**Problem 1. Caravan Analogy**

Recall the caravan analogy discussed in this week. Suppose the caravan travels 400 km, beginning in front of one tollbooth, passing through an intermediate tollbooth, and finishing just before the third tollbooth. Consider the following assumptions:

Assumptions:

* Ten cars in the caravan
* A tollbooth services a car at a rate of one car every 9 seconds
* A propagation speed of 100 km/hour
* The distance between any of two adjacent toll booths is 200 km.
* Whenever the first car of the caravan arrives at a tollbooth, it waits at the entrance until all the other cars have arrived and lined up behind it.

Question: How long does it take until the caravan is lined up before the third toll booth (from the first tool booth like the caravan analogy slide)?

**Problem 2. Traceroute (30 pt.)**

Perform a traceroute to [www.google.com](http://www.google.com) at three different hours of the day. Traceroute is a tool that measures round-trip delays to every intermediate router toward the final destination. The measurement to each router and the final destination contains three round-trip delays. (Command: traceroute in Linux/Mac; tracert in DOS)

1. (5 pt.) Obtain screenshots for every traceroute and attach them with the submitted document. Print the current date and time before running traceroute. To print date and time, use: “date” in Linux and Mac, “echo %DATE% %TIME%” in DOS.

1. (5 pt.) Find the average and standard deviation of the end-to-end round-trip delays at each of the three hours. The “end-to-end” round-trip delay stands for the round-trip time between the source (your machine) and the destination (the server). Fill out the following table. Show the calculation.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Date/time | Delay 1 | Delay 2 | Delay 3 | Average | Standard deviation |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

1. (5 pt.) Find the number of routers in the path at each of the three hours. Did the paths change during any of the hours?

d-f. (5 pt. each) Repeat a-c to to [**www.inria.fr**](http://www.inria.fr) (instead of [www.google.com)](http://www.google.com)).