Green light turns red. Part 1.

Split into two initial-boundary value problems (ahead and behind the light). We will do both problems, and clarify the physical meaning of the various waves observed.
"Light" traffic first.
Ahead of light: characteristics cross. Resolve issue by introduction of the last car to make the light. Discontinuity in solution where characteristics are chopped. Speed of this discontinuity is obvious (path of last car through the light).

Introduce notion of curves along which characteristics die as a solution to the problem of multiple values. That is: paths in space-time that are "characteristic cemeteries"

- Along these curves, the solution is discontinuous.
- These curves are called shocks.
- Key point: *** CHARACTERISTICS END/DIE AT SHOCKS ***

This works in this case, at least. We'll see it is generic.

**** Notice that this is new math. into the model. ****

Note that, since the discontinuity here is at the last car through the light, conservation follows trivially. Below we will see what is the general rule for the speed of the places where characteristics die [discontinuities/shocks].

We will also see that the general rule below reduces to:
Shock speed = car speed when state behind is $\rho = 0$.

Green light turns red. Behind the light.
Again, characteristics cross. Argue that in real life drivers wait till the last moment to break. Another discontinuity needed:

- **** Location of thin layer where cars break. ****
- **** Wave moving backwards from the light. ****
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How does one compute its velocity? Get law: speed = $[Q]/[\rho]$ by
1) Arguing from the integral form of the conservation law. Split integral $\int_a^b = \int_a^{shock} + \int_{shock}^b$.

2) Move into the shock frame and argue conservation "flow of cars into discont. = flow of cars out"
Note flow = $\rho *(u-s)$.
SHOCK LAW is CONSERVATION! **
Note: limit of shock speed as $[\rho]$ vanishes = characteristic speed.
Again: CHARACTERISTICS CHOPPED AT DISCONTINUITY AND CROSSING AVOIDED.