



## Make a Digital Magic 8 Ball

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In this activity you will build your own Magic 8 Ball using your Raspberry Pi, a Sense HAT, and some Python code. A Magic 8 Ball is a toy which you ask a closed question to, then shake, and it will give you a prediction.

### Using IDLE 3 on Raspberry Pi

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A great way to write your code and test it in intervals is to use IDLE 3, a development application for Python. You will be writing your code in Python 3.

1. Click on Menu > Programming > Python 3 (IDLE)
2. Once the Python shell window has loaded, click on **File** and **New File**. This will open a text editor window in which you can write, save and test your code.
3. Save the blank file as `magic8ball.py` by clicking on **File** and **Save As**.

### Printing replies to the screen randomly

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A good way to start your Magic 8 Ball program is to first create a text version of a Magic 8 Ball program. Let's think about what a Magic 8 Ball does. First you ask it a question, before shaking the ball, turning it over and then reading a reply that it has randomly chosen. Therefore, you will need a list of replies and a way of randomly choosing one from the list and displaying that answer on the screen.

1. First you need to import the `choice` function from the `random` library and the `sleep` function from the `time` library. Type the following into your `magic8ball.py` text file:

```
from random import choice
from time import sleep
```

- Using the `print` function you can print text to the screen, to the person using your program. Type:  

```
print("Ask a question")
```

- Then there needs to be a pause before the program responds with a reply, so that the user can ask a question. You can use the `time` library to ask the program to sleep for a set amount of time, like this:  

```
sleep(3)
```

The program will pause for three seconds. You can change this value to make the time longer or shorter.

- Now create a list of replies that the program could give to the question.

*Lists can be named in much the same way as variables; for example, `number = [1, 2, 3, 4]`. This list called 'number' has four items in it. Your list will contain strings of text that will be displayed on the screen. These strings will be quite long.*

To create your list, type:

```
replies = ['Signs point to yes', 'Without a doubt', 'You may rely on it',]
```

Add as many replies to your list as you like. Make sure that you separate each reply with a comma.

Finally, an instruction is needed to select an item from the list at random and then display it on the screen. You can use the `random` library to do this by typing:

```
print(choice(replies))
```

- Save your code by clicking on **File** and **Save**. Then run your program to test it works by clicking on **Run** and **Run Module**. You should see a similar output to this in the IDLE 3 shell window:

```
Ask a question
Looking good
```

## Display text on an LED Matrix

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Now that you have text outputting to the Python 3 shell window on your screen, let's change the code so that the text scrolls across the LED Matrix on your Sense HAT. To do this, you will need to use the SenseHat library and replace the print functions with a SenseHat `show_message` function.

- Underneath the imported modules section of your code, add the following lines:

```
from sense_hat import SenseHat
sense = SenseHat()
```

- Next replace `print` with `sense.show_message` in your code. There are two places where you will need to do this.

3. Save your program by pressing **Ctrl + S** on your keyboard.
4. Press **F5** to run and test your program.
5. You may find that the text is slow to scroll across the LED Matrix on your Raspberry Pi. To speed up the text you can add `scroll_speed=(0.06)` to your text strings like this:

```
sense.show_message("Ask a question", scroll_speed=0.06)
```

## Shake to start

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Traditional Magic 8 Balls require the person asking a question to shake it before a reply is given. This can be simulated with a Sense HAT using the accelerometer, which measures vibrations and movement. Accelerometers can be found in most smartphones that change the direction of the screen depending on which way you hold the device.

Let's use the accelerometer on the Sense HAT to detect any change to the amount of g-force acting on each of its axes (x, y and z) before it runs the part of your program that gives a random answer to the user.

1. First you need to create a continuous loop in your code to check the amount of the accelerometer's movement. You can use a `while True:` loop to do this. Underneath your list of replies, type:

```
while True:
    x, y, z = sense.get_accelerometer_raw().values()

    x = abs(x)
    y = abs(y)
    z = abs(z)
```

*Note that capital letters and indentation are very important in Python. Make sure that you use 4 spaces to indent after a `:` line.*

Using `abs` converts any number into a positive number, which means that it will ignore the direction of shaking and check for the amount of shake!

2. Now it is time to set a condition in our code that checks to see if the x, y and z axes have changed (i.e. it is being moved) before it selects a random reply. If it does not detect movement then a reply will not be given.

```
if x > 2 or y > 2 or z > 2 :
    sense.show_message(choice(replies))
else:
    sense.clear()
```

The program is checking to see if the axes of x, y and z are greater than the value 2. By changing this value you can change how sensitive the program is to movement. If you want someone to have to really shake the Raspberry Pi and Sense HAT a lot, use a higher value.

3. Save your program by pressing **Ctrl + S** on your keyboard.
4. Press **F5** to run and test your program.