

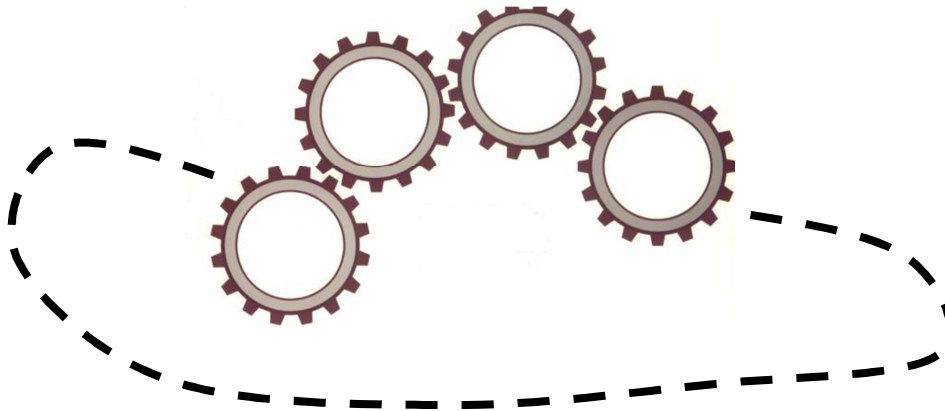
For this assignment, you may (and are encouraged to) work in pairs; if you do so, only one member of the pair should submit a solution to the Curator and you must make sure that both students are identified (name and PID) in the submitted solution. You must also write your solutions in such a way that it is clear how each member contributed to deriving the solution.

Prepare your answers to the following questions in Word document or a plain ASCII text file; submissions in other formats will not be graded. Submit your file to the Curator system by the posted deadline for this assignment. No late submissions will be accepted. No other formats will be graded.

You will submit your answers to the Curator System (www.cs.vt.edu/curator) under the heading OOC03.

For each question below, the quality of your explanation of how you derived the answer will carry more weight than whether you've stated a correct solution. If you applied one of the heuristics discussed in the course notes, identify the heuristic and explain how you applied it.

- [20 points] A number of bacteria were placed in a Petri dish at 10:00 am. One second later, each bacterium reproduces by dividing into two bacteria, each as large as the original bacterium was to begin with. At 10:01 am (on the same morning), the Petri dish becomes full. At what time was the Petri dish half-full? Why?
- [20 points] A total of 101 spur gears are placed in a closed chain, so that each gear meshes with exactly two others:



Is it possible for all the gears to rotate simultaneously? Why or why not?

- [20 points] Fifteen boys gathered a total of 100 nuts. Is it possible that no two boys gathered the same number of nuts? Why or why not?
- [20 points] Prove there must be an integer, whose base-10 representation consists entirely of 1's, that is divisible by 23. Note: writing a program to search for such an integer will not be considered to be a valid analysis.
- [20 points] The two-player game of Divido begins with three piles of small stones, one with 10 stones, one with 15 stones, and one with 20 stones. On each turn, the current player must choose a pile of stones and divide it into two smaller piles. Aside from the rule that a pile may not be empty, there are no restrictions on how many stones may be in each of the piles a player creates. The loser is the player who cannot carry out a valid move.

What strategy, if any, can the player who goes first use to guarantee that he wins? What strategy, if any, can the player who goes second use to guarantee that she wins?