1.1.4 Position, displacement, and separation vectors

the position vector for (x_p,y_p,z_p) is given by:

$$\vec{r}_p = x_p\hat{x} + y_p\hat{y} + z_p\hat{z} \quad .$$

The unit vector in this direction is given by:

$$\hat{r}_p = \frac{x_p\hat{x} + y_p\hat{y} + z_p\hat{z}}{\sqrt{\vec{r}_p \cdot \vec{r}_p}} \quad .$$

The infinitesimal displacement vector from (x,y,z) to (x+dx,y+dy,z+dz) is

$$d\,\vec{l} = dx\,\hat{x} + dy\,\hat{y} + dz\,\hat{z} \quad .$$

Now let "i" represent a source point and "p" represent a field point.
The separation vector pointing from the source point to the field point is given by:

$$\vec{r}_{ip} \equiv \vec{r}_p - \vec{r}_i \quad .$$

The unit vector pointing in the direction from i to p is given by:

$$\hat{r}_{ip} = \frac{\vec{r}_p - \vec{r}_i}{|\vec{r}_{ip}|} \quad .$$

Example: problem 1.7: i=(2,8,7) p=(4,6,8)

$$\vec{r}_i = 2\,\hat{x} + 8\,\hat{y} + 7\,\hat{z} : \vec{r}_p = 4\,\hat{x} + 6\,\hat{y} + 8\,\hat{z}$$

$$\vec{r}_{ip} = \vec{r}_p - \vec{r}_i = (4-2)\hat{x} + (6-8)\hat{y} + (8-7)\hat{z} = 2\,\hat{x} - 2\,\hat{y} + 1\,\hat{z}$$

$$|\vec{r}_{ip}| = \sqrt{\vec{r}_{ip} \cdot \vec{r}_{ip}} = \sqrt{2^2 + 2^2 + 1} = \sqrt{4+4+1} = \sqrt{9} = 3$$

$$\hat{r}_{ip} = \frac{2\,\hat{x} - 2\,\hat{y} + 1\,\hat{z}}{\sqrt{2^2 + 2^2 + 1}} = \frac{2}{3}\hat{x} - \frac{2}{3}\hat{y} + \frac{1}{3}\hat{z}$$