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Hands-on Rust

Effective Learning through 2D Game Development and Play

The Pragmatic Bookshelf

Raleigh, North Carolina

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Herbert Wolverson

edited by Tammy Coron

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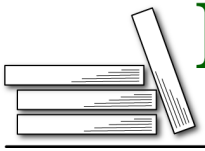

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Graphics, Camera, Action

ASCII is a great prototyping tool—even used for some full games such as Rogue or Nethack. Most games feature graphics, but this early in development isn't the right time to find an artist and make beautiful content—you might decide to change the game and waste hours of the artist's work. In early development, it's a much better idea to use *Programmer Art*—rough graphics designed to give you an idea for the feel of a game, but without requiring a significant time investment if (when) you decide to change things.

In this section, you'll implement graphical *layers*—so the player stands on top of the floor rather than replacing it. The graphics are much larger than simple ASCII glyphs, so you'll need to reduce the visible portion of the map—without sacrificing size or map quality. You'll solve this issue by creating a *camera*.

Programmer Art for the Dungeon

bracket-lib renders terminals by copying glyphs from a font file onto the terminal window. You can take advantage of this during prototyping by assigning a symbol to a tile type and replacing that character in the font file with your chosen programmer art. Any bitmap editor can do the job—I use *The Gimp*.[6]

Create a new directory named resources in your project's root directory. This directory will hold all graphical resources needed for the game. Copy dungeonfont.png into this directory. (It's already present in the example source code.) Rather than recreate this file throughout the book, the file includes all of the graphics needed for the game.

The following glyphs are defined:

Glyph	Graphic	Represents
#		Dungeon Wall
.		Dungeon Floor
"		Forest Wall
;		Forest Floor
>		Down Stairs

Glyph	Graphic	Represents
@		The Player
E		Ettin
O		Ogre
o		Orc
g		Goblin

Glyph	Graphic	Represents
|		Amulet of Yala
!		Healing Potion
{		Dungeon Map
s		Rusty Sword
S		Shiny Sword
/		Huge Sword

The font file with all of the graphic elements defined looks like this:

6. https://www.gimp.org/

The dungeon floor, wall, and adventurer graphics were kindly provided by Buch for free.[7] Potion and scroll graphics are from Melissa Krautheim's *Fantasy Magic Set*.[8] Weaponry is from Melle's *Fantasy Sword Set*.[9] Monster graphics are from the game *Dungeon Crawl Stone Soup* (CC0 license), packaged by Chris Hamons.[10]

Credit Your Artists

Even if you're using freely provided content, please credit the artists whose work you use. Making art is difficult work, just like programming. Be sure to thank the people who are giving it away.

Graphics Layers

Currently, your game renders everything to a single layer. The map is drawn and then the player is drawn on top of it. This works with graphics but tends to leave artifacts around the player's graphic. You can get much better results

7. https://opengameart.org/content/unfinished-dungeon-tileset
8. https://opengameart.org/content/fantasy-magic-set
9. https://opengameart.org/content/fantasy-sword-set
10. https://github.com/crawl/tiles

by using *layers*. The map is rendered to a base layer, and the player to the layer on top of it—with transparency, so the floor remains visible. Later in this book, you'll add a third layer for game information.

Start with a little housekeeping. Using large tiles makes the window *huge*—larger than many screens. Instead, render the game window as a smaller view of part of the map, centered on the player. Add some constants to your prelude in main.rs to indicate the dimensions of the smaller viewport into your world:

BasicDungeonCrawler/dungeon_crawl_graphics/src/main.rs

```
pub const DISPLAY_WIDTH: i32 = SCREEN_WIDTH / 2;
pub const DISPLAY_HEIGHT: i32 = SCREEN_HEIGHT / 2;
```

You can introduce layers to bracket-lib by changing your initialization code:

BasicDungeonCrawler/dungeon_crawl_graphics/src/main.rs

```
let context = BTermBuilder::new()
    .with_title("Dungeon Crawler")
    .with_fps_cap(30.0)
    .with_dimensions(DISPLAY_WIDTH, DISPLAY_HEIGHT)
    .with_tile_dimensions(32, 32)
    .with_resource_path("resources/")
    .with_font("dungeonfont.png", 32, 32)
    .with_simple_console(DISPLAY_WIDTH, DISPLAY_HEIGHT, "dungeonfont.png")
    .with_simple_console_no_bg(DISPLAY_WIDTH, DISPLAY_HEIGHT,
        "dungeonfont.png")
    .build()?;
```

❶ Use new() to create a generic terminal and specify attributes directly.

❷ with_dimensions specifies the size of subsequent consoles you add.

❸ The tile dimensions are the size of each character in your font file, in this case 32x32.

❹ The directory in which you placed the graphics file.

❺ The name of the font file to load and the character dimensions. These are usually the same as tile dimensions, but can be different for some advanced forms of rendering.

❻ Add a console using the dimensions already specified and the named tile graphics file.

❼ Add a second console with no background so transparency shows through it.

This code creates a terminal with two console layers, one for the map and one for the player. You won't be rendering the whole map at once—and to limit the viewport, you use a camera.

Make a Camera

The camera acts as your game's window into the world. It defines the section of the map that is currently visible. Create a new file, camera.rs. Import your prelude, and create a structure with enough information to define the boundaries of the camera view:

BasicDungeonCrawler/dungeon_crawl_graphics/src/camera.rs

```
use crate::prelude::*;

pub struct Camera {
    pub left_x : i32,
    pub right_x : i32,
    pub top_y : i32,
    pub bottom_y : i32
}
```

You need to be able to create a camera and update it when the player moves. Because the camera is centered on the player, you need the player's position for both of these functions:

BasicDungeonCrawler/dungeon_crawl_graphics/src/camera.rs

```
impl Camera {
    pub fn new(player_position: Point) -> Self {
        Self{
            left_x : player_position.x - DISPLAY_WIDTH/2,
            right_x : player_position.x + DISPLAY_WIDTH/2,
            top_y : player_position.y - DISPLAY_HEIGHT/2,
            bottom_y : player_position.y + DISPLAY_HEIGHT/2
        }
    }

    pub fn on_player_move(&mut self, player_position: Point) {
        self.left_x = player_position.x - DISPLAY_WIDTH/2;
        self.right_x = player_position.x + DISPLAY_WIDTH/2;
        self.top_y = player_position.y - DISPLAY_HEIGHT/2;
        self.bottom_y = player_position.y + DISPLAY_HEIGHT/2;
    }
}
```

The new and on_player_move functions are essentially the same: they define the visible window as being centered on the player. The left-most visible tile is the player's x coordinate, *minus* half of the screen size. The right-most visible tile is the x coordinate *plus* one half of the screen size. The y dimensions are the same, but with screen height.

Add the camera structure to your prelude and module imports in main.rs:

```
mod camera;

mod prelude {
  ...
  pub use crate::camera::*;
}
```

Add the camera to your game's state:

BasicDungeonCrawler/dungeon_crawl_graphics/src/main.rs

```
struct State {
    map: Map,
    player: Player,
    camera: Camera
}
```

You also need to update your state's new function to initialize the camera:

BasicDungeonCrawler/dungeon_crawl_graphics/src/main.rs

```
fn new() -> Self {
    let mut rng = RandomNumberGenerator::new();
    let map_builder = MapBuilder::new(&mut rng);
    Self {
        map : map_builder.map,
        player: Player::new(map_builder.player_start),
        camera: Camera::new(map_builder.player_start)
    }
}
```

Use the Camera for Rendering the Map

You need to update map.rs with a render function that understands camera placement:

BasicDungeonCrawler/dungeon_crawl_graphics/src/map.rs

```
pub fn render(&self, ctx: &mut BTerm, camera: &Camera) {
    ctx.set_active_console(0);
    for y in camera.top_y .. camera.bottom_y {
        for x in camera.left_x .. camera.right_x {
            if self.in_bounds(Point::new(x, y)) {
                let idx = map_idx(x, y);
                match self.tiles[idx] {
                    TileType::Floor => {
                        ctx.set(
                            x - camera.left_x,
                            y - camera.top_y,
                            WHITE,
                            BLACK,
                            to_cp437('.')
                        );
```

```
                    }
                    TileType::Wall => {
                        ctx.set(
                            x - camera.left_x,
                            y - camera.top_y,
                            WHITE,
                            BLACK,
                            to_cp437('#')
                        );
                    }
                }
            }
        }
    }
}
```

The function receives a borrowed Camera, and uses the boundaries from the camera to render just the visible part of the map. Notice that it now calls in_bounds to make sure that each tile exists. The *screen* coordinates sent to the set function have left_x and top_y subtracted from them—moving them to be relative to the camera. Notice that it calls set_active_console(0)—this tells the library to render to the first console layer, the base map.

The map will now be centered on the player.

Connect the Player to the Camera

The rendered map center is determined by the player's position, so you need to extend the update() function in player.rs to use it. Update the function signature as follows:

BasicDungeonCrawler/dungeon_crawl_graphics/src/player.rs
```
pub fn update(&mut self, ctx: &mut BTerm, map : &Map, camera: &mut Camera)
{
```

Notice that it receives a *mutable* camera—it will use it to send updates if the player moves:

BasicDungeonCrawler/dungeon_crawl_graphics/src/player.rs
```
if map.can_enter_tile(new_position) {
  self.position = new_position;
  camera.on_player_move(new_position);
}
```

Lastly, for the player, you need to update the render() function to take into account camera placement:

BasicDungeonCrawler/dungeon_crawl_graphics/src/player.rs
```
pub fn render(&self, ctx: &mut BTerm, camera: &Camera) {
  ctx.set_active_console(1);
  ctx.set(
    self.position.x - camera.left_x,
    self.position.y - camera.top_y,
    WHITE,
    BLACK,
    to_cp437('@'),
  );
}
```

Just like the map, this subtracts left_x and top_y from the player's coordinates when rendering. Notice the call to set_active_console. This specifies that you want to use the second layer for the player.

Clear Layers, Connect Functions

Finally, you need to update the tick function in main.rs to send the camera to the updated functions—and to clear all layers.

BasicDungeonCrawler/dungeon_crawl_graphics/src/main.rs
```
fn tick(&mut self, ctx: &mut BTerm) {
    ctx.set_active_console(0);
    ctx.cls();
    ctx.set_active_console(1);
    ctx.cls();
    self.player.update(ctx, &self.map, &mut self.camera);
    self.map.render(ctx, &self.camera);
    self.player.render(ctx, &self.camera);
}
```

Run the game now and you have a graphical dungeon: