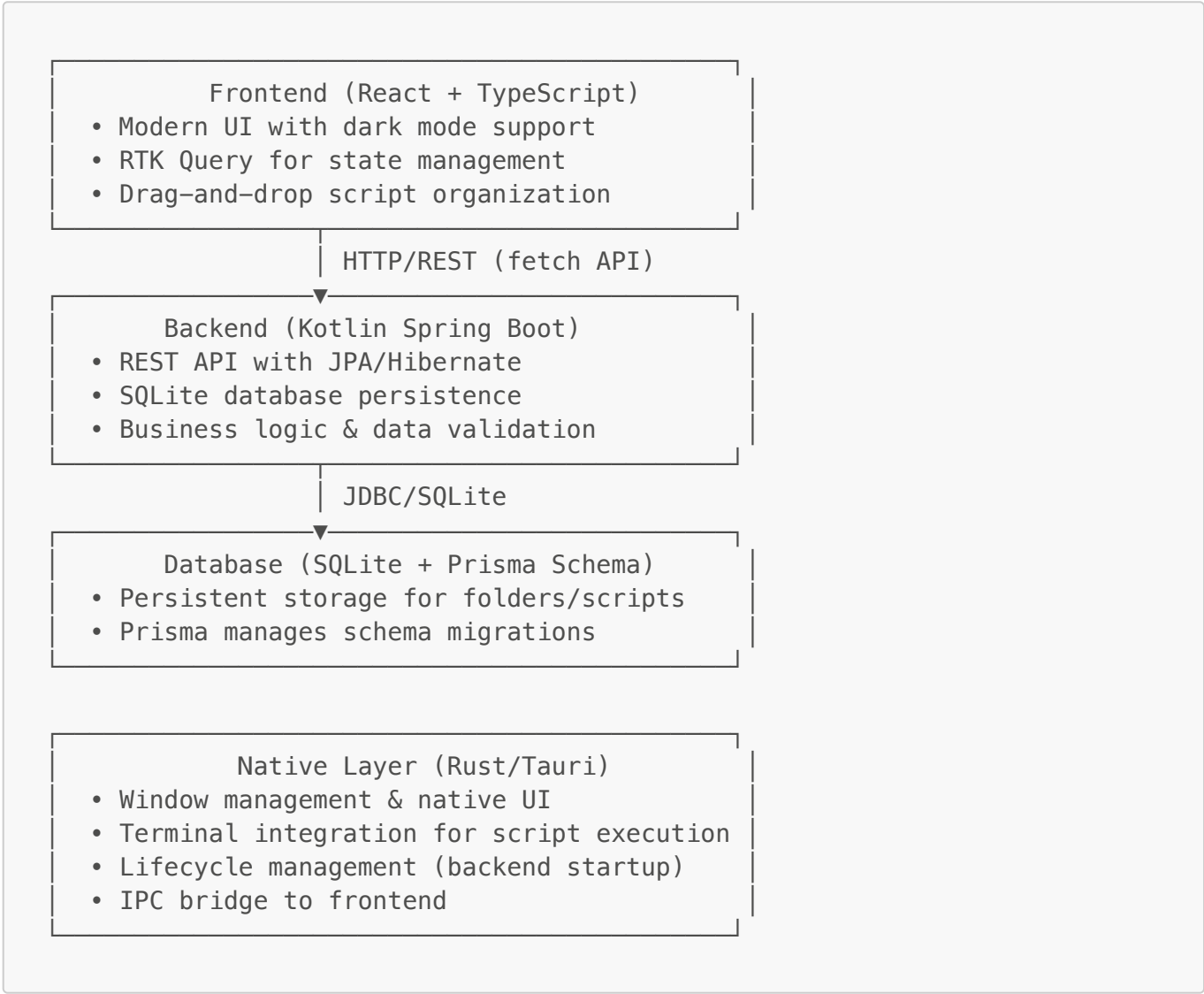
Shell Script Manager - Complete Project Summary

🎯 Project Overview

A modern desktop application for macOS that helps users organize and execute shell scripts through an intuitive GUI. Built with a hybrid architecture combining Rust (Tauri), React (TypeScript), and Kotlin (Spring Boot).

🏗️ Architecture

Three-Tier Architecture:



🛠️ Tech Stack

Frontend

- **Framework**: React 18 + TypeScript
- **UI Components**: Custom components with Tailwind CSS + shadcn/ui
- **State Management**: Redux Toolkit + RTK Query
- **Drag & Drop**: @dnd-kit for reordering

- **Build Tool**: Vite

Backend

- **Language**: Kotlin
- **Framework**: Spring Boot 3.x
- **Database**: SQLite with Hibernate ORM
- **Build System**: Gradle (Kotlin DSL)
- **API**: REST with automatic JSON serialization

Native/Desktop Layer

- **Framework**: Tauri v2
- **Language**: Rust
- **Database Schema**: Prisma (schema definition & migrations)
- **Build Tool**: Cargo

📁 Project Structure

```
shell-script-manager-tauri/
├── src/                          # React frontend
│   ├── app-component/           # Main UI components
│   │   ├── FolderColumn/        # Folder list & management
│   │   └── ScriptsColumn/       # Script list & execution
│   ├── components/              # Reusable UI components
│   ├── store/                   # Redux store & API slices
│   │   ├── api/                # RTK Query endpoints
│   │   └── slices/             # Redux state slices
│   └── hooks/                   # Custom React hooks
│
├── src-tauri/                   # Rust native layer
│   ├── src/lib.rs              # Core Tauri application logic
│   ├── prisma/schema.prisma    # Database schema definition
│   └── Cargo.toml              # Rust dependencies
│
├── backend-spring/              # Spring Boot backend
│   ├── src/main/kotlin/
│   │   └── com/scriptmanager/
│   │       ├── controller/     # REST API endpoints
│   │       ├── common/
│   │       │   ├── entity/     # JPA entities
│   │       │   └── dto/        # Data transfer objects
│   │       └── repository/     # Spring Data repositories
│   └── build.gradle.kts        # Gradle build configuration
│
└── docs/                        # Project documentation
```

🔗 Communication Bridges Between Components

1. Frontend ↔ Backend (HTTP/REST via RTK Query)

Frontend Side - RTK Query Base Configuration

```
// src/store/api/baseQuery/httpBaseQuery.ts
export const httpBaseQuery = (): BaseQueryFn<
  HttpQueryArgs,
  unknown,
  HttpQueryError
> => {
  return async ({ url, method = "GET", body, params }, api) => {
    // Get dynamic backend URL from Redux state
    const state = api.getState() as RootState;
    const port = state.config.backendPort;
    const backendUrl = `http://localhost:${port}`;

    // Build URL with query params
    const fullUrl = new URL(`${backendUrl}${url}`);
    if (params) {
      Object.entries(params).forEach(([key, value]) => {
        fullUrl.searchParams.append(key, value);
      });
    }

    // Make fetch request
    const response = await fetch(fullUrl.toString(), {
      method,
      headers: { "Content-Type": "application/json" },
      body: body ? JSON.stringify(body) : undefined,
    });

    if (!response.ok) {
      const errorData = await response.text();
      return { error: { status: response.status, data: errorData } };
    }

    const data = await response.json();
    return { data: data.result };
  };
};
```

Frontend Side - RTK Query API Definition

```
// src/store/api/folderApi.ts
export const folderApi = baseApi.injectEndpoints({
  endpoints: (builder) => ({
    getAllFolders: builder.query<ScriptsFolderDTO[], void>({
      query: () => ({
        url: "/folders",
        method: "GET",
```

```
      }),
      providesTags: ["Folder"],
    }),

    createFolder: builder.mutation<ScriptsFolderDTO, CreateFolderRequest>
({
      query: (request) => ({
        url: "/folders",
        method: "POST",
        body: request,
      }),
      invalidatesTags: ["Folder"],
    }),
  }),
});
```

Frontend Side - Using the API in Components

```
// src/app-component/FolderColumn/FolderColumn.tsx
export default function FolderColumn() {
  const backendPort = useAppSelector((s) => s.config.backendPort);

  // Query only runs when backendPort is available
  const { data: folders, isLoading } =
    folderApi.endpoints.getAllFolders.useQuery(undefined, {
      skip: !backendPort,
      selectFromResult: (result) => ({
        ...result,
        data: result.data ?? [],
      }),
    });

  const [createFolder] = folderApi.endpoints.createFolder.useMutation();

  const handleCreateFolder = async () => {
    await createFolder({ name: newFolderName.trim() });
  };
}
```

Backend Side - Spring Boot REST Controller

```
// backend-
spring/src/main/kotlin/com/scriptmanager/controller/FolderController.kt
@RestController
@RequestMapping("/folders")
class FolderController(
    private val folderRepository: ScriptsFolderRepository
) {
```

```
    @GetMapping
    fun getAllFolders(): ResponseEntity<ApiResponse<List<ScriptsFolder>>>
{
        val folders = folderRepository.findAllByOrderByOrderIndexAsc()
        return ResponseEntity.ok(ApiResponse.success(folders))
    }

    @PostMapping
    fun createFolder(@RequestBody request: CreateFolderRequest):
ResponseEntity<ApiResponse<ScriptsFolder>> {
        val maxOrder = folderRepository.findMaxOrderIndex() ?: -1
        val newFolder = ScriptsFolder(
            name = request.name,
            orderIndex = maxOrder + 1
        )
        val saved = folderRepository.save(newFolder)
        return ResponseEntity.ok(ApiResponse.success(saved))
    }
}
```

---

2. Backend ↔ Database (JPA/Spring Data)

Schema Definition - Prisma (Source of Truth)

```
// src-tauri/prisma/schema.prisma
model ScriptsFolder {
  id          Int      @id @default(autoincrement())
  name        String
  orderIndex  Int      @map("order_index")
  createdAt   DateTime @default(now()) @map("created_at")
  createdAtHk String   @default("0") @map("created_at_hk")

  scripts ShellScript[]

  @@map("scripts_folder")
}

model ShellScript {
  id          Int      @id @default(autoincrement())
  name        String
  command     String
  orderIndex  Int      @map("order_index")
  folderId    Int      @map("folder_id")
  createdAt   DateTime @default(now()) @map("created_at")
  createdAtHk String   @default("0") @map("created_at_hk")

  folder ScriptsFolder @relation(fields: [folderId], references: [id],
onDelete: Cascade)
```

```
  @@map("shell_script")
}
```

JPA Entity (Matches Prisma Schema)

```
// backend-
spring/src/main/kotlin/com/scriptmanager/common/entity/ScriptsFolder.kt
@Entity
@Table(name = "scripts_folder")
@DynamicInsert
data class ScriptsFolder(
    @Id
    @GeneratedValue(strategy = GenerationType.IDENTITY)
    @Column(name = "id")
    val id: Long = 0,

    @Column(name = "name", nullable = false)
    var name: String,

    @Column(name = "order_index", nullable = false)
    var orderIndex: Int,

    @Column(name = "created_at")
    var createdAt: LocalDateTime? = null,

    @Column(name = "created_at_hk")
    var createdAtHk: String? = null,

    @OneToMany(mappedBy = "folder", cascade = [CascadeType.ALL], fetch =
FetchType.LAZY)
    val scripts: MutableList<ShellScript> = mutableListOf()
)
```

Spring Data Repository

```
// backend-
spring/src/main/kotlin/com/scriptmanager/repository/ScriptsFolderRepositor
y.kt
@Repository
interface ScriptsFolderRepository : JpaRepository<ScriptsFolder, Long> {
    fun findAllByOrderByOrderIndexAsc(): List<ScriptsFolder>

    @Query("SELECT MAX(f.orderIndex) FROM ScriptsFolder f")
    fun findMaxOrderIndex(): Int?
}
```

Database Configuration

```
# backend-spring/src/main/resources/application.yml
spring:
  datasource:
    url: jdbc:sqlite:${DB_PATH:/path/to/database.db} # Overridden by Rust
    driver-class-name: org.sqlite.JDBC

  jpa:
    database-platform: org.hibernate.community.dialect.SQLiteDialect
    hibernate:
      ddl-auto: none # Prisma manages schema
    properties:
      hibernate:
        jdbc:
          use_get_generated_keys: false # Required for SQLite
```

---

3. Rust ↔ Database (Prisma Client)

Database Initialization in Rust

```
// src-tauri/src/lib.rs
pub fn init_db(app_handle: &tauri::AppHandle) -> Result<(), String> {
    // Get database path (dev vs production)
    let db_path = get_database_path(app_handle)?;
    println!("Database location: {}", db_path);

    // Set DATABASE_URL for Prisma
    let database_url = format!("file:{}", db_path);
    std::env::set_var("DATABASE_URL", &database_url);

    // Spawn separate thread to avoid async runtime conflicts
    let database_url_clone = database_url.clone();
    std::thread::spawn(move || {
        std::env::set_var("DATABASE_URL", &database_url_clone);

        let rt = tokio::runtime::Runtime::new().expect("Failed to create
runtime");
        rt.block_on(async move {
            let client = prisma::new_client_with_url(&database_url_clone)
                .await
                .expect("Failed to create Prisma client");

            // Sync schema (allows automatic updates in production)
            client
                ._db_push()
                .accept_data_loss()
                .await
                .expect("Failed to sync database schema");

            PRISMA_CLIENT
                .set(client)
```

```
                .expect("Failed to set Prisma client");
        });
    })
    .join()
    .map_err(|_| "Failed to initialize database".to_string())?;

    Ok(())
}
```

Dynamic Database Path

```
// src-tauri/src/lib.rs
fn get_database_path(app_handle: &tauri::AppHandle) -> Result<String,
String> {
    #[cfg(debug_assertions)]
    {
        // Development: use src-tauri/database.db
        let current_dir = std::env::current_dir()
            .map_err(|e| format!("Failed to get current directory: {}",
e))?;
        let db_path = current_dir.join("database.db");
        Ok(db_path.to_string_lossy().to_string())
    }

    #[cfg(not(debug_assertions))]
    {
        // Production: use Application Support directory
        let app_name = env!("CARGO_PKG_NAME");
        let home_dir = std::env::var("HOME")
            .map_err(|e| format!("Failed to get HOME directory: {}", e))?;

        #[cfg(target_os = "macos")]
        let app_support_dir = std::path::PathBuf::from(&home_dir)
            .join("Library")
            .join("Application Support")
            .join(app_name);

        // Create directory if it doesn't exist
        std::fs::create_dir_all(&app_support_dir)
            .map_err(|e| format!("Failed to create app data directory:
{}", e))?;

        let db_path = app_support_dir.join("database.db");
        Ok(db_path.to_string_lossy().to_string())
    }
}
```

---

4. Rust ↔ Spring Boot (Process Management & HTTP)

Starting Spring Boot Native Binary from Rust

```rust
// src-tauri/src/lib.rs
#[cfg(not(debug_assertions))]
fn start_spring_boot_backend(app_handle: tauri::AppHandle, port: u16) ->
Result<(), String> {
    println!("Starting Spring Boot backend on port {}...", port);

    // Get database path
    let db_path = get_database_path(&app_handle)?;

    // Get bundled native binary path
    let resource_path = app_handle
        .path()
        .resource_dir()
        .map_err(|e| format!("Failed to get resource directory: {}", e))?;
    let backend_dir = resource_path.join("resources").join("backend-
spring");

    println!("Backend directory: {:?}", backend_dir);

    // Use the bundled GraalVM native image (this function is only called
in production mode)
    let native_binary = backend_dir.join("backend-native");

    println!(
        "Production mode: Using native binary at {:?}",
        native_binary
    );

    // Verify native binary exists
    if !native_binary.exists() {
        return Err(format!("Native binary not found at {:?}",
native_binary));
    }

    // Use GraalVM native image (no Java required!)
    // This is a standalone executable - just run it directly!
    let child = Command::new(&native_binary)
        .arg(format!("--server.port={}", port))
        .arg(format!("--spring.datasource.url=jdbc:sqlite:{}", db_path))
        .spawn()
        .map_err(|e| format!("Failed to start Spring Boot backend: {}",
e))?;

    // Store process handle for cleanup
    if let Some(process_mutex) = SPRING_BOOT_PROCESS.get() {
        *process_mutex.lock().unwrap() = Some(child);
    }

    println!("Spring Boot backend started successfully");
    Ok(())
}
```

Key Points:

- ✅ **No Java/JRE required** - The `backend-native` is a standalone executable
- ✅ **Direct execution** - Use `Command::new(&native_binary)` to run it like any native binary
- ✅ **Command-line args work** - Pass Spring Boot properties as arguments
- ✅ **Much faster startup** - Native images start in milliseconds vs seconds for JVM
- ✅ **Smaller bundle size** - ~100MB native binary vs ~310MB JRE + 30MB JAR

What's Happening:

```
# This is what Rust is doing under the hood:
./backend-native \
  --server.port=7070 \
  --spring.datasource.url=jdbc:sqlite:/path/to/database.db
```

It's equivalent to running a native macOS application - no JVM, no Java, just pure compiled code!

Health Check from Rust

```
// src-tauri/src/lib.rs
#[tauri::command]
async fn check_backend_health() -> Result<bool, String> {
    let port = BACKEND_PORT
        .get()
        .ok_or_else(|| "Backend port not initialized".to_string())?;

    let client = reqwest::Client::new();
    match client
        .get(format!("http://localhost:{}/health", port))
        .send()
        .await
    {
        Ok(response) => Ok(response.status().is_success()),
        Err(_) => Ok(false),
    }
}
```

Dynamic Port Selection (Production)

```
// src-tauri/src/lib.rs
#[cfg(not(debug_assertions))]
fn find_available_port() -> Result<u16, String> {
    use rand::Rng;
    use std::net::TcpListener;

    let mut rng = rand::thread_rng();
```

```
    // Try up to 100 random ports in range 10000-60000
    for _ in 0..100 {
        let port = rng.gen_range(10000..=60000);
        if TcpListener::bind(("127.0.0.1", port)).is_ok() {
            return Ok(port);
        }
    }

    Err("Could not find an available port".to_string())
}
```

---

5. Frontend ↔ Rust (Tauri IPC)

Rust Side - Command Definitions

```
// src-tauri/src/lib.rs

// Command to execute a script in a visible terminal
#[tauri::command]
async fn run_script(command: String) {
    println!("Running script: {}", command);
    open_terminal_with_command(command);
}

// Command to get the backend port
#[tauri::command]
fn get_backend_port() -> Result<u16, String> {
    BACKEND_PORT
        .get()
        .copied()
        .ok_or_else(|| "Backend port not initialized".to_string())
}

// Command to execute shell commands silently
#[tauri::command]
async fn execute_command(command: String) {
    run_terminal_command(command);
}

// Register commands in Tauri
pub fn run() {
    tauri::Builder::default()
        .invoke_handler(tauri::generate_handler![
            run_script,
            execute_command,
            get_backend_port,
            check_backend_health,
        ])
        .setup(|app| {
```

```
            // ... initialization logic
            Ok(())
        })
        .run(tauri::generate_context!())
        .expect("error while running tauri application");
}
```

Frontend Side - Invoking Rust Commands

```
// src/App.tsx
import { invoke } from "@tauri-apps/api/core";

function App() {
  const dispatch = useAppDispatch();

  // Fetch backend port on mount (production only)
  useEffect(() => {
    if (!import.meta.env.DEV) {
      const fetchBackendPort = async () => {
        try {
          const port = await invoke<number>("get_backend_port");
          dispatch(configSlice.actions.setBackendPort(port));
          console.log("Backend running on port:", port);
        } catch (error) {
          console.error("Failed to get backend port:", error);
        }
      };
      fetchBackendPort();
    }
  }, [dispatch]);
}
```

```
// src/app-component/ScriptsColumn/ScriptItem.tsx
import { invoke } from "@tauri-apps/api/core";

const handleRun = async () => {
  try {
    // Opens terminal and executes script
    await invoke("run_script", { command: script.command });
  } catch (error) {
    console.error("Failed to run script:", error);
  }
};
```

```
// src/app-component/FolderColumn/FolderColumn.tsx
const handleOpenBackendApi = async () => {
  const url = `http://localhost:${backendPort}/api`;
```

```
  const isMac = navigator.userAgent.includes("Mac");
  const command = isMac ? `open "${url}"` : `start "${url}"`;

  await invoke("run_script", { command });
};
```

---

6. Frontend ↔ Native Events (Tauri Event System)

Rust Side - Emitting Events

```
// src-tauri/src/lib.rs
#[cfg(target_os = "macos")]
fn setup_menu_handlers(app: &tauri::App) {
    use tauri::Emitter;

    app.on_menu_event(move |app, event| {
        if event.id() == "toggle_dark_mode" {
            if let Some(window) = app.get_webview_window("main") {
                // Emit event to frontend
                window.emit("toggle-dark-mode", ()).unwrap_or_else(|e| {
                    eprintln!("Failed to emit toggle-dark-mode event: {}",
e);
                });
            }
        }
    });
}
```

Frontend Side - Listening to Events

```
// src/App.tsx
import { listen } from "@tauri-apps/api/event";

useEffect(() => {
  const unlisten = listen("toggle-dark-mode", async () => {
    const newDarkMode = !darkMode;
    if (appStateData) {
      updateAppState({ ...appStateData, darkMode: newDarkMode });
    }

    // Apply immediately for better UX
    if (newDarkMode) {
      document.documentElement.classList.add("dark");
      await invoke("set_title_bar_color", { isDark: true });
    } else {
      document.documentElement.classList.remove("dark");
      await invoke("set_title_bar_color", { isDark: false });
    }
```

```
  });

  return () => {
    unlisten.then((fn) => fn());
  };
}, [darkMode, updateAppState, appStateData]);
```

🔄 Data Flow Examples

Example 1: Creating a New Folder

```
User clicks "New Folder"
    ↓
Frontend (FolderColumn.tsx)
    → createFolder({ name: "My Folder" })
    ↓
RTK Query (folderApi.ts)
    → POST http://localhost:{port}/folders
    ↓
Spring Boot (FolderController.kt)
    → folderRepository.save(newFolder)
    ↓
Database (SQLite via JPA)
    → INSERT INTO scripts_folder ...
    ↓
Response flows back up the chain
    ↓
RTK Query invalidates 'Folder' tag
    ↓
UI automatically refetches and updates
```

Example 2: Executing a Script

```
User clicks "Execute" on a script
    ↓
Frontend (ScriptItem.tsx)
    → invoke('run_script', { command: "echo Hello" })
    ↓
Rust (lib.rs)
    → open_terminal_with_command(command)
    ↓
macOS Terminal.app opens
    → Executes the shell command
    → User sees output in terminal
```

Example 3: Application Startup (Production)

```
User launches .app bundle
    ↓
Rust (lib.rs::run())
    1. init_runtime() - Setup async runtime
    2. init_db() - Prisma creates/migrates database
    3. init_spring_boot() - Find random port, start Java backend
    4. setup_macos_window() - Configure native window
    5. setup_macos_menu() - Create menu bar
    ↓
Frontend (BackendLoadingScreen.tsx)
    → Polls check_backend_health() every 1s
    ↓
Backend becomes ready
    ↓
Frontend (App.tsx)
    → Fetches backend port
    → Sets backendPort in Redux
    ↓
All queries start (skip: !backendPort becomes false)
    ↓
UI loads with data from database
```

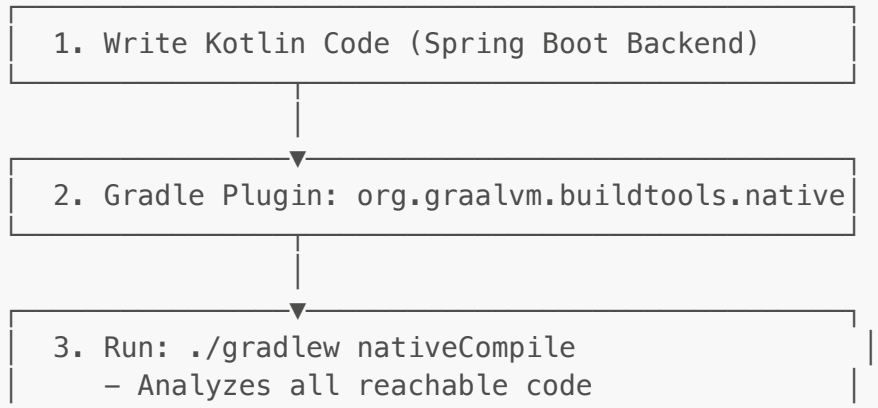
🔨 GraalVM Native Image Compilation

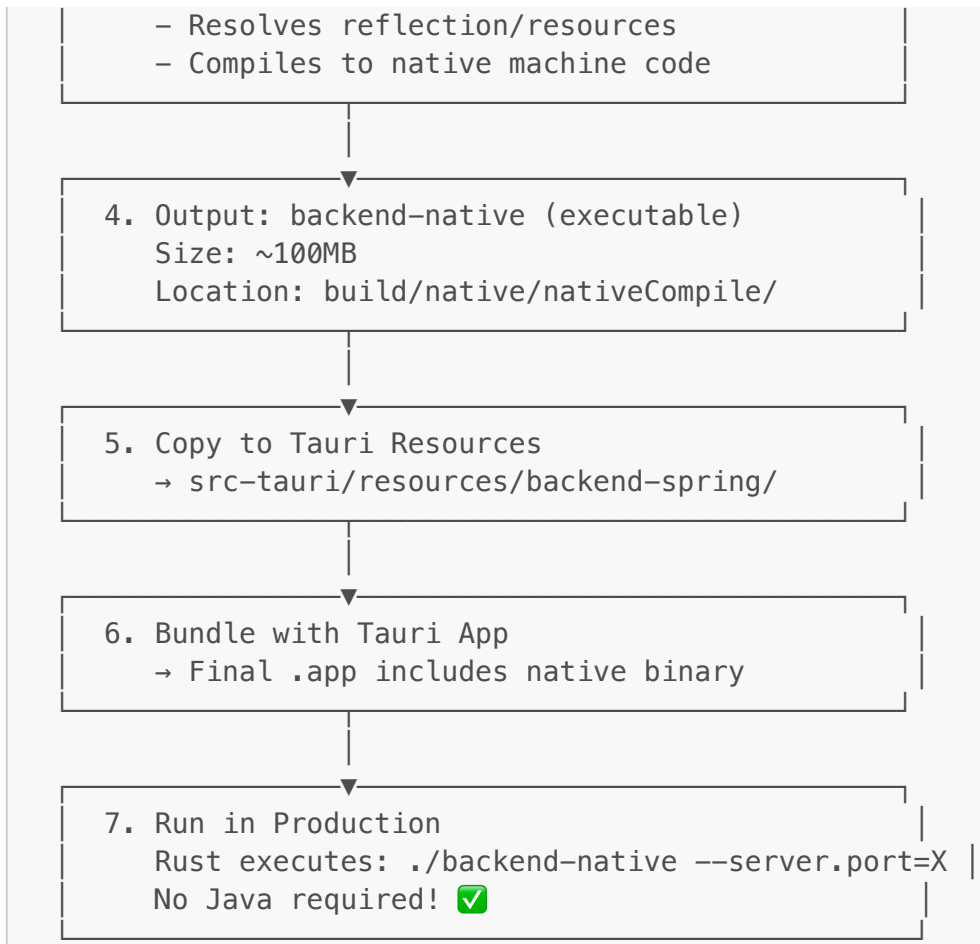
What is GraalVM Native Image?

GraalVM Native Image is an ahead-of-time (AOT) compilation technology that converts Java/Kotlin bytecode into a standalone native executable. Unlike traditional JVM applications that require a Java Runtime Environment, native images:

1. **Compile directly to machine code** - No bytecode interpretation
2. **Start instantly** - No JVM warmup time
3. **Use less memory** - No JVM overhead
4. **Are self-contained** - Everything bundled into one executable

How It Works in This Project





Configuration in `build.gradle.kts`

```
plugins {
    id("org.graalvm.buildtools.native") version "0.10.1"
}

graalvmNative {
    binaries {
        named("main") {
            imageName.set("backend-native")
            mainClass.set("com.scriptmanager.ApplicationKt")

            buildArgs.add("--verbose")
            buildArgs.add("--no-fallback")

            // Initialize common classes at build time for faster startup
            buildArgs.add("--initialize-at-build-time=org.slf4j")
            buildArgs.add("--initialize-at-build-time=ch.qos.logback")

            // Support all character sets (for database encoding)
            buildArgs.add("-H:+AddAllCharsets")

            // Enable all security services
            buildArgs.add("--enable-all-security-services")
        }
```

```
    }
}
```

Reflection Configuration

Native images need to know about classes used via reflection (common in Spring Boot). We provide hints in `reflect-config.json`:

```
// backend-spring/src/main/resources/META-INF/native-image/reflect-
config.json
[
  {
    "name": "org.sqlite.JDBC",
    "methods": [{ "name": "<init>", "parameterTypes": [] }]
  },
  {
    "name": "org.hibernate.dialect.SQLiteDialect",
    "methods": [{ "name": "<init>", "parameterTypes": [] }]
  }
  // ... more reflection hints
]
```

Executing the Native Binary in Rust

```
// src-tauri/src/lib.rs (lines 381-385)
let child = Command::new(&native_binary)  // ← Direct execution!
    .arg(format!("--server.port={}", port))
    .arg(format!("--spring.datasource.url=jdbc:sqlite:{}", db_path))
    .spawn()
    .map_err(|e| format!("Failed to start Spring Boot backend: {}", e))?;
```

This is equivalent to:

```
./backend-native \
  --server.port=7070 \
  --spring.datasource.url=jdbc:sqlite:/path/to/database.db
```

Build Output Verification

```
# Check the native binary
$ ls -lh backend-spring/build/native/nativeCompile/
-rwxr-xr-x  1 user  staff   97M Nov  2 12:34 backend-native

# Verify it's a Mach-O executable (macOS)
```

```
$ file backend-spring/build/native/nativeCompile/backend-native
backend-native: Mach-O 64-bit executable arm64

# Test it directly
$ ./backend-native --server.port=8080
# ✅ Spring Boot starts instantly (no JVM!)
```

Benefits vs Traditional JVM Deployment

Aspect	JVM (JAR + JRE)	GraalVM Native Image
Startup Time	2-5 seconds	50-200 milliseconds
Memory Usage	200-300MB	50-100MB
Bundle Size	~340MB (JRE + JAR)	~100MB (single binary)
Dependencies	Requires Java installed	Zero dependencies
Build Time	Fast (~30s)	Slower (~2-5 min)
Runtime Performance	Excellent (after warmup)	Good (no warmup needed)
Reflection Support	Automatic	Manual configuration

Key Takeaways

- ✅ **Production**: Native binary runs standalone
- ✅ **Development**: Still use `./gradlew bootRun` (fast iteration)
- ✅ **Build once**: `nativeCompile` creates platform-specific executable
- ✅ **Distribution**: Users get native app experience
- ✅ **No Java**: End users never know there's a "Java" backend

---

🎨 Key Features

1. **Folder & Script Organization**

- Create, rename, delete folders
- Create, edit, delete scripts
- Drag-and-drop reordering for both folders and scripts
- Persistent order maintained in database

2. **Script Execution**

- Double-click or click "Execute" to run scripts
- Opens in native Terminal.app (macOS)
- Preserves shell environment ($PATH, aliases, etc.)

3. **Dark Mode Support**

- System-integrated dark mode

- Toggle via menu (Cmd+Shift+D)
- Persists across sessions
- Native title bar color updates

4. **Native macOS Integration**

- Transparent title bar with traffic lights
- Custom menu bar with keyboard shortcuts
- Cmd+Q to quit, Cmd+Y for redo
- Standard text editing shortcuts

5. **Development vs Production**

- **Dev**: Fixed port (7070), manual backend start
- **Production**: Random port, automatic backend bundling
- Environment-specific database paths
- No backend startup delay in dev mode

🚀 Running the Application

Development Mode

```
# Terminal 1: Start Spring Boot backend manually
cd backend-spring
./gradlew bootRun

# Terminal 2: Start Tauri dev server
yarn tauri dev
```

Production Build

```
# Use the automated build script (recommended)
yarn bundle
```

Or manually:

```
# 1. Build Spring Boot Native Image (requires GraalVM)
cd backend-spring
./gradlew clean nativeCompile

# 2. Copy native binary to Tauri resources
mkdir -p ../src-tauri/resources/backend-spring
cp build/native/nativeCompile/backend-native ../src-
tauri/resources/backend-spring/
chmod +x ../src-tauri/resources/backend-spring/backend-native
```

```
# 3. Build frontend and Tauri app
cd ..
yarn build
yarn tauri build
```

What the Build Script Does:

```
# build-production.sh
# 1. Detects GraalVM installation and sets JAVA_HOME
# 2. Builds native image: ./gradlew clean nativeCompile
# 3. Copies backend-native to src-tauri/resources/
# 4. Builds frontend: yarn build
# 5. Builds Tauri app: yarn tauri build
```

Note: The production build uses **GraalVM Native Image** to compile the Spring Boot backend into a standalone native executable (~100MB). No JRE needed! End users do **not** need to install Java. The app is completely self-contained and starts instantly.

📦 Key Dependencies

Frontend

- `@tauri-apps/api` - Tauri JavaScript bindings
- `@reduxjs/toolkit` - State management
- `@dnd-kit/core` - Drag and drop
- `tailwindcss` - Styling
- `react-router-dom` - Routing (if needed)

Backend

- `spring-boot-starter-web` - REST API
- `spring-boot-starter-data-jpa` - Database ORM
- `sqlite-jdbc` - SQLite driver
- `hibernate-community-dialects` - SQLite dialect
- `org.graalvm.buildtools.native` (Gradle plugin) - Native image compilation

Rust

- `tauri` v2 - Desktop framework
- `serde` - JSON serialization
- `tokio` - Async runtime
- `reqwest` - HTTP client
- `prisma-client-rust` - Database client
- `rand` - Random port generation

🔐 Database Schema

```
AppState (application_state)
├── id (PRIMARY KEY)
├── last_opened_folder_id (NULLABLE)
├── dark_mode (BOOLEAN)
├── created_at
└── created_at_hk

ScriptsFolder (scripts_folder)
├── id (PRIMARY KEY)
├── name
├── order_index
├── created_at
└── created_at_hk

ShellScript (shell_script)
├── id (PRIMARY KEY)
├── name
├── command
├── order_index
├── folder_id (FOREIGN KEY → ScriptsFolder)
├── created_at
└── created_at_hk
```

Relationships:

- `ScriptsFolder` has many `ShellScript` (one-to-many)
- `ShellScript` belongs to one `ScriptsFolder` (with CASCADE delete)

🎯 Design Decisions

1. **Why Spring Boot + Rust?**
    - Spring Boot: Rich ecosystem for REST APIs and database management
    - Rust: Native performance, safe concurrency, Tauri integration
2. **Why SQLite?**
    - Embedded database (no separate server)
    - Single-file portability
    - Perfect for desktop applications
3. **Why Prisma in Rust?**
    - Type-safe database access
    - Automatic schema migrations
    - Single source of truth for schema
4. **Why RTK Query?**

- Automatic caching and invalidation
- Optimistic updates for better UX
- Reduces boilerplate vs manual fetch

5. **Why Dynamic Port in Production?**
   - Avoids port conflicts with other apps
   - Allows multiple instances if needed
   - More secure (unpredictable port)
6. **Why Use GraalVM Native Image?**
   - **Zero dependencies** - No JRE/Java required on user's system
   - **Instant startup** - Native binaries start in milliseconds (vs seconds for JVM)
   - **Smaller bundle size** - ~100MB native binary vs ~310MB JRE + 30MB JAR
   - **Lower memory footprint** - No JVM overhead
   - **Better security** - Ahead-of-time compilation, no runtime bytecode execution
   - **Self-contained** - Single executable with everything built-in

---

📝 Notes

- **Flyway removed**: Prisma manages all schema changes
- **Hibernate DDL disabled**: `ddl-auto: none` to prevent conflicts
- **Database path**: Dev uses project dir, Production uses Application Support
- **Backend lifecycle**: Managed by Rust, auto-starts in production
- **Query skipping**: Queries wait for backend port before executing
- **Error handling**: Rust uses `Result<>` to prevent panics in Objective-C context
- **GraalVM Native Image**: Spring Boot backend compiled to native executable (~100MB)
- **Native binary path**: `app.app/Contents/Resources/resources/backend-spring/backend-native`
- **No JVM required**: Native image runs directly on the OS (instant startup)
- **Build requirement**: GraalVM must be installed for `nativeCompile` (detected automatically by `build-production.sh`)

🚧 Future Enhancements

- [ ] Script templates library
- [ ] Script history/audit log
- [ ] Environment variable management per script
- [ ] Script output capture and display
- [ ] Search/filter functionality
- [ ] Import/export script collections
- [ ] Windows/Linux support
- [ ] Cloud sync (optional)

🎓 Learning Resources

Understanding the Build Process

1. What happens when you run `yarn bundle`?

- Builds Kotlin backend to native binary (`./gradlew nativeCompile`)
- Copies `backend-native` to `src-tauri/resources/`
- Builds React frontend (`yarn build`)
- Bundles everything with Tauri (`yarn tauri build`)

2. Where does Rust execute the backend?

- Location: `src-tauri/src/lib.rs`, lines 381-385
- Method: `Command::new(&native_binary)` - Direct executable invocation
- Context: Only runs in production builds (`cfg!(not(debug_assertions))`)

3. How do command-line arguments work?

```
Command::new(&native_binary)
    .arg("--server.port=7070")              // Spring property
    .arg("--spring.datasource.url=...")    // Spring property
    .spawn()                                // Launch as child process
```

These override properties in `application.yml`!

4. Development vs Production

- **Dev**: You manually start Spring Boot on port 7070 (`./gradlew bootRun`)
- **Production**: Rust automatically starts native binary on random port (10000-60000)

Generated: November 2, 2025
Last Updated: Added GraalVM Native Image documentation