Distributed implementation of a heterogeneous simulation of urban road traffic

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Outline

- Model of the system
- Implementation
- Conclusion

Models

- Microscopic
- Mesoscopic
- Macroscopic

The model of the system

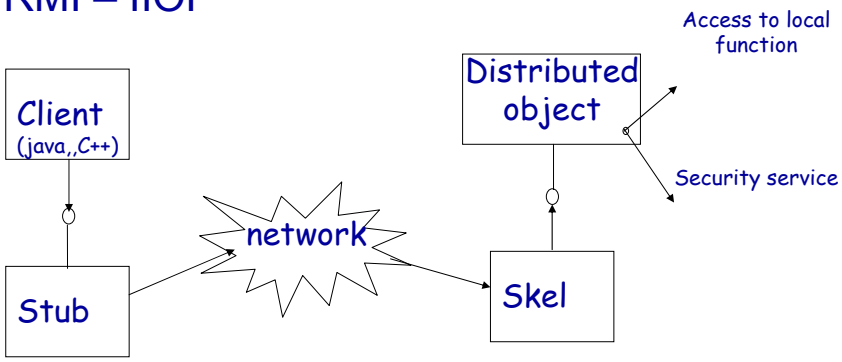
- Streets
  - Short segments
  - Long segments
- Intersections
  - Controlled
  - Uncontrolled
- Building the list with all the segments
  - nameSeg→{nope}, →{nameNextSeg}
  - nameSeg→{nameSeg1, nameSeg2, nameSeg3}
- Connection between two segments

Distributed and concurrent application

- Concurrent application
  - extends the *Thread* class
- Client / server
  - Socket
  - RMI – IIOP

Distributed programming

- Address of the computer
  - IP_Address:port 193.226.6.116:2000
- RMI – IIOP



Events

- Update clock
- Generate events
- Managing the event list

time: event: no. of events

Ex: 14.34: changing the color: 1
16.23: car#1 enter on the segment: 1
16.23: car#X exit from the segment: 2

Map of the system

- .Txt file
- Short segment

type: Name: No. of lane: capacity: length: direction: traffic light: max. speed: left

type: Name: No. of lane: length: traffic light: right neighbor: probability: parking area

type: Name: No. of streets: Name Str1,type of the street, name of the segment, probability, name of the segment, probability, name of the segment, probability: priority: …

1: CRS6: 4: Str1,2,Lane13,Lane14,Lane15,0.4,Lane19,0.3,Lane18,0.3: 1: Str2,2, Lane17,Lane18,Lane14,0.4,Lane15,0.3,Lane19,0.3:0:Str3,2,Lane20,Lane19, Lane18,0.4,Lane14,0.3,Lane15,0.3: 1: Str4,2,Lane16, Lane15, Lane19, 0.4,Lane18, 0.3,Lane14,0.3: 0

The initial state of the system

- .txt file

Name of the segment: no. of cars: speed

(time to pass the segment)

- Ex:

  Lane1: 3: 1.440

  Lane12: 0: 1.152

GUI

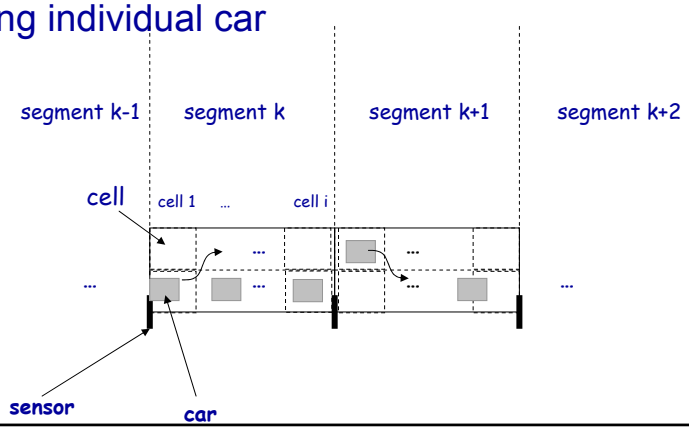
- Events list
- State of the system
- Changing the time of the traffic light
- Map of the system

Short segment

- Characteristics

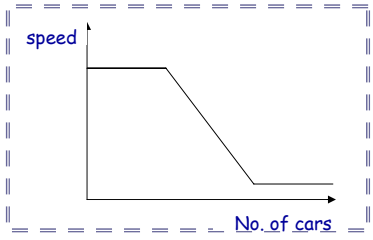
  length, no. of lanes, capacity, traffic light, sensors, next segment

- Tracking individual car



Short Segment – variables

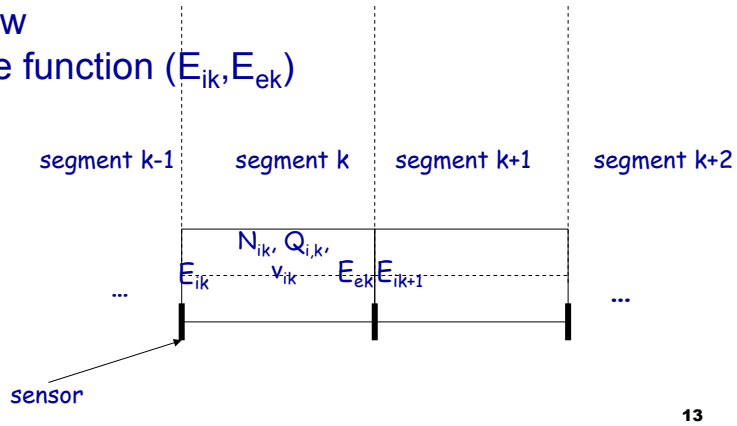
- Speed
  - no. of cars
  - speed limit
- No. of cars



Long Segment

- Characteristics

  length, no. of lanes, capacity, traffic light, sensors, next segment
- Traffic flow
- Exchange function (E_{ik},E_{ek})



Long Segment - variables

- Xi,k+1 = fi(xi,k)

  xi1,k = (Ni,k, vi,k) – state vector

  Ni,k – no. of cars

  vi,k – speed

- Nik = prev. value

- Evolution of Nik:

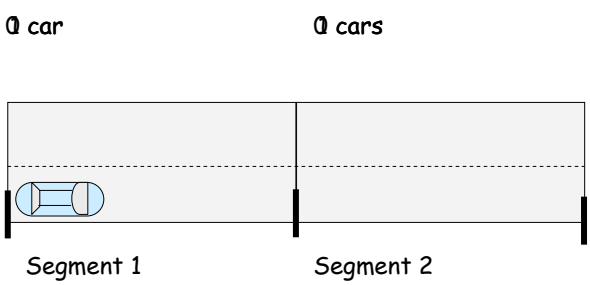
  Nik+1 = Nik + Qi-1,k - Qi,k

- Qi,k = min (Eik , Eek) – no. of cars which actually are succeeding to cross the boundary

Connection between two segments

- Short segment
  - Short segment
  - Long segment
- Long segment
  - Long segment
  - Short segment

short segment – short segment

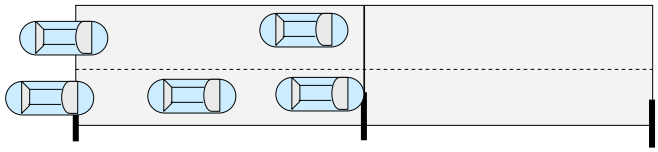


short segment – long segment

After deltaT

0 cars

New value N_i **cars**



- Long segment – long segment
- Long segment – short segment

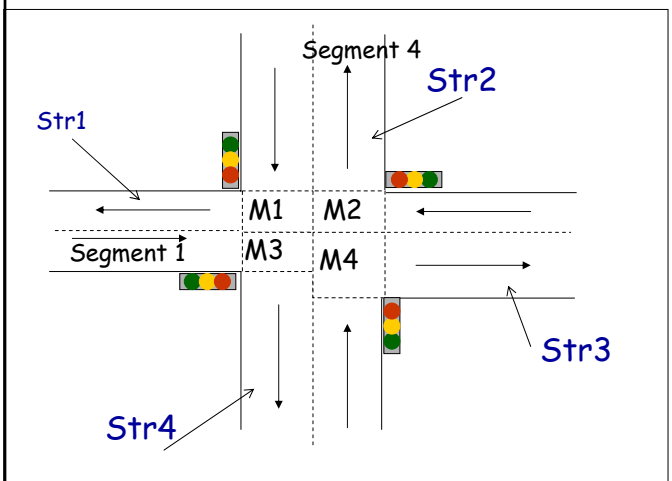
  Generate random numbers

Intersection

- Types:
  - Controlled (traffic light)
  - Uncontrolled
- Model
- Driving a car inside of the intersection

Intersection

Str1→Segment1, Segment2
Str2→Segment3, Segment4
Str3→Segment5, Segment6
Str4→Segment7, Segment8



Segment1 = 1 lane;
…
Segment4 = 2 lanes;
Segment5 = 1 lane;
…
Segment8 = 2 lanes;

M1, M2, M3, M4 – matrix M_x(no lane Seg X no lane Seg)

M2 =no_lanes.(Segment 5) x no_lanes.(Segment 4) = 1 x 2

M3 =no_lanes.(Segment 1) x no_lanes.(Segment 8) = 1 x 2

Distributed clients

- Update the clock (the event list)
- Send cars to the neighboring simulator clients
- Send result to the master server

Conclusion and future works

- Heterogeneous simulator for urban area
- Connecting application written in different programming languages (for analysis and control)

Conclusion and future works

- Control of the road traffic
- Traffic estimation
- Information for drivers

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