hump Documentation

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Contents

hump is a set of lightweight helpers for the awesome LÖVE game framework. It will help to get you over the initial hump when starting to build a new game.

hump differs from many other libraries in that every component is independent of the remaining ones. The footprint is very small, so the library should fit nicely into your projects.

CHAPTER 1

Read on

1.1 hump.gamestate

```
Gamestate = require "hump.gamestate"
```

A gamestate encapsulates independent data an behaviour in a single table.

A typical game could consist of a menu-state, a level-state and a game-over-state.

Example:

```
local menu = {} -- previously: Gamestate.new()
local game = {}

function menu:draw()
    love.graphics.print("Press Enter to continue", 10, 10)
end

function menu:keyreleased(key, code)
    if key == 'enter' then
        Gamestate.switch(game)
    end
end

function game:enter()
    Entities.clear()
    -- setup entities here
end

function game:update(dt)
    Entities.update(dt)
end

function game:draw()
    Entities.draw()
end

function love.load()
    Gamestate.registerEvents()
    Gamestate.switch(menu)
end
```

1.1.1 Gamestate Callbacks

A gamestate can define all callbacks that LÖVE defines. In addition, there are callbacks for initalizing, entering and leaving a state:

init() Called once, and only once, before entering the state the first time. See *Gamestate.switch()*.

enter(previous, ...) Called every time when entering the state. See *Gamestate.switch()*.

leave() Called when leaving a state. See *Gamestate.switch()* and *Gamestate.push()*.

resume() Called when re-entering a state by *Gamestate.pop()*-ing another state.

update() Update the game state. Called every frame.

draw() Draw on the screen. Called every frame.

focus() Called if the window gets or looses focus.

keypressed() Triggered when a key is pressed.

keyreleased() Triggered when a key is released.

mousepressed() Triggered when a mouse button is pressed.

mousereleased() Triggered when a mouse button is released.

joystickpressed() Triggered when a joystick button is pressed.

joystickreleased() Triggered when a joystick button is released.

quit() Called on quitting the game. Only called on the active gamestate.

When using *Gamestate.registerEvents()*, all these callbacks will be called by the corresponding LÖVE callbacks and receive receive the same arguments (e.g. `state:update(dt)` will be called by `love.update(dt)`).

Example:

```
menu = {} -- previously: Gamestate.new()
    self.background = love.graphics.newImage('bg.jpg')
    Buttons.initialize()
end

function menu:enter(previous) -- runs every time the state is entered
    Buttons.setActive(Buttons.start)
end

function menu:update(dt) -- runs every frame
    Buttons.update(dt)
end

function menu:draw()
    love.graphics.draw(self.background, 0, 0)
    Buttons.draw()
end

function menu:keyreleased(key)
    if key == 'up' then
        Buttons.selectPrevious()
    elseif key == 'down' then
        Buttons.selectNext()
    elseif
        Buttons.active:onClick()
    end
```

```
end

function menu:mousereleased(x,y, mouse_btn)
    local button = Buttons.hovered(x,y)
    if button then
        Button.select(button)
        if mouse_btn == 'l' then
            button:onClick()
        end
    end
end
```

1.1.2 Function Reference

`Gamestate.new()`

Returns An empty table.

Deprecated: Use the table constructor instead (see example)

Declare a new gamestate (just an empty table). A gamestate can define several callbacks.

Example:

```
menu = {}
-- deprecated method:
menu = Gamestate.new()
```

`Gamestate.switch(to, ...)`

Arguments

- **to** (*Gamestate*) – Target gamestate.
- **...** (*mixed*) – Additional arguments to pass to `to:enter(current, ...)`.

Returns The results of `to:enter(current, ...)`.

Switch to a gamestate, with any additional arguments passed to the new state.

Switching a gamestate will call the `leave()` callback on the current gamestate, replace the current gamestate with `to`, call the `init()` function if, and only if, the state was not yet inialized and finally call `enter(old_state, ...)` on the new gamestate.

Note: Processing of callbacks is suspended until `update()` is called on the new gamestate, but the function calling `Gamestate.switch()` can still continue - it is your job to make sure this is handled correctly. See also the examples below.

Examples:

```
Gamestate.switch(game, level_two)
```

```
-- stop execution of the current state by using return
if player.has_died then
    return Gamestate.switch(game, level_two)
end

-- this will not be called when the state is switched
player:update()
```

`Gamestate.Gamestate.current()`

Returns The active gamestate.

Returns the currently activated gamestate.

Example:

```
function love.keypressed(key)
    if Gamestate.current() ~= menu and key == 'p' then
        Gamestate.push(pause)
    end
end
```

`Gamestate.push(to, ...)`

Arguments

- **to** (*Gamestate*) – Target gamestate.
- **...** (*mixed*) – Additional arguments to pass to `to:enter(current, ...)`.

Returns The results of `to:enter(current, ...)`.

Pushes the `to` on top of the state stack, i.e. makes it the active state. Semantics are the same as `switch(to, ...)`, except that `leave()` is *not* called on the previously active state.

Useful for pause screens, menus, etc.

Note: Processing of callbacks is suspended until `update()` is called on the new gamestate, but the function calling `GS.push()` can still continue - it is your job to make sure this is handled correctly. See also the example below.

Example:

```
-- pause gamestate
Pause = Gamestate.new()
function Pause:enter(from)
    self.from = from -- record previous state
end

function Pause:draw()
    local W, H = love.graphics.getWidth(), love.graphics.getHeight()
    -- draw previous screen
    self.from:draw()
    -- overlay with pause message
    love.graphics.setColor(0,0,0, 100)
    love.graphics.rectangle('fill', 0,0, W,H)
    love.graphics.setColor(255,255,255)
    love.graphics.printf('PAUSE', 0, H/2, W, 'center')
end

-- [...]
function love.keypressed(key)
    if Gamestate.current() ~= menu and key == 'p' then
        return Gamestate.push(pause)
    end
end
```

`Gamestate.pop(...)`

Returns The results of `new_state:resume(...)`.

Calls `leave()` on the current state and then removes it from the stack, making the state below the current state and calls `resume(...)` on the activated state. Does *not* call `enter()` on the activated state.

Note: Processing of callbacks is suspended until `update()` is called on the new gamestate, but the function calling `GS.pop()` can still continue - it is your job to make sure this is handled correctly. See also the example below.

Example:

```
-- extending the example of Gamestate.push() above
function Pause:keypressed(key)
    if key == 'p' then
        return Gamestate.pop() -- return to previous state
    end
end
```

`Gamestate.`**`<callback>`**`(...)`

Arguments

- `...` (*mixed*) – Arguments to pass to the corresponding function.

Returns The result of the callback function.

Calls a function on the current gamestate. Can be any function, but is intended to be one of the *Gamestate Callbacks*. Mostly useful when not using `Gamestate.registerEvents()`.

Example:

```
function love.draw()
    Gamestate.draw() -- <callback> is `draw'
end

function love.update(dt)
    Gamestate.update(dt) -- pass dt to currentState:update(dt)
end

function love.keypressed(key, code)
    Gamestate.keypressed(key, code) -- pass multiple arguments
end
```

`Gamestate.`**`registerEvents`**`([callbacks])`

Arguments

- **`callbacks`** (*table*) – Names of the callbacks to register. If omitted, register all love callbacks (optional).

Overwrite love callbacks to call `Gamestate.update()`, `Gamestate.draw()`, etc. automatically. `love` callbacks (e.g. `love.update()`) are still invoked as usual.

This is by done by overwriting the love callbacks, e.g.:

```
local old_update = love.update
function love.update(dt)
    old_update(dt)
    return Gamestate.current:update(dt)
end
```

Note: Only works when called in love.load() or any other function that is executed *after* the whole file is loaded.

Examples:

```lua
function love.load()
    Gamestate.registerEvents()
    Gamestate.switch(menu)
end

-- love callback will still be invoked
function love.update(dt)
    Timer.update(dt)
    -- no need for Gamestate.update(dt)
end
```

```lua
function love.load()
    -- only register draw, update and quit
    Gamestate.registerEvents{'draw', 'update', 'quit'}
    Gamestate.switch(menu)
end
```

1.2 hump.timer

```lua
Timer = require "hump.timer"
```

hump.timer offers a simple interface to schedule the execution of functions. It is possible to run functions *after* and *for* some amount of time. For example, a timer could be set to move critters every 5 seconds or to make the player invincible for a short amount of time.

In addition to that, `hump.timer` offers various tweening functions that make it easier to produce juicy games.

Example:

```lua
function love.keypressed(key)
    if key == ' ' then
        Timer.after(1, function() print("Hello, world!") end)
    end
end

function love.update(dt)
    Timer.update(dt)
end
```

1.2.1 Function Reference

`Timer.`**`new`**`()`

Returns A timer instance.

Creates a new timer instance that is independent of the global timer: It will manage it's own list of scheduled functions and does not in any way affect the the global timer. Likewise, the global timer does not affect timer instances.

Note: If you don't need multiple independent schedulers, you can use the global/default timer (see examples).

Example:

```lua
menuTimer = Timer.new()
```

`Timer.`**`after`**`(`*delay*, *func*`)`

Arguments

- **delay** (*number*) – Number of seconds the function will be delayed.
- **func** (*function*) – The function to be delayed.

Returns The timer handle. See also `Timer.cancel()`.

Schedule a function. The function will be executed after `delay` seconds have elapsed, given that `update(dt)` is called every frame.

Note: There is no guarantee that the delay will not be exceeded, it is only guaranteed that the function will *not* be executed *before* the delay has passed.

`func` will receive itself as only parameter. This is useful to implement periodic behavior (see the example).

Examples:

```
-- grant the player 5 seconds of immortality
player.isInvincible = true
Timer.after(5, function() player.isInvincible = false end)
```

```
-- print "foo" every second. See also every()
Timer.after(1, function(func) print("foo") Timer.after(1, func) end)
```

```
--Using a timer instance:
menuTimer:after(1, finishAnimation)
```

`Timer.`**`every`**(*delay*, *func*[, *count*])

Arguments

- **delay** (*number*) – Number of seconds between two consecutive function calls.
- **func** (*function*) – The function to be called periodically.
- **count** (*number*) – Number of times the function is to be called (optional).

Returns The timer handle. See also `Timer.cancel()`.

Add a function that will be called `count` times every `delay` seconds.

If `count` is omitted, the function will be called until it returns `false` or `Timer.cancel()` or `Timer.clear()` is called on the timer instance.

Example:

```
-- toggle light on and off every second
Timer.every(1, function() lamp:toggleLight() end)
```

```
-- launch 5 fighters in quick succession (using a timer instance)
mothership_timer.every(0.3, function() self:launchFighter() end, 5)
```

```
-- flicker player's image as long as he is invincible
Timer.every(0.1, function()
    player:flipImage()
    return player.isInvincible
end)
```

`Timer.`**`during`**(*delay*, *func*[, *after*])

Arguments

- **delay** (*number*) – Number of seconds the func will be called.

- **func** (*function*) – The function to be called on `update(dt)`.
- **after** (*function*) – A function to be called after delay seconds (optional).

Returns The timer handle. See also `Timer.cancel()`.

Run `func(dt)` for the next `delay` seconds. The function is called every time `update(dt)` is called. Optionally run `after()` once `delay` seconds have passed.

`after()` will receive itself as only parameter.

Note: You should not add new timers in `func(dt)`, as this can lead to random crashes.

Examples:

```
-- play an animation for 5 seconds
Timer.during(5, function(dt) animation:update(dt) end)
```

```
-- shake the camera for one second
local orig_x, orig_y = camera:pos()
Timer.during(1, function()
    camera:lookAt(orig_x + math.random(-2,2), orig_y + math.random(-2,2))
end, function()
    -- reset camera position
    camera:lookAt(orig_x, orig_y)
end)
```

```
player.isInvincible = true
-- flash player for 3 seconds
local t = 0
player.timer.during(3, function(dt)
    t = t + dt
    player.visible = (t % .2) < .1
end, function()
    -- make sure the player is visible after three seconds
    player.visible = true
    player.isInvincible = false
end)
```

`Timer.`**`cancel`**(*handle*)

Arguments

- **handle** (*table*) – The function to be canceled.

Prevent a timer from being executed in the future.

Examples:

```
function tick()
    print('tick... tock...')
end
handle = Timer.every(1, tick)
-- later
Timer.cancel(handle) -- NOT: Timer.cancel(tick)
```

```
-- using a timer instance
function tick()
    print('tick... tock...')
end
handle = menuTimer:every(1, tick)
```

```
-- later
menuTimer:cancel(handle)
```

`Timer.clear()`

Remove all timed and periodic functions. Functions that have not yet been executed will discarded.

Examples:

```
Timer.clear()
```

```
menu_timer:clear()
```

`Timer.update(dt)`

Arguments

- **dt** (*number*) – Time that has passed since the last `update()`.

Update timers and execute functions if the deadline is reached. Call in `love.update(dt)`.

Examples:

```
function love.update(dt)
    do_stuff()
    Timer.update(dt)
end
```

```
-- using hump.gamestate and a timer instance
function menuState:update(dt)
    self.timer.update(dt)
end
```

`Timer.tween(duration, subject, target, method, after, ...)`

Arguments

- **duration** (*number*) – Duration of the tween.
- **subject** (*table*) – Object to be tweened.
- **target** (*table*) – Target values.
- **method** (*string*) – Tweening method, defaults to 'linear' (*see here*, optional).
- **after** (*function*) – Function to execute after the tween has finished (optiona).
- **...** (*mixed*) – Additional arguments to the *tweening* function.

Returns A timer handle.

Tweening (short for in-betweening) is the process that happens between two defined states. For example, a tween can be used to gradually fade out a graphic or move a text message to the center of the screen. For more information why tweening should be important to you, check out this great talk on juicy games.

`hump.timer` offers two interfaces for tweening: the low-level *`Timer.during()`* and the higher level interface *`Timer.tween()`*.

To see which tweening methods hump offers, *see below*.

Examples:

```
function love.load()
    color = {0, 0, 0}
    Timer.tween(10, color, {255, 255, 255}, 'in-out-quad')
```

```
end

function love.update(dt)
    Timer.update(dt)
end

function love.draw()
    love.graphics.setBackgroundColor(color)
end
```

```
function love.load()
    circle = {rad = 10, pos = {x = 400, y = 300}}
    -- multiple tweens can work on the same subject
    -- and nested values can be tweened, too
    Timer.tween(5, circle, {rad = 50}, 'in-out-quad')
    Timer.tween(2, circle, {pos = {y = 550}}, 'out-bounce')
end

function love.update(dt)
    Timer.update(dt)
end

function love.draw()
    love.graphics.circle('fill', circle.pos.x, circle.pos.y, circle.rad)
end
```

```
function love.load()
    -- repeated tweening

    circle = {rad = 10, x = 100, y = 100}
    local grow, shrink, move_down, move_up
    grow = function()
        Timer.tween(1, circle, {rad = 50}, 'in-out-quad', shrink)
    end
    shrink = function()
        Timer.tween(2, circle, {rad = 10}, 'in-out-quad', grow)
    end

    move_down = function()
        Timer.tween(3, circle, {x = 700, y = 500}, 'bounce', move_up)
    end
    move_up = function()
        Timer.tween(5, circle, {x = 200, y = 200}, 'out-elastic', move_down)
    end

    grow()
    move_down()
end

function love.update(dt)
    Timer.update(dt)
end

function love.draw()
    love.graphics.circle('fill', circle.x, circle.y, circle.rad)
end
```

1.2.2 Tweening methods

At the core of tweening lie interpolation methods. These methods define how the output should look depending on how much time has passed. For example, consider the following tween:

```
-- now: player.x = 0, player.y = 0
Timer.tween(2, player, {x = 2})
Timer.tween(4, player, {y = 8})
```

At the beginning of the tweens (no time passed), the interpolation method would place the player at `x = 0, y = 0`. After one second, the player should be at `x = 1, y = 2`, and after two seconds the output is `x = 2, y = 4`.

The actual duration of and time since starting the tween is not important, only the fraction of the two. Similarly, the starting value and output are not important to the interpolation method, since it can be calculated from the start and end point. Thus an interpolation method can be fully characterized by a function that takes a number between 0 and 1 and returns a number that defines the output (usually also between 0 and 1). The interpolation function must hold that the output is 0 for input 0 and 1 for input 1.

hump predefines several commonly used interpolation methods, which are generalized versions of Robert Penner's easing functions. Those are:

`'linear'`, `'quad'`, `'cubic'`, `'quart'`, `'quint'`, `'sine'`, `'expo'`, `'circ'`, `'back'`, `'bounce'`, and `'elastic'`.

It's hard to understand how these functions behave by staring at a graph, so below are some animation examples. You can change the type of the tween by changing the selections.

Note that while the animations above show tweening of shapes, other attributes (color, opacity, volume of a sound, ...) can be changed as well.

Custom interpolators

You can add custom interpolation methods by adding them to the *tween* table:

```
Timer.tween.sqrt = function(t) return math.sqrt(t) end
-- or just Timer.tween.sqrt = math.sqrt
```

Access the your method like you would the predefined ones. You can even use the modyfing prefixes:

```
Timer.tween(5, 'in-out-sqrt', circle, {radius = 50})
```

You can also invert and chain functions:

```
outsqrt = Timer.tween.out(math.sqrt)
inoutsqrt = Timer.tween.chain(math.sqrt, outsqrt)
```

1.3 hump.vector

```
vector = require "hump.vector"
```

A handy 2D vector class providing most of the things you do with vectors.

You can access the individual coordinates by `vec.x` and `vec.y`.

Note: The vectors are stored as tables. Most operations create new vectors and thus new tables, which *may* put the garbage collector under stress. If you experience slowdowns that are caused by hump.vector, try the table-less version hump.vector-light.

Example:

```
function player:update(dt)
    local delta = vector(0,0)
    if love.keyboard.isDown('left') then
        delta.x = -1
    elseif love.keyboard.isDown('right') then
        delta.x =  1
    end
    if love.keyboard.isDown('up') then
        delta.y = -1
    elseif love.keyboard.isDown('down') then
        delta.y =  1
    end
    delta:normalizeInplace()

    player.velocity = player.velocity + delta * player.acceleration * dt

    if player.velocity:len() > player.max_velocity then
        player.velocity = player.velocity:normalized() * player.max_velocity
    end

    player.position = player.position + player.velocity * dt
end
```

1.3.1 Vector arithmetic

hump provides vector arithmetic by implement the corresponding metamethods (`__add`, `__mul`, etc.). Here are the semantics:

`vector + vector = vector` Component wise sum: \((a,b) + (x,y) = (a+x, b+y)\)

`vector - vector = vector` Component wise difference: \((a,b) - (x,y) = (a-x, b-y)\)

`vector * vector = number` Dot product: \((a,b) \cdot (x,y) = a\cdot x + b\cdot y\)

`number * vector = vector` Scalar multiplication/scaling: \((a,b) \cdot s = (s\cdot a, s\cdot b)\)

`vector * number = vector` Scalar multiplication/scaling: \(s \cdot (x,y) = (s\cdot x, s\cdot y)\)

`vector / number = vector` Scalar multiplication/scaling: \((a,b) / s = (a/s, b/s)\).

Common relations are also defined:

`a == b` Same as `a.x == b.x and a.y == b.y`.

`a <= b` Same as `a.x <= b.x and a.y <= b.y`.

`a < b` Lexicographical order: `a.x < b.x or (a.x == b.x and a.y < b.y)`.

Example:

```
-- acceleration, player.velocity and player.position are vectors
acceleration = vector(0,-9)
player.velocity = player.velocity + acceleration * dt
player.position = player.position + player.velocity * dt
```

1.3.2 Function Reference

`vector.new(x, y)`

Arguments

- **x,y** (*numbers*) – Coordinates.

Returns The vector.

Create a new vector.

Examples:

```
a = vector.new(10,10)
```

```
-- as a shortcut, you can call the module like a function:
vector = require "hump.vector"
a = vector(10,10)
```

`vector.isvector(v)`

Arguments

- **v** (*mixed*) – The variable to test.

Returns `true` if `v` is a vector, `false` otherwise.

Test whether a variable is a vector.

Example:

```
if not vector.isvector(v) then
    v = vector(v,0)
end
```

`vector:clone()`

Returns Copy of the vector.

Copy a vector. Assigning a vector to a variable will create a *reference*, so when modifying the vector referenced by the new variable would also change the old one:

```
a = vector(1,1) -- create vector
b = a           -- b references a
c = a:clone()   -- c is a copy of a
b.x = 0         -- changes a,b and c
print(a,b,c)    -- prints '(1,0), (1,0), (1,1)'
```

Example:

```
copy = original:clone()
```

`vector:unpack()`

Returns The coordinates `x,y`.

Extract coordinates.

Examples:

```
x,y = pos:unpack()
```

```
love.graphics.draw(self.image, self.pos:unpack())
```

vector:permul (*other*)

Arguments

- **other** (*vector*) – The second source vector.

Returns Vector whose components are products of the source vectors.

Multiplies vectors coordinate wise, i.e. `result = vector(a.x * b.x, a.y * b.y)`.

Does not change either argument vectors, but creates a new one.

Example:

```
-- scale with different magnitudes
scaled = original:permul(vector(1,1.5))
```

vector:len ()

Returns Length of the vector.

Get length of the vector, i.e. `math.sqrt(vec.x * vec.x + vec.y * vec.y)`.

Example:

```
distance = (a - b):len()
```

vector:len2 ()

Returns Squared length of the vector.

Get squared length of the vector, i.e. `vec.x * vec.x + vec.y * vec.y`.

Example:

```
-- get closest vertex to a given vector
closest, dsq = vertices[1], (pos - vertices[1]):len2()
for i = 2,#vertices do
    local temp = (pos - vertices[i]):len2()
    if temp < dsq then
        closest, dsq = vertices[i], temp
    end
end
```

vector:dist (*other*)

Arguments

- **other** (*vector*) – Other vector to measure the distance to.

Returns The distance of the vectors.

Get distance of two vectors. The same as `(a - b):len()`.

Example:

```
-- get closest vertex to a given vector
-- slightly slower than the example using len2()
closest, dist = vertices[1], pos:dist(vertices[1])
for i = 2,#vertices do
    local temp = pos:dist(vertices[i])
    if temp < dist then
        closest, dist = vertices[i], temp
    end
end
```

vector:dist2(*other*)

Arguments

- **other** (*vector*) – Other vector to measure the distance to.

Returns The squared distance of the vectors.

Get squared distance of two vectors. The same as `(a - b):len2()`.

Example:

```
-- get closest vertex to a given vector
-- slightly faster than the example using len2()
closest, dsq = vertices[1], pos:dist2(vertices[1])
for i = 2,#vertices do
    local temp = pos:dist2(vertices[i])
    if temp < dsq then
        closest, dsq = vertices[i], temp
    end
end
```

vector:normalized()

Returns Vector with same direction as the input vector, but length 1.

Get normalized vector: a vector with the same direction as the input vector, but with length 1.

Does not change the input vector, but creates a new vector.

Example:

```
direction = velocity:normalized()
```

vector:normalizeInplace()

Returns Itself – the normalized vector

Normalize a vector, i.e. make the vector to have length 1. Great to use on intermediate results.

Warning: This modifies the vector. If in doubt, use *vector:normalized()*.

Example:

```
normal = (b - a):perpendicular():normalizeInplace()
```

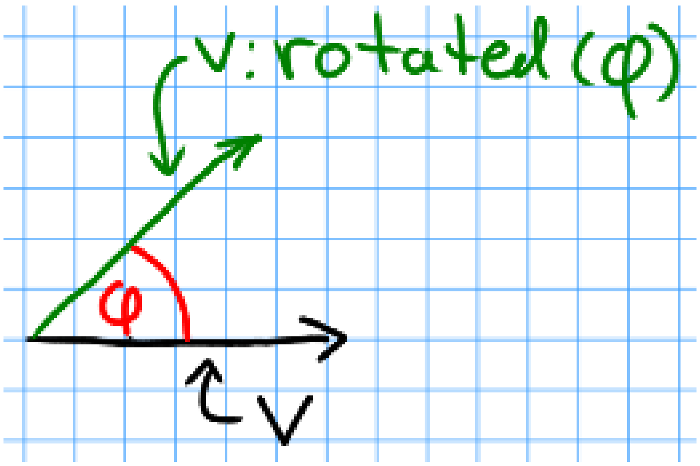
vector:rotated(*angle*)

Arguments

- **angle** (*number*) – Rotation angle in radians.

Returns The rotated vector

Get a vector with same length, but rotated by `angle`:



Does not change the input vector, but creates a new vector.

Example:

```
-- approximate a circle
circle = {}
for i = 1,30 do
    local phi = 2 * math.pi * i / 30
    circle[#circle+1] = vector(0,1):rotated(phi)
end
```

vector:rotateInplace(*angle*)

Arguments

- **angle** (*number*) – Rotation angle in radians.

Returns Itself – the rotated vector

Rotate a vector in-place. Great to use on intermediate results.

Warning: Yhis modifies the vector. If in doubt, use *vector:rotated()*.

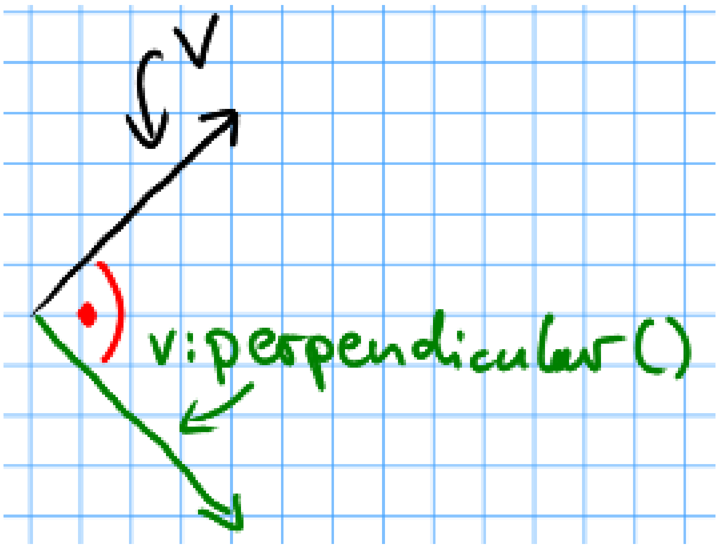
Example:

```
-- ongoing rotation
spawner.direction:rotateInplace(dt)
```

vector:perpendicular()

Returns A vector perpendicular to the input vector

Quick rotation by 90°. Creates a new vector. The same (but faster) as `vec:rotate(math.pi/2)`:



Example:

```
normal = (b - a):perpendicular():normalizeInplace()
```

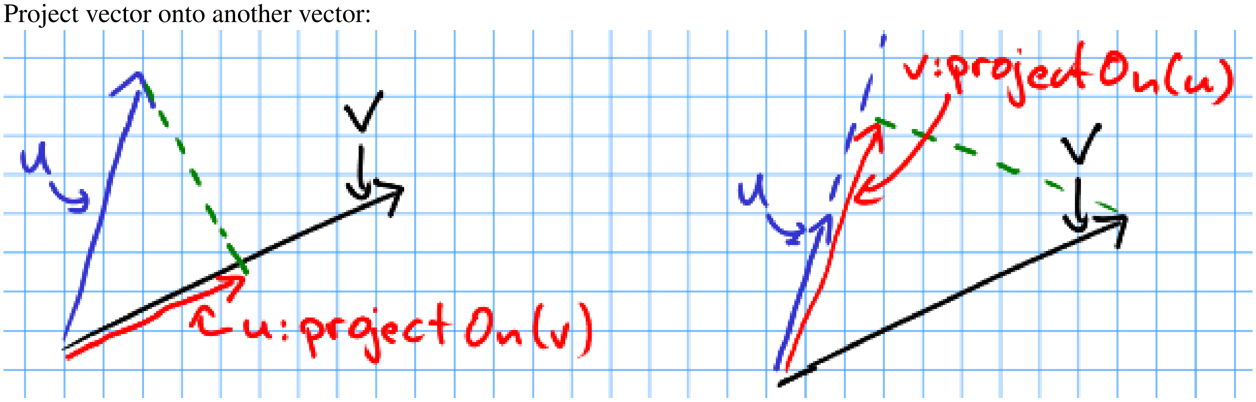
vector:projectOn(*v*)

Arguments

- **v** (*vector*) – The vector to project on.

Returns `vector` The projected vector.

Project vector onto another vector:



Example:

```
velocity_component = velocity:projectOn(axis)
```

vector:mirrorOn(*v*)

Arguments

- **v** (*vector*) – The vector to mirror on.

Returns The mirrored vector.

Mirrors vector on the axis defined by the other vector:

Example:

```
deflected_velocity = ball.velocity:mirrorOn(surface_normal)
```

vector:cross (*other*)

Arguments

- **other** (*vector*) – Vector to compute the cross product with.

Returns `number` Cross product of both vectors.

Get cross product of two vectors. Equals the area of the parallelogram spanned by both vectors.

Example:

```
parallelogram_area = a:cross(b)
```

vector:angleTo (*other*)

Arguments

- **other** (*vector*) – Vector to measure the angle to (optional).

Returns Angle in radians.

Measures the angle between two vectors. If `other` is omitted it defaults to the vector `(0,0)`, i.e. the function returns the angle to the coordinate system.

Example:

```
lean = self.upvector:angleTo(vector(0,1))
if lean > .1 then self:fallOver() end
```

vector:trimmed (*max_length*)

Arguments

- **max_length** (*number*) – Maximum allowed length of the vector.

Returns A trimmed vector.

Trim the vector to `max_length`, i.e. return a vector that points in the same direction as the source vector, but has a magnitude smaller or equal to `max_length`.

Does not change the input vector, but creates a new vector.

Example:

```
ship.velocity = ship.force * ship.mass * dt
ship.velocity = ship.velocity:trimmed(299792458)
```

vector:trimInplace (*max_length*)

Arguments

- **max_length** (*number*) – Maximum allowed length of the vector.

Returns Itself – the trimmed vector.

Trim the vector to `max_length`, i.e. return a vector that points in the same direction as the source vector, but has a magnitude smaller or equal to `max_length`.

> **Warning:** Yhis modifies the vector. If in doubt, use *vector:trimmed()*.

Example:

```
ship.velocity = (ship.velocity + ship.force * ship.mass * dt):trimInplace(299792458)
```

1.4 hump.vector-light

```
vector = require "hump.vector-light"
```

An table-free version of hump.vector. Instead of a vector type, `hump.vector-light` provides functions that operate on numbers.

Using this module instead of hump.vector may result in faster code, but does so at the expense of speed of development and code readability. Unless you are absolutely sure that your code is significantly slowed down by hump.vector, I recommend using it instead.

Example:

```
function player:update(dt)
    local dx,dy = 0,0
    if love.keyboard.isDown('left') then
        dx = -1
    elseif love.keyboard.isDown('right') then
        dx =  1
    end
    if love.keyboard.isDown('up') then
        dy = -1
    elseif love.keyboard.isDown('down') then
        dy =  1
    end
    dx,dy = vector.normalize(dx, dy)

    player.velx, player.vely = vector.add(player.velx, player.vely,
                                    vector.mul(dy, dx, dy))

    if vector.len(player.velx, player.vely) > player.max_velocity then
        player.velx, player.vely = vector.mul(player.max_velocity,
                                vector.normalize(player.velx, player.vely)
    end

    player.x = player.x + dt * player.velx
    player.y = player.y + dt * player.vely
end
```

1.4.1 Function Reference

`vector.`**`str`**`(`*x*, *y*`)`

Arguments

- **`x, y`** (*numbers*) – The vector.

Returns The string representation.

Produce a human-readable string of the form `(x,y)`. Useful for debugging.

Example:

```
print(vector.str(love.mouse.getPosition()))
```

vector.**mul**(*s*, *x*, *y*)

Arguments

- **s** (*number*) – A scalar.
- **x,y** (*numbers*) – A vector.

Returns `x*s, y*s`.

Computes `x*s,y*s`. The order of arguments is chosen so that it's possible to chain operations (see example).

Example:

```
velx,vely = vec.mul(dt, vec.add(velx,vely, accx,accy))
```

vector.**div**(*s*, *x*, *y*)

Arguments

- **s** (*number*) – A scalar.
- **x,y** (*numbers*) – A vector.

Returns `x/s, y/s`.

Computes `x/s,y/s`. The order of arguments is chosen so that it's possible to chain operations (see example).

Example:

```
x,y = vec.div(self.zoom, x-w/2, y-h/2)
```

vector.**add**(*x1*, *y1*, *x2*, *y2*)

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1+x2, x1+x2`.

Computes the sum \((x1+x2, y1+y2)\)`` of two vectors. Meant to be used in conjunction with other functions like *vector.mul()*.

Example:

```
player.x,player.y = vector.add(player.x,player.y, vector.mul(dt, dx,dy))
```

vector.**sub**(*x1*, *y1*, *x2*, *y2*)

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1-x2, x1-x2`.

Computes the difference \((x1-x2, y1-y2)\) of two vectors. Meant to be used in conjunction with other functions like *vector.mul()*.

Example:

```
dx,dy = vector.sub(400,300, love.mouse.getPosition())
```

vector.**permul**(*x1*, *y1*, *x2*, *y2*)

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1*x2, y1*y2`.

Component-wise multiplication, i.e.: `x1*x2, y1*y2`.

Example:

```
x,y = vector.permul(x,y, 1,1.5)
```

`vector.`**`dot`**`(`*x1*, *y1*, *x2*, *y2*`)`

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1*x2 + y1*y2`.

Computes the dot product of two vectors: `x1*x2 + y1*y2`.

Example:

```
cosphi = vector.dot(rx,ry, vx,vy)
```

`vector.`**`cross`**`(`*x1*, *y1*, *x2*, *y2*`)`

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1*y2 - y1*x2`.

Computes the cross product of two vectors: `x1*y2 - y1*x2`.

Example:

```
parallelogram_area = vector.cross(ax,ay, bx,by)
```

`vector.vector.`**`det`**`(`*x1*, *y1*, *x2*, *y2*`)`

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1*y2 - y1*x2`.

Alias to `vector.cross()`.

Example:

```
parallelogram_area = vector.det(ax,ay, bx,by)
```

`vector.`**`eq`**`(`*x1*, *y1*, *x2*, *y2*`)`

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1 == x2 and y1 == y2`

Test for equality.

Example:

```
if vector.eq(x1,y1, x2,y2) then be.happy() end
```

`vector.le(x1, y1, x2, y2)`

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1 <= x2 and y1 <= y2`.

Test for partial lexicographical order, <=.

Example:

```
if vector.le(x1,y1, x2,y2) then be.happy() end
```

`vector.lt(x1, y1, x2, y2)`

Arguments

- **x1,y1** (*numbers*) – First vector.
- **x2,y2** (*numbers*) – Second vector.

Returns `x1 < x2 or (x1 == x2) and y1 <= y2`.

Test for strict lexicographical order, <.

Example:

```
if vector.lt(x1,y1, x2,y2) then be.happy() end
```

`vector.len(x, y)`

Arguments

- **x,y** (*numbers*) – The vector.

Returns Length of the vector.

Get length of a vector, i.e. `math.sqrt(x*x + y*y)`.

Example:

```
distance = vector.len(love.mouse.getPosition())
```

`vector.len2(x, y)`

Arguments

- **x,y** (*numbers*) – The vector.

Returns Squared length of the vector.

Get squared length of a vector, i.e. `x*x + y*y`.

Example:

```
-- get closest vertex to a given vector
closest, dsq = vertices[1], vector.len2(px-vertices[1].x, py-vertices[1].y)
for i = 2,#vertices do
    local temp = vector.len2(px-vertices[i].x, py-vertices[i].y)
```

```
    if temp < dsq then
        closest, dsq = vertices[i], temp
    end
end
```

`vector.`**`dist`**`(`*x1*, *y1*, *x2*, *y2*`)`

Arguments

- **`x1,y1`** (*numbers*) – First vector.
- **`x2,y2`** (*numbers*) – Second vector.

Returns The distance of the points.

Get distance of two points. The same as `vector.len(x1-x2, y1-y2)`.

Example:

```
-- get closest vertex to a given vector
-- slightly slower than the example using len2()
closest, dist = vertices[1], vector.dist(px,py, vertices[1].x,vertices[1].y)
for i = 2,#vertices do
    local temp = vector.dist(px,py, vertices[i].x,vertices[i].y)
    if temp < dist then
        closest, dist = vertices[i], temp
    end
end
```

`vector.`**`dist2`**`(`*x1*, *y1*, *x2*, *y2*`)`

Arguments

- **`x1,y1`** (*numbers*) – First vector.
- **`x2,y2`** (*numbers*) – Second vector.

Returns The squared distance of two points.

Get squared distance of two points. The same as `vector.len2(x1-x2, y1-y2)`.

Example:

```
-- get closest vertex to a given vector
closest, dsq = vertices[1], vector.dist2(px,py, vertices[1].x,vertices[1].y)
for i = 2,#vertices do
    local temp = vector.dist2(px,py, vertices[i].x,vertices[i].y)
    if temp < dsq then
        closest, dsq = vertices[i], temp
    end
end
```

`vector.`**`normalize`**`(`*x*, *y*`)`

Arguments

- **`x,y`** (*numbers*) – The vector.

Returns Vector with same direction as the input vector, but length 1.

Get normalized vector, i.e. a vector with the same direction as the input vector, but with length 1.

Example:

```
dx,dy = vector.normalize(vx,vy)
```

`vector.`**`rotate`**`(`*phi*, *x*, *y*`)`

Arguments

- **`phi`** (*number*) – Rotation angle in radians.
- **`x,y`** (*numbers*) – The vector.

Returns The rotated vector

Get a rotated vector.

Example:

```
-- approximate a circle
circle = {}
for i = 1,30 do
    local phi = 2 * math.pi * i / 30
    circle[i*2-1], circle[i*2] = vector.rotate(phi, 0,1)
end
```

`vector.`**`perpendicular`**`(`*x*, *y*`)`

Arguments

- **`x,y`** (*numbers*) – The vector.

Returns A vector perpendicular to the input vector

Quick rotation by 90°. The same (but faster) as `vector.rotate(math.pi/2, x,y)`.

Example:

```
nx,ny = vector.normalize(vector.perpendicular(bx-ax, by-ay))
```

`vector.`**`project`**`(`*x*, *y*, *u*, *v*`)`

Arguments

- **`x,y`** (*numbers*) – The vector to project.
- **`u,v`** (*numbers*) – The vector to project onto.

Returns The projected vector.

Project vector onto another vector.

Example:

```
vx_p,vy_p = vector.project(vx,vy, ax,ay)
```

`vector.`**`mirror`**`(`*x*, *y*, *u*, *v*`)`

Arguments

- **`x,y`** (*numbers*) – The vector to mirror.
- **`u,v`** (*numbers*) – The vector defining the axis.

Returns The mirrored vector.

Mirrors vector on the axis defined by the other vector.

Example:

```
vx,vy = vector.mirror(vx,vy, surface.x,surface.y)
```

`vector.`**`angleTo`**(*ox*, *y*, *u*, *v*)

Arguments

- **`x,y`** (*numbers*) – Vector to measure the angle.
- **`u,v (optional)`** (*numbers*) – Reference vector.

Returns Angle in radians.

Measures the angle between two vectors. `u` and `v` default to `0` if omitted, i.e. the function returns the angle to the coordinate system.

Example:

```
lean = vector.angleTo(self.upx, self.upy, 0,1)
if lean > .1 then self:fallOver() end
```

`vector.`**`trim`**(*max_length*, *x*, *y*)

Arguments

- **`max_length`** (*number*) – Maximum allowed length of the vector.
- **`x,y`** (*numbers*) – Vector to trum.

Returns The trimmed vector.

Trim the vector to `max_length`, i.e. return a vector that points in the same direction as the source vector, but has a magnitude smaller or equal to `max_length`.

Example:

```
vel_x, vel_y = vector.trim(299792458,
                           vector.add(vel_x, vel_y,
                                      vector.mul(mass * dt, force_x, force_y)))
```

1.5 hump.class

```
Class = require "hump.class"
```

A small, fast class/prototype implementation with multiple inheritance.

Implements class commons.

Example:

```
Critter = Class{
    init = function(self, pos, img)
        self.pos = pos
        self.img = img
    end,
    speed = 5
}

function Critter:update(dt, player)
    -- see hump.vector
    local dir = (player.pos - self.pos):normalize_inplace()
    self.pos = self.pos + dir * Critter.speed * dt
```

```
end

function Critter:draw()
    love.graphics.draw(self.img, self.pos.x, self.pos.y)
end
```

1.5.1 Function Reference

`Class.new` (*{init = constructor, __includes = parents, ...}*)

Arguments

- **constructor** (*function*) – Class constructor. Can be accessed with `theclass.init(object, ...)`. (optional)
- **or table of classes parents** (*class*) – Classes to inherit from. Can either be a single class or a table of classes. (optional)
- **...** (*mixed*) – Any other fields or methods common to all instances of this class. (optional)

Returns The class.

Declare a new class.

`init()` will receive the new object instance as first argument. Any other arguments will also be forwarded (see examples), i.e. `init()` has the following signature:

```
function init(self, ...)
```

If you do not specify a constructor, an empty constructor will be used instead.

The name of the variable that holds the module can be used as a shortcut to `new()` (see example).

Examples:

```
Class = require 'hump.class' -- `Class' is now a shortcut to new()

-- define a class class
Feline = Class{
    init = function(self, size, weight)
        self.size = size
        self.weight = weight
    end;
    -- define a method
    stats = function(self)
        return string.format("size: %.02f, weight: %.02f", self.size, self.weight)
    end;
}

-- create two objects
garfield = Feline(.7, 45)
felix = Feline(.8, 12)

print("Garfield: " .. garfield:stats(), "Felix: " .. felix:stats())
```

```
Class = require 'hump.class'

-- same as above, but with 'external' function definitions
Feline = Class{}
```

```
function Feline:init(size, weight)
    self.size = size
    self.weight = weight
end

function Feline:stats()
    return string.format("size: %.02f, weight: %.02f", self.size, self.weight)
end

garfield = Feline(.7, 45)
print(Feline, garfield)
```

```
Class = require 'hump.class'
A = Class{
    foo = function() print('foo') end
}

B = Class{
    bar = function() print('bar') end
}

-- single inheritance
C = Class{__includes = A}
instance = C()
instance:foo() -- prints 'foo'
instance:bar() -- error: function not defined

-- multiple inheritance
D = Class{__includes = {A,B}}
instance = D()
instance:foo() -- prints 'foo'
instance:bar() -- prints 'bar'
```

```
-- class attributes are shared across instances
A = Class{ foo = 'foo' } -- foo is a class attribute/static member

one, two, three = A(), A(), A()
print(one.foo, two.foo, three.foo) --> prints 'foo    foo    foo'

one.foo = 'bar' -- overwrite/specify for instance `one' only
print(one.foo, two.foo, three.foo) --> prints 'bar    foo    foo'

A.foo = 'baz' -- overwrite for all instances without specification
print(one.foo, two.foo, three.foo) --> prints 'bar    baz    baz'
```

`class.`**`init`**(*object*, ...)

Arguments

- **`object`** (*Object*) – The object. Usually `self`.
- `...` (*mixed*) – Arguments to pass to the constructor.

Returns Whatever the parent class constructor returns.

Calls class constructor of a class on an object.

Derived classes should use this function their constructors to initialize the parent class(es) portions of the object.

Example:

```
Class = require 'hump.class'

Shape = Class{
    init = function(self, area)
        self.area = area
    end;
    __tostring = function(self)
        return "area = " .. self.area
    end
}

Rectangle = Class{__includes = Shape,
    init = function(self, width, height)
        Shape.init(self, width * height)
        self.width  = width
        self.height = height
    end;
    __tostring = function(self)
        local strs = {
            "width = " .. self.width,
            "height = " .. self.height,
            Shape.__tostring(self)
        }
        return table.concat(strs, ", ")
    end
}

print( Rectangle(2,4) ) -- prints 'width = 2, height = 4, area = 8'
```

Class:include(*other*)

Arguments

- **other** (*tables*) – Parent classes/mixins.

Returns The class.

Inherit functions and variables of another class, but only if they are not already defined. This is done by (deeply) copying the functions and variables over to the subclass.

Note: `class:include()` doesn't actually care if the arguments supplied are hump classes. Just any table will work.

Note: You can use `Class.include(a, b)` to copy any fields from table `a` to table `b` (see second example).

Examples:

```
Class = require 'hump.class'

Entity = Class{
    init = function(self)
        GameObjects.register(self)
    end
}

Collidable = {
    dispatch_collision = function(self, other, dx, dy)
        if self.collision_handler[other.type])
```

```
            return collision_handler[other.type](self, other, dx, dy)
        end
        return collision_handler["*"](self, other, dx, dy)
    end,

    collision_handler = {["*"] = function() end},
}

Spaceship = Class{
    init = function(self)
        self.type = "Spaceship"
        -- ...
    end
}

-- make Spaceship collidable
Spaceship:include(Collidable)

Spaceship.collision_handler["Spaceship"] = function(self, other, dx, dy)
    -- ...
end
```

```
-- using Class.include()
Class = require 'hump.class'
a = {
    foo = 'bar',
    bar = {one = 1, two = 2, three = 3},
    baz = function() print('baz') end,
}
b = {
    foo = 'nothing to see here...'
}

Class.include(b, a) -- copy values from a to b
                    -- note that neither a nor b are hump classes!

print(a.foo, b.foo) -- prints 'bar    nothing to see here...'

b.baz() -- prints 'baz'

b.bar.one = 10 -- changes only values in b
print(a.bar.one, b.bar.one) -- prints '1    10'
```

class:clone()

Returns A deep copy of the class/table.

Create a clone/deep copy of the class.

Note: You can use `Class.clone(a)` to create a deep copy of any table (see second example).

Examples:

```
Class = require 'hump.class'

point = Class{ x = 0, y = 0 }

a = point:clone()
a.x, a.y = 10, 10
```

```
print(a.x, a.y) --> prints '10    10'

b = point:clone()
print(b.x, b.y) --> prints '0    0'

c = a:clone()
print(c.x, c.y) --> prints '10    10'
```

```
-- using Class.clone() to copy tables
Class = require 'hump.class'
a = {
    foo = 'bar',
    bar = {one = 1, two = 2, three = 3},
    baz = function() print('baz') end,
}
b = Class.clone(a)

b.baz() -- prints 'baz'
b.bar.one = 10
print(a.bar.one, b.bar.one) -- prints '1    10'
```

1.5.2 Caveats

Be careful when using metamethods like `__add` or `__mul`: If a subclass inherits those methods from a superclass, but does not overwrite them, the result of the operation may be of the type superclass. Consider the following:

```
Class = require 'hump.class'

A = Class{init = function(self, x) self.x = x end}
function A:__add(other) return A(self.x + other.x) end
function A:show() print("A:", self.x) end

B = Class{init = function(self, x, y) A.init(self, x) self.y = y end}
function B:show() print("B:", self.x, self.y) end
function B:foo() print("foo") end
B:include(A)

one, two = B(1,2), B(3,4)
result = one + two -- result will be of type A, *not* B!
result:show()       -- prints "A:    4"
result:foo()        -- error: method does not exist
```

Note that while you can define the `__index` metamethod of the class, this is not a good idea: It will break the class mechanism. To add a custom `__index` metamethod without breaking the class system, you have to use `rawget()`. But beware that this won't affect subclasses:

```
Class = require 'hump.class'

A = Class{}
function A:foo() print('bar') end

function A:__index(key)
    print(key)
    return rawget(A, key)
end

instance = A()
```

```
instance:foo() -- prints foo  bar

B = Class{__includes = A}
instance = B()
instance:foo() -- prints only foo
```

1.6 hump.signal

```
Signal = require 'hump.signal'
```

A simple yet effective implementation of Signals and Slots, aka the Observer pattern: Functions can be dynamically bound to signals. When a *signal* is *emitted*, all registered functions will be invoked. Simple as that.

`hump.signal` makes things a little more interesing by allowing to emit all signals that match a Lua string pattern.

Example:

```
-- in AI.lua
signals.register('shoot', function(x,y, dx,dy)
    -- for every critter in the path of the bullet:
    -- try to avoid being hit
    for critter in pairs(critters) do
        if critter:intersectsRay(x,y, dx,dy) then
            critter:setMoveDirection(-dy, dx)
        end
    end
end)

-- in sounds.lua
signals.register('shoot', function()
    Sounds.fire_bullet:play()
end)

-- in main.lua
function love.keypressed(key)
    if key == ' ' then
        local x,y   = player.pos:unpack()
        local dx,dy = player.direction:unpack()
        signals.emit('shoot', x,y, dx,dy)
    end
end
```

1.6.1 Function Reference

`Signal.new()`

Returns A new signal registry.

Creates a new signal registry that is independent of the default registry: It will manage it's own list of signals and does not in any way affect the the global registry. Likewise, the global registry does not affect the instance.

Note: If you don't need multiple independent registries, you can use the global/default registry (see examples).

Example:

```
player.signals = Signal.new()
```

Signal.**register**(*s*, *f*)

Arguments

- **s** (*string*) – The signal identifier.
- **f** (*function*) – The function to register.

Returns A function handle to use in *Signal.remove()*.

Registers a function `f` to be called when signal `s` is emitted.

Examples:

```
Signal.register('level-complete', function() self.fanfare:play() end)
```

```
handle = Signal.register('level-load', function(level) level.show_help() end)
```

```
menu:register('key-left', select_previous_item)
```

Signal.**emit**(*s*, ...)

Arguments

- **s** (*string*) – The signal identifier.
- **...** (*mixed*) – Arguments to pass to the bound functions. (optional)

Calls all functions bound to signal `s` with the supplied arguments.

Examples:

```
function love.keypressed(key)
    -- using a signal instance
    if key == 'left' then menu:emit('key-left') end
end
```

```
if level.is_finished() then
    -- adding arguments
    Signal.emit('level-load', level.next_level)
end
```

Signal.**remove**(*s*, ...)

Arguments

- **s** (*string*) – The signal identifier.
- **...** (*functions*) – Functions to unbind from the signal.

Unbinds (removes) functions from signal `s`.

Example:

```
Signal.remove('level-load', handle)
```

Signal.**clear**(*s*)

Arguments

- **s** (*string*) – The signal identifier.

Removes all functions from signal `s`.

Example:

```
Signal.clear('key-left')
```

`Signal.`**`emitPattern`**(*p*, ...)

Arguments

- **p** (*string*) – The signal identifier pattern.
- **...** (*mixed*) – Arguments to pass to the bound functions. (optional)

Emits all signals that match a Lua string pattern.

Example:

```
-- emit all update signals
Signal.emitPattern('^update%-.*', dt)
```

`Signal.`**`removePattern`**(*p*, ...)

Arguments

- **p** (*string*) – The signal identifier pattern.
- **...** (*functions*) – Functions to unbind from the signals.

Removes functions from all signals that match a Lua string pattern.

Example:

```
Signal.removePattern('key%-.*', play_click_sound)
```

`Signal.`**`clearPattern`**(*p*)

Arguments

- **p** (*string*) – The signal identifier pattern.

Removes **all** functions from all signals that match a Lua string pattern.

Examples:

```
Signal.clearPattern('sound%-.*')
```

```
player.signals:clearPattern('.*') -- clear all signals
```

1.7 hump.camera

```
Camera = require "hump.camera"
```

A camera utility for LÖVE. A camera can “look” at a position. It can zoom in and out and it can rotate it’s view. In the background, this is done by actually moving, scaling and rotating everything in the game world. But don’t worry about that.

Example:

```
function love.load()
    cam = Camera(player.pos.x, player.pos.y)
end
```

```
function love.update(dt)
    local dx,dy = player.x - cam.x, player.y - cam.y
    cam:move(dx/2, dy/2)
end
```

1.7.1 Function Reference

Camera.**new** (*x*, *y*, *zoom*, *rot*)

Arguments

- **x,y** (*numbers*) – Point for the camera to look at. (optional)
- **zoom** (*number*) – Camera zoom. (optional)
- **rot** (*number*) – Camera rotation in radians. (optional)

Returns A new camera.

Creates a new camera. You can access the camera position using `camera.x, camera.y`, the zoom using `camera.scale` and the rotation using `camera.rot`.

The module variable name can be used at a shortcut to `new()`.

Example:

```
camera = require 'hump.camera'
-- camera looking at (100,100) with zoom 2 and rotated by 45 degrees
cam = camera(100,100, 2, math.pi/2)
```

camera:move (*dx*, *dy*)

Arguments

- **dx,dy** (*numbers*) – Direction to move the camera.

Returns The camera.

Move the camera *by* some vector. To set the position, use *camera:lookAt()*.

This function is shortcut to `camera.x,camera.y = camera.x+dx, camera.y+dy`.

Examples:

```
function love.update(dt)
    camera:move(dt * 5, dt * 6)
end
```

```
function love.update(dt)
    camera:move(dt * 5, dt * 6):rotate(dt)
end
```

camera:lookAt (*x*, *y*)

Arguments

- **x,y** (*numbers*) – Position to look at.

Returns The camera.

Let the camera look at a point. In other words, it sets the camera position. To move the camera *by* some amount, use *camera:move()*.

This function is shortcut to `camera.x,camera.y = x, y`.

Examples:

```
function love.update(dt)
    camera:lookAt(player.pos:unpack())
end
```

```
function love.update(dt)
    camera:lookAt(player.pos:unpack()):rotation(player.rot)
end
```

camera:pos()

Returns x,y – Camera position.

Returns `camera.x, camera.y`.

Example:

```
-- let the camera fly!
local cam_dx, cam_dy = 0, 0

function love.mousereleased(x,y)
    local cx,cy = camera:position()
    dx, dy = x-cx, y-cy
end

function love.update(dt)
    camera:move(dx * dt, dy * dt)
end
```

camera:rotate(*angle*)

Arguments

- **angle** (*number*) – Rotation angle in radians

Returns The camera.

Rotate the camera by some angle. To set the angle use *camera:rotateTo()*.

This function is shortcut to `camera.rot = camera.rot + angle`.

Examples:

```
function love.update(dt)
    camera:rotate(dt)
end
```

```
function love.update(dt)
    camera:rotate(dt):move(dt,dt)
end
```

camera:rotateTo(*angle*)

Arguments

- **angle** (*number*) – Rotation angle in radians

Returns The camera.

Set rotation: `camera.rot = angle`.

Example:

```
camera:rotateTo(math.pi/2)
```

camera:zoom(*mul*)

Arguments

- **mul** (*number*) – Zoom change. Should be > 0.

Returns The camera.

Multiply zoom: `camera.scale = camera.scale * mul`.

Examples:

```
camera:zoom(2)    -- make everything twice as big
```

```
camera:zoom(0.5) -- ... and back to normal
```

```
camera:zoom(-1)  -- mirror and flip everything upside down
```

camera:zoomTo(*zoom*)

Arguments

- **zoom** (*number*) – New zoom.

Returns The camera.

Set zoom: `camera.scale = zoom`.

Example:

```
camera:zoomTo(1) -- reset zoom
```

camera:attach()

Start looking through the camera.

Apply camera transformations, i.e. move, scale and rotate everything until `camera:detach()` as if looking through the camera.

Example:

```
function love.draw()
    camera:attach()
    draw_world()
    cam:detach()

    draw_hud()
end
```

camera:detach()

Stop looking through the camera.

Example:

```
function love.draw()
    camera:attach()
    draw_world()
    cam:detach()

    draw_hud()
end
```

camera:draw (*func*)

Arguments

- **func** (*function*) – Drawing function to be wrapped.

Wrap a function between a `camera:attach()`/`camera:detach()` pair. Equivalent to:

```
cam:attach()
func()
cam:detach()
```

Example:

```
function love.draw()
    camera:draw(draw_world)
    draw_hud()
end
```

camera:worldCoords (*x, y*)

Arguments

- **x, y** (*numbers*) – Point to transform.

Returns `x,y` – Transformed point.

Because a camera has a point it looks at, a rotation and a zoom factor, it defines a coordinate system. A point now has two sets of coordinates: One defines where the point is to be found in the game world, and the other describes the position on the computer screen. The first set of coordinates is called world coordinates, the second one camera coordinates. Sometimes it is needed to convert between the two coordinate systems, for example to get the position of a mouse click in the game world in a strategy game, or to see if an object is visible on the screen.

camera:worldCoords() and *camera:cameraCoords()* transform points between these two coordinate systems.

Example:

```
x,y = camera:worldCoords(love.mouse.getPosition())
selectedUnit:plotPath(x,y)
```

camera:cameraCoords (*x, y*)

Arguments

- **x, y** (*numbers*) – Point to transform.

Returns `x,y` – Transformed point.

Because a camera has a point it looks at, a rotation and a zoom factor, it defines a coordinate system. A point now has two sets of coordinates: One defines where the point is to be found in the game world, and the other describes the position on the computer screen. The first set of coordinates is called world coordinates, the second one camera coordinates. Sometimes it is needed to convert between the two coordinate systems, for example to get the position of a mouse click in the game world in a strategy game, or to see if an object is visible on the screen.

camera:worldCoords() and *camera:cameraCoords()* transform points between these two coordinate systems.

Example:

```
x,y = cam:cameraCoords(player.pos)
love.graphics.line(x, y, love.mouse.getPosition())
```

camera:mousepos ()

Returns Mouse position in world coordinates.

Shortcut to `camera:worldCoords(love.mouse.getPosition())`.

Example:

```
x,y = camera:mousepos()
selectedUnit:plotPath(x,y)
```

1.7.2 Camera Movement Control

Camera movement is one of these things that go almost unnoticed when done well, but add a lot to the overall experience. The article Scroll Back: The Theory and Practice of Cameras in SideScrollers by Itay Keren gives a lot of insight into how to design good camera systems.

hump.camera offers functions that help to implement most of the techniques discussed in the article. The functions *camera:lockX()*, *camera:lockY()*, *camera:lockPos()*, and *camera:lockWindow()* move the camera so that the interesting content stays in frame. Note that the functions must be called every frame:

```
function love.update()
   -- vertical locking
   cam:lockX(player.pos.x)
end
```

All movements are subject to smoothing (see *Movement Smoothers*). You can specify a default movement smoother by assigning the variable *camera.smoother*:

```
cam.smoother = Camera.smooth.linear(100)
```

camera:lockX(*x*, *smoother*, *...*)

Arguments

- **x** (*number*) – X coordinate (in world coordinates) to lock to.
- **smoother** (*function*) – Movement smoothing override. (optional)
- **...** (*mixed*) – Additional parameters to the smoothing function. (optional)

Horizontal camera locking: Keep the camera locked on the defined `x`-position (in *world coordinates*). They `y`-position is not affected.

You can define an off-center locking position by "aiming" the camera left or right of your actual target. For example, to center the player 20 pixels to the *left* of the screen, aim 20 pixels to it's *right* (see examples).

Examples:

```
-- lock on player vertically
cam:lockX(player.x)
```

```
-- ... with linear smoothing at 25 px/s
cam:lockX(player.x, Camera.smooth.linear(25))
```

```
-- lock player 20px left of center
cam:lockX(player.x + 20)
```

camera:lockY(*y*, *smoother*, *...*)

Arguments

- **y** (*number*) – Y coordinate (in world coordinates) to lock to.

- **smoother** (*function*) – Movement smoothing override. (optional)
- **...** (*mixed*) – Additional parameters to the smoothing function. (optional)

Vertical camera locking: Keep the camera locked on the defined y-position (in *world coordinates*). They x-position is not affected.

You can define an off-center locking position by "aiming" the camera above or below your actual target. For example, to center the player 20 pixels *below* the screen center, aim 20 pixels *above* it (see examples).

Examples:

```
-- lock on player horizontally
cam:lockY(player.y)
```

```
-- ... with damped smoothing with a stiffness of 10
cam:lockY(player.y, Camera.smooth.damped(10))
```

```
-- lock player 20px below the screen center
cam:lockY(player.y - 20)
```

camera:lockPos (*x*, *y*, *smoother*, *...*)

Arguments

- **x,y** (*numbers*) – Position (in world coordinates) to lock to.
- **smoother** (*function*) – Movement smoothing override. (optional)
- **...** (*mixed*) – Additional parameters to the smoothing function. (optional)

Horizontal and vertical camera locking: Keep the camera locked on the defined position (in *world coordinates*).

You can define an off-center locking position by "aiming" the camera to the opposite direction away from your real target. For example, to center the player 10 pixels to the *left* and 20 pixels *above* the screen center, aim 10 pixels to the *right* and 20 pixels *below*.

Examples:

```
-- lock on player
cam:lock(player.x, player.y)
```

```
-- lock 50 pixels into player's aiming direction
cam:lockY(player.x - player.aiming.x * 50, player.y - player.aiming.y * 50)
```

camera:lockWindow (*x*, *y*, *x_min*, *x_max*, *y_min*, *y_max*, *smoother*, *...*)

Arguments

- **x,y** (*numbers*) – Position (in world coordinates) to lock to.
- **x_min** (*numbers*) – Upper left X coordinate of the camera window *(in camera coordinates!)*.
- **x_max** (*numbers*) – Lower right X coordinate of the camera window *(in camera coordinates!)*.
- **y_min** (*numbers*) – Upper left Y coordinate of the camera window *(in camera coordinates!)*.
- **y_max** (*numbers*) – Lower right Y coordinate of the camera window *(in camera coordinates!)*.
- **smoother** (*function*) – Movement smoothing override. (optional)

- `...` (*mixed*) – Additional parameters to the smoothing function. (optional)

The most powerful locking method: Lock camera to `x,y`, but only move the camera if the position would be out of the screen-rectangle defined by `x_min`, `x_max`, `y_min`, `y_max`.

Note: The locking window is defined in camera coordinates, whereas the position to lock to is defined in world coordinates!

All of the other locking methods can be implemted by window locking. For position locking, set `x_min = x_max` and `y_min = y_max`. Off-center locking can be done by defining the locking window accordingly.

Examples:

```
-- lock on player
cam:lock(player.x, player.y)
```

`camera.`**`smoother`**

The default smoothing operator. Must be a `function` with the following prototype:

```
function customSmoother(dx,dy, ...)
    do_stuff()
    return new_dx,new_dy
end
```

where `dx,dy` is the offset the camera would move before smoothing and `new_dx, new_dy` is the offset the camera should move after smoothing.

Movement Smoothers

It is not always desirable that the camera instantly locks on a target. Platform snapping, for example, would look terrible if the camera would instantly jump to the focussed platform. Smoothly moving the camera to the locked position can also give the illusion of a camera operator an add to the overall feel of your game.

hump.camera allows to smooth the movement by either passing movement smoother functions to the locking functions or by setting a default smoother (see *`camera.smoother`*).

Smoothing functions must have the following prototype:

```
function customSmoother(dx,dy, ...)
    do_stuff()
    return new_dx,new_dy
end
```

where `dx,dy` is the offset the camera would move before smoothing and `new_dx, new_dy` is the offset the camera should move after smoothing.

This is a simple "rubber-band" smoother:

```
function rubber_band(dx,dy)
    local dt = love.timer.getDelta()
    return dx*dt, dy*dt
end
```

hump.camera defines generators for the most common smoothers:

`Camera.smooth.`**`none`**`()`

Returns Smoothing function.

Dummy smoother: does not smooth the motion.

Example:

```
cam.smoother = Camera.smooth.none()
```

`Camera.smooth.`**`linear`**`(`*speed*`)`

Arguments

- **`speed`** (*number*) – Smoothing speed.

Returns Smoothing function.

Smoothly moves the camera towards to snapping goal with constant speed.

Examples:

```
cam.smoother = Camera.smooth.linear(100)
```

```
-- warning: creates a function every frame!
cam:lockX(player.x, Camera.smooth.linear(25))
```

`Camera.smooth.`**`damped`**`(`*stiffness*`)`

Arguments

- **`stiffness`** (*number*) – Speed of the camera movement.

Returns Smoothing function.

Smoothly moves the camera towards the goal with a speed proportional to the distance to the target. Stiffness defines the speed of the motion: Higher values mean that the camera moves more quickly.

Examples:

```
cam.smoother = Camera.smooth.damped(10)
```

```
-- warning: creates a function every frame!
cam:lockPos(player.x, player.y, Camera.smooth.damped(2))
```

1.8 License

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CHAPTER 2

Get hump

You can view and download the individual modules on github: vrld/hump. You may also download the whole packed sourcecode either in the zip or tar format.

Using Git, you can clone the project by running:

```
git clone git://github.com/vrld/hump
```

Once done, tou can check for updates by running

```
git pull
```

CHAPTER 3

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