PV259
Generative Design Programing

Week 5

Vectors and motion

MUNI FI

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Ciele, štruktúra hodiny

ciele:

- vysvetlit 2 funkcie vektorov v programovaní:
  - kontajner 2 hodnot s rovnakym pôvodom => čistota kodu
  - matematicke operacie sluziace na pohyb

    “However, using vectors will help organize your code and provide a set of methods for common mathematical operations you’ll need over and over and over again while programming motion.”
- zopakovať fyzikálny princíp polohy, rýchlosti a zrychlenia pre potreby pohybu
- zaviest principy pohybu v p5 pre potreby buducich 2 tyzdnov - tam bude ich lepsie použitie (agenti, motion design, pendulums, flowfield, typografia)
- implementácia hry s pohybom

štruktura:

1. preco vektory
2. vektory v p5
3. pohyb
   a. poloha
   b. rychlost
   c. zrychlenie
4. catch me if u can
5. game jam

Introduction

-paci sa mi DS pohlad na to, preco vlastne potrebujeme novu syntakticku konstrukciu - vektor => kvoli prehladnosti. na tomto slide preto by som dal snippet 2 kodov, ktore ukazuju, ze pouzitie cisto premennych dokaze kod skomplikovat.
https://natureofcode.com/vectors/#the-point-of-vectors

3 moznosti pre prednasku:

a) na prednaske iba ilustrovat priamo na kode, nepisat ho.
b) napisat simple kod ako napr. **Bouncing Ball with No Vectors**
    1. najprv pohyb
    2. potom rychlost
    3. potom 3D? friction?

    to bude dobre preto, aby sme sa k tomu vratili pri posune v teme. Nasledne si totiz predstavime prepis tohto kodu na pohybovy vektor, potom pre rýchlostny.
c) nechat napisat simple kod na rozcvicku im - simple bouncing ball. Nasledne na tom ilustrovat problemy.

Feedbacks

Yes, we read them.

- cool project examples: http://www.generative-gestaltung.de/2/
- playlist: https://open.spotify.com/playlist/6X185BlQApNN7mjiFFhPdi?si=34bd5ec6294d4281

Bouncing ball

Create a ball that moves straight and bounces at a reflection angle when it meets the edge of the canvas.

Ensure the ball moves quicker to the left than to the right.

Just a pinch of adjustment...

Replace the ball with something else.

Use this code

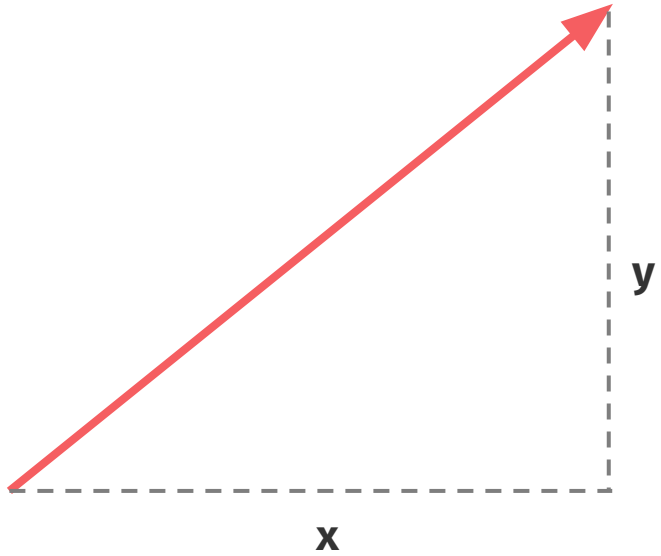
Vectors in P5

p5.Vector

- Can represent: position, velocity, acceleration, force, ...
- Useful simplification of math operations.

Creating a vector object :

```
const v = createVector(x, y, [z])
// v.x returns x coordinate
// v.y returns y coordinate
/*
You could use new p5.Vector(x, y) instead,
however the p5 documentation recommends
createVector(x, y).
*/
```



p5.Vector Methods

- Some **non-static** methods change the vector object from which they are called.
- There are **static** equivalents which return a new vector object.
- They generally take scalars, other vector objects, and arrays as arguments.

p5 reference

Quick overview :

```
v.add(u)
w = p5.Vector.add(u, v)
sub(), mult(), div(), rem() //modulo

v.limit(magnitude)
length = v.mag()
v.setMag(magnitude)
distance = p5.Vector.dist(u, v)
w = p5.Vector.lerp(u, v, amount)
```

```
v.set(x, y)
w = v.copy()
v.rotate(angle)
v.angleBetween(u)
s = p5.Vector.dot(u, v)
w = p5.Vector.cross(u, v)
w = p5.Vector.random2D()
w = p5.Vector.slerp(u, v, amount)
// also interpolates magnitude
```

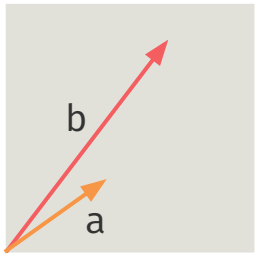
Motion

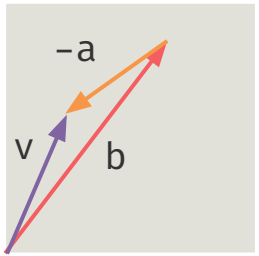
Position (vector), Displacement (vector)

position

- = location of an object with respect to time
- = a vector which starts at the origin and is directed towards point of interest
  (it expresses both the *distance* of the point from the origin and its *direction* from the origin)
- used to help us find the location of one object relative to another object = *displacement*

v = b - a





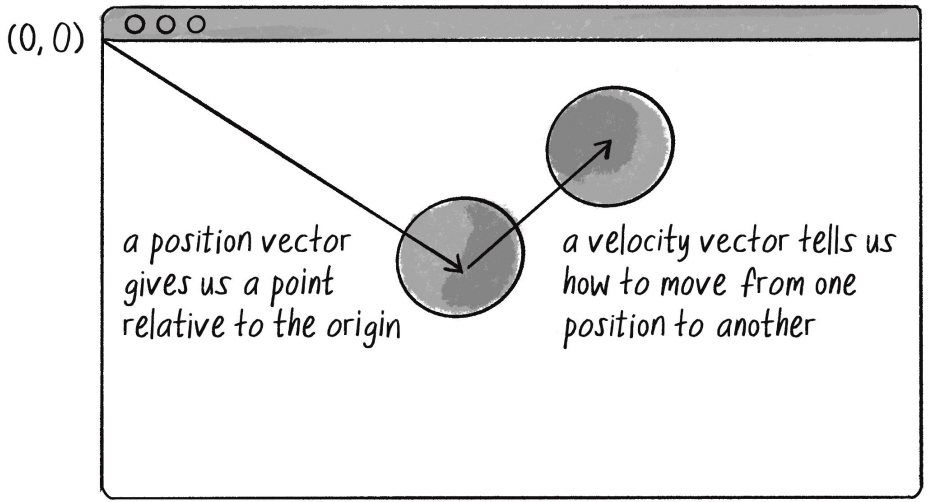
displacement

- = the change in position of an object
- = a vector with the shortest distance between initial and final position of a point undergoing motion

Velocity

- the rate of change of the object's position with respect to time.
- basic algorithm for motion:

position = position + velocity



Nature of Code, Ch. 1, Fig. 1.4

Rewrite the bouncing ball exercise using vectors.

Acceleration

- the rate of change of velocity
- advanced algorithm for motion:

    1. velocity = velocity + acceleration
    2. position = position + velocity

- [from The nature of Code]

    “... acceleration doesn’t merely refer to speeding up or slowing down. Rather, as this example has shown, it refers to any change in velocity—magnitude or direction. “

- smoother motion is a result of a more indirect change in position

Add acceleration to the ball.
Convert code to the class named Ball.

Basic kinematic variables (recap)

Position

poznamky

iamge

mozno prec

Velocity

poznamky

iamge

Acceleration

poznamky

iamge

Catch me if you can

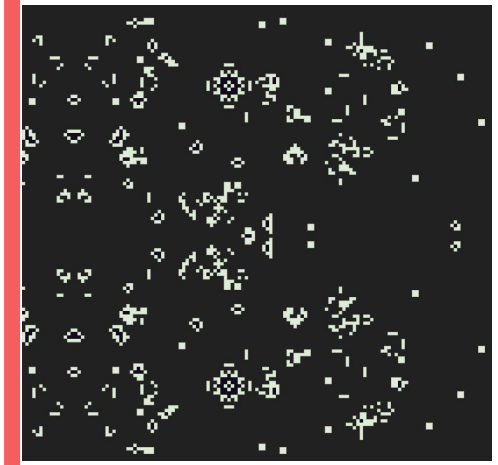
Make the ball accelerate towards the current mouse position.

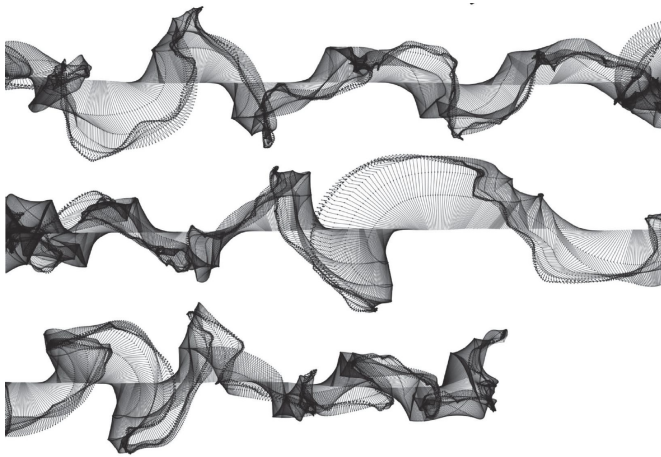
Taken from: The Nature Of Code

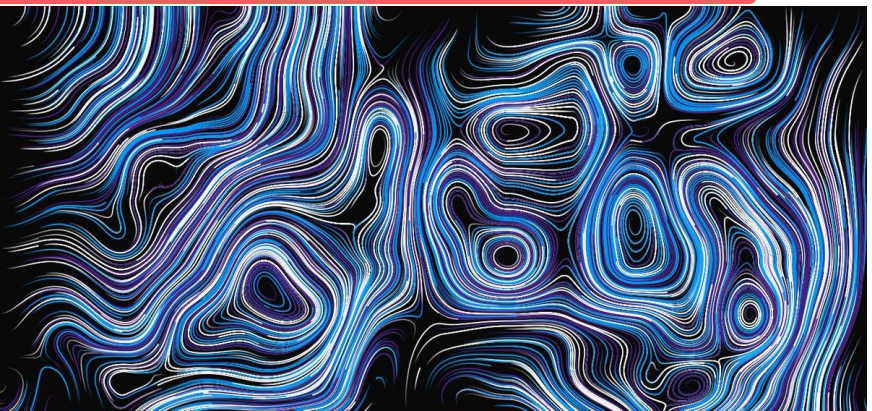
Exercise 1.5

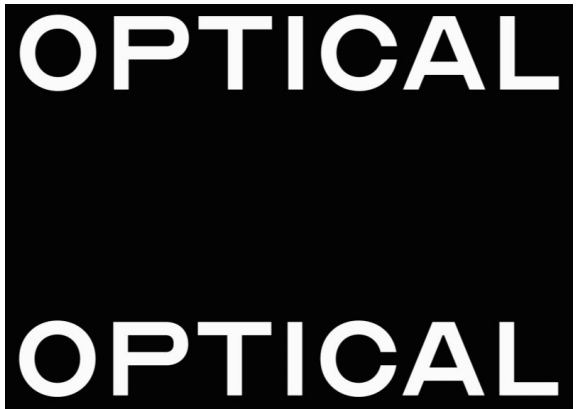
Create a simulation of an object (think about a vehicle) that accelerates when you press the up arrow and brakes when you press the down arrow.

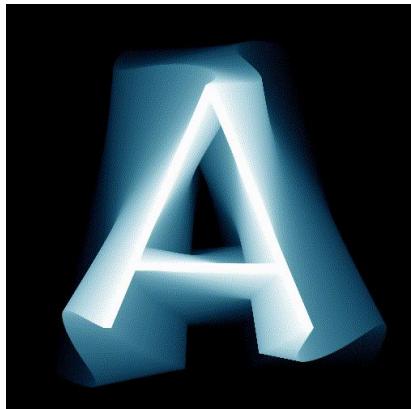
p5.Vector Applications







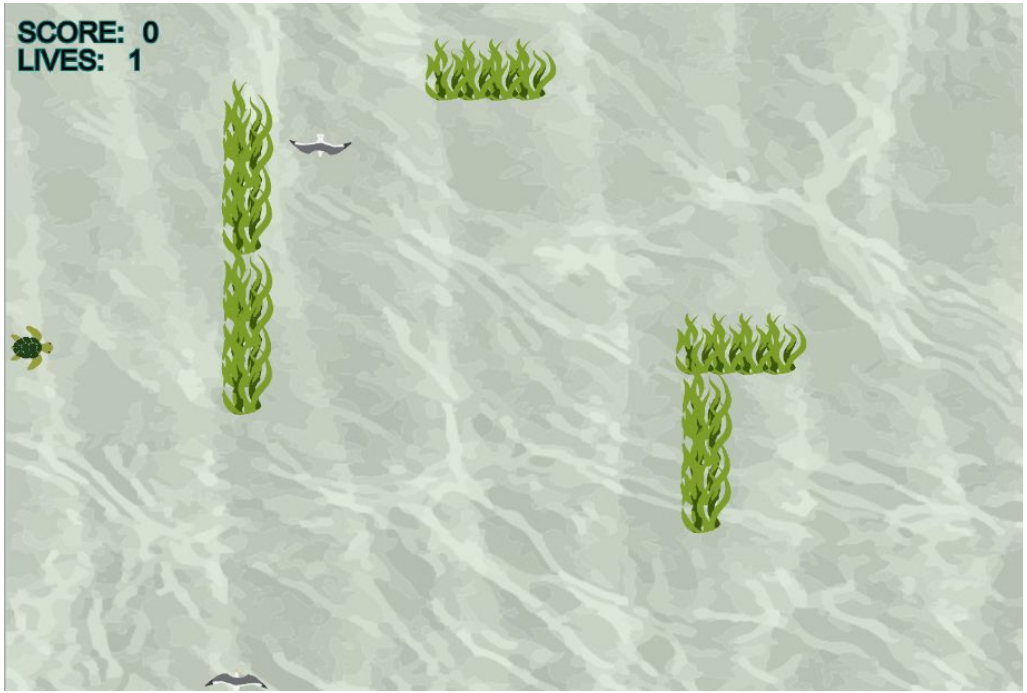




p5 games

p5.js games collection

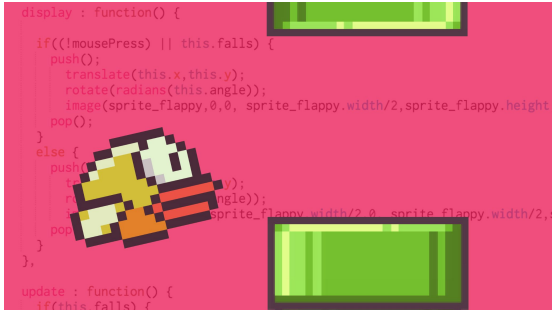
by: skgmmt



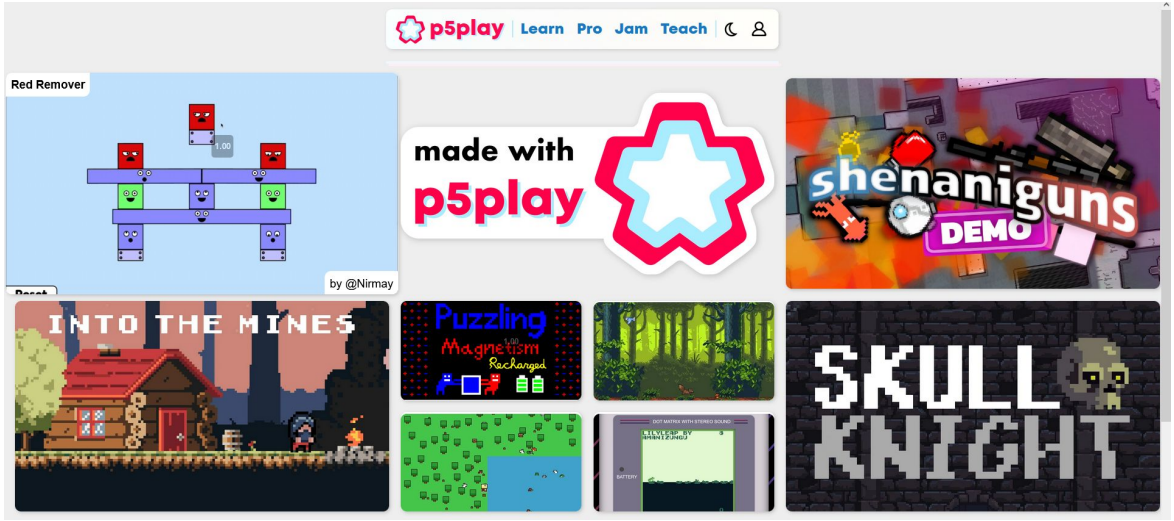
by: 2sman

Games inspirations

by: Flappy.p5 →



↓ by: p5play



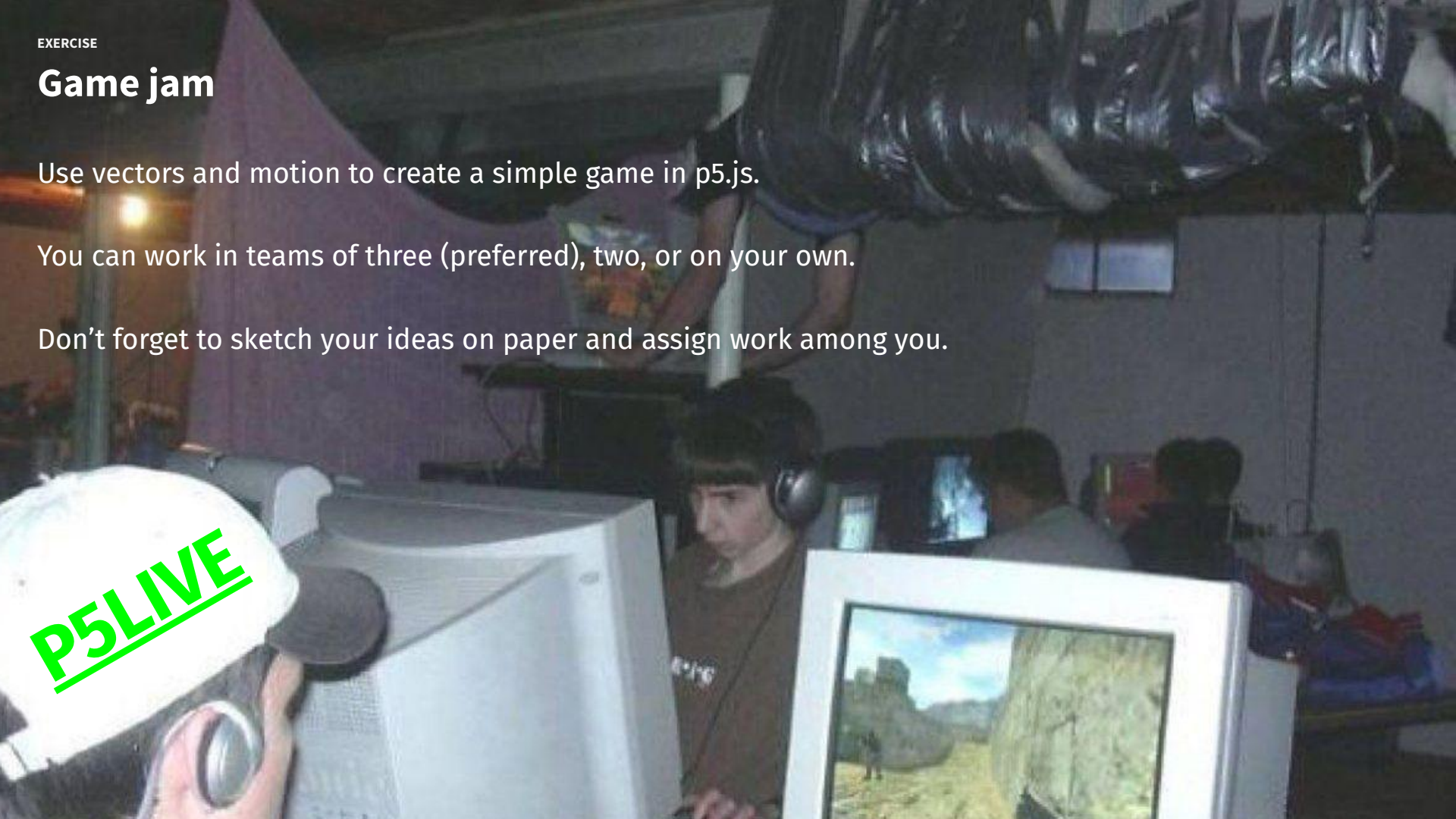
EXERCISE

Game jam

Use vectors and motion to create a simple game in p5.js.

You can work in teams of three (preferred), two, or on your own.

Don’t forget to sketch your ideas on paper and assign work among you.



Prototyp 2024 invitation

Use vectors and motion to create a simple game in p5.js.

You can work in teams of three (preferred), two, or on your own.

Don’t forget to sketch your ideas on paper and assign work among you.

Drawing with a simple pendulum

Also taken from Daniel Shiffman, but modified a tiny bit

Example code

toto bude mozno vhodne do dalsieho tyzdna, tam su pendulums popisane

Motion around us

Choose one of the following exercises and implement it yourself:
https://chatgpt.com/share/6715acbd-94d8-8012-bc0f-b3cb3ee8005b

Sources

Bouncing ball :

The Nature of Code, Chapter 1: Vectors

Linear interpolation :

lerp() in p5.js by Patt Vira

Feedback questions

Did you enjoy working in P5.LIVE?

?