AI Offline 2
Time Tabling Problem

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Problem Description

I am starting from the middle. So, don't panic if you don't find any similarities between the problem statement given by Sir and my description. Just go on.

NB: I am showing an easier solution. Because easier solutions are easy to understand and to implement. Only problem is that প্রসেসরের খাটতে খাটতে জান শেষ হয়ে যায়

Given

- A time table

	Period 0	Period 1	Period 2
Day 0			
Day 1			
Day 2			

- In the given problem:
  - 5 days per week (I have shown here only 3 days per week)
  - 6/7/8 periods per day (I have shown here only 3 periods per day)

Given

- Some Requirements:

Teacher	Class	Room	Credit (ie. Classes/week)
T1	C1	R1	2
T1	C2	R2	1

- We call the teacher-class-room combination an element
  - For example: (T1, C1, R1) is an element. So is (T1, C2, R2)
  - (T1, C1, R1) & credit = 2 means Teacher T1 takes 2 classes/week of class C1 in room R1.
  - (T1, C2, R2) & credit = 1 means Teacher T1 takes 1 class/week of class C2 in room R2.

Given

- We can place the elements in the timetable in many ways
  - One way:

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1)		
Day 1	(T1, C1, R1)		
Day 2	(T1, C2, R2)		

  - Just like our class routine, eh?
  - Think: why (T1, C1, R1) appears twice in the table, while (T1, C2, R2) once?
    - Credit hours

Given

- We can place the elements in the timetable in many ways
  - Another way:

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C1, R1) (T1, C2, R2)		
Day 1			
Day 2			

- Think: why (T1, C1, R1) appears twice in the table, while (T1, C2, R2) once?
  - Credit hours

Given

- A heuristic cost function, h(timetable)
  - It takes a timetable as argument, and returns a number
  - Its minimum value = 0
  - We shall see how to calculate this function later

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1)		
Day 1	(T1, C1, R1)		
Day 2	(T1, C2, R2)		

Cost = 0

Given

- A heuristic cost function, h(timetable)
    - It takes a timetable as argument, and returns a number
    - Its minimum value = 0
    - We shall see how to calculate this function later

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C1, R1) (T1, C2, R2)		
Day 1			
Day 2			

Cost, h = 2 + 1 + 1 = 4

Problem

- Experiment with different versions of
    - Hill climbing (A1/B1)
    - Local Beam Search (A2/B2)

    to find out one time table whose cost is minimum (that is 0)

Problem Formulation

We need to transform the problem to one that can be solved by computers

I shall show Hill Climbing first, then local beam search. Because hill climbing is easier than local beam search (assigned to the bosses of A2/B2 :p)

[The previous problem for A2/B2 was also harder :3 (at least to me)]

The difference between the two is minor.

Initial States

- Time table is chosen randomly
    - One initial time table for hill climbing
    - K initial time tables for local beam search

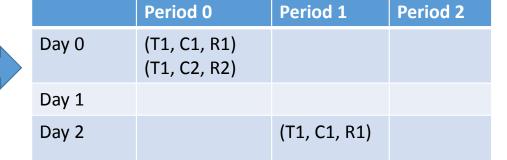|	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C1, R1) (T1, C2, R2)		
Day 1			
Day 2			

Action

- Take each of the elements of the time table & move to another period
  - For example:

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C1, R1) (T1, C2, R2)		
Day 1			
Day 2			

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C2, R2)	(T1, C1, R1)	
Day 1			
Day 2			

Action

- Take each of the elements of the time table & move to another period
  - Another example:

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C1, R1) (T1, C2, R2)		
Day 1			
Day 2			

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C2, R2)		
Day 1			
Day 2		(T1, C1, R1)	

Action

- As I mentioned earlier, this is the simples (=dumbest) solution.
  - This action will generate ~40k successors, for the problems given when k=5
  - But don't worry. The whole solution will take less that 30 seconds
- You can make it more efficient by defining a better action
  - Hint: try thinking about only conflicted elements

Goal States

- Any time table with heuristic cost = 0
  - For example:

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1)		
Day 1	(T1, C1, R1)		
Day 2	(T1, C2, R2)		

Input File Format

hdtt4list

- Just ignore the file. We don't need this file. Because all the information here is in the file hdtt4req

hdtt4note

- You will understand this file by seeing the labels
- Just ignore: "NUMBER OF SUBJECTS", "NUMBER OF REQUIREMENTS"
  - We don't need them

hdtt4req

- Consider it as a 3D array
  - Example:

		T0	T1	T2	T3
R0	C0	2	2	1	2
	C1	1	1	1	2
	C2	1	1	1	6
	C3	2	2	3	2
R1	C0	2	3	1	2
	C1	0	4	3	2
	C2	1	2	1	0
	C3	2	2	1	2

- For example: at first row and first column, there is 2. This means that Teacher T0 takes 2 classes/week of Class C0 in the Room R0

Cost Function Calculation

Consider the Table

	Period 0	Period 1	Period 2
Day 0	(T1, C1, R1) (T1, C1, R1) (T1, C2, R2) (T2, C3, R3)		
Day 1			
Day 2			

Calculate the conflicts per teacher per period

- Conflict of teacher, T1 = max (0, # of element in the period that contains T1 - 1)
  - max(0, 3 − 1) = 2
- Similarly, conflict of teacher, T2 = max(0, 1 − 1) = 0

Calculate the Sum of teacher conflict per period

- Sum of teacher conflict = 2 + 0 = 2
- Determine this sum for each of the periods

Calculate the sum of teacher conflict for all the periods

- In the similar way, calculate the sum of
    - Class conflict
    - Room Conflict

    for all the periods

- Then the Cost function = w1 * (number of total teacher conflict) +

    w2 * (number of total room conflict) +

    w3 * (number of total class conflict)

    - Here w1, w2, w3 are weighting factors. You have to experiment by setting
        - [w1, w2, w3] = [1, 1, 1], [10, 1, 1], [1, 10, 1], [1, 1, 10]

এখন আর পারতাম না ভাই

These information should be sufficient to implement the offline by seeing the pseudo code from googling.

তারপরেও সমস্যা হলে সামনা সামনি বোঝাব নি। ডকে গ্রাফ–টাফ একে বোঝানো অনেক সময়ের বেপার