

■ Sudoku Web App

A full-stack Sudoku puzzle generator and solver built with **FastAPI (Python)** and **Next.js (TypeScript)** — deployable via **AWS Amplify (frontend)** and **AWS App Runner (backend)**.

■ Features

- ■ Smart puzzle generator with adjustable difficulty
- ■■ Fast Sudoku solver using recursive backtracking
- ■ Mobile-friendly responsive UI
- ■ Modern minimalist design
- ■ REST API powered by FastAPI
- ■ Dockerized for seamless deployment
- ■■ Hosted on AWS Amplify & App Runner

■■ Project Structure

sudoku_web/

■■■ backend/

■ ■■■ src/api/main.py

■ ■■■ src/api/models.py

■ ■■■ src/api/solver.py

■ ■■■ src/api/generator.py

■ ■■■ src/api/utils.py

■ ■■■ Dockerfile

■ ■■■ requirements.txt

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■■■ frontend/

■■■ app/page.tsx

■■■ lib/api.ts

■■■ next.config.mjs

■■■ package.json

■■■ public/ / styles/

■ Backend Overview

Framework

****FastAPI**** — lightweight and async Python framework for APIs.

Algorithms

Task	Algorithm	Description
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Puzzle Generation	Randomized removal + backtracking	Ensures one valid solution
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Solving	Depth-First Search (DFS) Backtracking	Efficient recursive solver
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Validation	Pydantic model schema	Enforces 9x9 structure
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Endpoints

Method	Endpoint	Description
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GET	/health	Health check endpoint
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GET	/	Root endpoint
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POST	/generate	Generate new Sudoku puzzle
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POST	/solve	Solve given Sudoku board
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■ Frontend Overview

****Next.js (React + TypeScript)**** app that fetches puzzles and solutions from the backend.

```
```ts
```

```
export const API_BASE =
```

```
process.env.NEXT_PUBLIC_SUDOKU_BASE ||
```

```
(process.env.NODE_ENV === 'production'
```

```
? 'https://pba2vssyyd.us-east-1.awsapprunner.com'
```

```
: 'http://127.0.0.1:8000');
```

```
```
```

■ Local Development

Prerequisites

- Docker

- Node.js ≥ 18

- Python ≥ 3.10

Run Backend

```
cd backend
```

```
docker build -t sudoku-backend .
docker run --rm -e PORT=8080 -p 8080:8080 sudoku-backend
```

Run Frontend

```
cd frontend
npm install
npm run dev
```

■ AWS Deployment

- Backend via ****AWS App Runner****
- Frontend via ****AWS Amplify****
- Env vars:
- PORT=8080
- ALLOWED_ORIGINS=https://
- NEXT_PUBLIC_SUDOKU_BASE=https://

■ Tech Stack

| Layer | Technology |
|------------|------------------------------|
| Frontend | Next.js + React + TypeScript |
| Backend | FastAPI (Python) |
| Styling | CSS + Flexbox |
| Build | Docker |
| Cloud | AWS Amplify + App Runner |
| Validation | Pydantic |
| Solver | DFS Backtracking |

■ Author

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