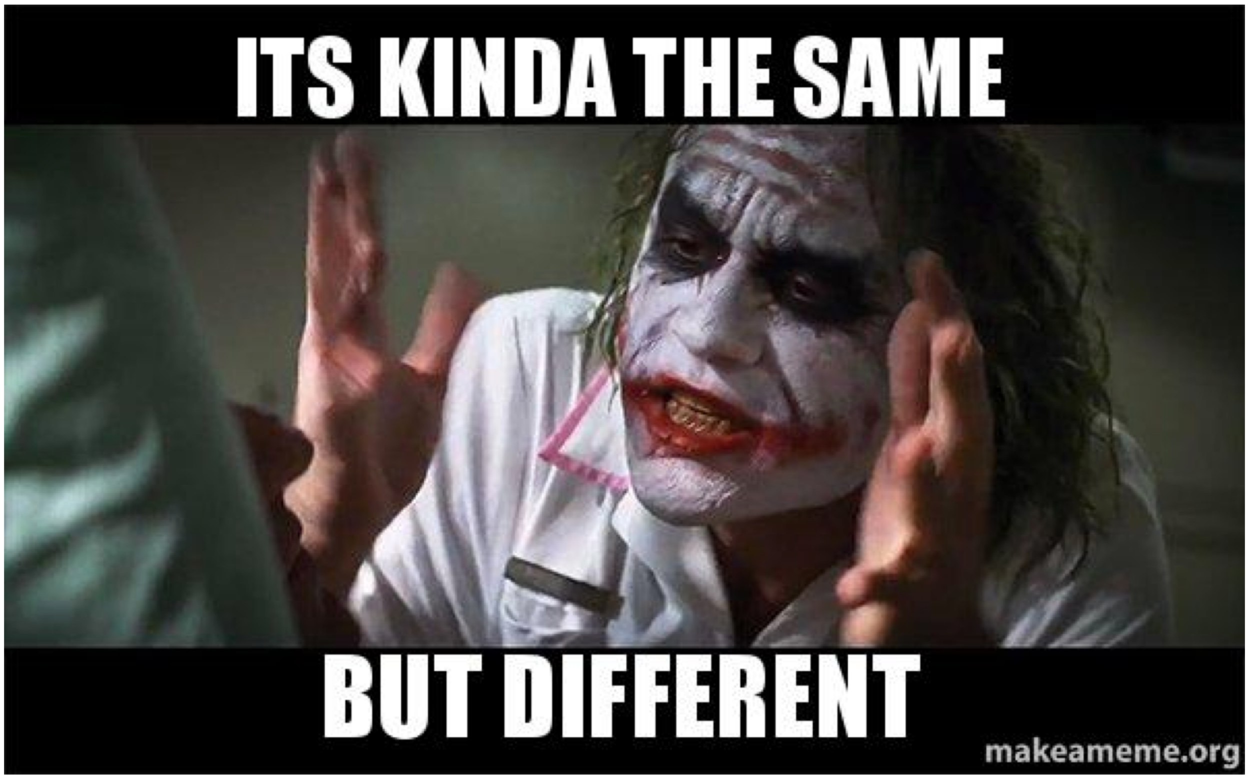
Same same because

Both design recursive algorithms



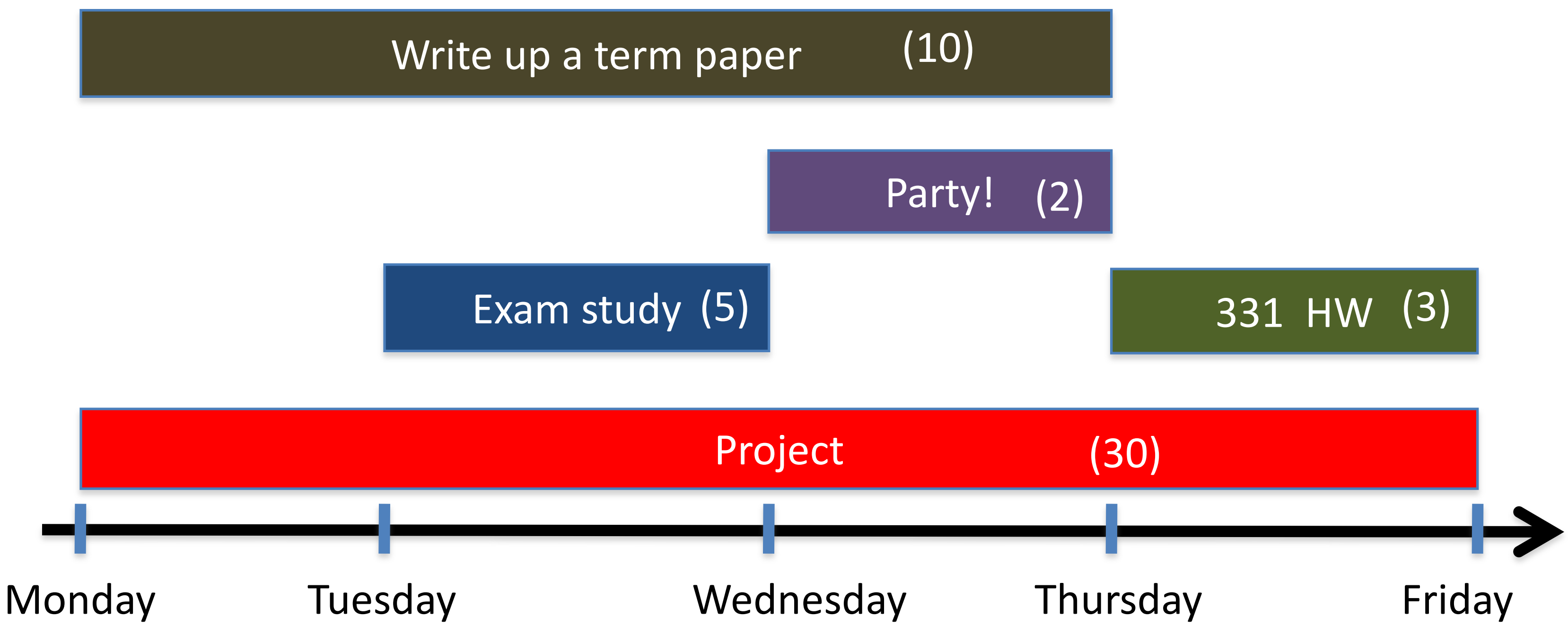
Different because

Dynamic programming is smarter about solving recursive sub-problems



End of Semester blues

Can only do one thing at any day: what is the optimal schedule to obtain maximum value?



Previous Greedy algorithm

Order by end time and pick jobs greedily

Greedy value = 5+2+3= 10

OPT = 30

Write up a term paper (10)

Party! (2)

Exam study (5)

331 HW (3)

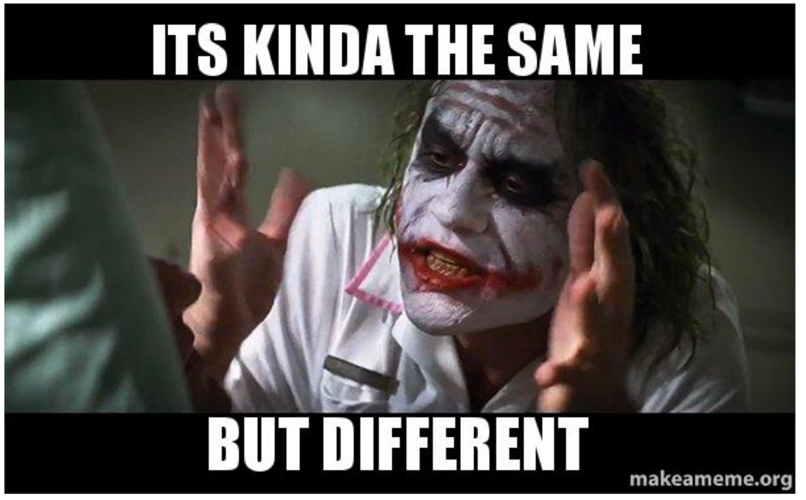
Project (30)

Monday Tuesday Wednesday Thursday Friday

Today's agenda

Formal definition of the problem

Start designing a recursive algorithm for the problem



Weighted Interval Scheduling

Input: n jobs/intervals. Interval i is triple (s_i, f_i, v_i)

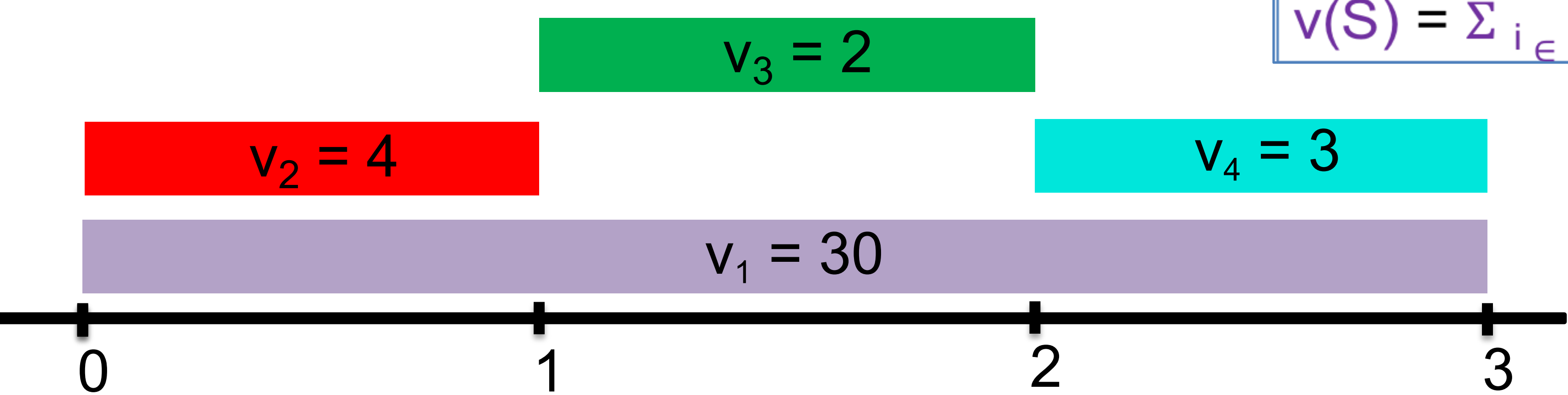
start time

finish time

value

Output: A valid schedule $S \subseteq [n]$ that maximizes $v(S)$

$v(S) = \Sigma_{i \in S} v_i$



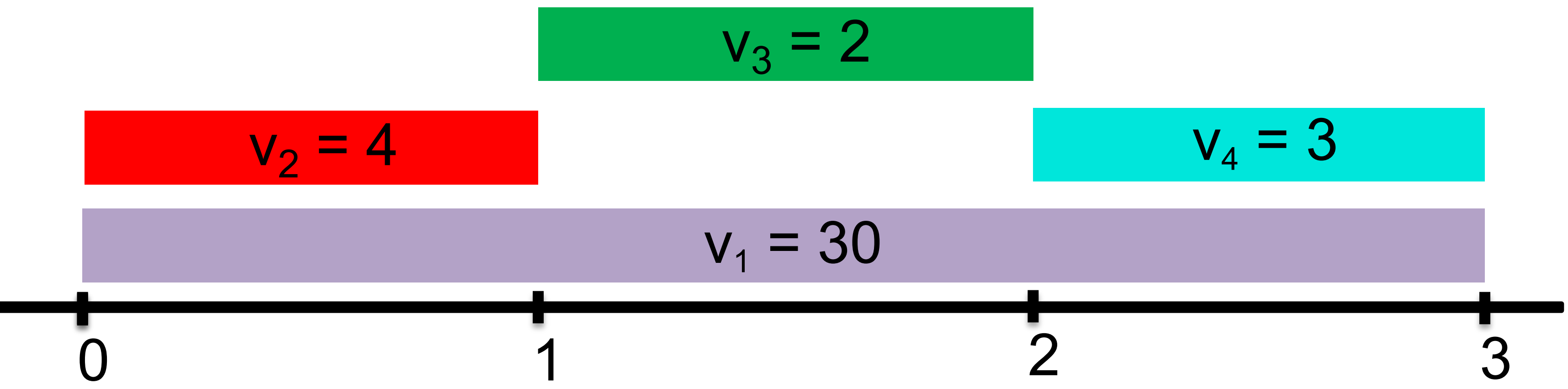
Previous Greedy Algorithm

R = original set of jobs

S = ϕ

While R is not empty
    Choose i in R where f_i is the smallest
    Add i to S
    Remove all requests that conflict with i from R

Return S* = S



Perhaps be greedy differently?

R = original set of jobs

$S = \phi$

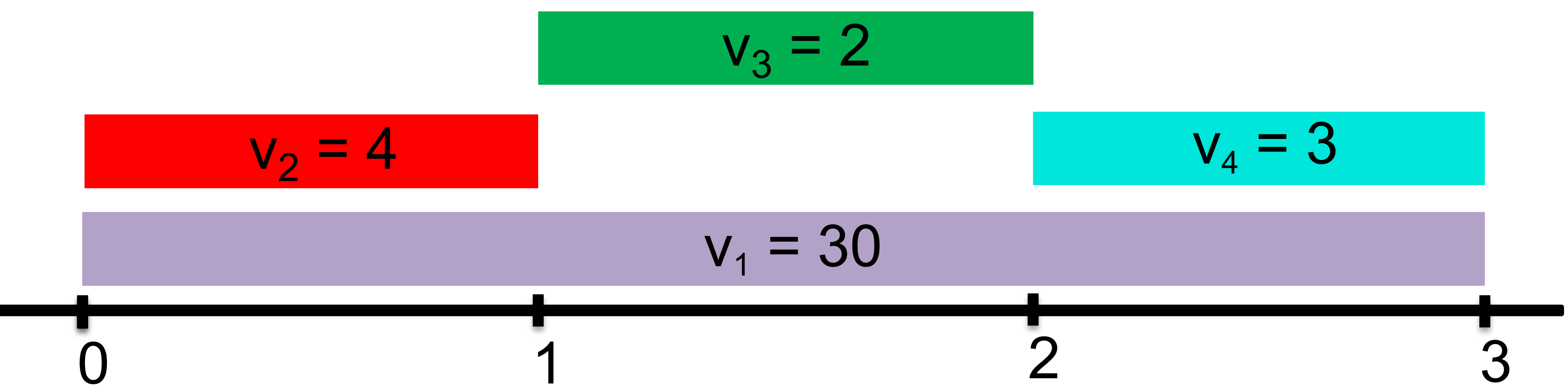
While R is not empty

  Choose i in R where $v_i/(f_i - s_i)$ is the largest

  Add i to S

  Remove all requests that conflict with i from R

Return $S^* = S$



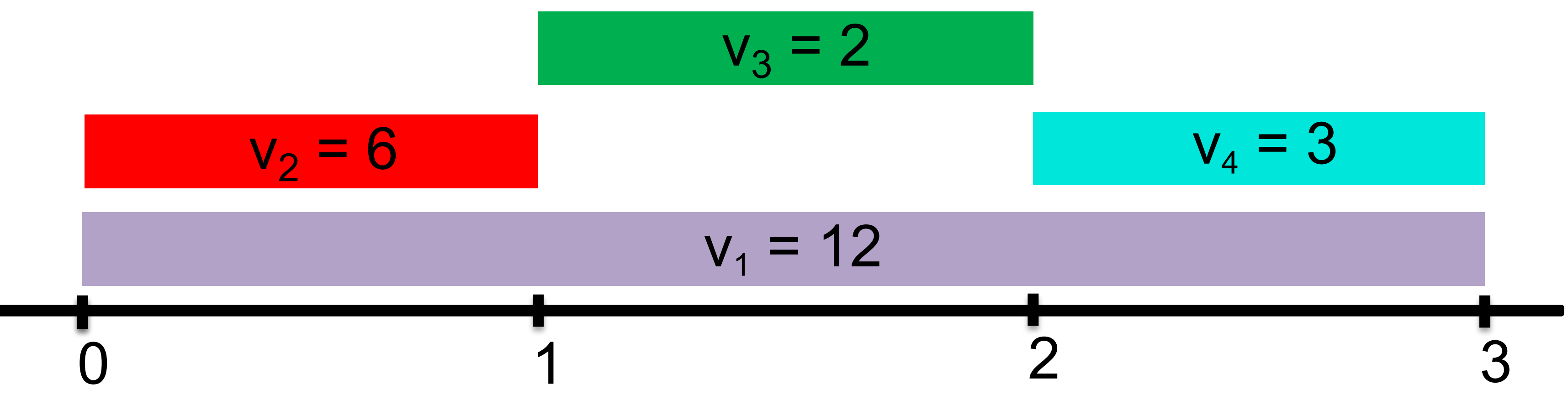
Can this work?

R = original set of jobs

S = ϕ

While R is not empty
  Choose i in R where $v_i/(f_i - s_i)$ is the largest
  Add i to S
  Remove all requests that conflict with i from R

Return S* = S



Avoiding the greedy rabbit hole

https://www.writerightwords.com/down-the-rabbit-hole/

Provably IMPOSSIBLE for a large class of greedy algos

There are no known greedy algorithm to solve this problem

Perhaps a divide & conquer algo?

Divide the problem in 2 or more many EQUAL SIZED INDEPENDENT problems

Recursively solve the sub-problems

Patchup the SOLUTIONS to the sub-problems

Perhaps a divide & conquer algo?

RecurWeightedInt([n])

if $n = 1$ return the only interval

L = first $n/2$ intervals

R = last $n/2$ intervals

S_L = RecurWeightedInt(L)

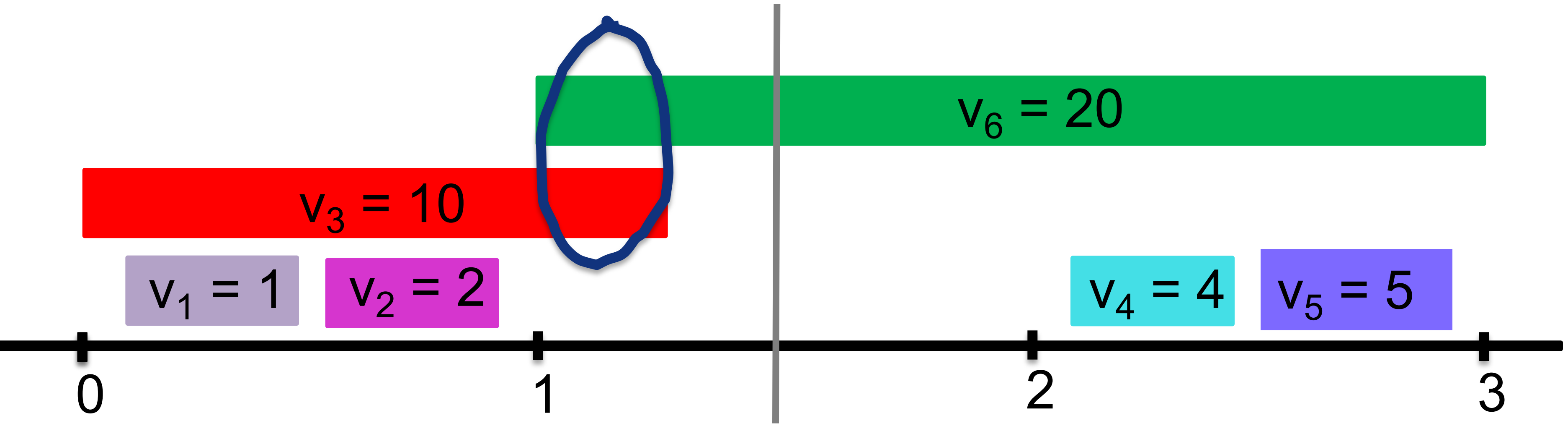
S_R = RecurWeightedInt(R)

PatchUp(S_L, S_R)

Would this general scheme work?

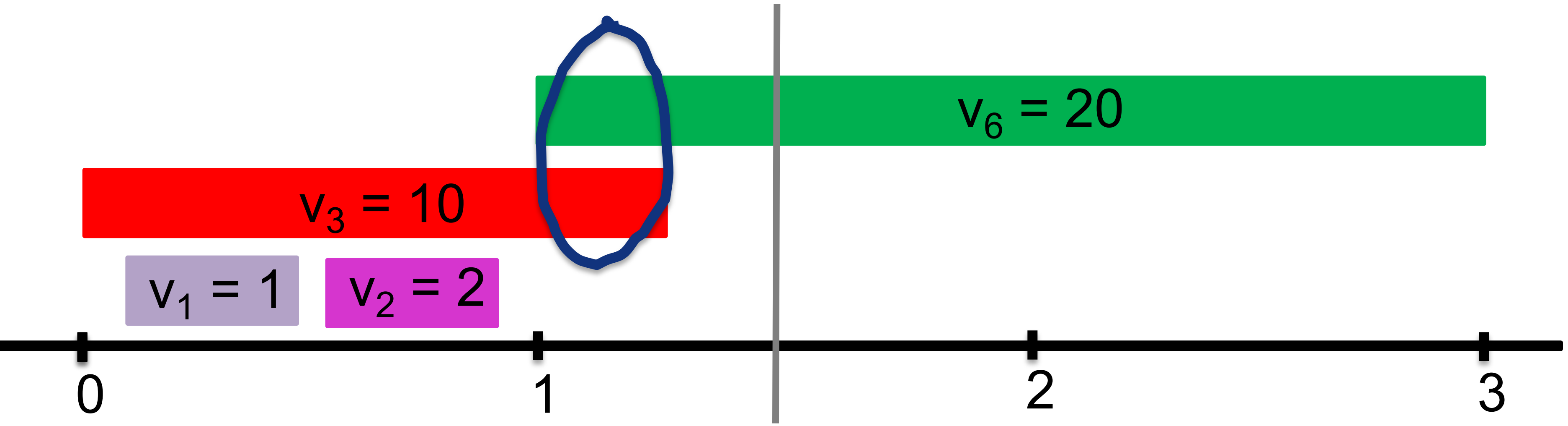
Divide the problem in 2 or more many EQUAL SIZED INDEPENDENT problems

Sub-problems NOT independent!

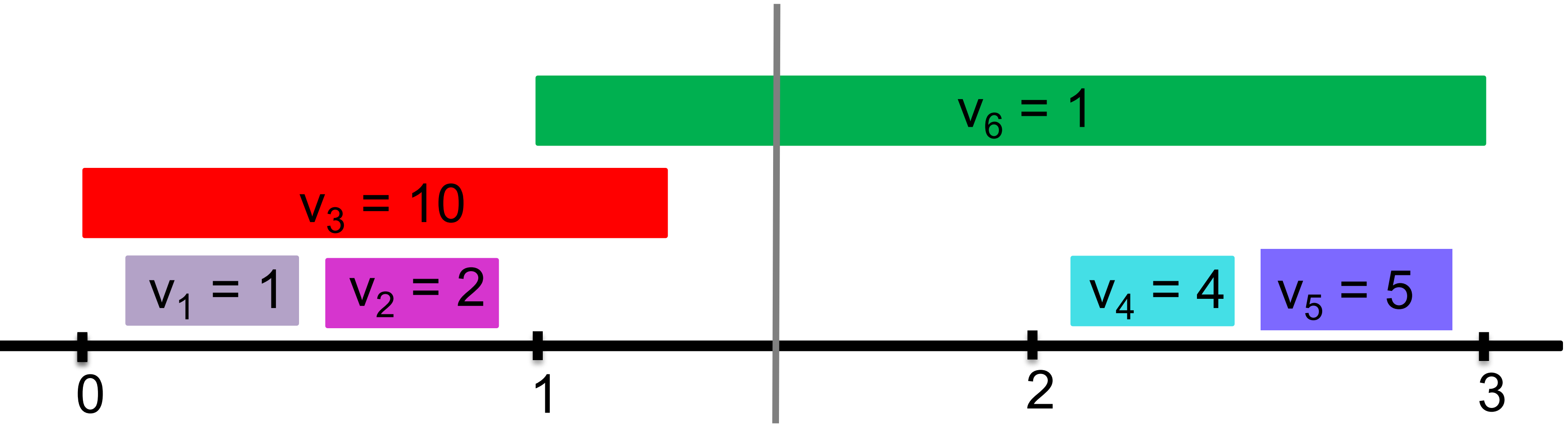


Perhaps patchup can help?

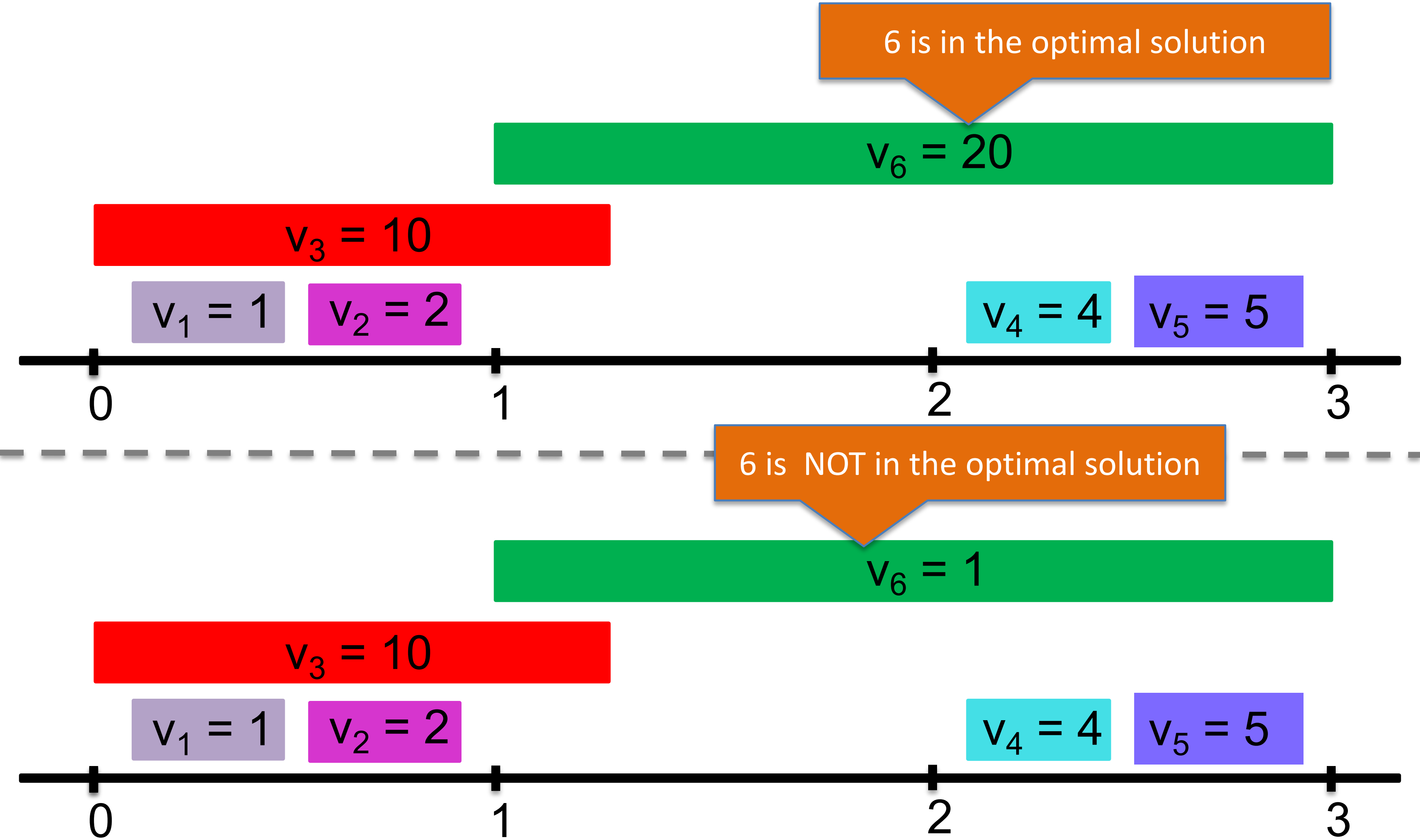
Patchup the SOLUTIONS to the sub-problems



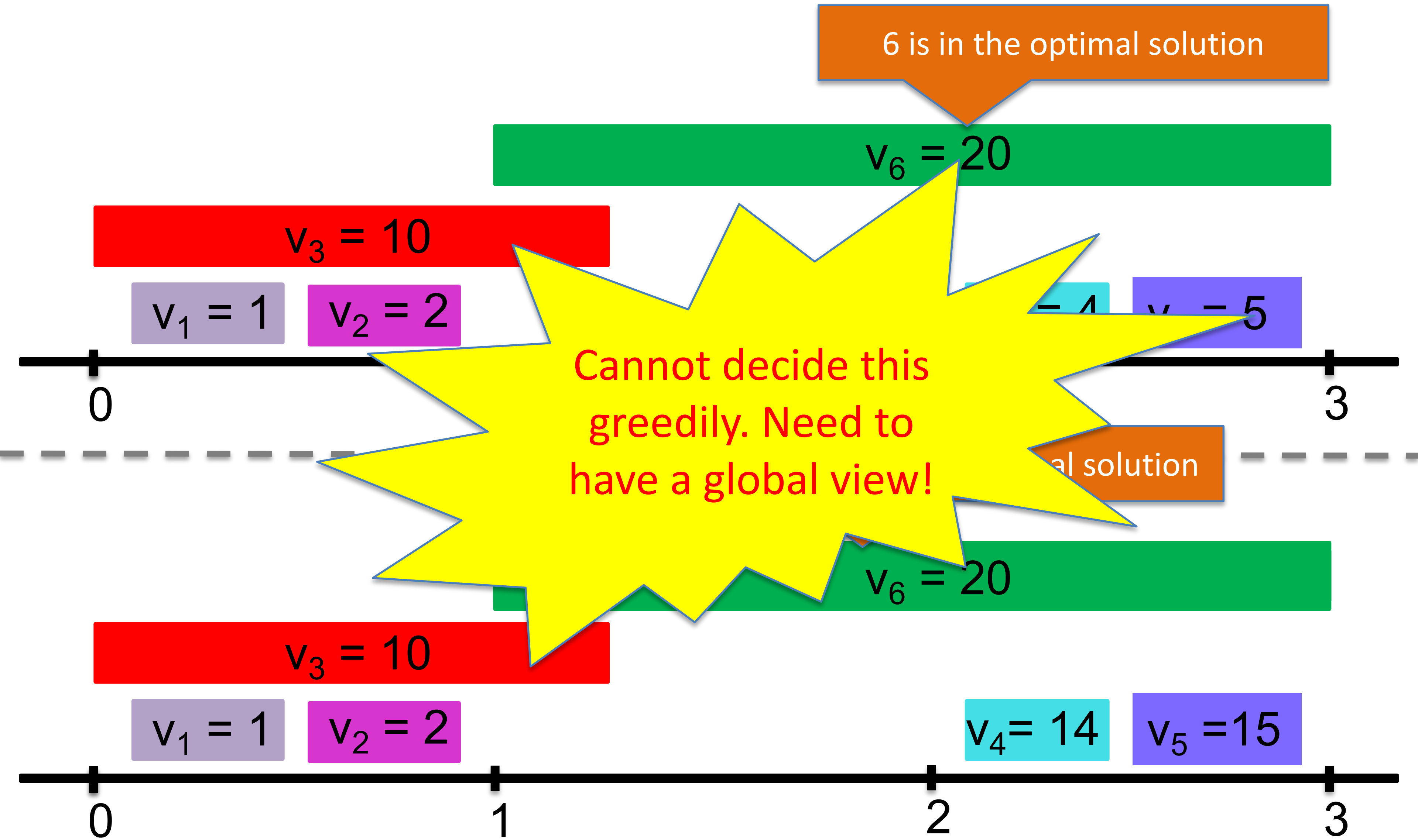
Sometimes patchup NOT needed!



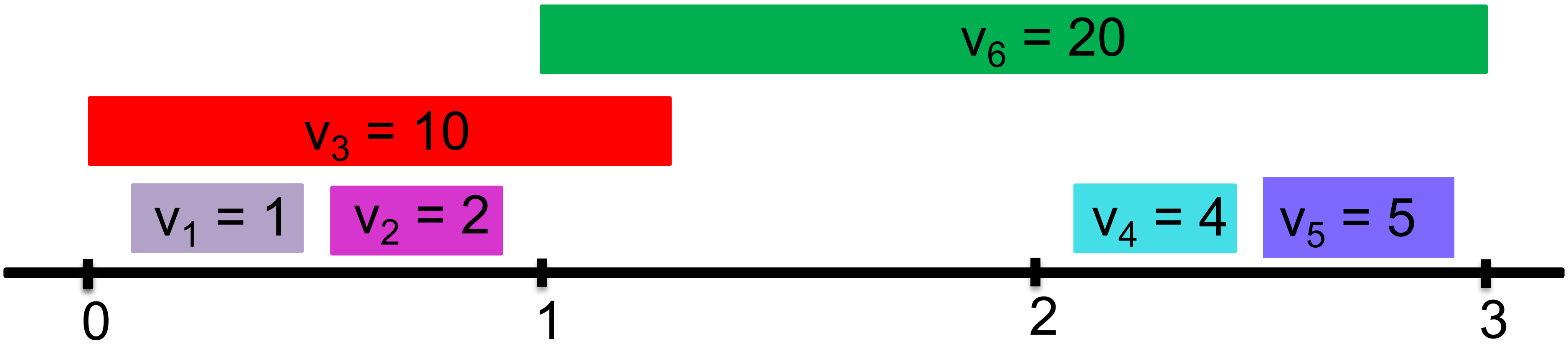
Check for two cases?



Check if v_6 is the largest value?



Check out both options!



Case 1: 6 is in the optimal solution

6 is not in optimal solution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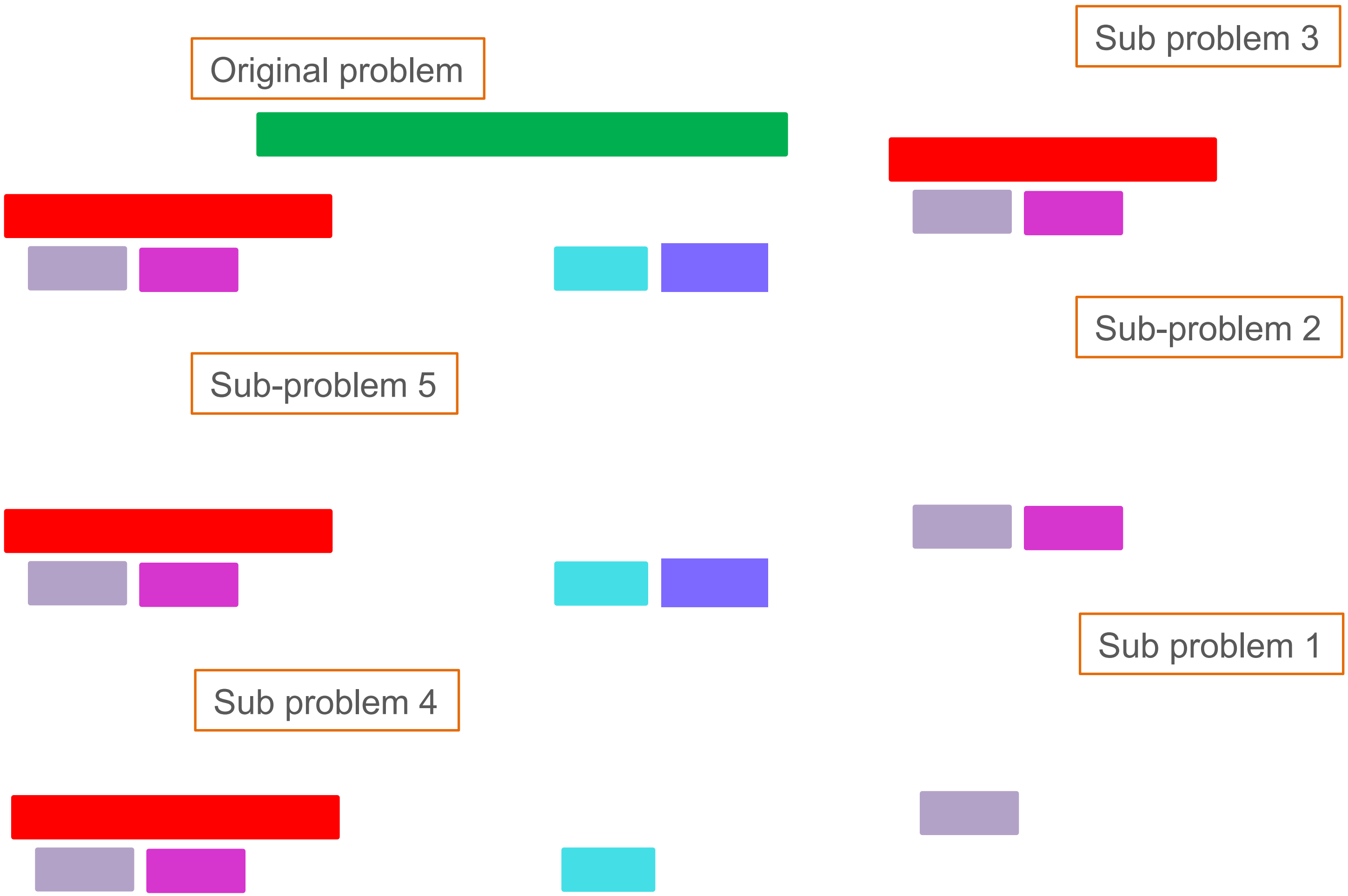
So what sub-problems?

Divide the problem in 2 or more many ~~EQUAL SIZED~~ ~~INDEPENDENT~~ problems

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