Lab 8: Refining the GUI

This week we will make our 2048 GUI more attractive using better colours. We will also implement "game over" and "well done" messages and allow the user to restart.

Setting the basic background colours

The first step is to grab colours from the online version of the game. If we visit the site and view the styles applied to the game elements, or use a colour picker tool, we can extract the precise colours used.

Let's declare them as named constants above our `Game` class.

```
bg1 = "#faf8ef"
bg2 = "#bbada0"
bg3 = "#cdc1b4"
fg1 = "#776e65"
```

> `bg1` is the colour of the main background
>
> `bg2` is the colour of the frame, around and between tiles
>
> `bg3` is the colour of an empty tile
>
> `fg1` is the main text colour

Now we can set the background of the entire window to `bg1` by updating the existing call to `self.configure`.

```
self.configure(padx=50, pady=50, bg=bg1)
```

You should see that we also need to set the two score label backgrounds to the same colour and apply the foreground colour too.

```
tk.Label(text="SCORE: ", font=normal, bg=bg1, fg=fg1).grid(column=0, row=0)
tk.Label(textvariable=self.score, font=normal, bg=bg1, fg=fg1).grid(column=1,
row=0, sticky="w")
```

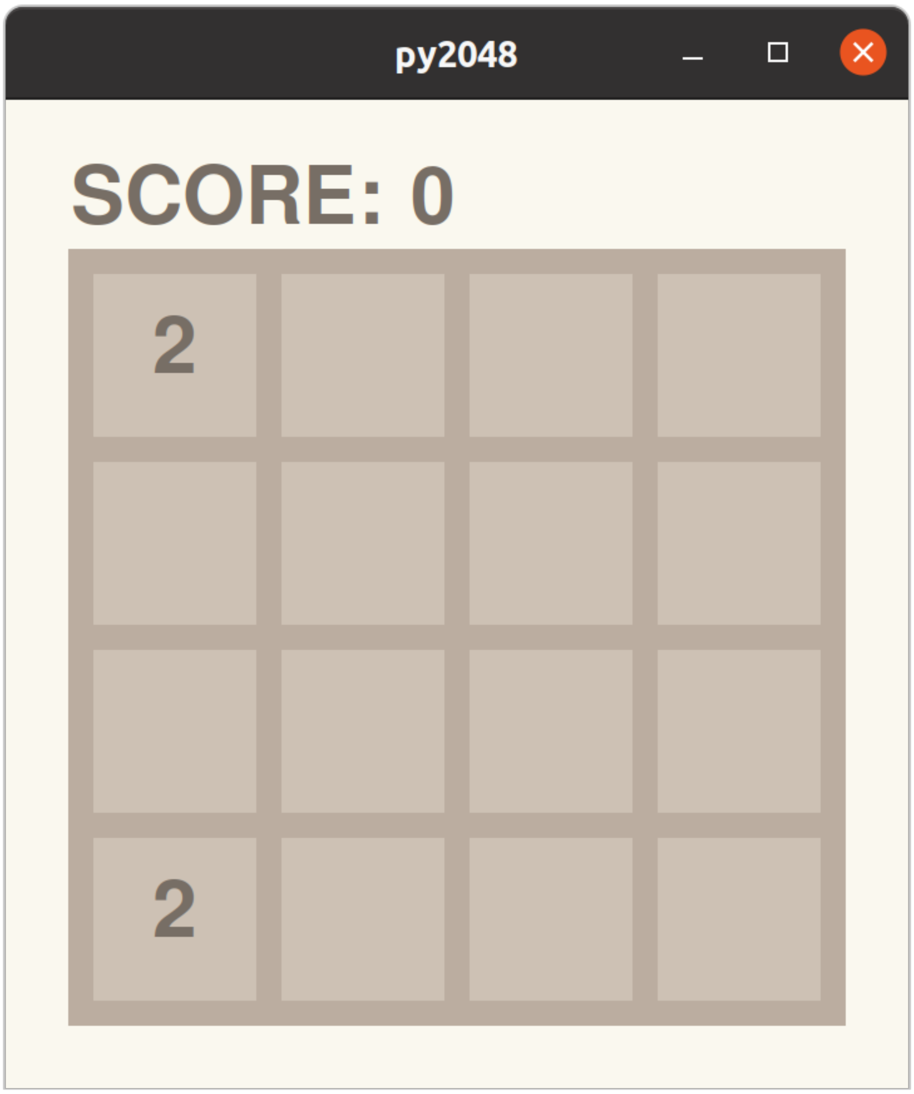
Now we can also set the background of the frame to `bg2` by updating the following line.

```
frame = tk.Frame(padx=10, pady=10, bg=bg2)
```

Finally, we will set the tiles to `bg3` and `fg1` by updating the appropriate line.

```
tile = tk.Label(frame, textvariable=self.tiles[(row, col)], font=normal, bg=bg3,
fg=fg1)
```

The result should be much closer to what we want.



However, its not quite right. The numbered tiles should each have a different colour.

Setting the tile colours

Tiles are implemented as labels and so, to change their background colour, we need to call their `configure` method and pass in the new colour value as an argument.

The colours we need are as follows, for each tile value up to 2048. Add this to your file, somewhere at the top.

```
tile_colours = {
    2: "#eee4da",
    4: "#eee1c9",
    8: "#f3b27a",
    16: "#f69664",
    32: "#f77c5f",
    64: "#f75f3b",
    128: "#edd073",
    256: "#edcc62",
    512: "#edc950",
    1024: "#edc53f",
    2048: "#edc22e"
}
```

We can now implement a customised version of the standard `tk.Label` widget that automatically updates its colours accordingly.

```
class Tile(tk.Label):
    """
    A custom label whose colours and font are determined by the value it's given
    """
    def __init__(self, parent):
        super().__init__(parent, anchor=tk.CENTER)

    def set(self, value):
        self.configure(
            text=value or " ",
            bg=tile_colours.get(value, "#cdc1b4")
        )
```

Add the class to your code. We can see it has two methods. The `__init__` method takes a `parent` argument and passes it to the `tk.Label.__init__` method along with another argument `anchor` which sets the label to be centrally aligned.

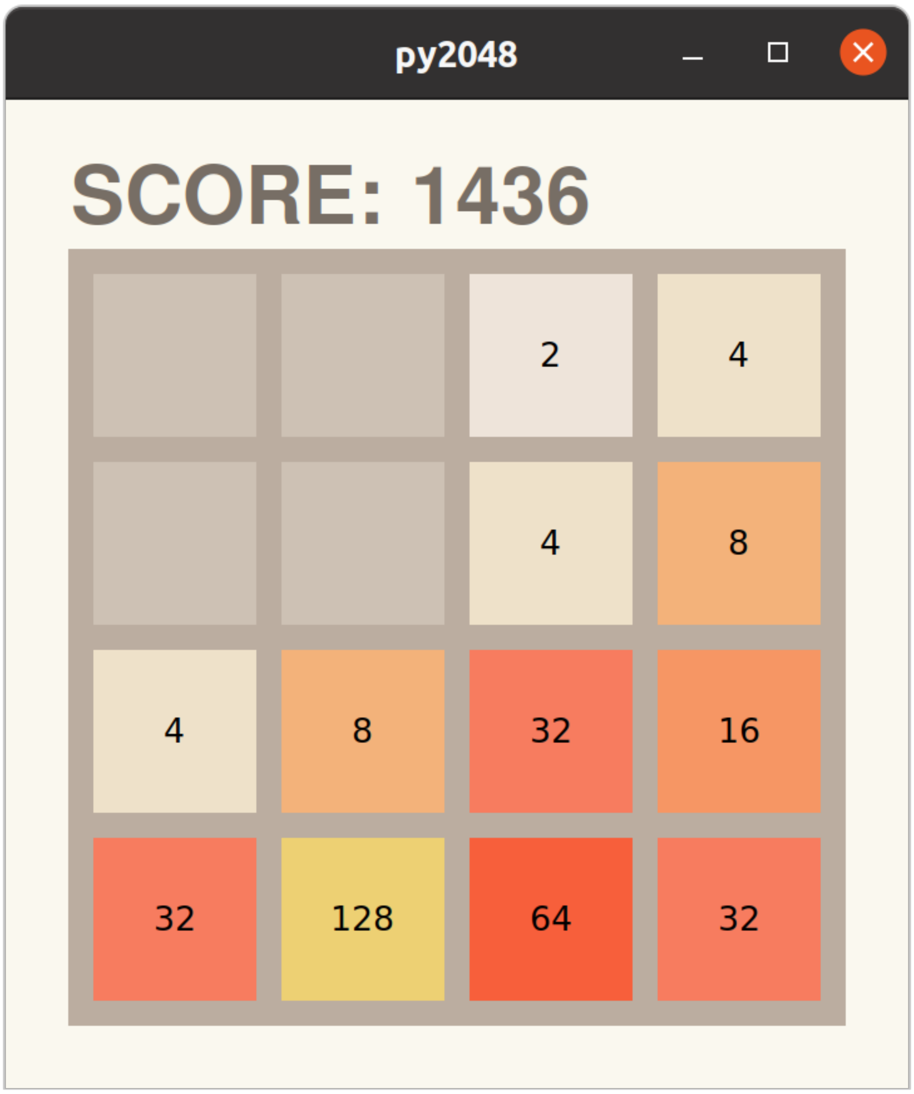
The second method, `set` is the key here. It takes a value as an argument (e.g. `None` or `2`) and calls the `tk.Label.configure` method accordingly. It sets the `text` property to `value or ""` just as we were doing already. But it also sets the `bg` property to a value drawn from the `tile_colours` dictionary.

> Note that `dict.get()` takes an optional second argument which provides a default value to use if the requested key is not found. We use this to set the empty cell colour. This colour would also be used if we reached `4096` in a cell, since we have not defined a colour for this.

The final change is to the `self.tiles` dictionary within the `Game` class. We change it to contain instances of our new `Tile` widget, which we place on the `grid` instead of the `tk.Label` widgets we had.

```
self.tiles = {}
for row in range(4):
    for col in range(4):
        self.tiles[(row, col)] = Tile(frame)
        self.tiles[(row, col)].grid(row=row, column=col, sticky="news", padx=10, 
pady=10)
```

Now, try to run the game and you should see the tiles change colour automatically.



> Surprised? This works because we are already calling `set` on the tiles in the `update` method.

Fonts and foreground colours

Notice we have lost the use of our `normal` font and that the font colour is wrong. We can easily update this within the same framework.

Add the following additional constant data at the top of your file with the `tile_colours` dictionary.

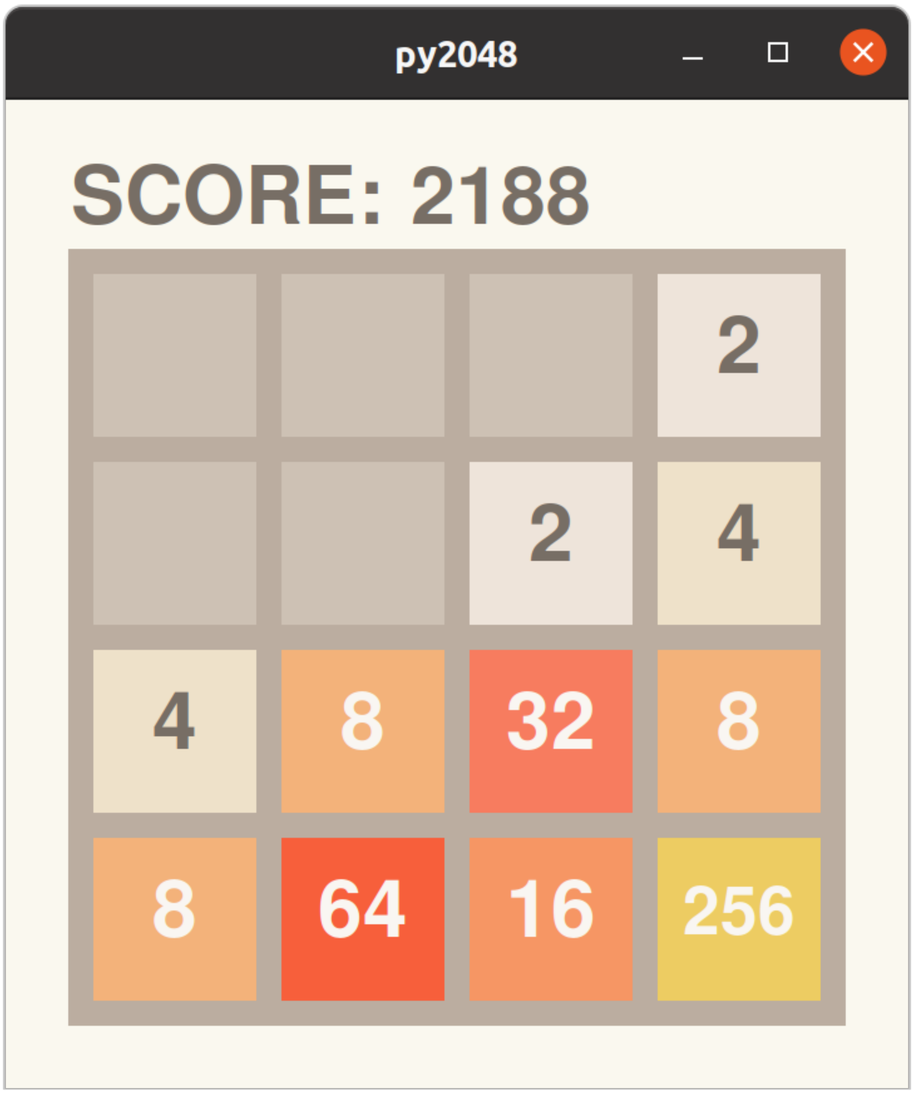
```
font_colours = {
    2: "#776e65",
    4: "#776e65"
}

fonts = {
    128: ("Helvetica", 20, "bold"),
    256: ("Helvetica", 20, "bold"),
    512: ("Helvetica", 20, "bold"),
    1024: ("Helvetica", 16, "bold"),
    2048: ("Helvetica", 16, "bold")
}
```

Above, we are defining the unusual cases. Now, we can set the default values by updating our new `Tile.set` method.

```
def set(self, value):
    self.configure(
        text=value or " ",
        bg=tile_colours.get(value, "#cdc1b4"),
        fg=font_colours.get(value, "#f9f6f2"),
        font=fonts.get(value, normal)
    )
```

Try again. The game should look pretty much as we want.

> Feel free to change the colour scheme



The game is nearly complete.

However, if you play a game to completion, when there are no longer any moves available, the game just stops. We want to display a "GAME OVER" message and allow the player to restart.

Adding a restart option

Restarting the game requires resetting the grid to the starting position and setting the score back to zero. We already do this in the `__init__` method, but we would like to extract this functionality into a method we can call on demand.

Create a new `restart` method as follows.

```
    def restart(self):
        self.grid = [[None, None, None, None],
                     [None, None, None, None],
                     [None, None, None, None],
                     [None, None, None, None]]

        self.set_random_empty_tile(2)
        self.set_random_empty_tile(2)
        self.score.set(0)
        self.game_over = False
        self.update()
```

Most of this code came directly from your `__init__` method. Remove the repeated lines from your `__init__` method. Notice that setting the score requires a new line. Also, we initialise the `self.game_over` property which we will use in the next section.

Finally, we can call the new method and provide the user access to our new feature by binding the `<KeyPress-r>` event.

```
self.restart()
self.bind("<KeyPress-r>", lambda ev: self.restart())
```

You should now be able to restart the game by pressing the `r` key at any time.

Detecting and reporting game over

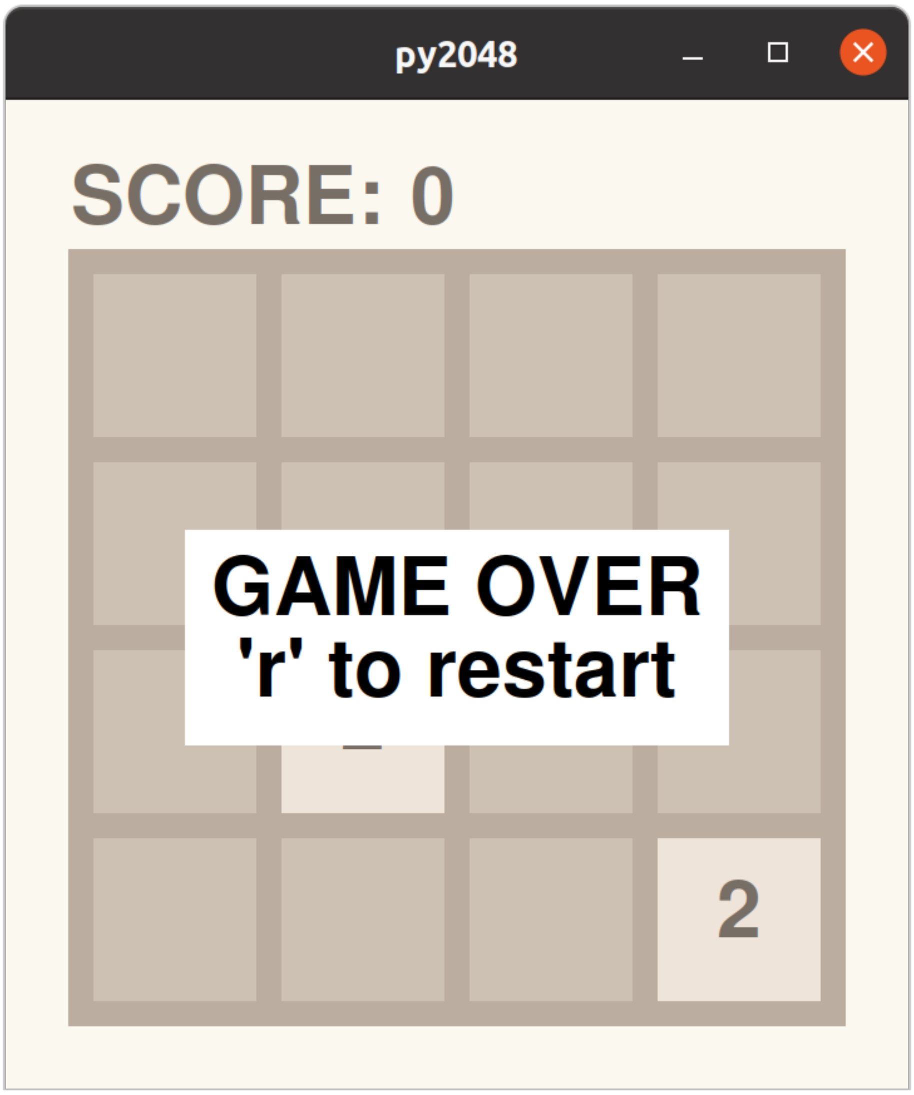
In this final step we will display a labe showing a "game over" message and implement the logic to show the message when the game over state is detected.

We can start by creating a label for the message and placing it on the main window.

```
self.game_over_message = tk.Label(
    text="GAME OVER\n'r' to restart",
    font=normal,
    bg="white",
    padx=20,
    pady=20
)
self.game_over_message.grid(row=1, column=0, columnspan=2)
```

> Do this in your `__init__` method.

Run the game and you should see the message slapped on top of the grid.



But, obviously, we don't want to show the message unless the game is actually over. We can implement this very simply using `widget.remove_grid()` to hide the prepared message.

Add the following to the end of your update method.

```python
if self.game_over:
    self.game_over_message.grid()
else:
    self.game_over_message.grid_remove()
```

Now, try running the game. The message should no longer appear unless there are no more legal moves.

So that's it. We are finally done.

Challenges

There are many more features you might want to consider adding, but these will be left for you to consider.

- remember the highest score (maybe write it to a file?)
- present a "well done" message when the user achieves a 2048 tile.
- Make the user interface stretch to fit the window.