

Python & PixelPAD

Introduction to App Dev with PixelPAD

FIRST Robotics Canada

Castle Crashers Tutorial





Table of Contents

Getting Started.....	4
What is PixelPAD?	4
Scripts.....	6
Scripts	6
The Game Script.....	7
Default Object Properties.....	8
Sprite, sprite_height and sprite_width.....	8
X, Y and Z Coordinates.....	8
DOT Notation and Self.....	9
Dot Notation.....	9
The “Self” Property	9
Collisions.....	10
What are collisions?	10
The collision_check function	10
Bounding Boxes.....	11
Bounding Boxes	11
Destroying Objects	12
Destroying Objects.....	12
The Start and Loop.....	13
The Start and the Loop Tabs	13
The Game Loop.....	13
Loops.....	14
How Do We Use the Game Loop?	14
Conditionals.....	15
Conditionals	15
Indentation in Python	16
Indentation.....	16
Key Press.....	17
Comparisons	18
Comparisons	18
Adding Boundaries Example.....	19
Comments	21

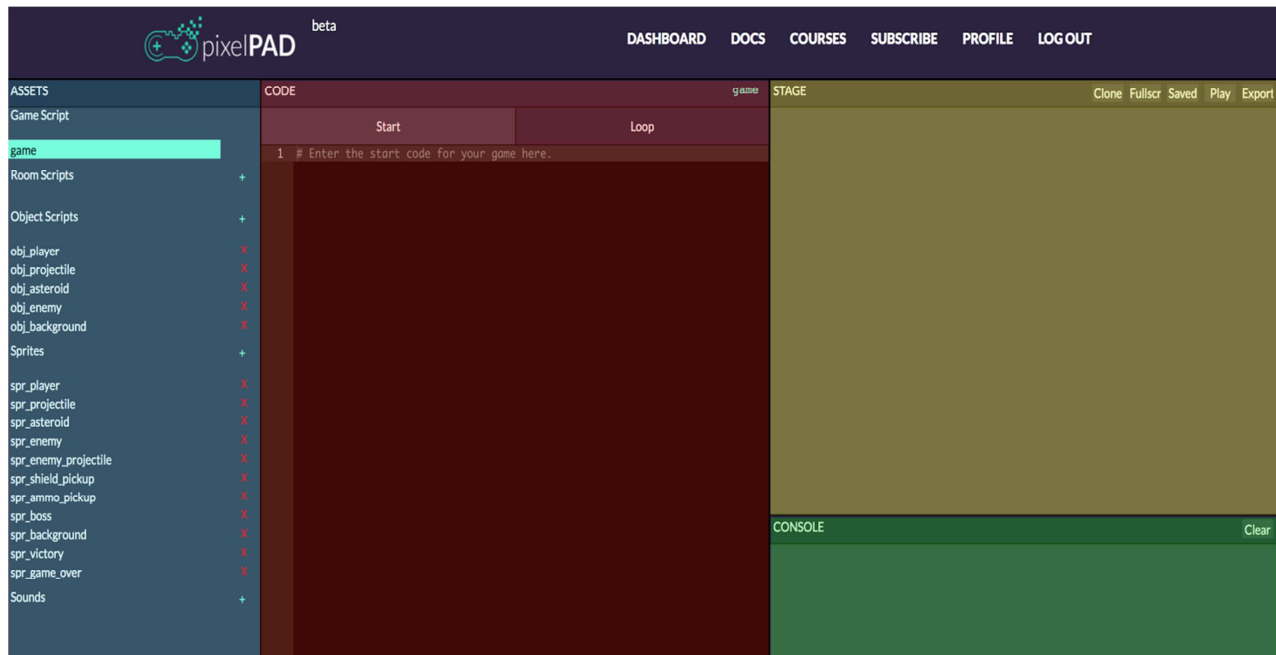
Explaining Code with Comments.....	21
How to Write a Comment.....	21
Types of Bad Comments.....	22
Misleading Comments	22
Obvious Comments.....	23
Vague Comments	23
Frames Per Second.....	25
Frames	25
Timers.....	26
Timers	27
Random & Import.....	28
Random Numbers.....	28
Random Positions	28
Random Function.....	29
Probability	29
Modules.....	30
Rooms & Persistence	31
Rooms	31
Persistent Objects	31
Errors.....	32
Types of Errors	32
Compile-time Errors	32
Runtime Errors.....	32
Debugging	33
Debugging.....	33
The Debug Loop.....	33
Logging In.....	34
Logging onto PixelPAD	34
Game Guide Preface.....	35
Preface - Read me.....	35
Example Project	36
Creating Objects.....	37
Start of App Guide.....	37
Game Script	38
Create Your Scene	39
Creating the Scene.....	40

Teachers Edition Answers.....	40
obj_FIRST_ball Start	41
FIRST Ball Movement.....	42
FIRST Ball Explosion	43
FIRST Ball on Ground	44
Game Guide.....	45
Animations	49
obj_explosion	50
Coding Player 2.....	51
Challenge Puzzles.....	54

Getting Started

What is PixelPAD?

PixelPAD is an online platform we will be using to create our own apps or games!

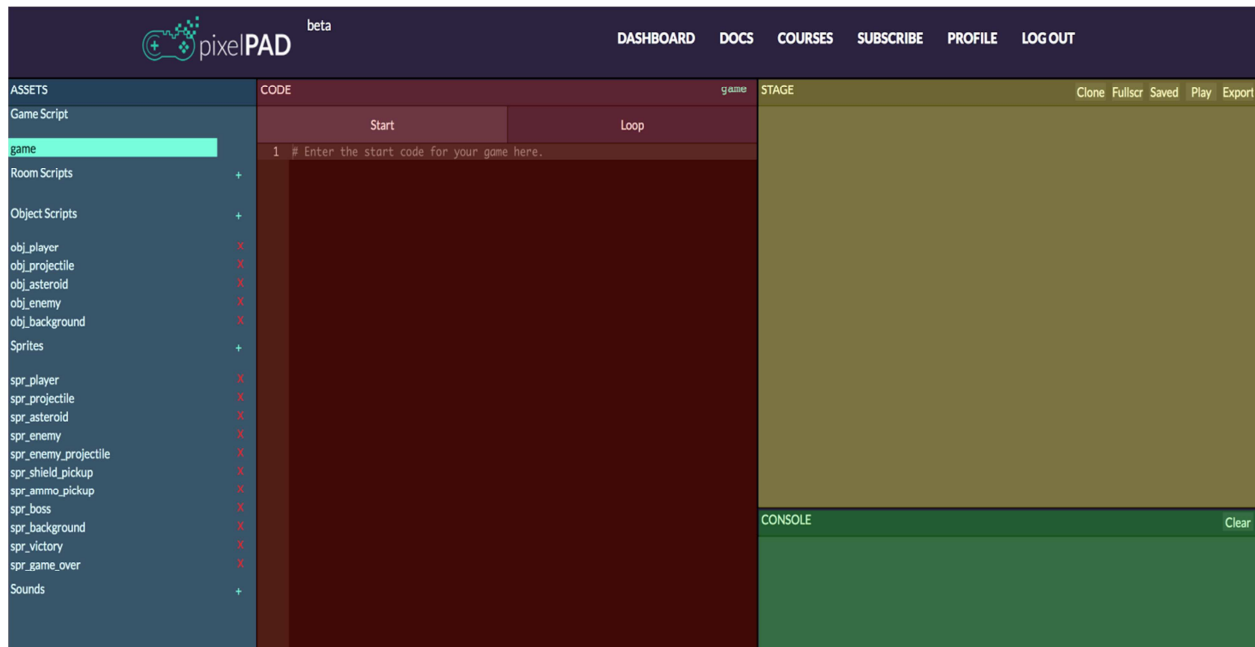


The PixelPAD IDE is composed of 4 areas:

ASSETS: Your assets are where you can add and access your object scripts and sprites. Scripts are step-by-step instructions that are unique to the object. For example, the instructions for how your player moves will be different from the way your asteroid moves! Sprites is another word for image, and these images give your objects an appearance!

CODE: In this section, you will write instructions for your game. To write your code, click within the black box and on the line you want to type on. To make a new line, click the end of the previous line and then press “Enter” on your keyboard.

Getting Started



STAGE: The stage is where your game will show up after you write your code and click Play (or Stop and then Play). Don't forget to click save after you make changes to your code!

CONSOLE: Your console is where you will see messages when there are errors in your code, and also where you can have messages from your game show up such as the score, or instructions on how to play your game.

Scripts

Scripts

Two of the asset types we just covered, rooms and objects, are script assets. Script assets (or scripts) are assets that have code inside them. Sprites are not considered scripts, because they do not contain any code.

Creating Scripts and Assets: To Create an asset, you start by clicking the **+** next to “room scripts”, “object scripts” or “sprites”



A screenshot of a file name input dialog box. At the top, it says "Enter file name:". Below this is a text input field containing the text "rm_home". At the bottom right of the dialog, there are two buttons: "Cancel" and "OK".

Then type in any name you'd like. My particular convention looks like this:

“rm_openworld” -> room

“obj_player” -> player

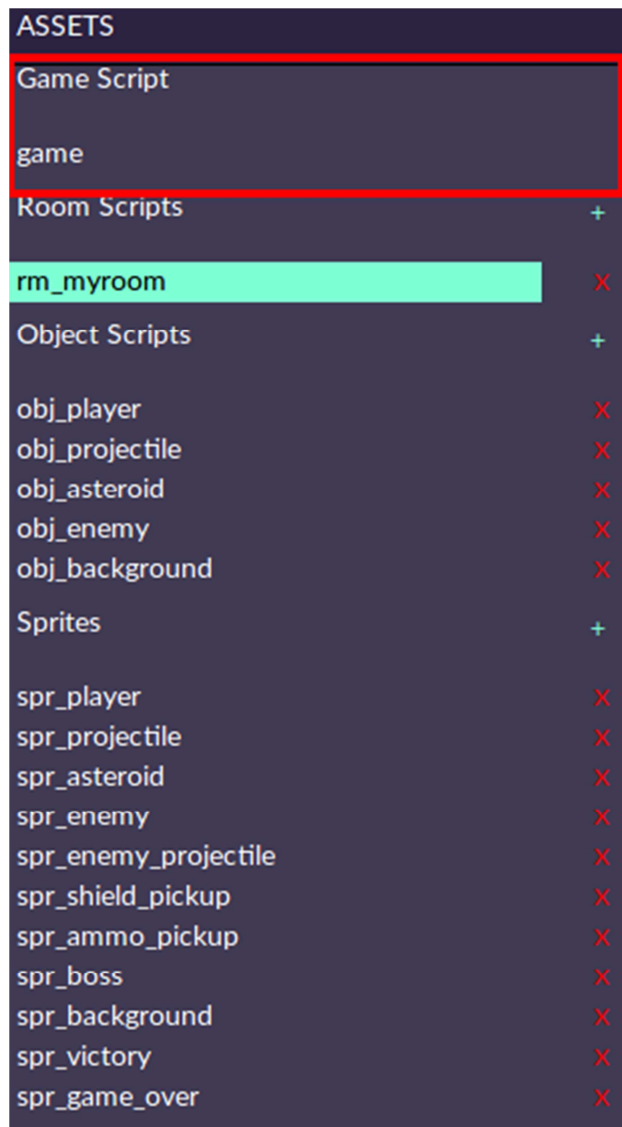
“spr_background” -> background

I always preface my assets with the type of asset followed by the name. This isn't necessary, but keeps your code neat and readable.

Scripts

The Game Script

There is one script asset that always exists in every project: the game script. The purpose of the game script is to load all of the other assets in our project. The game script represents our entire game, so it doesn't count as a room or as an object.



Default Object Properties

Sprite, `sprite_height` and `sprite_width`

Every object or object script inherits default properties when created in PixelPAD.

The First of these few properties you should learn about are:

`.sprite`, `.sprite_height` and `.sprite_width`.

`.sprite` is image of the object. The value of `.sprite` is an image object which we will get to later.

`.sprite_height` takes a float between 0 and 1 and stretches the sprite of the object lengthwise

`.sprite_width` takes a float between 0 and 1 and stretches the sprite of the object widthwise

X, Y and Z Coordinates

The position of an object is where the object is. In programming, we usually describe an object's position using a pair of numbers: its X coordinate and its Y coordinate.

An object's X coordinate tells us where the object is horizontally (left and right), and its Y coordinate tells us where the object is vertically (up and down).

[0,0] is the middle of the screen

`.x` takes the value of the x position of the object. The higher `.x` is, the farther to the right it is.

`.y` takes the value of the y position of the object. The higher `.y` is, the higher up the object is.

`.z` takes the value of the z position of the object. The higher `.z` is, the close to you the object is.

DOT Notation and Self

Dot Notation

Dot notation is like an apostrophe s ('s). Like "Timmy's ball" or "Jimmy's shoes".

The 's tells you who you're talking about. In code instead of using apostrophes we use dots to talk about ownership.

So when we say `player1.x` we're really saying "player1's x"

Examples of Dot Notation:

`obj_player.x` -> referse to `obj_player`'s x value

`obj_player.sprite_width` -> referes to `obj_player`'s image width (percentage)

The "Self" Property

Self refers to whichever object you are currently in.

So if you're typing code inside the `obj_FIRST_ball` script, saying "self" refers to `obj_FIRST_ball` itself.

Examples of Self

#Code inside "obj_FIRST_ball"

```
self.x = 50
self.y = 30
self.sprite_width = 0.5
self.sprite_height = 0.5
```

The code would make `obj_FIRST_ball` move to the right by 50px, up by 30px and reduce its image size in half.

Collisions

What are collisions?

Think of collision as checking whenever two objects touch. In Mario, whenever he collides with a coin, it runs the code to add to score.

In PixelPAD, it's when the "bounding boxes" of sprites touch. This includes the transparent areas of the sprite as well!

We will use collisions in our game to determine when our ship is hit by obstacles, when we've collected a power-up or health refill, and when we've managed to shoot down an asteroid.

The collision_check function

When we want to check for a collision between two objects, we use an `if` statement combined with a special function called `collision_check`.

Here is an example of a `collision_check` function:

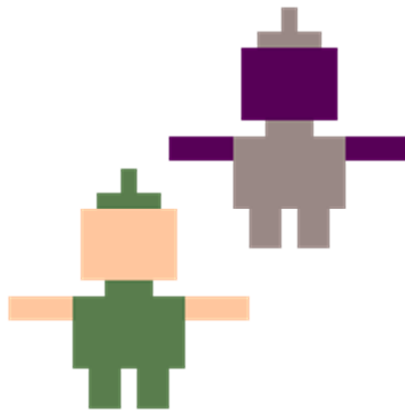
```
if collision_check(self, "obj_asteroid"):
    print("This object is colliding with an asteroid object")
```

- We start with an ordinary `if` statement.
- For our condition, we specify `collision_check`.
- We then write a pair of parentheses `()`.
- Next, we write `self`. This specifies that we want to check for collisions against the current object.
- Finally, we write `"obj_asteroid"`. This specifies the kind of object we want to check for collisions with. In this case, we are checking for collisions with `obj_asteroid` objects.

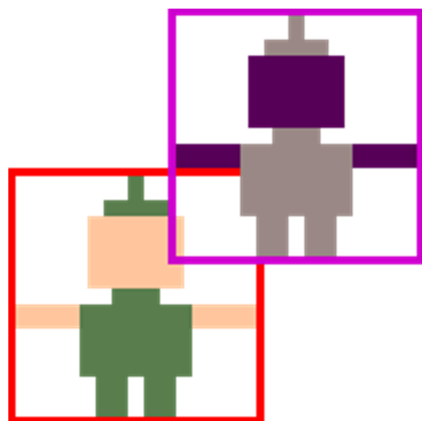
Bounding Boxes

Bounding Boxes

Every object has a bounding box, which is the rectangle that contains the object's entire sprite. The `collision_check` condition checks for overlaps between the bounding boxes of objects, not the actual sprites. This can sometimes create surprising results. Here is an example of two objects that don't look like they should be colliding, but do:



And here they are again, with their bounding boxes shown:



Destroying Objects

Destroying Objects

When two objects collide, we generally would like to destroy at least one of them. Destroying an object removes it from the game. When an object is destroyed, it no longer exists, and trying to use it could make your game behave strangely or crash.

Destroying an object is very simple. Here is an example of destroying the player object:

```
destroy(player)
```

The Start and Loop

The Start and the Loop Tabs

Say you decide to go for a run. You put on your runners and then you run. Running the loop because it repeats (one foot in front of the other), and putting runners on is the start because it only happens in the beginning.

Similarly, in PixelPAD the “start” describes an instruction that only happens once, such as the starting position of the robot. Whereas the “loop” could describe its animation.

The Game Loop

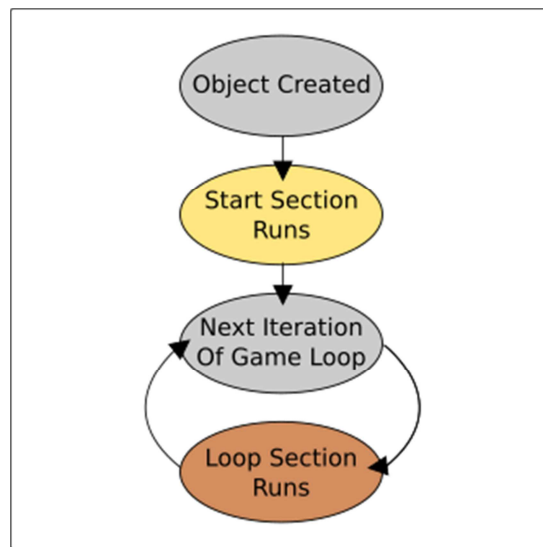
Loops exist in our day-to-day life. For example, you wake up, get ready, go to school, come back home, go to sleep and repeat these things every day! So looping is the act of repeating. In programming, loops describe instructions that repeat instead of having to code each instruction again and again!.

Loops can happen every day, or they can repeat a specific number of times. For example, a programmer can code a robot to jump 100 times, or code the robot to keep jumping forever!

Video games are built around a game loop. Specifically for PixelPAD, our game loop runs the code 60 times every second!

Loops

The loop starts when we click the Play button, and stops when we click the Stop button. It goes around and around for as long as the game is playing, updating each of our objects a little bit at a time.



How Do We Use the Game Loop?

When we write code for our objects, we can choose to place it in one of two sections: the Start Section or the Loop Section. Code placed in the Start Section is executed as soon as we create the object using `object_new`. Code placed in the Loop Section, however, is added to the game loop, which means it will be executed over and over until the game stops.

Conditionals

Conditionals

So far, whenever we've written any code, all we've done is give the computer a list of commands to do one after the other. Using conditions, we can tell the computer to make a decision between doing one thing or another.

If Statements

The way we write conditions in our code is by using `if` statements. Here is an example of a simple `if` statement:

```
if key_is_pressed('left'):
    x = x - 1
```

- Start with the word `if`.
- Next, we write our `condition`. The condition of an `if` statement is a true or false question that we ask the computer to answer for us. In the above example, our condition is `key_is_pressed("left")`, which is asking, "Is the `left` arrow key being pressed?"
- After the condition, we write a `full colon (:)`, and then make a new line.
- Next, we `indent` our code, which means we start typing it a little bit further to the right than we normally would.
- Finally, we write the `body` of the `if` statement. If the condition of the `if` statement turns out to be true, then the computer will run whatever code we put inside the body. In the above example, the body is `x = 300`.

Indentation in Python

Indentation

Indentation is when code is shifted to the right by adding at least two spaces to the left of the code. Indentation is important for two reasons:

- Code that is indented is considered to be part of the body of the `if` statement by the computer. As soon as we stop indenting the code, we are no longer inside of the `if` statement.
- Indentation helps us visually see the structure of our program based on the shape of the our code. This helps us navigate our code and find bugs more easily.

For example:

```
# weapons
if key_is_pressed('space'):
    if ammo > 0:
        laser = object_new('obj_laser')
        laser.x = x
        laser.y = y
        ammo = ammo - 1
if key_is_pressed('c'):
    if shields > 0:
        shield = object_new('obj_shield')
        shield.x = x
        shield.y = y
        shields = shields - 1
```

We can see clearly that the statements only run if the condition is met. E.g. the player presses the SPACE button.

It is very important that all of the code in the same body be indented using the same number of spaces on every line.

Key Press

Keyboard Input

One kind of condition we can use is a keyboard check. Keyboard checks can be used to determine whether a keyboard key is being pressed or not. We can use keyboard checks to make things happen when the player presses or releases a keyboard key.

Keyboard checks are done using the `key_is_pressed` function. Here is an example of using the `key_is_pressed` function:

```
if key_is_pressed("w"):
    print("You are pressing the W key!")
```

The code inside the quotation marks is the name of a keyboard key. Most keys are named the same as the letter or word on their keyboard key. A few keys have specific names:

- The space bar's name is space.
- The arrow keys are named left, right, up, and down.
- If you have a return key, it is named enter.

Comparisons

Comparisons

If we have code like: `x > 300`, this is a specific kind of condition called a comparison. Comparisons are true/false questions we can ask the computer about pairs of numbers. There are six main kinds of comparisons, each with its own operator (special symbol). This table shows an example of each kind of comparison:

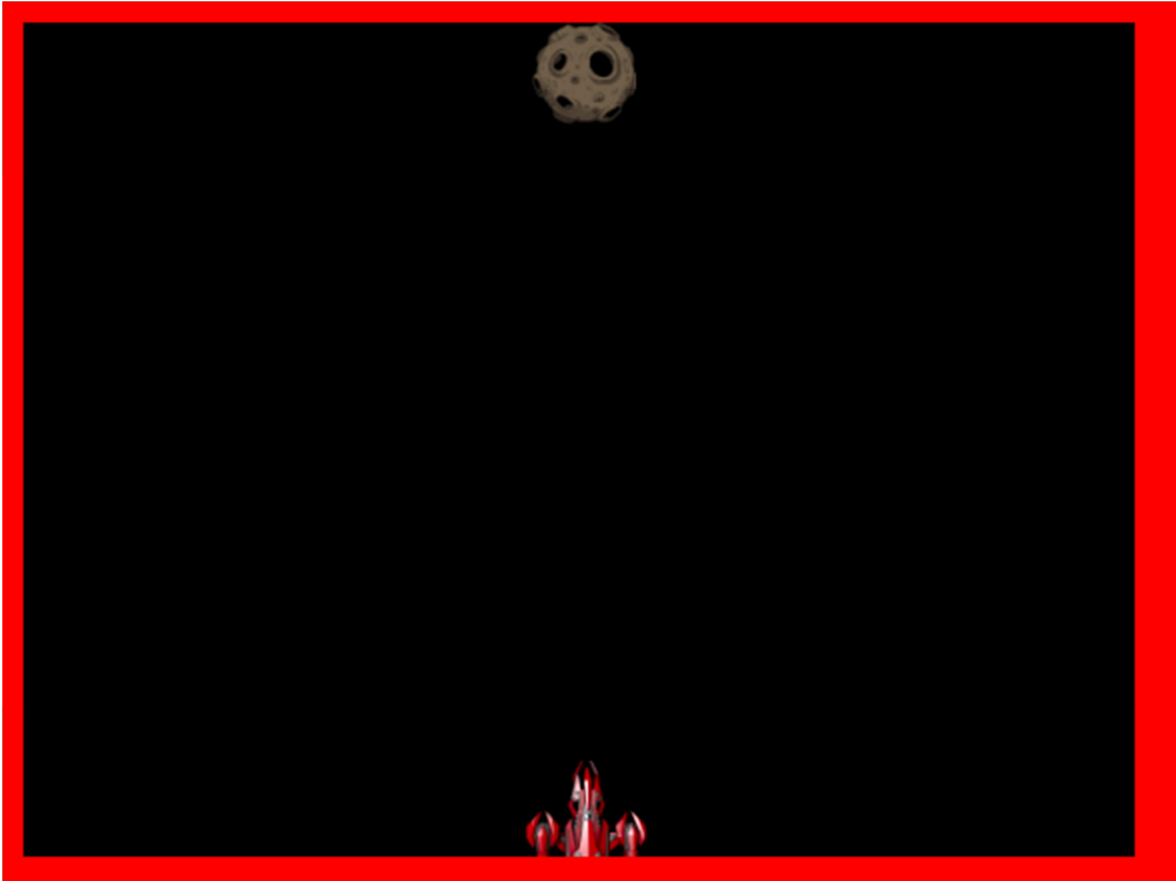
Example Question	Example Code
Is <code>x</code> smaller than <code>y</code> ?	<code>x < y</code>
Is <code>x</code> bigger than <code>y</code> ?	<code>x > y</code>
Is <code>x</code> smaller than or equal to <code>y</code> ?	<code>x <= y</code>
Is <code>x</code> bigger than or equal to <code>y</code> ?	<code>x >= y</code>
Is <code>x</code> equal to <code>y</code> ?	<code>x == y</code>
Is <code>x</code> not equal to <code>y</code> ?	<code>x != y</code>

There are other kinds of conditions, but comparisons are the kind that we will be using most often.

Comparisons

Adding Boundaries Example

We can add boundaries to our game using `if` statements and comparisons.



Comparisons

The Left Boundary

In our player script's Loop Section, add this new code at the bottom:

```
if x < -300:  
    x = -300
```

The Right Boundary

Next, add this code:

```
if x > 300:  
    x = 300
```

The Top Boundary

Next, add this code:

```
if y > 220:  
    y = 220
```

The Bottom Boundary

Finally, add this code:

```
if y < -220:  
    y = -220
```

Comments

Explaining Code with Comments

Computer code is complicated. That's why, a long time ago, some very smart programmers invented code comments.

Comments are like little notes that you can leave for yourself in your programs. The computer completely ignores comments in your code. You can write whatever you want inside of a comment.

How to Write a Comment

You can write a comment by starting a line of code with a pound sign, which is the `#` symbol (you might call this symbol a hashtag). Here is an example of some well-commented code:

CODE		obj_asteroid
Start		Loop
1	# Set the sprite of this object to "spr_asteroid",	
2	sprite = sprite_new("spr_asteroid")	
3		
4	# Move this object up to the middle-top of the screen.	
5	x = 0	
6	y = 200	

Comments are an extremely useful tool, and you should get in the habit of writing them. Comments help us remember what our code does, help others understand our code, and help us keep our code organized.

Comments

Types of Bad Comments

Misleading Comments

It's important to remember that comments are notes. The computer doesn't read our comments when it's deciding what to do next. Because of this, comments can sometimes be inaccurate. We should always read the code, even if it is commented, to make sure it does what we think it is doing.

Here is an example of a misleading comment:

```
# This code makes the player move up when they press the "up" key
if key_is_pressed('up'):
    y = y - 10
```

The comment says that this code makes the player move upwards, but when we read the code, it actually makes them move downwards. If we just read the comment without checking it against the code, we would have no idea why our game wasn't working properly.

Comments

Obvious Comments

Another type of bad comment is an obvious comment. Obvious comments don't add any meaningful information to your code; they usually just re-state what the code is saying in plain English. Here is an example of an obvious comment:

```
# Add one to x  
x = x + 1
```

Obvious comments clutter up our code and can slowly turn into misleading comments if we're not careful. If a comment doesn't add anything meaningful to our code, it's best to just delete it.

Vague Comments

Vague comments are comments that don't actually explain anything. Vague comments are usually written without very much thought, or because the author of the comment was told to comment their code. Here is an example of a vague comment:

Comments

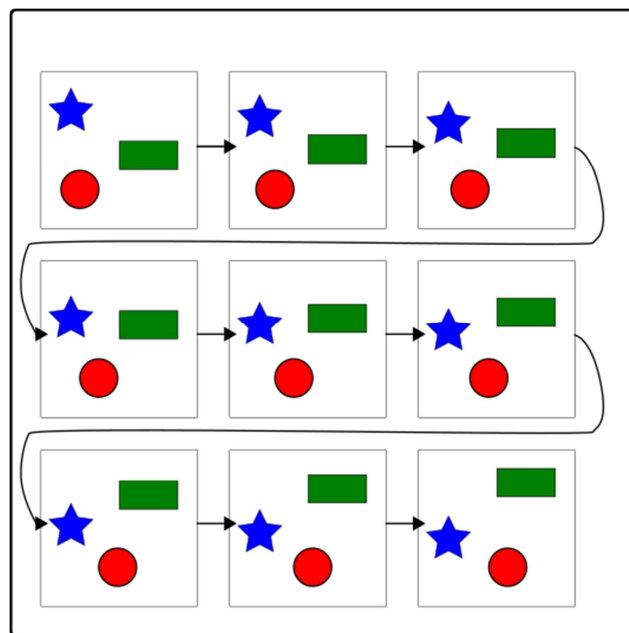
```
# weapons
if key_is_pressed('space'):
    if ammo > 0:
        laser = object_new('obj_laser')
        laser.x = x
        laser.y = y
        ammo = ammo - 1
if key_is_pressed('c'):
    if shields > 0:
        shield = object_new('obj_shield')
        shield.x = x
        shield.y = y
        shields = shields - 1
```

The comment at the top of this code just says "weapons." It doesn't say what the code does, or how it works. Some of this code doesn't even have anything obvious to do with weapons. Similar to obvious comments, vague comments clutter up our code and can slowly become misleading as we work on our project. It is better to just delete any vague comments you find in your code.

Frames Per Second

Frames

When you watch a movie, it looks like you're seeing one single, moving picture on the screen. This is a trick: a movie is a long series of slightly different pictures, and those pictures are being shown to you so fast that you can't tell they're individual images. Each of those single pictures is called a frame. Here is an example of a movie with 9 frames:



Notice how each of the three objects is in a slightly different place every frame: the green rectangle moves up, the blue star moves down, and the red circle moves to the right. We can barely notice a difference between two consecutive frames, but the objects have moved quite a bit when you compare the first and last frames!

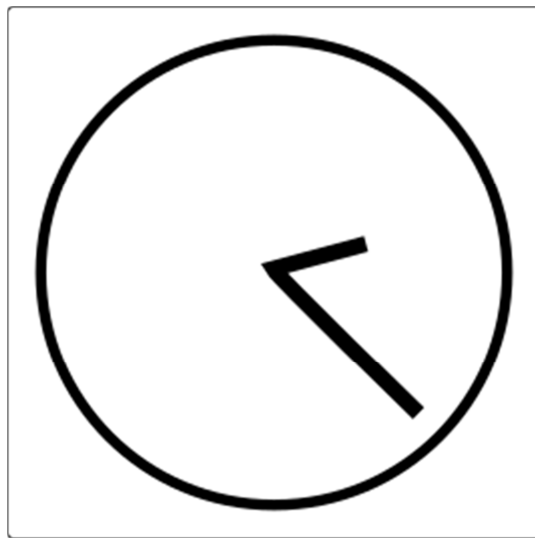
Frames Per Second

Games use frames, too. Every time the code in an object's Loop Section runs, the game is drawing a new frame based on where our objects are and what sprites we have attached to those objects.

Every frame in our game lasts exactly the same amount of time: 1/60th of a second. That means that there are 60 frames in a second.

Timers

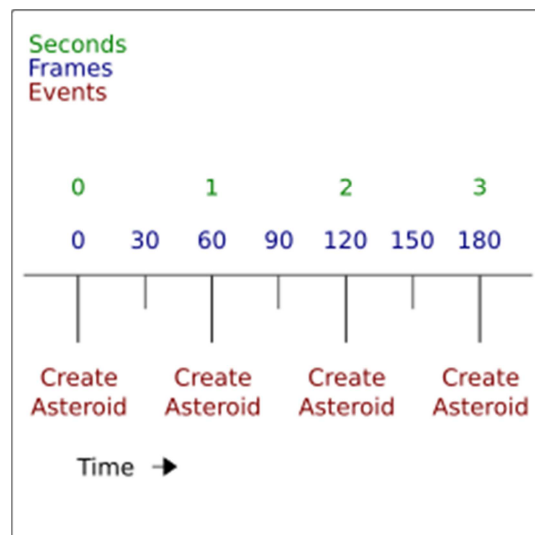
A timer is a number that counts time. For example, if we were watching a clock, and counted up by one every time the clock's second hand moved, we would be timing seconds.



Timers

Since each frame in our games lasts the same amount of time, we can build a timer that counts frames by counting up by one whenever our game's Loop Section is run.

Why are timers useful? Timers let us schedule things. For example, if we wanted an asteroid to appear at the top of the screen every second, we could use a timer that counted to 60 (since each frame lasts 1/60th of a second).



Random & Import

Random Numbers

Most video games use some kind of randomness to change what happens in the game each time we play, to stop the game from getting boring. We can add randomness to our games using random numbers.

Random Positions

For example, whenever we create an asteroid, we've been using code like this:

```
asteroid = object_new("obj_asteroid")
asteroid.x = 0
asteroid.y = 200
```

This code makes asteroids appear at the top of our screen, right in the middle. When we play the game, every asteroid will appear in exactly the same place. We can change this by asking for random numbers when we set the asteroid's position:

```
asteroid = object_new("obj_asteroid")
asteroid.x = random.randint(-200, 200)
asteroid.y = 200
```

Random & Import

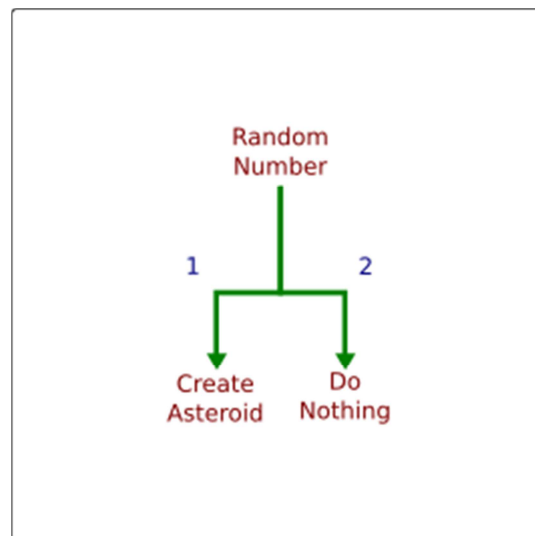
Random Function

`random.randint` is a special command which asks for a random number. The numbers between the parentheses are the smallest and largest values you want to get. For example, if we were writing a dice-rolling game, we could use `random.randint(1, 6)` to perform a dice roll.

Probability

Random numbers can be used to affect the probability that something will happen in your program.

For example, in the code below we're only creating an asteroid only half the time we used to by adding the `random.randint(1,2) == 1` conditional.



Random & Import

```
if asteroid_frames >= asteroid_timer:  
    asteroid_frames = 0  
    if asteroid_count < asteroid_max:  
        if random.randint(1, 2) == 1:  
            new_asteroid = object_new("obj_asteroid")
```

This code randomly chooses between the numbers 1 and 2. If it chooses 1, it creates an asteroid. If it chooses 2, it does not create an asteroid. Because the random number will be 1 half of the time, and 2 the other half of the time, this code will end up creating an asteroid half of the time as well.

Modules

When we want to use random numbers, we have to write another special command at the very beginning of our program. This is the command:

```
import random
```

This is called importing a module. Since we don't always need to use random numbers, the `random.randint` command is normally turned off. Importing the random module turns the `random.randint` command on, so we can use it.

Rooms & Persistence

Rooms

Rooms are the big sections of our game. At the very beginning of this course, we set up a room for our game to happen in. Now that we've finished building most of our game, it's time to add a few new rooms.

Recall that when we want to change rooms, we use the `room_set` command. This command does two things:

1. It automatically destroys every object that was part of the previous room
2. It runs the Start Section of the new room, which should create all the objects that are part of the new room

Because each room controls all of the objects that are part of that room, each room can be used to create an independent section of our game.

Persistent Objects

When an object is created inside the `game` script, it is automatically made into a persistent object. Persistent objects do not belong to any room, and are never automatically destroyed by the `room_set` command. Persistent objects can be useful, but we have to be extremely careful to clean them up with the `destroy` command when we don't need them any more.

Since persistent objects are part of the `game` script, they can be accessed in a special way: a persistent object called `foo` can be accessed from anywhere by writing `game.foo`.

Errors

Types of Errors

Compile-time Errors

Sometimes, we make mistakes when we write code. We mean to type `x`, but accidentally type `y`. We accidentally write `lf` instead of `if`. These are called programmer errors.

A compile-time error is an error that results from the programmer writing code incorrectly. Another way of thinking about it is any error that produces an error message.

Compile-time errors are generally easy to find and fix, because they tend to produce detailed error messages with line numbers and file names.

Runtime Errors

On the other hand, sometimes we've written our code in the correct way, but it doesn't do what we expect it to do. For example, we could expect an object to move in one direction, but it ends up moving in the opposite direction. These are called runtime errors, and are much harder to debug.

Runtime errors occur when code is written without mistakes, but does not behave correctly.

The easiest way to find and fix runtime errors is to use the debug loop. Many problems are caused by incorrect assumptions, so make sure to always reread your code thoroughly to make sure it is doing what you think it is doing.

Debugging

Debugging

Debugging is when we find and fix problems in our programs. Debugging is very important, because it's very easy to make mistakes when we write code. Even the very best programmers need to debug their code every day.

The Debug Loop

When we're fixing our programs, we can always just change code at random until our program behaves the way we want it to. If we're persistent, we can fix problems this way, but it's not a very fast (or easy!) way to work.

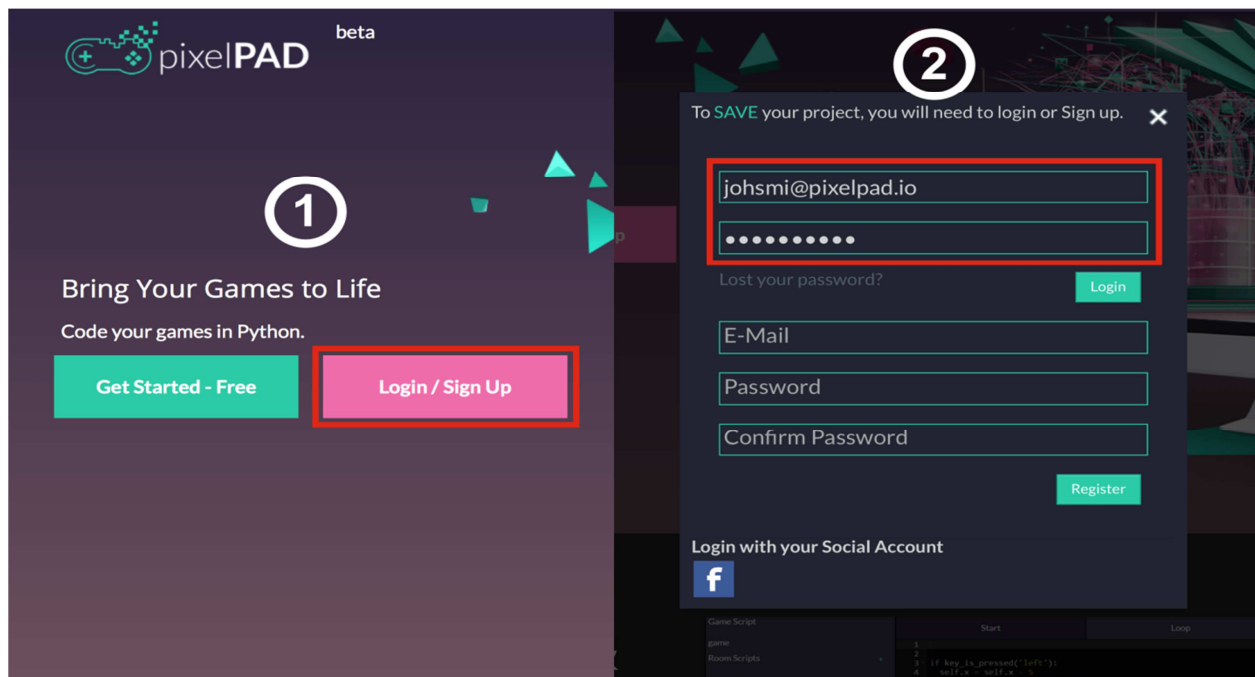
A better way to debug is to use the debug loop. The debug loop is a simple process that we repeat until our program works properly. This is what it looks like:

1. First, we **Run** our code. Running our code will let us observe it, which will show us whether there are any errors or other problems. If everything is working properly, we can stop debugging.
2. Next, we **Read** our code. Using what we learned from running our code, we look for specific commands that might be causing problems. Sometimes, an error message will tell us exactly where to look by giving us a line number and file name (for example, `error in obj_player on line 4` means that the 4th line of code in the `obj_player` object is wrong). When we don't have an error message, we have to look for the problem ourselves.
3. Lastly, we **Change** our code a tiny little bit. Once we think we've found the source of a bug, we can change our code to either make it give us more information (this is called tracing), or we can try to fix the problem. It is important to change only a small amount of code in this step, because whenever we change our code, we risk adding new bugs to our program.

Logging In

Logging onto PixelPAD

We will access PixelPAD using an internet browser such as Google Chrome, Firefox, or Safari. This way you can play and create your game from any computer! Go onto <https://www.pixelpad.io>



1. Click Login/Sign Up
2. Your username and password will be provided for you! If you don't have a username, please speak to one of your facilitators!
3. Click on the Game Tutorial you'd like to work on and choose Asset Pack 1. This will download the necessary assets directly to your game to get you started.

Game Guide Preface

Preface - Read me

This tutorial tries its best to present all code in order. That is, code given to the user later in this tutorial should be placed after code already written into their program. For example if we say:

a) In `obj_player1`'s start tab write:

```
self.sprite_width = 0.5  
self.sprite_height = 0.5
```

Then later on say:

b) In `obj_player1` start tab write:

```
if self.name != "":  
    print("hello " + self.name)
```

You can confidently place b)'s code after a)

Be cautious however, as from time to time we may ask the user to insert code within existing conditionals. In cases like this, read and understand the code carefully and place it in the most logical place.

There may also be times we ask the user to write their own code with the knowledge they've learned gained from the previous lessons. This code is necessary to ensure a fully functioning app.

Example Project

This is what your game will look like after you finish this tutorial:



You can try out an example project here:

<https://pixelpad.io/play/hhx6nfpdsfl/>

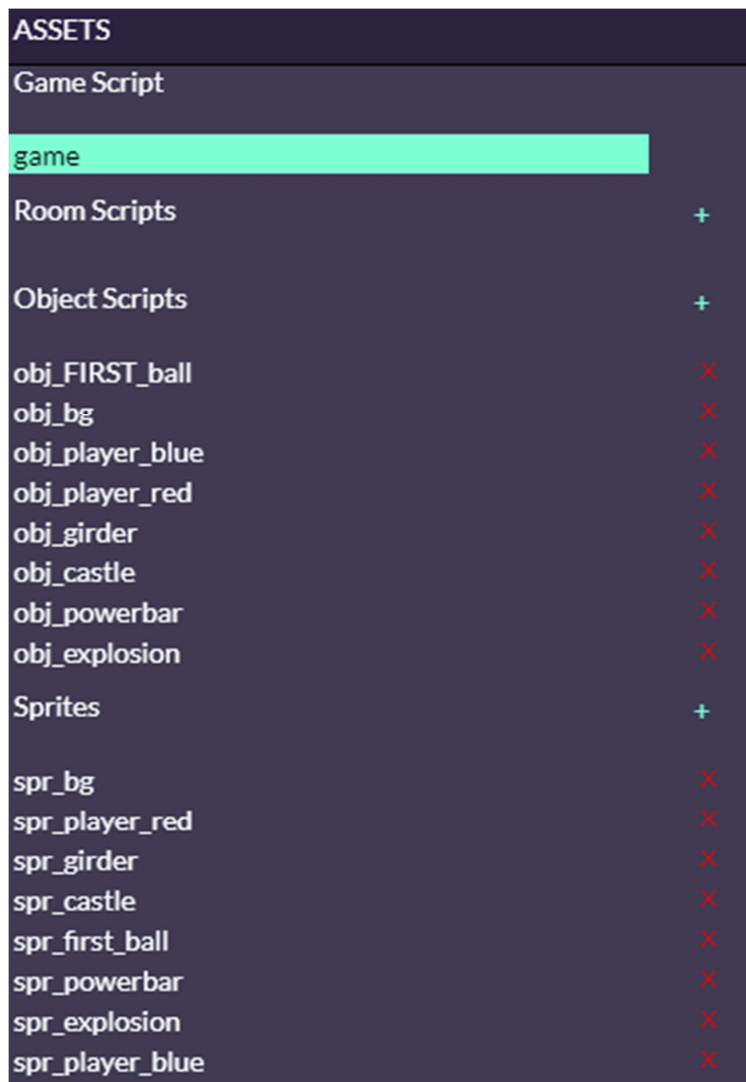
Creating Objects

Start of App Guide

First we need to create the objects we're going to use in our game. If you forget how to add objects and/or assets into PixelPAD you can always refer to the introductory lessons in an earlier chapter.

Add the following objects into the game:

- obj_bg
- obj_player_blue
- obj_player_red
- obj_castle
- obj_FIRST_ball
- obj_girder
- obj_powerbar
- obj_explosion



We will be referring to these assets throughout the tutorial.

Game Script

Game Script - Start tab	
<pre># Enter the start code for your game here. bg = object_new("obj_bg") bg.sprite = sprite_new("spr_bg") bg.sprite_height = 0.5 bg.sprite_width = 0.5</pre>	<p>Create a new object called "bg" (short for background) Give bg the sprite spr_bg Change the background to half its height and half its width</p>
<pre>p1 = object_new("obj_player_blue") p1.sprite = sprite_new("spr_player_blue") p1.sprite_height = 0.5 p1.sprite_width = 0.5 p1.x = -100</pre>	<p>This code does very similar things to what we did with the background, creating a new object p1 (short for player 1), adding its sprite and changing its size.</p> <p>The new thing here is we changed the starting X position of p1 to -100</p>

Game Script - Start tab	
<pre>p1.castle = object_new("obj_castle") p1.castle.sprite = sprite_new("spr_castle") p1.castle.x = -300 p1.castle.y = -52 p1.castle.sprite_width = 0.5 p1.castle.sprite_height = 0.5</pre>	<p>I know what you may be asking: is there a default object property called "castle"?</p> <p>Nope! This is a new variable that we made up. This variable now stores the object "obj_castle"</p> <p>To access the object obj_castle, we need to use the dot notation twice!</p>

Create Your Scene

Now is your turn! Try to recreate the scene in the image on the next page using what we've learned so far. See if you can add the girders to land on, p2, and the FIRST Robotics ball.



Creating the Scene

Teachers Edition Answers

Game Script - Start tab

```
p2 = object_new("obj_player_red")
p2.sprite = sprite_new("spr_player_red")
p2.sprite_height = 0.6
p2.sprite_width = 0.6
p2.x = 100
p2.castle = object_new("obj_castle")
p2.castle.sprite = sprite_new("spr_castle")
p2.castle.x = 300
p2.castle.y = -52
p2.castle.sprite_width = 0.5
p2.castle.sprite_height = 0.5
girder1 = object_new("obj_girder")
girder1.sprite = sprite_new("spr_girder")
girder1.y = -240
girder1.sprite_height = 0.5
girder1.sprite_width = 0.5

girder2 = object_new("obj_girder")
girder2.sprite = sprite_new("spr_girder")
girder2.y = -240
girder2.x = 288
girder2.sprite_height = 0.5
girder2.sprite_width = 0.5

girder3 = object_new("obj_girder")
girder3.sprite = sprite_new("spr_girder")
girder3.y = -240
girder3.x = -288
girder3.sprite_height = 0.5
girder3.sprite_width = 0.5

FIRST_ball = object_new("obj_FIRST_ball")
FIRST_ball.sprite = sprite_new("spr_first_ball")
```

obj_FIRST_ball Start



obj_FIRST_ball - Start tab

```
xspeed = 0  
yspeed = 0
```

In the start tab of obj_FIRST_ball, we have to setup some new variables. These are NOT default variables, but new ones we've made up.

By itself, xspeed and yspeed are just variables we made up that store a float. They could've been called "data1" and "data2" if we wanted, but that would've been confusing.

We will use xspeed and yspeed as vectors, that is a velocity variable with an associated direction.

xspeed being the horizontal vector
yspeed being the vertical vector

FIRST Ball Movement

obj_FIRST_ball - Loop tab

Enter the loop code for obj_FIRST_ball here.

```
self.x += xspeed  
self.y += yspeed
```

Remember self.x and self.y?

Here we're saying, add whatever xspeed is to self.x every frame.

Earlier we set xspeed to 0, so that means we're going to add 0 to self.x every frame until we change the value of x.

Can you guess what will happen if we compile our game right now?

If you guessed "nothing" you're absolutely right!

obj_FIRST_ball - Loop tab

```
cblock = collision_check(self, "obj_girder")  
cCastle = collision_check(self, "obj_castle")
```

Next we need to add collision checks.

The first line checks if (self) i.e. the obj_FIRST_ball is colliding with any girders. Since this is happening in the loop, this will happen every frame.

We're creating a new variable called "cblock" that will store the value of whatever collision_check returns.

If obj_FIRST_ball is colliding with a girder, cBlock will store the girder it's colliding with. If it's not colliding with anything it will store NULL

We do this twice, checking for collisions with the girder AND the castle.

FIRST Ball Explosion

obj_FIRST_ball - Loop tab

```
if cCastle:
    if abs(xspeed) > 15:
        explosion = object_new("obj_explosion")
        explosion.x = self.x
        explosion.y = self.y
        new_ball = object_new("obj_FIRST_ball")
        new_ball.sprite = sprite_new("spr_first_ball")
        destroy(self)
    else:
        xspeed = 0
```

This code may look complicated but it's actually just a bunch of stuff we've learned before put together.

The first if cCastle statement asks "is cCastle a value other than null?"

If its null it means our earlier collision check returned no value. But if it's a value, we can assume the obj_FIRST_ball has hit a castle!

Now we check if xspeed > 15 because we only want the ball to explode if its going fairly fast.

We must take the "absolute" value of xspeed, or else player 2, who is catapulting the ball to the left (-15) will never be able to hit the castle!

Once both these conditions are met, we will create an explosion object and a new ball because we just blew up our old one.

At the very bottom here, we added

```
else:
    xspeed = 0
```

This else is connected with the if statement:

```
if abs(xspeed) > 15:
    ...
else:
    xspeed = 0
```

In plain English, if the ball thrown as the castle is greater than 15 do ... or ELSE make it stop moving.

FIRST Ball on Ground

obj_FIRST_ball - Loop tab

```
if cblock:  
    if yspeed < 0:  
        self.y = cblock.y + 47  
        yspeed = 0  
        xspeed = 0  
    if yspeed > 0:  
        yspeed = 0  
else:  
    yspeed -= 0.5
```

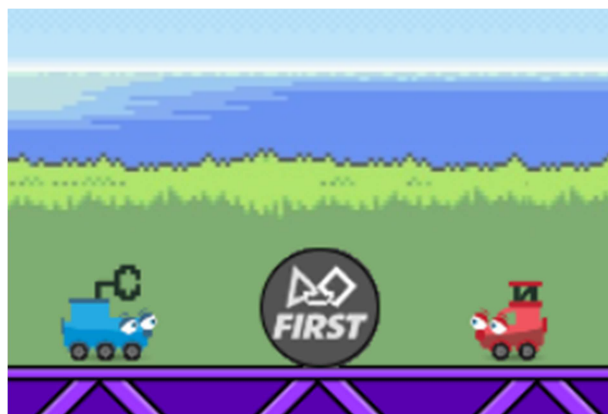
This last if statement checks if cblock is value other than NULL. If we check the start tab, we'll see that cblock stores the value of the girder the obj_FIRST_ball is colliding with.

Next check is if we're travelling downwards. If we are, then completely stop moving with xspeed = 0 and yspeed = 0.

So what does it mean by:
self.y = cblock.y + 47

When we go down really fast, the ball may only be touching the girder when the ball is already inside the girder. This ensures that the ball is moved back above the girder.

Lastly, if we're not colliding with any blocks we set subtract yspeed by 0.5. This means we will be travelling faster and faster downwards, simulating gravity.



Game Guide

obj_player_blue - Start tab

```
yspeed = 0
onground = False
power = 0
powerbar = ""
```

Here we are setting up some default values for variables our player will use.

These will be referred to in the loop tab of this player's script. If you forget to do this part, you'll get some unexpected errors..!

obj_player_blue - Loop Tab

Enter the loop code for obj_player_blue here.

```
self.y += yspeed

cblock = collision_check(self, "obj_girder")
cFIRST = collision_check(self, "obj_FIRST_ball")

if cblock and yspeed < 0:
    self.y = cblock.y + 45
    onground = True
else:
    yspeed -= 0.5
    onground = False
```

Similar to what we did before, we will move the player vertically at yspeed and store any collisions with girders.

We'll need to know when the player is contacting the FIRST ball so we'll need to check for this as well; storing the FIRST ball in the variable "cFIRST"

This is asking if the player is moving downwards and is colliding with a girder we should stop moving down and set a variable called "onground" to True.

The variable "onground" is what we call a "flag" or in technical terms, a boolean variable.

Boolean variables only take 2 values, 1 or 0 aka True or False.

Game Guide

obj_player_blue - Loop Tab

```
if key_is_pressed("a"):
    self.x -= 4

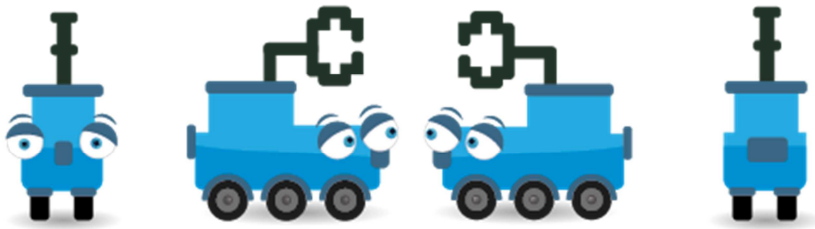
if key_is_pressed("d"):
    self.x += 4

if key_was_pressed("w") and onground:
    yspeed = 10
```

A new function: `key_is_pressed("")` checks if a key is currently being pressed. This function checks every frame in the loop.

If you only want it to check once, then you should use `key_was_pressed("")`

This last if statement is used to pick up the FIRST ball.



Game Guide

obj_player_blue - Loop Tab

```
if key_is_pressed("space") and cFIRST:
    cFIRST.x = self.x
    cFIRST.y = self.y + 16
    cFIRST.yspeed = 0
    power += 0.5
    if power > 100:
        power = 1
else:
    if cFIRST and power > 0:
        cFIRST.xspeed = power / 4
        cFIRST.yspeed = power / 10
    power = 0
```

If I'm colliding with the ball AND I press space, pick up the ball. That is, set the FIRST ball's x value to the same as the player's x value and set the FIRST ball's y value to the same as the player's y value.

We added 16 to make the ball go over the player's head instead of directly in the middle.

If we have the ball picked up, we also want to add "power" as we're holding the ball.

ELSE - if i'm not holding the ball I need to know if I recently let go of the ball or was I never holding it in the first place.

If I recently let go of the ball, my power should be > 0. So if power > 0 set the xspeed and yspeed of the ball relative to the power.

Then reset the power back down to 0.

Something to note about why I divided by 4 and 10. I wanted the ball to travel more horizontally than vertically, so I made the power less effective on the yspeed than the xspeed



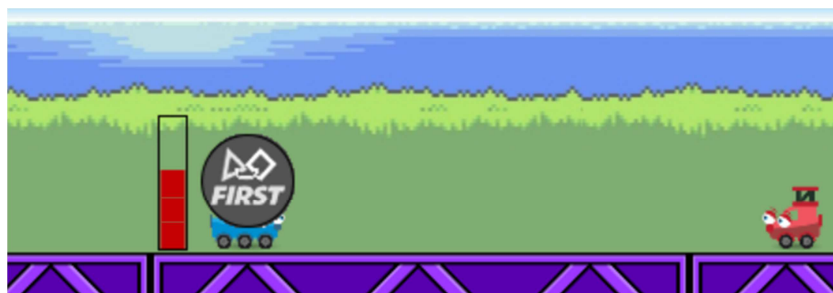
Game Guide

obj_player_blue - Loop Tab

```
#create the powerbar
if power > 0:
    if powerbar == "":
        powerbar = object_new("obj_powerbar")
        powerbar.sprite_width = 0.5
        powerbar.sprite_height = 0.5
        powerbar_sheet = sprite_new("spr_powerbar", 1, 5)
        powerbar_0 = animation_new(powerbar_sheet, 0, 0,0)
        powerbar_1 = animation_new(powerbar_sheet, 0, 1,1)
        powerbar_2 = animation_new(powerbar_sheet, 0, 2,2)
        powerbar_3 = animation_new(powerbar_sheet, 0, 3,3)
        powerbar_4 = animation_new(powerbar_sheet, 0, 4,4)
    if power > 0:
        animation_set(powerbar, powerbar_0)
    if power > 20:
        animation_set(powerbar, powerbar_1)
    if power > 40:
        animation_set(powerbar, powerbar_2)
    if power > 60:
        animation_set(powerbar, powerbar_3)
    if power > 80:
        animation_set(powerbar, powerbar_4)
    powerbar.x = self.x - 40
    powerbar.y = self.y + 15
else:
    if powerbar != "":
        destroy(powerbar)
    powerbar = ""
```

This part of the code adds a little charm to your game. It shows how much power is accumulating as you're carrying the FIRST ball.

The only part that should be new to you here is the animation, so let's talk about the 3 functions that make animation work, `sprite_new`, `animation_new` and `animation_set`.

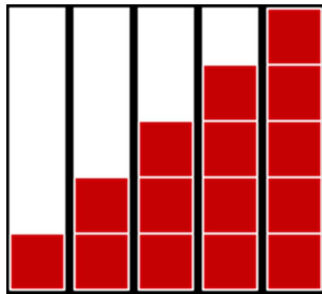


Animations

obj_player_blue - Loop Tab

sprite_new needs 3 arguments, the location of the sprite and the number of columns and rows this sprite has.

Considering the sprite sheet for the powerbar looks like this:



The number of rows is 1 and number of columns is 5.

animation_new takes 4 arguments, the sprite sheet, speed of animation, frame start and frame end.

Here we named our sprite_sheet "power_sheet"

We set animation speed to 0 because it's not changing frames and we set the start and end frames to the frame we want.

Lastly animation_set sets the animation. Animation set takes 2 arguments, the object you want to set the animation for, and the animation you want to set it to.

In this case, we only want to change the animation at certain power values.

obj_explosion

obj_explosion - Start tab

```
self_destruct_timer = 30
```

```
explosion_sheet = sprite_new("spr_explosion", 4, 4)
```

```
explosion_anim = animation_new(explosion_sheet, 30, 0,15)
```

```
animation_set(self, explosion_anim)
```

Here we create a new variable called self_destruct_timer to 30.

We set it to 30 because that's about the time it takes for the explosion animation to start and end.

If you chose a different sprite sheet for the explosion, this number may differ. Experiment yourself to find the perfect timing.

obj_explosion - Loop Tab

```
self_destruct_timer -=1
```

```
if self_destruct_timer < 0:  
    destroy(self)
```

This should be self-explanatory by now, but let's explain it again for good measure.

Every frame the self_destruct_timer counts down by 1. Once it counts down to 0 we destroy the explosion.

Coding Player 2

Try to add the p2 code on your own! It's very similar to p1, except there are some minute changes that need to be made to the variables.

obj_player_red - Start Tab

```
yspeed = 0
onground = False
power = 0
powerbar = ""
```

obj_player_red - Loop Tab

```
# Enter the loop code for obj_player_red here.

self.y += yspeed

cblock = collision_check(self, "obj_girder")
cFIRST = collision_check(self, "obj_FIRST_ball")

if cblock and yspeed < 0:
    self.y = cblock.y + 45
    onground = True
else:
    yspeed -= 0.5
    onground = False

if key_is_pressed("left"):
    self.x -= 4

if key_is_pressed("right"):
    self.x += 4

if key_was_pressed("up") and onground:
    yspeed = 10
```

Coding Player 2

obj_player_red - Loop Tab

```
if key_is_pressed("enter") and cFIRST:
    cFIRST.x = self.x
    cFIRST.y = self.y + 16
    cFIRST.yspeed = 0
    power += 0.5
    if power > 100:
        power = 1
else:
    if cFIRST and power > 0:
        cFIRST.xspeed = -power / 4
        cFIRST.yspeed = power / 10
    power = 0
```

Coding Player 2

obj_player_red - Loop Tab

```
#create the powerbar
if power > 0:
    if powerbar == "":
        powerbar = object_new("obj_powerbar")
        powerbar.sprite_width = 0.5
        powerbar.sprite_height = 0.5
        powerbar_sheet = sprite_new("spr_powerbar", 1, 5)
        powerbar_0 = animation_new(powerbar_sheet, 0, 0,0)
        powerbar_1 = animation_new(powerbar_sheet, 0, 1,1)
        powerbar_2 = animation_new(powerbar_sheet, 0, 2,2)
        powerbar_3 = animation_new(powerbar_sheet, 0, 3,3)
        powerbar_4 = animation_new(powerbar_sheet, 0, 4,4)
    if power > 0:
        animation_set(powerbar, powerbar_0)
    if power > 20:
        animation_set(powerbar, powerbar_1)
    if power > 40:
        animation_set(powerbar, powerbar_2)
    if power > 60:
        animation_set(powerbar, powerbar_3)
    if power > 80:
        animation_set(powerbar, powerbar_4)
    powerbar.x = self.x + 40
    powerbar.y = self.y + 15
else:
    if powerbar != "":
        destroy(powerbar)
    powerbar = ""
```

Challenge Puzzles

- Can you figure out how to add 3 additional FIRST balls in the game?
- Can you figure out how to make the explosion animation twice its size?
- Can you figure out how to add powerups to the game that spawn every minute or so and gives higher jumps and faster speed?
- Can you figure out how to add health to the castles and add win and lose conditions?
- What's the difference between `sprite_new`, `animation_new`, and `animation_set`?
- What does `collision_check()` return?
- `xspeed` and `yspeed` are used frequently in this tutorial. Are these properties inherent in the objects in PixelPAD?