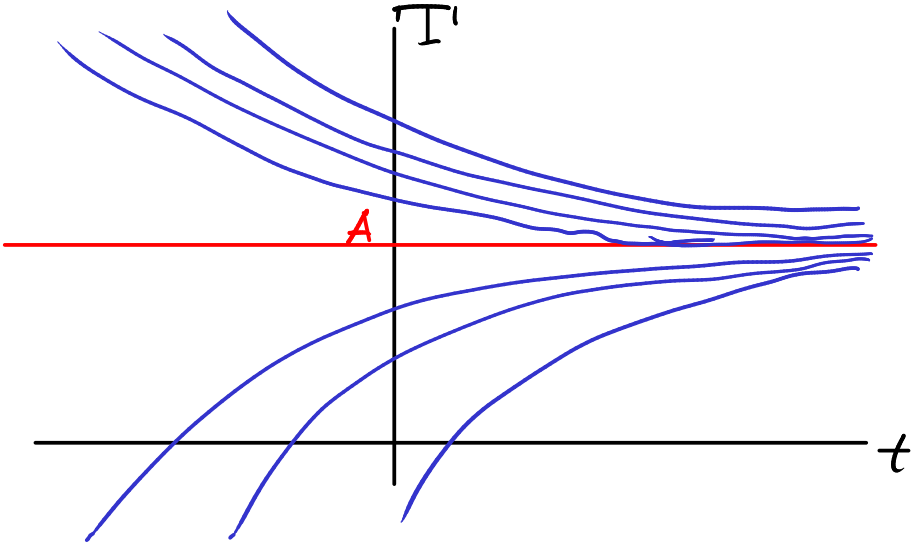
Observe: the DE has infinitely many solutions, because there are infinitely many possibilities for the constant C. This is a typical characteristic.

Plots of possible solutions



Makes sense that T(t) is not unique, because we never decided whether the object starts out above or below the Ambient temp. A.

In other words, we need to specify the initial temperature $T_0 = T(0)$.

T_0 is related to C:

$$T_0 = T(0) = Ce^{-k\cdot 0} + A = C + A$$

So $C = T_0 - A$.

So $$T(t) = (T_0 - A)e^{-kt} + A$$

We solved the initial value problem $\frac{dT}{dt} = -k(T-A)$, $T(0) = T_0$.