

□ **Example Technology Exercise 11**
James Jones ← Use F9 for Title

□ ***1 See Word Document*** ← Use F8 for numbered headings

□ ***2 Section 11.5***

⌈ Load the "vect" utility file so we have access to cross products.
 Define the norm and projection ← Use F6 for comments

⌈ (%i1) load("vect")\$
 norm(u):=sqrt(u.u)\$
 proj(u,v):=(u.v)/(v.v)*v\$

□ **2.1 Problem 11.5.99** ← Use F7 for sub-parts

⌈ Find the distance between (2,8,4) and $2x+y+z=5$

⌈ (%i4) n:[2,1,1];
 Q:[2,8,4];
(%o4) [2,1,1]
(%o5) [2,8,4]

⌈ Find a point P in plane by letting $y=z=0$
 and solving for x

⌈ (%i6) solve(2*x+y+z=5,x),y=0,z=0\$
 P:[rhs(%[1]),0,0];
(%o7) [$\frac{5}{2}$,0,0]

⌈ Find the vector PQ

⌈ (%i8) PQ:Q-P;
(%o8) [$-\frac{1}{2}$,8,4]

The distance is the norm of the projection of PQ onto n

```
(%i9) norm(proj(PQ,n));
```

```
(%o9)  $\frac{11}{\sqrt{6}}$ 
```

2.2 Problem 11.5.101

Find the distance between two parallel planes

```
(%i10) plane1: x-3*y+4*z-10;
        plane2: x-3*y+4*z-6;
        n: [1,-3,4];
```

```
(%o10) 4 z - 3 y + x - 10
```

```
(%o11) 4 z - 3 y + x - 6
```

```
(%o12) [1, -3, 4]
```

Let P be a point in plane1
and Q be a point in plane2

```
(%i13) solve(plane1=0,x),y=0,z=0$
        P:[rhs(%[1]),0,0];
        solve(plane2=0,x),y=0,z=0$
        Q:[rhs(%[1]),0,0];
```

```
(%o14) [10,0,0]
```

```
(%o16) [6,0,0]
```

Find the vector PQ

```
(%i17) PQ:Q-P;
```

```
(%o17) [-4,0,0]
```

The distance is the norm of the projection of PQ onto n

```
(%i18) norm(proj(PQ,n));
```

```
(%o18) 
$$\frac{2^{3/2}}{\sqrt{13}}$$

```

2.3 Problem 11.5.105

Find the distance between a point and a line

```
(%i19) Q:[1,5,-2];
```

```
      P:[-2,3,1];
```

```
      u:[4,0,-1];
```

```
      PQ:Q-P;
```

```
(%o19) [1,5,-2]
```

```
(%o20) [-2,3,1]
```

```
(%o21) [4,0,-1]
```

```
(%o22) [3,2,-3]
```

The distance is $\text{norm}(\text{PQ cross } u)/\text{norm}(u)$

```
(%i23) express(PQ~u);
```

```
      norm(%)/norm(u);
```

```
(%o23) [-2,-9,-8]
```

```
(%o24) 
$$\frac{\sqrt{149}}{\sqrt{17}}$$

```

2.4 Problem 11.5.109

Define points and vectors

```
(%i25) P:[2,3,4]$
```

```
      u:[-1,2,1]$
```

```
      Q:[0,1,4]$
```

```
      v:[3,-6,-3]$
```

Find the vector PQ

```
(%i29) PQ:Q-P;  
(%o29) [-2,-2,0]
```

```
Find the cross product  
The distance is the norm of the cross product  
over the norm of the directional vector for the line
```

```
(%i30) express(PQ~u);  
norm(%)/norm(u);  
(%o30) [-2,2,-6]  
(%o31)  $\frac{2\sqrt{11}}{\sqrt{6}}$ 
```