1. Find the length of the curve \( \mathbf{r}(t) = \langle t, 3, \frac{2}{3}(t - 1)^{3/2} \rangle \), \( 0 \leq t \leq 1 \).

The arclength is

\[
\int_0^1 |\mathbf{r}'(t)| dt = \int_0^1 |\langle 1, 0, (t - 1)^{1/2} \rangle| dt = \int_0^1 \sqrt{1 + \frac{1}{1 + 4t^2}} dt = \frac{2}{3}.
\]

2. Find the unit normal to the curve \( \mathbf{r}(t) = \langle 1, t, t^2 \rangle \).

The unit tangent is

\[
\mathbf{T}(t) = \frac{\mathbf{r}'(t)}{|\mathbf{r}'(t)|} = \frac{\langle 0, 1, 2t \rangle}{\sqrt{1 + 4t^2}} = \frac{\langle 0, 1, 2t \rangle}{\sqrt{1 + 4t^2}}.
\]

The unit normal is given by

\[
\mathbf{N}(t) = \frac{\mathbf{T}'(t)}{|\mathbf{T}'(t)|}.
\]

You have to be careful when differentiating \( \mathbf{T}(t) \) since that \( \sqrt{1 + 4t^2} \) is in the denominator of every component. So for example in the last component you have to use the quotient rule. This got messier than I expected, but the above formula is what you want to use.