Algorithm

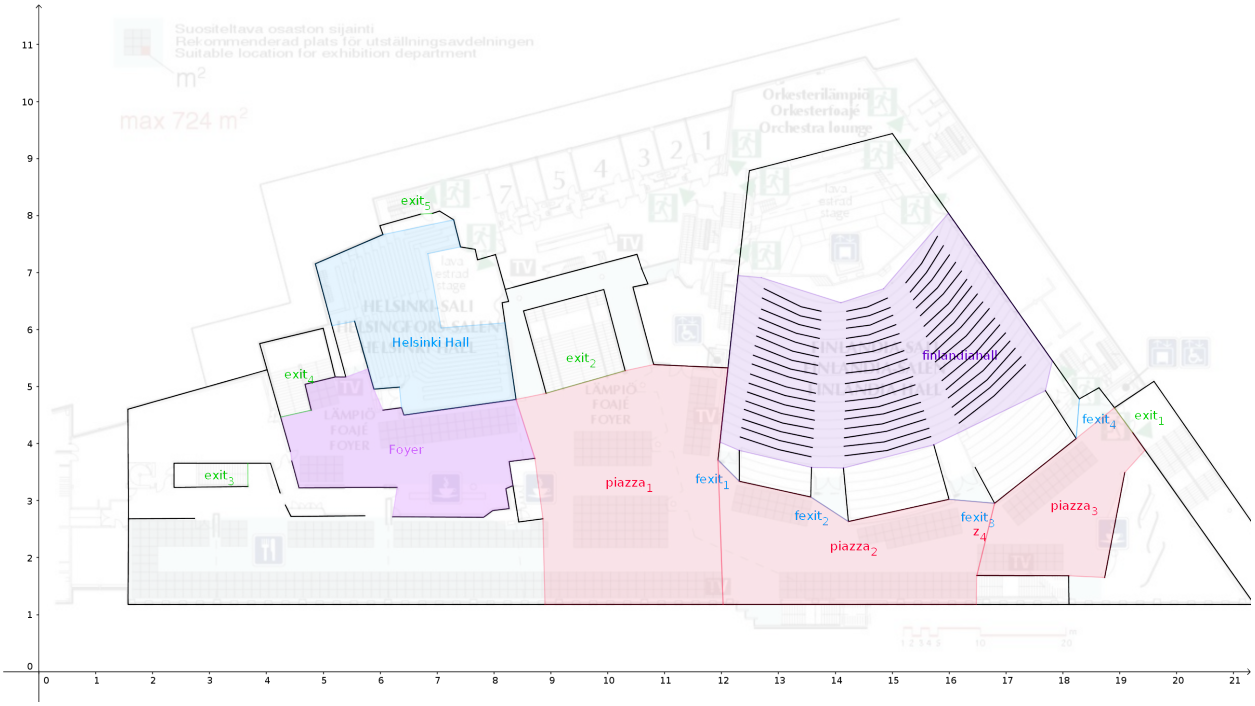

Figure 1: *Finlandia Talo*

Description

Genetic algorithm for optimizing the evacuation time of crowd of people by placing leaders into the area S.

Input

Initial values

- k leaders.
- m different non-empty disjoint regions from the area S. We denote individual region by its index $i \in \{1, ..., m\}$.
- Population of size of n (simulations per generation).

Total number of combinations of placements of k leaders into m regions.

$$\binom{m}{k}, \quad m \geq k$$

Each leader is also assigned a target that is one of the exits

$$Targets = \{exit_i \mid i \ \in \{1, 5\}\}$$

Output

Egress time distribution function

- x-axis: Unit of time
- y-axis: Number of agents that have reached the exit

$$\frac{\text{number of agents that have reached the exit}}{\text{unit of time}}$$

Genetic algorithm

- **Individual**: Each suggested solution for a genetic algorithm. *Each individual consists k number of $(region, target)$ tuples. Because leaders are indentical order does not matter.*

$$I = \{(region, target)_1, ..., (region, target)_k\}$$

- **Population**: The collection of unique individuals.

$$P = \{I_1, ..., I_n\}, \quad I_i \neq I_j$$

- **Fitness function**: Measure of how effective each solution (individual) is. *Some function that depends on the cumulative distribution of the egress times of agents. e.g minimize evacuation time of 95% (to avoid pollution from outliers) of the agents.*
- **Grade**: Population's average fitness.

Evolution of population. Advances one **generation** to the next one closer to optimal solution defined by the fitness function. Each cycle consists of

1) **Selection**: Take a portion of best performing individuals. Also randomly select lesser performing individuals for genetic diversity.
2) **Breeding**: Breed together parents to repopulate the population to its desired size.

   TODO ???
3) **New population**: Merge together the parents and children to constitute the next generation's population.
4) **Random mutation**: Finally we mutate a small random portion of the population. What this means is to have a probability of randomly modifying each individual. *Change the region where some leader is places of an random individual.*

where the **parameters** are

- Percentage of best performing individual to retain into new generation.

$$p_{retain} \in [0, 1]$$

- Change of random selection of lesser performing individual.

$$p_{selection} \in [0, 1]$$

- Change of mutation.

$$p_{mutation} \in [0, 1]$$

Implementation Notes

- Simulation exit condition depends on the chosen fitness function
- Memoize the values generated by simulation configurations