Assignment, Constraint Satisfaction For Decision Making (CE884-7-SP), 2013-14
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1.   **Introduction:**

This is an assignment on constraint satisfaction problem formulation and solving. This assignment accounts for 20% of your total marks in this course. This assignment must be submitted electronically. The deadline of this assignment is *15:59:59, Friday 21 March 2014*.

2.   **Objective:**

The objective of this assignment is to test your ability to formulate and solve constraint satisfaction problems.

3.   **The Project Selection Problem:**

In some business projects, such as telecom projects, an initial investment is made in the first year. Income will grow over the subsequent years (see Project choices 1 and 2 in the following table). In other projects, such as construction projects, investments have to be made in the first few years before the income arrives on completion (see Project choices 3 and 4 below). The company may also borrow money. In that case, the company gets cash up front and pays back the loan in subsequent years. For simplicity, without loss of generality, we can assume that the profit is the total net cash inflow by the end of the all years. So if all four projects were taken on, profit would be 1,209,782.

Given a fixed budget, an investor has to pick the projects carefully. Profitability is important, but cash flow constraints must be satisfied given the budget. For example, if one's budget is 2,000,000, one may only take on a subset of the four projects, because the cash demand for all projects in the first two years exceed the funds available.

Project choices	Year 1	Year 2	Year 3	Year 4
1	-840,139	218,436	321,101	484,863
2	-1,354,776	406,433	593,392	789,211
3	-422,806	-483,598	-366,261	1,603,558
4	-292,582	-249,558	-325,754	1,128,262
Net cash flow per year	-2,910,303	-108,287	222,478	4,005,894
Overall net cash flow (profit)				1,209,782

4.   **Your tasks:**

The attached Excel file contains a spreadsheet called Portfolio10, Portfolio20 and Portfolio30, which involve 10, 20 and 30 projects.

1.   You can pick any of them and formulate the problem in this spreadsheet as a constraint satisfaction. You must clearly state the variables, domains and constraints. You must also provide a function using the variables you define to express the profit (which is to be maximised). What is the size of your search space?

2.   **Solve the problem:** You should report your choice of projects that would fit into a budget of 6,000,000 and maximize total revenue. You can use any tools. You may use Excel, or write your own programs. If you write your own programs, use any programming language that is available in our laboratories (so that I can test your programs).

5.   **Submission requirements:**

a)   You must submit a report of no more than 500 words explaining how you formulate and solve the problem. State clearly any constraint satisfaction techniques that you might be using – there is no need to explain details of the techniques. Explain how your program should be run and how the output should be interpreted. Your program should produce output that helps others to understand how your algorithm works;

b)   You must state clearly what the best project portfolio that you have found, and the revenue that it brings;

c)   If you have written programs, you must submit your programs, in both source code and executive form if applicable.

6. **Assessment criteria for this assignment:**

Your work will be assessed by the following criteria:
a) Clarity – clarity is essential. You must clearly address the requirements stated above. No work will score 70% or above unless it is clearly explained;
b) Correctness – your program must do exactly what you intended it to do. Please be reminded that I shall only be able to assess the correctness of your work if it is clearly explained;
c) Technical knowledge – Marks will be awarded to the use of appropriate technique or packages. As a last resort, you may attempt to find the optimal portfolio manually. If you do so, try to apply constraint techniques that you have learned in the module and explain your approach clearly;
d) Quality of the portfolio generated.
e) Size of the problem: the bigger problem you attempt, the more you will be rewarded. If your program can handle Portfolio30, that is better than tackling Portfolio20.
f) Generality and presentation: Bonus will be awarded to any program that can read in any project choices – but **only** if the interface is simple and clear.

7. **Notes:**

- You may be asked to defend your submission in an interview.
- Please refer to the Student's handbook on the School's Policy on Plagiarism and Late Submission