1. NEIGHBORHOOD

1. **What is the mathematical formulation of the neighborhood size?**

   Result: n(n-3)/2
   n because we choose one initial node over n
   n-3 because the 1st chosen node and its 2 neighbors are excluded from the choice of the 2nd node.
   /2 because i and j can be chosen in reverse order, but we have the same neighbors; this transformation is symmetrical.

   What is the effect of the transformation on the cycle?

   It reverses the order of travel of all cities between i and j.

2. **What is the mathematical formulation of the neighborhood size?**

   Result: n(n-5)/2
   n because we choose one initial node over n
   n-5 because the 1st chosen node, its 2 neighbors and their neighbors are excluded from the choice ofthe 2nd node.
   /2 because i and j can be chosen in reverse order, but we have the same neighbors; this transformation is symmetrical.

   What is the effect of the transformation on the cycle?

   We exchange 2 cities without changing the order of the route.

2. PROBLEM MODELING

1. a) Nodes = sessions => 11 nodes
   b) 2 nodes are connected when they're not compatible (coloring graph -> 2 nodes with differents colors are linked) If 2 sessions cannot take place simultaneously
   c) The colors represent the half-days, coloring a node means that the session takes place in the corresponding half-day
   d) 1/2 on 2 days => 1/2 day = 1 color
   e) We can only have 3 nodes of the same color

2. a) An oriented edge is created to mean the precedence of E on J, from D on K, from F on K.
   b) The colors that represent the 1/2 days are ordered from 1 to 4, where 1 represents the 1st 1/2 day and 4 the last 1/2 day.

Proposition 1: A whole table of size 11 (number of nodes) where each element of the table takes as its value an entire number (from 1 to 4) for each color where a 1/2 day is assigned. It should be checked in the table that no color is used more than 3 times (number of rooms).
Proposition 2: A binary Matrix of size (line, column) = (4, 11) for (node, session) where each item equals 1 if the session is assigned to the slot, with the sum by column = 1 (each session is assigned only once) and the sum by line ≤ 3 (each half-day has only 3 rooms).
Proposition 3: A binary Matrix of size (line, column) = (3, 11) for (room, session) where each item equals 1 if the session is assigned to the room, with the sum by column = 1 (each session is assigned only once) and the sum by line ≤ 4 (each room is usable for 4 half-days).

Neighborhood algorithm: it does not guarantee a valid solution!!
- Generate randomly an initial assignment
- As long as the solution is invalid, a node is moved to another color such as the couple (node, color) minimizes incompatibilities. If the number of nodes is greater than 3 in a

color, move in priority one node of this color.

Solution

1/2 day 1: A D I

1/2 day 2: B E F

1/2 day 3: C G K

1/2 day 4: H J

3. TABOU SEARCH

a) How many solutions has this problem (the size of the search space)?

K^E

b) Formulate the fitness function that counts the number of invalid assignments in a solution *s*. Use *c(e)* to note the color of the edge *e*. What should be the optimal value of this fitness?

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$$f(s) = \sum_{\substack{\{e,e'\}\in E^2, e'\neq e \\ st\ \{i,j\}\cap\{i',j'\}\neq\emptyset}} (c(e) == c(e'))$$

The optimal value is f(s)=0

c. Let the graph to color with 3 colors (R Red, G Green, Y Yellow):