Solving Puzzles
Lesson Plan: Class 05 / DM / 02

Overall goal of the lesson	This class is an introduction to systematic enumeration.
Prior knowledge required	Nothing specific.

MODULE 1: **Module time:** 45 minutes

Goal:	How to enumerate possibilities that need to satisfy rules.
Description:	The puzzle is the main motivation. One starts in the initial position and then enumerates various possibilities. The students should discover the process for themselves. This puzzle has been chosen as the solution is not obvious to all right away. A harder version of the puzzle is presented where it is impractical to enumerate all possibilities. In this case, the student needs to think of and eliminate those moves which are obviously bad.
Material required:	**Physical:** **For the student –** Access to the slides but mainly pencil and eraser. **For the teacher –** Access to the slides and blackboard**.**
Procedure Summary:	The teacher just needs to read the procedure details before following the slides. Most of the information is contained in the slides and the procedure details gives some more information which might help in teaching from the slides.
Procedure Details:	1. **Slides 2-7**: Explain the puzzle 2. **Slide 8**: Check understanding of the puzzle. List a few different scenarios. Optionally, one could ask the students to come up with obviously bad scenarios (eg. B and C cross, C comes back, C goes again alone, C comes back alone and so on). This is just to show that there can be very long scenarios, even ones which can never end. 3. It is possible to ask students before going to Slide 9 if they can find the best solution (i.e. a 10-minute solution) 4. **Slide 10**: The notation might need explanation A --- BC means A is on the left side of the bridge and B, C are on the right side of the bridge. 5. **Slide 11**: This slide is fairly complex and explains many things. (i) explains how to look at all possible moves from one position; (ii) explains why we can exclude drawing certain moves because they could be replaced by a faster set of moves. Spend more time with this slide. 6. **Slide 13**: The solution here is the 2 + 1 + 7 path at the bottom: (ABC ----) to (C ---- AB) to (CA ---- B) to (---- ABC). The moves are: AB cross, then A comes back, then AC cross. 7. **Slide 15**: It is not possible to solve this by enumerating because there are atleast 72 different ways by which 4 people can cross. The students can discover it themselves if they try to draw it. 8. **Slide 18**: We should ideally take some fast people across first, then bring one fast person back, send two slow people, and send the fast person back with the lantern. It makes sense to avoid sending slow people both in the beginning and the end. 9. **Worksheet**: The ideas and hints of slides 16 – 18 will help coming up with the

	fastest solution. (i) A, B cross (ii) B comes back (iii) C, D cross (iv) A comes back (v) A, B cross. This takes 2 + 2 + 10 + 1 + 2 = 17 minutes. An alternate solution which also takes the same time is (i) A, B cross (ii) A comes back (iii) C, D cross (iv) B comes back (v) A, B cross.
Assessment:	Let students try and solve the 4 friends version of the same puzzle.
Information Broadcast:	Technically the representation are called graphs. But that is not really relevant – it is about enumeration avoiding obviously bad moves.