<div align="center">

Math 4530
Computing curvature and torsion
Wednesday, January 23

</div>

These procedures are taken directly from the text, pages 40-41

```
> restart:
> dp:=proc(X,Y)  #dotproduct
  X[1]*Y[1]+X[2]*Y[2]+X[3]*Y[3];
  end:
> x:=[a,b,c]:  #example
  y:=[r,s,t]:
  dp(x,y);
```

$$a\,r+b\,s+c\,t$$

```
> nrm:=proc(X)  #magnitude (norm)
  sqrt(dp(X,X));
  end:
> nrm(y);
```

$$\sqrt{r^2+s^2+t^2}$$

```
> xp:=proc(X,Y)  #cross product
  local a,b,c;
  a:=X[2]*Y[3]-X[3]*Y[2];
  b:=X[3]*Y[1]-Y[3]*X[1];
  c:=X[1]*Y[2]-X[2]*Y[1];
  [a,b,c];
  end:
> xp(x,y);
```

$$[b\,t-c\,s,\,c\,r-t\,a,\,a\,s-b\,r]$$

```
> curv:=proc(alpha)   #curvature
  local alphap,alphapp,num,denom;
  alphap:=diff(alpha,t);
  alphapp:=diff(alphap,t);
  num:=simplify(nrm(xp(alphap,alphapp)),radical,symbolic);
  denom:=nrm(alphap)^3;
  RETURN(kappa=simplify(num/denom));
  end:
> tor:=proc(alpha)
  local alphap,alphapp,alphappp,num;
  alphap:=diff(alpha,t);
  alphapp:=diff(alphap,t);
  alphappp:=diff(alphapp,t);
  num:=dp(xp(alphap,alphapp),alphappp);
  RETURN(tau=simplify(num/nrm(xp(alphap,alphapp))^2));
  end:
```

Helicoid, we just did:
```
> hel:=[a*cos(t),a*sin(t),b*t];
  curv(hel);tor(hel);
```

$$hel := [a \cos(t), a \sin(t), b\ t]$$

$$\kappa = \frac{a}{b^2 + a^2}$$

$$\tau = \frac{b}{b^2 + a^2}$$

[>