3.1)  *Carroll* Chapter 2, exercise 7

3.2) Consider the 2d metric given by
\[ ds^2 = -v^2 du^2 + dv^2 \]  
(0.1)

It turns out this space is none other than the 2d Minkowski space with metric
\[ ds^2 = -dt^2 + dx^2 \]  
(0.2)

Show that this is the case by finding coordinate transformations \( x(v, u) \) and \( t(v, u) \) which take the metric in Eqn. (0.1) into the form in Eqn. (0.2).

3.3) Consider Fig. 2.22 in *Carroll* and the discussion surrounding it in the book.

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a) Show mathematically that Carroll’s statement that “light cones are tangent to the singularity” is true. *(You may start with Carroll’s solution for \( t(x) \) for the light cone.)*

b) Sketch the figure, and add curves showing the light cones for events A, B, C and D.

c) Which (if any) of the events A, B, C, D, E and F are out of causal contact?