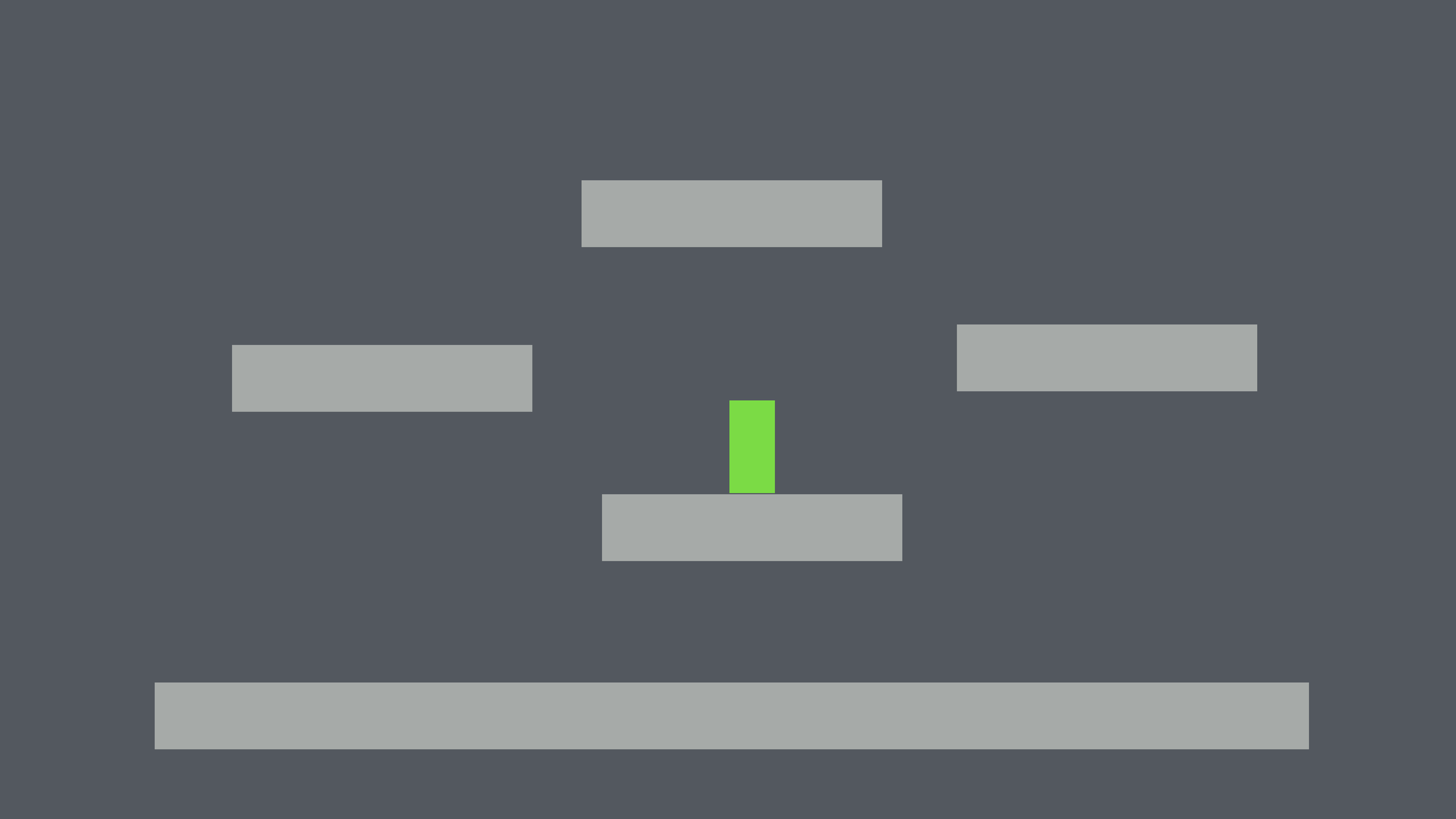
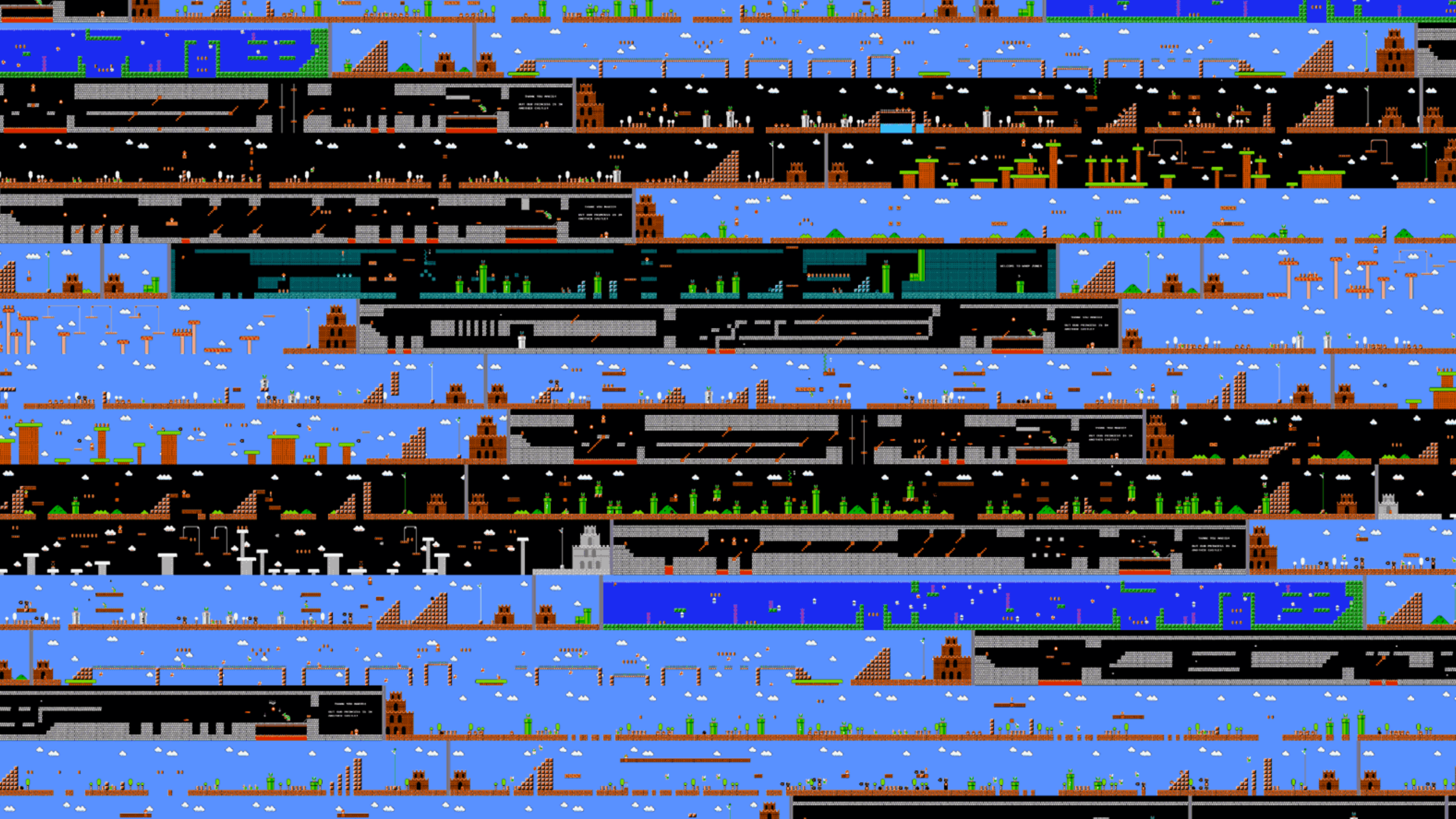
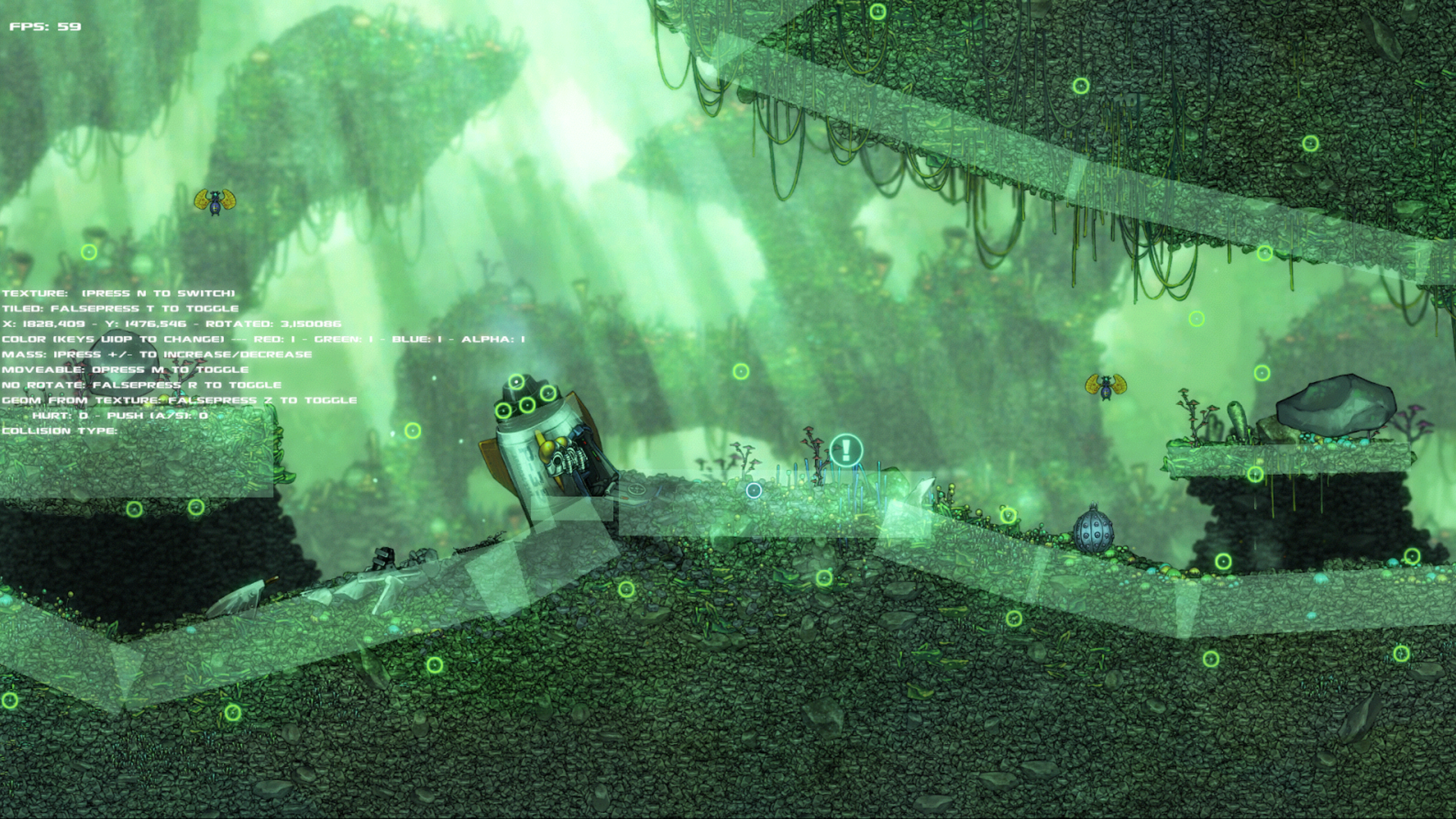
Creating worlds.

Part 1



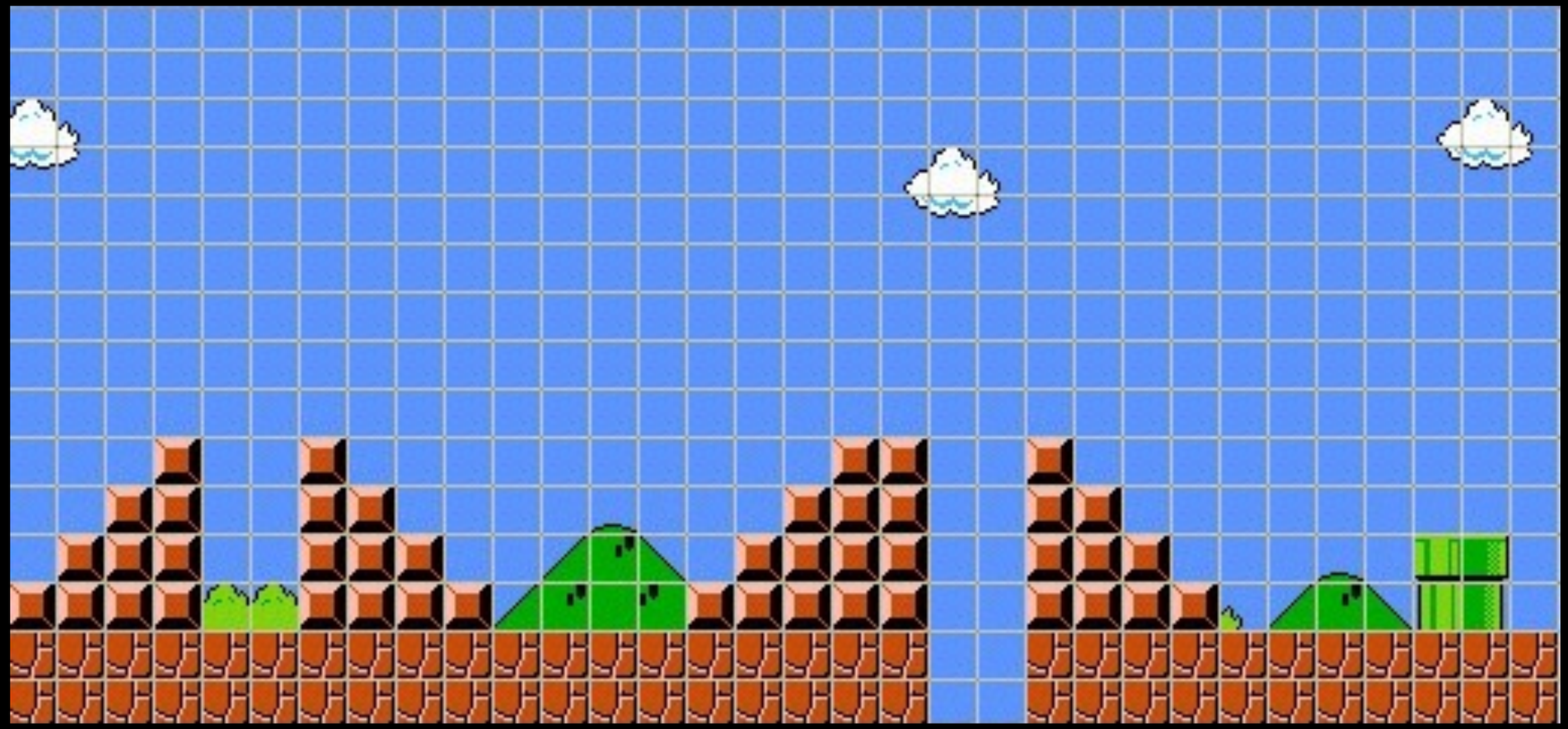



HEALTH
FUEL
EXIT
BLAST-CARBINE

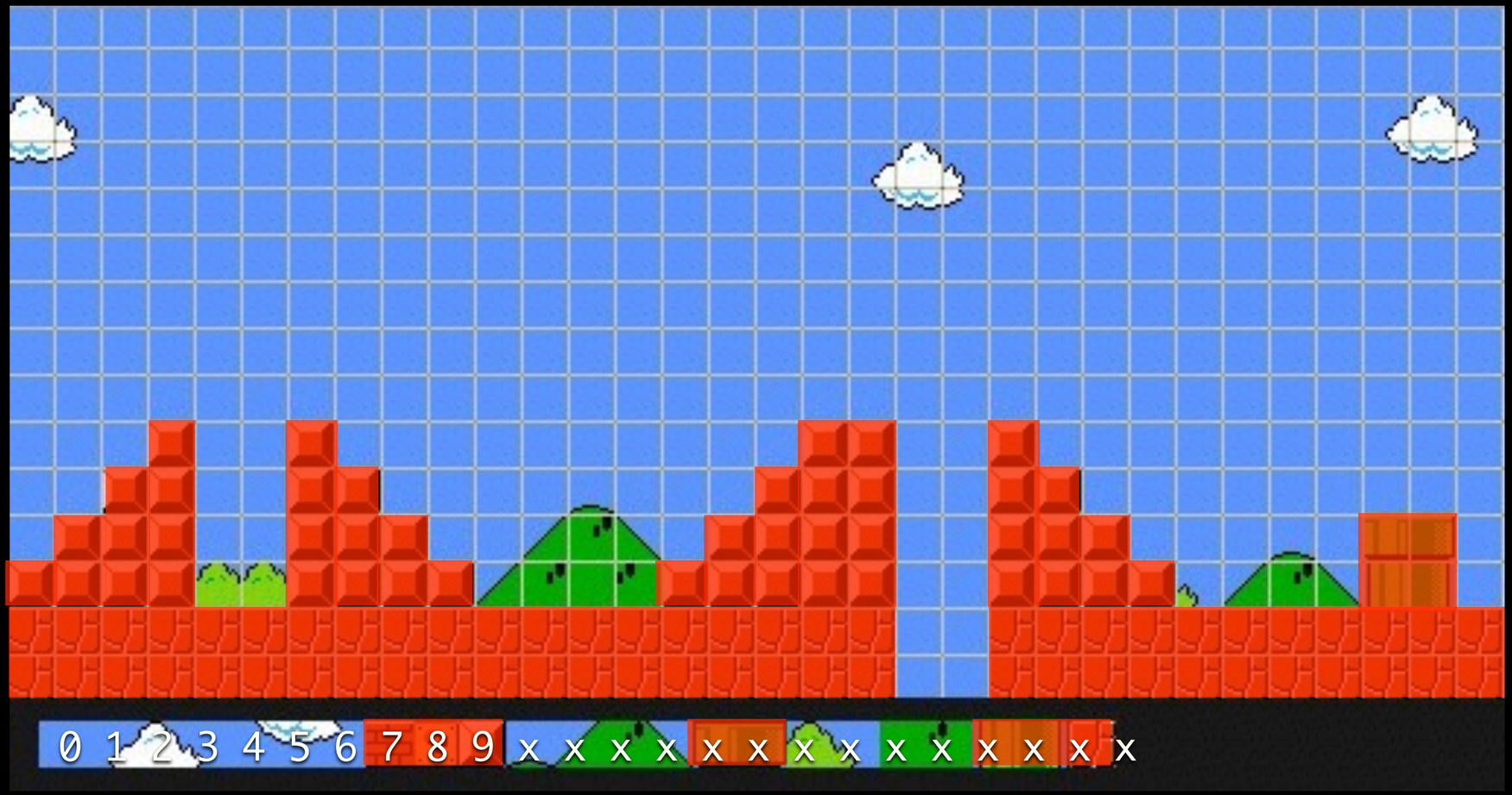

FPS: 59
TEXTURE: (PRESS N TO SWITCH)
TILED: FALSEPRESS T TO TOGGLE
X: 1828,409 - Y: 1476,546 - ROTATED: 3,150086
COLOR (KEYS UIOP TO CHANGE) --- RED: 1 - GREEN: 1 - BLUE: 1 - ALPHA: 1
MASS: 1PRESS +/- TO INCREASE/DECREASE
MOVEABLE: 0PRESS M TO TOGGLE
NO ROTATE: FALSEPRESS R TO TOGGLE
GEOM FROM TEXTURE: FALSEPRESS Z TO TOGGLE
HURT: 0 - PUSH (A/S): 0
COLLISION TYPE:

Tile-based levels.


MARIO
000500
×01
WORLD
1-1
TIME
321




0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
2 3 0 0 0 0 0 0 0 0 0
5 6 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 9 0 0 9 0 0 0 0
0 0 9 9 0 0 9 9 0 0 0
0 9 9 9 0 0 9 9 9 0 0
0 1 2 3 4 5 6 7 8 9 x x x x x x x x x x x x x x

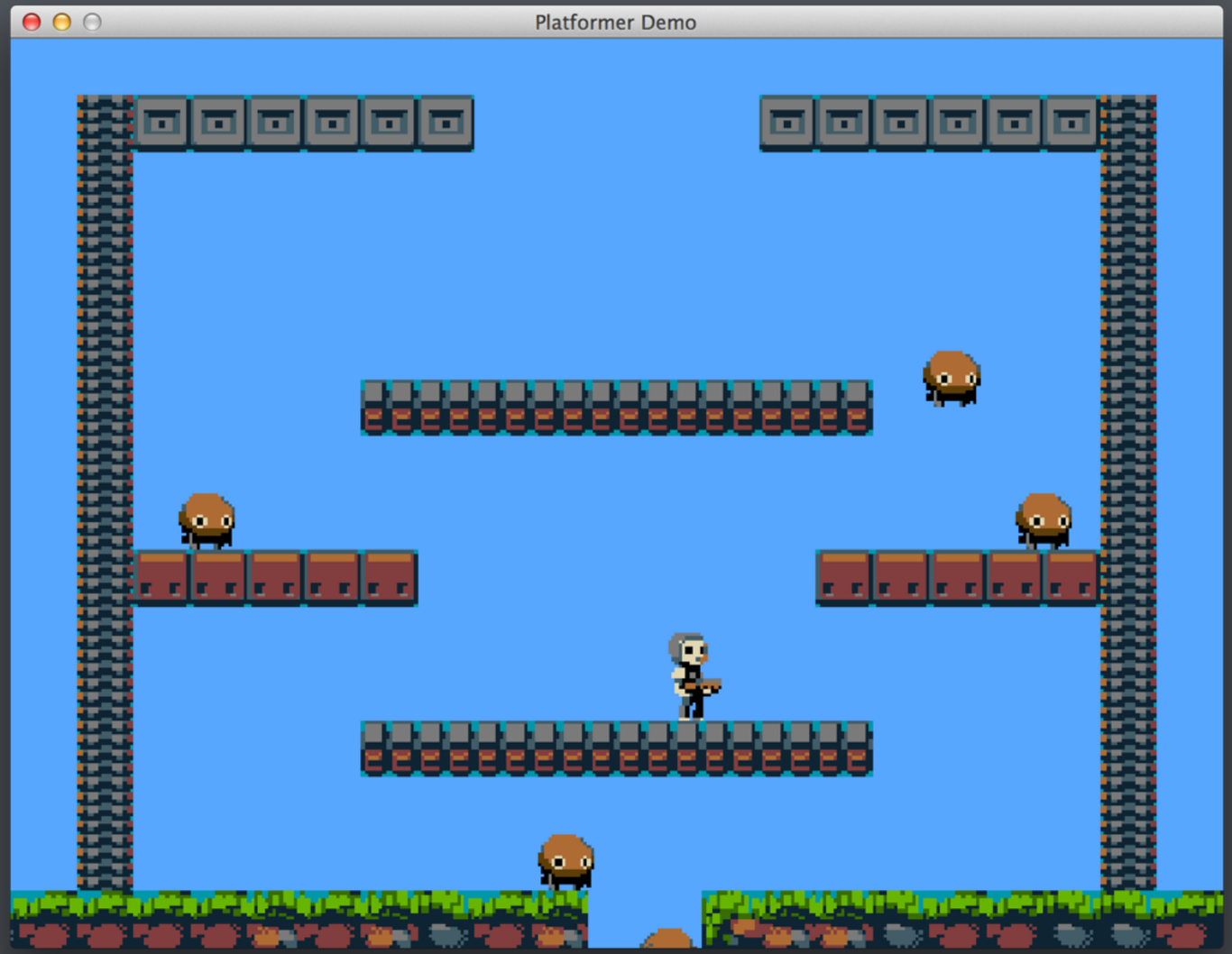


solids = 7,8,9,14,15,20,21,22


1
3
8
16


3D
OFF


1
4
4
0


Platformer Demo

```
void ClassDemoApp::buildLevel() {
    int blockIndex = 0;

    for(int i=0; i < 9; i++) {
        blocks[blockIndex].sprite = SheetSprite(spriteSheetTexture, 5);
        blocks[blockIndex].width = 2.0/8.0f;
        blocks[blockIndex].height = 2.0/8.0f;
        blocks[blockIndex].isStatic = true;
        blocks[blockIndex].y = (2.0/8.0f * -4) - 1.0f/8.0f;
        blocks[blockIndex].x = (-2.0/8.0f * 4) + (2.0/8.0f * i);
        entities.push_back(&blocks[blockIndex]);
        blockIndex++;
    }

    for(int i=0; i < 9; i++) {
        blocks[blockIndex].sprite = SheetSprite(spriteSheetTexture, 5);
        blocks[blockIndex].width = 2.0/8.0f;
        blocks[blockIndex].height = 2.0/8.0f;
        blocks[blockIndex].isStatic = true;
        blocks[blockIndex].y = (2.0/8.0f * 2) - 1.0f/8.0f;
        blocks[blockIndex].x = (-2.0/8.0f * 4) + (2.0/8.0f * i);
        entities.push_back(&blocks[blockIndex]);
        blockIndex++;
    }

    for(int i=0; i < 5; i++) {
        blocks[blockIndex].sprite = SheetSprite(spriteSheetTexture, 6);
        blocks[blockIndex].width = 2.0/8.0f;
        blocks[blockIndex].height = 2.0/8.0f;
        blocks[blockIndex].isStatic = true;
        blocks[blockIndex].y = (2.0/8.0f * -1) - 1.0f/8.0f;
        blocks[blockIndex].x = (-2.0/8.0f * 8) + (2.0/8.0f * i);
        entities.push_back(&blocks[blockIndex]);
```

```
void ClassDemoApp::buildLevel() {
    int blockIndex = 0;

    for(int i=0; i < 9; i++) {
        blocks[blockIndex].sprite = SheetSprite(spriteSheetTexture, 5);
        blocks[blockIndex].width = 2.0/8.0f;
        blocks[blockIndex].height = 2.0/8.0f;
        blocks[blockIndex].isStatic = true;
        blocks[blockIndex].y = (2.0/8.0f * -4) - 1.0f/8.0f;
        blocks[blockIndex].x = (-2.0/8.0f * 4) + (2.0/8.0f * i);
        entities.push_back(&blocks[blockIndex]);
        blockIndex++;
    }

    for(int i=0; i < 9; i++) {
        blocks[blockIndex].sprite = SheetSprite(spriteSheetTexture, 5);
        blocks[blockIndex].width = 2.0/8.0f;
        blocks[blockIndex].height = 2.0/8.0f;
        blocks[blockIndex].isStatic = true;
        blocks[blockIndex].y = (2.0/8.0f * 2) - 1.0f/8.0f;
        blocks[blockIndex].x = (-2.0/8.0f * 4) + (2.0/8.0f * i);
        entities.push_back(&blocks[blockIndex]);
        blockIndex++;
    }

    for(int i=0; i < 5; i++) {
        blocks[blockIndex].sprite = SheetSprite(spriteSheetTexture, 6);
        blocks[blockIndex].width = 2.0/8.0f;
        blocks[blockIndex].height = 2.0/8.0f;
```

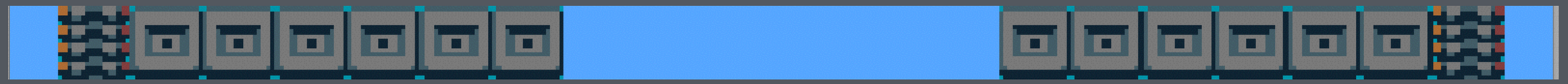
Defining a **tile map** level.


0
1
2
3
4
5
6
7
8
9
10
11
12
...

Storing level data as a **2-dimensional array**.

```
unsigned char levelData[LEVEL_HEIGHT][LEVEL_WIDTH];
```

```
{0,20,4,4,4,4,4,4,0,0,0,0,0,0,4,4,4,4,4,4,20,0};
```



```
#define LEVEL_HEIGHT 16
#define LEVEL_WIDTH 22

unsigned char level1Data[LEVEL_HEIGHT][LEVEL_WIDTH] =
{
    {11,11,11,11,11,11,11,11,11,11,11,11,11,11,11,11,11,11,11,11},
    {0,20,4,4,4,4,4,4,0,0,0,0,0,0,4,4,4,4,4,4,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,6,6,6,6,6,6,6,6,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,6,6,6,6,6,0,0,0,0,0,0,0,6,6,6,6,6,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,6,6,6,6,6,6,6,6,0,0,0,0,0,20,0},
    {0,20,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0},
    {0,20,125,118,0,0,116,0,0,0,0,0,0,0,0,0,0,117,0,127,20,0},
    {2,2,2,2,2,2,2,2,2,3,0,0,1,2,2,2,2,2,2,2,2,2},
    {32,33,33,34,32,33,33,34,33,35,100,101,35,32,33,32,34,32,33,32,33,33}
};
```

```
void ClassDemoApp::buildLevel() {
    memcpy(levelData, level1Data, LEVEL_HEIGHT*LEVEL_WIDTH);
}
```

Rendering a tile map level.

Need to **render the entire tilemap** as **one vertex array**.


Hello

Go through the tiles **line by line** and **add vertices to a single array**.

(Keep in mind that our **Y axis** points **upwards**, while tile **indexes count downwards**)

```
std::vector<float> vertexData;
std::vector<float> texCoordData;

    for(int y=0; y < LEVEL_HEIGHT; y++) {
        for(int x=0; x < LEVEL_WIDTH; x++) {

                float u = (float)(((int)levelData[y][x]) % SPRITE_COUNT_X) / (float) SPRITE_COUNT_X;
                float v = (float)(((int)levelData[y][x]) / SPRITE_COUNT_X) / (float) SPRITE_COUNT_Y;

                float spriteWidth = 1.0f/(float)SPRITE_COUNT_X;
                float spriteHeight = 1.0f/(float)SPRITE_COUNT_Y;

                vertexData.insert(vertexData.end(), {

                    TILE_SIZE * x, -TILE_SIZE * y,
                    TILE_SIZE * x, (-TILE_SIZE * y)-TILE_SIZE,
                    (TILE_SIZE * x)+TILE_SIZE, (-TILE_SIZE * y)-TILE_SIZE,

                    TILE_SIZE * x, -TILE_SIZE * y,
                    (TILE_SIZE * x)+TILE_SIZE, (-TILE_SIZE * y)-TILE_SIZE,
                    (TILE_SIZE * x)+TILE_SIZE, -TILE_SIZE * y
                });

                texCoordData.insert(texCoordData.end(), {
                    u, v,
                    u, v+(spriteHeight),
                    u+spriteWidth, v+(spriteHeight),

                    u, v,
                    u+spriteWidth, v+(spriteHeight),
                    u+spriteWidth, v
                });
        }
    }
```

We can **optimize** by **not drawing empty grid tiles** at all.

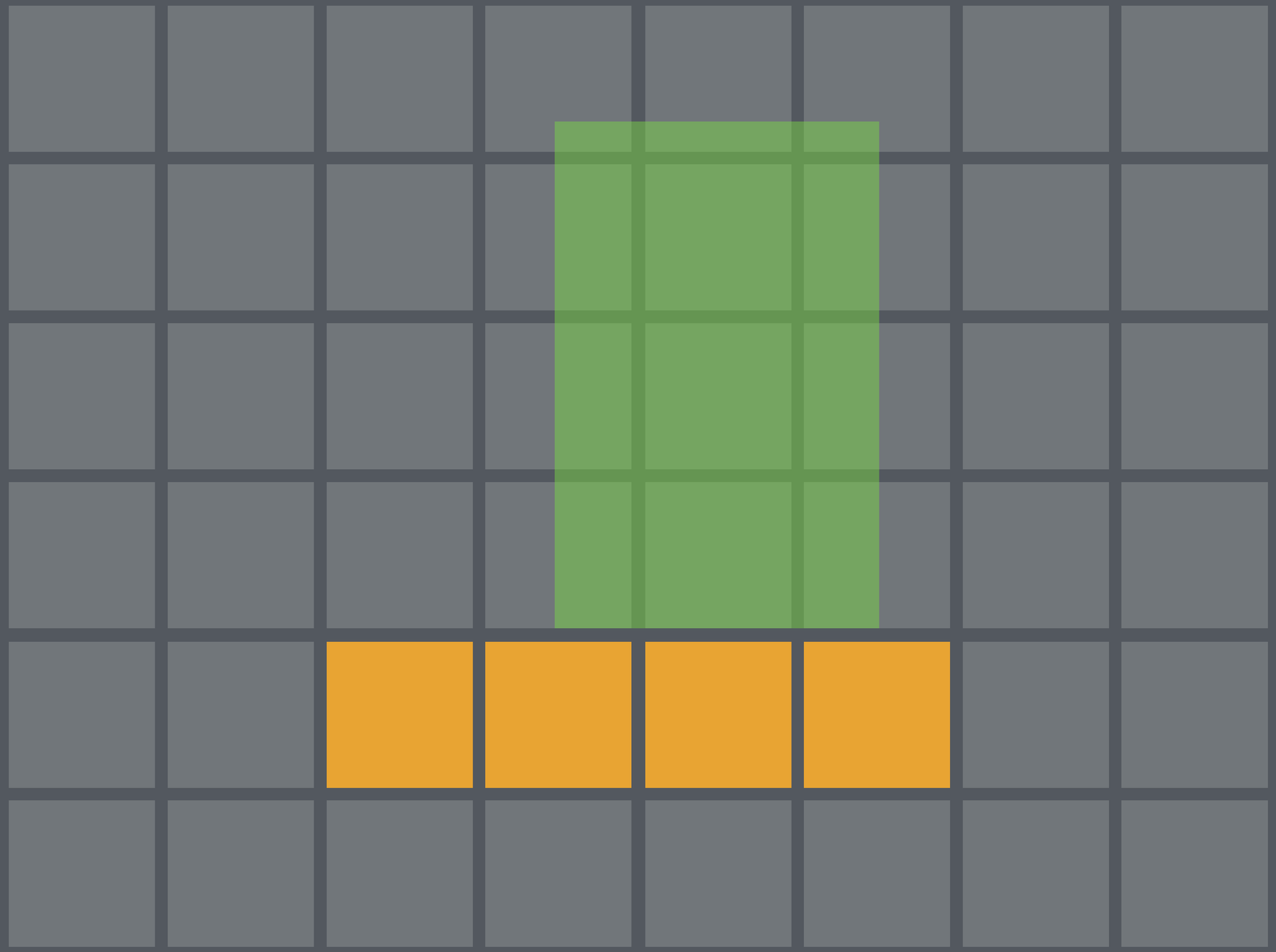
```
for(int y=0; y < LEVEL_HEIGHT; y++) {
    for(int x=0; x < LEVEL_WIDTH; x++) {

        if(levelData[y][x] != 0) {
            // add vertices
        }
    }
}
```

Colliding with a tilemap.

Separate axis movement again!

First the **Y axis**...

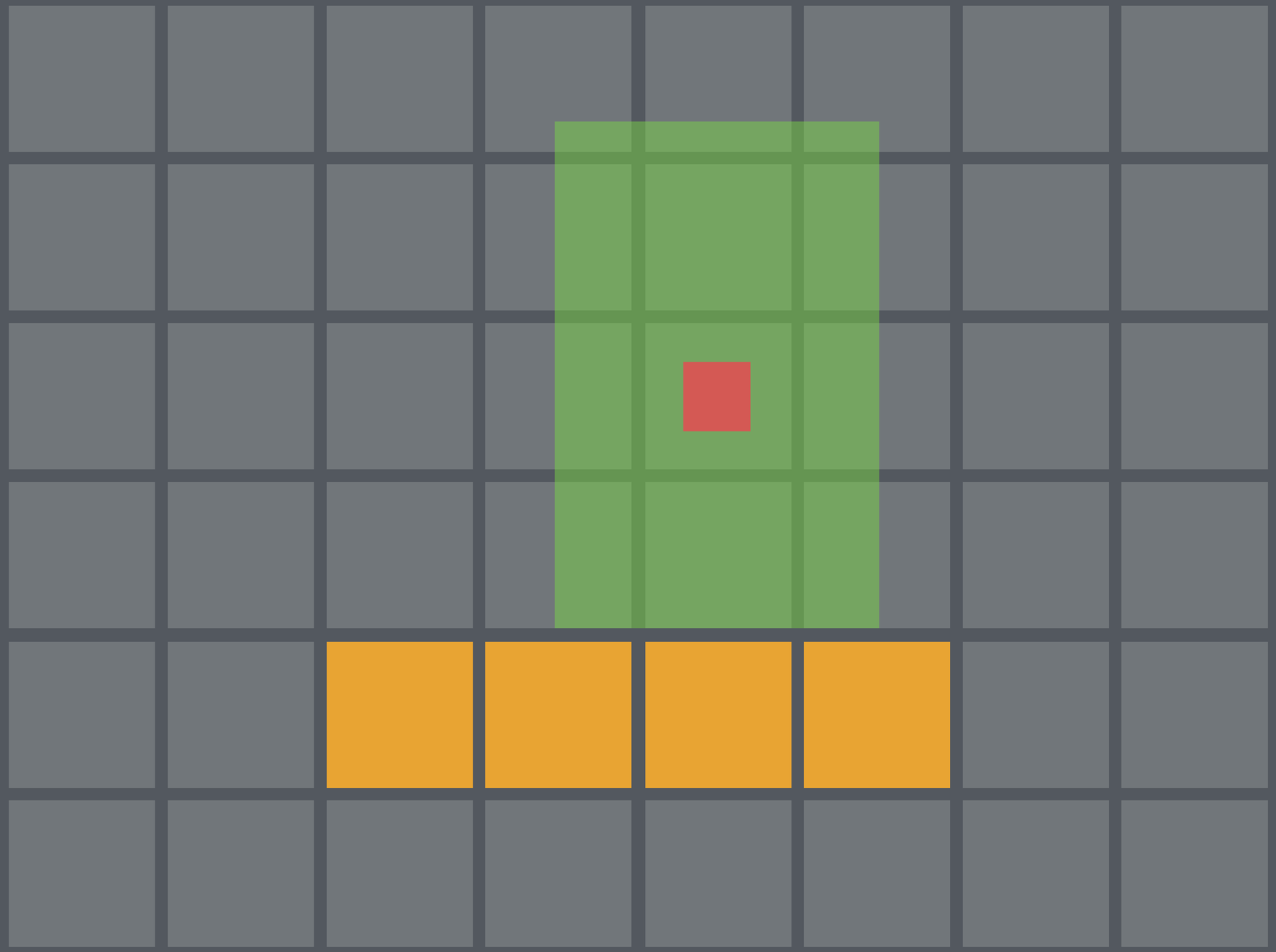


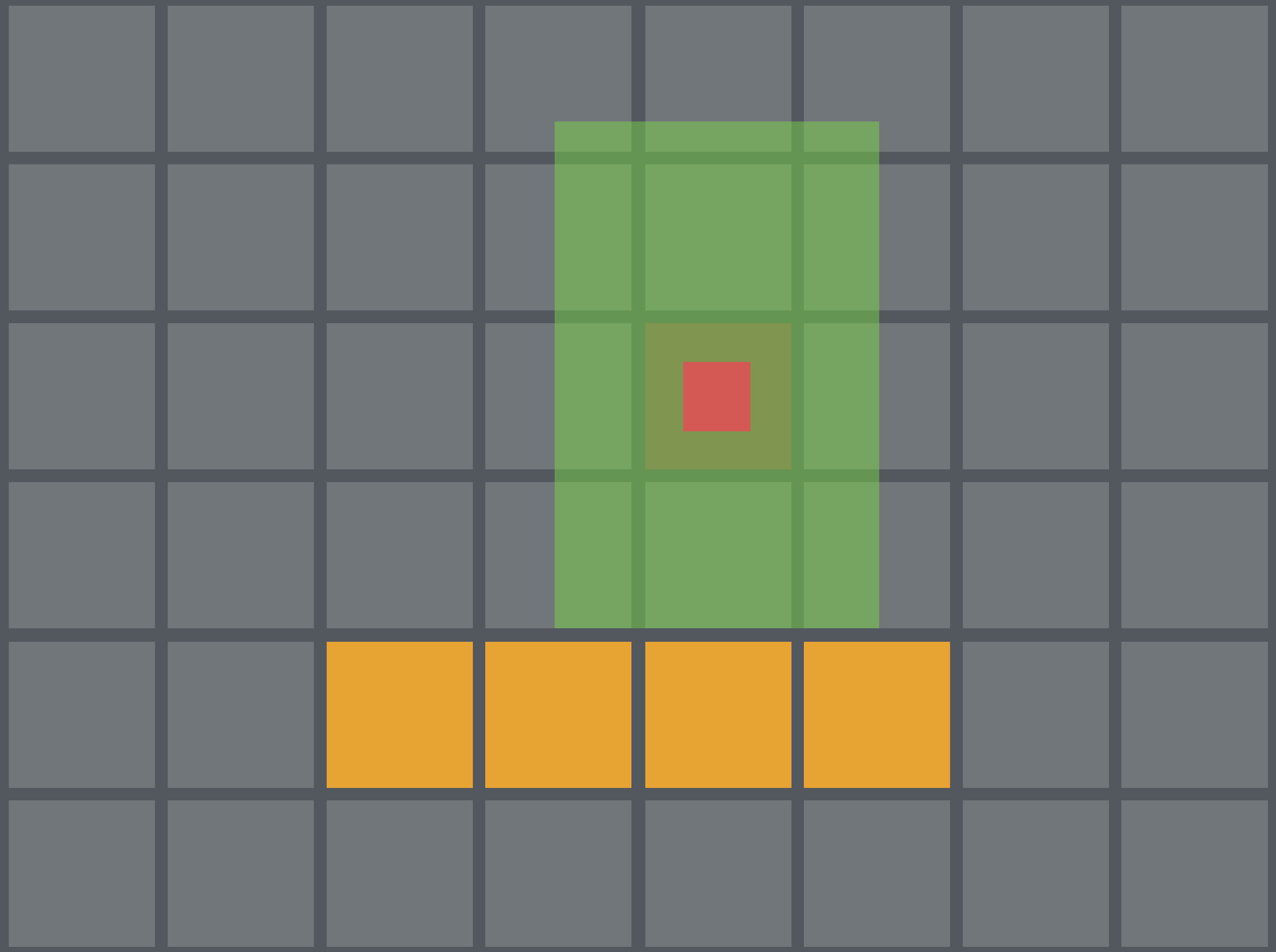
Convert our **entity position**
to the **grid coordinates** and check
if that **tile is solid**.

What is a **solid tile**?

It’s up to you!

Define the tile indexes that are considered solid!

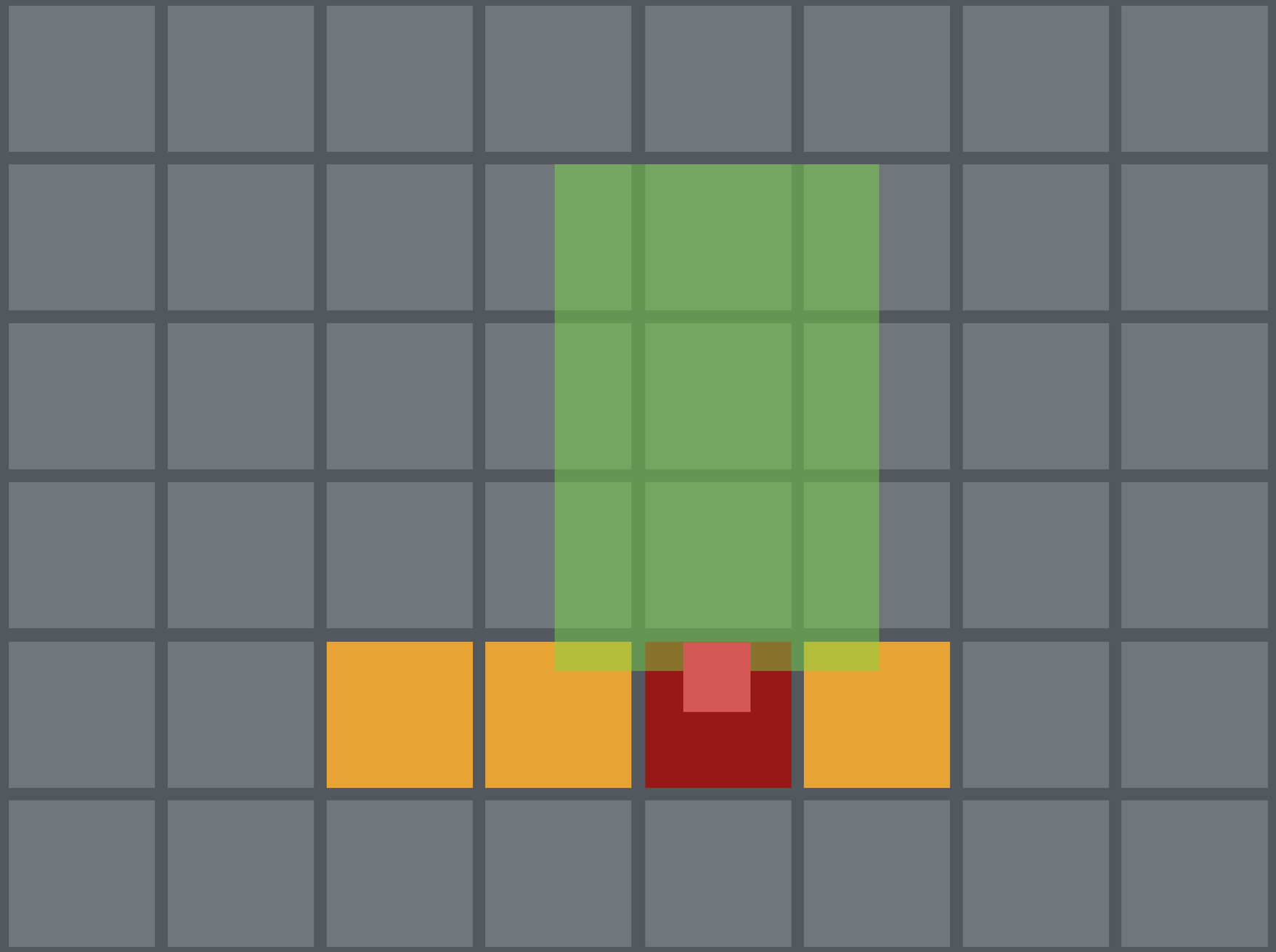


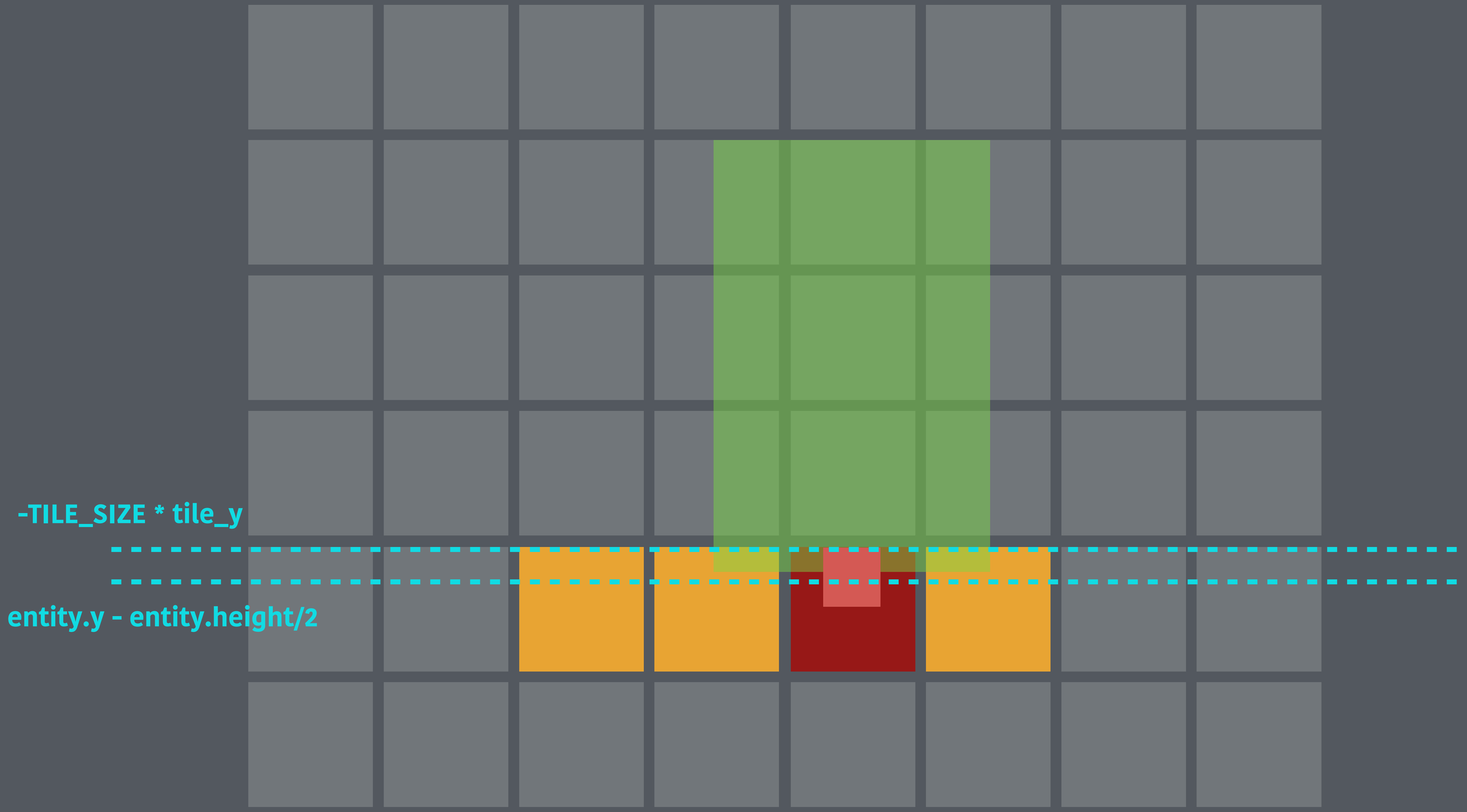


```
void worldToTileCoordinates(float worldX, float worldY, int *gridX, int *gridY) {
    *gridX = (int)(worldX / TILE_SIZE);
    *gridY = (int)(-worldY / TILE_SIZE);
}
```

Make sure that your **tile coordinates** are **not negative** or **larger than your map**!

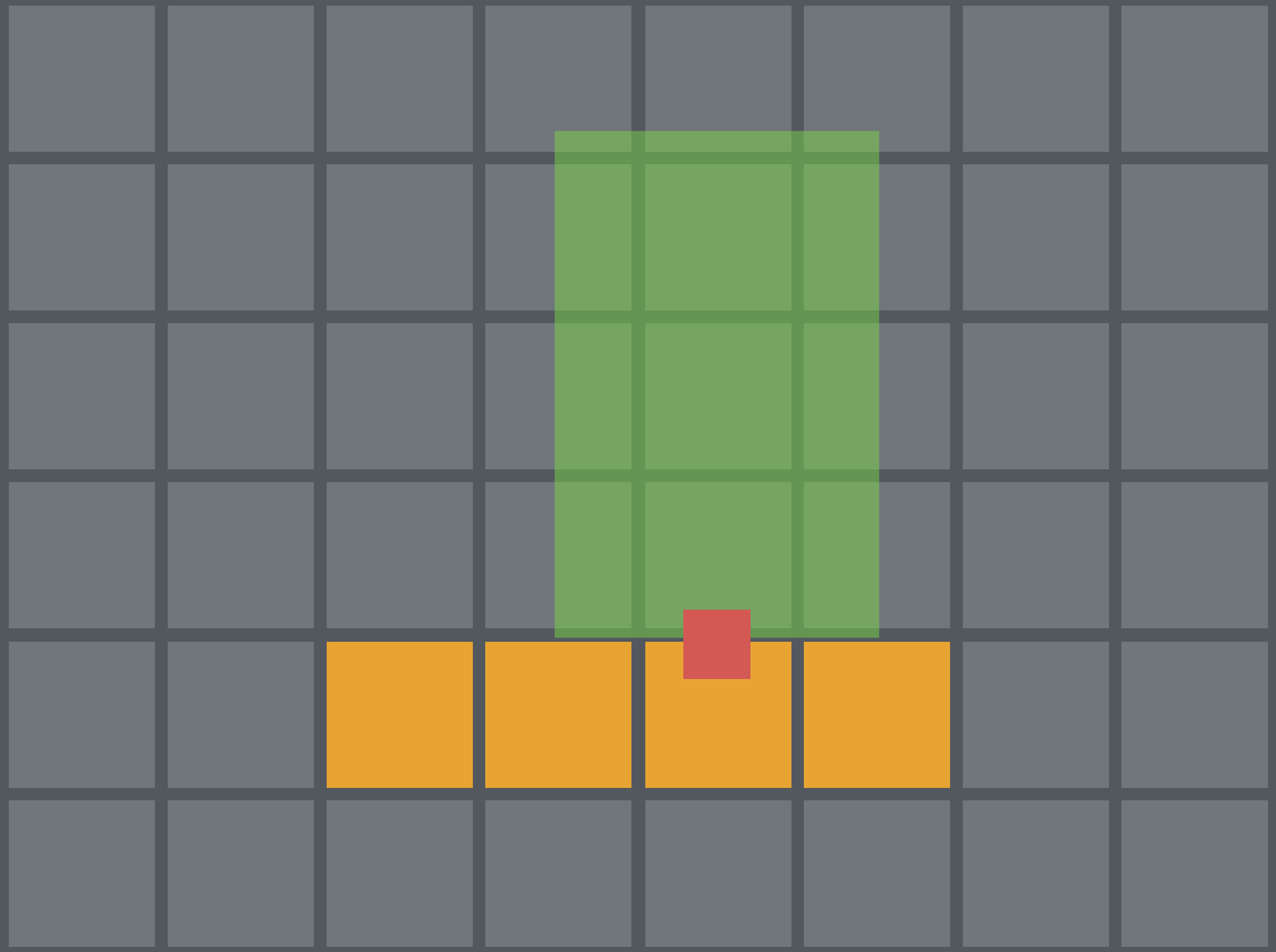
We don’t want to collide using the entity’s center, so **check the point at the bottom** (-half height).



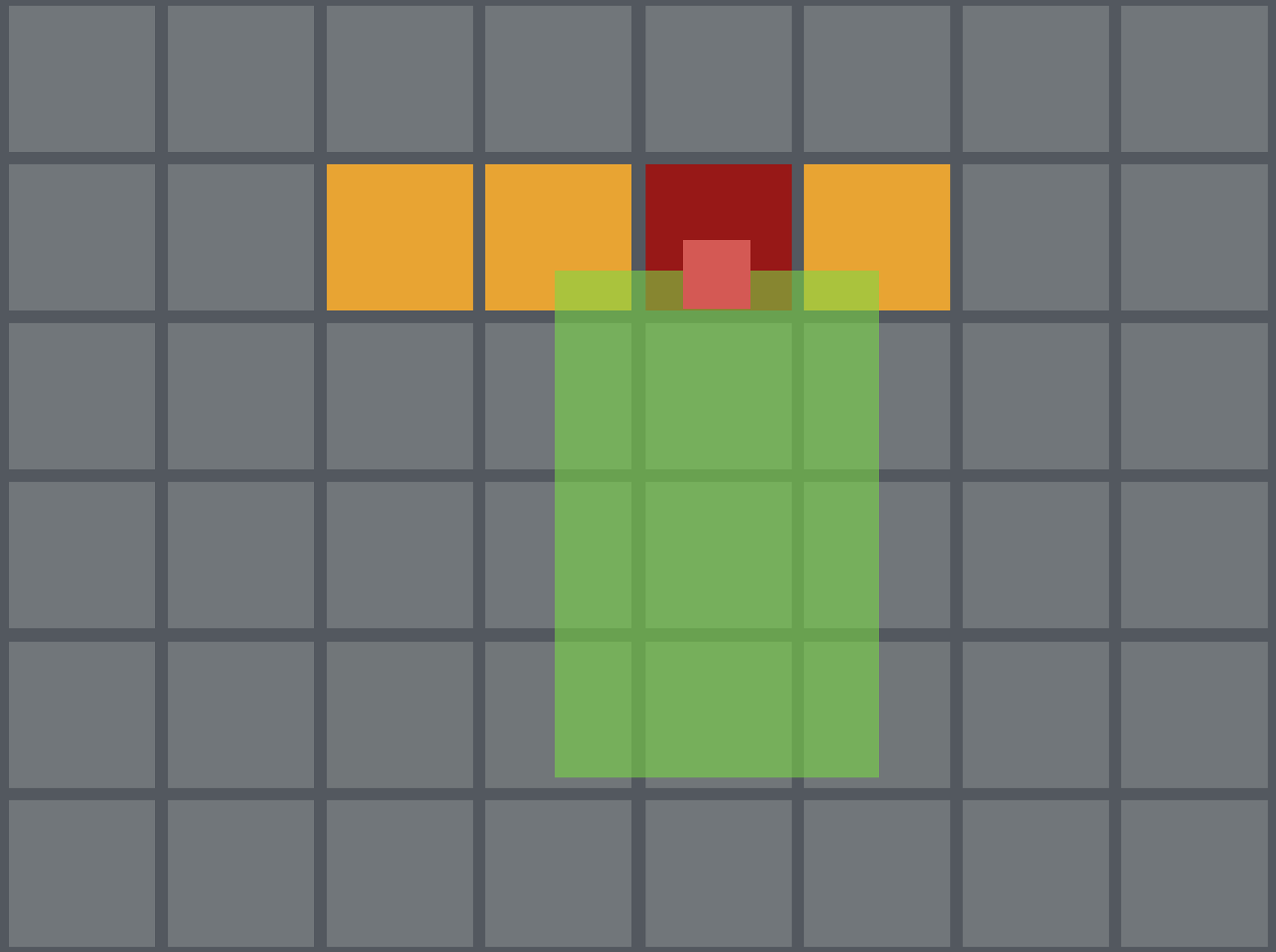

-TILE_SIZE * tile_y
entity.y - entity.height/2

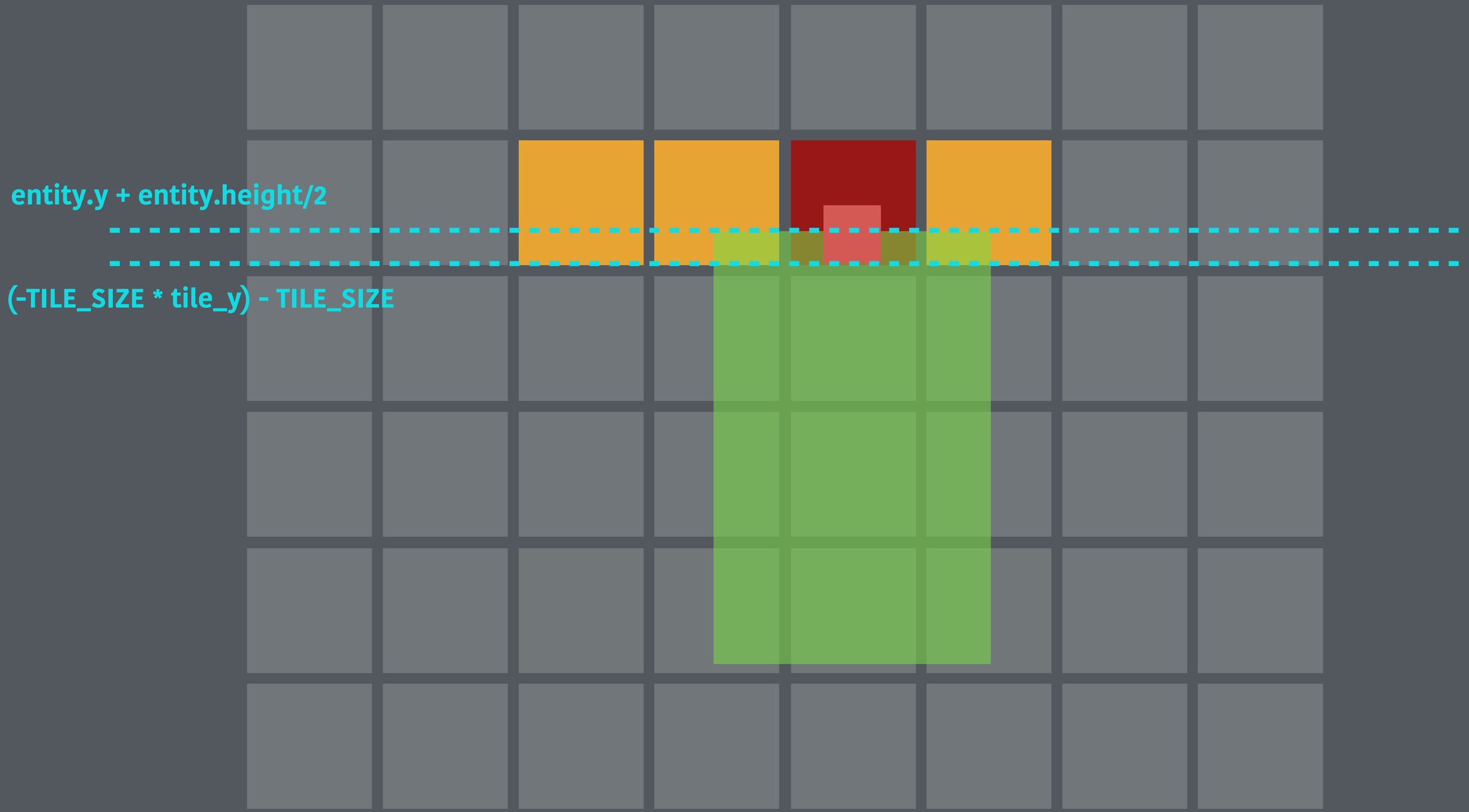
If the **tile is solid**, adjust our **Y-coordinate up** by the **difference** between **the point we are testing** and **the top of the tile** (plus a tiny amount)**.**

Don’t forget to **reset velocity to 0** and **set your collision flags**!

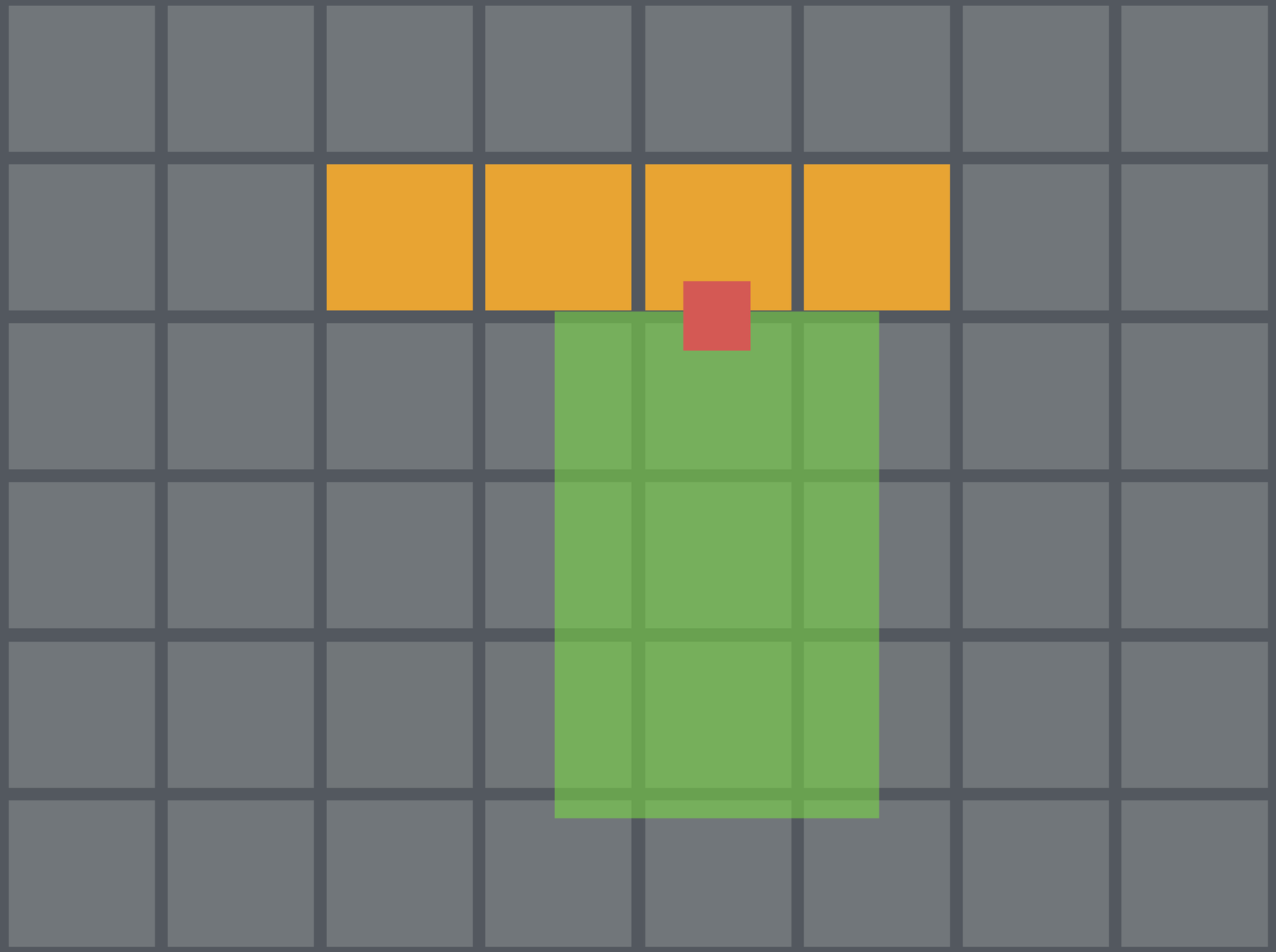


Now, check the **point at the top**...



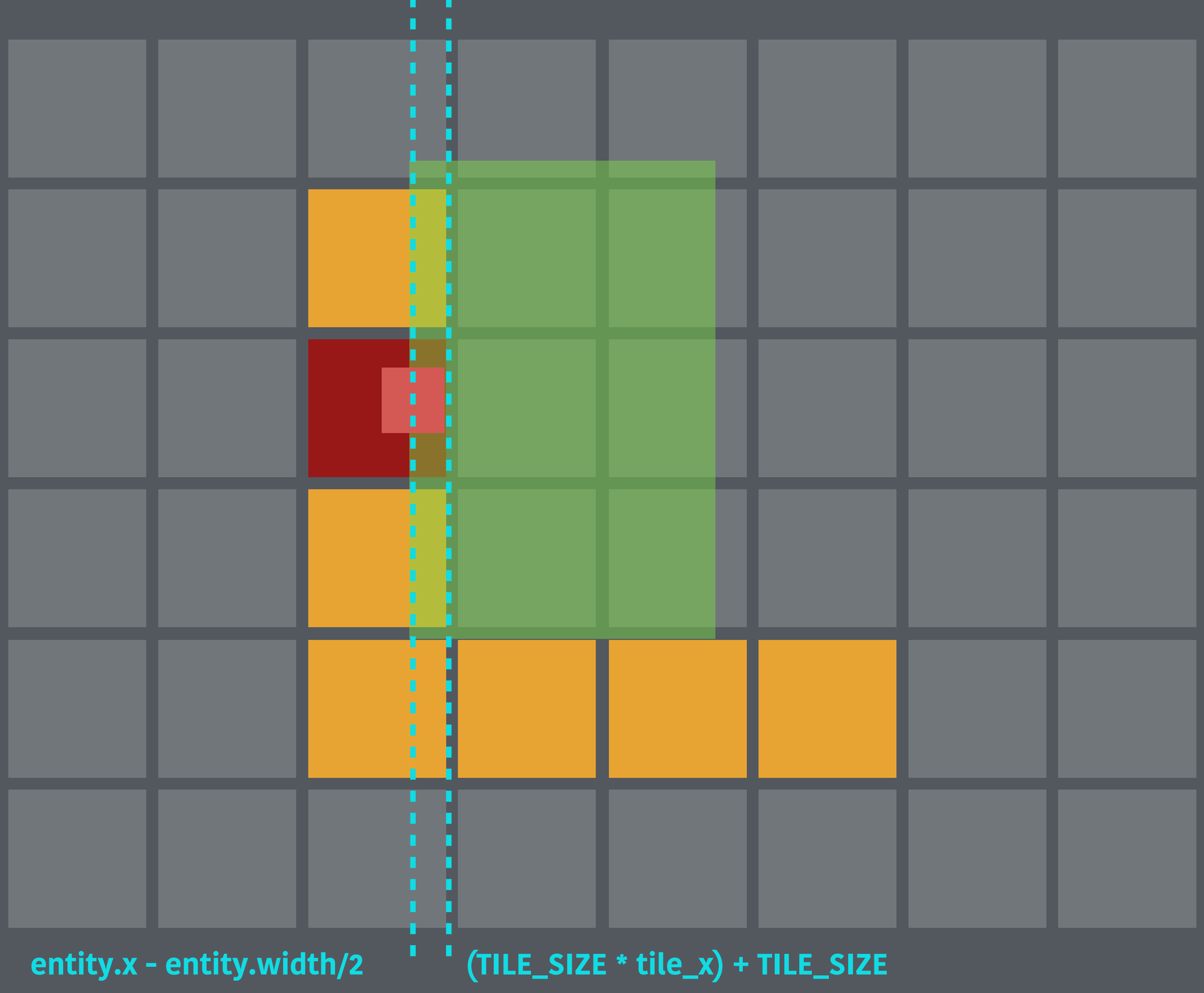

entity.y + entity.height/2
(-TILE_SIZE * tile_y) - TILE_SIZE

If the **tile is solid**, adjust our **Y-coordinate down** by the **difference** between **the point we are testing** and **the bottom of the tile** (plus a tiny amount)**.**

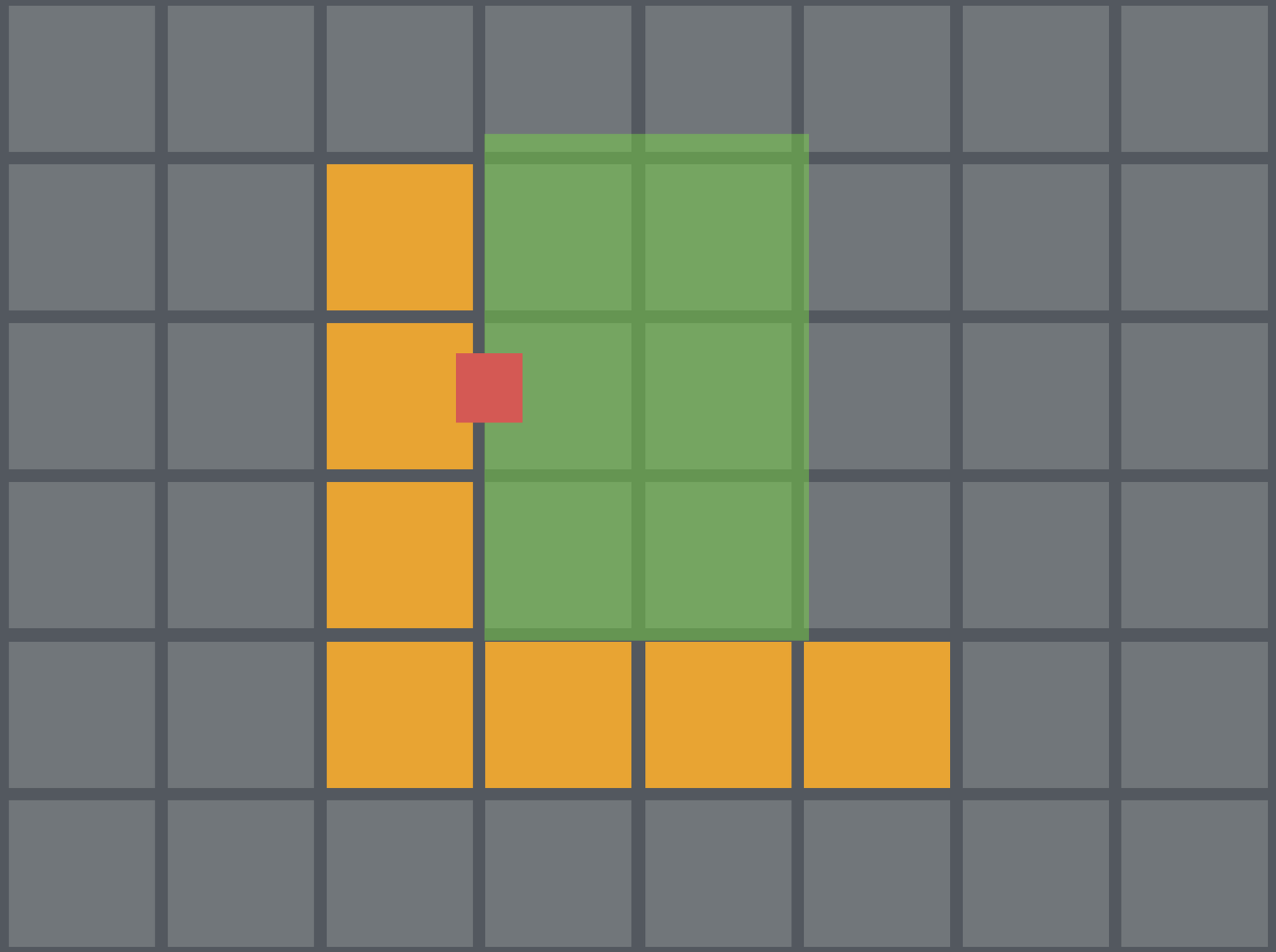


Now the **X axis**...

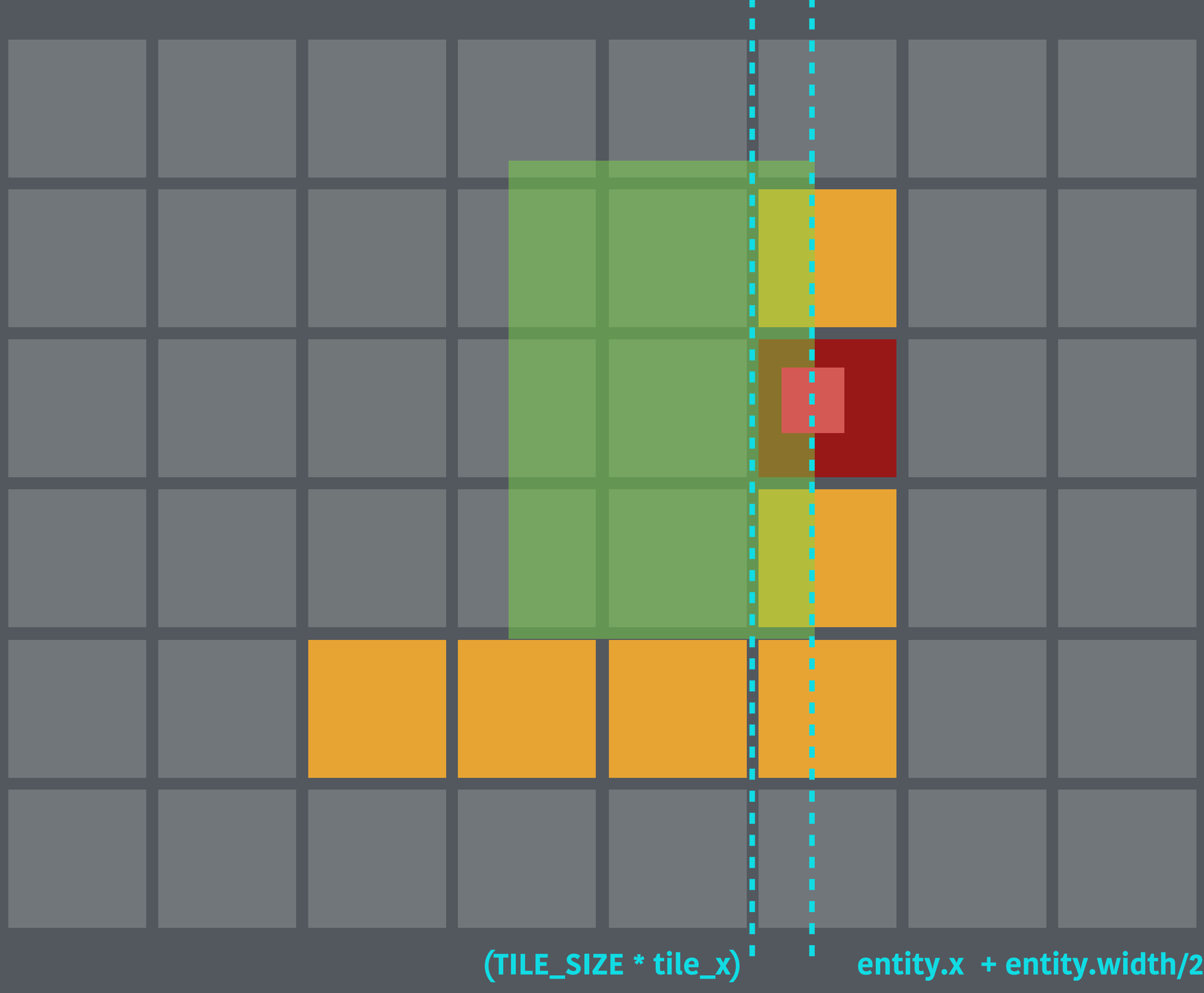
On the **left**...


entity.x - entity.width/2
(TILE_SIZE * tile_x) + TILE_SIZE

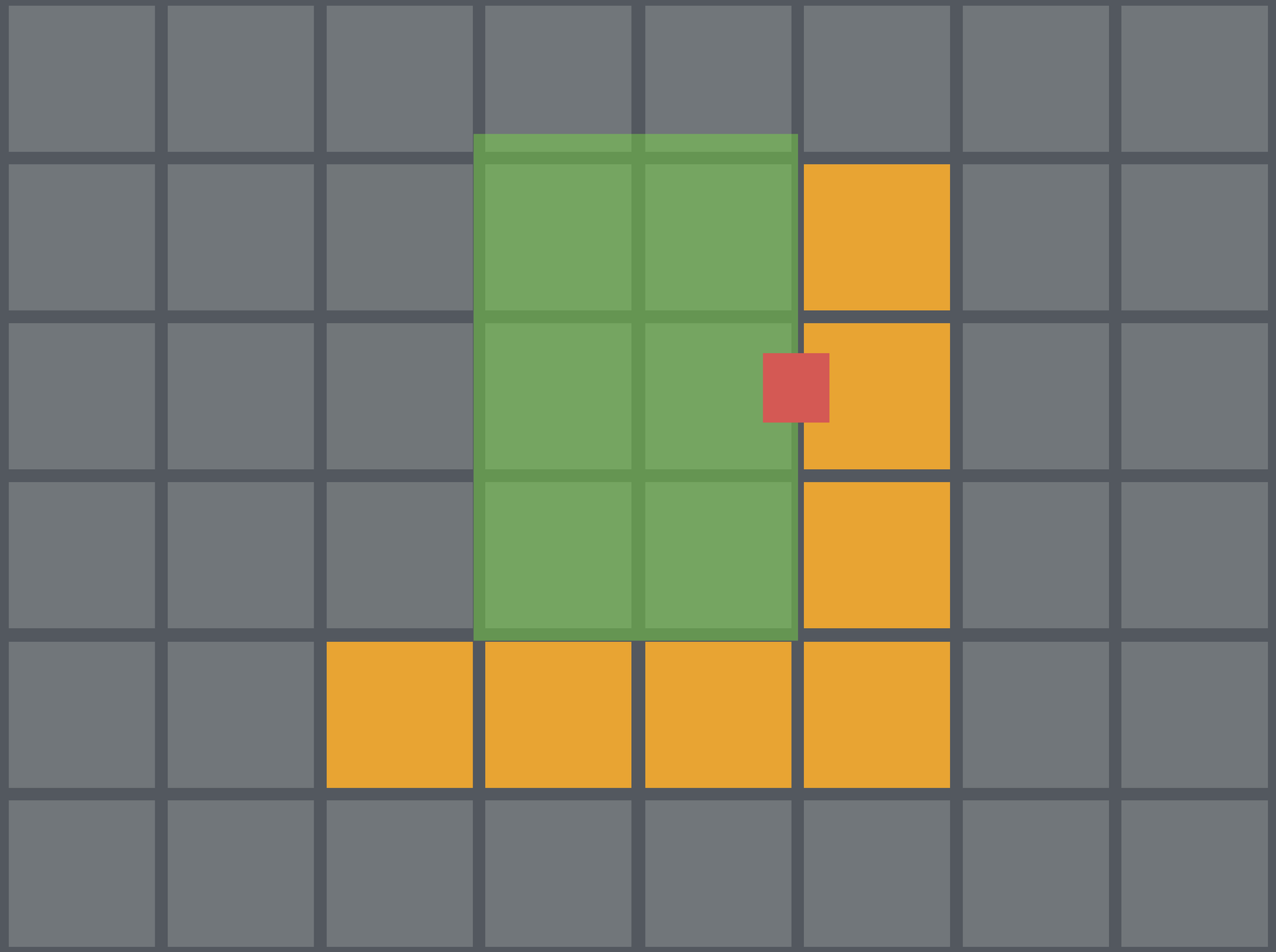
If the **tile is solid**, adjust our **X-coordinate right** by the **difference** between **the point we are testing** and **the right of the tile** (plus a tiny amount)**.**



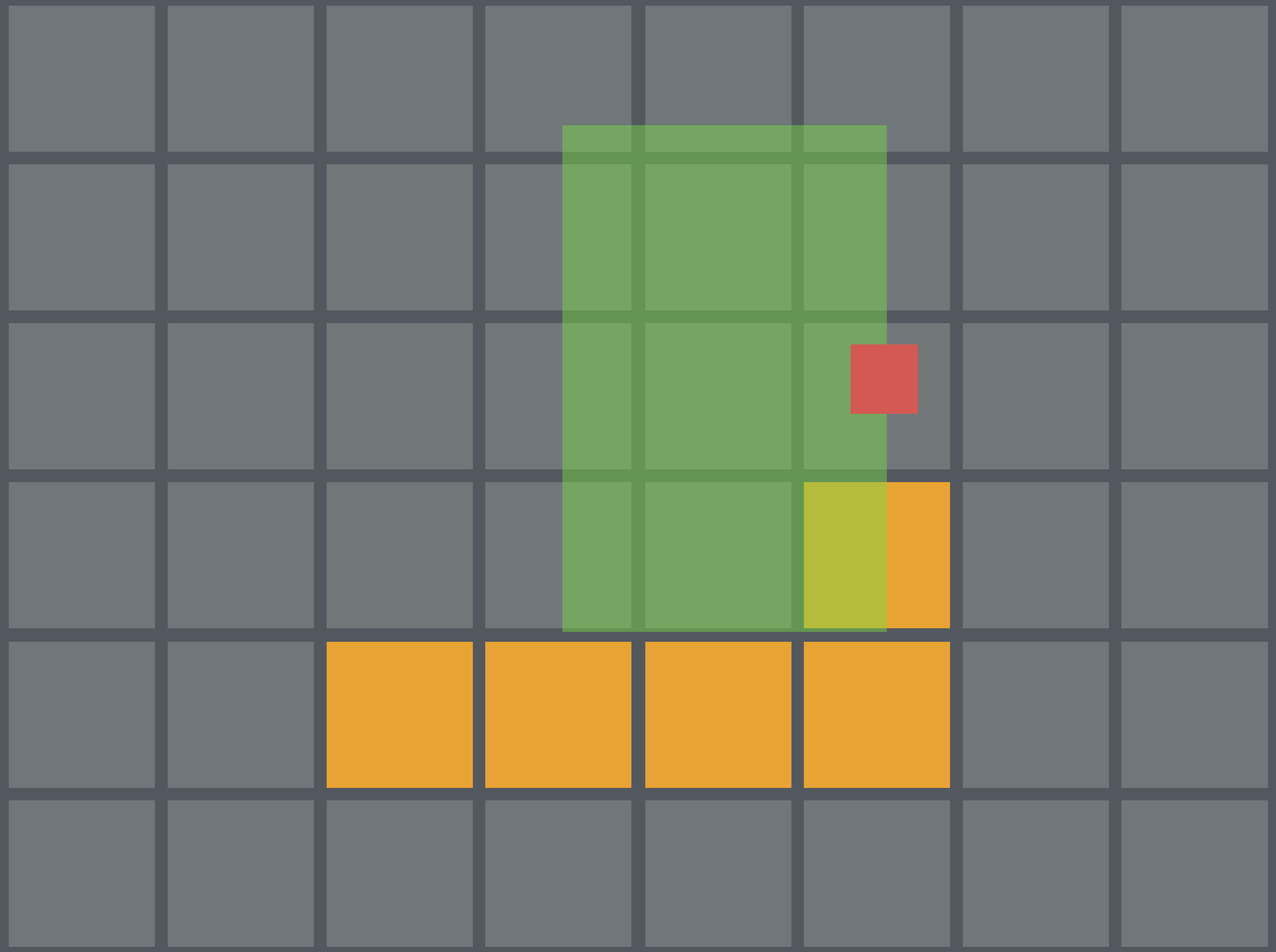
Now finally on the **right**...

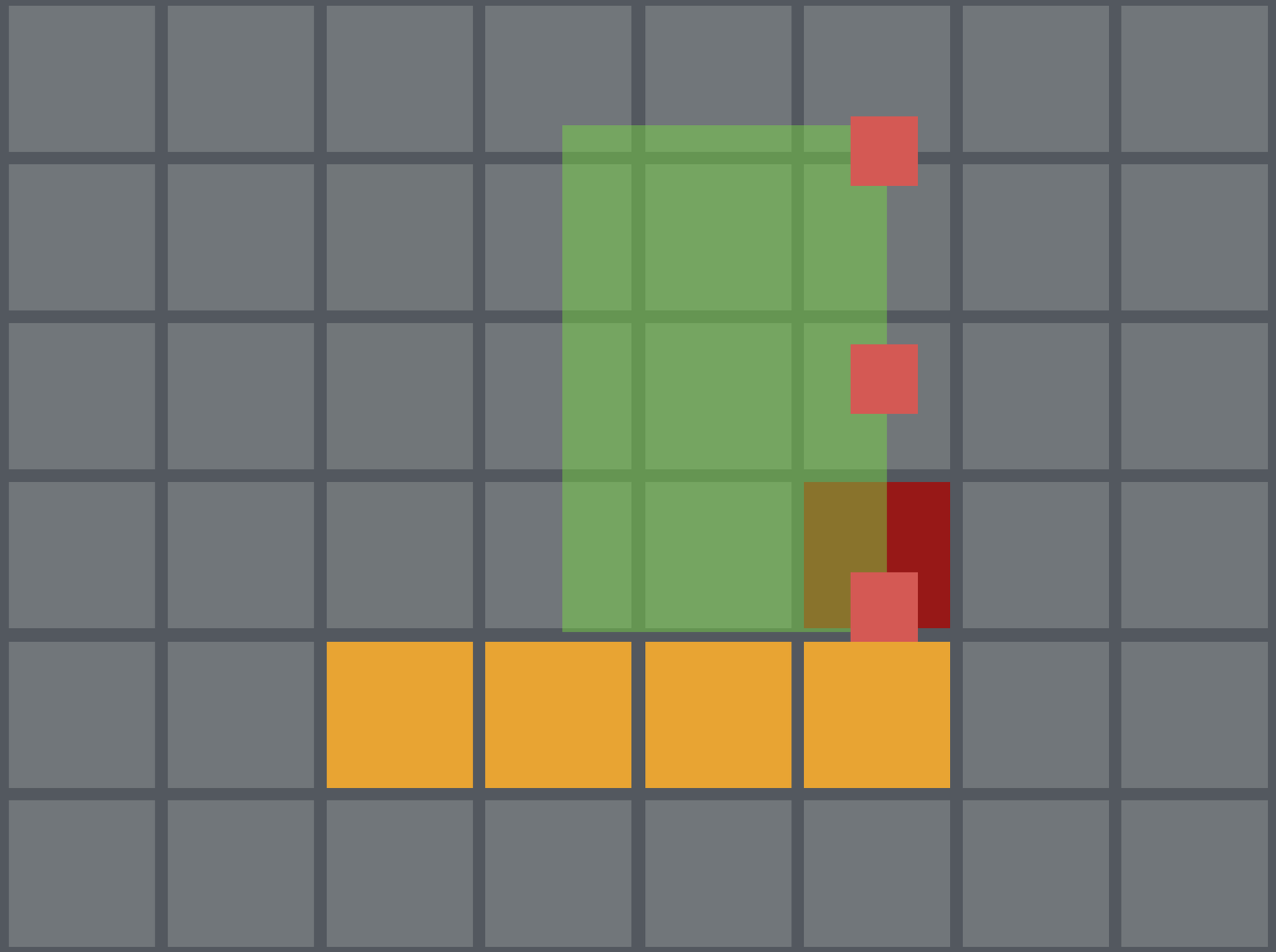

(TILE_SIZE * tile_x)
entity.x + entity.width/2

If the **tile is solid**, adjust our **X-coordinate left** by the **difference** between **the point we are testing** and **the left of the tile** (plus a tiny amount)**.**



You may t**est additional points** along the sprite
if it is l**arger than a tile**.

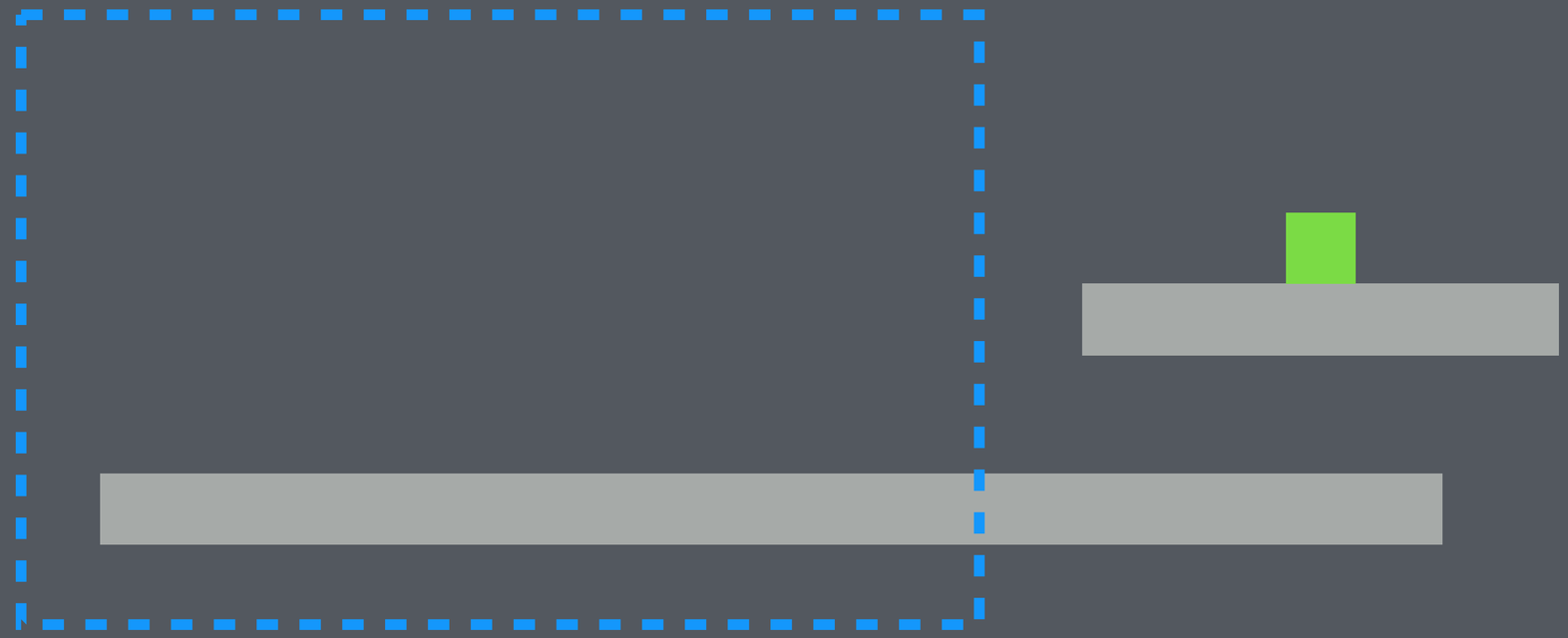




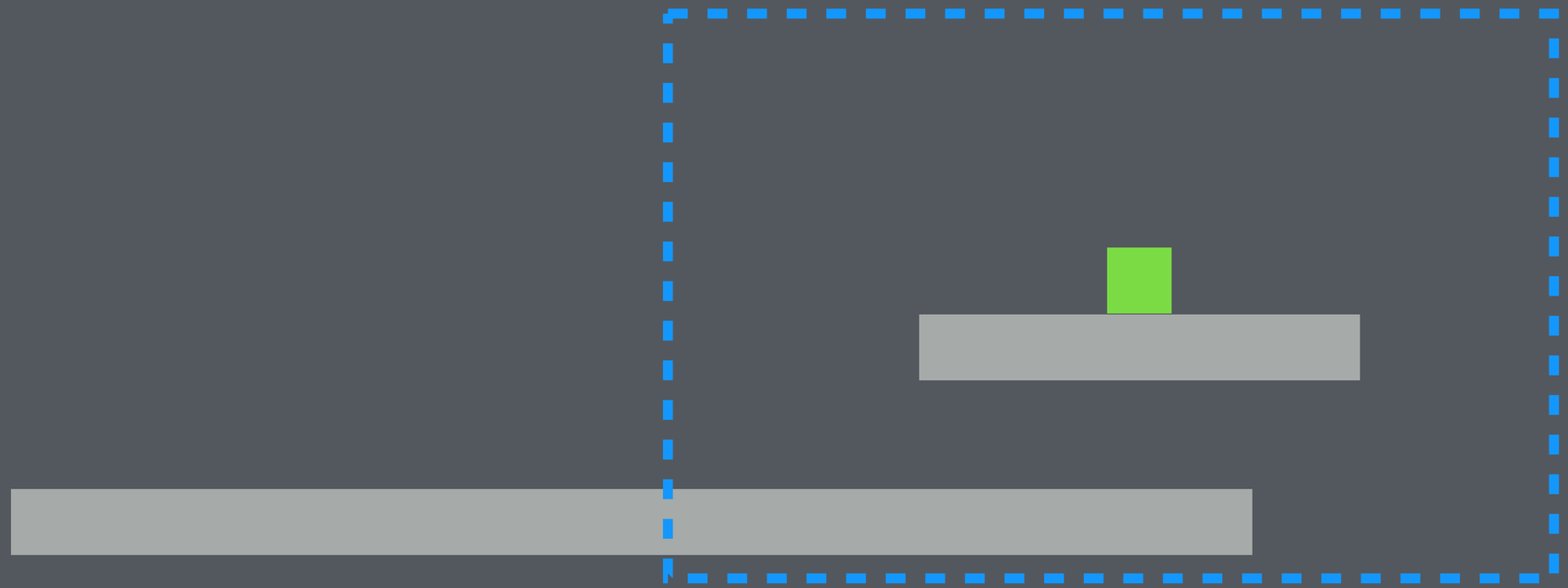
Scrolling

What is **scrolling**?

We need to **translate everything** so
that the **player** is in the **center of the screen**.



We need to **translate everything** so
that the **player** is in the **center of the screen**.



The **view matrix**!

Translate the **view matrix** by the **inverse of the player's position**!
(or whatever you want to center on)!