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A beginner's guide to:

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1. Introduction to Lua and this book

1.1 What is Lua?

Lua is a scripting language, which works completely in an interpreted environment. It has been coded in C and has been set up to be easily implemented with any program written in C. It's been used for many kinds of application. For example for creating addons for utilities, and most of all for games.

Lua was designed by Roberto Ierusalimschy, Waldemar Celes and Luiz Henrique de Figueiredo in a university in Rio de Janeiro in Brazil, and is completely free. It was named after the moon as “lua” means “moon” in Portuguese. Despite Lua itself being set up in C, you don't need any knowledge of C in order to use it, due to language quite often being implemented in tools in which you may need it.

Lua is very extremely symplistic in its syntax and general setup, making it very easy to learn and understand, even when you never touched a programming language before. Still Lua has a kind of low-level approach and is despite being interpreted quite fast. Since it's specifically designed to work in a C environment, it's very popular in the professional industry and knowing the basics of Lua can get you some extra tickets into the professional gaming industry.

I will go into the deep of how Lua works later in this book, but the famous “Hello World” program is only one line: “print('Hello World!')”.

Lua has also been designed to not bother about platform specific issues. So basically a Lua script should work in Windows, MacOS and Linux and basically any platform you can think of.

1.2 What do you need to install for this course.

When it comes to Game programming one of the most complete Lua engines to make anything is LÖVE (http://love2d.org) but I advise you not to start with LÖVE right away. Before we get onto a complete engine like that it's essential that you first understand how Lua itself works. For that you need a Lua program you can run from the CLI. This program can only perform the core features, but it's good enough for testing what you've learned. If CLI tools are too difficult for you to understand, you can also use the Lua playground (https://www.lua.org/cgi-bin/demo). You can just enter the Lua code and the result will appear as soon as you click “run”. For training this will do.

To Test the playground just type “print('Hello World!')” in the textarea and then click “Run”, and “Hello World!” should appear below. When you use the cli tool type “cat > hello.lua” in the terminal when you use Linux, Mac or BSD and “copy con hello.lua” on Windows and type

“print('Hello World!')” and press enter and press ctrl-D in Linux/Mac/BSD and ctrl-z on Windows then type “lua hello.lua” and if you see “Hello World!”, you can see you installed the CLI tool correctly.

When you really get serious into Lua scripting you will need an editor that can handle Lua Scripting. I use the Lua Devolopment Tools for Eclipse, but that can be a rather complex to understand. Atom, Geany, SublimeText, NotePad++ should all be able to allow you to work with Lua scripts.

1.3 How to use this book

I will try to take you step by step into the secrets of Lua. I will show you many scripts. It could be wise to copy these and try what they do.

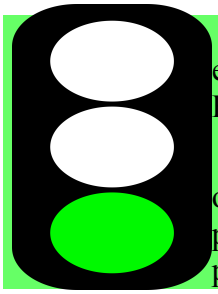
Code will look like this:

```
-- Test
a="Hello World"
print(a)
```

The colors you see is called “Syntax Highlight”. This will help you a lot keep some overview over your code.

When you see this icon and the text beside it with a blue background, it means that I got something very important to tell. Like all programming languages Lua can be full of trapdoors you can easily fall through, and you should therefore be aware of those. I make these warnings for a reason.

When you see this icon on an amber background, it means that I am about to tell you some typical nerdy stuff, that is just nice to know, but most of all aimed to people who can look beyond the regular stuff. If you have no understanding of what I tell here, then don't you worry one bit, as it's not really important to move on. Perhaps if you got more understanding of Lua and you want to read this over, hey, why not ;)



And lastly when you see this icon on a green background, I'll be giving you some exercise. The best way to learn to code, no matter if you do that in Lua, Pascal, BASIC or even in C is by doing it. And thus a few assignments never hurt.

These assignments may sometimes have some code snippets, but mostly you are on your own, but you area allowed to look things up in the previous chapter or paragraphs or sections to see the solution. Sometimes I may even give you some pointers of the expected output, so you can check a few things for yourself.

And with this all discussed, I wish you good luck with this book.

2. Hello World! Your first real program.

Most traditionally the first program you'll be writing in whatever language you're gonna learn is Hello World! It's been said that the first time Hello World was written was to demonstrate a prototype of the C programming language.

In C Hello World looks like this:

```
#include <stdio.h>
int main(void){
     printf("Hello World\n");
}
```

Not really much to it, even in C, although in C you need 4 lines and in Lua, just one.

```
print("Hello World")
```

Now “print” is a function. I'll go into the deep about what functions are later in this book, but for now it's important to know that a function can be used to make Lua do something. In the case of “print” that is to put something on the screen. “Hello World” is was we call a string. A string is a series of characters, usually used to form text. So in English we said to Lua *put the text “Hello World” on the screen.*

Let's test this out. Copy that line into a program or onto the playground and run it and see what happens. It should show “Hello World”.

When it comes to strings in nearly any language you will need quotes. In the example I used double quotes. Lua will also understand single quotes. It doesn't really matter if you use single or double quotes, as long as you are consequent in using the same quotes to end the quotes as you started them. I however advice double quotes. If you will ever consider moving on to C, Go, C# and some other languages in this family single quotes have a different meaning, and thus you can confuse yourself when you use single quotes (big exception is Pascal that requires single quotes).

Now I'm gonna take you into something important. Especially when you coded in BASIC or Pascal before you can really suffer here. Lua is case sensitive.

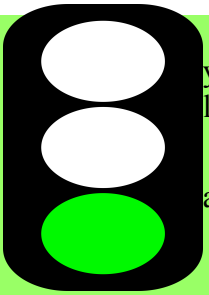
```
PRINT("Hello World")
```

This code will therefore not work. Try it and you will see Lua complain about a trying to call a “nil value” or something like that. I shall go into the deep about what a “nil value” is later, but for now let's suffice to say that a nil value means that you are trying to do something with something that does not exist, and therefore Lua can't handle that. Lua does make a difference between upper and lower case letters. So “print” and “PRINT” are therefore not the same. Especially when you move on to more complex Lua scripting you should be very strict on yourself on how you use upper and lower case or your scripts can become a big mess.

Now with this knowledge you can take this a little bit further. “print” will not only show text on screen. It will also move to the next line. And thus we can also do this:

So without trying this out in the playground or a cli tool, you must be able to tell what this program does:

```
print("USA stands for United States of America")
print("Its first president was George Washington")
print("It borders to Canada and Mexico")
```



Now write a program that shows your name and your age, your date of birth and your city of birth onto the screen. All data fields I asked for should have their own line in the output.

If you can do this, you have understood the basic of the Hello World sequence and then we can get on the move for the next chapter.

3. Variables

Like any programming language Lua handles data most of all through variables.

Unlike compiler based languages such as C, Go and Pascal, Lua does not require any variable declarations. A variable is technically created on the moment it's first asked for.

Variables can be defined, and read out. Read data can be put on the screen, or be used for creating new data, or be checked.

In this particular chapter I'll limit stuff to definitions of variables, reading and some nice manipulations.

Strictly speaking Lua only has 5 data types for variables: nil, boolean, string, number, table and function. I will not discuss function in this chapter. I will get to that once we'll really go into the deep of functions, and for tables same story.

Variables can also be global and local. I will get to the difference between the local and global in a later section. For now we'll only use globals. Global variables are available in your entire script, and that is all you need to know for now.

Definining variables is as easy as this:

```
a = 1 -- number
b = true -- boolean
c = "Hello World" -- string
d = { 3, 4, 5, 10 } -- table
e = function() print("Yo!") end -- function
n = nil -- nil
```

Now "--" in Lua means a comment. Lua will ignore everything that comes after that.

3.1 The nil type

Nil is a word that you'll soon hate when you get into Lua coding. It will haunt you wherever you go. Any variable you did not yet define will automatically be of the nil type, and the nil type only has one "value". Nil.

Nil just means your variable contains no data at all. In most cases nil cannot be used and thus an error will pop up if you try.

Nil can also be enforced like you can see in the code in the intro section of this chapter by simply saying "myvar = nil". Especially when working with tables this can get you far as this may cause Lua to automatically clean up all the memory taken by the table. More about that when I actually come to tables.

3.2 The number type

The number type is like the name suggests for storing numbers. These can be integers as well as floats. Now number variables are pretty important as they allow you to perform mathematical calculations, and even the simplest of programs (well except maybe Hello World) will often require you to do some calculations. Scoring points, deducting hitpoints, but also determining coordinates of the player or the enemies. The number type makes it all possible.

3.2.1 Definition and showing numbers

```
a = 1
print(a)
```

Yeah, well it's really that simple. This program will define 1 into variable a. And print will then show the content of a.

Note that now that we are using a variable and not a string we do not quote it. Due to that Lua understands this is a variable and will thus just show the value of variable a

```
a = 1
b = 5
print(b)
print(a)
```

Now 1 will be put in a and 5 will be put in b. Note that I first asked to show variable b and then variable a. This will cause Lua to first output 5 and then 1. It is very important that you put the commands in the correct order to prevent bugs. In this case it didn't matter in which order I defined the variables, but the order of the print instructions do.

3.2.2 Mathematics with variables

Now we get into actual programming.

For this I'll need to discuss operators. For mathematic formulas Lua has 6 operators at your disposal.

Addition	+
Subtraction	-
Multiplication	*
Division	/
Modulo	%
Empower	^

Lua does take in calculations the official order into account when multiple operators are used, so first empowering, then multiplication and division and lastly additions and subtractions, but just like in normal mathematics you can alter this order with parents ( ).

Now I'm sure this all sounds a bit like abracedabra. So let's explain by means of some examples.

When doing math in Lua you can use both numbers and variables in your formulas and you can use them in both your definitions as in function arguments, so you can do this:

```
print( 2 + 5 )
```

And you can also do this:

```
a = 2
print(a + 5)
```

Both examples will put 7 on the screen.

But this works too:

```
a = 2 + 5
print(a)
```

And yeah, you can also go this way:

```
a = 2
b = 5
c = a+b
print(c)
```

Anything is possible.

Now that's interesting, but can you also make a variable increment itself? Sure!

```
a = 1
a = a + 1
print(a) -- outputs 1
a = a + a
print(a) -- outputs 4
```

And basically you can go all the way with this with the other operators.

The “%” operator or “modulo” (in some programming languages this is the “mod” keyword) is an operator that can confuse some people. It contains the remainder value of a division.

8 % 4 = 0

9 % 4 = 1 (8:4=2 and 1 remains).

If you have been using C/C++/Go/C# before you will not like to hear this, but Lua has no shortcut incrementors or manipulation support. So a++ or a-- do not exist in Lua and there is also no variant for a+=4 or anything like that. I'm afraid this is something you'll have to deal with.

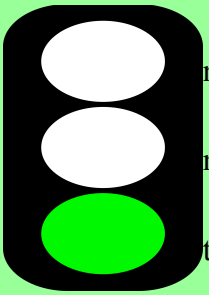
I've not been informed by any plans of support for this in the future. I wouldn't be surprised if it will be implemented, but for the good of this book, I'll do without them. :(

Now like I said before, Lua can handle more complex formulas by working with parents, in which like in real-life mathematics the stuff between parents takes priority

```
a = 4
b = 6
c = 2
d = (a+b)/c
print(d) -- outputs 5
```

Since a is 4 and b is 6 and c is 2 the formula send to d is basically *(4+6)/2*, so first calculate what is between the parents, well 4+6=10, so that makes 10:2 which is 5 and thus the output.

3.2.3 Assignment



Write a program in which you have variable a and b are defined with random numbers of your choice, as long as it's anything higher than zero.

Then let it output the result of adding the two variables, then subtract then multiplied by each other and then divided.

Then make the same program make the two variables double themselves and do the same sequence of mathematic results again.

Please make sure you read the assignment well and that you've understood it well, as this may be one of the more complex ones to understand at once.

3.3 The string type

3.3.1 An introduction to strings

Strings are in Lua pretty easy to use. Like I said strings are a chain of characters, usually used for text. Technically strings can have any length and you can do various things with them.

Defining a string variable is as simple as this:

```
mystring = "Hello World"
```

It's that easy. Now you can just use functions like print to put the content onto the screen.

```
mystring = "Hello World"
print(mystring)
```

Copying a string to another variable does not require special functions (like strcpy in C), but can just be done as easily as this:

```
mystring = "Hello World"
mystring2 = mystring
print(mystring2)
```

3.3.2 Concatenation

Now in Lua you cannot do any mathematic things on strings (seems logical, but there are some languages (like JavaScript) that can under certain circumstances, so that's why I explicitly note it), but there are ways to do some manipulations on strings.

One of the most common actions you can do with strings is concatenation, which is, simply appending a string to a string. Maybe that didn't make much sense, so let's demonstrate.

```
h = "Hello"
w = "World"
hw = h..w
print(hw)
```

So we placed “Hello” in h and “World” in w. In the third line we concatenate these strings and the result is stored in hw.

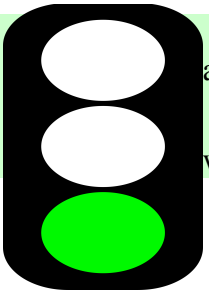
Now when you copied this program to the playground or a cli tool you will see something went “wrong”. The output is “HelloWorld” and not “Hello World”. This is not Lua's fault, but mine. I didn't put a space in the original variables. Spaces are just characters just like letters, so if you want them you must put them in, and if you don't want them, leave them out. Unwanted spaces or spaces not appearing when they should can easily happen in careless handing of strings, and sometimes the results are pretty downhearting and heart to find when debugging.

Now the funny part to concatenation is that Lua even allows numbers to be concatenated into strings.

```
s = "I am "..40.." years old"
print(s)

s = "I was born in "
y = 1975
s2 = s..y
print(s2)
```

Both examples work just fine.



Create a program in which one variable contains your name as a string and another variable that contains your age (in years) as a number.

Create a third variable that concatenates the variables in a string where the out put will be “My name is <name> and I am <age> years old.”

3.3.3 C formatted strings in Lua

Now the C junkies reading this will very likely prefer C-formatting for concatenation, and therefore it's good to know that Lua has full support for this. There are basically 2 ways to do this, and it just comes down to what you think is best.

There is no variant to printf, but rather to sprintf and the result is just returned as a string. Two examples to do this:

```
name = "Jeroen"
year = 1975
mystring = string.format("My name is %s and I was born in %d",name,year)
print(mystring)
```

This is the simple way to do this. Of course to a real C programmer it goes without saying that you can use functions as parameters, so you can also do print(string.format(blah blah)).

There is also a kind of OOP way to do this and that'll look like this:

```
name = "Jeroen"
year = 1975
mystring = ("My name is %s and I was born in %d"):format(name,year)
print(mystring)
```

Now this way to go is also completely valid. Please note the (and the) in which the format string is set *is* required, or Lua will throw an error.

3.3.4 String Slicing

String slicing has always been an important thing you can do with strings. And that's why Lua too has support for this. Lua uses the string.sub() function for this.

The basic syntax for string.sub is as follows:

`string.sub(`*`string`*`,`*`startsubstring`*`,`*`endsubstring`*`)`

Now this is pretty vague, I know.

When you are new to programming let me first tell you what string slicing is. It's nothing more or less than cutting or copying a part out of a string and make a new string out of that.

I guess that made even less sense, so let's demonstrate with some examples:

```
s = "I am Jeroen"
print(string.sub(s,6)) -- outputs "Jeroen".
print(string.sub(s,1,4)) -- outputs "I am".
print(string.sub(s,6,8)) -- outputs "Jer".
print(string.sub(s,6,6)) -- outputs "J".
```

Of course, the question is if you have understood what this all does.

Let's ignore the first print line for now, I'll get back to that later. The second line I did request the

characters on spots 1 till 4. Well:

1. Spot #1 contains “I”
2. Spot #2 contains a space
3. Spot #3 contains “a”
4. Spot #4 contains “m”

And the combined result is returned and thus the string “I am” was formed this way. Now all the two lines below that line basically perform the same trick.

In the first print line you may have seen that I did not give a number for the ending spot. And yet the line outputs “Jeroen”. When no ending spot is given Lua will assume that the last spot of the string will be the ending spot, and since the first letter of “Jeroen” was on spot #6, it therefore puts in all letters coming next.

Now there's another trick... Negative numbers in string.sub()

```
s = "I am Jeroen"
print(string.sub(s,-6)) -- Outputs "Jeroen"
print(string.sub(s,-6,-2)) -- Outputs "Jeroe"
print(string.sub(s,-6,8)) -- Outputs "Jer"
```

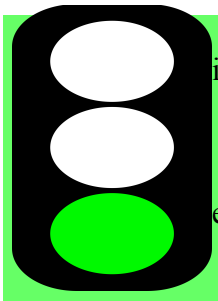
Well do you have any idea what just happened here?

Indeed when negative numbers are used, it will count from the right in stead of the left. So -6 means 6th spot from the right. Since the last word “Jeroen” contains 6 letters, you can easily guess why my name was outputted. And I did not give an ending number so Lua did just assume I wanted to go to the end of the string.

Well the -6 -2 combination is now easy to guess. From the 6th spot from the right (J) to the 2nd spot from the right (e) and thus “Jeroe” was outputted. Easy, huh?

The last one is put in to show you that negative numbers and positive numbers can just be combined. From the 6th spot from the right (J) to the 8th spot from the left (r) and thus “Jer” was outputted.

Now Lua will not moan or whine or anything when you come up with an impossible combination like from 6 to 5 (from the left). Whenever you come up with impossible combinations, string.sub will just return an empty string. As a programmer you are fully responsible for giving correct digits to string.sub for proper output!



Now create a program with a string variable containing the string “Donald Trump is the 45th president of the United States”.

Then make it output “Donald” by slicing out that name.

Then make it output “States” simply by slicing out from the right without an ending point.

Then make it output “Trump” by slicing out that name from the left.

And lastly (and that may be a tricky one) make it output “United” simply by slicing from the right only.

3.4 Boolean type

Now the last type I will cover in this chapter (as I will go into the deep of tables and functions types later) is the boolean type. Now “boolean” is not really coming from an existing word like the names of the other types. It was named after the English mathematician and philosopher George Boole, who lived from 1815 until 1864.

Boolean types can be pretty abstract when you are new to programming, but they might well be one of the most important types in the history of programming.

A boolean type can only have two values. “true” and “false”.

Now at first sight, this may seem pretty pointless, however boolean values are often generated through expressions. When I'm gonna explain about the 'if' and the 'while' commands you will find out how important boolean expressions can be, and then it's good to know that you can store the output in a variable.

Now this is getting quite abstract, so let's throw in an example:

```
s1 = "Donald Trump"
s2 = "Donald Trump"
s3 = "Barack Obama"

b1 = s1 == s2
b2 = s1 == s3

print(b1) -- Outputs "true"
print(b2) -- Outputs "false"
```

Now the first three lines don't need any explanation, I think.

Now in Lua “==” means that Lua needs to check if the value in both variables are the same. If so the outcome is “true” if not the outcome is false. Now this makes it very easy to see why b1 contains “true” since both s1 and s2 contained “Donald Trump”. As s3 contains “Barack Obama” which is of course not “Donald Trump” b2 became false.

```
s1 = "Donald Trump"
s2 = "Donald Trump"
s3 = "Barack Obama"

b1 = s1 ~= s2
b2 = s1 ~= s3

print(b1) -- Outputs "false"
print(b2) -- Outputs "true"
```

Now I've altered the code a bit. You can see I replaced both “==” operators with “~=”. In Lua “~=” means “is not”. And hence now b1 became false as I made it check if “Donald Trump” is not “Donald Trump”, but as that is both the same string “is not” is therefore not the case (you follow as double negative is always hard to understand), and thus the outcome “false”. And I wanted “Donald Trump” not to be “Barack Obama” in b2, well since that is not the case, the outcome is “true”.

Now boolean expressions too are in for combinations.

```
s1 = "Donald Trump"
s2 = "Donald Trump"
s3 = "Barack Obama"

b1 = s1 == s2 and s1 == s3
b2 = s1 == s2 or  s1 == s3

print(b1) -- Outputs "false"
print(b2) -- Outputs "true"
```

“and” and “or” are keywords reserved for usage in boolean checks. Now can you see why the output is the way it is?

Basically the code explains itself.

For b1 in wanted “Donald Trump” to be “Donald Trump” AND “Donald Trump” to be “Barack Obama”. Due to the “and” keyword both statements must be true, but as the latter is false the entire expression is false.

For b2 either one of the two statements or both had to be true, well since the first statement is true so the entire statement is true and that the latter is not, is no longer relevant.

Then there is one final keyword to keep in mind and that is “not” and it does exactly what the name implies.

```
s1 = "Donald Trump"
s2 = "Donald Trump"
s3 = "Barack Obama"

b1 = not ( s1 == s2 )
b2 = not ( s1 == s3 )

print(b1) -- Outputs "false"
print(b2) -- Outputs "true"
```

Since I put in “not” this time, it basically may not be “true”. Since s1 *has* the same value as s2 that is true, but as it may not be true, “false” is the result, and since s1 did not have the same value we did see what we want and get “true”.

Lua can be a very strange beast in parse checkings, and if you are using an IDE that supports parse checking then “b1 = not s1==s2” will be taken as a valid instruction, but the outcome may surprise you as what Lua will do is “b1 = (not s1)==s2”. I therefore advice to never use 'not' without parents, but to always include them like shown above.

Now it is also cool to note, and that is where boolean expressions can be powerful is that they can also be used on mathematic operations and concatenations, and all this in real time. Let's write a

small program to demonstrate this:

```
b1 = 5+7 == 12
b2 = 5+8 == 15
d1 = "Donald"
d2 = "Trump"
d3 = "DonaldTrump"
b3 = d3 == d1..d2
print(b1)
print(b2)
print(b3)
```

Well since 5+7 is indeed 12, b1 will be true. Since 5+8 is 13 and not 15, b2 will be “false”, and the concatenation of “Donald” and “Trump” is indeed “DonaldTrump”, so that outcome also fits and thus “true”.

Lastly there are a few more operators for you to keep in mind:

- Greater than >
- Lower than <
- Greater than or equal >=
- Lower than or equal <=

They can be used in stead of == or ~= but only when you are using number values.

```
b1 = 5+7 == 12
b2 = 5+8 <= 15
d1 = "Donald"
d2 = "Trump"
d3 = "DonaldTrump"
b3 = d3 == d1..d2
print(b1)
print(b2)
print(b3)
```

When I change the code to this, you will see 3x “true” as output, and that fits since 5+8 is 13 which happens to be lower than 15.

4. The “if” keyword

4.1 if … then … end

Now the “if” keyword is important to understand. This is one of the commands in which you'll be able to make your program actually respond to what the user is doing.

Basically you say “*if* something is the case *then* perform all instructions until the *end*”.

The basic syntax is like this:

```
if <boolean-expression> then
<all instructions to perform when the boolean expression happens
to be true>
end
```

Now the “end” keyword pops up for the first time in this book, and it's the most used keyword in Lua. “if” creates what we call a scoop. A scoop is just a collection of commands. Every scoop ends with the “end” keyword (few exceptions, but we'll get to that later). For C users, it's basically what you use accolades for in C, but in Lua “if” and other commands like that will always open a scoop.

Now let's demonstrate this:

```
name = "Neil Armstrong"
print(name)
if name=="Neil Armstrong" then
    print("Yup, that's the name of the first man on the moon.")
end
```

Let's break this down a bit. The first two lines should be known by now. With “if” we start the “if”-statement and as you can see the name is checked in the same way as we create a boolean variable. The “then” keywords lets Lua know the end of the expression is reached and starts the scoop with all the commands that should be executed then, which is now only one, but there is no limit how far you can go with then and lastly the “end” commands closes the “if” scoop.

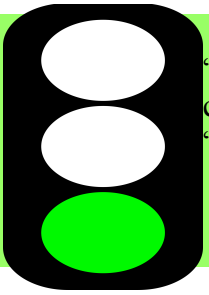
If you run this program you can see that the program confirms that Neil Armstrong is the first man on the moon. If you put anything else in the “name” variable nothing will happen aside from showing the name, after all that confirmation command should only be executed if the expression is true.

NOTE: You can see that I put in some leading spaces for all commands within the “if” scoop. We call this “indenting”. It is good practice to follow my example on this, as this keeps your code more readable. It's then easier to see what belongs to what scoop. If you want to plan to learn Python in the future all scoops end when you stop indenting in Python. Although Lua doesn't care about this, you can spare yourself some misery when you also learn Python, and also for good overview it's better.

4.2 if...then...else... end

```
name = "Neil Armstrong"
print(name)
if name=="Neil Armstrong" then
    print("Yup, that's the name of the first man on the moon.")
else
    print("No, the name is not the name of the first man on the moon.")
end
```

Perhaps you can see a little where I'm going here. If the variable name contains “Neil Armstrong” then the first scoop is performed. Else will end the first scoop and open a new one and there all the commands are shown performed when the expression was false.



Now you should be able to make a program that checks if a variable called “name” (string) actually contains your name, and if a variable called “age”(number) contains your correct age and make the computer say “Correct” if it's correct and “Incorrect” when it's incorrect.

All the information you need to do so is in the last two subsections.

4.3 if … then … elseif … then … else … end

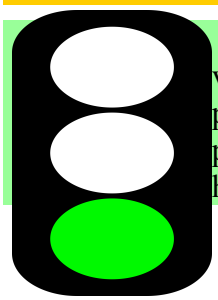
```
name = "Neil Armstrong"
print(name)
if name=="Neil Armstrong" then
    print("That's the name of the first man on the moon.")
elseif name=="George Washington" then
    print("That's the first president of the United States")
elseif name=="Margaret Thatcher" then
    print("That's the first female prime minister of the United Kingdom")
else
    print("I don't know who that is.")
end
```

Now this looks a bit more complicated, but it's not as hard as it looks.

“elseif” simply means “if any of the previous statements was wrong check this one and execute if true”. You can throw in as many elseif statements as you want, and the last else is also optional. Now you can get a real show on the road, eh?

This note only matters when you have experience with C, Go, C#, Pascal or any other programming language.

Lua has no case-support, meaning that if you ever need casing you are basically condemned to use if-elseif-else structures like above. It's a very serious downside about Lua, and I do not know if future versions will ever support it. Sorry about that!



Now make a program in which you put in the name of a person you know in a variable called “name” and use ifs and elseifs to check the name and state that person's profession and in the end an else statement stating that you don't know that persons profession. Now change the name variable with several tests to see what happens.

5. Loops

Loops allow your program to do things over and over, again and again.

Now basically there are three ways in which Lua can loop. “For”, “While” and “Repeat/Until”.

5.1 For

For can be used in multiple ways, but for now, we will only use it for countdowns and countups. Let's demonstrate the for routine, eh?

```
for i=1,10 do
    print(i)
    if i%2==0 then
       print("Even")
    else
       print("Odd")
    end
end
```

The “for” command creates a variable just for itself and that is in this case “i”. This variable will only exist within the “for”-scoop, not outside of it. It will be defined as 1 and then all commands in the for-scoop will be executed and after that “i” will be increased with 1 and then the scoop will go on again. Once “i” has reached 10 at the end of the for-scoop, the loop will end and the first command after the “end” will then execute.

Now it's nice to note that if has its own scoops. Lua will know which end belong to which scoop, as basically end closes all scoops in reverse order as they are created, so the parser (the program inside Lua that checks and interprets your code) will not get confused.

Now basically any value can do, as long as you first put in the start value and the end value at the end. The instruction as shown above however, can only count up, but like I hinted, counting down is possible if you enter a third number, which we call the “step value”

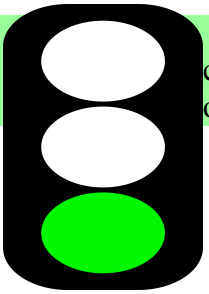
```
for i=10,1,-1 do
    print(i)
    if i%2==0 then
       print("Even")
    else
       print("Odd")
    end
end
```

Due to the step value being negative Lua knows it should now count backwards.

Now this is fun, but we can basically go into any direction here with any kind of values

```
for i=0,50,5 do
    print(i)
    if i%2==0 then
       print("Even")
    else
       print("Odd")
    end
end
```

This example works the same as the programs before, however now “i” will be incremented with 5 every cycle.



Now make a program and use the for-command in order count from 1 till five and combine it with the if-elseif commands to make it print the number in word in stead of digits.

5.2 While

Now proper understanding of the “while” command is very important. The working of the “while” command is similar to “if” command however while keeps repeating the scoop until the boolean expression it comes with returns false.

Now while should be handled with care and perhaps this examples show you why:

```
name = "Jeroen"
while name=="Jeroen" do
    print("Looping")
end
```

Yup, the loop goes on forever, as the expression will always be true.

But we can do something else here:

```
a = 0
b = 1
while b<10 do
     a = a + 1
     if a>b then
        a = 1
        b = b + 1
     end
     print(a..",",..b)
end
```

Well as the variable being checked by while now we don't have an infinite loop. The variable b can be changed in every cycle, but that doesn't necessarily happen (as would be the case in a for-

loop). This is one of the most common loops in most of your programming work. Since we've not yet gone into the deep of functions yet, I cannot demonstrate much more, but this does show the basic idea of what to expect on while loops.

5.3 Repeat Until

Repeat until work pretty similar to while, although it is different on a small yet essential point. Where while checks as soon as the loop starts, repeat until checks when the loop ends. Due to this it is possible with while the loop gets skip altogether, as there could be a boolean expression that is false from the start. Since Repeat Until checks at the end the loop will always be executed at least once.

```
a = 0
b = 1
repeat
      a = a + 1
      if a>b then
         a = 1
         b = b + 1
      end
      print(a..","..b)
until b>=10
```

This program is a bit of the repeat/until variant of the program I wrote earlier with while. Now if you'd make b to value 10 in the while-version of this program, you'd see nothing happens, if you do that here, you'll see the loop is performed once. In this original setup you should see any difference. Whether you should go for while or repeat/until is always a matter of judging the situation you're in as a programmer.

Please note that repeat until does not require an “end” to end the scoop the loop is in. Since until always comes at the end of the scoop, it's simply not needed.

Now here's a trapdoor, and especially when you are used to coding in C (or any of its variants) and therefore used to the do{}while() loops you can easily fall for this.

Where while keeps looping as long as the boolean expression is true, the repeat/until loops will loop like the word “until” implies, loop until the expression is true. In other words the expression must be false in order to keep looping. (It may seem a bit strange for a language developed in C to take over the standard of Pascal for this).

5.4 Break

This is a command I do not want to put too much attention on, as you can better avoid it, but when you need it, it's there. The break command will immediately terminate a loop and continue the program with the next command after it.

```
while true do -- start infinite loop
   a = math.random(1,10) -- generate random number from 1 till 10
    print(a)
    if a == 5 then break end
end
print("I have now left the loop")
```

Normally I'd use repeat until for this, but this terrible code demonstrates how break works.

The math.random() function just generates (pseudo-)random numbers and as soon as number 5 was generated the break command is executed causing the loop to end and go to the “print” command after the “end” (or until in case of a repeat/until loop).

Please note that break only works inside a loop. It has no effect on other kinds of scoops and without a loop it may even throw an error.

6. Tables

Tables is where working with Lua becomes fun. Tables are a very powerful instrument. There is a lot a programming language should support which Lua does not, however tanks to the table system you can cheat on that. Even OOP (object oriented programming) becomes possible, although Lua officially doesn't support that.

6.1 Using tables as arrays

Arrays in programming languages are variables containing a series of values. In Lua you can use tables to make this happen. Best is maybe to show this in example code.

```
a = {} -- create table
a[1] = "One"
a[2] = "Two"
a[3] = "Three"
a[4] = "Four"
a[5] = "Five"
for i=1,5 do
    print(a[i])
end
```

When you ever programmed in another language you'll be used to 0 being starting index of an array. Lua however uses 1 as starting index on an array. Never forget this or you can mess up dearly!

Although 0 can be used as an index, in array usage it will be ignored.

Well the variable “a” is thus the table and the numbers between the brackets [and] are called the indexes. Now now you can see maybe why understanding arrays is so important and how much power they can give. The for-loop at the end of the code above shows that you can use a variable to determine the index number.

The fun doesn't end there. The example above can be done with less code. Like this:

```
a = {"One","Two","Three","Four","Five","Six","Seven","Eight","Nine","Ten"}
for i=1,#a do
    print(a[i])
end
```

You can, as you can see, easily define the entire array in one line. The first entry will be index #1, the 2nd will be index #2 and so on. And #a means “length” of “a”. This sign can be used for strings and array-based tables to get the length. If it's a string #a will contain the number of characters, and in a table the number of indexes.

Now in Lua any undefined variable will be considered “nil”. Table elements are no different from this point. So a[12] will be nil, as I didn't define that index. #a will basically count from index 1 until the first 'nil'. Since a[11] is the first nil in the example above #a will therefore be 10. When you put in the line a[6]=nil, then #a will be 5 and despite 7, 8, 9 and 10 having values. They will be ignored. I'll get later on how you can properly remove values from an array.

The for loop I used in the example above is considered dirty in Lua. Many programming languages contain a workabout that we often call “foreach”. Now “foreach” is not a keyword in Lua, but the name is based on the fact that much programming languages either have “foreach” or “for” and an expression with “each” in it. Forget about that for now, let's do this the Lua way.

```
a = {"One","Two","Three","Four","Five","Six","Seven","Eight","Nine","Ten"}
for i,n in ipairs(a) do
    print(n)
end
```

The keyword “ipairs” is one you'll find a lot in Lua scripts. The “for” command will loop as always, but a bit differently than in the examples we had up until now. It will now take all indexes in order and loop the scoop tied to this until the first “nil” arrives. In the example above “i” will contain the index number during each loop cycle and “n” the value stored in that specific element.

Is the fun over of using arrays in Lua. No! Lua can do something more. Tables can be altered after their definitions. In the first example you saw you can do that one by one so adding “a[11]='Eleven'” is just a simple way to go, but in an OOP set up game, you can go even further than this, as then you can just add objects as they go. Imagine a space shooter in which enemies just fly in at random, becoming more and more? Arrays can do this.

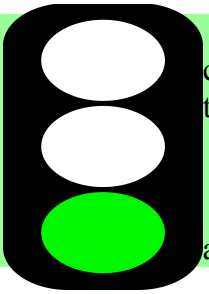
```
a = {}
-- method #1 for addition
table.insert(a,"One")
table.insert(a,"Two")
table.insert(a,"Three")

-- method #2 for addition
a[#a+1]="Four"
a[#a+1]="Five"
a[#a+1]="Six"

for i,n in ipairs(a) do
    print(n)
end
```

In the example above I've shown you two methods to add elements to an array. There is some debate among Lua programmers which method is best and even the creators of Lua are not too sure, but I personally prefer method #2.

Anyway, you can go as far as you want to go with this. There is no official limit (although there are limitations to your RAM, but don't worry about that when you are only an amateur. In my Sixty-Three Fires of Lung game, I've used with array with over thousands if not ten-thousands if elements).



Make a program and create a table and add three animal names in it in the creation instruction. Then add any number of other animals you like with either table.insert() or the a[#a+1] method I showed above.

Now make a for-loop that shows all these animals.

Lastly use a print instruction that shows how many animals there are in your array.

Lastly I will explain table.remove(). That can be used to remove one element from your array and all the other elements will be adapted to the new situation.

Try adding the line “table.remove(a,3)” in your program (assuming your table variable is “a”) just before the for-loop and run the program again and see what happens. ;)

6.2 Using tables as dictionaries and structures

Now as all programming languages should support arrays, Lua cheated a little on the array functionality. The true power of tables is now gonna be revealed. Or at least part of that. ;)

Where arrays could only use numbers for index, and which had to be all in order, tables in full work in key values and they can basically be any type. Most common for key values are strings though, and I will limit myself to that.

```
a = {}
a["dog"]="woof"
a["cat"]="meow"
a["chicken"]="bacock"
a["cow"]="moo"
for k,v in pairs(a) do
    print(k.." says: "..v)
end
```

Now you can see that in stead of numbers I used strings. Other than that you see the behavior is pretty similar to arrays. Now in stead of ipairs() I used pairs() in the for-loop... without the “i”. As the usage is pretty similar tables are when used as a dictionary easy to use.

Important to note though is that there's no specific order in which pairs() will give the data to the for-command. You can be sure that all keys and its respective values will be given to the for loop (as long as the table variable is not modified during the loop), and that is all. There are a few advanced tricks when the order is really important, but that is the more advanced stuff.

Of course, up until now I only used strings for values, but can numbers be values too?

Of course!

```
a = {}
a["George Washington"] = 1
a["Andrew Jackson"] = 7
a["Abraham Lincoln"] = 16
a["Grover Cleveland"] = 22
a["Herbert Hoover"] = 31
a["John F. Kennedy"] = 35
a["Ronald Reagon"] = 40
a["George H.W. Bush"] = 41
a["Bill Clinton"] = 42
a["George W. Bush"] = 43
a["Barack Obama"] = 44
a["Donald Trump"] = 45
for president,number in pairs(a) do
    print(president.." was president number "..number.." of the United States")
end
```

The downside is that all presidents can be shown in any order, but to come to the point, this

works.

And now we're gonna take this to the next level. Can you make a table of tables?

Yes!

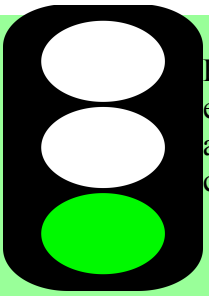
```
presidents = {}

president["George Washington"] = {}
president["George Washington"]["Gender"] = "Male"
president["George Washington"]["Country"] = "United States"

president["Park"] = {}
president["Park"]["Gender"] = "Female"
president["Park"]["Country"] = "South Korea"

president["Vladimir Putin"] = {}
president["Vladimir Putin"]["Gender"] = "Male"
president["Vladimir Putin"]["Country"] = "Russian Federation"
```

And a table in a table in a table in a table... yeah... you get the idea.



Make a table and put in it any number of fictional people you like. Like “Harry Potter” or “Frodo Baggins” or whatever. Those names are the keys. Now every element should be a table on its own containing the characters name, their gender and the name of their lover (just add the string “none” if they have none) and of course use key names you can easily recognize.

Now comes the hard part of this assignment, but with a bit of thinking you can do it. Use the for-command (you may use it multiple times if you think you need that) that lists out all these persons and all the data inside the tables attached to them.

6.3 Reference or value

It's very important that you'll understand this part of Lua, and it unfortunately *is* a bit hard to understand.

In Lua strings, booleans and numbers are value based types. And as such a boolean check such as “JohnCleese=='comedian'” works and “five==5” can work too. Arrays and tables (which are in Lua technically the same thing) are pointers. They do not contain any values, but only a reference to the memory address where the data is stored.

Now unlike C where you have to allocate the memory yourself and to release the memory yourself, Lua has this part fully automated, and the code doing this is also pretty damn fast. So at least you don't have to worry about that part, but I will show you a few trapdoors if you are not aware of how the pointer based structure works.

```
a = {}
b = a
a["Hello"] = "Hi"
print(b["Hello"])
```

Did the output say “Hi”?

It did, didn't it?

But how is that possible when you didn't define “Hello” in b?

That is because the “b = a” instruction did not copy the data in a, it only copied the pointer, the reference to where in the memory 'a' is stored. Now since a and b have now the same memory address, everything you change in “a” will therefore automatically affect “b” and vice versa.

The same trapdoor also happens here:

```
a = {}
b = {}
a["Hello"]="Hi"
b["Hello"]="Hi"
print(a==b)
```

You could have expected “true” as the outcome since a and b have the same data, but what the boolean checker checks is the true data in the variables themselves which happen to be the pointers, and they are different.

```
a = {}
b = a
a["Hello"]="Hi"
b["Hello"]="Hi"
print(a==b)
```

This version of the code, will result in true.

This goes for the table and function type variables (and strictly speaking for the userdata type as well, but that is only important if you are going to make C-APIs for Lua and that's something I am not gonna cover in this book).

This is maybe one of the more complex parts of Lua to understand for beginning programmers, but once you do you are well on the road. Also there are many other languages in which the same kind of rules apply as I now explained for Lua. Python, BlitzMax, C# to name a few.

6.4 The dot syntactic sugar

Syntactic sugar means a notation that is not official, but the parser will still accept it as legit.

Lua is full of these sugar things. Since Lua has no support for “structs” and “classes” which are deemed essential in programming these days, Lua invented a few ways to cheat around.

Now I won't go into the dept what “structs” and “classes” are, as structs are only relevant to refer to when you have experience in C and the C programmers should know what they are, and classes will be discussed when we get to the Object Oriented Programming part of Lua (or rather how Lua cheated its way around in this with syntactic sugar as well).

Let's suffice to say that in C you can often see this kind of code

```
a.AnimalName = "Cow";
a.Sound = "Moo";
a.Food = "Grass";
b.AnimalName = "Cat";
b.Sound = "Meow";
b.Food = "Birds and mice";
```

Basically a and b are struct variables then. In Lua we can simply use tables for this.

```
a = {}
a.AnimalName = "Cow"
a.Sound = "Moo"
a.Food = "Grass"
b = {}
b.AnimalName = "Cat"
b.Sound = "Meow"
b.Food = "Birds and mice"
```

Now what good does this do?

Well, add this line to your code and be surprised:

```
 print("a "..b["AnimalName"].." says '"..b["Sound"].."' and eats
"..b["Food"]..".")
```

What did we see? What did we learn.

Yes in Lua “a.Sound” and “a[“Sound”]” are the same thing. This makes a shorter notation for tables and their keys and gives C-junkies the illusion they are actually using struct variables, so they are also happy.

What is very extremely important to note:

First of all, this only works when the key value is a string. So saying “a.1” instead of “a[1]” will lead to a crash, and when the key value is a reserved word in Lua (also known as “keyword”) you also got a problem. “a[“for”]” is valid “a.for” is not. This because “for” with quotes is just a string, but as for without them is not, Lua won't understand what you are doing. Fortunately the number of keywords in Lua is rather small.

7. Functions

In order to make Lua communicate well with the underlying C program, or for quick programming in general, Lua heavily relies on functions. I told you in the “Hello World” lesson that 'print' is a function. And the 'pairs' and 'ipairs' I discussed in the arrays and tables chapter are functions as well.

7.2 General approach

You can think of them as a kind of 'mini-programs' in your main program, yet they can be called whenever needed and even return data.

Let's put up a simple example:

```
function Bart()
    print("Yo!")
    print("Hey! What's happenin', dude!")
end

Bart()
```

So the function keyword is used for defining functions. And the two 'print' calls are now part of the function named “Bart”. And yes, just typing Bart() calls it.

Now I see you wonder. The “print” function accepts data to put on screen. Can I do that too?

Of course, easy as pie!

```
function ShowSum(a,b)
     print(a+b)
end

ShowSum(4,5)
-- Outputs 9
```

Now I like to call these functions “void” functions (after the keyword 'void' that you use in C to define these kinds of functions), as they are not designed to return data. But in Lua you can also make functions return values, and those can be values of ANY kind:

```
function TimesFour(a)
     return a * 4
end


print ( TimesFour(2) ) -- outputs 8
```

The code is pretty self-explaining. “a” is now automatically created as a local variable. It can therefore only be called inside the TimesFour function. By calling TimesFour(2) this local variable contains the number 2, and the return command ends the execution of function TimesFour() and returns outcome of a*4 or in this case 2*4 and since that is 8, that is what the print function will display.

As you can see a function can accept no values, multiple values, but can it also return multiple values. Well, yes, in Lua it can, and it's shockingly easy to do so, also!

Trust me!

```
-- double, triple, quadruple
function dtq(a)
   return a*2,a*3,a*4
end

value=20
doubled,tripled,quadrupled = dtq(value)

print(value)
print(doubled)
print(tripled)
print(quadrupled)
```

So yeah, all you need the function to do is to place all the values behind the “return” keyword separated by commas and you can just get them like shown above with all variables noted all at once.

Now there's also a drill. In Lua you can expect more values than there will be given/returned. Lua will just go on, and the values that are not given will be “nil”.

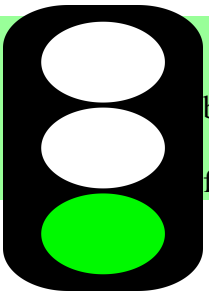
```
function myfunc(a,b)
    print(a)
    print(b)
end

myfunc("Hello")
-- outputs
-- "Hello"
-- nil

function myreturn()
    return 1,2,3
end

a,b,c,d,e = myreturn()

print(a)
print(b)
print(c)
print(d)
print(e)
-- You'll get
-- 1
-- 2
-- 3
-- nil
-- nil
```



Make a program which has a function saying hello.
A function that returns the sum and the product of two values, and return them both in once, and catch them in two variables.
Now make the program say hello with your function and print the results of the function returning the sum.

7.2 Cyclic or recursive function calls

This is the magic of making functions call itself. Yes that is possible yet risky. Doing this will carelessly will cause in infinite loop and can be costly on your RAM. Now Lua has been protected against this and will eventually cause a “stack overflow” error, but you want to prevent his.

However when done right, this can be a very handy tool at your disposal.

Traditionally nearly all programming guides for all programming languages create a factorial function to demonstrate this process.

```
function factorial(n)
    if n==0 then return 1 end
    return faculty(n-1)*n
end


for i=1,9 do
    print( "!"..i.." = "..factorial(i) )
end
```

Well I only added the for-loop so you can see this program can successfully calculations the factorials of 1 till 9. Now the true nature of a factorial can be read in this wikipedia article, but is not really relevant for our Lua lessons, so I will not go too much in the deep of that.

The easiest way to calculate factorials is though to always deem factorial 0 as 1, and all next factorials as the factorial as the number before times the number you have. More complicated than it needs to be, but anyway, you can see how the factorial recalls itself in a cyclic manner in order to come to the full number.

I will not give any assignments on this one, but it's just handy you know that this routine exists.

Oh yeah, I warned you for infinite loops... let's give you one!

```
function wrong()
    print("This will go wrong")
    wrong()
end

wrong()
```

Now the playground will most likely terminate this program before the stack overflow goes off, but the cli tool and real-time Lua engines will eventually throw an error.

7.3 Treating functions as variables

Now I told you that “function” was a variable type. So maybe you could draw the conclusion yourself already that functions are in Lua just variables, they only contain a pointer to code in stead of data. Now this will be very important when you get into OOP programming, but I will get into that part later.

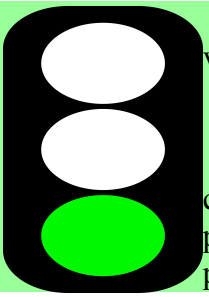
Officially the function commands as I used them in the previous section are “syntactic sugar”. The official way to write “function hello()” would actually be “hello = function()” in Lua, although, in most situations not a single soul uses that notation, that does not mean it's not important to know as

it can do great things.

```
function GetMeAFunction()
   return function()
         print("Hello World")
   end
end

hello = GetMeAFunction()
hi = hello
hi()
```

I guess this might be one of the most complicated versions of “Hello World” you've ever seen, but it demonstrates how you can easily use functions themselves as variables. As soon as you don't give up the (and the), the function will be treated as any other variable, and thus I could easily turn the variable hi into a function with the “hi=hello” command.



Now create a function the way you were used to do, and copy it to another variable, and make a call to this variable.

And a little test for you to see if you have understood the way Lua works completely. You don't have to feel ashamed if you don't know the answer, but it is possible to make Lua forget about a function. Do you know how? If not, no problem, but if you know, you're on the way to become a pro.

7.4 Functions and tables, and a way to fake classes. The way to OOP.

Now a lot of programming languages work with classes, and C# in particular can't cope without them.

This is an example of a class in C#

```
class ohyeah{
    public int i=0;
    public void changeme(int newvalue){
          i = newvalue;
    }
}
```

In C# this would enable me to create a variable of the type “ohyeah”, let's name it “y” for now, and when I type y.changeme(4) then y.i will thus be 4... well this is the basic idea. Now void changeme acts here as a function tied in to this class and we call that a method, and due to that it will know that “i” belongs to the class.... Do you understand this? If not, then don't fret, as Lua has no support for this at all.

Then why did I mention this. As the example above is basically a textbook example for OOP programming, and although Lua does officially not support OOP, Lua can cheat its way around that to “pretend” an OOP environment, and to fake the class system, and that's what we're getting into today.

The cheat I'm gonna explain to you, lies in stuff I explained to you before. Tables. In section 6.4 I already presented you with the syntactic sugar using dots in stead of [], right. Well, we're gonna exploit that part a little bit more.

OOP, which is the acronym for “Object Oriented Programming”, came to be as people realized over time how important it is not to think in data in general, but but to objects, and to also tie the code to objects, as well. Now this can allow us easily for example in a space shooter game to make all the enemies move independently, and to carry all the data they need, and even all the functions they need.

This way of programming can be a bit hard for a beginner to understand as it's a rather abstract way of programming, and when you really dive into the depths of OOP, you will no longer be just doing a bunch of code line by line and hop over to the next when you're done, etc, etc. So proper thinking is required.

Don't let that all discourage you though. Once you got the hang of OOP, you will not easily want to put it away, and especially in game programming, OOP can work wonders.

Before we begin on this, I did tell you that functions were nothing more but variables, right. Let me work out that class I showed you in C# at the beginning of this chapter in a Lua workout.

```
function ohyeah()
    return {
          i=0,
          changeme = function (self,newvalue)
              self.i = newvalue
          end
    }
end
```

Yeah, that looks pretty cool, huh?

I won't blame you if you do not fully understand it. Like I said, as Lua doesn't understand classes I created this function to fake my “ohyeah” class. It returns a new table, and yes as you can see Lua allows me to immediately define keys in it. You should make sure that every field is separated by commas though, and that means that if you put in a function this way a comma will be required after the end if you have more keys to add after that function.

Now let's use add a few lines of code in order to take “ohyeah” into action.

```
a = ohyeah()
a:changeme(4)
print(a.i)
```

Now can you see what I did here?

Well “a = ohyeah()” is very likely the easy part. Now a contains a table with the number in “i” and the function in “changeme”. And “print(a.i)” should speak for itself.

But how about “a:changeme(4)”?

Yup, this is syntactic sugar. Lua will translate “a:changeme(4)” into “a[“changeme”](a,4)” (or as a.changeme(a,4) if you prefer), and I guess the call will then make more sense, won't it?

With the “:” operator after a table's name, Lua will automatically add the table itself as the function's first parameter, and add the parameters I manually added. This is as close as Lua can get to method calls. Keeping this in mind now “self.i” inside changeme will make sense.

Now keep the code as you have it and add these lines, and try to understand what they do prior to checking the result on the playground.

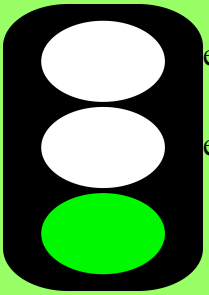
```
function a:doubleme()
     self.i = self.i * 2
end

a:doubleme()
print(a.i)
```

Syntactic sugar?

Definitely!

If you define a function like this Lua will translate it as “a.doubleme = function(self)”, and this makes things very easy now, isn't it?



I will now do things a differently than you are used to see, but I want you to examine the following code, and try to predict the output. Write it down if you will.

Then you can copy the code in the playground to check if the output is what you expected. If so, you are well on the way.

```
template = {
     x = 0,
     y = 0,
     s = 5
}

function template:move(x,y)
     self.x = self.x + x
     self.y = self.y + y
end

actors = {}
for i=1,10 do
   newactor = {}
   actors[#actors+1] = newactor
   for k,v in pairs(template) do newactor[k] = v end
   newactor.x=i
   newactor.y=100-i
end


for cycle=1,10 do
  for i,actor in ipairs(actors) do
    print("Actor #"..i)
    actor:move(i,-i)
    print("Position ("..actor.x..","..actor.y..."), speed: "..actor.s)
  end
end
```

Now let's make a little variation to this. If you have understood the code above, you will know this code will run 10 cycles with 10 actors. If you have really understood everything, then try to find how you can make a new actor be added to the actors table prior to the for-ipairs loop.
This may be the hardest task so far, so think it out well.

7.5 Local variables

Before we move on to chapter 8 in which we will prepare for some actual game coding, first an easy section after the complicated OOP stuff. Local variables. Up until now we've only worked with global variables, except for the variables created in for-loops and function parameters.

Locals only live in the function or scoop in which they are created. Now all variables (even functions) can be local. In Lua all you have to do is to put the keyword “local” prior to their definition.

```
function lv()
   local x = 40
   print(x)
end

lv()
print(x)
-- output
-- 40
-- nil
```

Since the “local” keyword told Lua to keep “x” local to the function lv, the x=40 definition only affects the print(x) inside that function, and that's why the second print(x) outputs nil. Well, and if the local keyword is not present when a variable is created Lua will assume it's a global.

Now here are a few things to keep into account.

```
x = 70

function lv()
   local x = 40
   print(x)
end

lv()
print(x)
-- output
-- 40
-- 70
```

At the start of the program I now created x as a global, and yet inside lv x behaved as a local as told, and the print(x) outside the function returned the 70 as I originally asked for.

Now what Lua does when you use the local keyword is always create a new variable, and if a global or a “higher-level” local (more on that later) already exists, it will simply put emphasis on the local created within that scoop and ignore everything else until that scoop has ended.

Now locals can not only be used inside functions, but inside any kind of scoop:

```
function test()
  local a = 10
  if a == 10 then
     local b = 20
     print ( b )
  end
  print( b )
end

test()
```

See what I mean? Since b was defined as a local inside the “if”-scoop, the print(b) outside the “if”-scoop became “nil”...

```
function test()
  local a = 10
  local b = 80
  if a == 10 then
     local b = 20
     print ( b )
  end
  print( b )
end

test()
```

And now this, and now the output will be 80 and 20. Value 80 is in b tied to the function as a whole, and the b containing 20 to the if-scoop, hence the output the way it is.

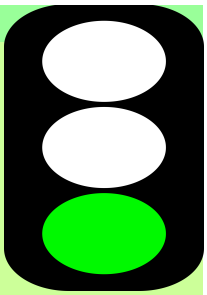
But what about locals that are made a local in the function as a whole, but not inside the sub-scoops? Let's try it!

```
function test()
  local a = 10
  local b = 80
  if a == 10 then
     local b = 20
     print ( a )
     print ( b )
  end
  print( b )
end

test()
```

Well, as you can see, since “a” was not recreated inside the “if” scoop and the “if” scoop being part of the function scoop, a was just taken the way it was in the higher scoop.

Does this code work, and if not, why not?



```
function test1()

    print("test1")

    function test2()
       print("test2")
    end

    local function test3()
       print("test3")
    end

end

test1()
test2()
test3()
```

fd

dfdf

s

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