SCHOOL OF COMPUTING

CS4344 NETWORK AND MOBILE GAMES

CS4344: LAB EXERCISE 1 - TIPS

A) Moving object in a given angle θ:-

$x = x + \cos\theta$ (Assumed initial velocity is 1)
$y = y + \sin\theta$ (Assumed initial velocity is 1)

For screen co-ordinate system

$x = x + \cos\theta$ (Assumed initial velocity is 1)
$y = y - \sin\theta$ (Assumed initial velocity is 1)

Note: Instead of moving an object in one direction, you can retain it at the same position (center of screen) and move the background in opposite direction. [eg. Racing games….]

B) Rotating the Space Ship 30 degree each time:

angle = 0; //initial angle

Sprites:
Create 3 sprites or 1 sprite with 3 frames. Using 1 sprite with 3 frames has advantages (easy to handle collision, easy to move the space ship….).

ship1 // facing 0 degree, or *frame 0 of ship*
ship2 // facing 30 degree or *frame 1 of ship*
ship3 // facing 60 degree or *frame 2 of ship*

Inside game loop:

```
LEFT_PRESSED
 {
  if angle = 0 then
      angle = 330
  else
      angle = angle – 30
 }

RIGHT_PRESSED
 {
  if angle = 360 then
      angle = 30
  else
      angle = angle + 30
 }
```

Painting the Space Ship:

```
switch (angle) {
  0: ship1.paint(g); break;    // or ship.setFrame(0), ship.paint(g); break;
30: ship2.paint(g); break;     // or ship.setFrame(0), ship.paint(g); break;
60: ship3.paint(g); break;     // or ship.setFrame(0), ship.paint(g); break;

……..
……..

}
```

C. Acceleration due to gravity on the Earth's surface

Every object (with mass) is attracted to every other object in the universe by the force of gravity. This force is proportional to the mass of the objects, and inversely proportional to the square of the distance between the objects:

F = G(m1)(m2)/r^2

"Force equals G (the Gravitational Constant, 6.67259e-11) multiplied by the mass of the two objects, and divided by the square of the distance between them." Now, we also know that:

F = ma

"Force equals mass times acceleration." Using these two equations we can, for example, determine the acceleration imposed by one object on another:

F = (m2)a = G(m1)(m2)/r^2
a = G(m1)/r^2

Note: The mass of an object has no effect on the acceleration it feels! It cancels out.

Now, if we apply this equation using the values present on the surface of the Earth (mass = 6.02e24kg, radius = 6400km)...

a = (6.67259e-11)(6.02e24kg)/(6400000m)^2 = 9.81m/s^2

We get 9.81m/s^2, the correct value for acceleration due to gravity on the Earth's surface! For situations directly on the surface of the Earth (or close to it, ie. In the sky), we can assume that this acceleration will bring objects back down to the surface. When we're in distant space, however, since the Earth's mass acts as though it were exerting gravity from a point (its center of mass), it is now possible to fall around the Earth, ORBIT!

g = 9.81 m/s^2 or 32.2 ft/s^2 (where g is gravity constant or acceleration due to gravity force 'G')

D. Transformations of a vertex / object in 2D space

Translation:
Moving one of more vertices from one location to another.

newX = oldX + Dx
newY = oldY + Dy
Calculate for each point/vertex to move the whole object. (Dx – Displacement in X and Dy – Displacement in y)

Scaling:
newX = oldX * Sx
newY = oldY * Sy
where Sx – scale value for x axis, Sy – scale value for y axis

Rotation:
(Anti-clock wise)
newX = oldX * cos(θ) – oldY * sin(θ)
newY = oldX * sin(θ) + oldY * cos(θ)

for Screen coordinate use,
newX = oldX * cos(θ) – oldY * sin(θ)
newY = (-1) * oldX * sin(θ) + oldY * cos(θ)
to get anti-clockwise. Otherwise it will be clock-wise rotation.

Use Transformation Matrices to combine the three transformations together and apply at once. [No need to do one by one.].

E. Degree to Radians Conversion:

$180^0 = \Pi^r$

$1^0 = (\Pi/180)^r$

Where = $\Pi = 3.14$

F. Motion:

Velocity: Velocity is simply the speed at which your object is moving.
Acceleration: Acceleration is simply a measure of a change in velocity. If your object is currently moving at a certain velocity, you can change that by applying acceleration to it. (Acceleration itself depends on the mass of the object and the force applied to it).

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f = m * a
a = f / m
where a – acceleration, f – force, m – mass

---

v = u + at
acceleration *a* starts with an initial velocity *u* and achieves a final velocity *v* in a time of *t* seconds.

G. Projectile:

Velocity in x and y axis. (Directional Movement or Movement in the given angle θ)

$Vx = V_0 \, Cos\theta$
$Vy = V_0 \, Sin\theta$
$x = x + Vx$
$y = y + Vy$
where V_0 – initial velocity, θ is angle of release/movement in radians

$x = x + Cos\theta$ (Assumed initial velocity is 1)
$y = y + Sin\theta$ (Assumed initial velocity is 1)

Movement of a projectile is also affected by the gravitational force. After *t* seconds the position of a projectile can be calculated as:

$x(t) = (V_0 \, Cos\theta)t$
$y(t) = (V_0 \, Sin\theta)t – (gt2)/2$
where V0 – initial velocity, θ - angle of release/movement in radians, t – time in seconds, g – gravitational constant or acceleration due to gravity force, it is equal to 9.8 meter/sec^2. [$g = 9.8 \, m/s^2$]

After *t* second velocity of a projectile can be calculated as:

$Vx\,(t)= V_0 \, Cos\theta$
$Vy\,(t)= V_0 \, Sin\theta - gt$
where V_0 – initial velocity, θ - angle of release/movement in radians, t – time in seconds, g – gravitational constant or acceleration due to gravity force, it is equal to 9.8 meter/sec^2. [$g = 9.8 \, m/s^2$]

How long will it take for the projectile to go up and then go down and finally hit the target?

$$T = \frac{2 \, V_0 \, Sin\theta}{g}$$

The distance the projectile travels in the x-axis is computed as follows:

$X_{dis} = 2VxVy/g$
where $Vx = V_0 \, Cos\theta$, $Vy = V_0 \, Sin\theta$, g is 9.8 m/s^2

The maximum height (position along y axis) the projectile travels is:

$$h = \frac{V_0^2 \, Sin^2\theta}{2g}$$

What is the optimal angle of release to achieve maximum horizontal displacement for some constant magnitude of initial velocity?

45 degrees

- Anand.