vec_unit and cross product

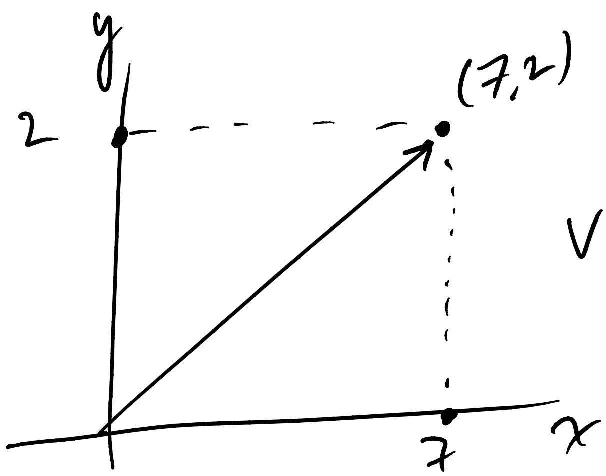
Wednesday, August 25, 2010
9:00 AM

vec_unit(vec_t $\underline{\underline{v1}}$, vec_t $\underline{\underline{v2}}$)

comments state:

Compute v2 (output), a unit vector in dir. of v1
(what we're writing to

"a unit vector" $\equiv \dfrac{v}{\|v\|}$, a vector <u>scaled</u> (mult. by) by 1/<u>length</u>(v)



v = (7,2) is a <u>point</u>, a location, with coordinates (7, 2)

if I take its length, $\|v\| = \sqrt{7^2 + 2^2}$
$= \sqrt{53}$

& scale v by $1/\|v\|$, $\dfrac{v}{\|v\|} = \left(\dfrac{7}{\sqrt{53}}, \dfrac{2}{\sqrt{53}} \right)$

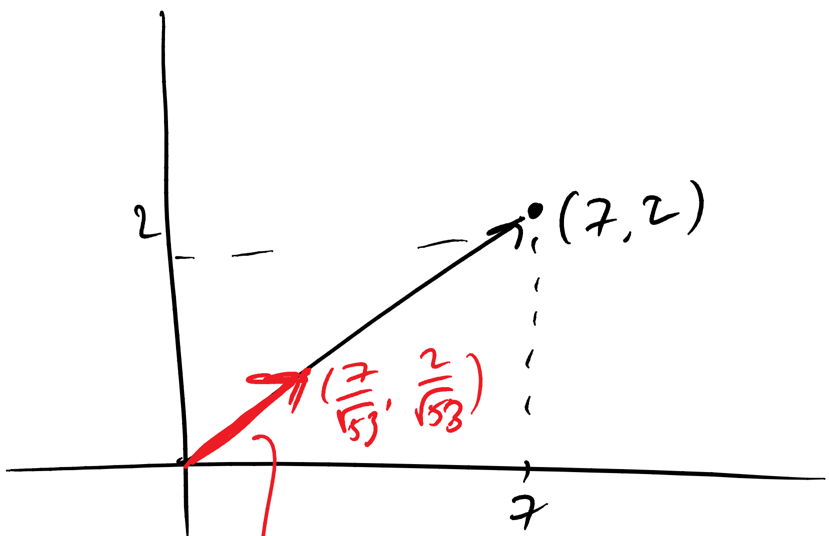
$\dfrac{v}{\|v\|}$ should be a <u>unit vector</u>, v has

$\frac{v}{\|v\|}$ [illegible] a unit vector, v [illegible]

been normalized

(check: $\sqrt{\left(\frac{7}{\sqrt{53}}\right)^2 + \left(\frac{2}{\sqrt{53}}\right)^2} = \sqrt{\frac{49}{53}+\frac{4}{53}}$

$= \sqrt{\frac{53}{53}} = \sqrt{1} = 1$



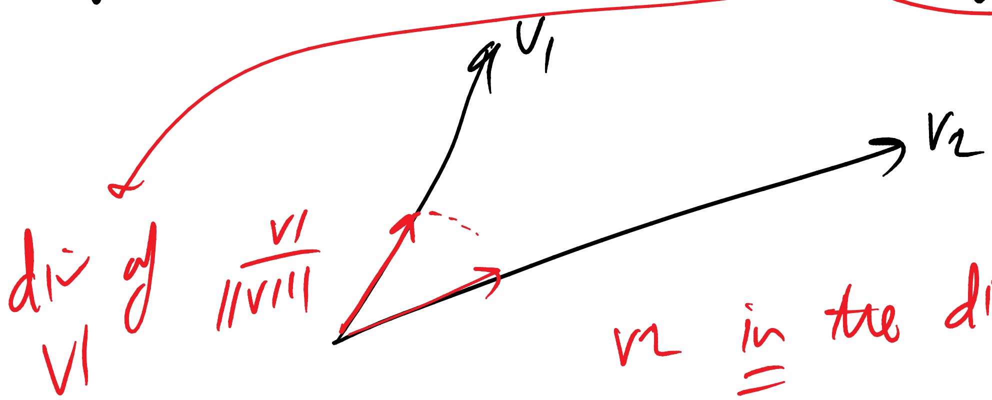
$\frac{v}{\|v\|}$ gives $\boxed{\text{direction}}$

so there's this "duality": vector can mean position or direction

back to vec_unit:

v2: a unit vector in dir. of v1

V2: a unit vector in dir. of V1



V2 in the direction of V1 just means to copy to V2

vec_unit:

a) find V1 length
b) scale V1 by $\frac{1}{\text{length}}$
c) copy result to V2

Be careful about aliased parameters

```
vec_unit( vec_t vin, vec_t vout)
{
    vout[0] = vin[0] / vec_len(vin)
    vout[1] = vin[1] / vec_len(vin)
```

vout[2] = vin[2] / vec_len(vin)

}

Problem exists in intended use of vec_unit:

$\boxed{\text{vec\_unit (v1, v1)}}$

proper way:

```
vec_unit (v1, v2)
{
        double len = vec_len(v1);
    v2[0] = v1[0] / len;
    v2[1] = v1[1] / len;
    v2[2] = v1[2] / len;
}
```

See Westall's notes on this if not clear.

---

void vec_unit(vec_t v1, vec_t v2)

```
{
    vec_scale(1.0/vec_len(v1), v2, v2);
}

void vec_scale(double s, vec_t v1, vec_t v2)
{
    int i;
    for(s=0; i<3, i++) v2[i] = s * v1[i];
}
```

Remember, intended use is:

vec_unit(v1, v1)

$\Rightarrow$ normalize v1; after a call to vec-unit, v1 will be of unit length, a direction vector

cross product

Wednesday, August 25, 2010
9:25 AM

```
void vec_cross (vec_t v1, vec_t v2, vec_t v3)
{
/*
    v3[0] = v1[1] * v2[2] - v1[2] * v2[1];
    v3[1] = v1[2] * v2[0] - v1[0] * v2[2];
    v3[2] = v1[0] * v2[1] - v1[1] * v2[0];
*/
        int i;
        vec_t w;
    for(i=0; i<3; i++)
        w[i] = v1[(3+i+1)%3] * v2[(3+i-1)%3] -
               v1[(3+i-1)%3] * v2[(3+i+1)%3];

    vec_copy (w, v3);
}
```

$c = a \times b$

what does it mean? What is a cross prod?

$$c_x = \begin{pmatrix} a_x \\ a_y \\ a_z \end{pmatrix} \times \begin{pmatrix} b_x \\ b_y \\ b_z \end{pmatrix}$$

+ −

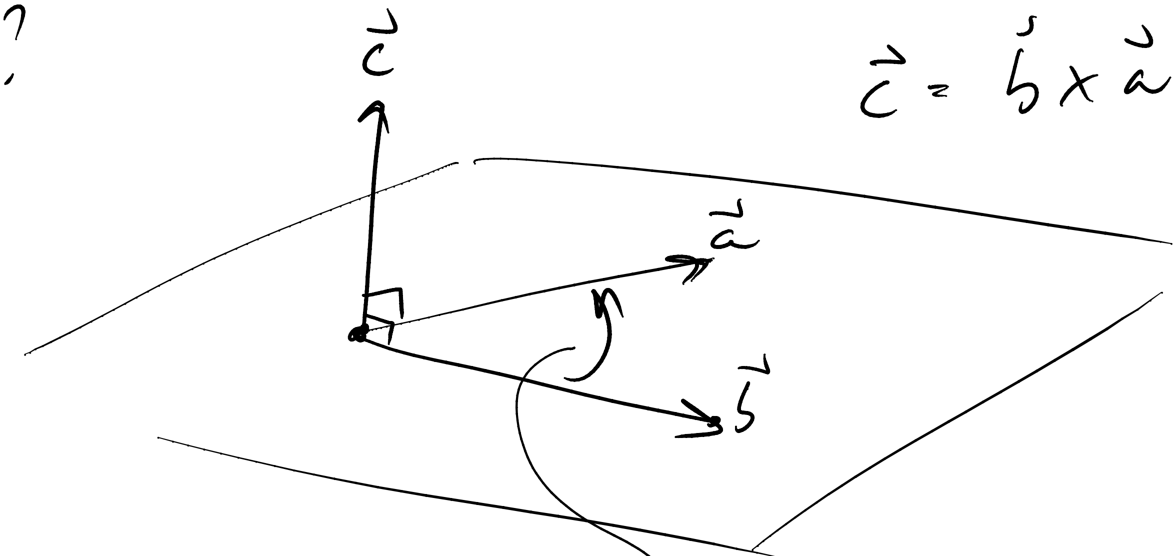
b_x

$$c_y = \begin{pmatrix} a_x \\ a_y \\ a_z \end{pmatrix} \times \begin{pmatrix} b_x \\ b_y \\ b_z \end{pmatrix}$$

$$c_z = \begin{pmatrix} a_x \\ a_y \\ a_z \end{pmatrix} \times \begin{pmatrix} b_x \\ b_y \\ b_z \end{pmatrix}$$

So?

$\vec{c} = \vec{b} \times \vec{a}$

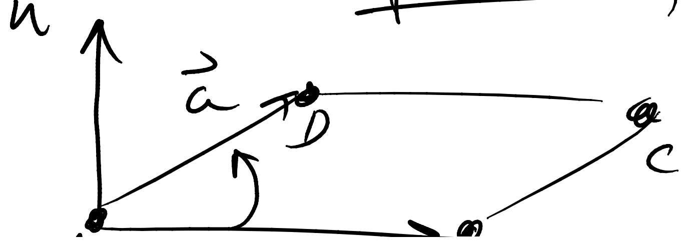


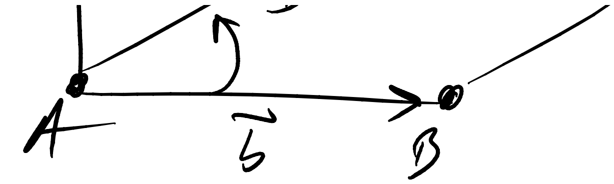
right-handed rule:

$\vec{c}$ is $\perp$ perpendicular to both $\vec{a}$, $\vec{b}$

"orthogonal"

why do we need this? given a plane,





defined by 4 vertices A, B, C, D,
we want to know the plane's orientation
(or tilt), given by the plane's
normal

$$\vec{n} = \vec{b} \times \vec{a}$$

$$= \frac{(B - A)}{\|B - A\|} \times \frac{(D - A)}{\|D - A\|}$$