





















A hand-drawn illustration of a hand, palm facing forward. The hand is shaded in light gray and outlined with thick black lines. On the palm, the text "A18" is written in a dark gray, hand-drawn font. Below it, a thick black horizontal line is drawn across the palm. Underneath this line, the text "3PM!" is written in the same dark gray, hand-drawn font.

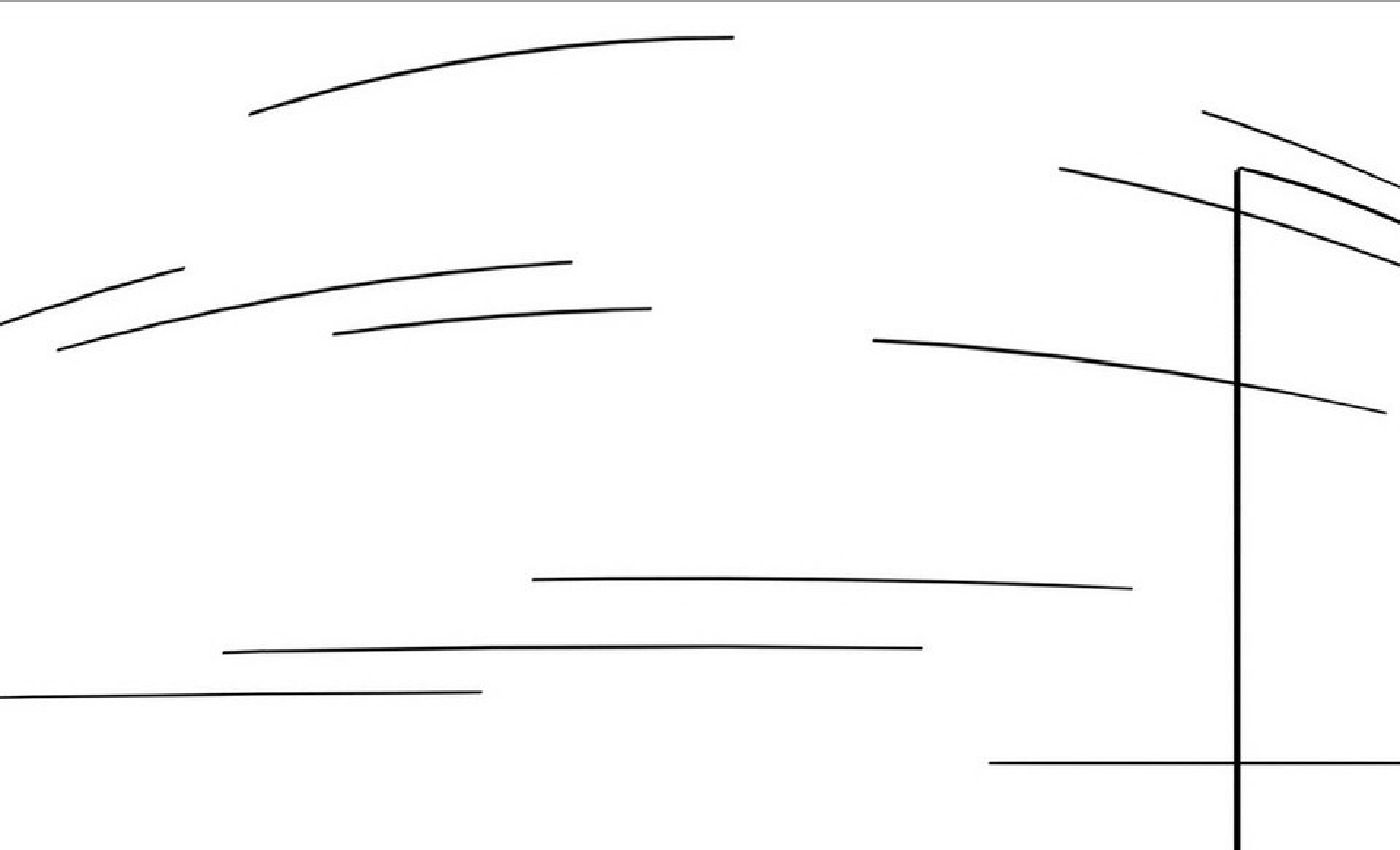
A18

3PM!





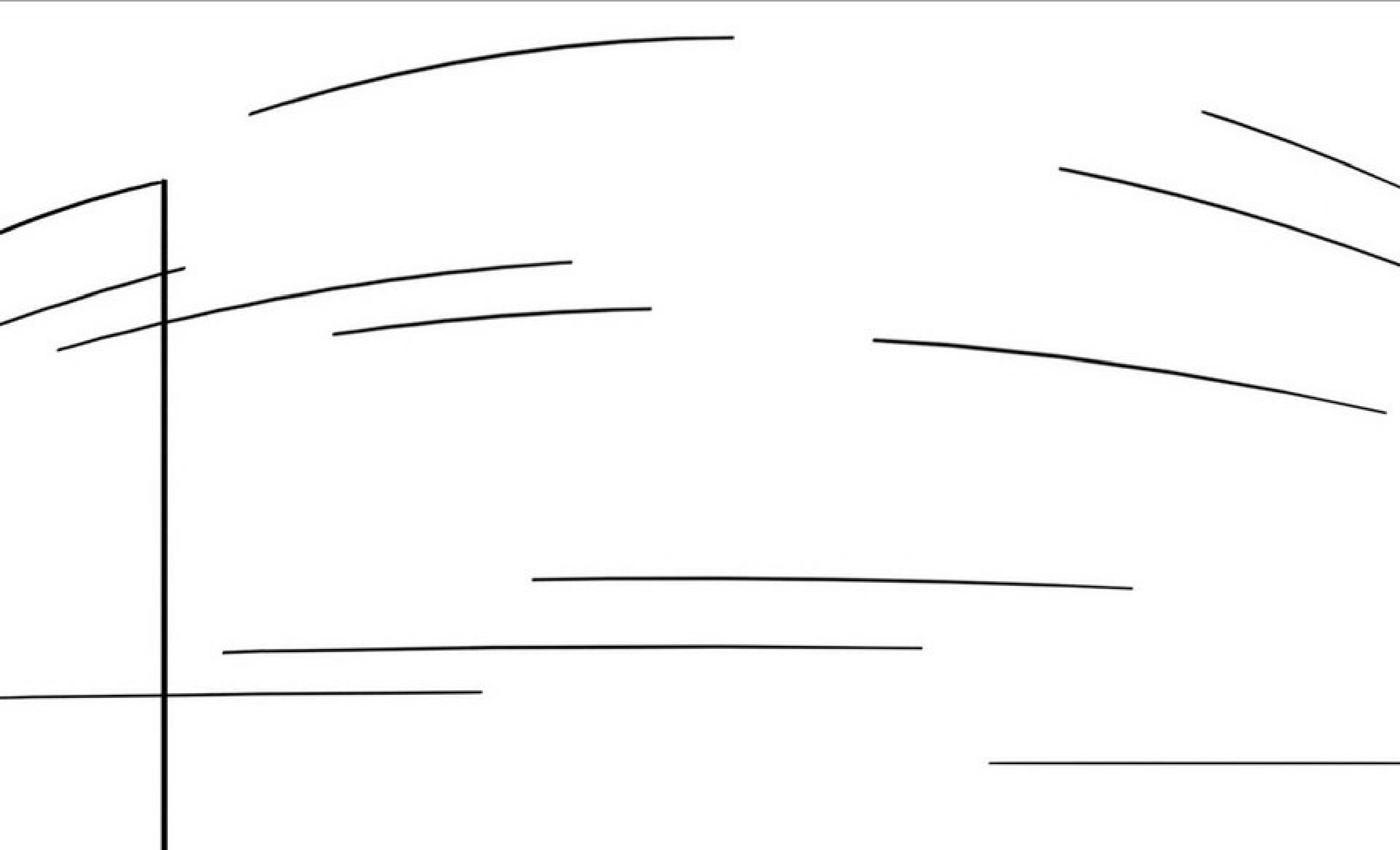


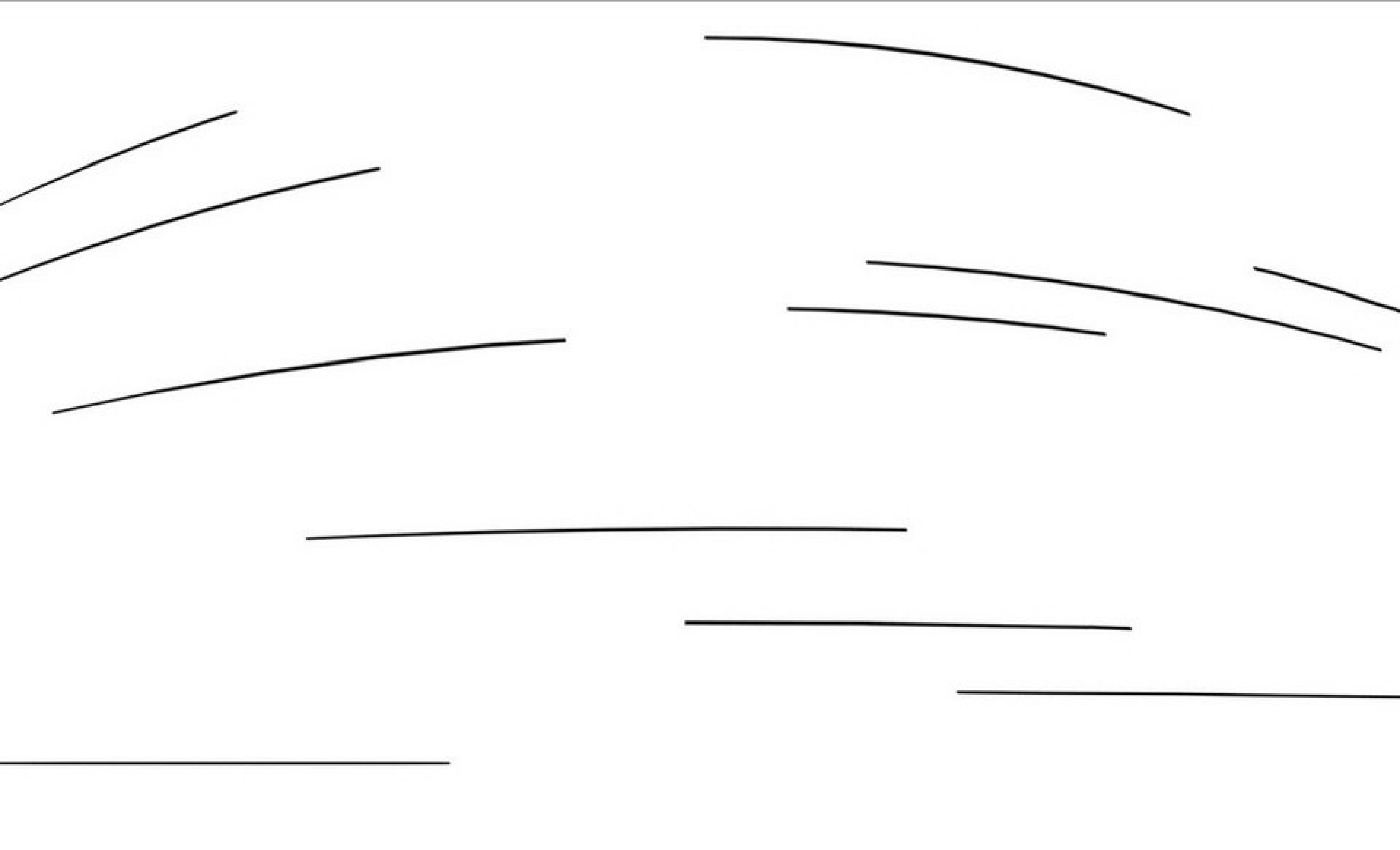


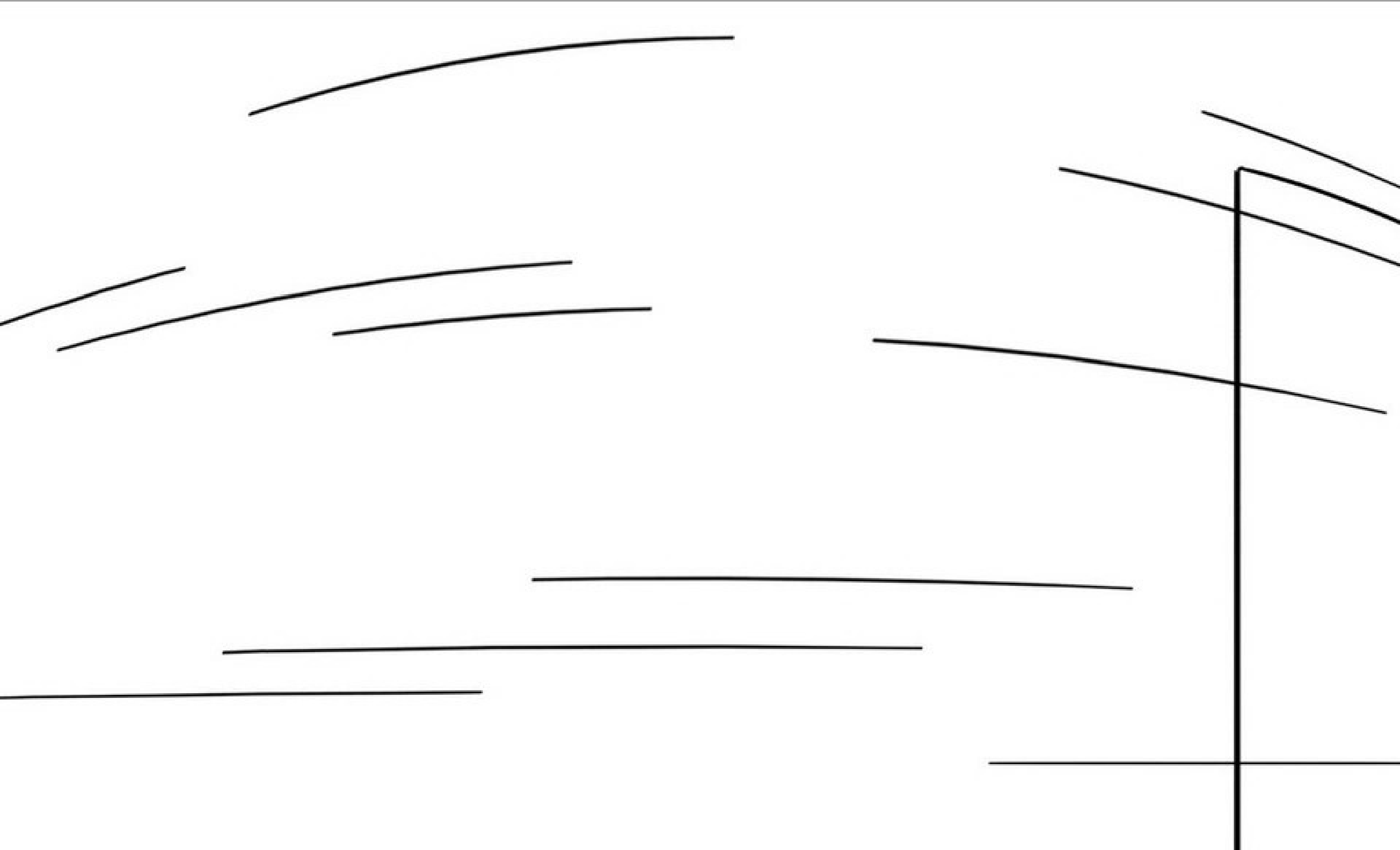


A hand-drawn diagram consisting of several lines. Two vertical lines are positioned on the left and right sides. A horizontal line crosses both. A smaller horizontal line is located below the main horizontal line. In the center, a box with a slightly curved top and bottom contains the text 'B18'. Several other lines are scattered around the diagram, some parallel to the main lines and others at different angles.

B18

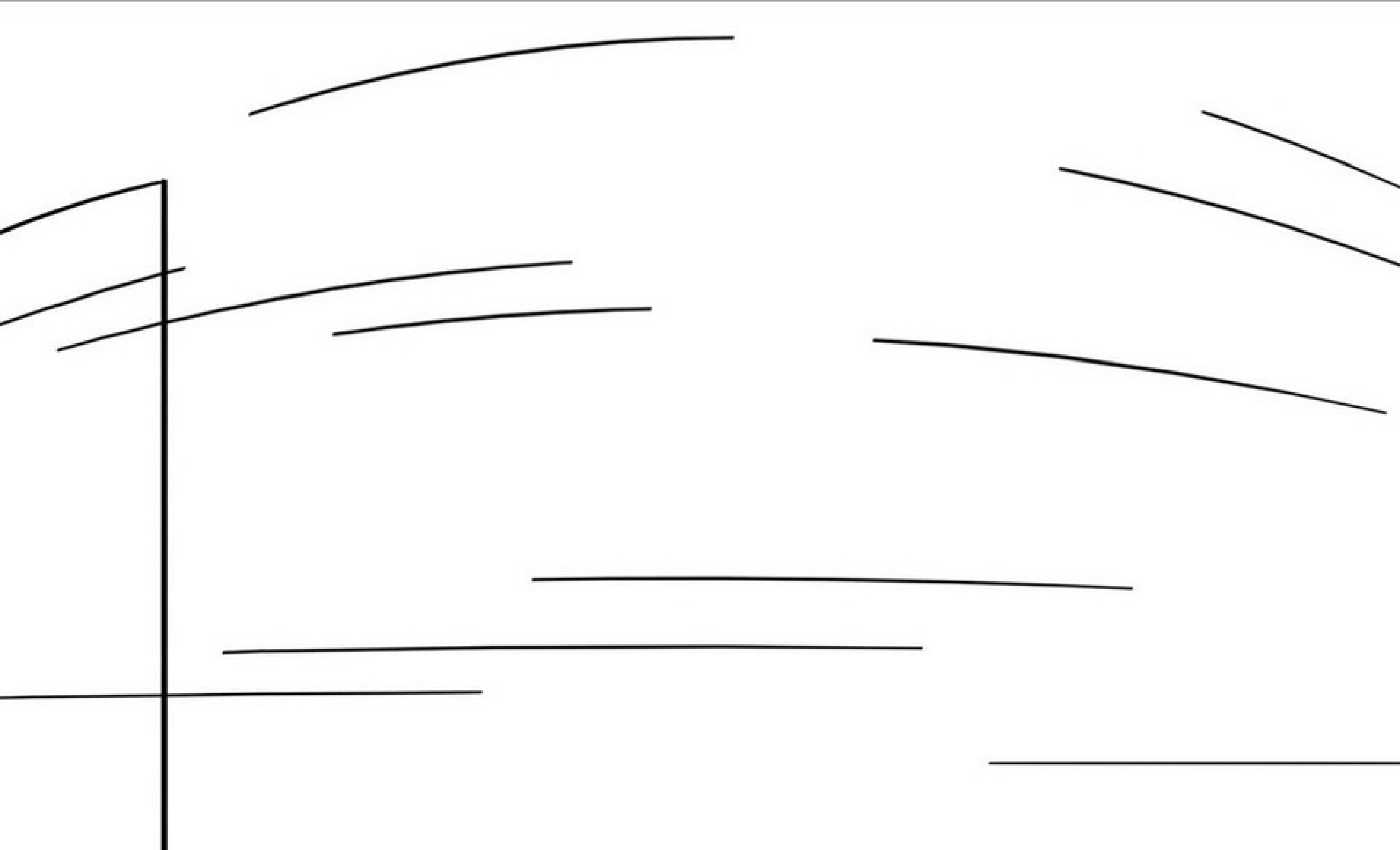


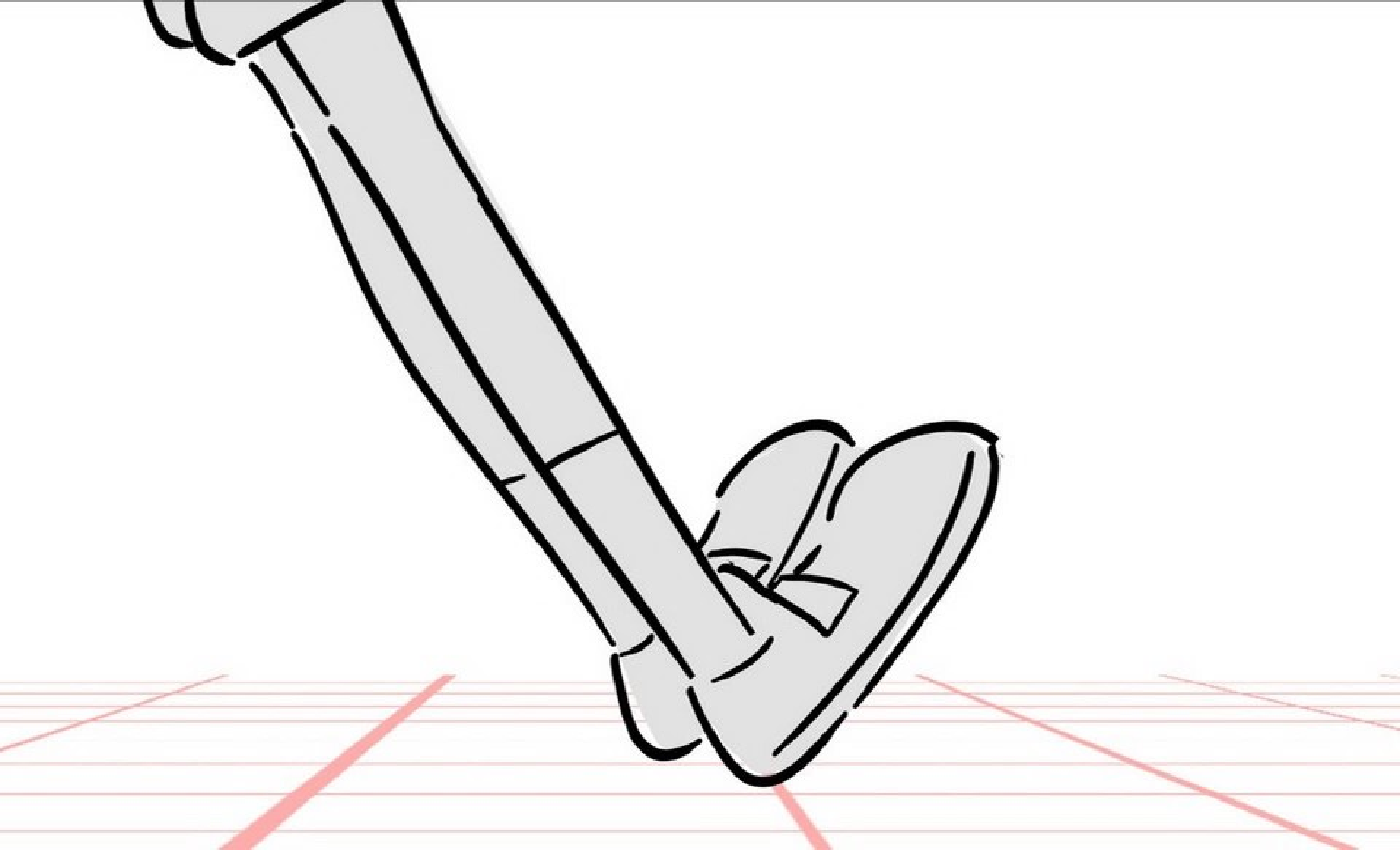




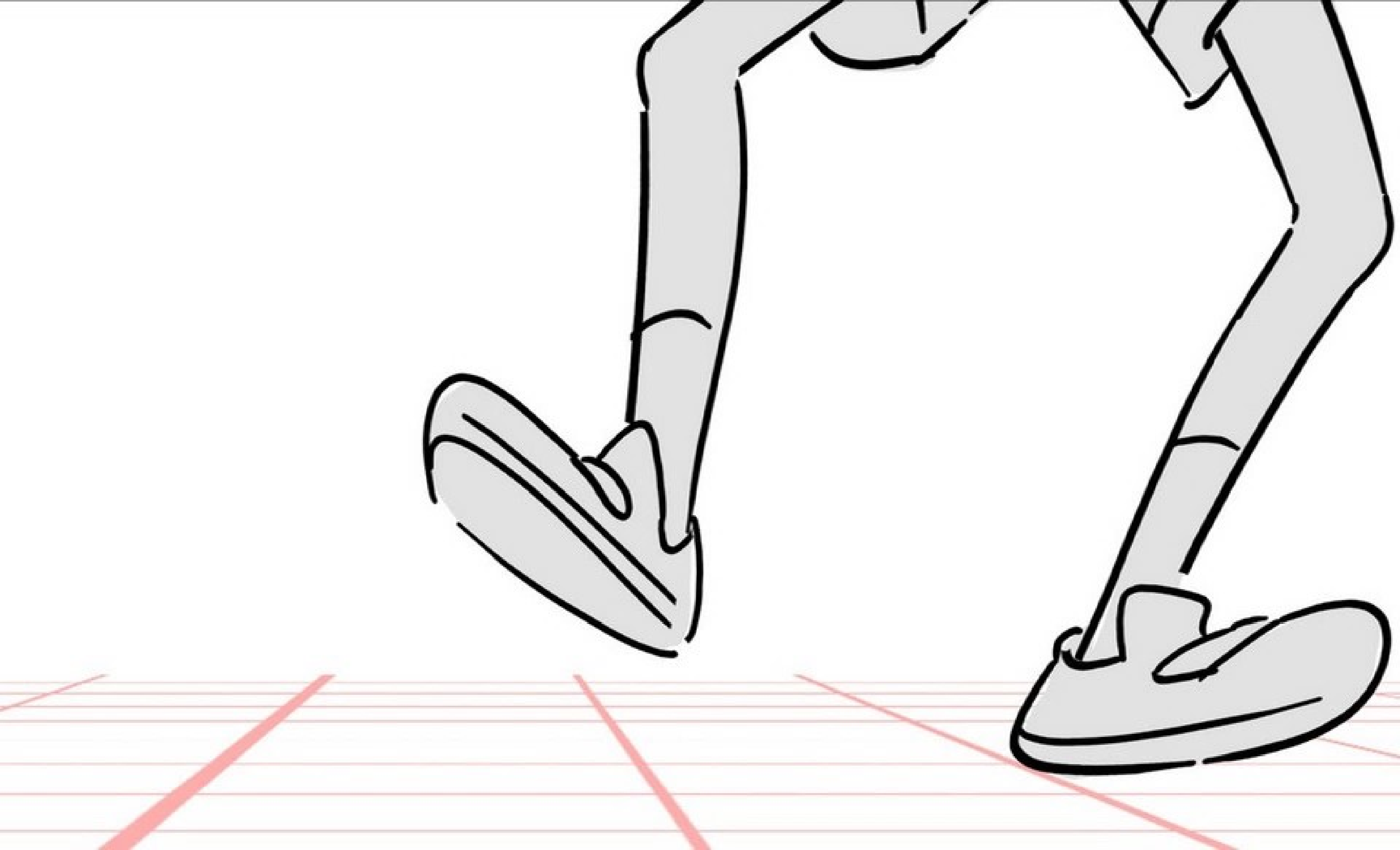
A hand-drawn diagram consisting of several lines. Two vertical lines are positioned on the left and right sides. A horizontal line crosses both vertical lines. Above this horizontal line, there is a smaller, roughly rectangular box with a slightly curved top and bottom. Inside this box, the text 'A18' is written in a simple, hand-drawn font. Several other lines are scattered around the diagram, some parallel to the main lines and others at various angles, suggesting a sketch or a preliminary drawing.

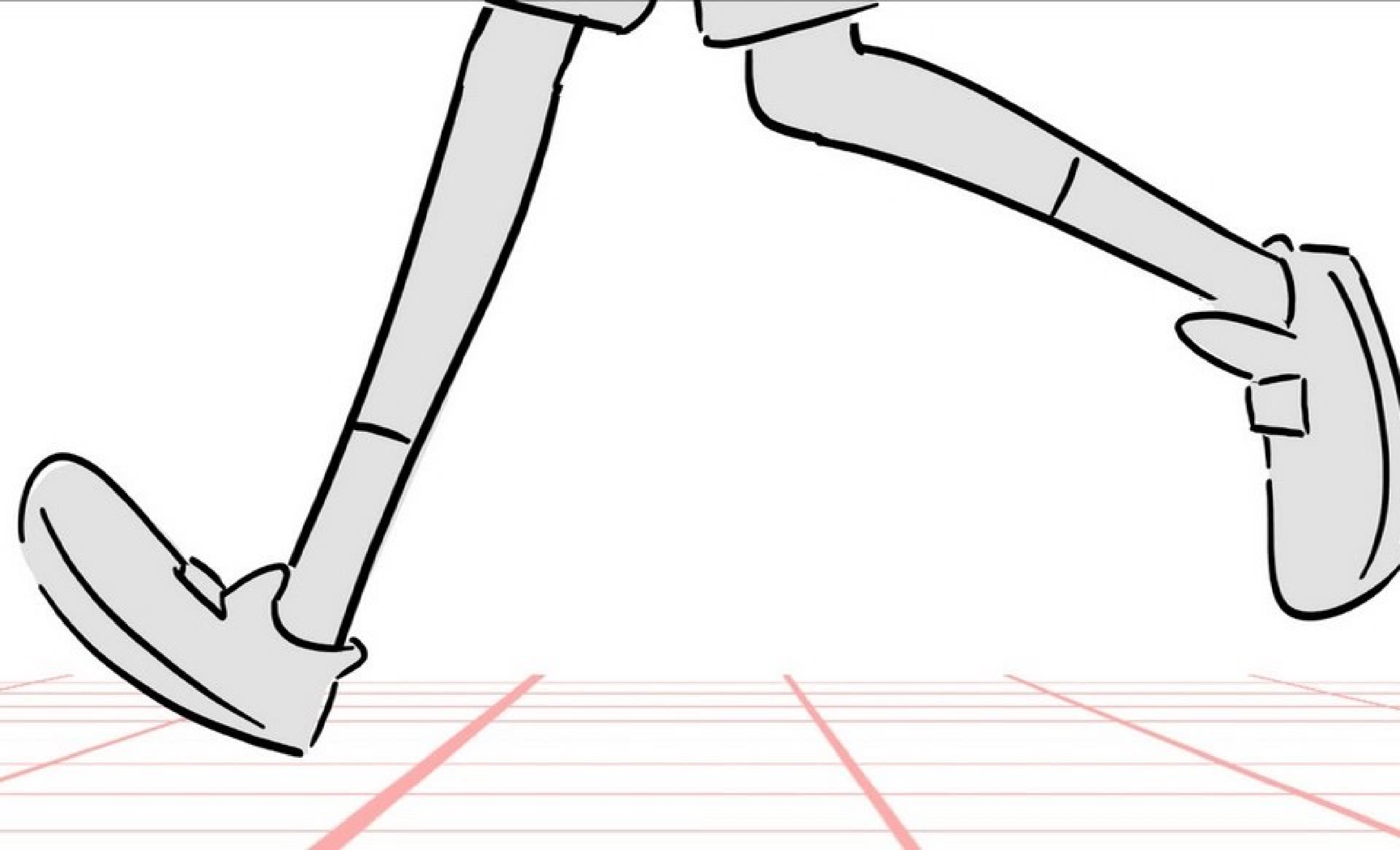
A18























































Deep learning applications: Image search

- Different from image processing using computer vision
 - Computer vision relies on pixel difference for identification
 - Hard to account for rotation, skew...etc
- Usable with only a handful of labelled examples of image
- **Pre-lecture activity: Where's Waldo?**
 - Download the TensorFlow module to your py project
 - Label training data.
 - Find instances of Waldo in images and create bounding box
 - Do NOT use Waldo image sets off Kaggle
 - Configure model using TensorFlow Object Detection API
 - Train model (Due to the small size of the set, it should only take a few seconds)
 - Test model on validation data found in [valid.zip](#), until hit rate is 99%



Deep learning applications: Image search

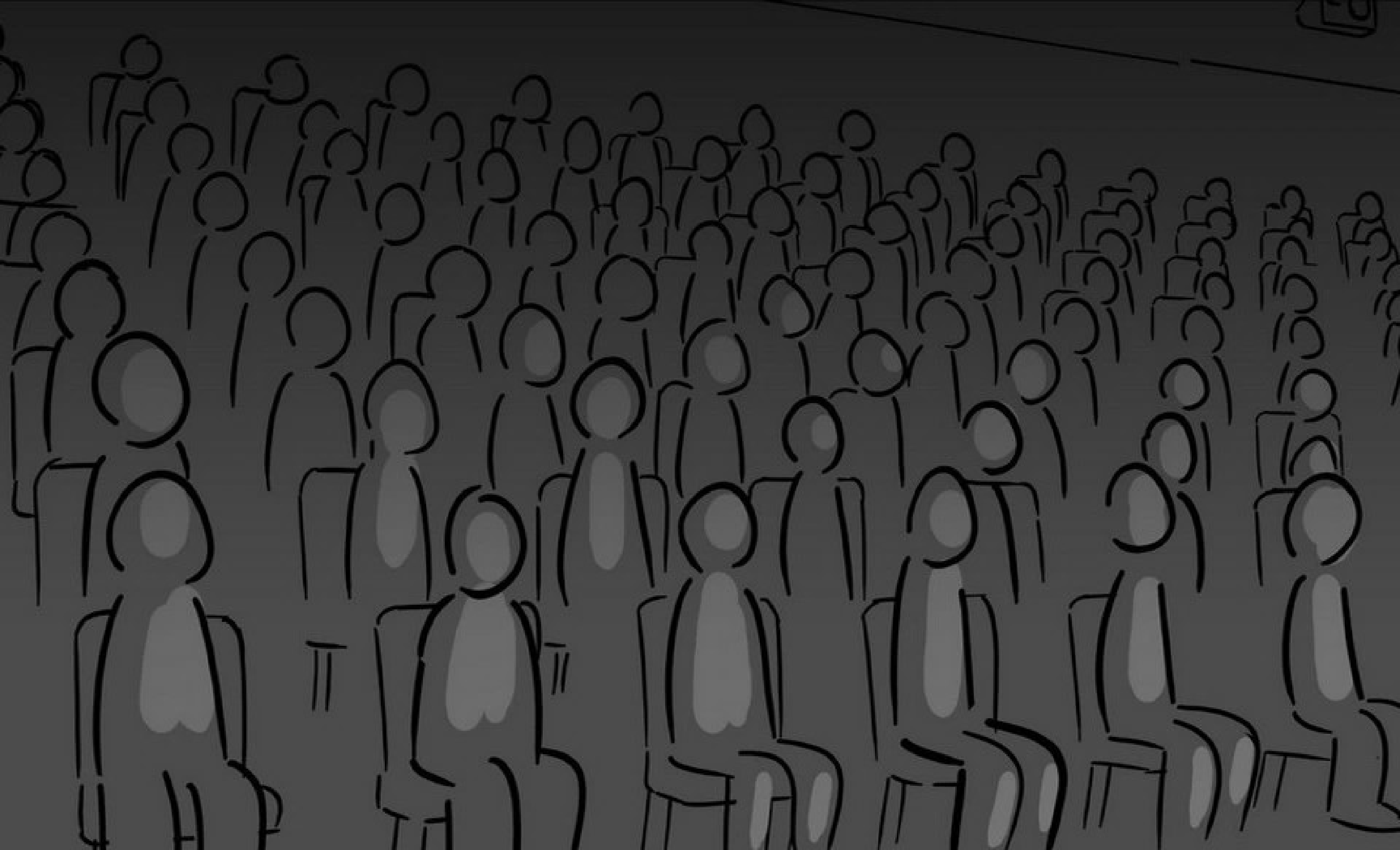
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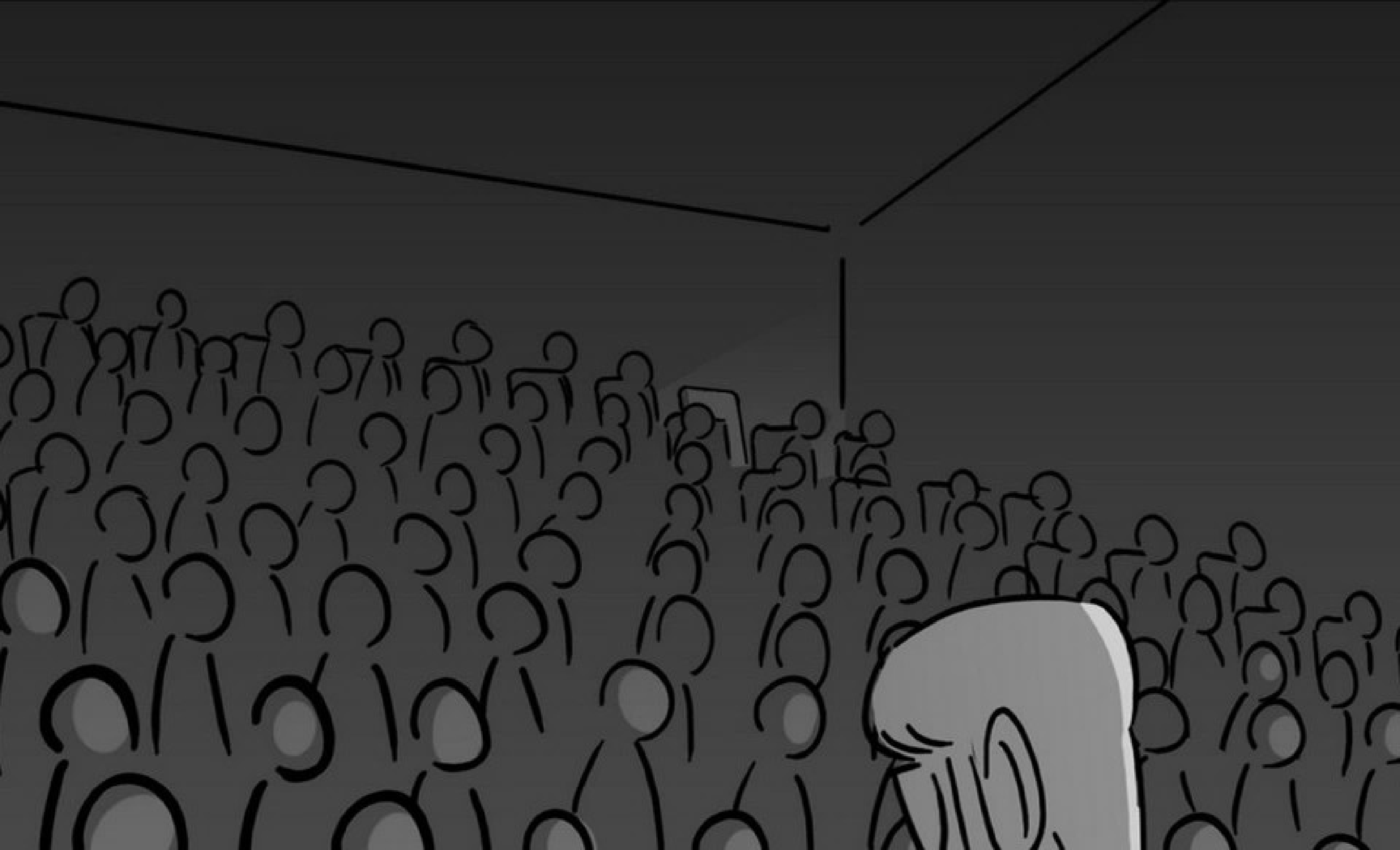












processing using computer vision
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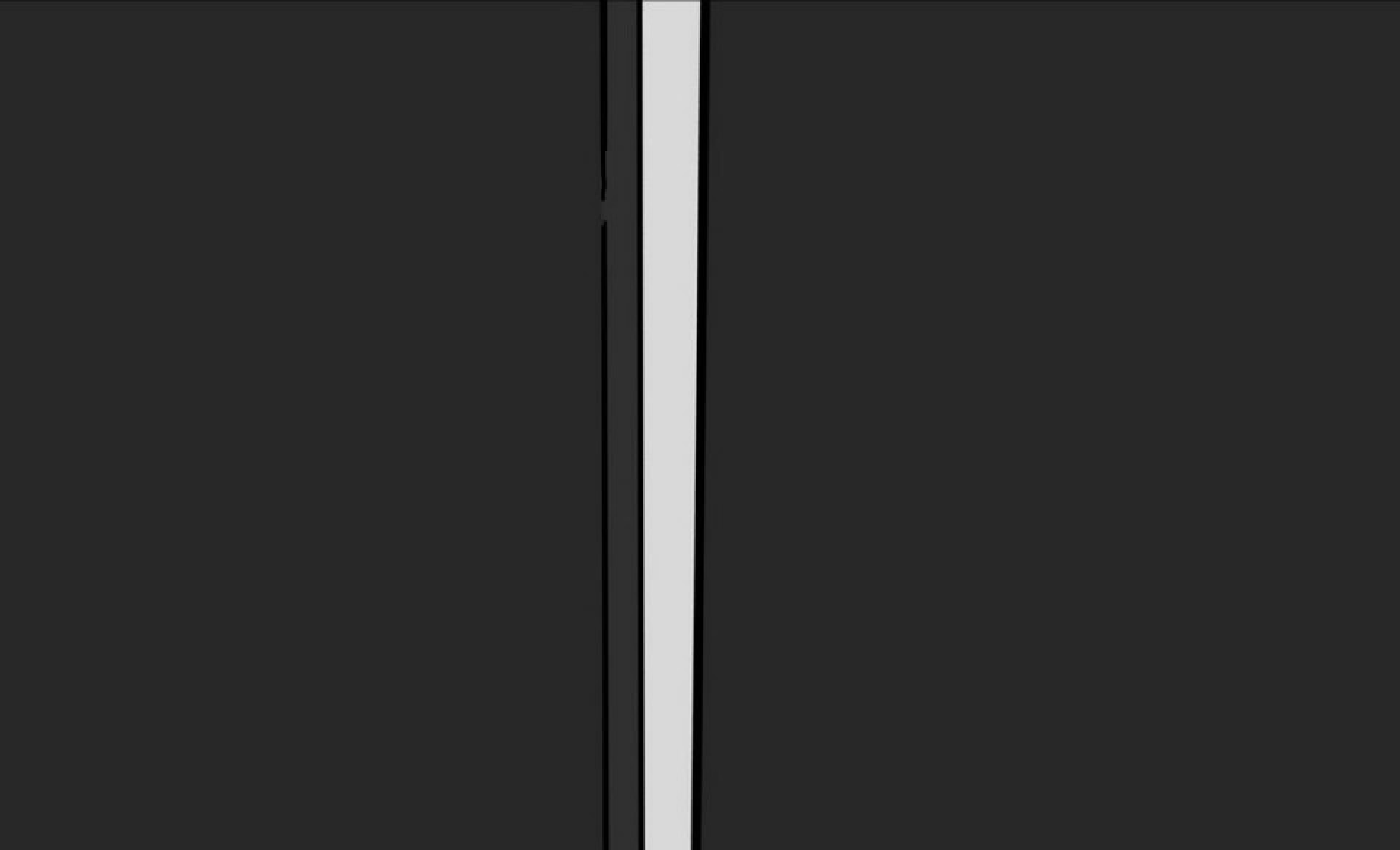


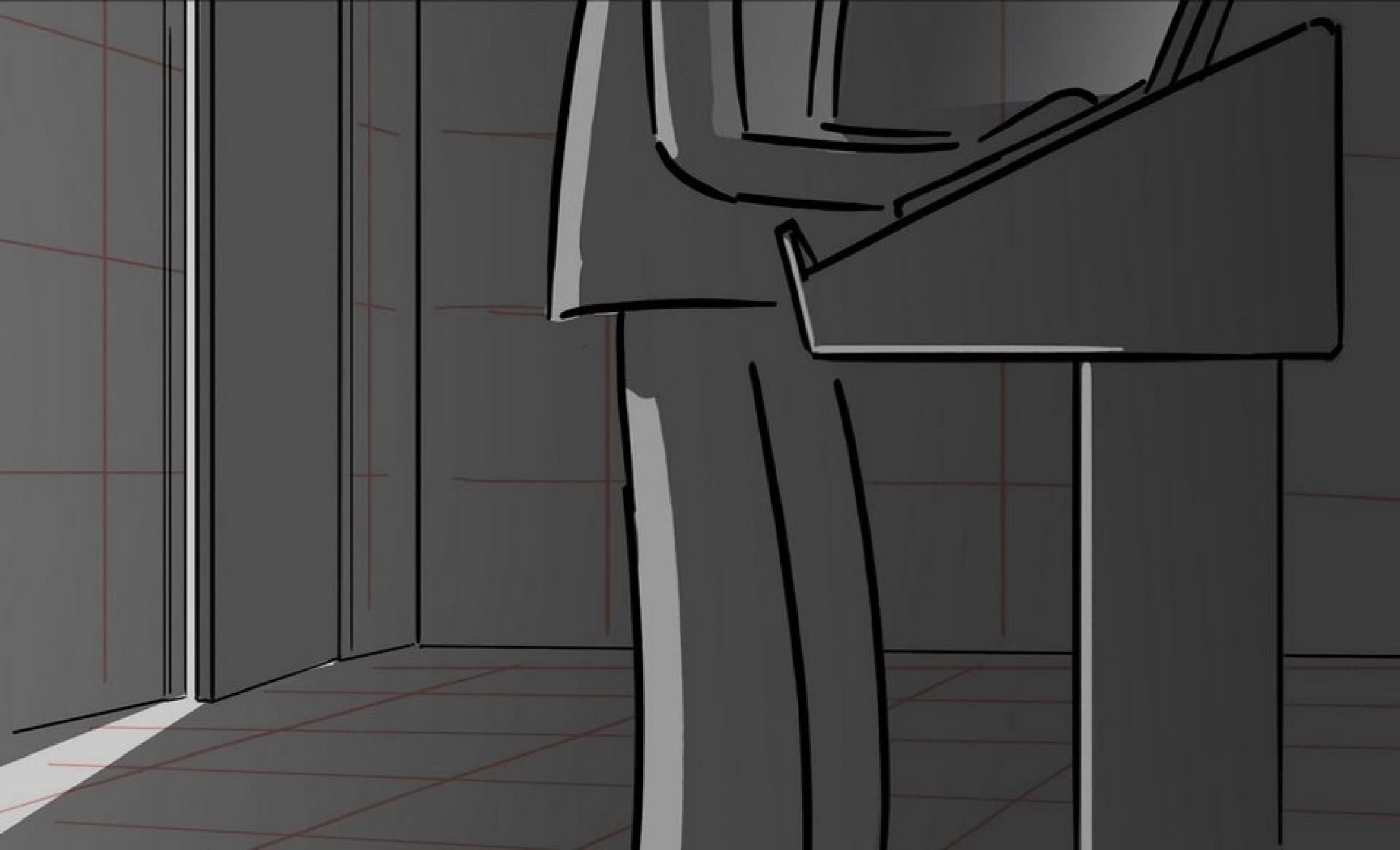


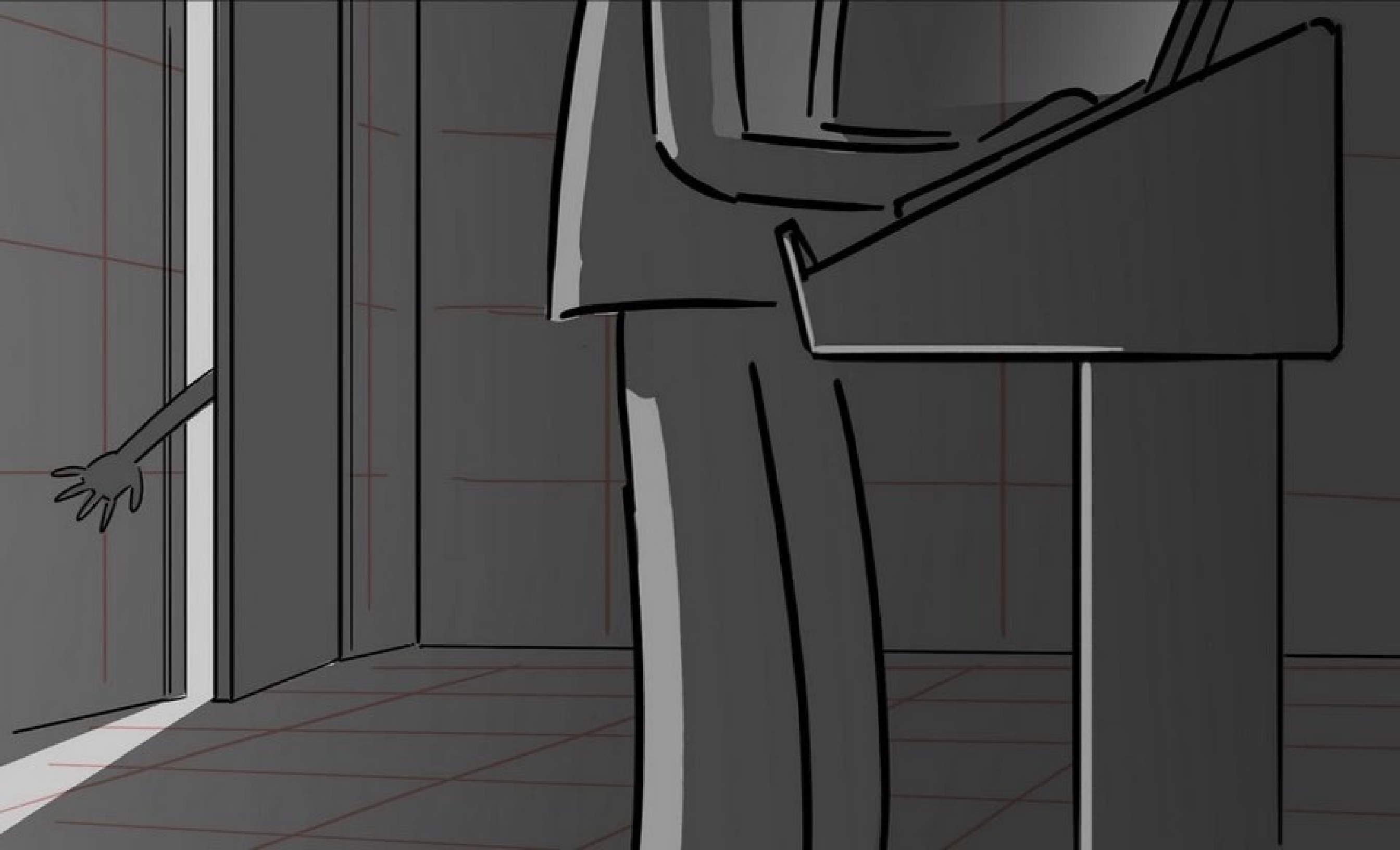


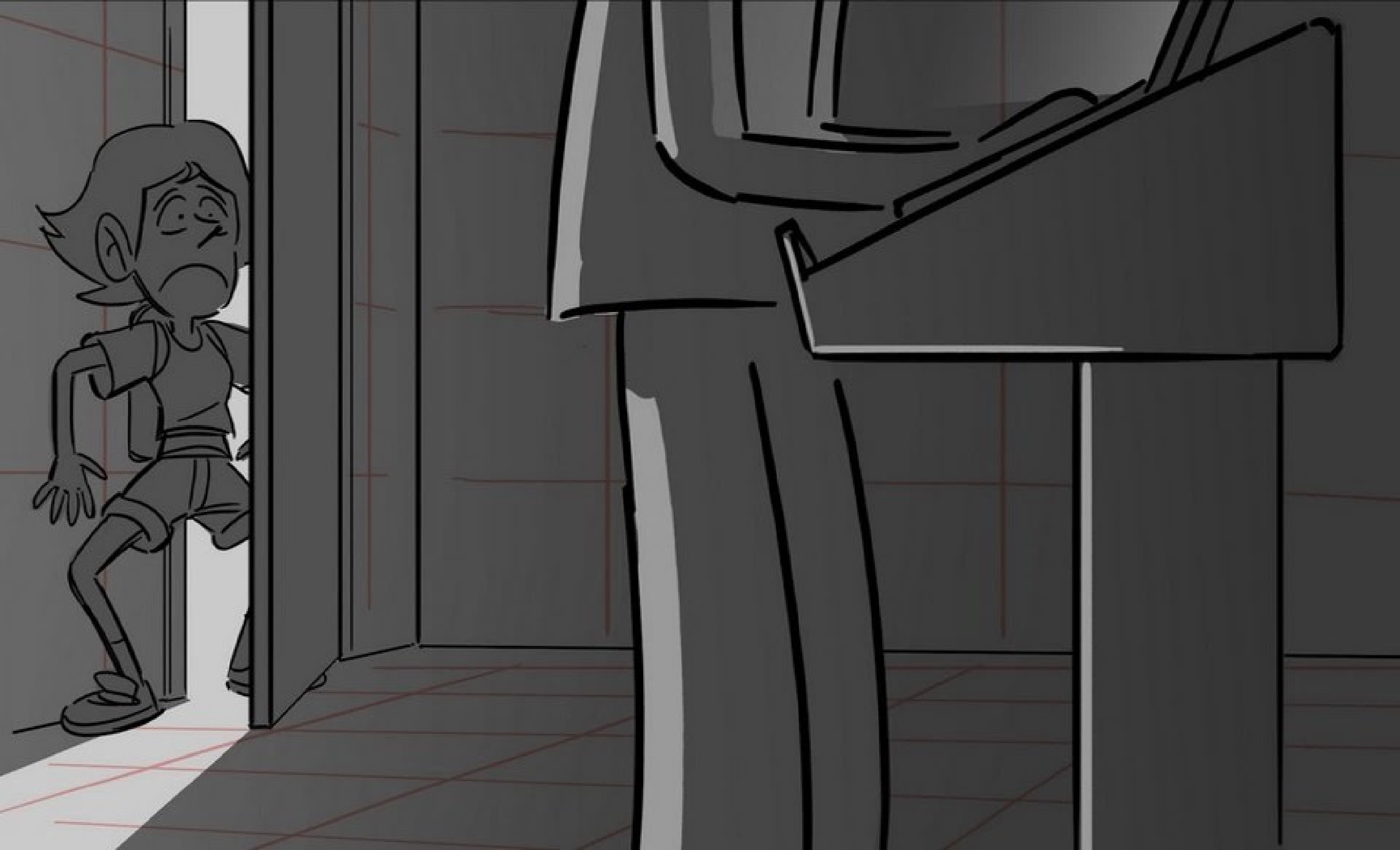


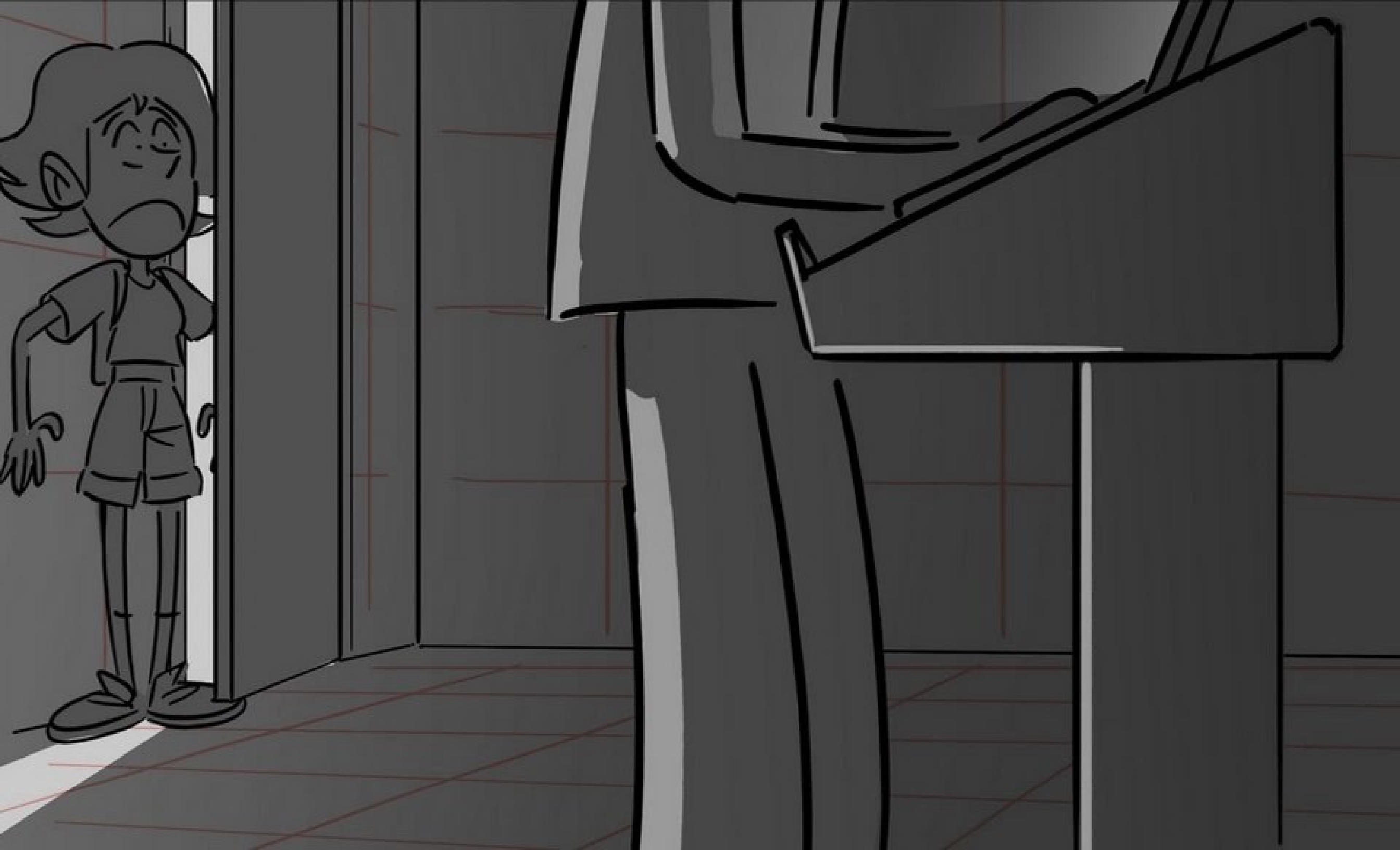


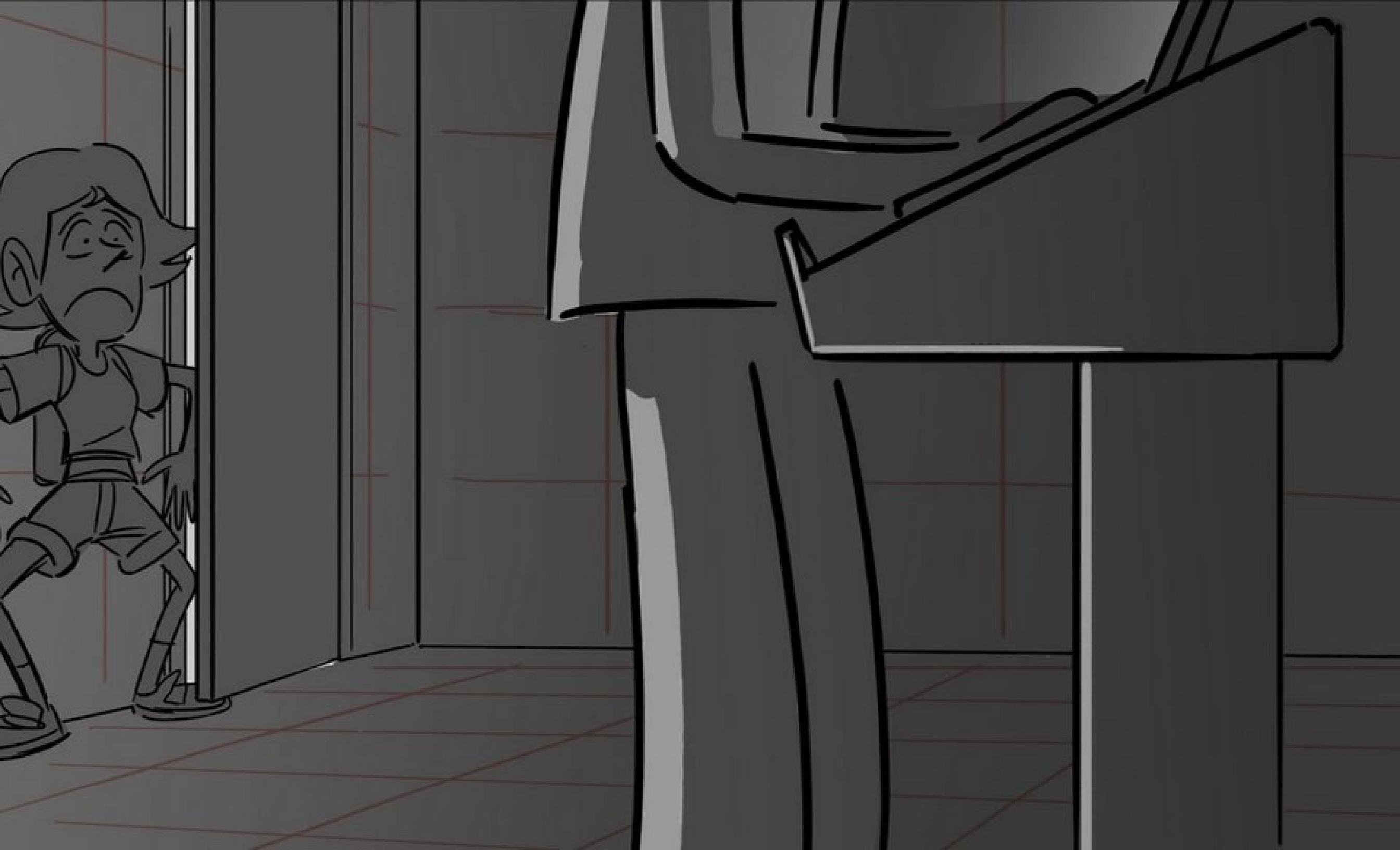


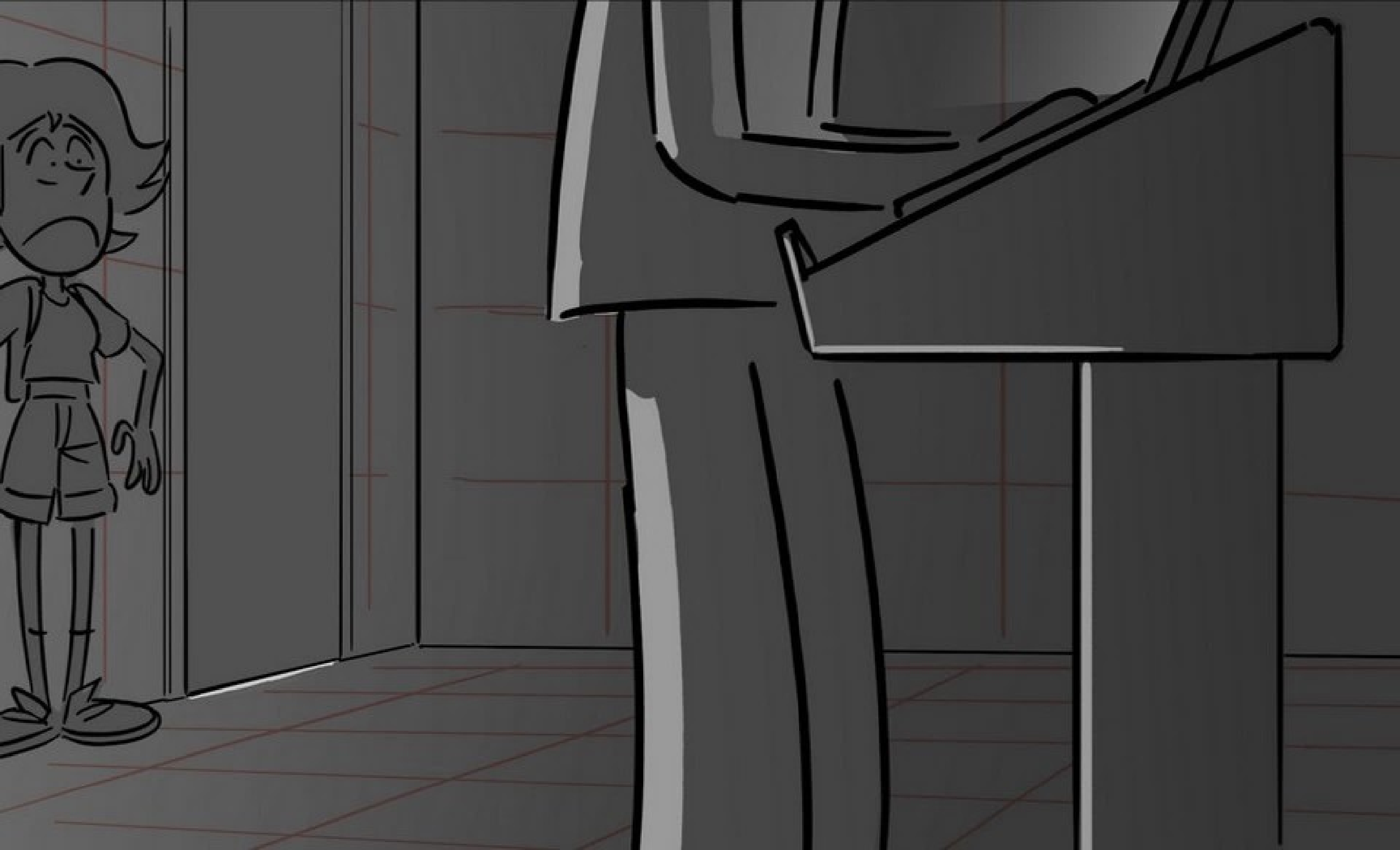


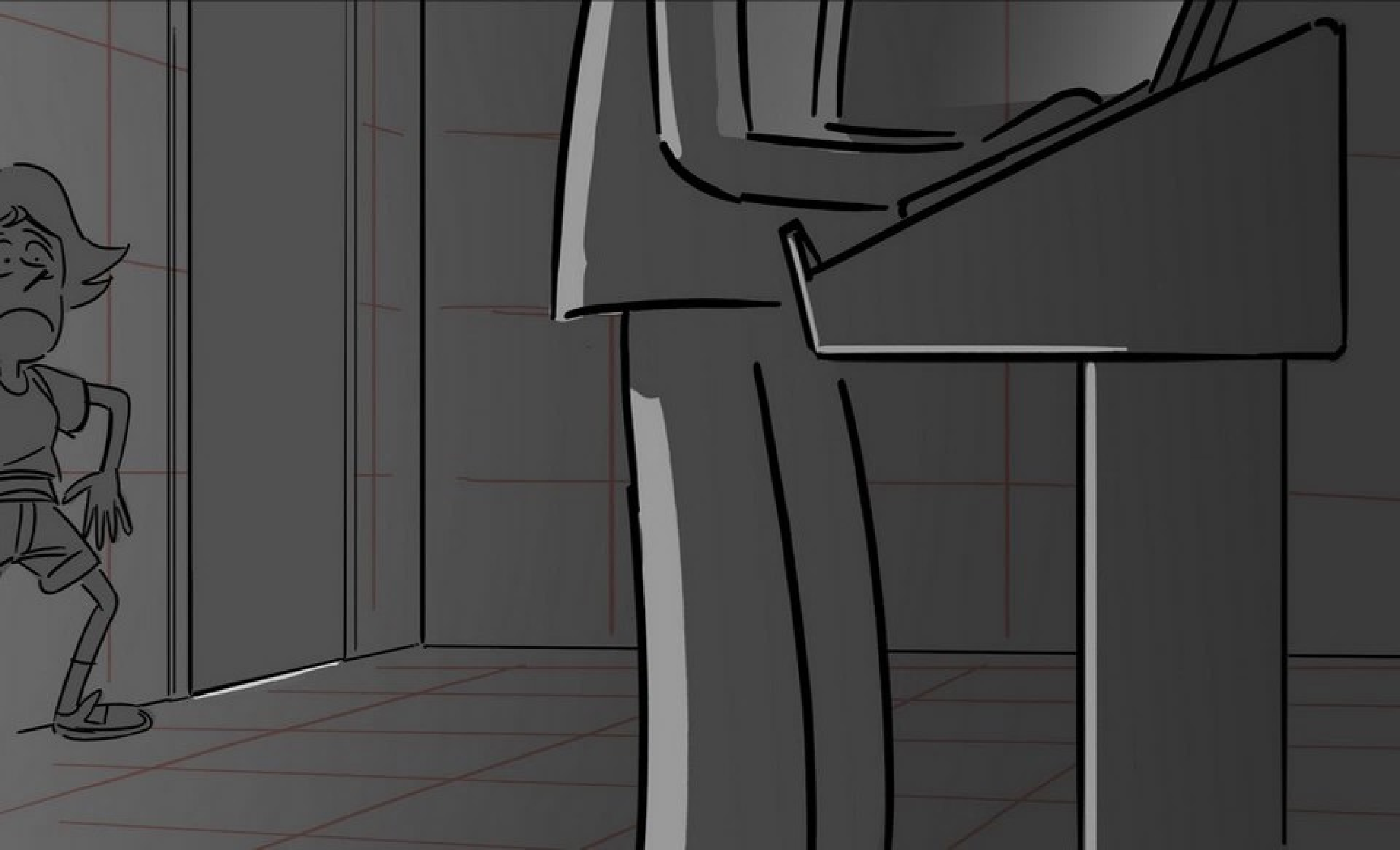


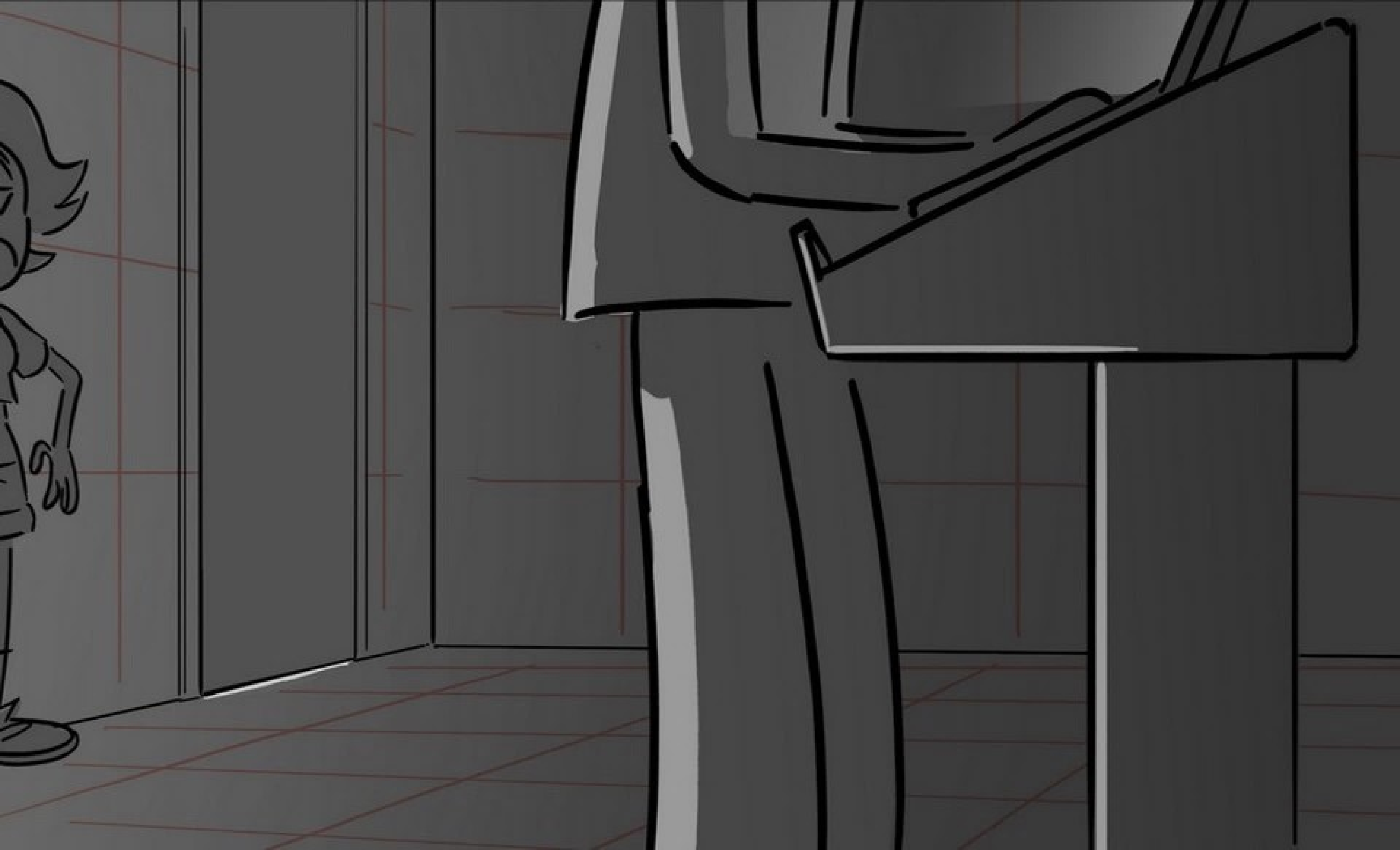


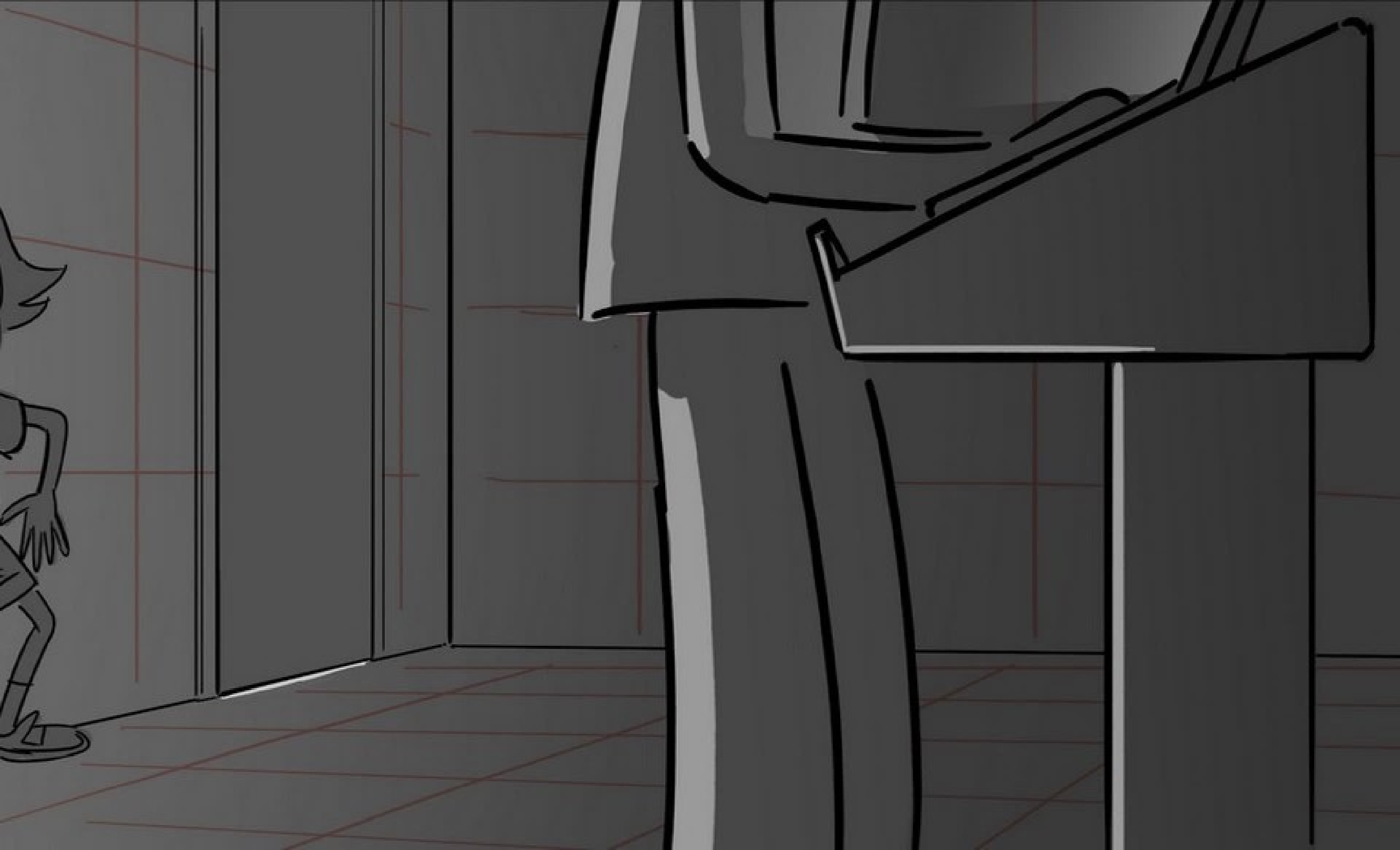




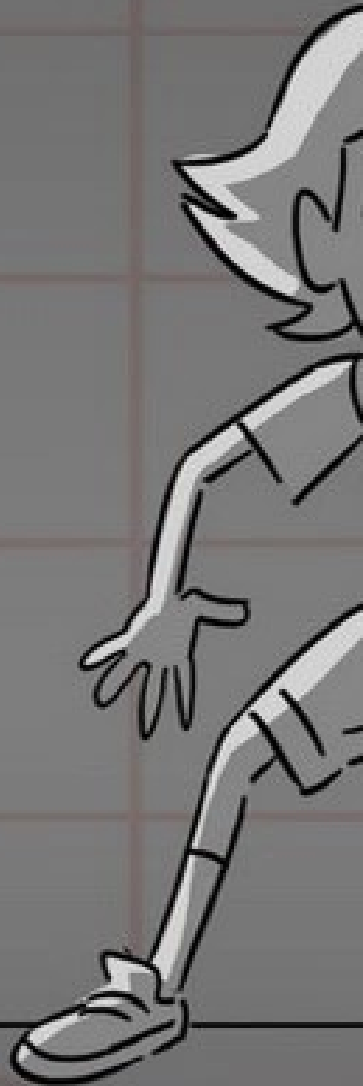
























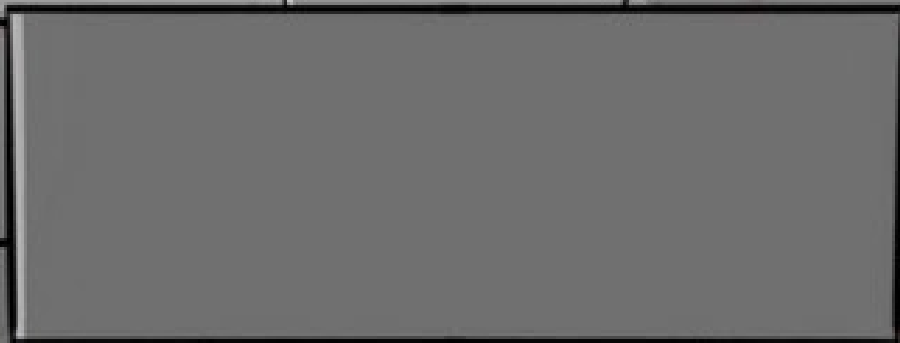


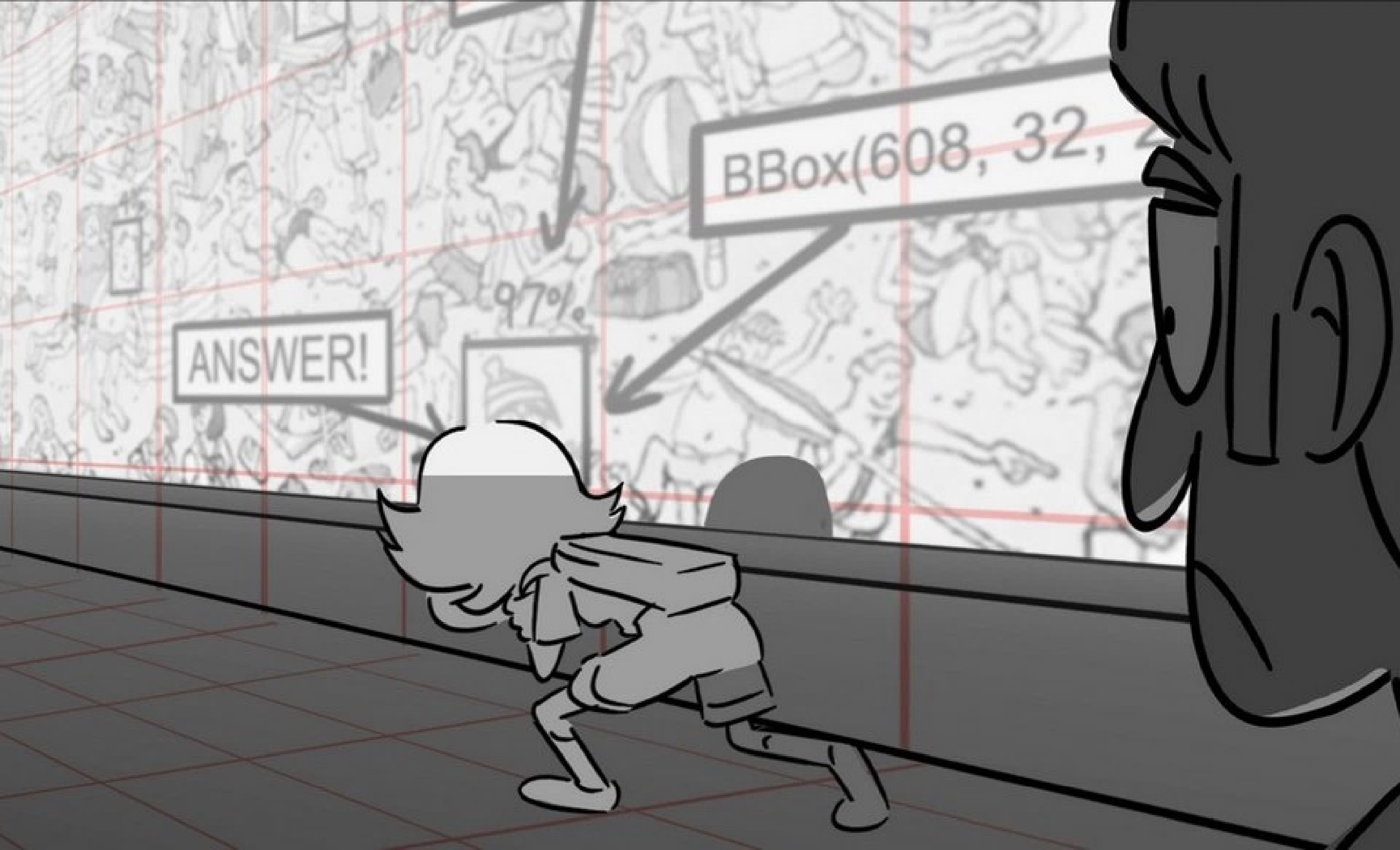












ANSWER!

BBox(608, 32, ...)

97%



BBox(608)

ANSWER!

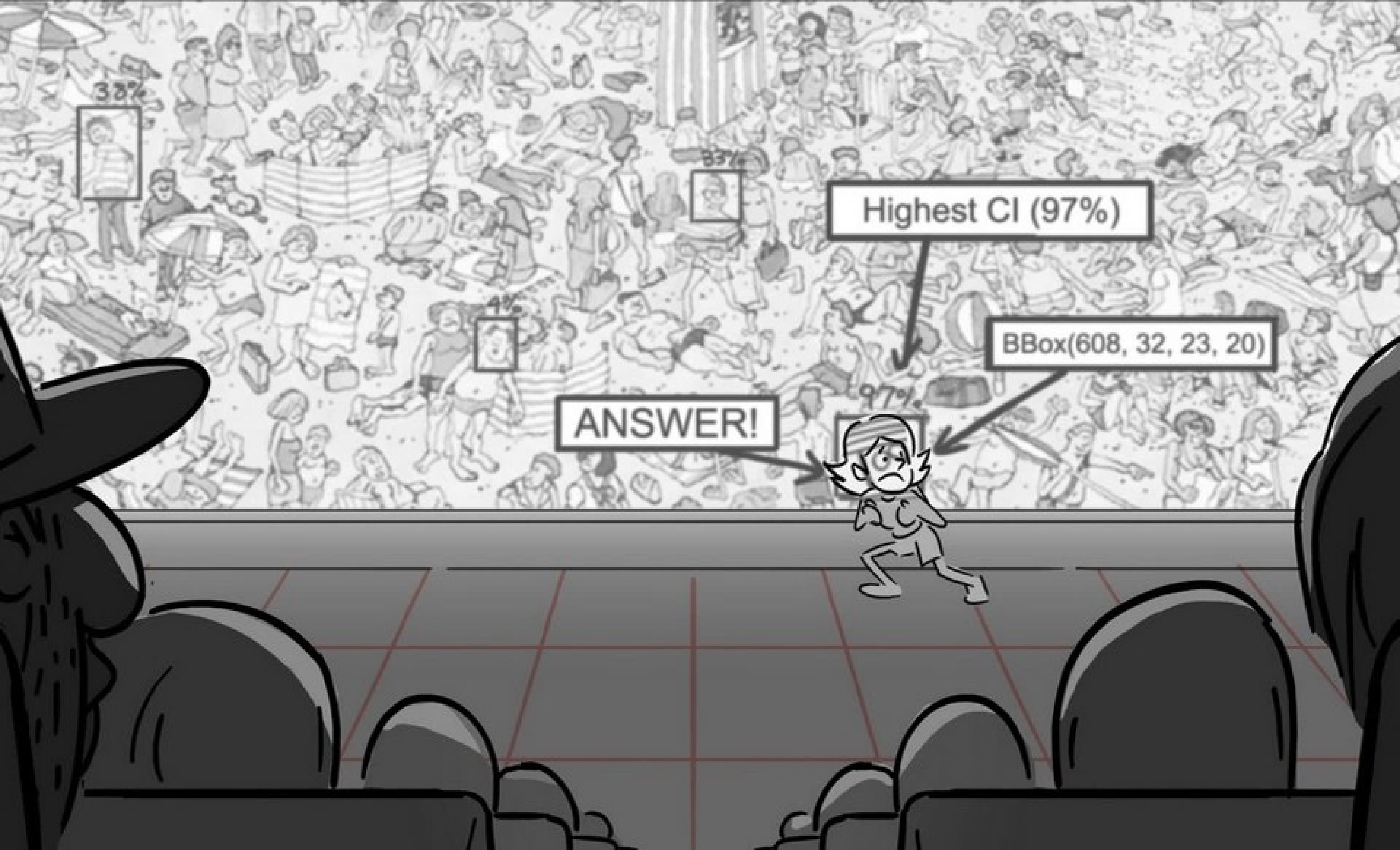
97%



`BBox(608, 32, 4`

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33%



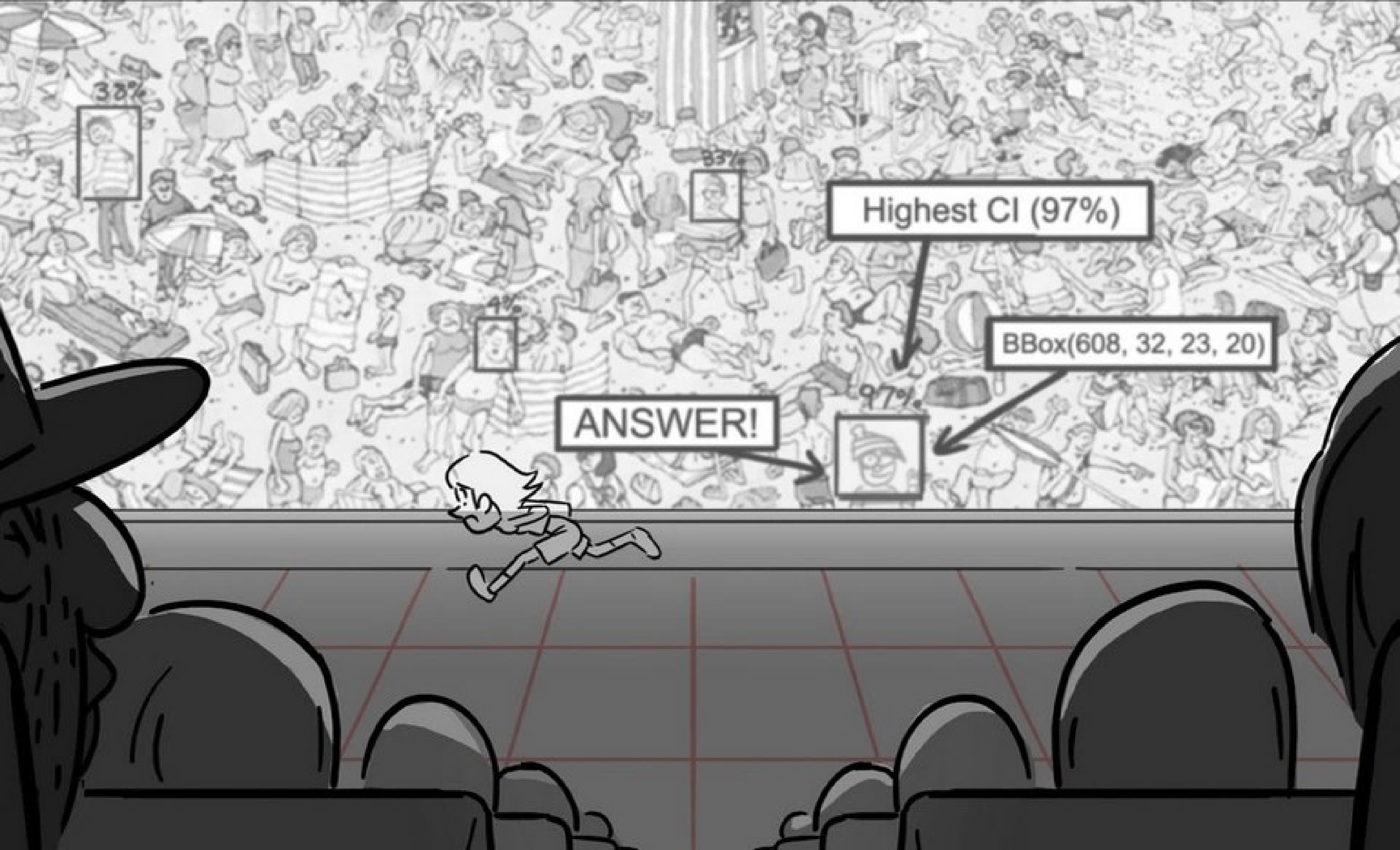
ANSWER!



Highest CI (97%)

BBox(608, 32, 23, 20)





38%



33%



ANSWER!

Highest CI (97%)

BBox(608, 32, 23, 20)

97%





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83%

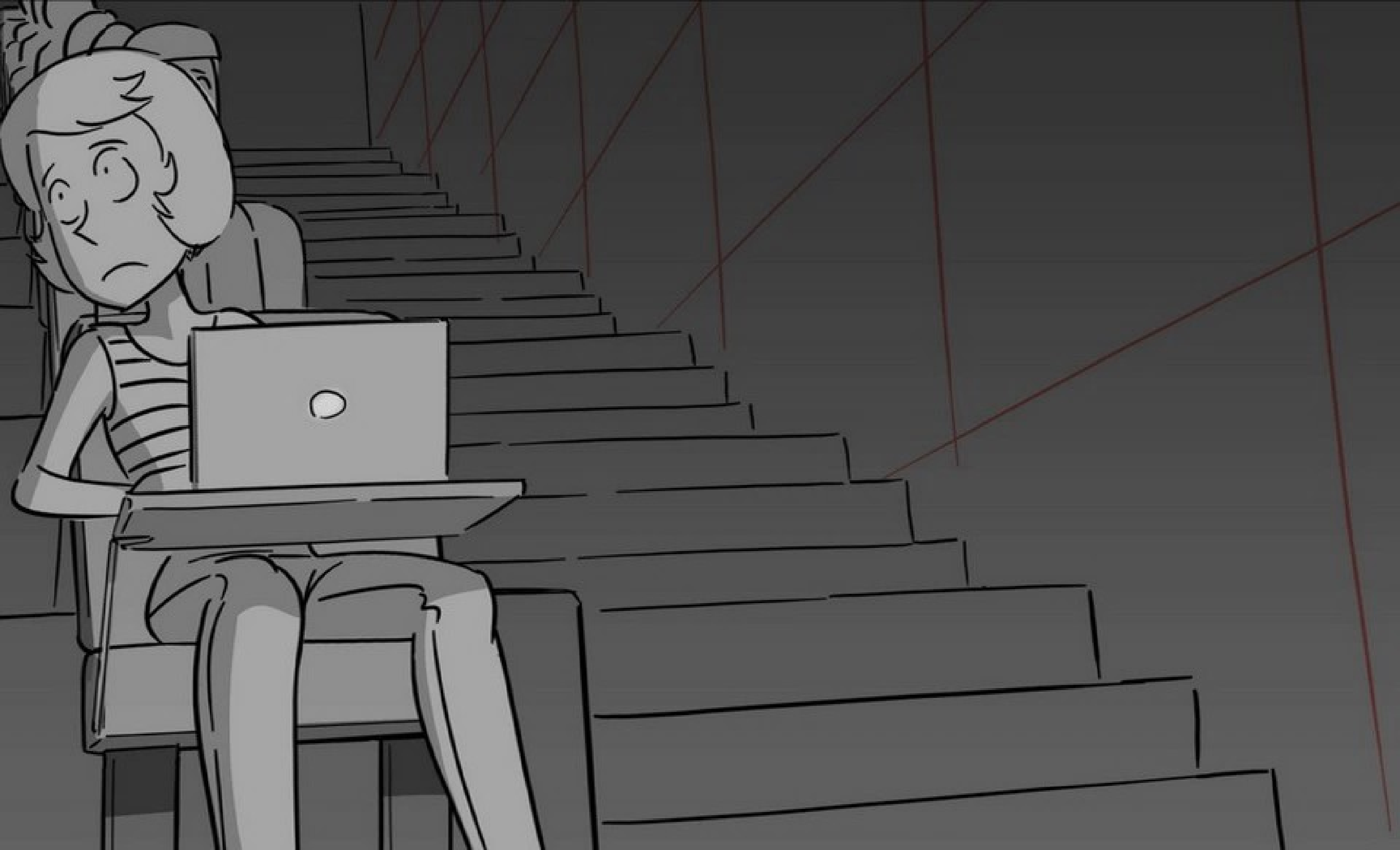
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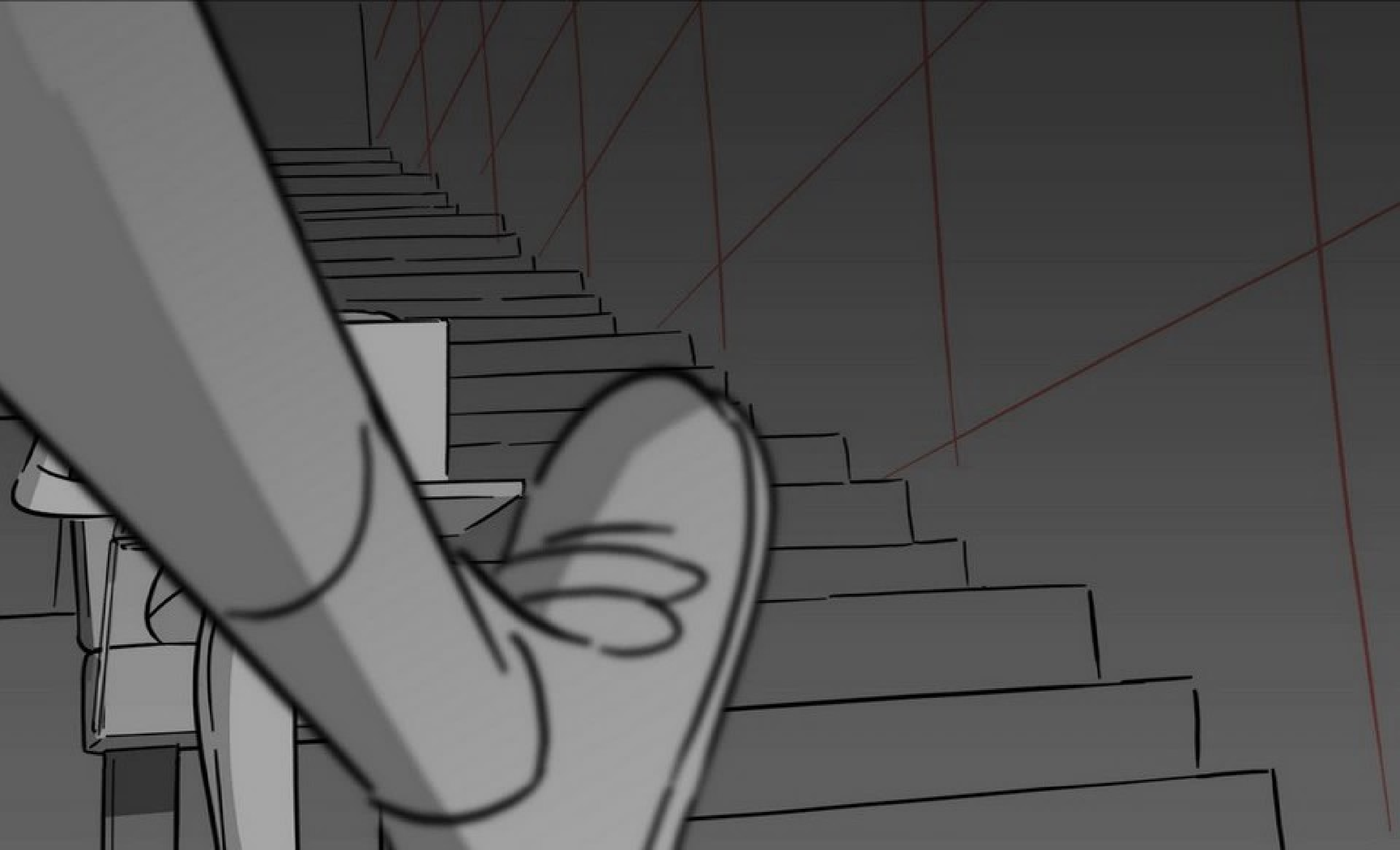
Highest CI (97%)

BBox(608, 32, 23, 20)

ANSWER!

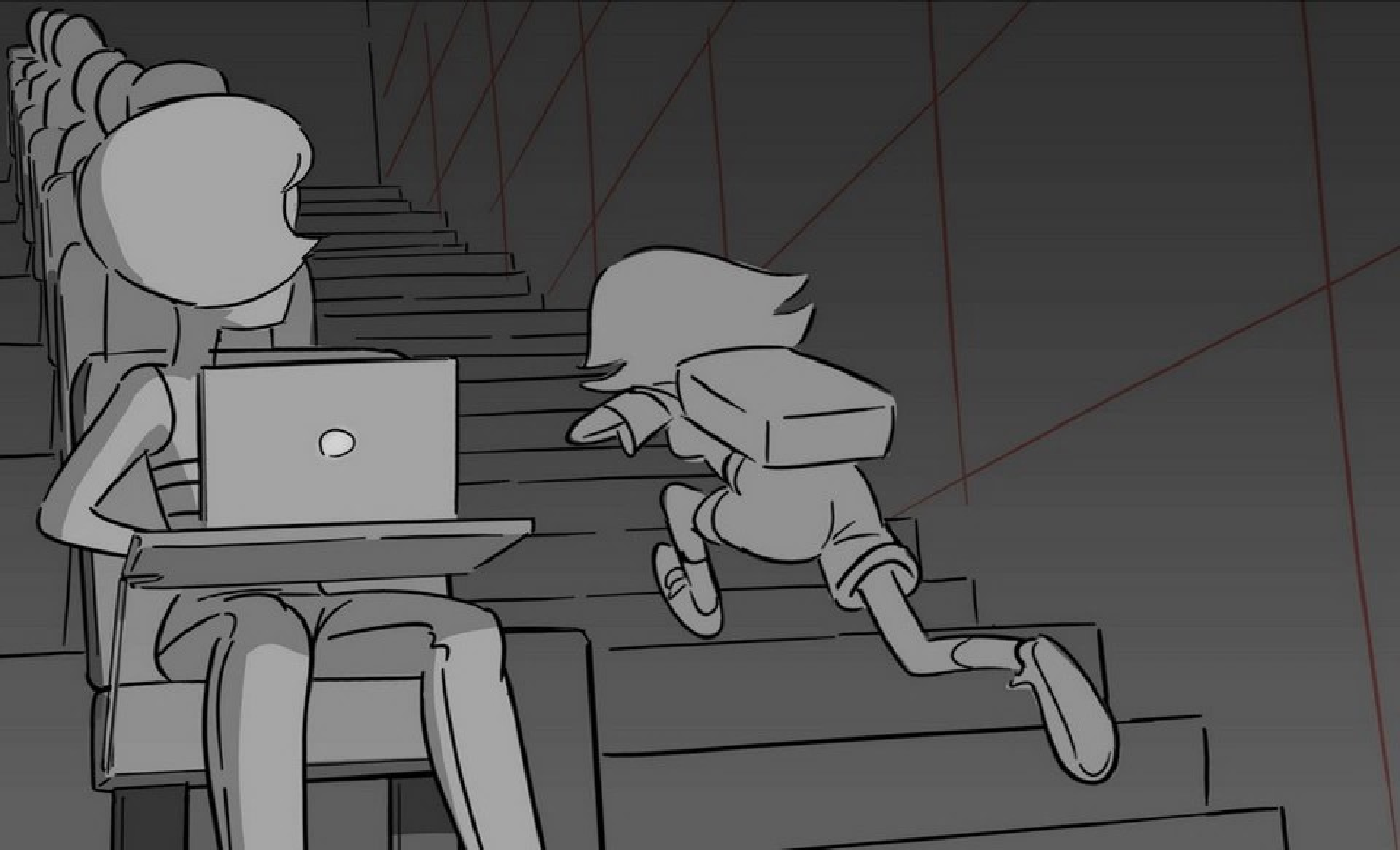
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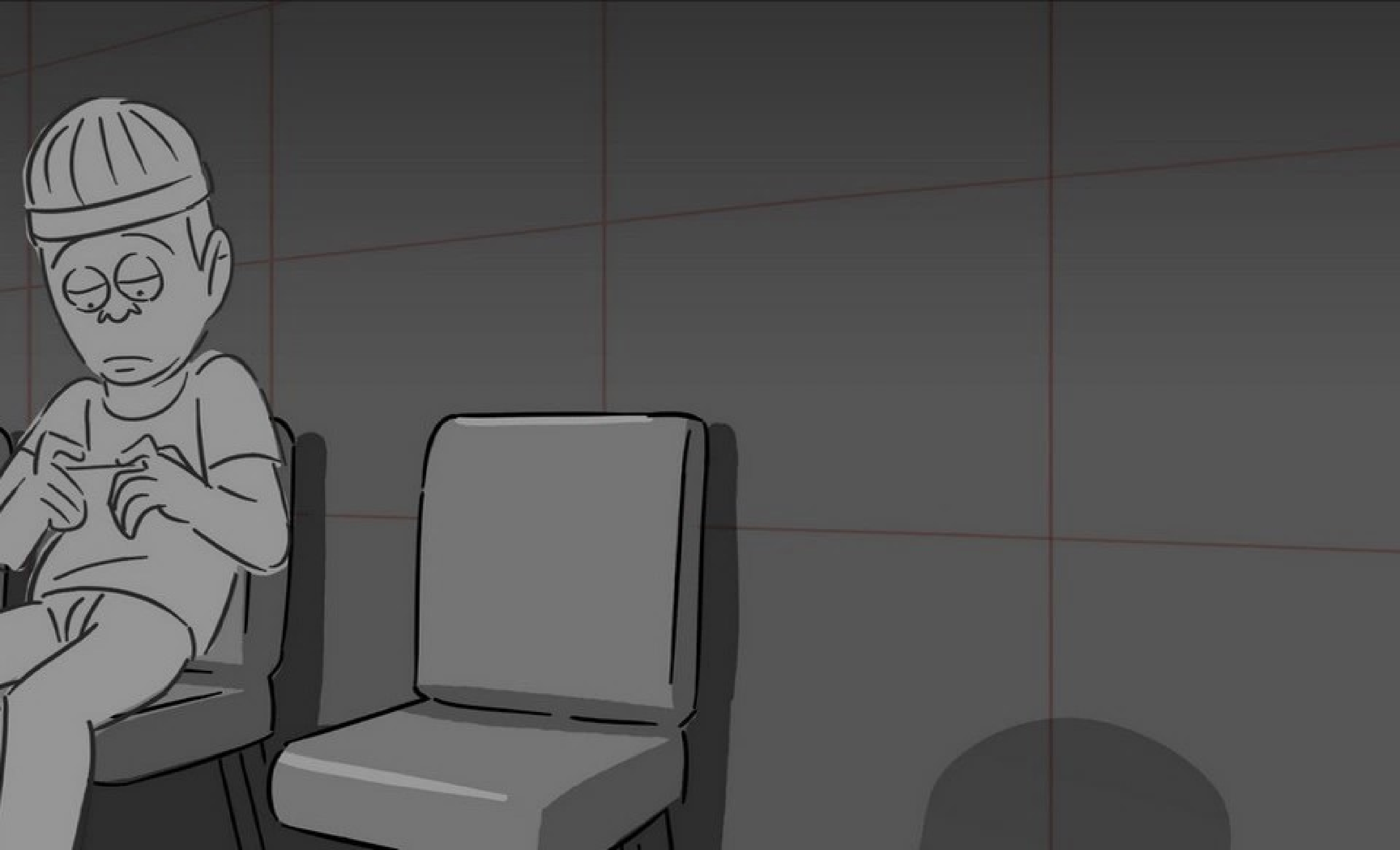


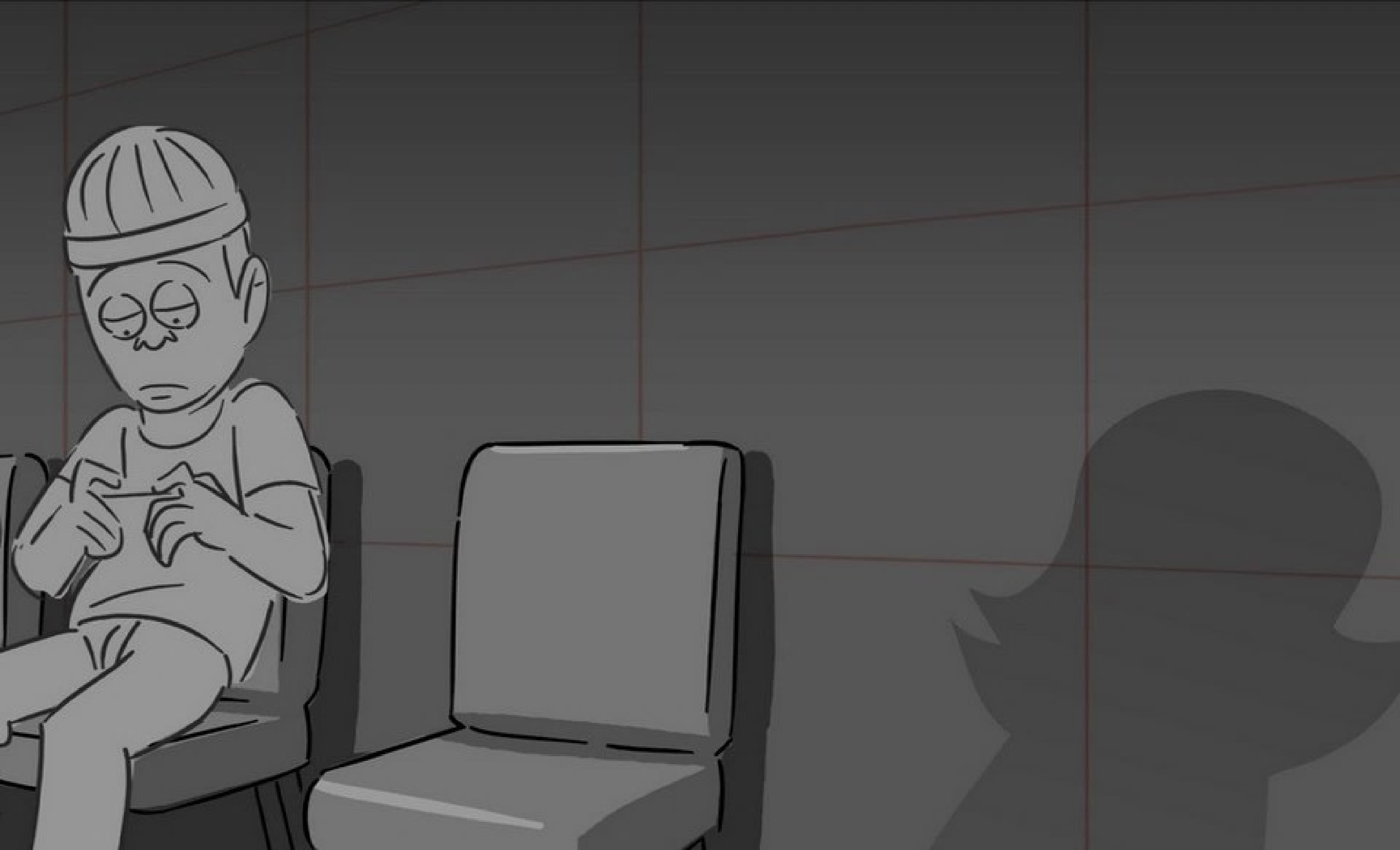


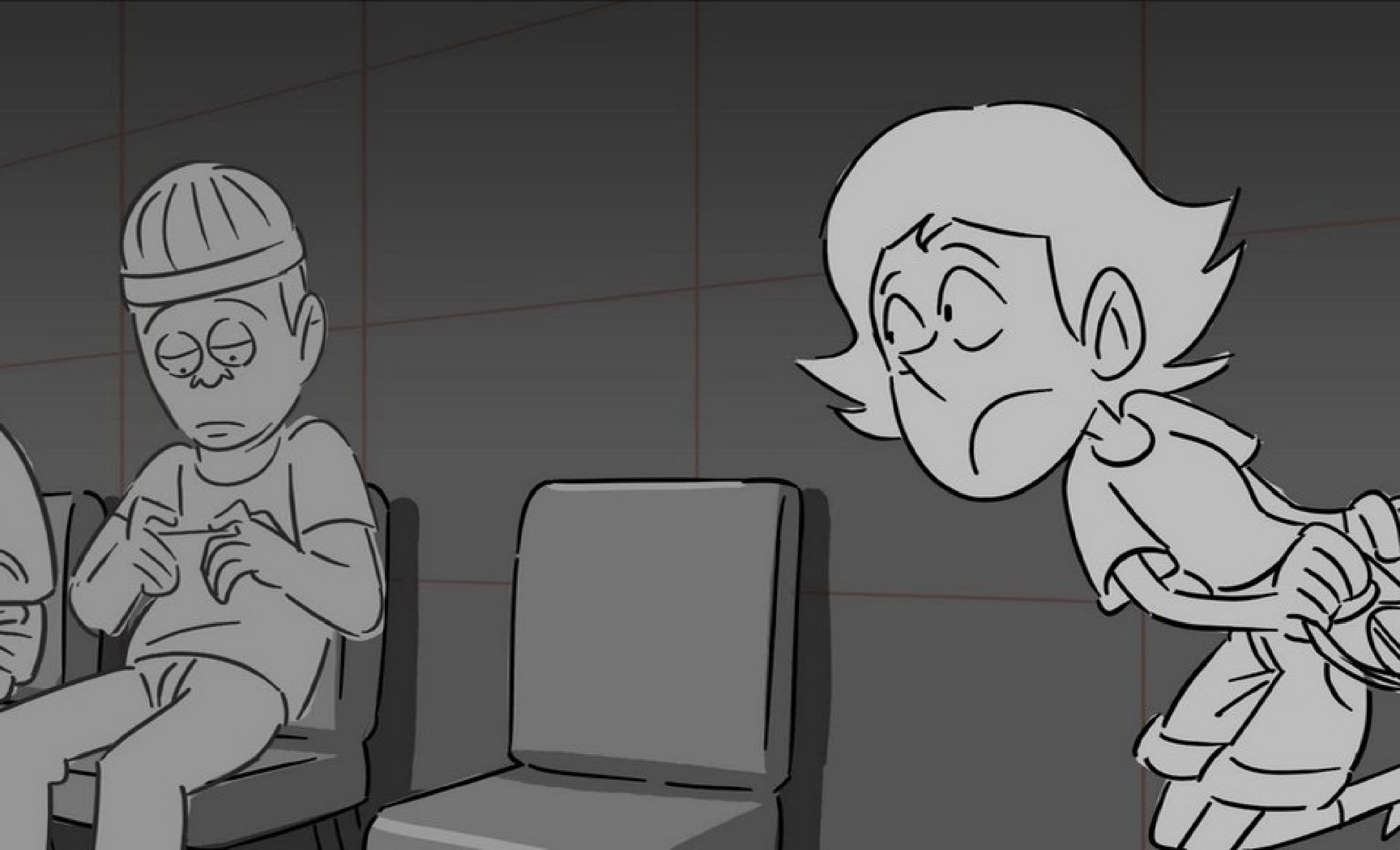


























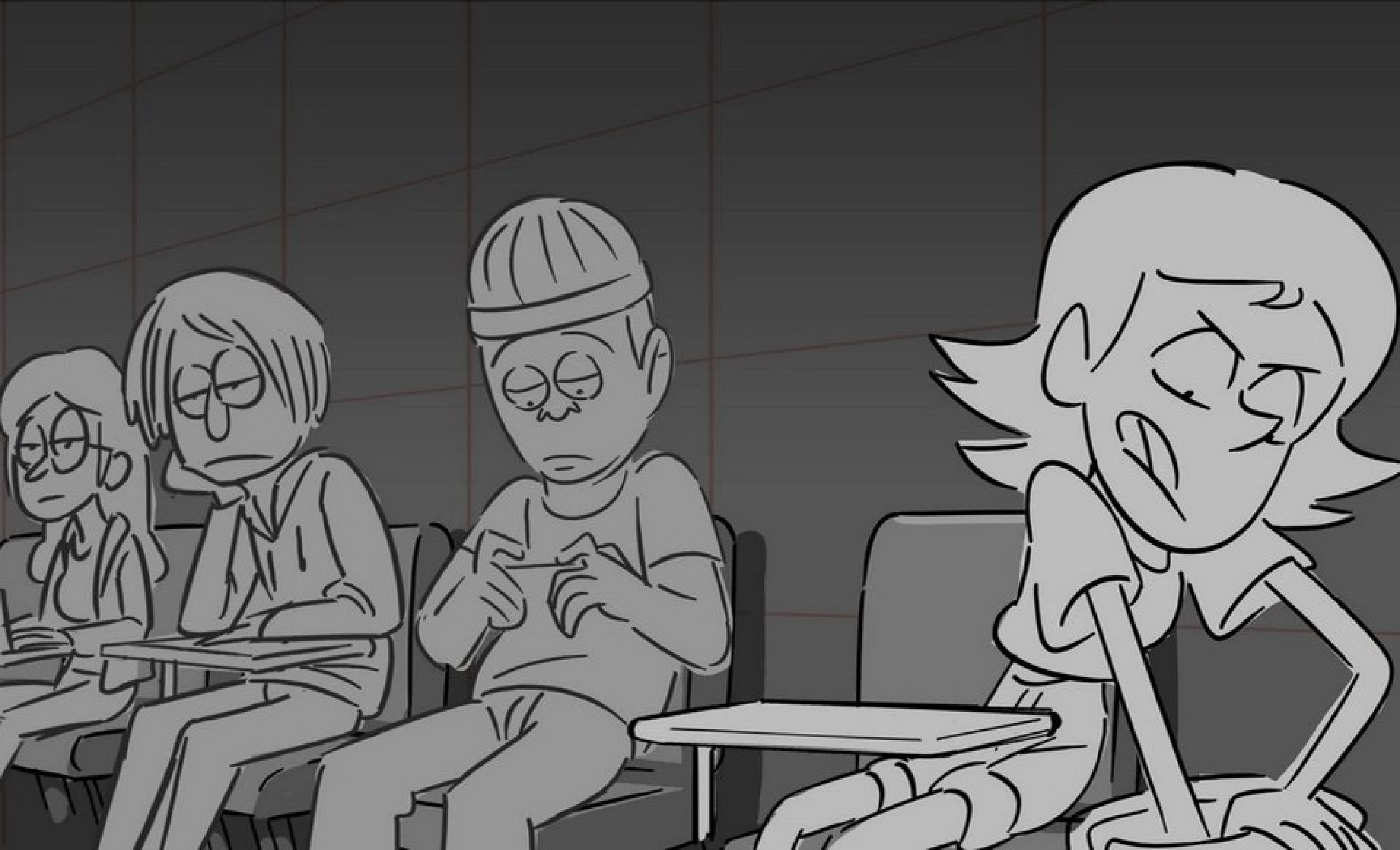




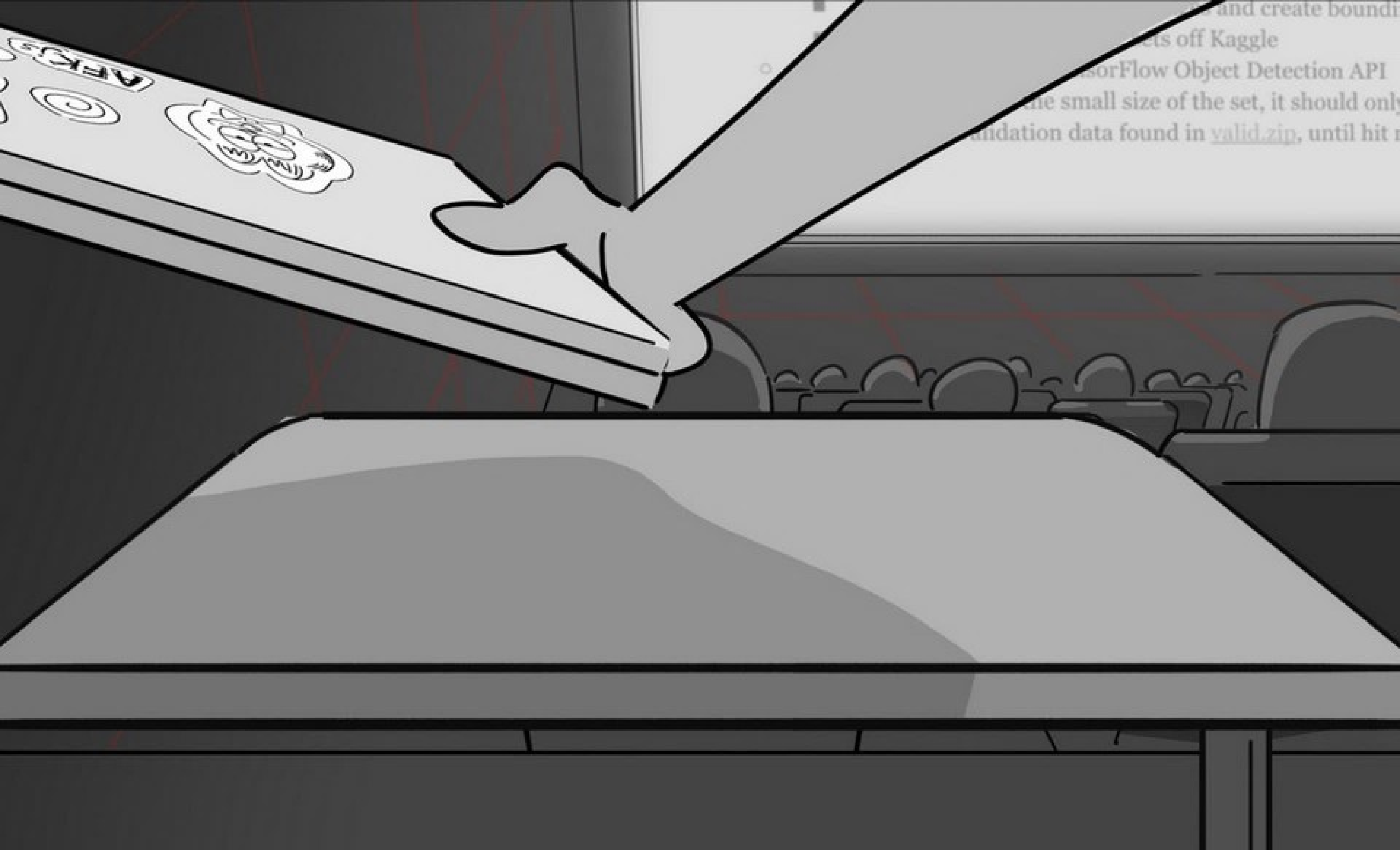












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- Find instances of Waldo in images and create bounding boxes
- Do NOT use Waldo image sets off Kaggle
- Configure model using TensorFlow Object Detection API
- Train model (Due to the small size of the set, it should only take a few hours)
- Test model on validation data found in [valid.zip](#), until hit rate is high



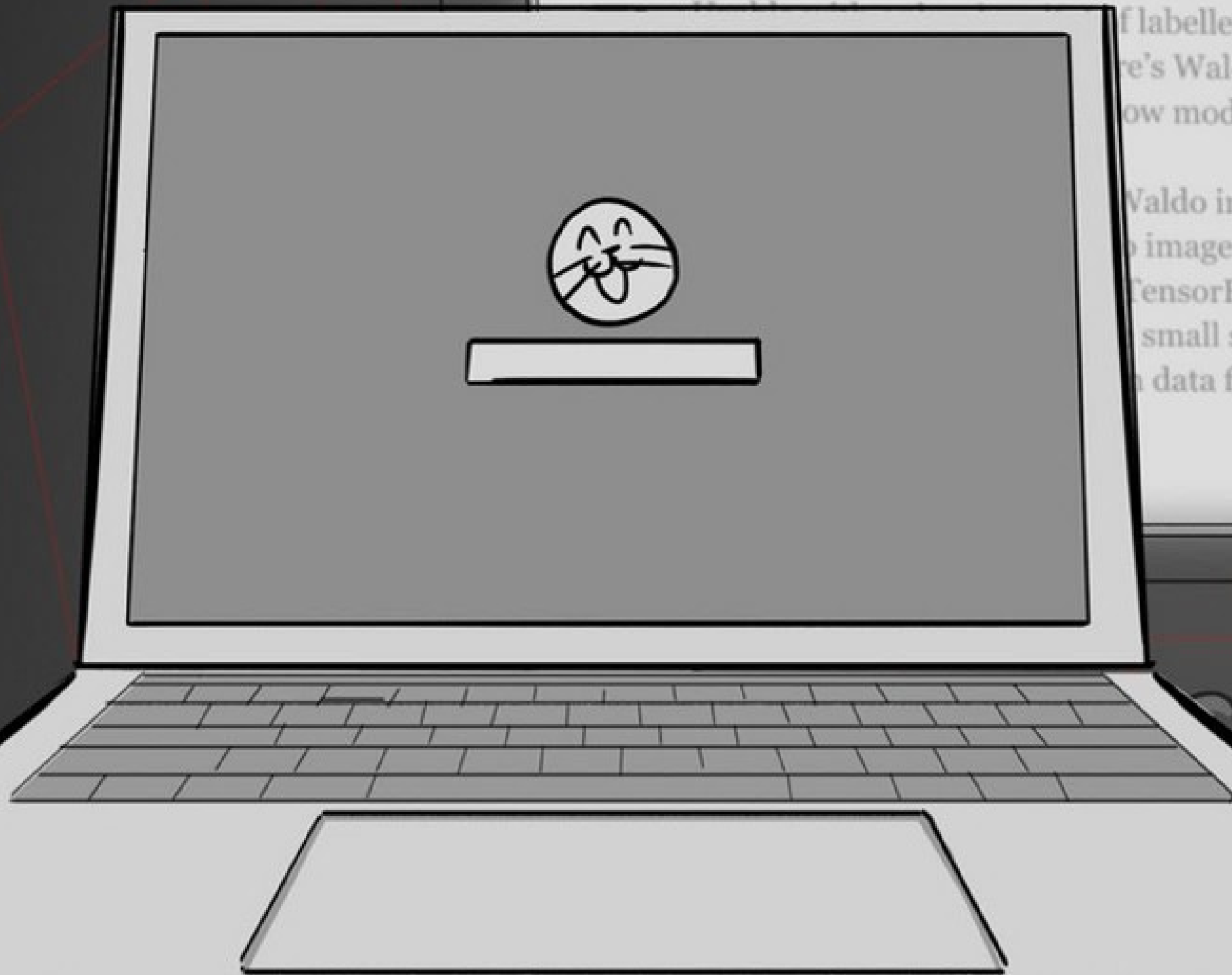
- Find instances of Waldo in images
- Do NOT use Waldo image sets off
- Configure model using TensorFlow C
- Train model (Due to the small size
- Test model on validation data fou





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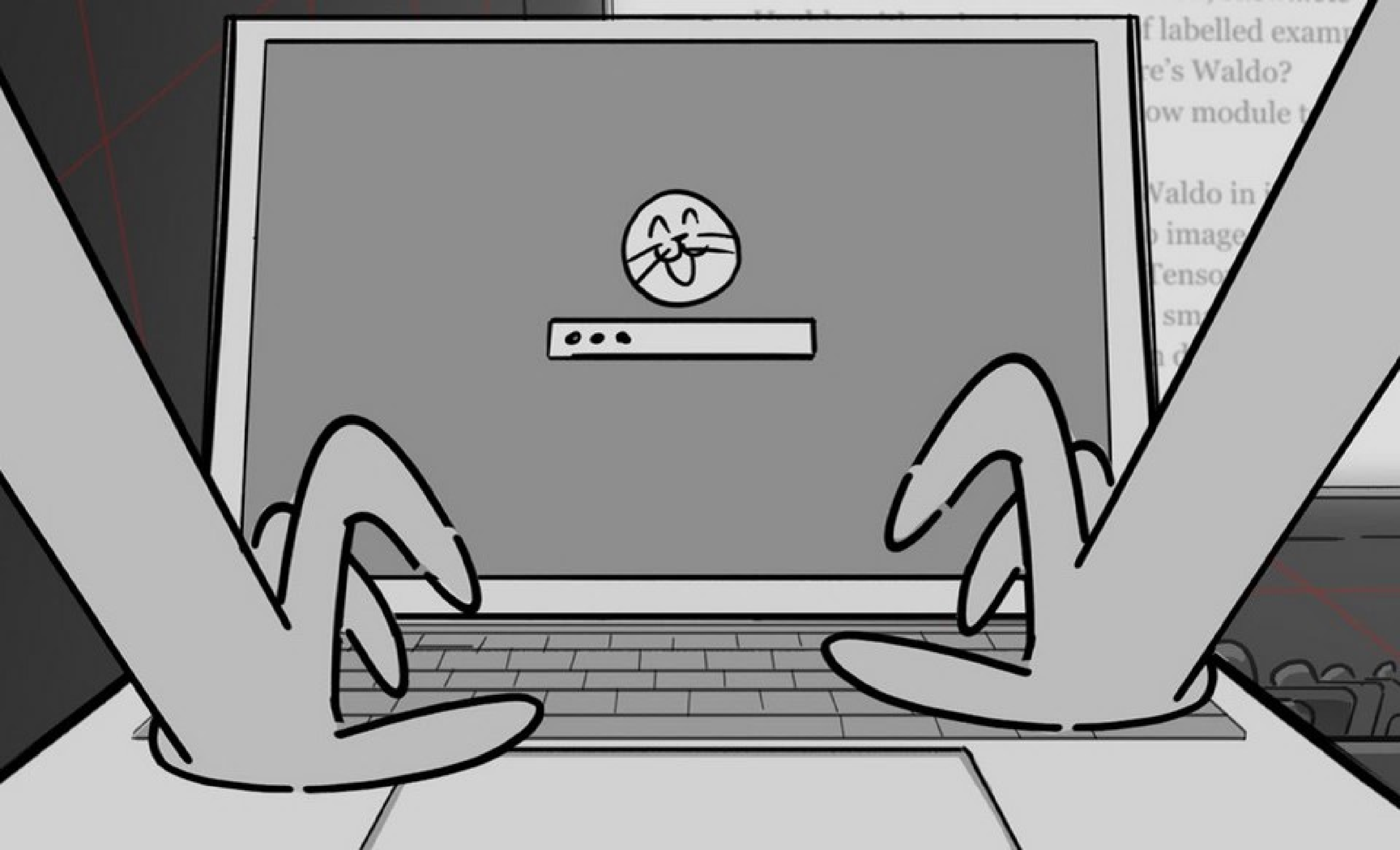
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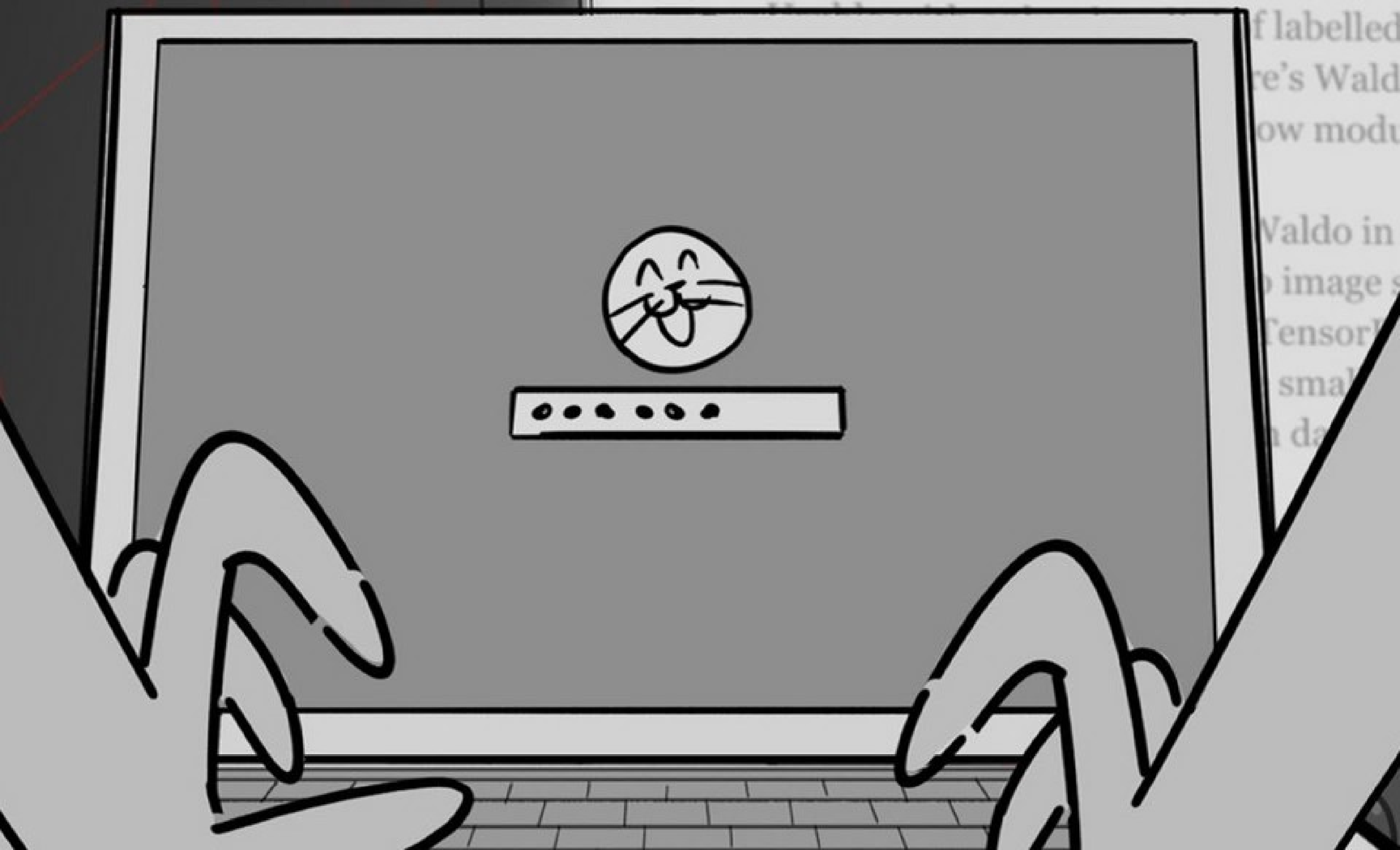
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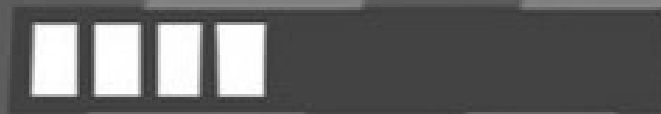
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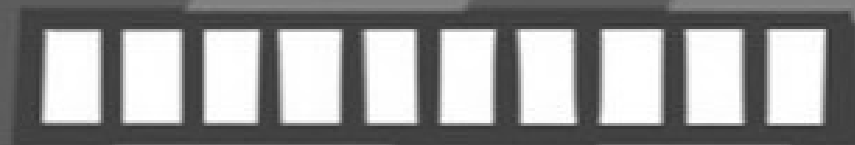
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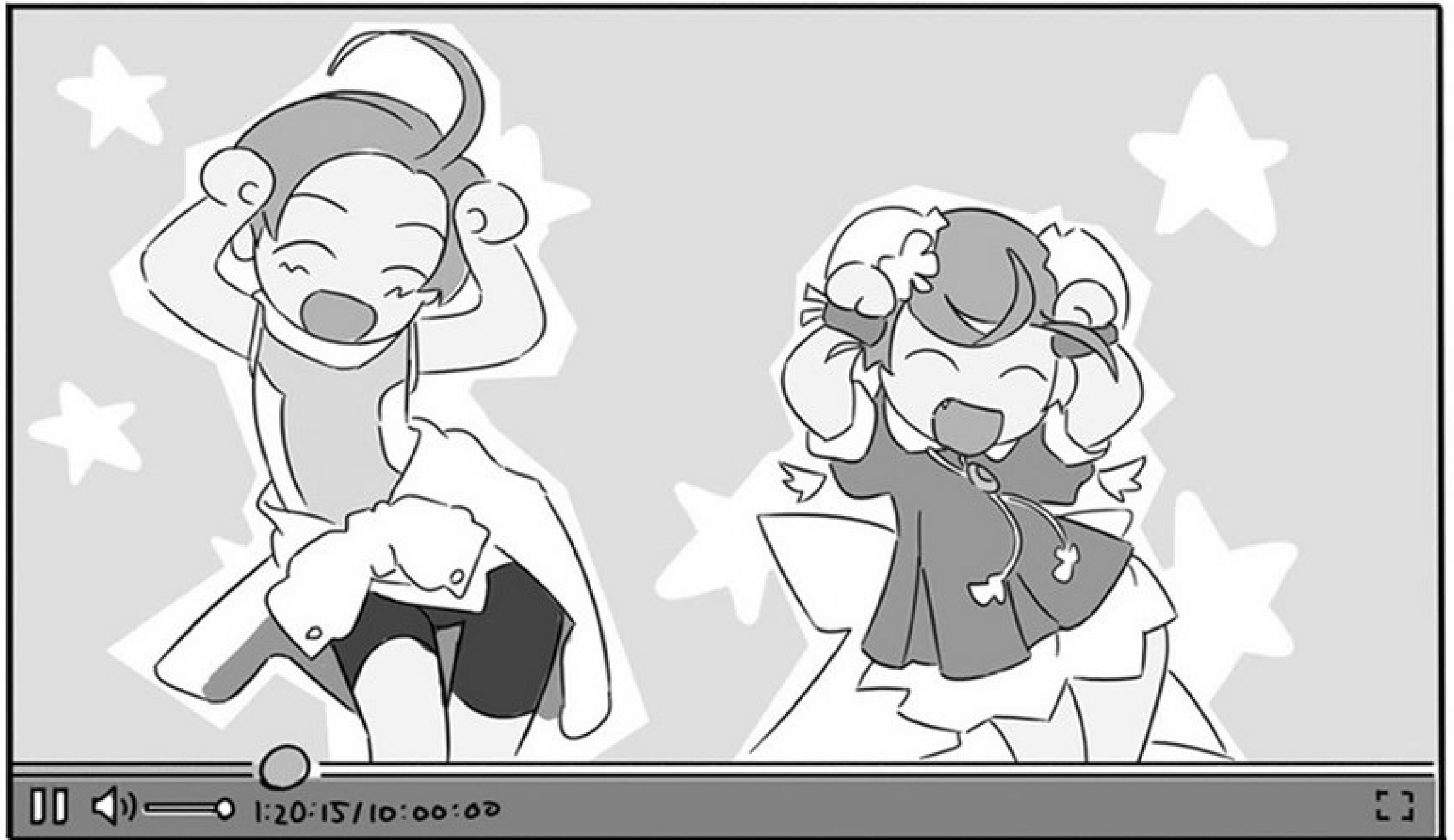
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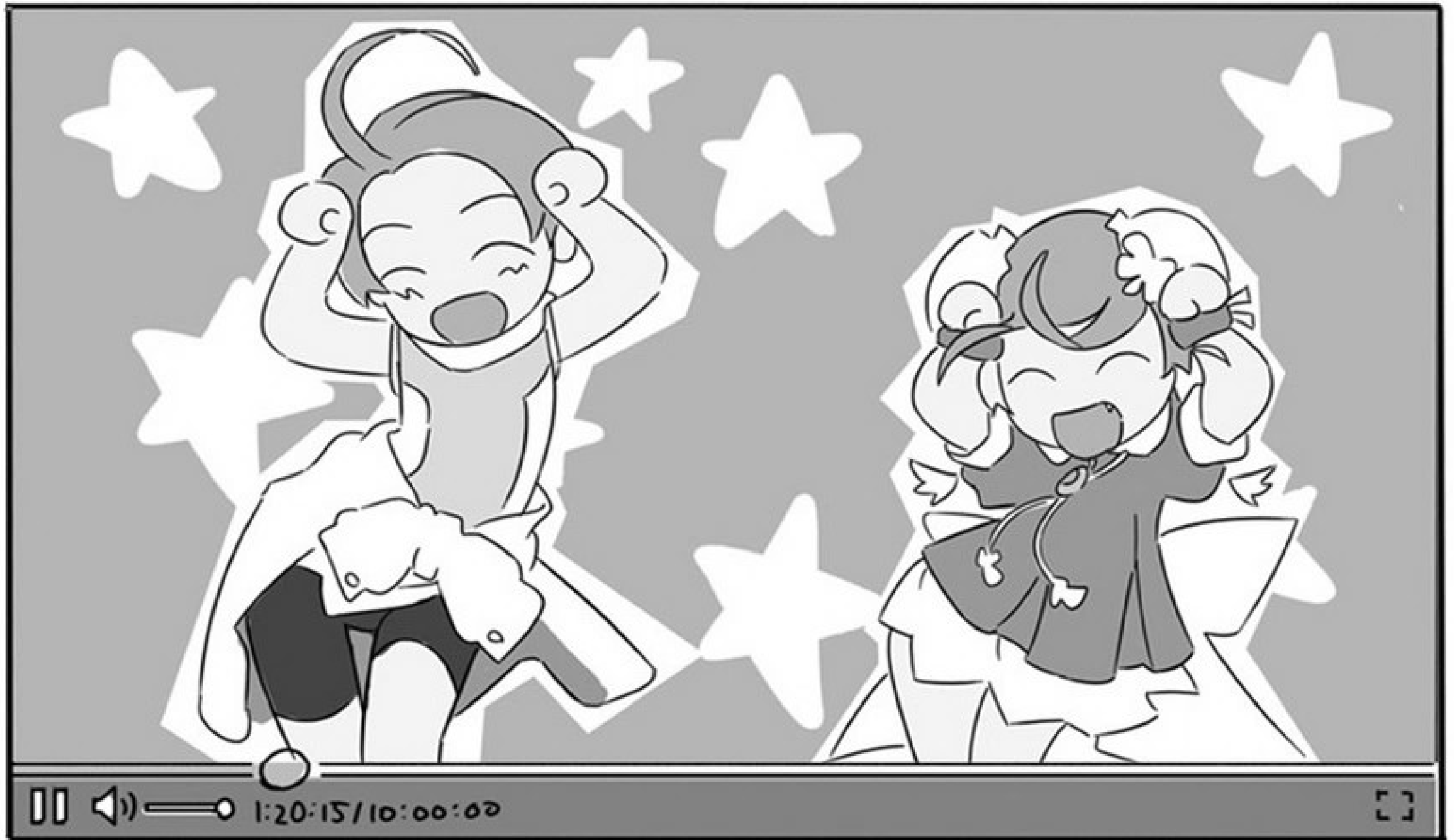
LOADING...





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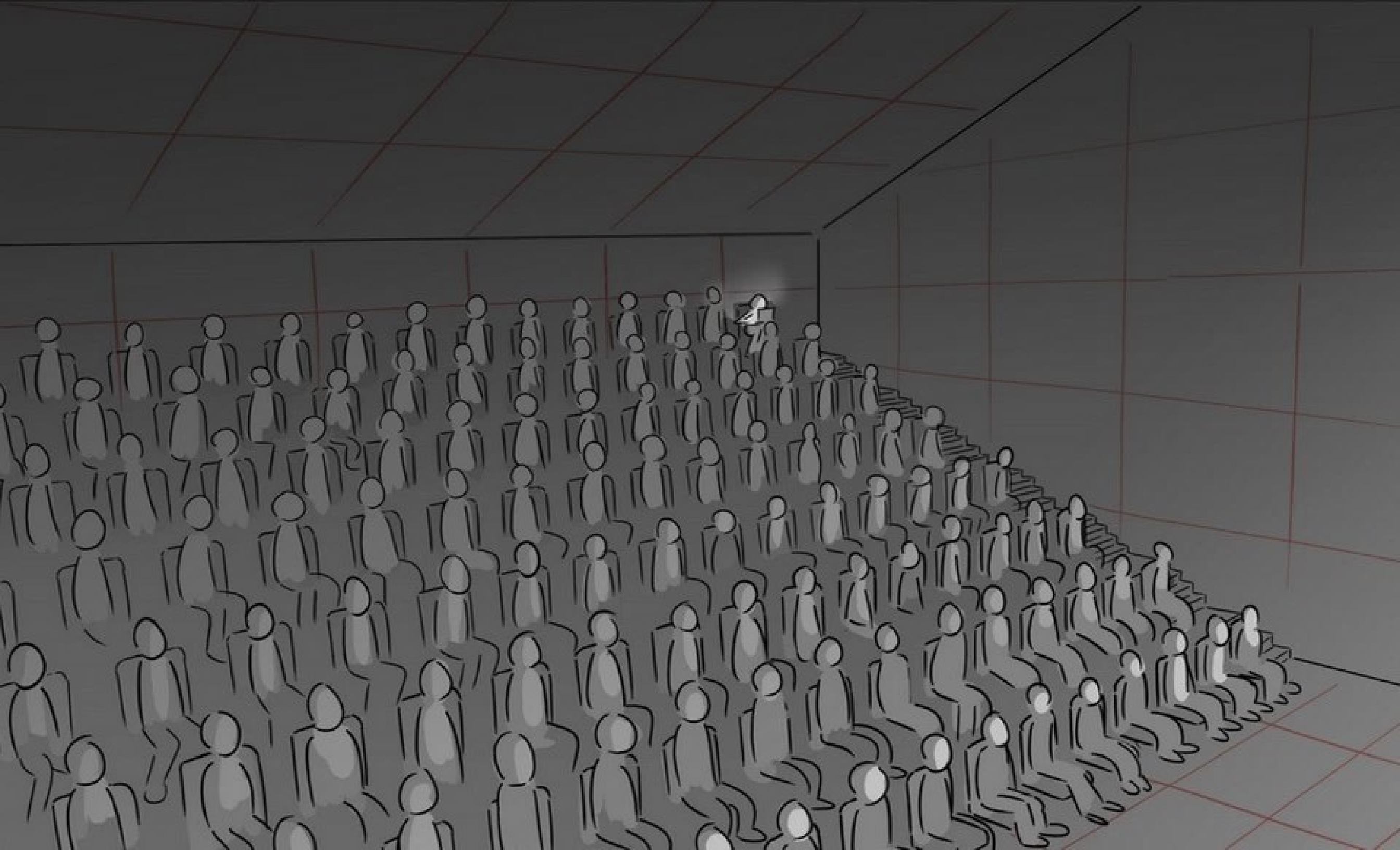
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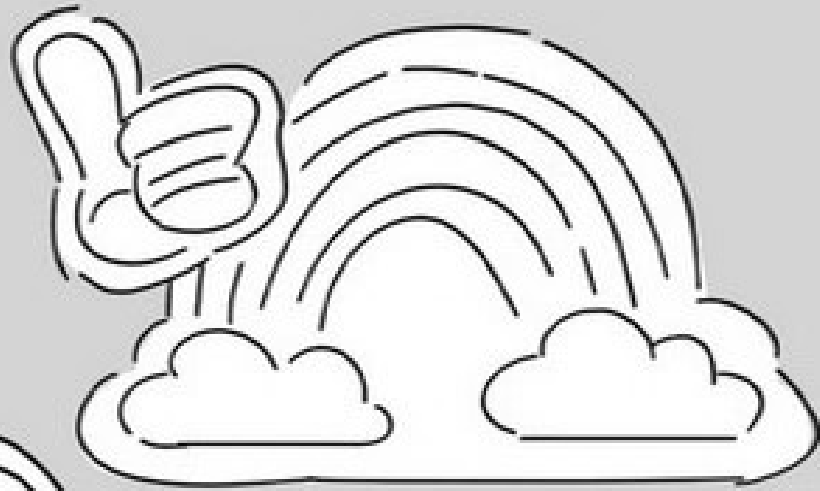






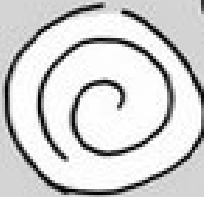
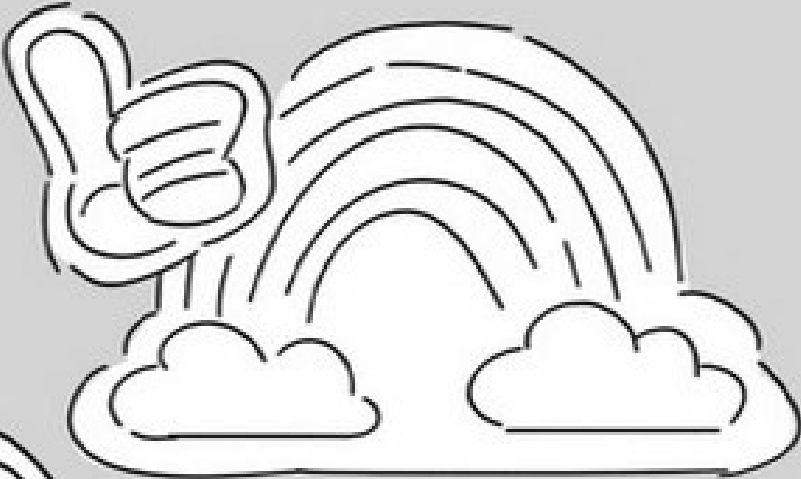


AFK.js





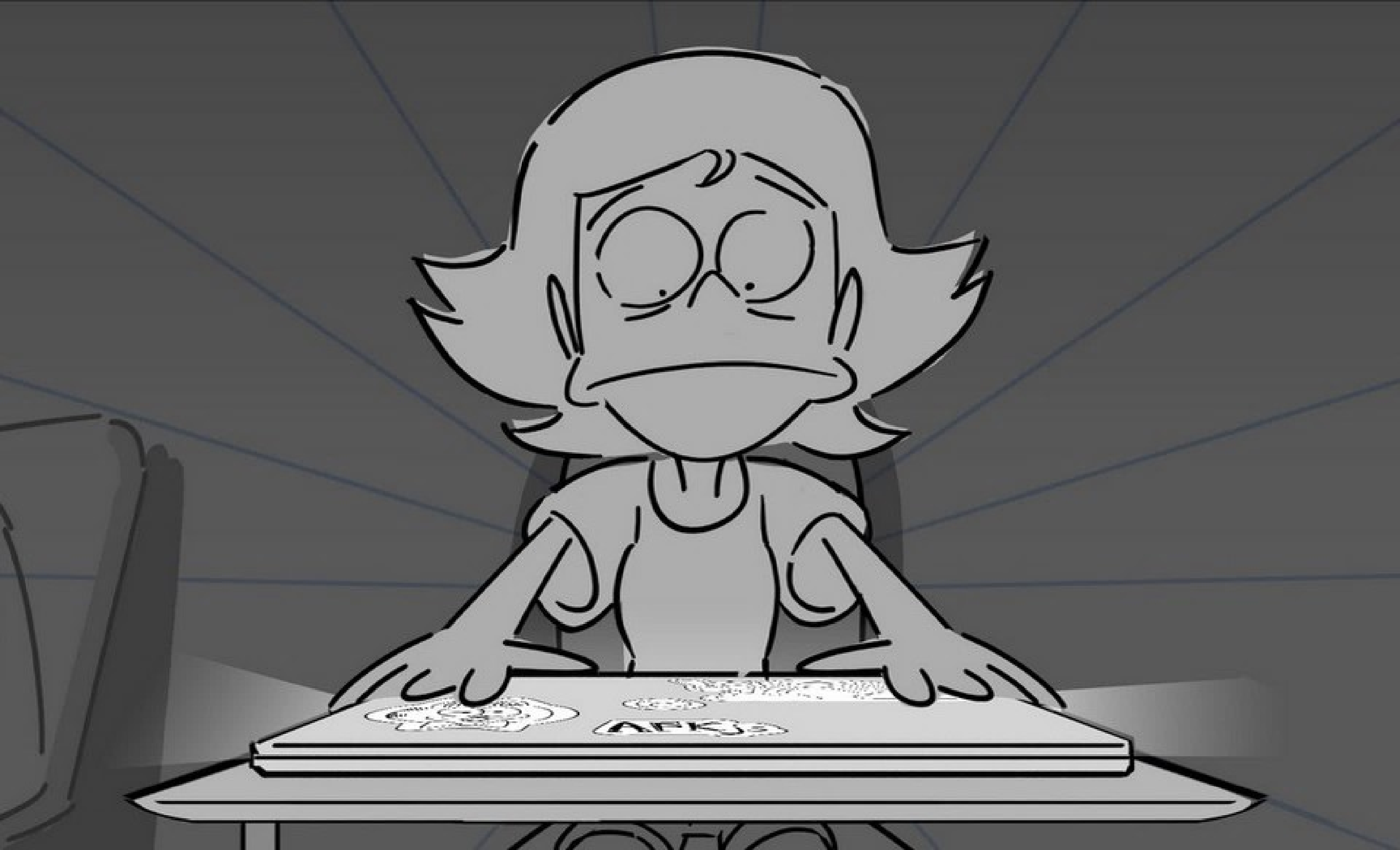
AFK.js

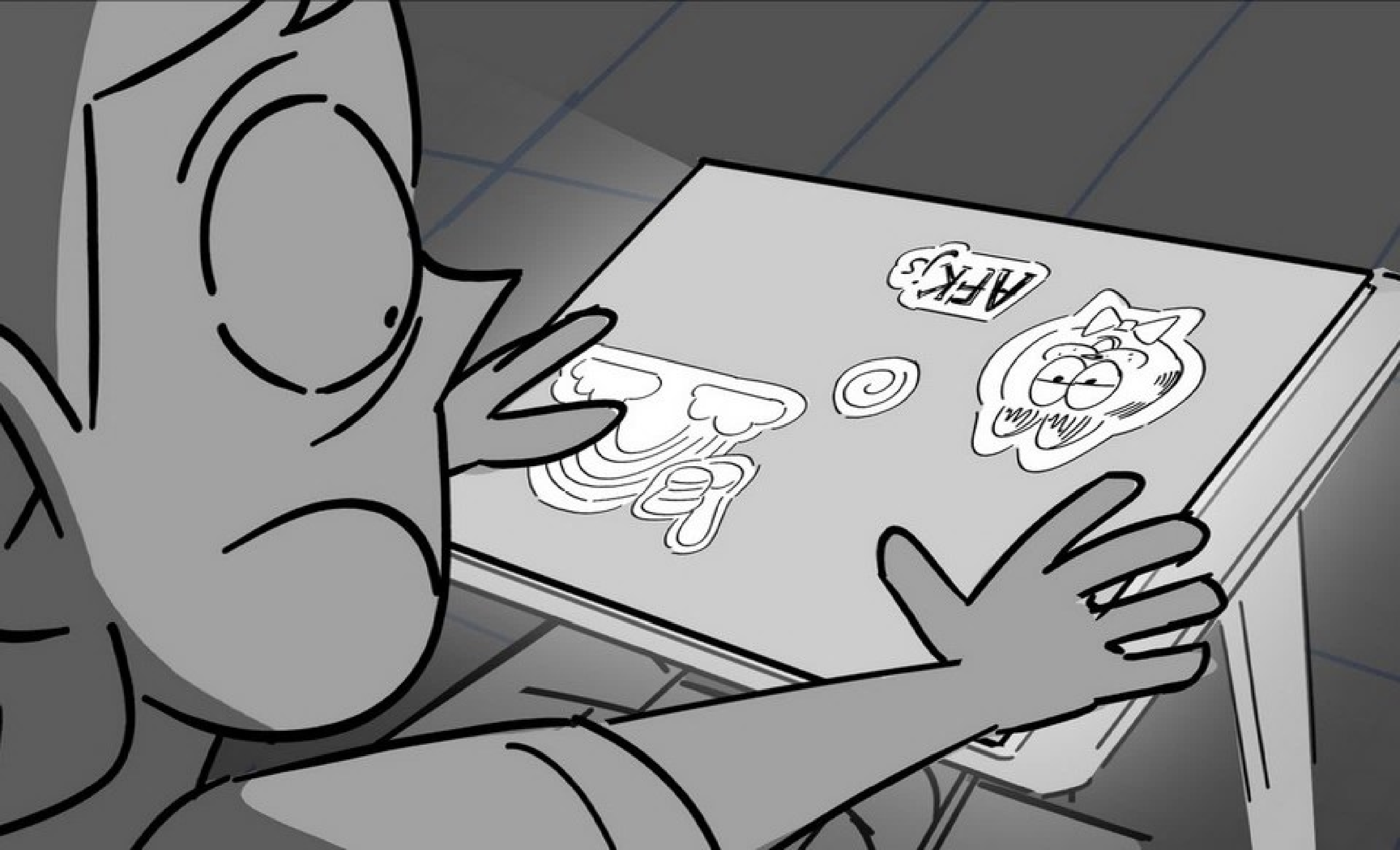


AFK.js





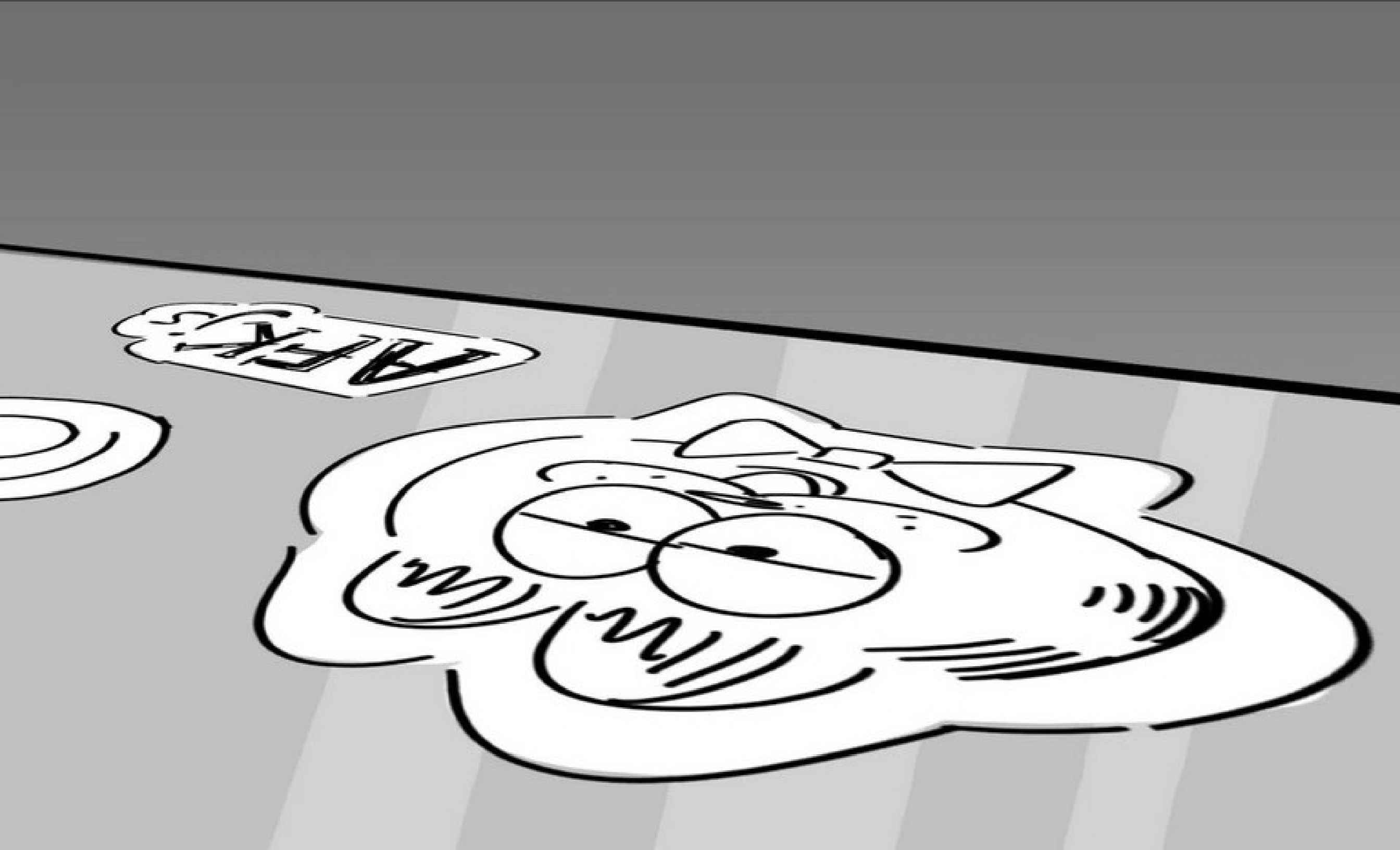


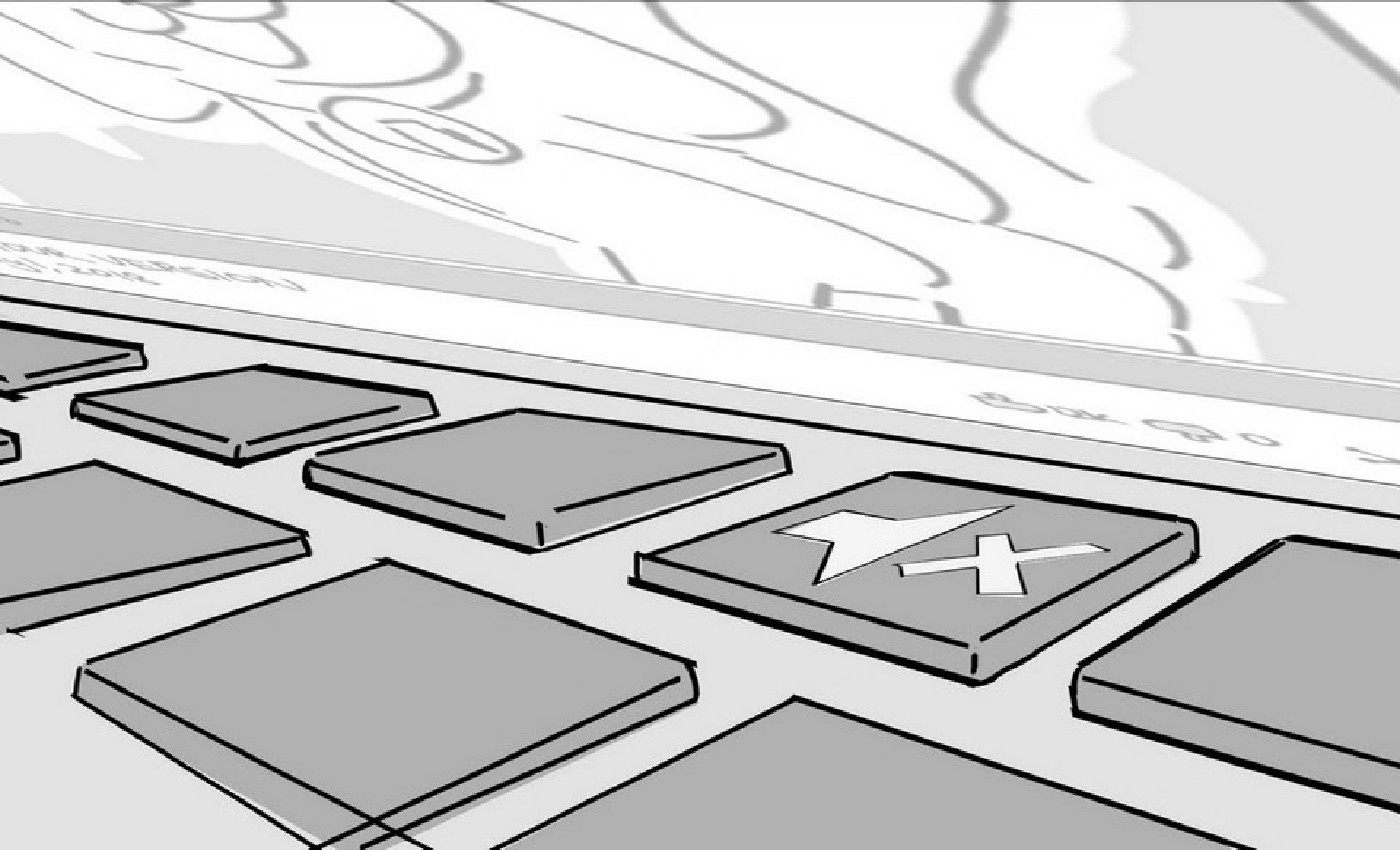






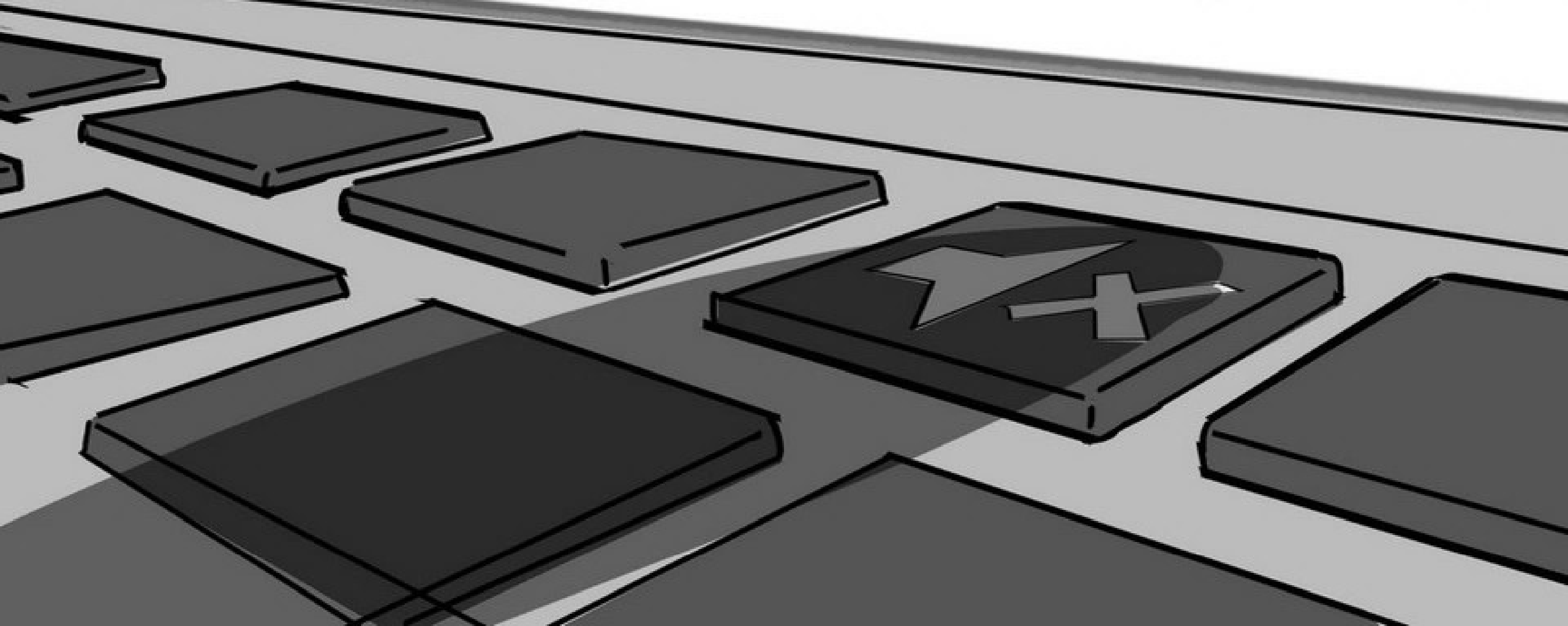






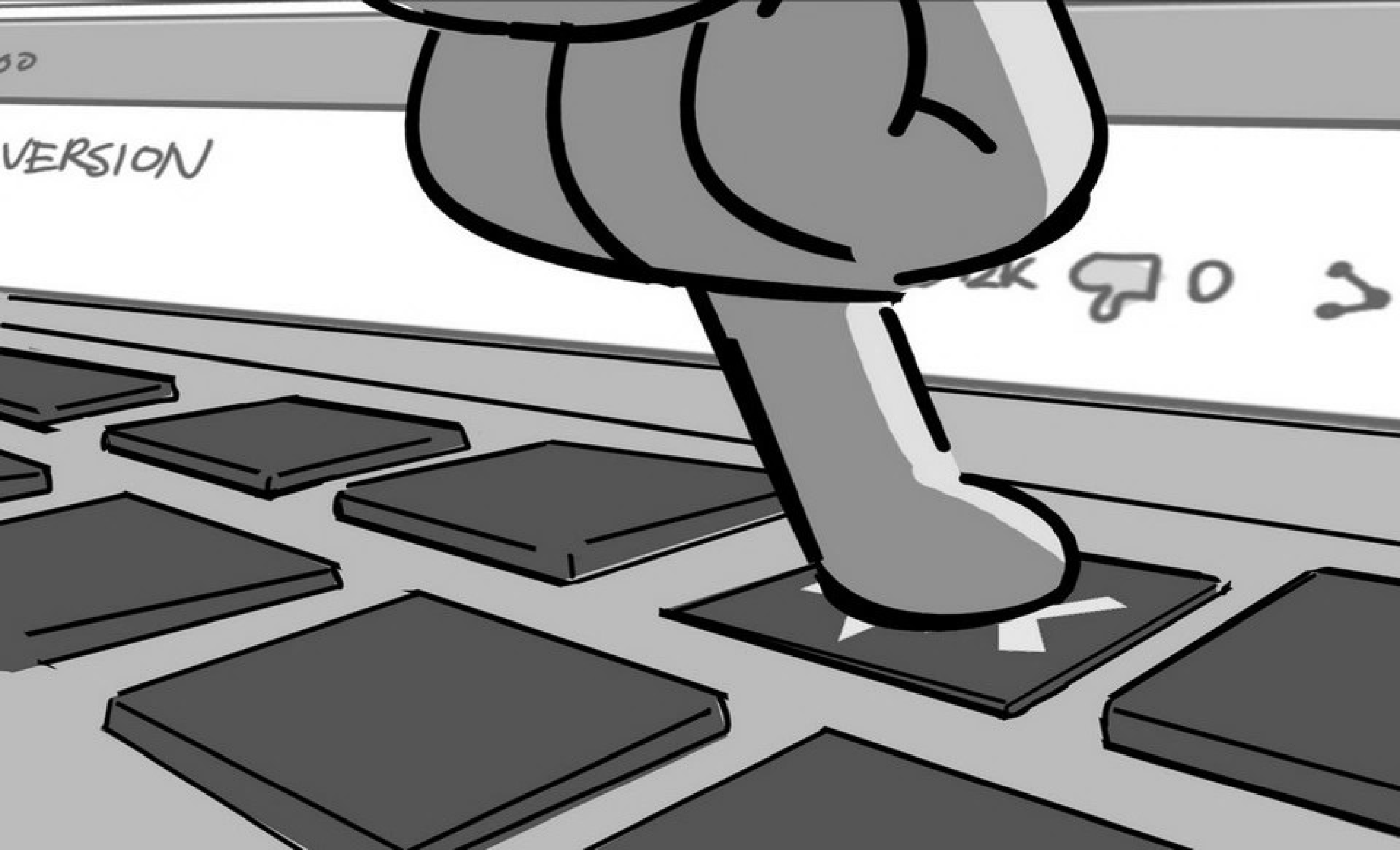
VERSION

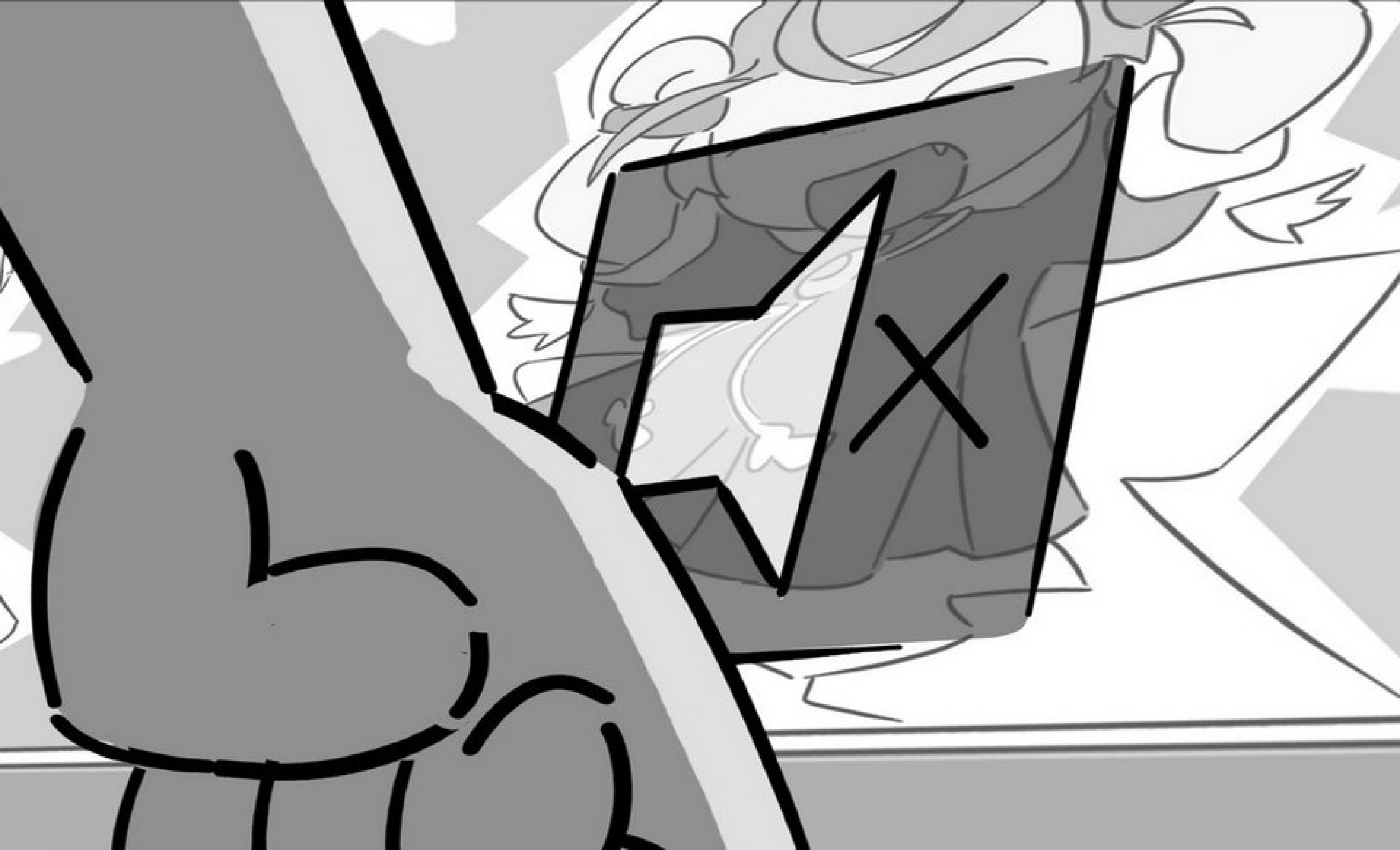
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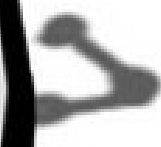




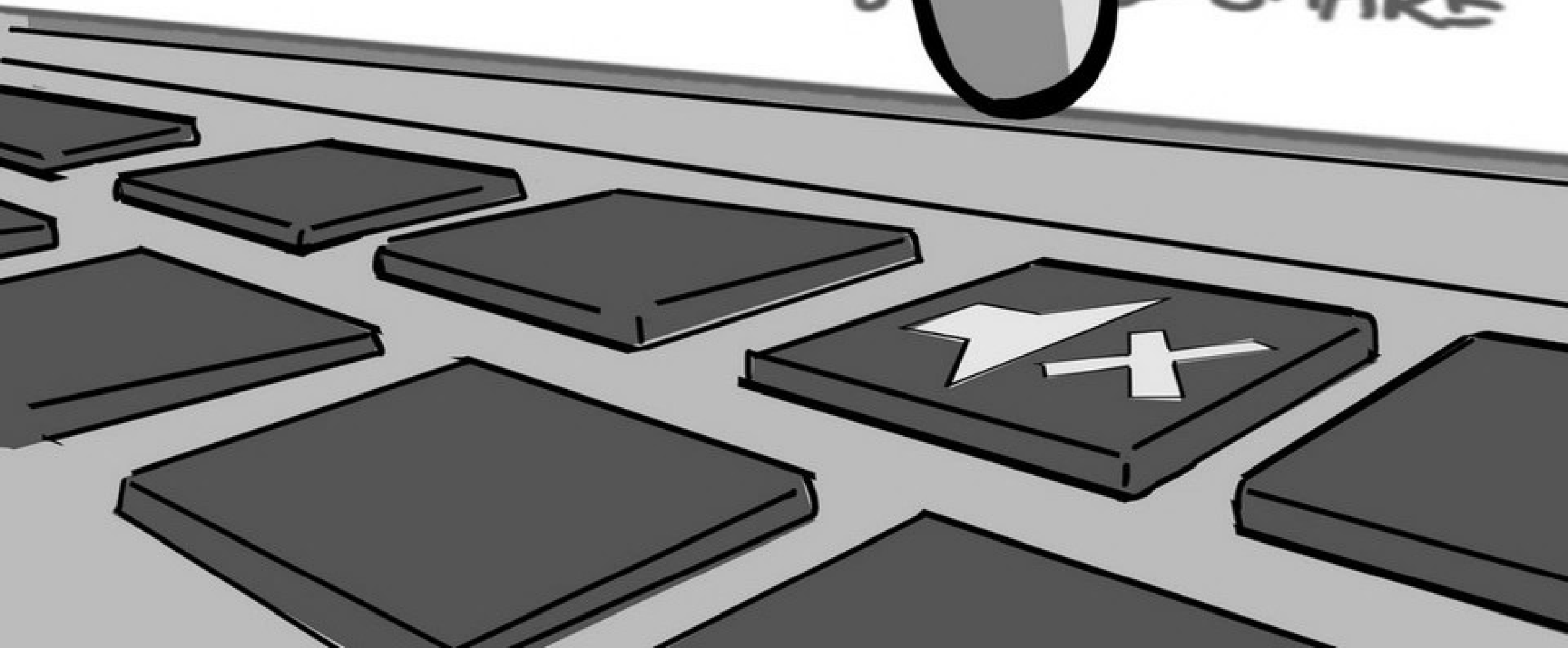


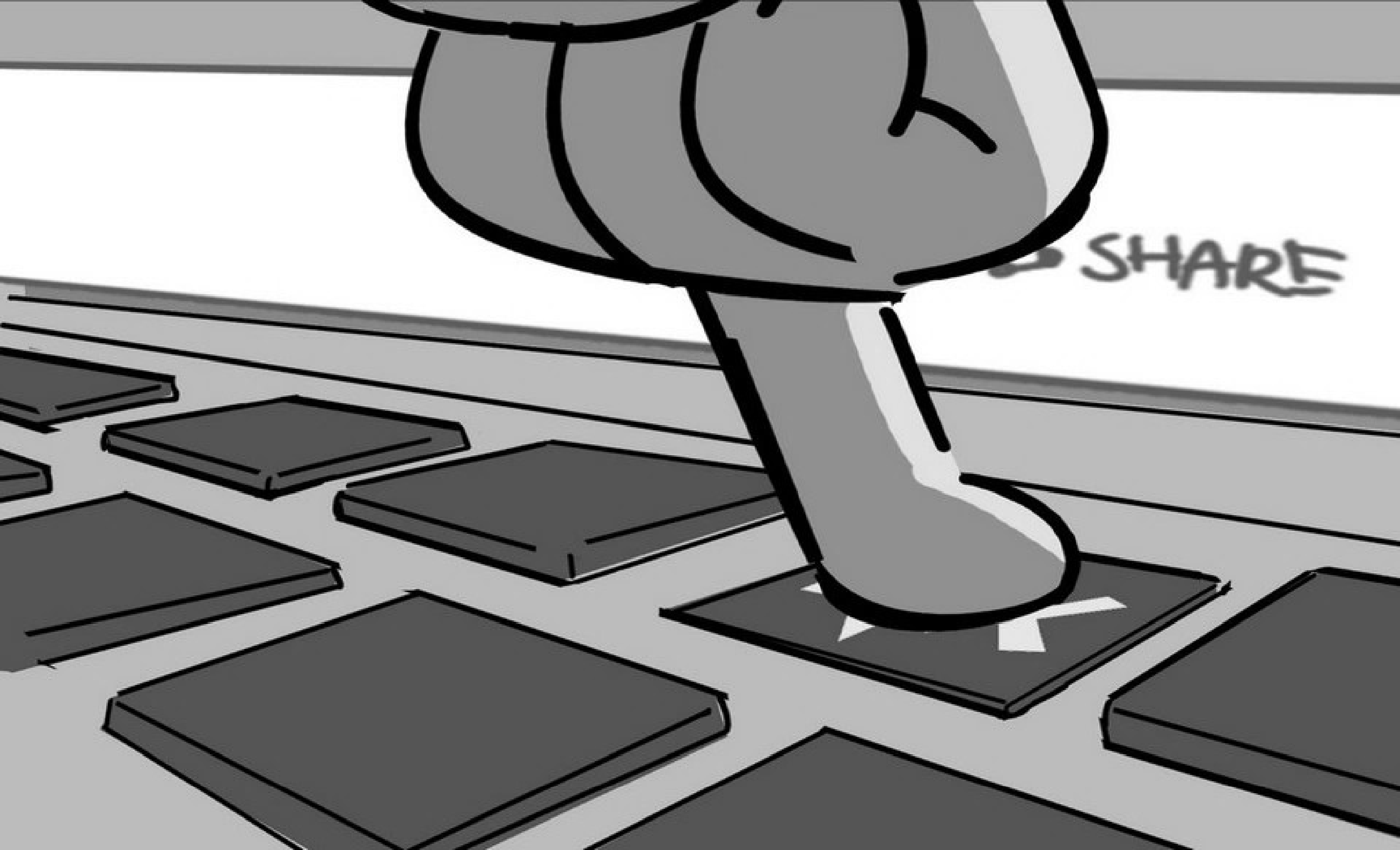


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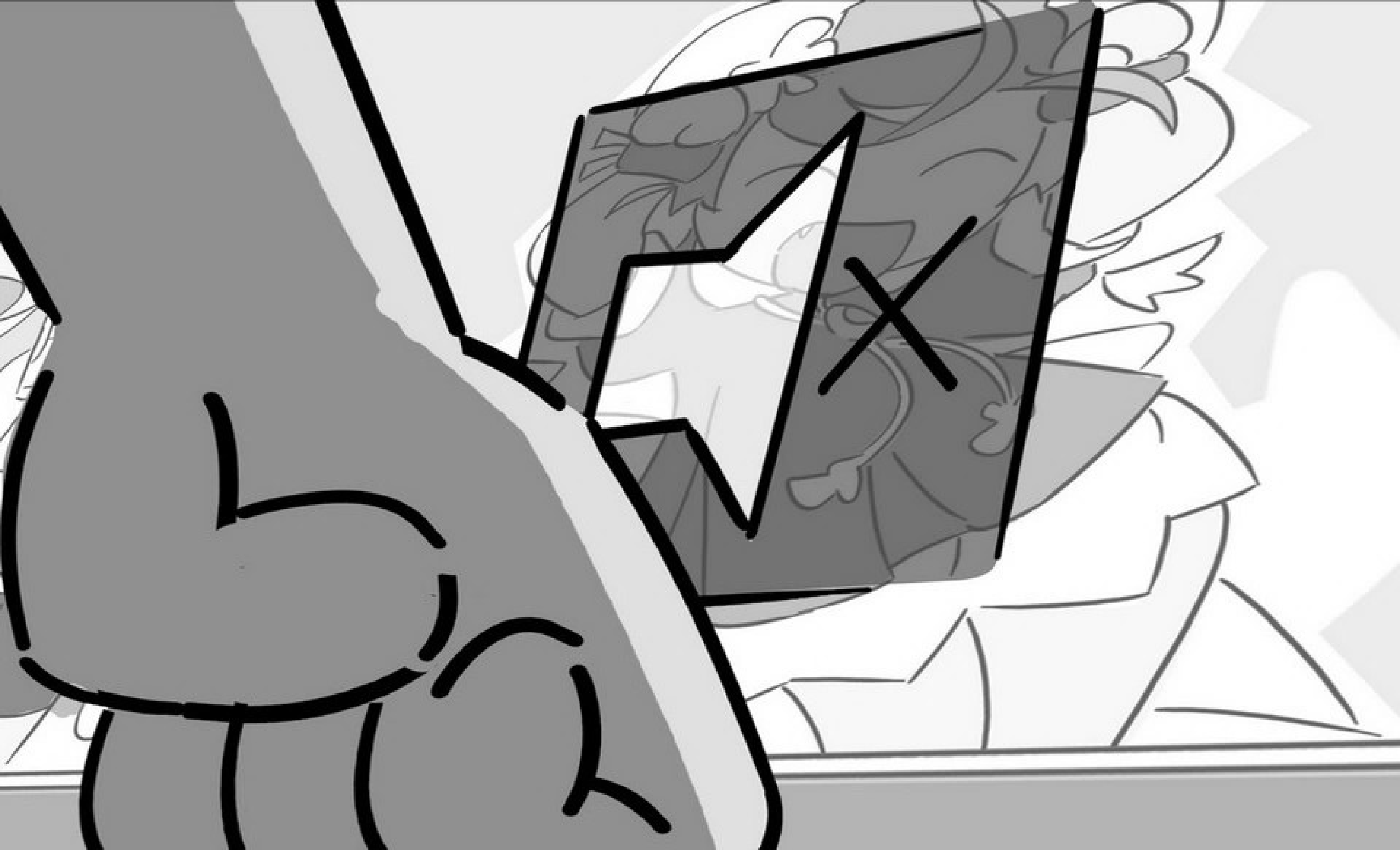
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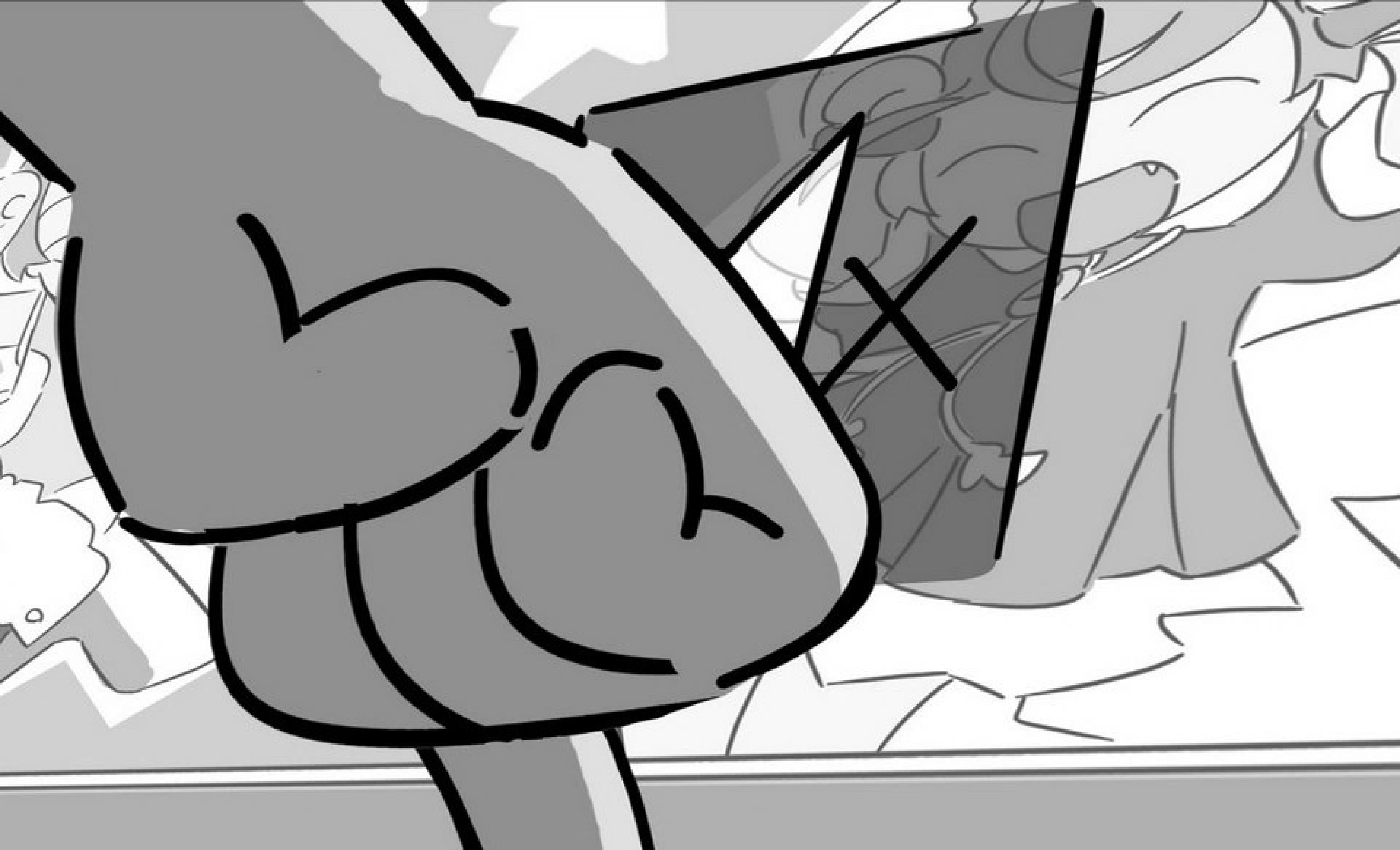


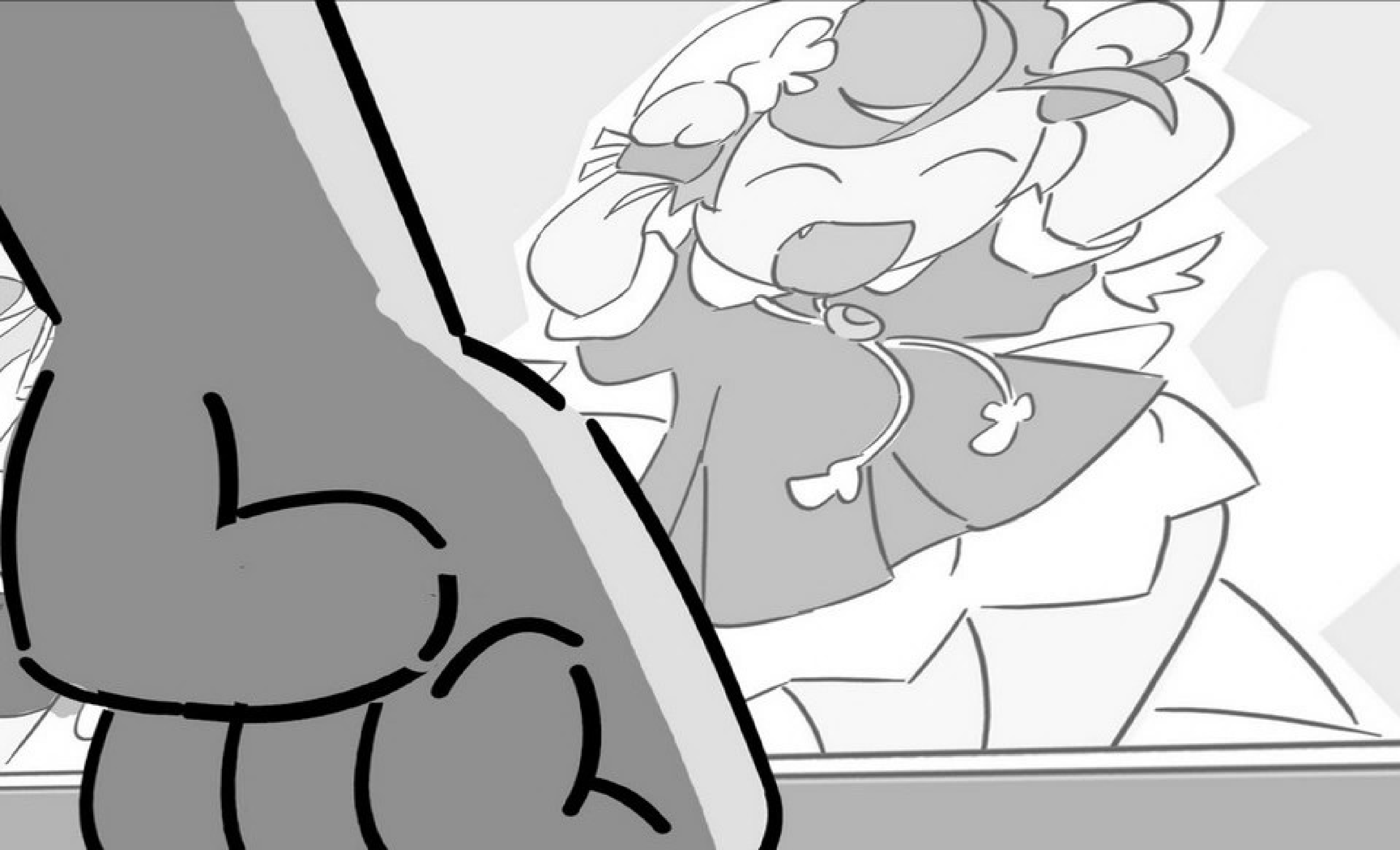


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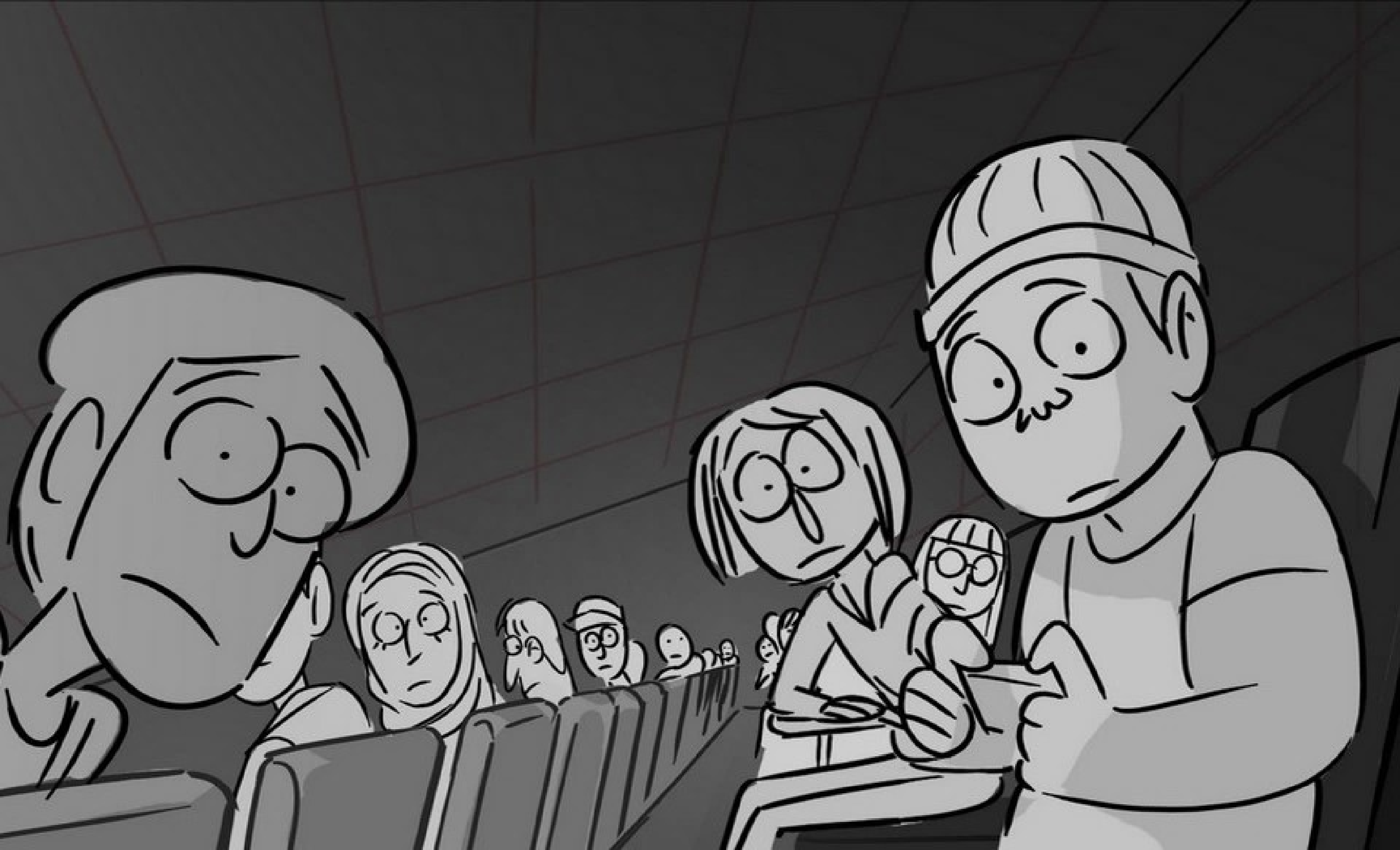
















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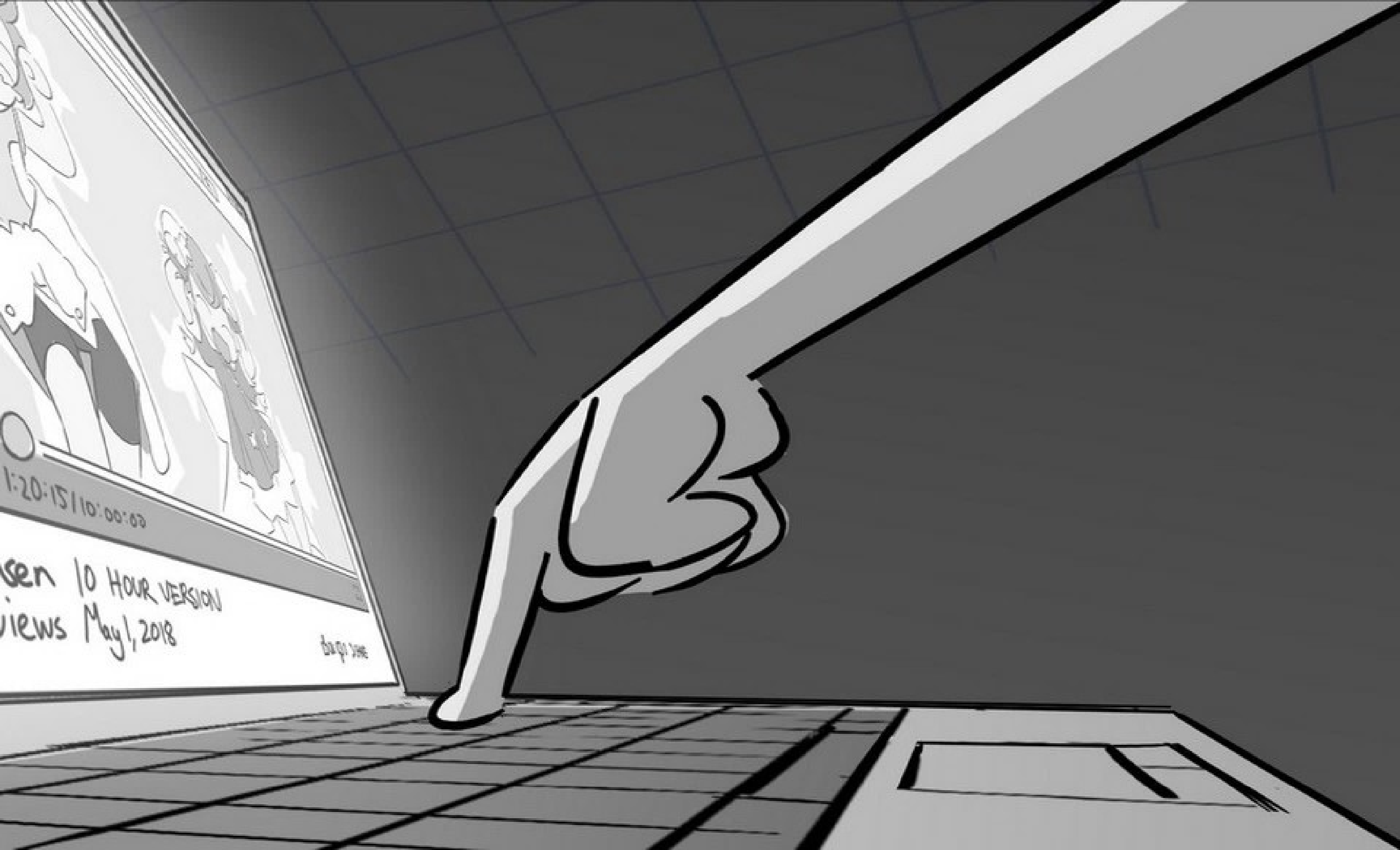




REC ●



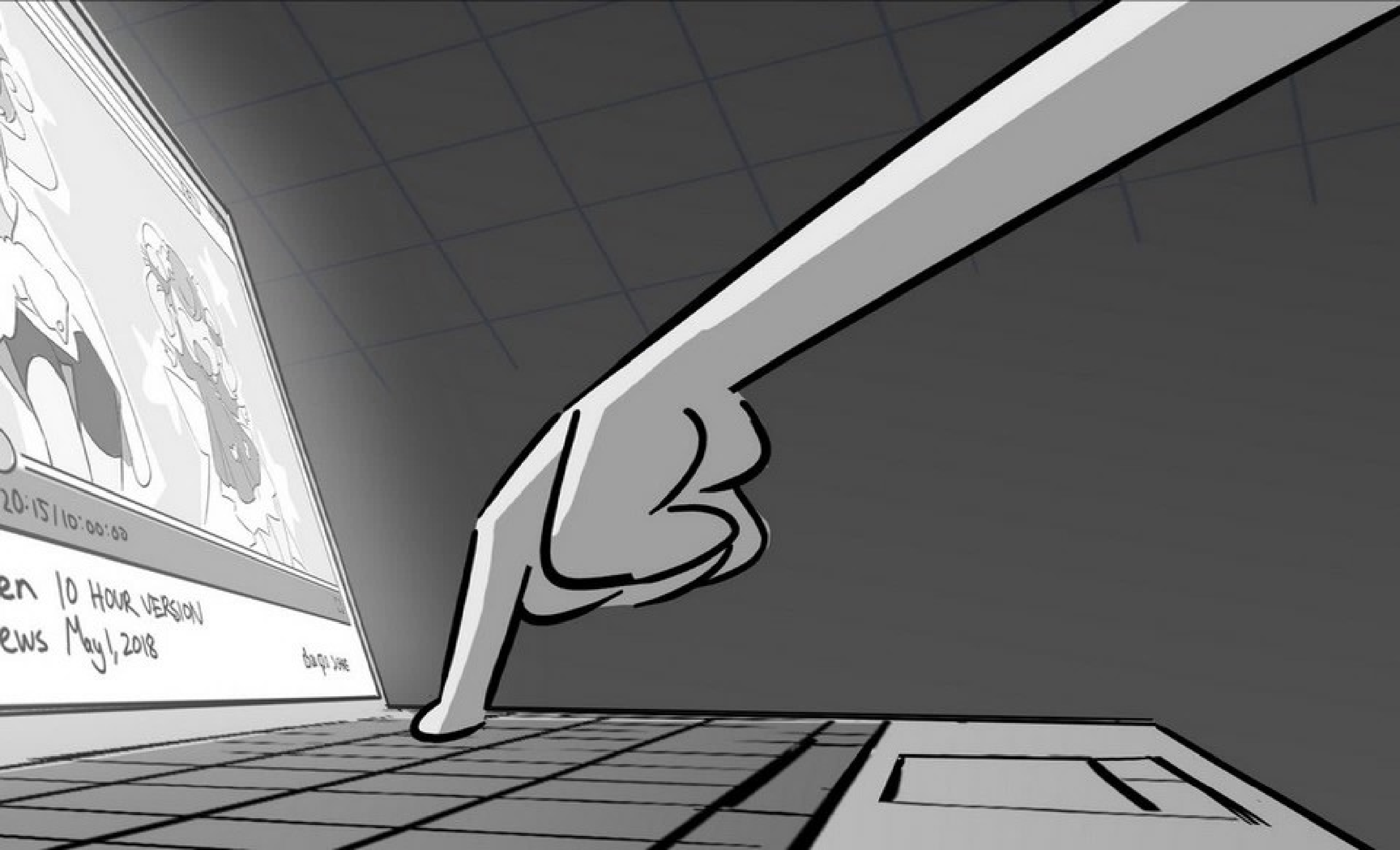




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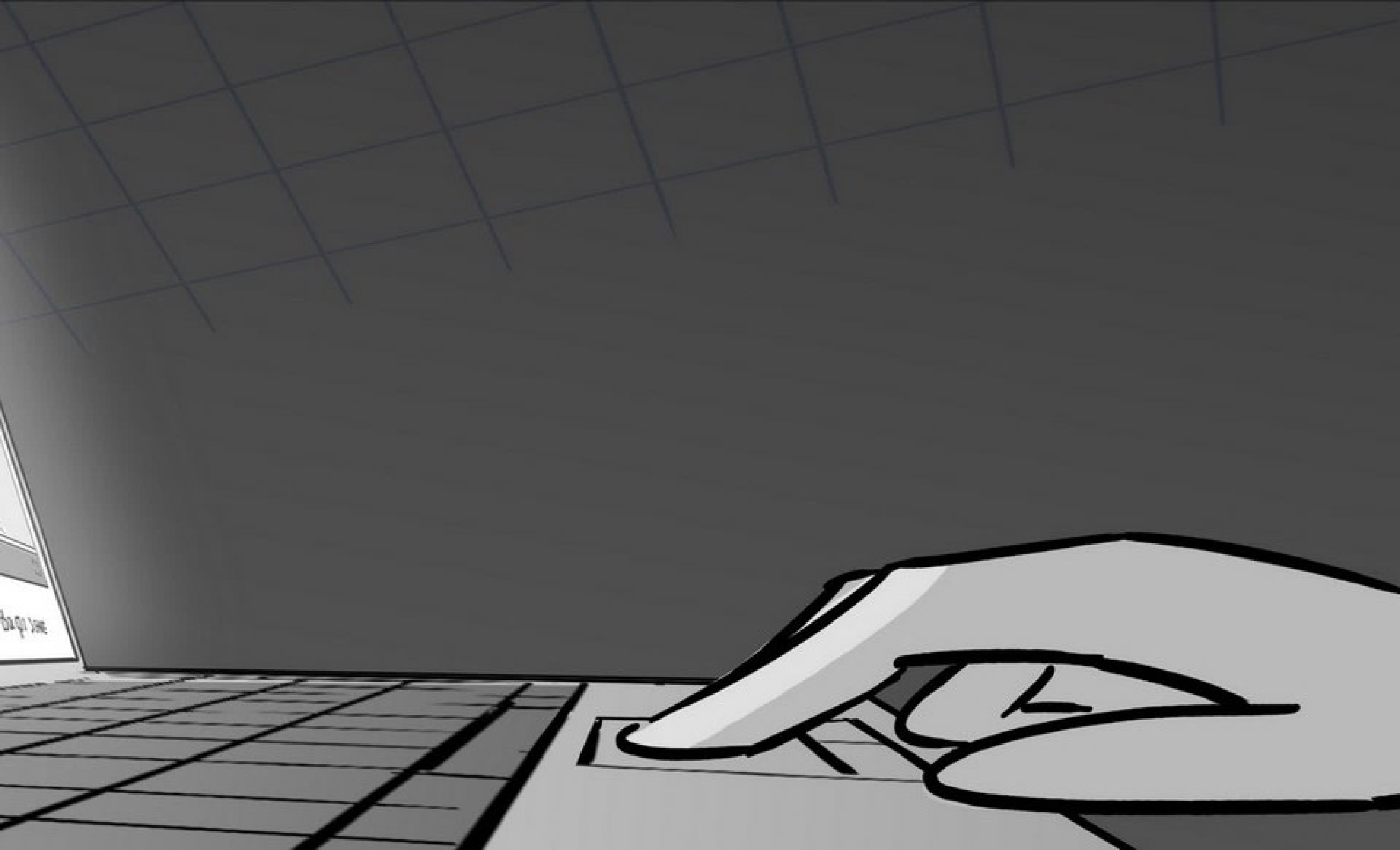
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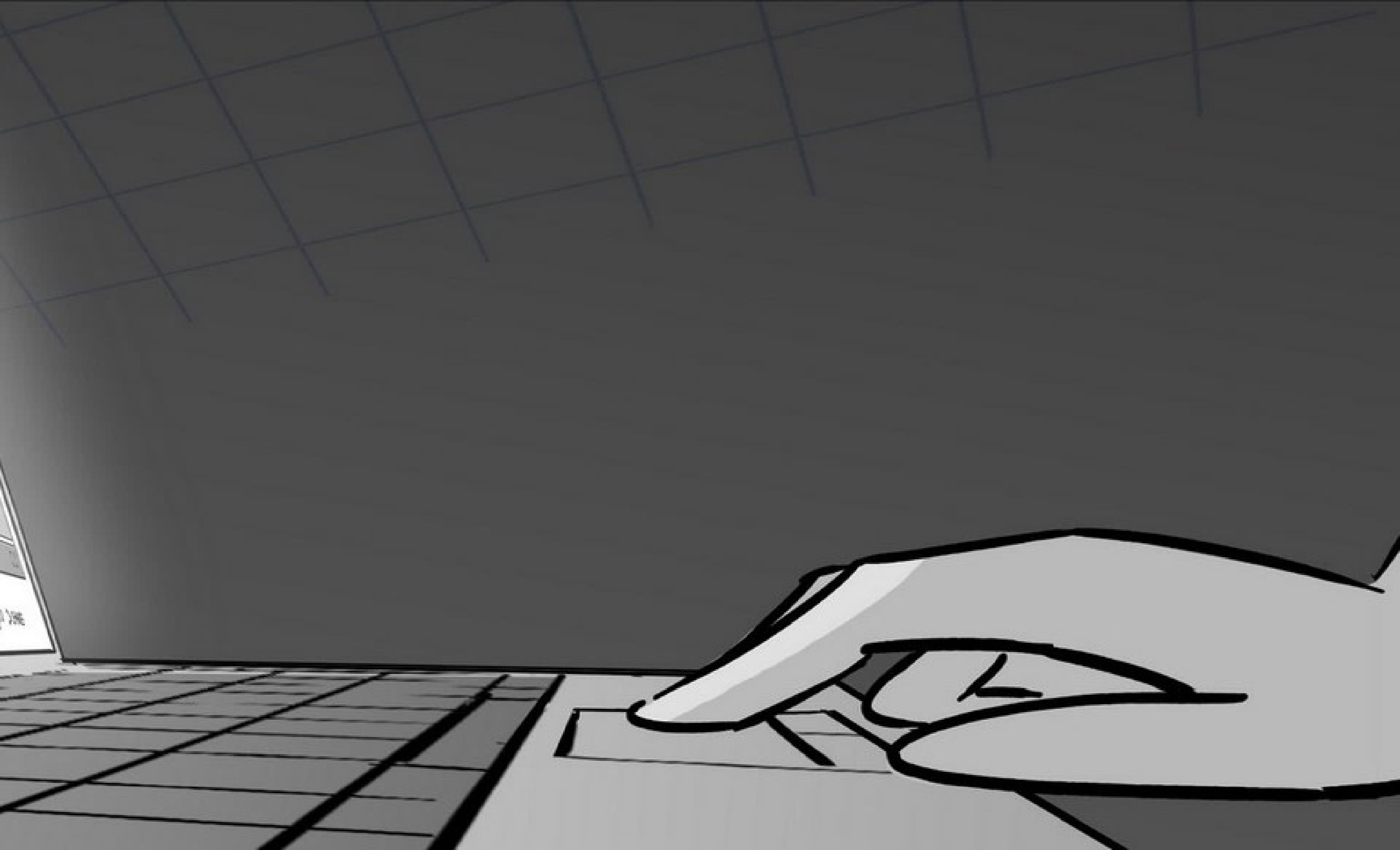


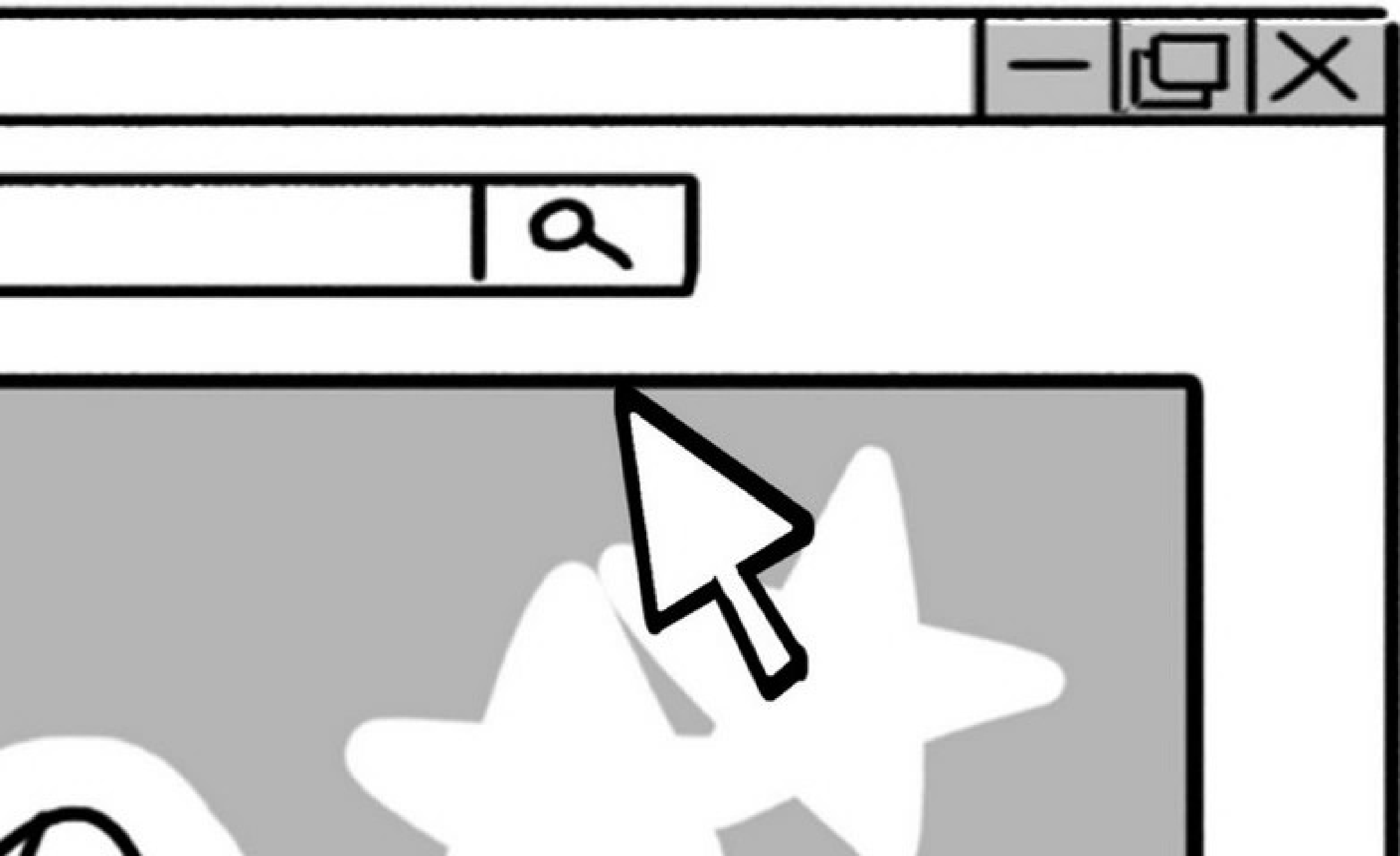
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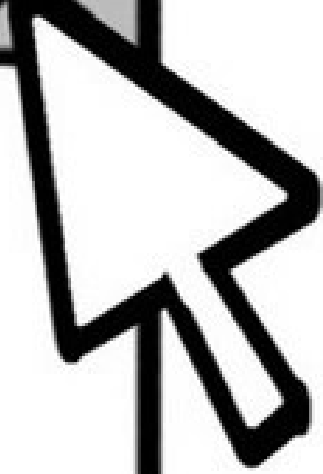
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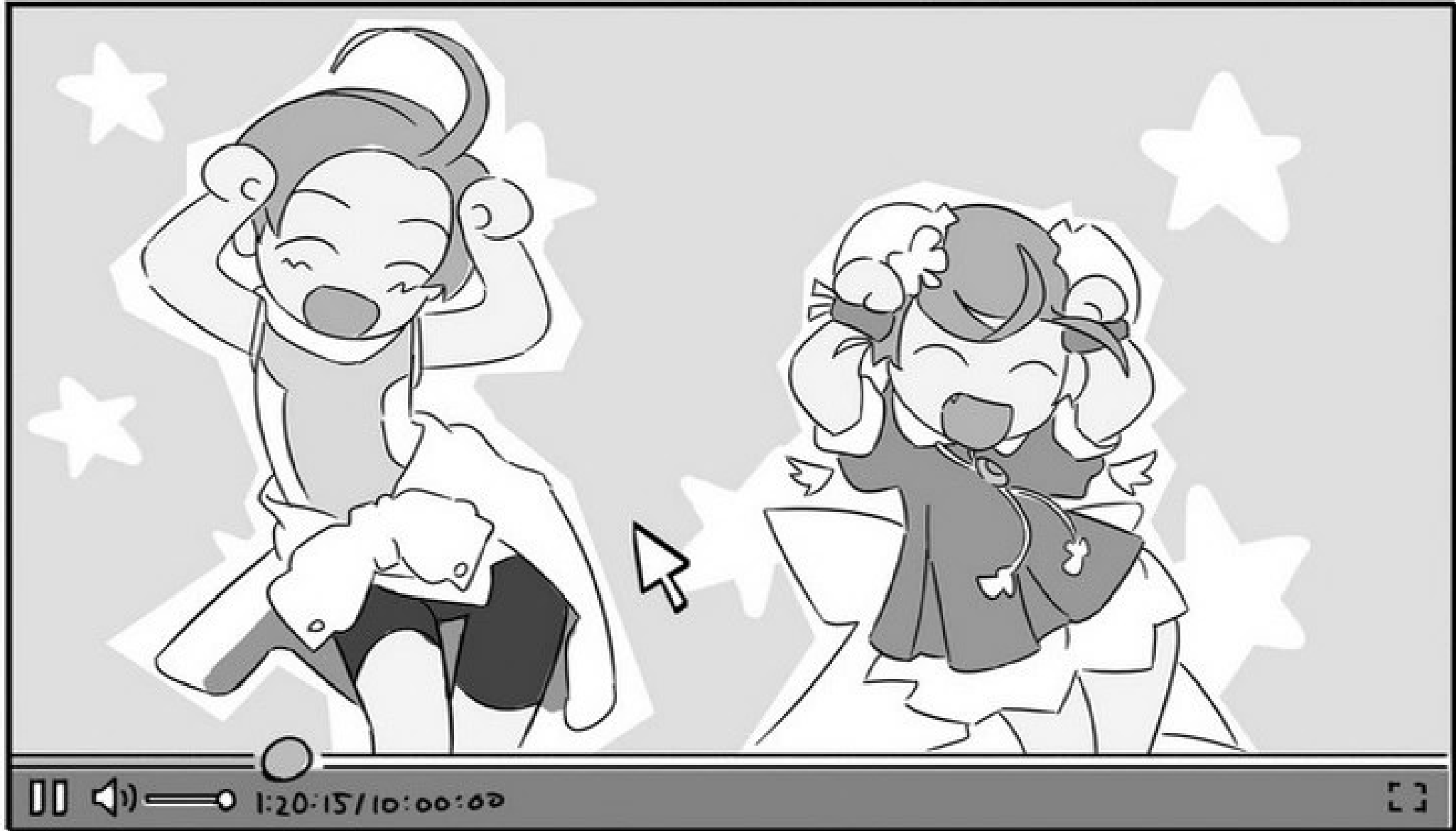
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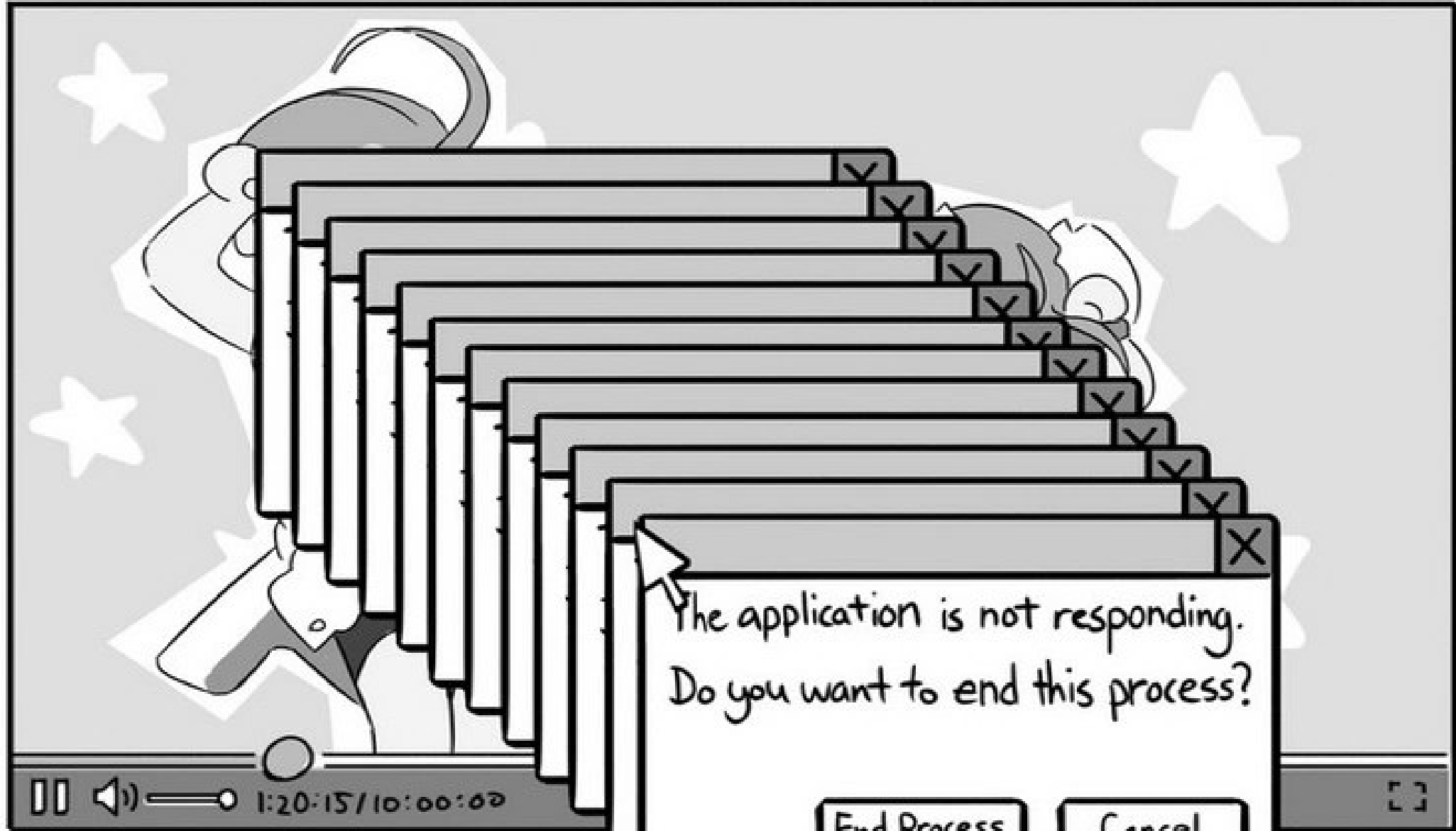
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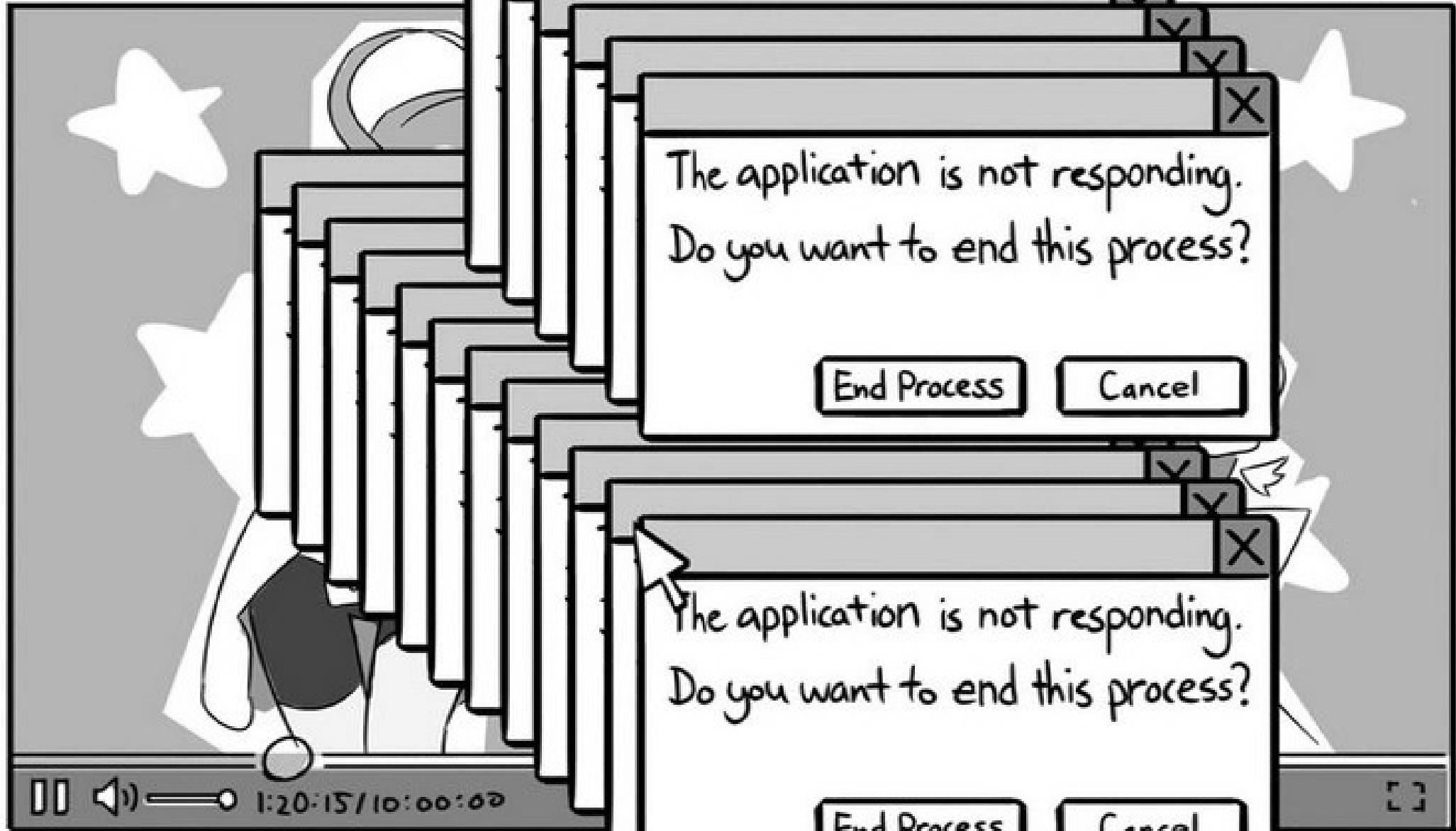
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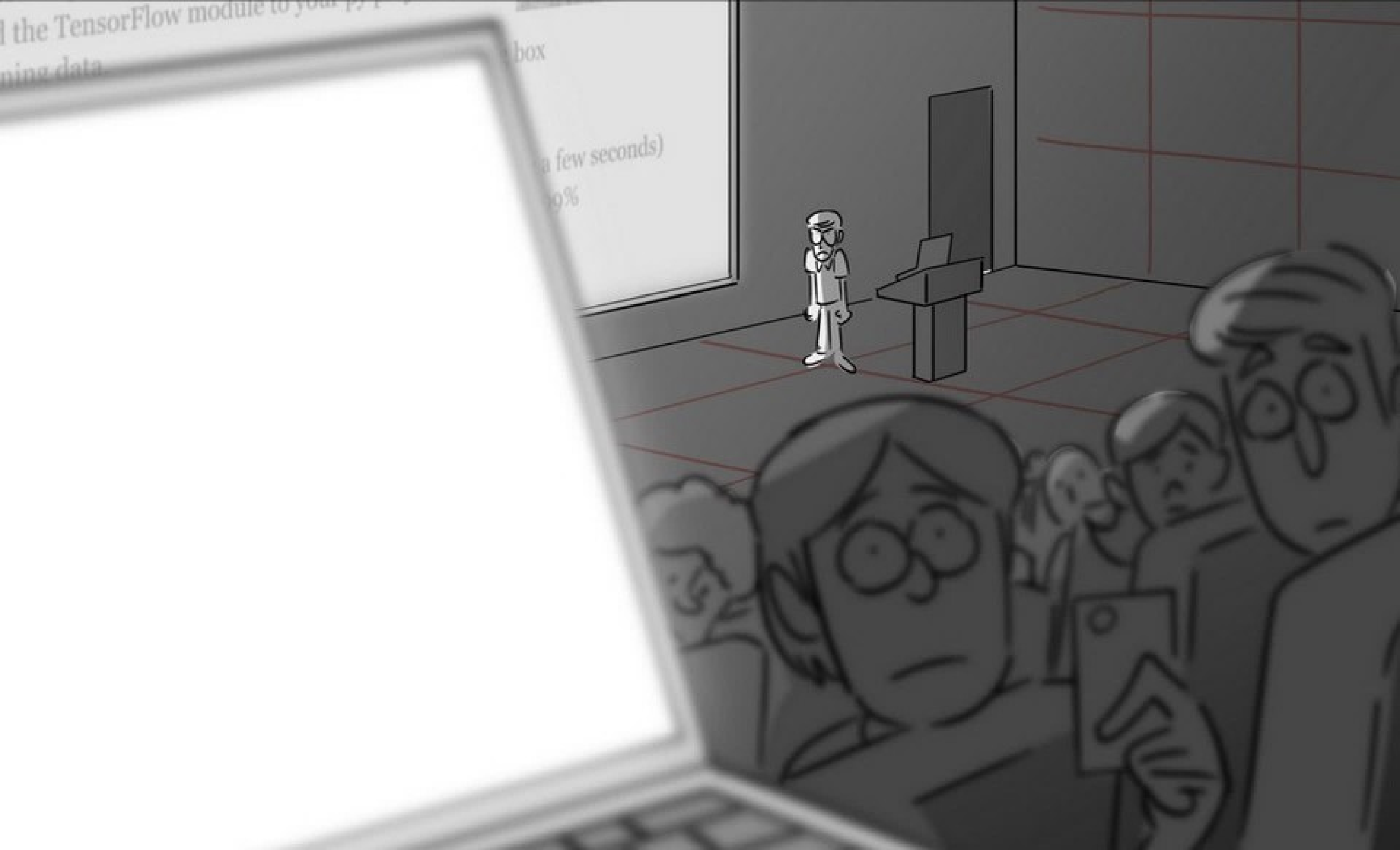
AFK.js



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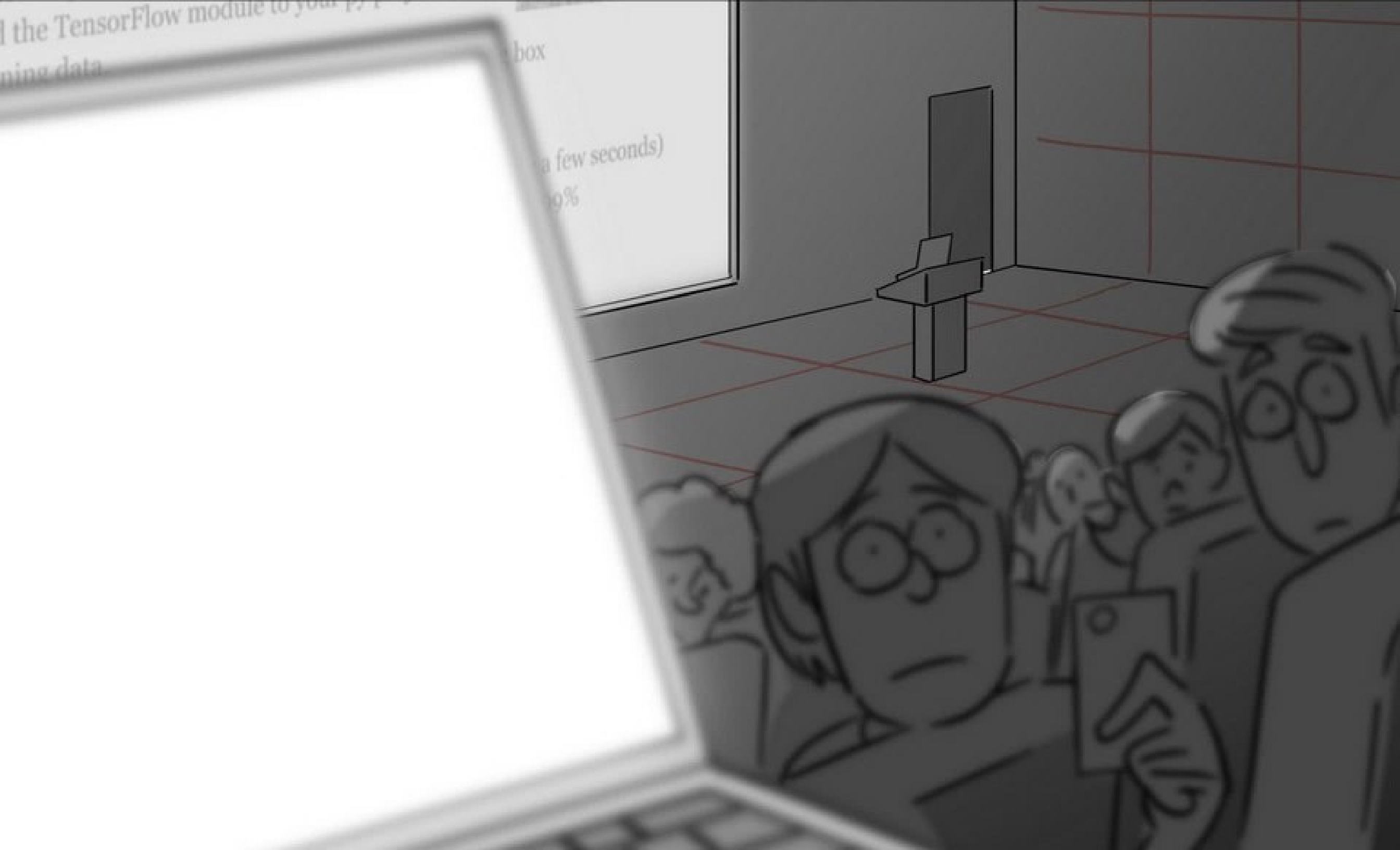
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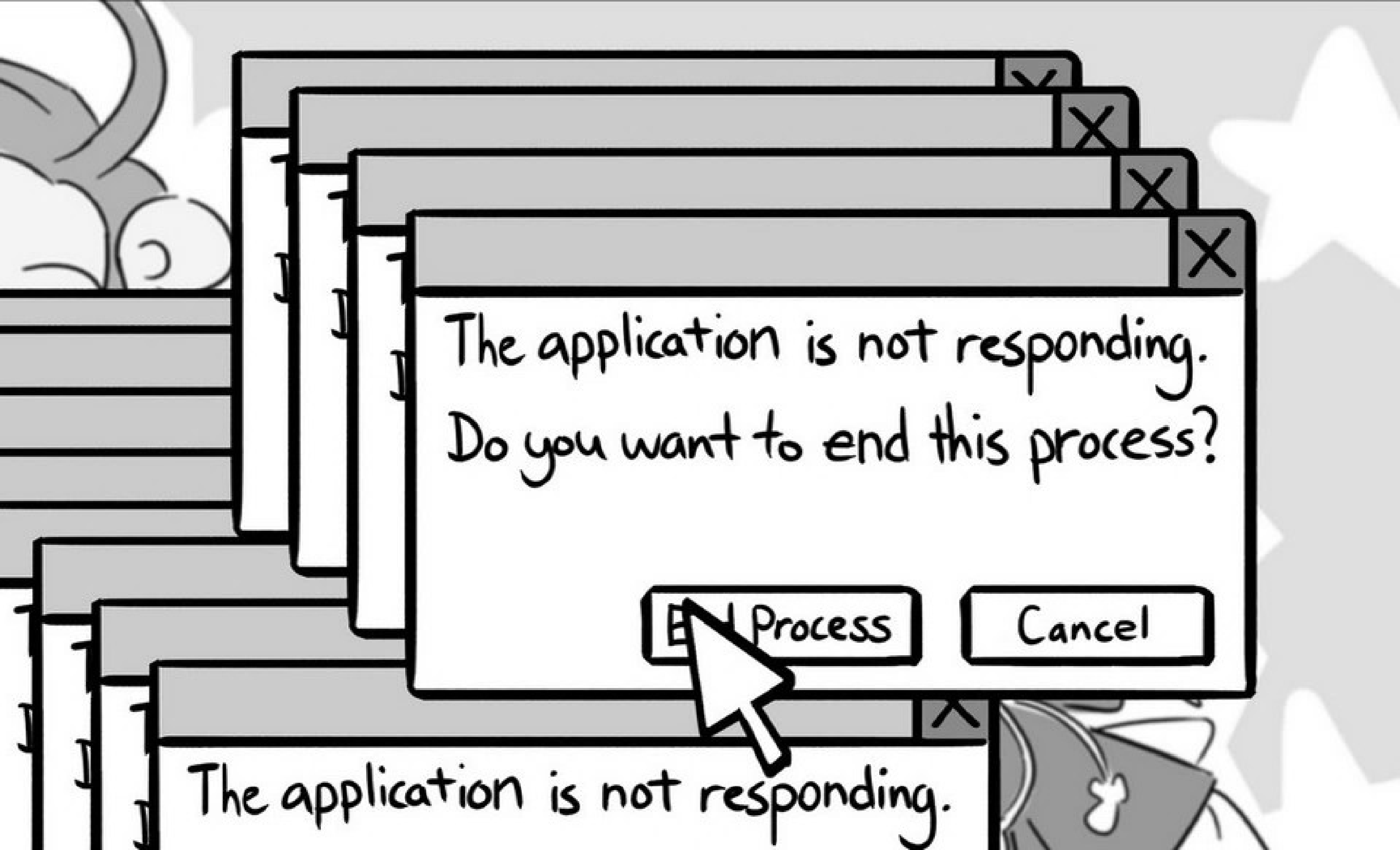








AFK.js

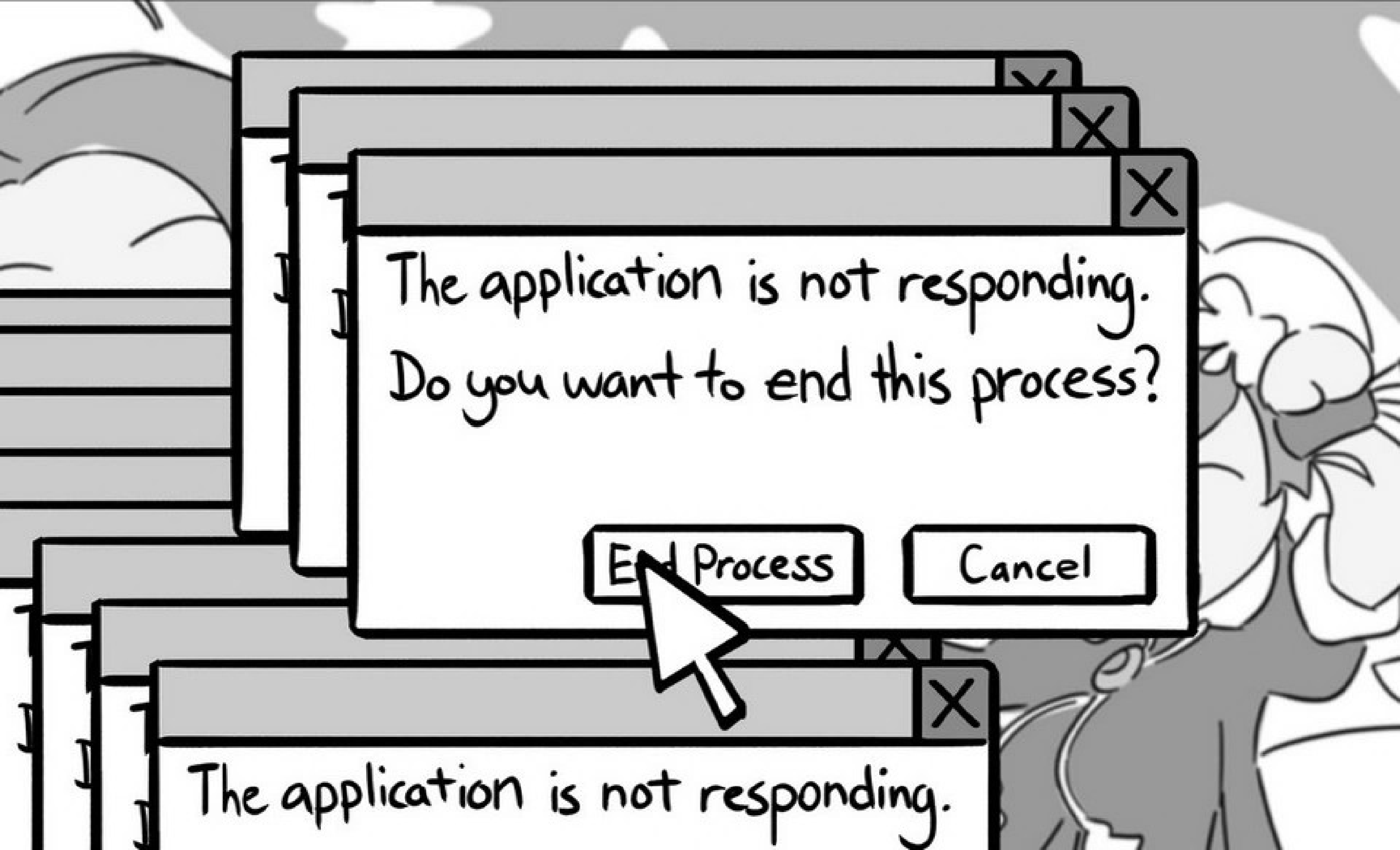
A hand-drawn illustration of a computer interface. On the left, a character with large eyes and a small mouth looks on. In the center, a stack of overlapping windows is shown. The top-most window is a dialog box with a title bar containing an 'X' icon. The text inside the dialog box reads: "The application is not responding. Do you want to end this process?". At the bottom of the dialog box are two buttons: "End Process" and "Cancel". A white mouse cursor arrow is pointing at the "End Process" button. Below the dialog box, the top of another window is visible, showing the text "The application is not responding.".

The application is not responding.
Do you want to end this process?

End Process

Cancel

The application is not responding.

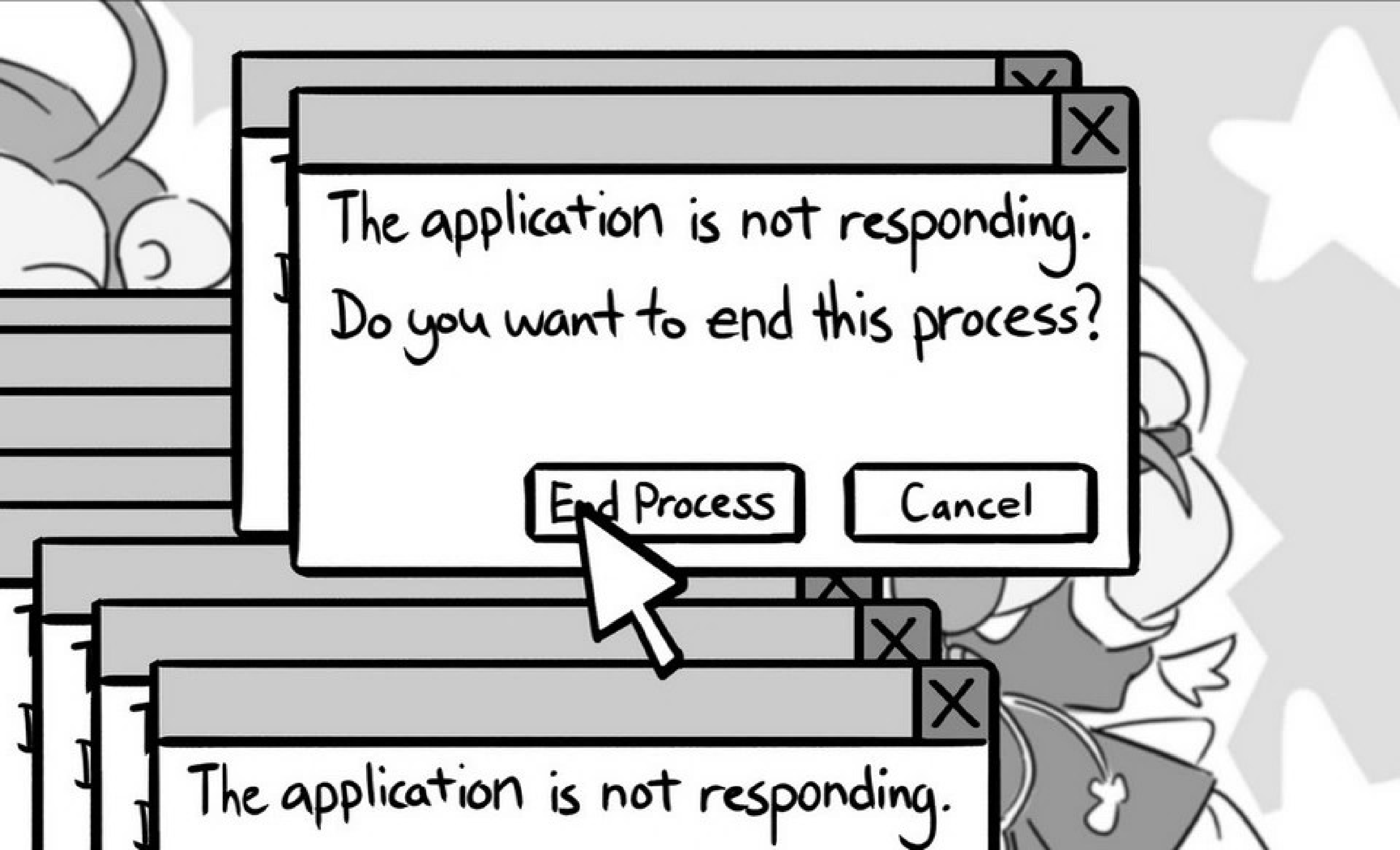


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Do you want to end this process?

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Do you want to end this process?

End Process

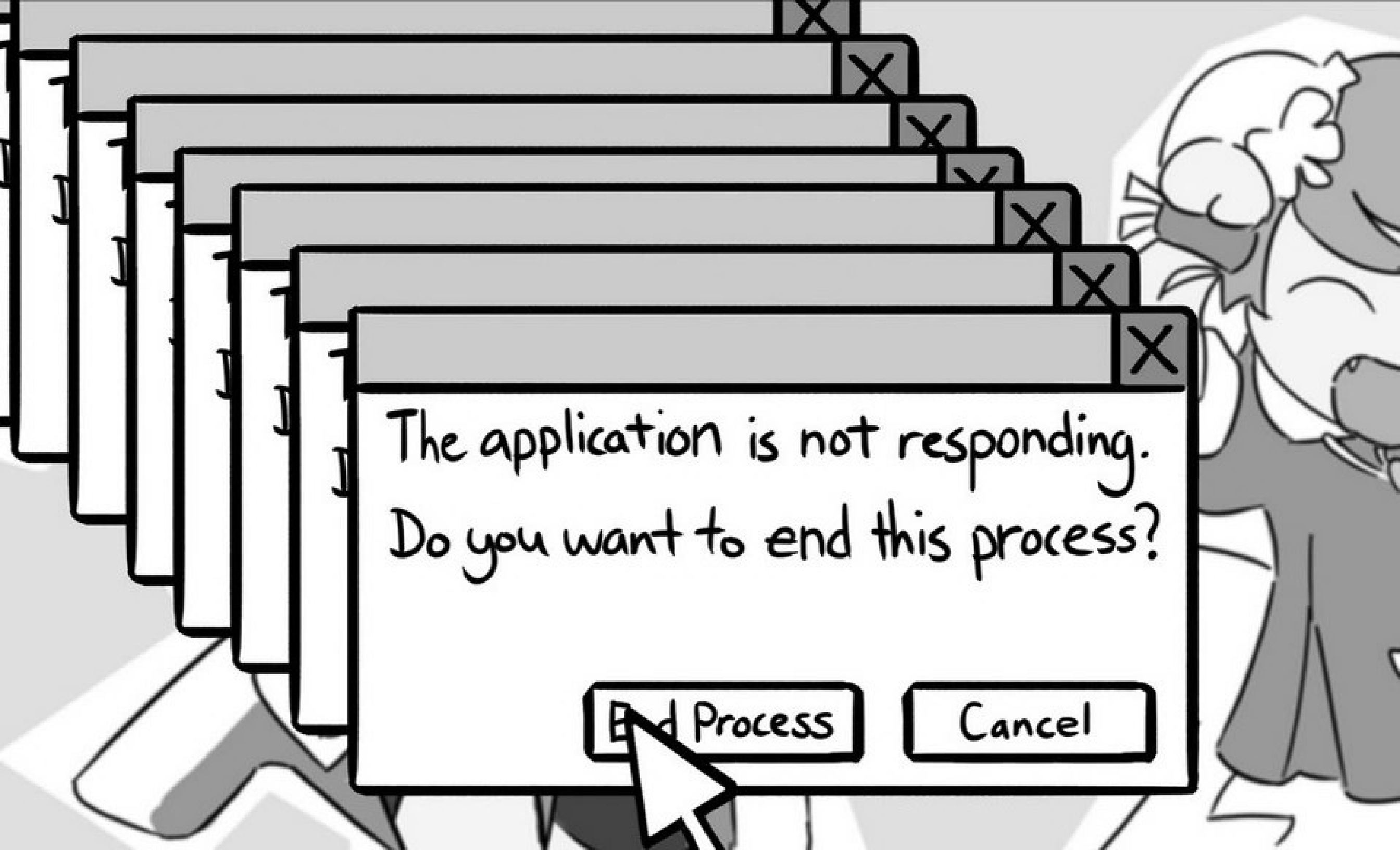
Cancel

The application is not responding.





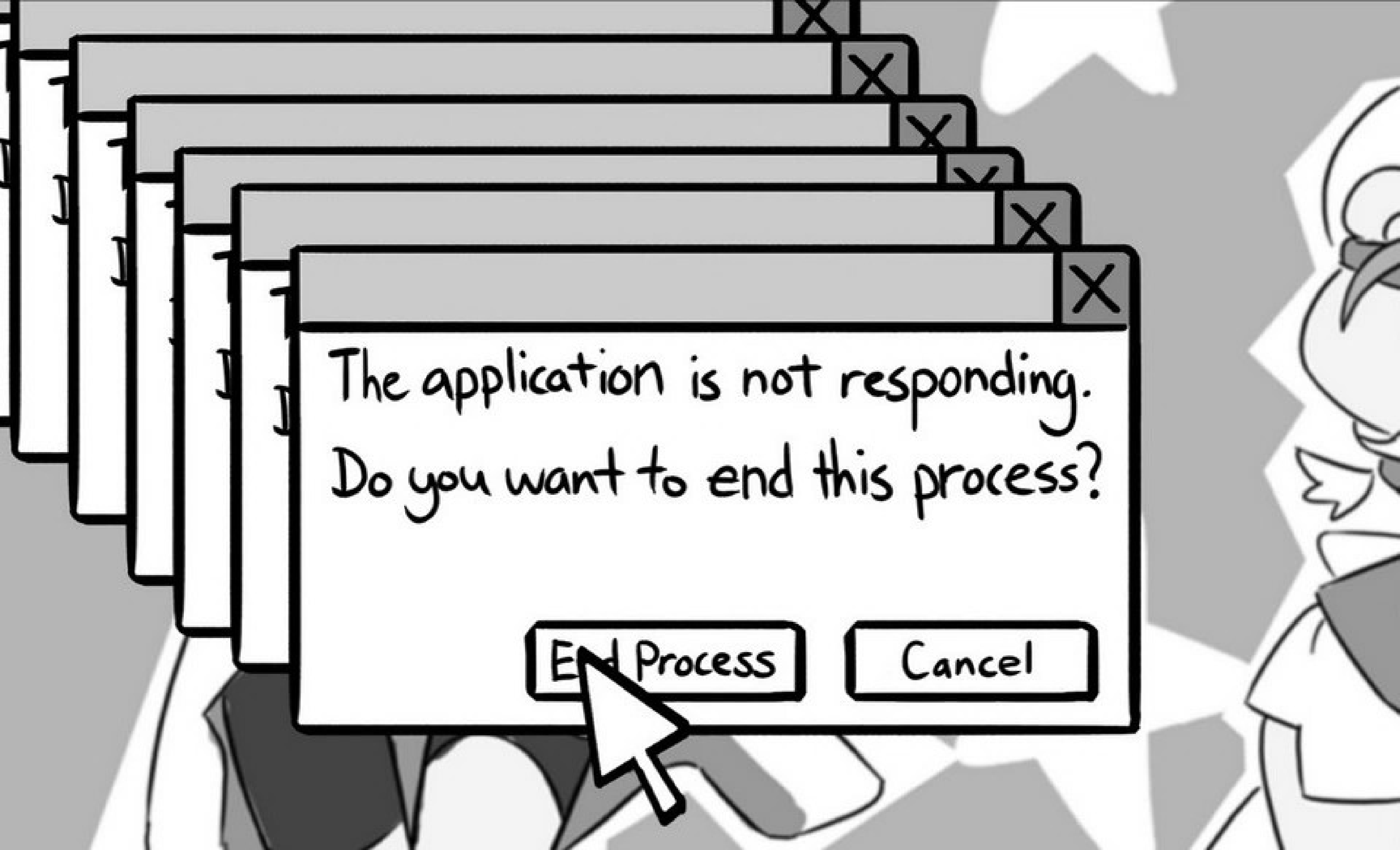


A cartoon illustration of a computer desktop. On the left, there is a stack of several overlapping windows, each with a small 'X' icon in its top-right corner. In the foreground, a larger window is open, displaying a message. The message text is: "The application is not responding. Do you want to end this process?". At the bottom of this window, there are two buttons: "End Process" and "Cancel". A mouse cursor is pointing at the "End Process" button. In the background on the right, there is a cartoon character with a large, bushy white beard and a white cap, wearing a grey tunic. The character has a slightly annoyed or frustrated expression.

The application is not responding.
Do you want to end this process?

End Process

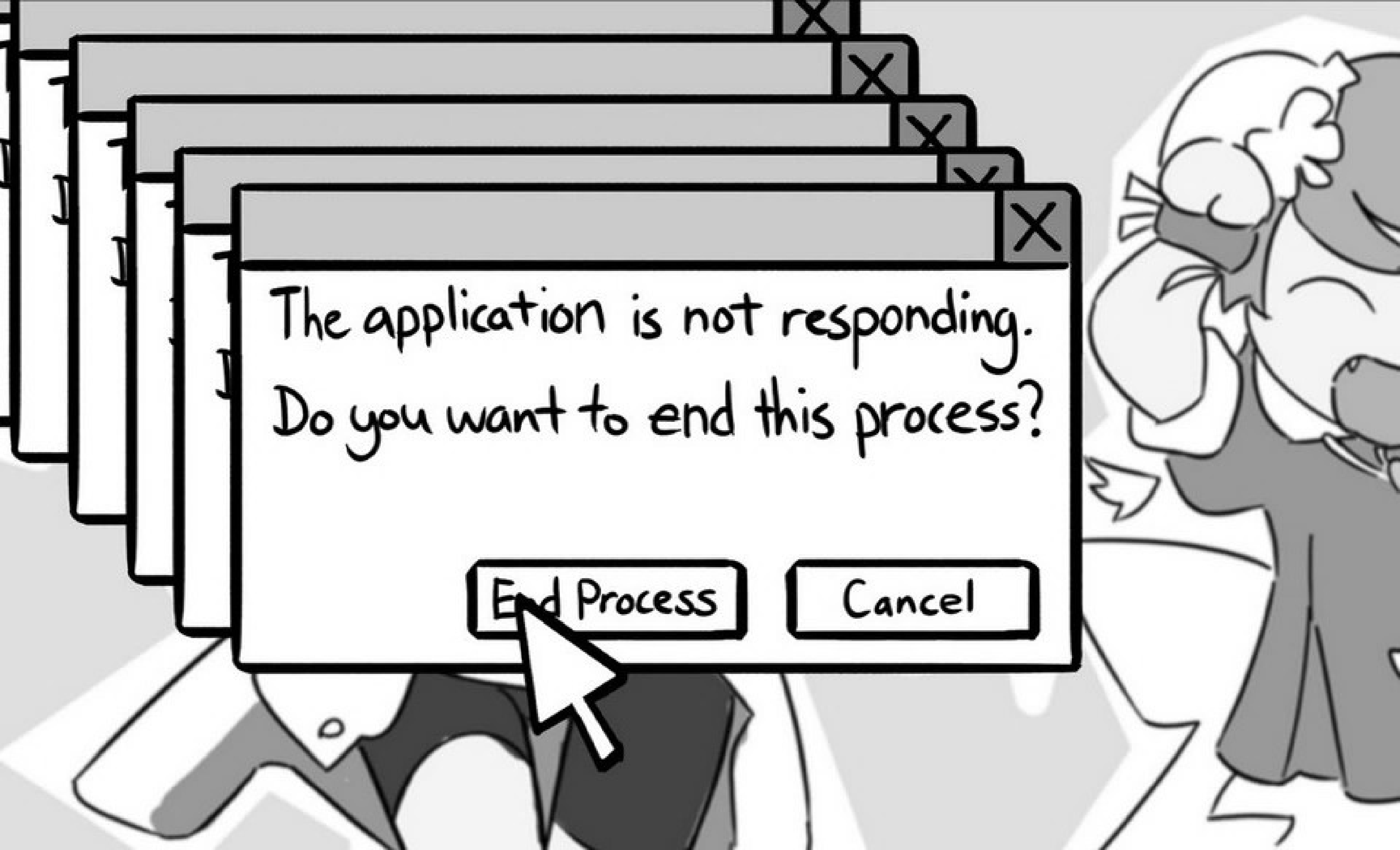
Cancel



The application is not responding.
Do you want to end this process?

End Process

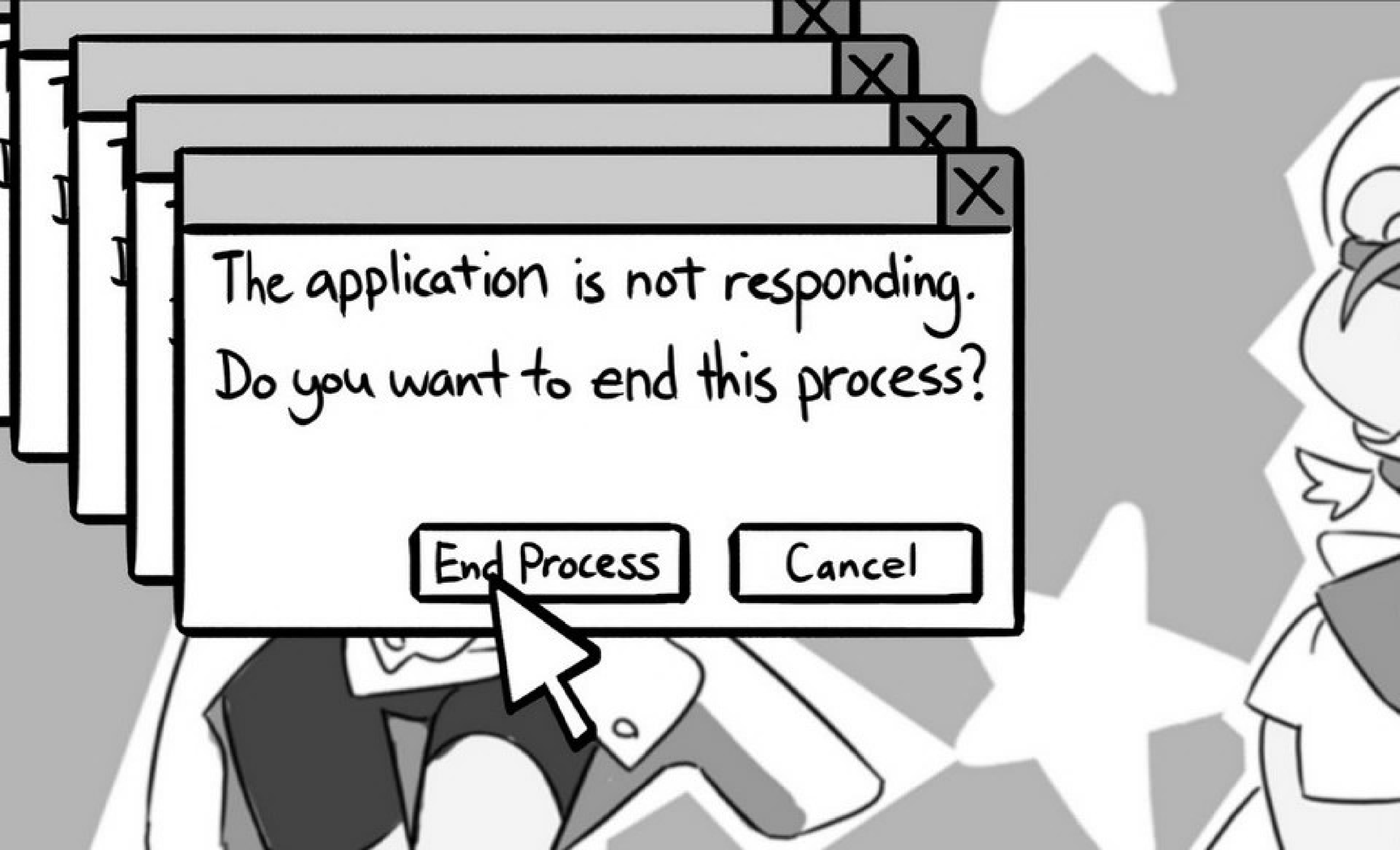
Cancel



The application is not responding.
Do you want to end this process?

End Process

Cancel



The application is not responding.
Do you want to end this process?

End Process

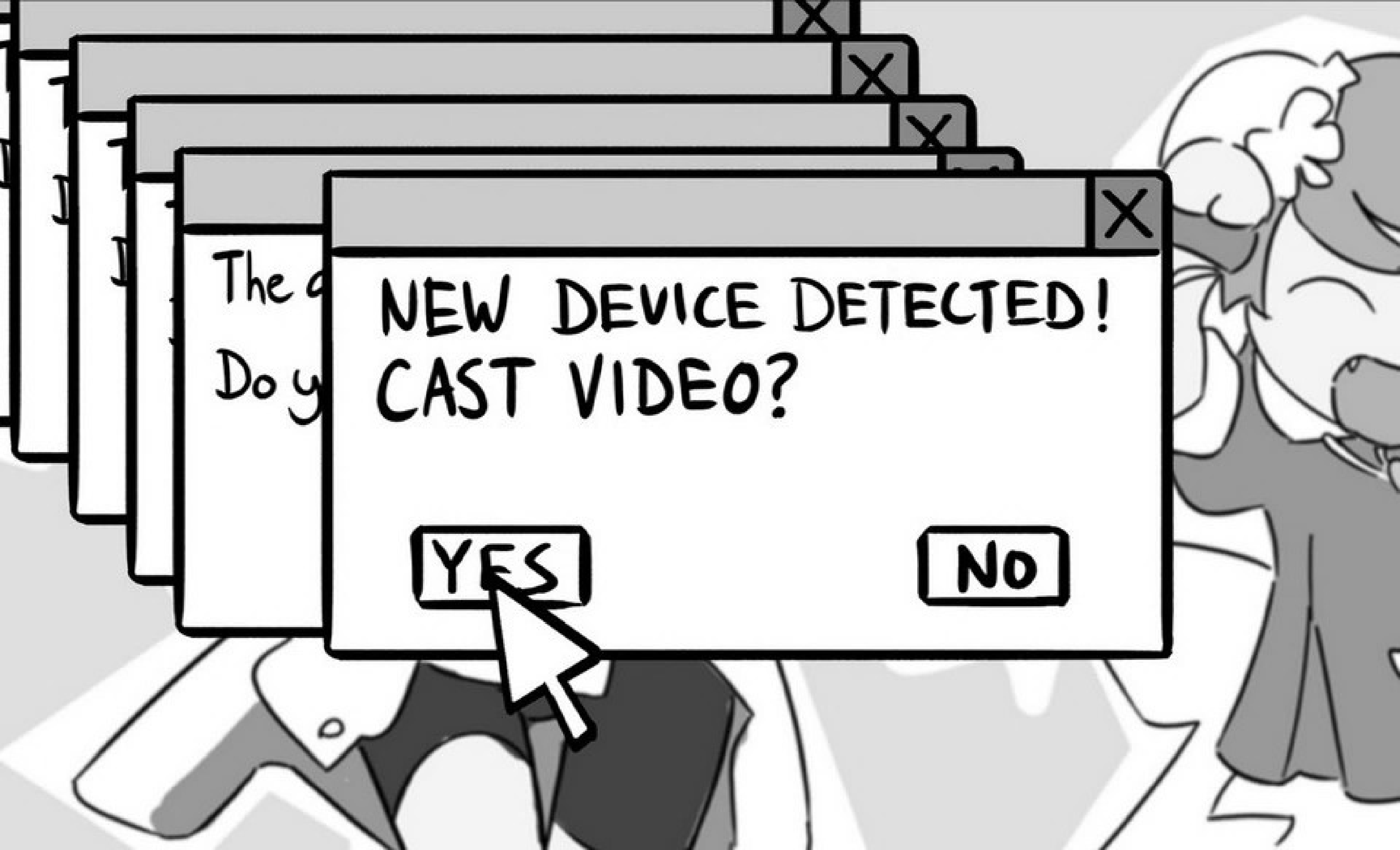
Cancel

The d
Do y

NEW DEVICE DETECTED!
CAST VIDEO?

YES

NO



The d
Do y

NEW DEVICE DETECTED!
CAST VIDEO?

YES

NO



The application is not responding.

Do you want to end this process?

CASTING...

End Process

Cancel









Method. Take N samples, regularly spaced.

```
public class PlotFunctionEx
```

```
public static void main(String[] args)
```

```
{  
    int N = Integer.parseInt(args[0]);
```

```
    double[] x = new double[N+1];
```

```
    double[] y = new double[N+1];
```

```
    for (int i = 0; i <= N; i++)
```

```
{
```

```
        x[i] = Math.PI * i / N;
```

```
        y[i] = Math.sin(4*x[i]) + Math.sin(20*x[i]);
```

```
}
```

```
StdDraw.setXscale(0, Math.PI);
```

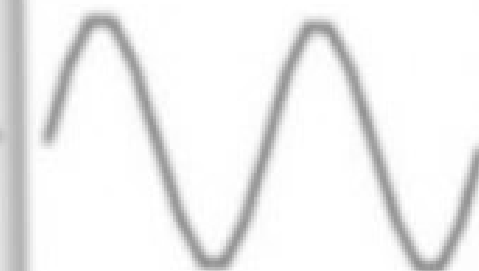
```
StdDraw.setYscale(-2.0, +2.0);
```

```
for (int i = 0; i < N; i++)
```

```
    StdDraw.line(x[i], y[i], x[i+1], y[i+1]);
```

```
% java PlotFunctionEx 20
```

Lesson 1: Plotting is easy.



```
% java PlotFunctionEx 200
```



Lesson 2: Take a sufficiently large sample—otherwise you might miss something.



Method. Take N samples, regularly spaced.

```
public class PlotFunctionEx
```

```
public static void main(String[] args)
```

```
{  
    int N = Integer.parseInt(args[0]);
```

```
    double[] x = new double[N+1];
```

```
    double[] y = new double[N+1];
```

```
    for (int i = 0; i <= N; i++)
```

```
{
```

```
        x[i] = Math.PI * i / N;
```

```
        y[i] = Math.sin(4*x[i]) + Math.sin(2*x[i]);
```

```
}
```

```
StdDraw.setXscale(0, Math.PI);
```

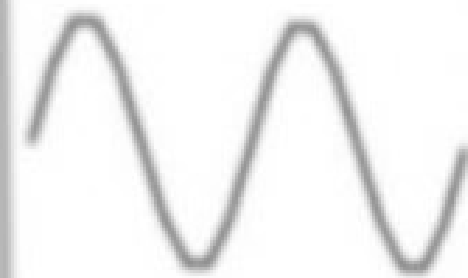
```
StdDraw.setYscale(-2.0, +2.0);
```

```
for (int i = 0; i < N; i++)
```

```
    StdDraw.line(x[i], y[i], x[i+1], y[i+1]);
```

% java PlotFunctionEx 20

Lesson 1: Plotting is easy.



% java PlotFunctionEx 200



Lesson 2: Take a sufficiently large sample—otherwise you might miss something.





















