Software Applications Development
EuroSkills 2027 National Competition
HUNGARY

Round 1

Submitted by:
Skills IT

Contents

1. Introduction

You used to work as a freelance software developer, but now you've applied for a job as a developer at a large software development company. The company's management wants to test your skills, so as part of the recruitment process, they asked you to develop prototype applications for the **GreenWind** company.

In the prototype, all you need to develop is an **import script**, a map view and a **small simulation service**. The simulation service helps wind turbine planners plan the proper layout of wind turbines in an area.

Your API must use a JSON Server stable version (v0.17.4) as its data provider.

Your UI has to use the provided images/icons for visualization.

Finally you have to create a short **demo video** to show your presentation skills.

1.1 Description of project and tasks

Your task is divided into four parts.

1. In the first part, you will develop a script to import maps.
2. In the second part, you will develop a map view.
3. In the third part, you will extend the map view with a basic simulation service.
4. In the fourth part, you have to create a demo video.

1.2 Database

1. Use the **`database.json`** from the assets folder
2. Run JSON Server (port 3000): **`json-server database.json`**

Projects:

Field Name	Data Type	Description
id	`string` (UUID)	Unique identifier for each project.
name	`string`	The name of the map.
mapData	`string (base64)`	The image data of the map in base64 format.
cells	`Cell (array)`	The cell list representing the map.

Cells:

Field Name	Data Type	Description
x	`number`	The x (horizontal) coordinate.
y	`number`	The y (vertical) coordinate.
type	`string`	The type of the cell. (Valid values are: Grass, Lake, Mountain)
hasTurbine	`boolean`	Whether there is a turbine in the cell or not.

1.3 How to submit your work

1. You have to share your work in a private GitHub repo as described in the README file of the test project GitHub repo (https://github.com/skillsit-hu/es2027-s09-hu-r1).
2. Share a link with us in email (es2027s09@skillsit.hu) from where we can download the executable files and code to test your solutions.
3. Your **README** file has to contain instructions on how to start your backend and frontend. We prefer you provide executable files or a built/deployed solution.
4. You must also provide us with a filled out version of the **AI Statement** that's been provided for you in the assets folder.

2. Part 1 – Import script

2.1 Command Line Tool

Create a command-line application that can read a folder and import it into the json-server.

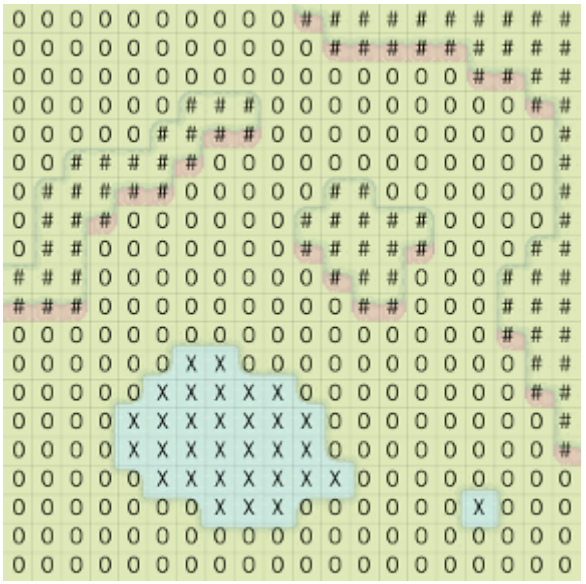
2.2 Import

A Wind Park Project is represented by a folder containing two required files:

- **map.png**: visual representation of the map
- **map.txt**: machine-readable version of the map

If any of these files are missing, an appropriate error message should be displayed. However, there is no need to validate the contents of the files – if they are present, they can be assumed to be correct.

Each map consists of a grid of 20 × 20 cells. map.txt is an ASCII art representation of this grid. For example, the map named Mariager looks like this:



Each character corresponds to one grid cell:

- O: Grass
- X: Lake
- #: Mountain

You must save the file to the **json-server** after transforming the data to the required format specified above. **The name of the project should be the name of the folder**.

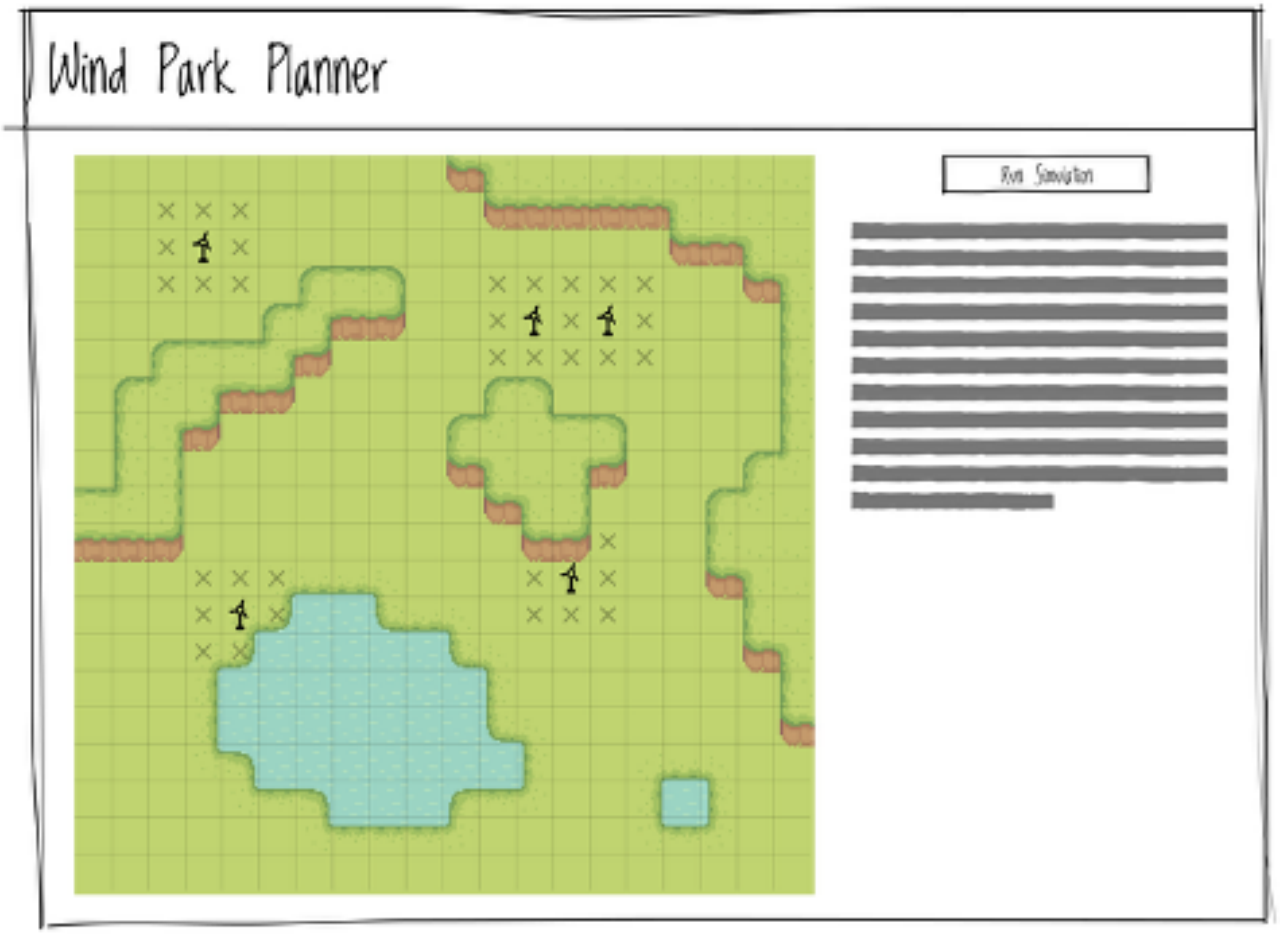
3. Part 2 – UI

In this section, you need to create a web-based map view.

3.1 Map view

Design and develop a UI to show off previously imported project maps. The user should be able to intuitively select one of their previously imported projects.

Once a project is selected, a map of the project area should be displayed (map.png), overlaid with lines of the grid: 19 vertical and 19 horizontal lines, forming the 20 × 20 cells.



3.2 Turbine placement

You **must implement** a custom REST API to place and remove wind turbines from a specific project by the user.

Users should now be able to place wind turbines on the map in grid cells:

- Each cell can contain zero or one wind turbine.
- Wind turbines can only be placed on grass, not on lakes or mountains.
- Wind turbines may not be placed directly next to each other (including diagonally) – there must be at least one empty cell between two wind turbines. Grass cells in this “exclusion zone” around a wind turbine should be marked with the provided icon (as shown in the first wireframe).

Once placed, a wind turbine should be represented by its corresponding image within the cell. Users should also have the option to remove any previously placed wind turbine.

The changes made should be persisted in the json-server and should automatically show-up when reloading the page.

4. Part 3 – Simulation

In this section, you have to extend the map view with a simple simulation.

The performance of each wind turbine is influenced by environmental factors such as wind patterns, terrain (e.g., mountains), and proximity to water bodies like lakes.

The colour of a turbine is determined by its power/energy output: The turbine with the worst output is shown in red, the turbine with the best output is shown in green, and the remaining turbines get an interpolated colour. If there's only one turbine, or all produce the same output, show them in green.

Further, each cell should contain an arrow that represents the average wind speed and direction for the selected period.

The user should be able to specify the following attributes for the simulation:

- Wind direction (North, East, South, West)
- Wind speed - The wind speed is limited to a range of 0 to 40 m/s.

Users should be able to click on any individual wind turbine to view the power output and applied environmental modifiers (value and reason; see the algorithm below for an overview of environmental modifiers).

4.1 Wind modifiers

After selecting a wind direction from that point, trace the wind from the edge (meaning selecting North you should go from top to bottom).

Apply modifiers:

- +20 % wind speed for turbines within 2 cells downwind of lakes
- −30 % wind speed for turbines within 5 cells downwind of mountains
- −15 % wind speed for turbines in the wake zone (3 cells downwind of another turbine)
- For wind turbines close to the map's edge, you can assume that everything outside the provided map is grass without a turbine on it.

If multiple modifiers apply to a turbine, the percentages are summed.

For example:

- If a turbine is placed downwind of a mountain, it will have –30 % wind speed.
- If we then place another turbine 2 cells behind it, it will get –30 % from the mountain and –15 % because it is in the wake zone of the first turbine, resulting in –45 % wind speed.

4.2 Wind speed

For each turbine calculate the wind speed using the applied modifiers.

4.3 Estimate power output

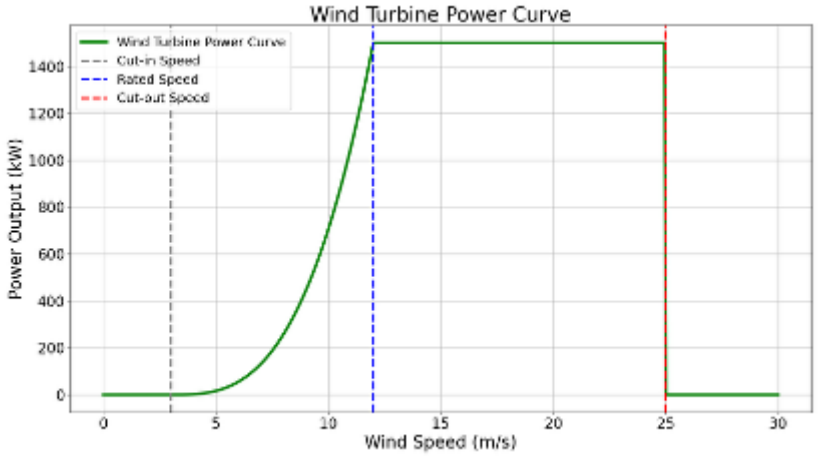
Let:

$$
\begin{aligned}
v &= \text{wind speed (m/s)} \\
v_{\text{cut-in}} &= 3\,\text{m/s} \\
v_{\text{rated}} &= 12\,\text{m/s} \\
v_{\text{cut-out}} &= 25\,\text{m/s} \\
P_{\text{rated}} &= 1500\,\text{kW} \quad \text{(max power)}
\end{aligned}
$$

Then the power curve is:

$$
P(v) = \begin{cases}
0 & \text{if } v < v_{\text{cut-in}} \\
P_{\text{rated}} \cdot \left(\frac{v - v_{\text{cut-in}}}{v_{\text{rated}} - v_{\text{cut-in}}} \right)^3 & \text{if } v_{\text{cut-in}} \le v < v_{\text{rated}} \\
P_{\text{rated}} & \text{if } v_{\text{rated}} \le v < v_{\text{cut-out}} \\
0 & \text{if } v \ge v_{\text{cut-out}}
\end{cases}
$$

Note: The $\left(\frac{v - v_{\text{cut-in}}}{v_{\text{rated}} - v_{\text{cut-in}}} \right)^3$ part models the **cubic increase** in power with wind speed (a physical approximation).



You should show off the details of the project, the number of wind turbines placed and the total generated power (in kW).

5. Part 4 – Demo video

Create a demo video showcasing the completed solution. The video should include the following sections:

- Import process
- Map view
- Simulation, calculation and all the different features of the simulation (like coloring, hovering on a wind turbine etc.)

Make the demo video available to us through a video-sharing platform.

6. Additional information

- Some media, icons and text have been provided for you in the media files. You are free to use these, but you can also create your own, as long as the application is still fit for purpose. **You should not use any other media files (e.g. downloaded videos, images, icons, etc.)**.
- Clean code and user interface accessibility are also important considerations.
- Do not hardcode API responses as another database will be used for testing.