



**Big City**



# Modeling of small-scale spatial events

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# Small-scale spatial events

“The events we have in mind are those in which **large numbers** of agents are present, where the focus of interest is mainly on the attraction and not on the interaction between agents.”

Batty M., DeSyllas J., Duxbury E. The discrete dynamics of small-scale spatial events: agent-based models of mobility in carnivals and festivals

# The motivating example: science, art, expo and...

Geek Picnic - the biggest **science, technology** and **art** festival in



Geek Picnic 2015 in Saint P  
**2** days, **30 000** people

**Lectures** with fixed schedule

All-day **points of interest**

**Expo** and **market**

**Food** court



# The motivating example: queues!

“More than **3000 people** are not able to

“At the entrance to the park there was q

“Many stood **unsuccessfully** for over a

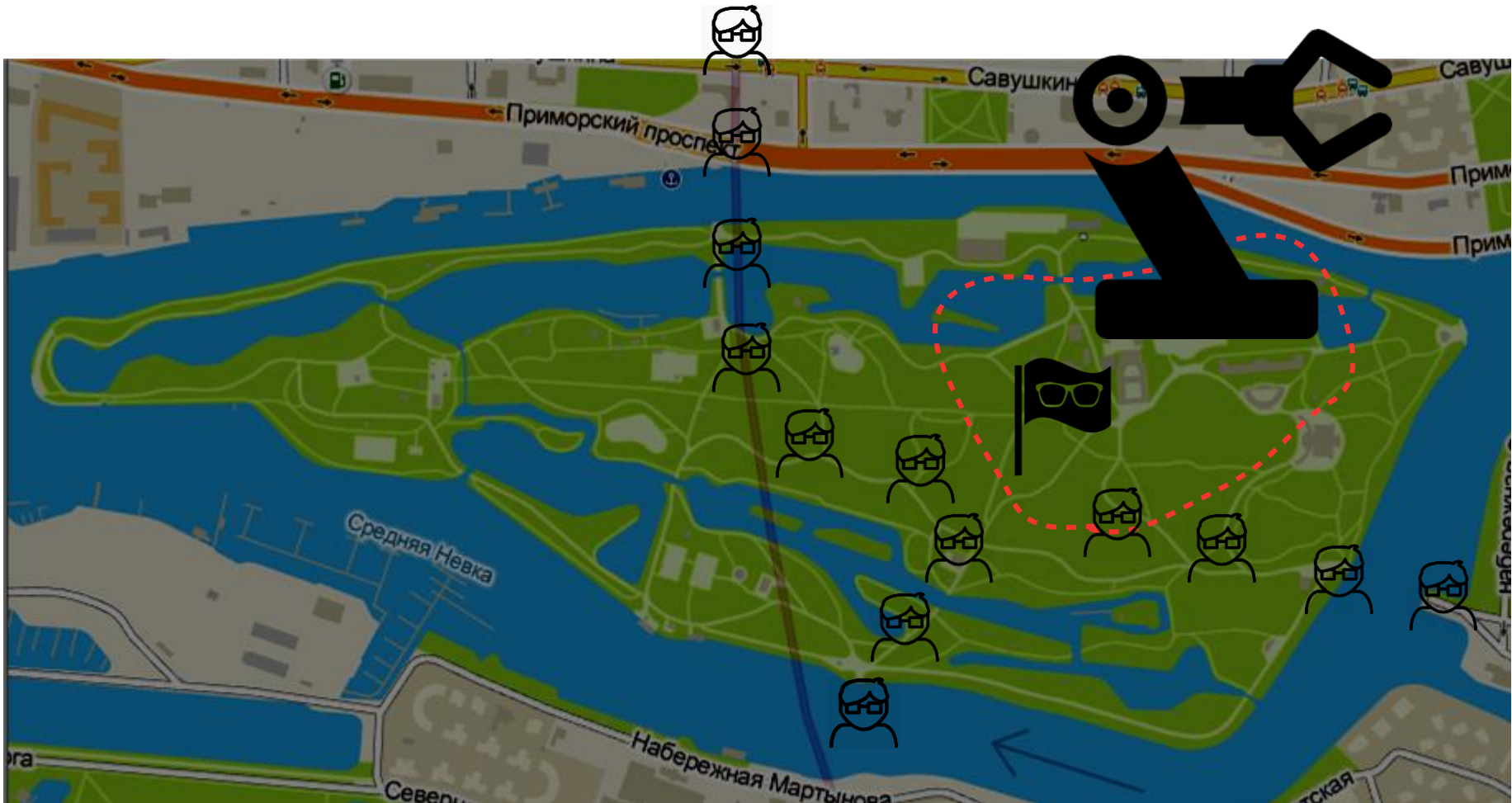
“**The main thing to do for the next year**





# Outside queues

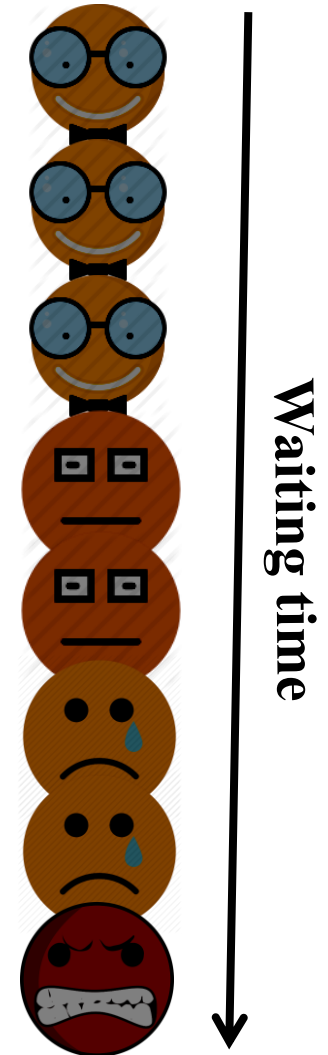
◆ Staraya derevnya



◆ Krestovskiy ostrov

YSC 2015, Athens, Greece

# Inside queues





# Problem statement

## I. Planning of the event

The goal: to find the **placement of entrances** to the event and p

## II. Management of the event

### a. **Personalized support** via mobile application

The goal: to provide the **personal recommendations** to the visi

### b. **Managerial support** (for organizers).

The goal: to control the queues



# Literature Research

## 1. Crowd modeling

- *Flow-based Approach*: models a crowd as continuous flow of fluid.
- *Entity-based Approach*: Individuals are modeled as a set of homogeneous entities.
- *Agent-based Approach*: models each individual in a crowd as an intelligent and autonomous agent, which

## 2. Pedestrian Modeling (prediction of pedestrian motion to assess potential safety hazards and operational performance)

- *Models Based on Continuum Theory*: formulation of PDEs for “pedestrian flow”.
- *Models Based on Cellular Automata*: pedestrians can only be located on the (finite number of) points of a grid.
- *Models Based on Newtonian Dynamics*: each pedestrian is treated as a mechanical object subjected to forces.

## 3. Small-scale spatial events (situations in which elements or objects vary in such a way that temporal dynamics are dominated by local interactions)

- *Movement Dynamics*: agents modeled in terms of their mobility characteristics. Spatial models at any scale.





# Literature Research

## 4. Emergency Modeling (The most widely accepted approach in the emergency evacuation research simulation)

- *Reflective middleware*: multi-level emergency simulator capable of reproducing the interaction of such factors
- *Filippoupolitis et al*: integration of the models representing the physical space of a tall building, fire hazard

## 5. Queuing Theory

- Infinite population model, Unlimited capacity, One server per queue.
- Random arrivals (proposed: scheduled arrivals when buying e-ticket).
- Queue behavior: Balk, Renege. No Jockey (move from one line to a shorter line).
- Queue discipline: First-in-first-out (FIFO).

## 6. Personalized Decision Support

- Lots of options (points of interests) to see – Guidance to find attraction with smaller queue.
- *J. Li and Y. Feng, XML Schema*: user preference is applied to product searching process and is used to
- *Fuzzy Decision Making Systems (FDMS)*: applies the architecture concept of Service Oriented Architect

# Agents description

## Agent properties:

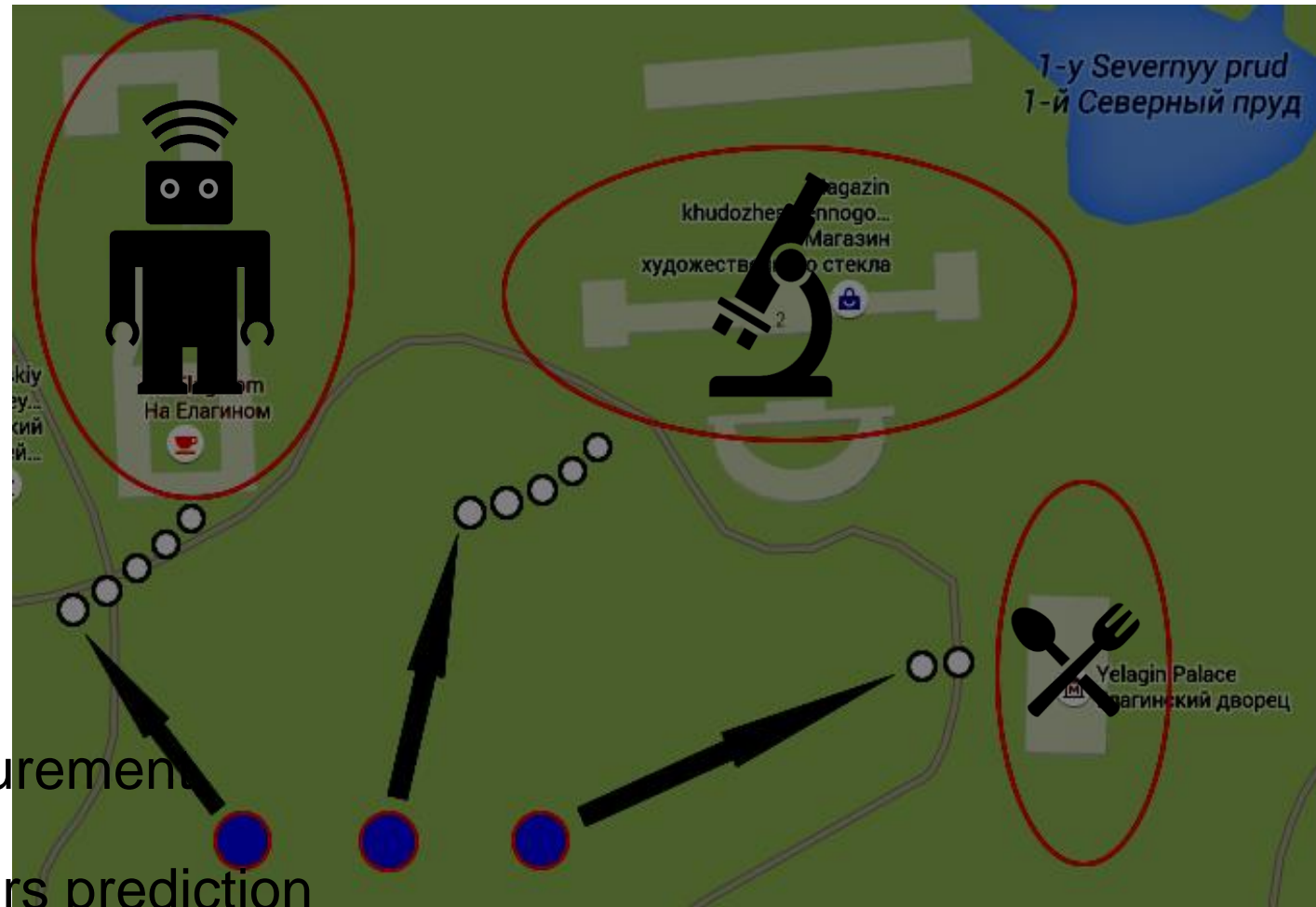
- current position
- nearest point of interest
- current level of patience
- physical stamina
- performed and scheduled activities
- personality type



# Personalized decision support

## Rules:

- agents' preferences
- length of queues
- service time
- measure of interest
- tracking people
- GPS patience measurement
- total number of visitors prediction





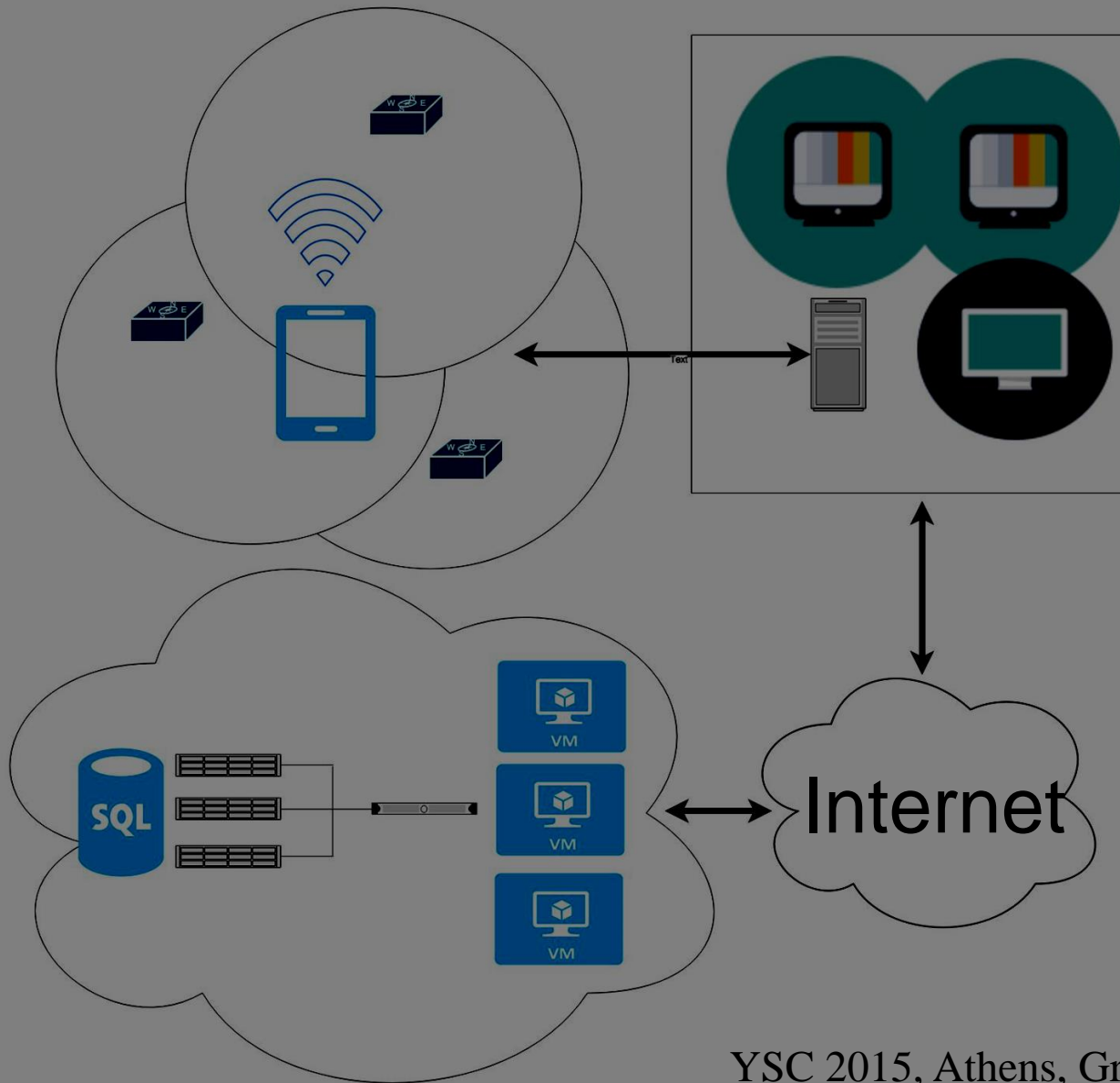
# Mobile application



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# System architecture



- AnyLogic
- Mobile application
- Router software
- Virtual Machine
- Cloud services
- Presentation



# Timeline

## Duration

- 1 year overall (3 months for each part and 2 months for testing)

## Team requirements

- Software Engineer, Specialist in queuing theory, Data analyst (st



# Desired outcomes

The approach to **reduce the queues** in **small-scale spatial events**

1. **planning** of location of entrances and points of interest
2. real-time **personal recommendation** service
3. **managerial support** (accumulation of detailed statistics for future events)

Further directions:

The technique of short-time deployment of public events support