# Piscine iOS Swift - Day 06

## MotionCube

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*Summary: This document contains the subject for Day 06 for the „Piscine iOS Swift" from 42*

# Contents

# Chapter I

# Foreword

Here is the world of **Poincaré** from the *Science and Hypothesis* book, chapter 4 :

Suppose, for example, a world enclosed in a large sphere and subject to the following laws:

—The temperature is not uniform; it is greatest at the centre, and gradually decreases as we move towards the circumference of the sphere, where it is absolute zero.

The law of this temperature is as follows: If R be the radius of the sphere, and r the distance of the point considered from the centre, the absolute temperature will be proportional to $R^2$-$r^2$.

Further, I shall suppose that in this world all bodies have the same co-efficient of dilatation, so that the linear dilatation of any body is proportional to its absolute temperature..

Finally, I shall assume that a body transported from one point to another of different temperature is instantaneously in thermal equilibrium with its new environment.

There is nothing in these hypotheses either contradictory or unimaginable.

A moving object will become smaller and smaller as it approaches the circumference of the sphere.

Let us observe, in the first place, that although from the point of view of our ordinary geometry this world is finite, to its inhabit ants it will appear infinite.

As they approach the surface of the sphere they become colder, and at the same time smaller and smaller. The steps they take are therefore also smaller and smaller, so that they can never reach the boundary of the sphere.

If to us geometry is only the study of the laws according to which invariable solids move, to these imaginary beings it will be the study of the laws of motion of solids deformed by the differences of temperature alluded to.

No doubt, in our world, natural solids also experience variations of form and volume due to differences of temperature.

But in laying the foundations of geometry we neglect these variations; for besides being but small they are irregular, and consequently appear to us to be accidental.

In our hypothetical world this will no longer be the case, the variations will obey very simple and regular laws. On the other hand, the different solid parts of which the bodies of these inhabitants are composed will undergo the same variations of form and volume.

Let me make another hypothesis: suppose that light passes through media of different refractive indices, such that the index of refraction is inversely proportional to $R^2$-$r^2$.

Under these conditions it is clear that the rays of light will no longer be rectilinear but circular.

To justify what has been said, we have to prove that certain changes in the position of external objects may be corrected by correlative movements of the beings which inhabit this imaginary world; and in such a way as to restore the primitive aggregate of the impressions experienced by these sentient beings. Suppose, for example, that an object is displaced and deformed, not like an invariable solid, but like a solid subjected to unequal dilatations in exact conformity with the law of temperature assumed above. To use an abbreviation, we shall call such a movement a non-Euclidean displacement.

If a sentient being be in the neighbourhood of such a displacement of the object, his impressions will be modified; but by moving in a suitable manner, he may reconstruct them. For this purpose, all that is required is that the aggregate of the sentient being and the object, considered as forming a single body, shall experience one of those special displacements which I have just called non-Euclidean. This is possible if we suppose that the limbs of these beings dilate according to the same laws as the other bodies of the world they inhabit.

Although from the point of view of our ordinary geometry there is a deformation of the bodies in this displacement, and although their different parts are no longer in the same relative position, nevertheless we shall see that the impressions of the sentient being remain the same as before; in fact, though the mutual distances of the different parts have varied, yet the parts which at first were in contact are still in contact. It follows that tactile impressions will be unchanged.

On the other hand, from the hypothesis as to refraction and the curvature of the rays of light, visual impressions will also be unchanged. These imaginary beings will therefore be led to classify the phenomena they observe, and to distinguish among them the "changes of position" which may be corrected by a voluntary correlative movement, just as we do.

If they construct a geometry, it will not be like ours, which is the study of the movements of our invariable solids; it will be the study of the changes of position which they will have thus distinguished, and will be "non-Euclidean displacements," and this will be non-Euclidean geometry. So that beings like ourselves, educated in such a world, will not have the same geometry as ours.

The World of Four Dimensions.—Just as we have pictured to ourselves a non-Euclidean world, so we may picture a world of four dimensions.

The sense of light, even with one eye, together with the muscular sensations relative to the movements of the eyeball, will suffice to enable us to conceive of space of three dimensions.

The images of external objects are painted on the retina, which is a plane of two dimensions; these are perspectives.

But as eye and objects are movable, we see in succession different perspectives of the same body taken from different points of view. We find at the same time that the transition from one perspective to another is often accompanied by muscular sensations.

If the transition from the perspective A to the perspective B, and that of the perspective Aʹto the perspective Bʹare accompanied by the same muscular sensations, we connect them as we do other operations of the same nature.

Then when we study the laws according to which these operations are combined, we see that they form a group, which has the same structure as that of the movements of invariable solids.

Now, we have seen that it is from the properties of this group that we derive the idea of geometrical space and that of three dimensions. We thus understand how these perspectives gave rise to the conception of three dimensions, although each perspective is of only two dimensions,—because they succeed each other according to certain laws. Well, in the same way that we draw the perspective of a three-dimensional figure on a plane, so we can draw that of a four-dimensional figure on a canvas of three (or two) dimensions. To a geometer this is but child's play.

We can even draw several perspectives of the same figure from several different points of view. We can easily represent to ourselves these perspectives, since they are of only three dimensions.

Imagine that the different perspectives of one and the same object to occur in succession, and that the transition from one to the other is accompanied by muscular sensations.

It is understood that we shall consider two of these transitions as two operations of the same nature when they are associated with the same muscular sensations.

There is nothing, then, to prevent us from imagining that these operations are combined according to any law we choose—for instance, by forming a group with the same structure as that of the movements of an invariable four-dimensional solid.

In this there is nothing that we cannot represent to ourselves, and, moreover, these sensations are those which a being would experience who has a retina of two dimensions, and who may be displaced in space of four dimensions. In this sense we may say that we can represent to ourselves the fourth dimension.

Conclusions.—It is seen that experiment plays a considerable rôle in the genesis of geometry; but it would be a mistake to conclude from that that geometry is, even in part, an experimental science.

If it were experimental, it would only be approximative and provisory.

And what a rough approximation it would be! Geometry would be only the study of the movements of solid bodies; but, in reality, it is not concerned with natural solids: its object is certain ideal solids, absolutely invariable, which are but a greatly simplified and very remote image of them.

The concept of these ideal bodies is entirely mental, and experiment is but the opportunity which enables us to reach the idea. The object of geometry is the study of a particular "group"; but the general concept of group pre-exists in our minds, at least potentially.

It is imposed on us not as a form of our sensitiveness, but as a form of our understanding; only, from among all possible groups, we must choose one that will be the standard, so to speak, to which we shall refer natural phenomena.

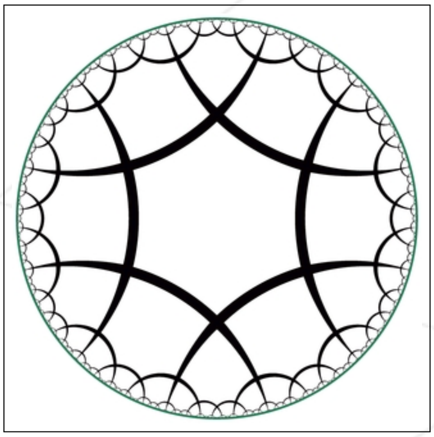
Experiment guides us in this choice, which it does not impose on us.

It tells us not what is the truest, but what is the most convenient geometry.

It will be noticed that my description of these fantastic worlds has required no language other than that of ordinary geometry.

Then, were we transported to those worlds, there would be no need to change that language.

Beings educated there would no doubt find it more convenient to create a geometry different from ours, and better adapted to their impressions; but as for us, in the presence of the same impressions, it is certain that we should not find it more convenient to make a change.



# Chapter II

# General Instructions

- Only this document will serve as reference. Do not trust rumors.
- Read carefully the whole subject before beginning.
- Watch out! This document could potentially change up to an hour before submission.
- This project will be corrected by humans only.
- The document can be relied upon, do not blindly trust the demos which can contain unrequired additions.
- You will have to submit one app every day (except for Day 01) on your git repository, submit the folder of the Xcode project.
- Here it is the official manual of Swift and of Swift Standard Library
- It is forbidden to use other libraries, packages, pods, etc. before Day 07
- Got a question ? Ask your peer on the right. Otherwise, try your peer on the left.
- You can discuss on the Piscine forum of your Intra !
- By Odin, by Thor ! Use your brain !!!

> The videos on Intra were produced before Swift 3. Remove the prefix "NS" which you see in front of the class/struct/function in the code in the videos in order to use them in Swift 3.

Intra indicates the date and the hour of closing for your repositories. This date and hour also corresponds to the beginning of the peer-evaluation period for the corresponding piscine day. This peer-evaluation period lasts exactly 24h. After 24h passed, your missing peer grades will be completed with 0.

# Chapter III

# Introduction

Have you ever heard “Don’t put your fingers on the screen!”? Of course today this sentence will have no sense. The disappearence of keyboard in favour of touch screens allows application to expend their interface to not be limited by keyboard keys anymore. As a matter of fact, when you used to play snake on a nokia 3310, we just need 4 keys to direct the snake, everything else is useless.

Apple also equiped their devices with different sensors such as an accelerometer, a gyroscope, proximity sensor or a barometer.

Therefore it is possible to retrieve user input or environment data thanks to the screen and the device’s sensors.

Today you will learn hos to use the **UIGestureRecognizer**, to retrieve user’s acctions on the screem as well as **CoreMotion** to get the orientation of the device in an application that will allow you to play with small squares and small circles. This shapes will be subject to the laws of physics like gravity, elasticity and collision using a**UIDynamicAnimator**.

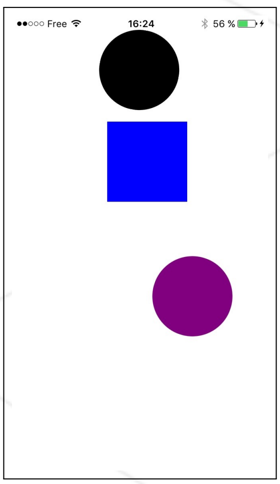
# Chapter IV

# Exercise 00 : TapGesture

| | |
|---|---|
| | Exercice : 00 |
| TapGesture | |
| Files to turn in : `.xcodeproj and all the necessary files` | |
| Allowed functions : `Swift Standard Library, UIKit` | |
| Notes : `n/a` | |

The aim of this exercise is to be able to add a shape in a empty view by touching the screen. For this, you have to create a class that inherits the **UIView** class which will represent a shape.

- Its shape must be either a square either a circle.
- Its size must be 100 x 100.
- Its shape and color must be random.
- When touching the screen, the shape must appear under our finger.



# Chapter V

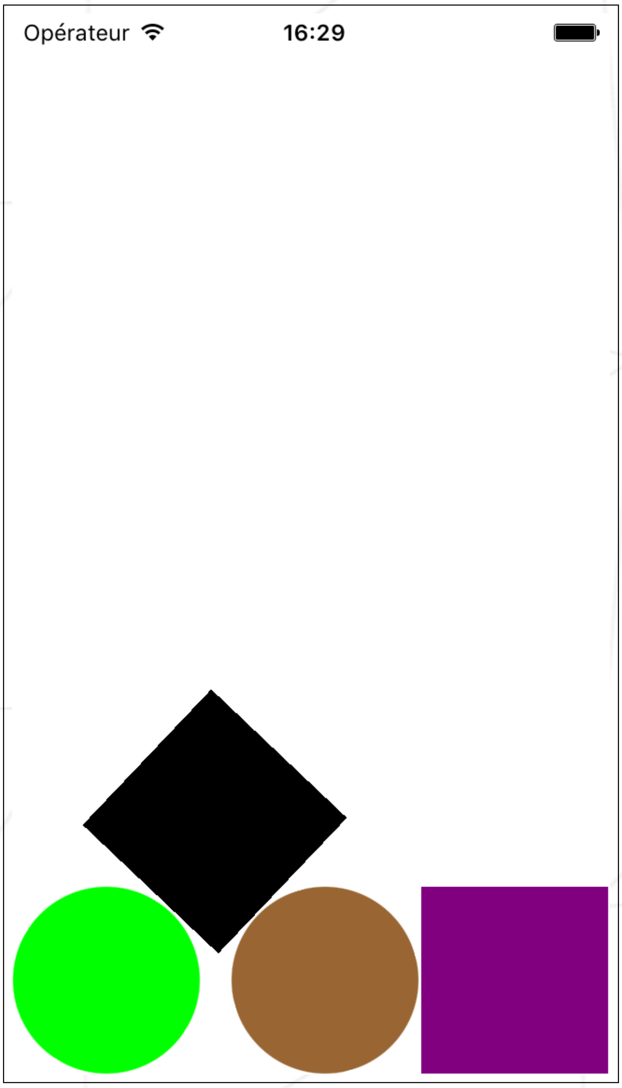
# Exercise 02 : Dynamic Behavior

| Exercice : 02 |
|---|
| Dynamic Behavior |
| Files to turn in : `.xcodeproj and all the necessary files` |
| Allowed functions : `Swift Standard Library, UIKit` |
| Notes : `n/a` |

Add a little bit of physics to your shapes. They must be subject to several **UIDynamicBehavior** :

- Fall under the effect of gravity.
- Collision cannot make them go out of their “superview”.
- Have an elasticity effect, they must rebound.

> `Shapes must rebound on the border of the screen, they cannot disappear.`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# Chapter VI

# Exercise 04 : Gestures

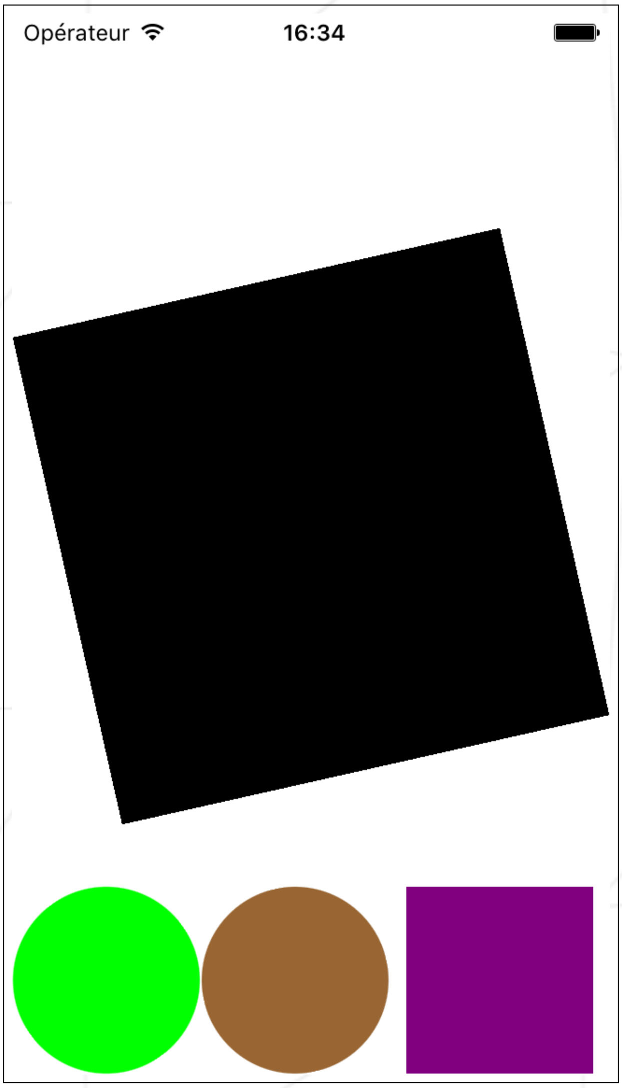
| | |
|---|---|
| | Exercice : 04 |
| Gestures | |
| Files to turn in : `.xcodeproj and all the necessary files` | |
| Allowed functions : `Swift Standard Library, UIKit` | |
| Notes : `n/a` | |

Interaction with those shapes would be fun!

Now add some **Gesture** to your shapes:

- **UIPanGestureRecognizer** to move them.
- **UIPinchGestureRecognizer** to enlarge or reduce them.
- **UIRotationGesture** to rotate them.

`When you interact with a shape, you must remove its gravity effect but not its collision or elasticity effect. When you release the shape, it must be subject to gravity again.`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# Chapter VII

# Exercise 06 : CoreMotion

| | Exercice : 06 |
|---|---|
| CoreMotion | |
| Files to turn in : `.xcodeproj and all the necessary files` | |
| Allowed functions : `Swift Standard Library, UIKit, CoreMotion` | |
| Notes : `n/a` | |

In the project's settings, only allow portrait mode.

You now have to modify the gravity vector depending on the accelerometer data using the **CoreMotion**. Shapes must fall in the different directions depending on the orientation of the device.

> The iOS simulator doens't allow you yet to simulate sensor's data therefore it is advised to test this app on a real Apple device. If you don't have one, don't panic, as to your peers to lend one to you. If you really couldn't find any Apple device, don't worry too much, this exercise is quite simple and p2p will not take it into consideration.