Example 10.5  Let $\Gamma$ be the curve defined by the vector valued position function
\[
\mathbf{r} = [\sin(t), \cos(t) - \sin(t), \cos(3t)] \quad (0 \leq t \leq 2\pi)
\]
Compute the vectors $T, N, B$ at the point on $\Gamma$ corresponding to $t = \frac{\pi}{4}$. Plot $\Gamma$ along with the frame $T, N, B$ based at point on $\Gamma$ corresponding to $t = \frac{\pi}{4}$. Finally, determine the curvature of $\Gamma$ at $t = \frac{\pi}{4}$.

Solution:
Using row vectors $\mathbf{r} := <a | b | c>$ to represent vectors, as convenient as it can be, will not be used in this example. This data type, its advantages and disadvantages is discussed in the second edition of Maple Approach to Calculus. In this problem, it is convenient to use functions and rather than risk surprises with row vectors as functions, we use the "safe" way to do this problem. By using the "vector( )" command, our vectors take on Maple's preferred way of representing vectors as matrices.

```maple
ger:=restart;
with(linalg):
dot:=(u,v)->dotprod(u,v,orthogonal);
r:=map(unapply,vector([sin(t),cos(t)-sin(t),cos(3*t)]),t);
rp:=map(D,r);
T:=map(unapply,scalarmul(rp(t),1/mylength(rp(t))),t);
T1:=T(Pi/4);
N1:=normalize(map(D,T)(Pi/4));
B1:=crossprod(T1,N1);
```

This work sheet was prepared with Maple 6, which does not have any tools for plotting vectors. Consequently, we represent the vectors $T, N, B$ in our plot as line segments of length 1. Here are two commands for producing the line segments and then the frame consisting of the three vectors (as line segments)
Maple 7 has plotting tools to produce these vectors.

\[\text{frame} := \text{vline}(r(Pi/4), T_1), \text{vline}(r(Pi/4), N_1), \text{vline}(r(Pi/4), B_1);\]

\[> \text{kappa} := \text{norm} (\text{map} (\text{D}, T, (Pi/4), 2)) / \text{norm} (\text{rp}(Pi/4), 2);\]

\[\kappa := \frac{1}{49} \sqrt{91} \sqrt{7}\]