Describe the construction of the model for linear car following with delay. Carefully note all of the assumptions that you make. Obtain the delay-differential equation

\[ v_{n+1}'(t + r) = \lambda \left( v_n(t) - v_{n+1}(t) \right) \]

for the velocities of the cars \( v_n(t) \). Use Laplace transform techniques to obtain an equation for \( \mathcal{L}v_{n+1} \). On the assumption that all of the cars are initially at rest and that the lead car instantaneously accelerates to cruising velocity, solve this equation for \( v_{n+1}(t) \) for every \( n \). Give correct and accurate graphs of the functions \( v_n(t) \) for a reasonable set of parameters; also give correct and accurate graphs of the positions of the cars. Comment on the resulting graphs and their significance.

Notes:

Your paper will contain a mix of things that were presented in class, like the construction of the model, and things that are new to you and your group, like the solution of the equation for \( v_{n+1}(t) \). You will be graded both on the correctness of your (new) mathematics as well as your ability to write.

Rules:
1. The assignment is due at the beginning of class on Thursday, October 3, 2002.
2. This project is to be completed by teams of 1–4 students, and all students shall make a reasonable contribution to the solution of the problem. Separate from the assignment, each student shall hand in a sheet that describes the work of the group. This will be used in grading; students in the same group may receive different grades.
3. You may not discuss this project with other members of class, or with anyone outside of class. You may (only) discuss the project with the instructor.
4. Aside from the restrictions in (3) above, the use of outside references is acceptable, and indeed encouraged. However, all outside references need to be properly acknowledged.
5. Answers should be a well-written paper that describes the problem and the solution. All of the usual rules of English grammar and composition apply.
6. Papers need to be neat, clean, and paper-clipped or stapled. They do not need to be typed or written in ink, but they must be legible and easily readable.
7. Copying the work of another student or portions of a published work constitutes plagiarism. Plagiarism or any other form of academic dishonesty will be cause for immediate failure of the course.