

# The Boston Public School Challenge

Yu Liu,  
Akash Chidananda Murthy,  
George Karmelich

**\$100-120M** each year

BPS spends about \$100-120M each year just for transportation which is a whole 10% of their annual budget

# The challenge !!!

- Boston public school is committed to providing free of cost transportation facility to its students.
- BPS spends about \$100-120M each year just for transportation which is a whole 10% of their annual budget
- The transportation cost per pupil is second highest in the nation.
- Routing done manually.

# Client Benefits

## Before:

- Might not be the shortest path
- Manually calculating the route
- Hard to make change to current scenario

## After:

- Calculate route automatically
- Considering both cost-efficient factor and school preferences
- Flexible in add/delete data input for future

# Scenario

- Cost Efficient System
- Maximizing Satisfaction
- Your proposed optimal solution

# Cost Efficient System

- Schedule start times for schools, considering factors such as total number of students in the bus, time taken for travel, etc.
- Assign bell times to school based on the bus-stops nearby.
- Group schools and stops based on location.
- Main focus on reducing deadhead time.
- Greedy approach for selecting stops.

# The outcome

- Reduce the number of buses used.
- Reduce deadhead time.
- Bell times padded with extra cushion time.
- Automated routing.

From : Boston College Campus

Start Time 07:30:00.000

\*\* SAVIN HILL AVE@SYDNEY ST@S SYDNEY ST

\*\* MASSACHUSETTS AVE@PIERSON ST

\*\* MASSACHUSETTS AVE@TREMONT ST

\*\* MASSACHUSETTS AVE@SHAWMUT AVE

To : Boston Collegiate

End Time 07:53:30.000

New BellTime 08:08:30.000

From : Boston Collegiate

Start Time 08:30:00.000

\*\* COLUMBIA RD@POND ST

\*\* 10 Elder St

\*\* COLUMBIA RD @ ANNABELLE ST

\*\* MASSACHUSETTS AVE@TREMONT ST

To : Clap ES

End Time 08:56:57.000

New BellTime 09:11:57.000

# Max Satisfaction System

1. Throw out schools with non-adjustable start times
2. Merge school data among family of schools
3. Preference weighting:
  - Family -  $\frac{2}{3}$
  - Other + Teacher -  $\frac{1}{3}$
4. Account for small sample size
5. Weight each school's preference data by enrollment size
6. Calculate weighted average across the system



# Client Benefits

## Before:

- Satisfaction scores not accounted for in current bell times

## After:

- Calculate satisfaction scores at school and system level
- Reads data from excel file for easy, familiar use
- Platform that can be quickly scaled for increased functionality

# The outcome

- Obtained solution to make everyone happy.
- Increases cost beyond feasibility.

See bell time table

school address: 18 Croftland Ave Boston MA 02124  
time: 07:00:00.000

school address: 1669 Dorchester Ave Boston MA 02124  
time: 08:20:45.000

school address: 1 Worrell St Dorchester MA 02122  
time: 07:00:00.000

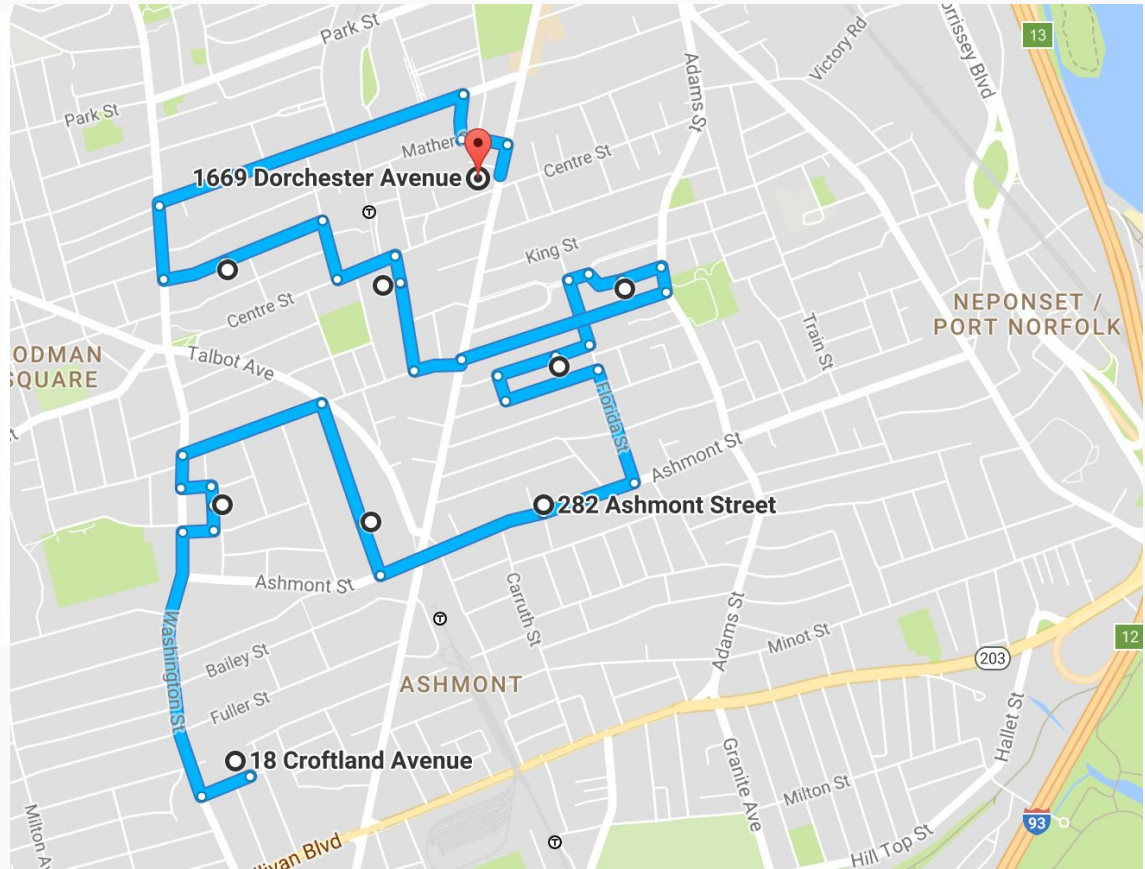
school address: 1 Parish St Dorchester MA 02122  
time: 08:18:27.000

school address: 85 Olney St Dorchester MA 02121  
time: 07:00:00.000

school address: 40 School St Boston MA 02124  
time: 08:14:52.000

# The outcome

- Obtained solution to make everyone happy.
- Increases cost beyond feasibility.



# Next Steps

- Refactor code
- Rigorous system testing
- Increase Functionality
  - Reduce excel legwork
  - Combine with low cost algorithm to reach optimum result
  - Combine with routing solution

# Teamwork

BT board

All sprints Switch sprint ▾

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Board ▾

To Do	In Progress	Done
<div>✓ <b>BT-27</b> <span>DONE</span> 1 sub-task Implement two algorithms into prototype</div> <div></div>		<div><div>BT-34</div><div>↑ Design prototype of the cost effective algorithm</div><div></div></div>
<div>▼ Other Issues 30 issues</div> <div></div>	<div><div>✓ <b>BT-5</b></div><div>↑ Mathematical formulation for routing/bell time</div><div></div></div> <div><div>BT-17</div><div>↑ Satisfaction Algorithm</div><div></div></div>	<div><div>✓ <b>BT-7</b></div><div>↑ Read in the student data - which students go to which schools? which students go to which bus stop?</div><div></div></div> <div><div>✓ <b>BT-10</b></div><div>↑ Finalize data model (objects) for stops and school</div><div></div></div> <div><div>✓ <b>BT-2</b></div><div>↑ Learn application of Google Maps API</div><div></div></div> <div><div>✓ <b>BT-3</b></div><div>↑ Learn application of Google Maps API</div><div></div></div>

BT board

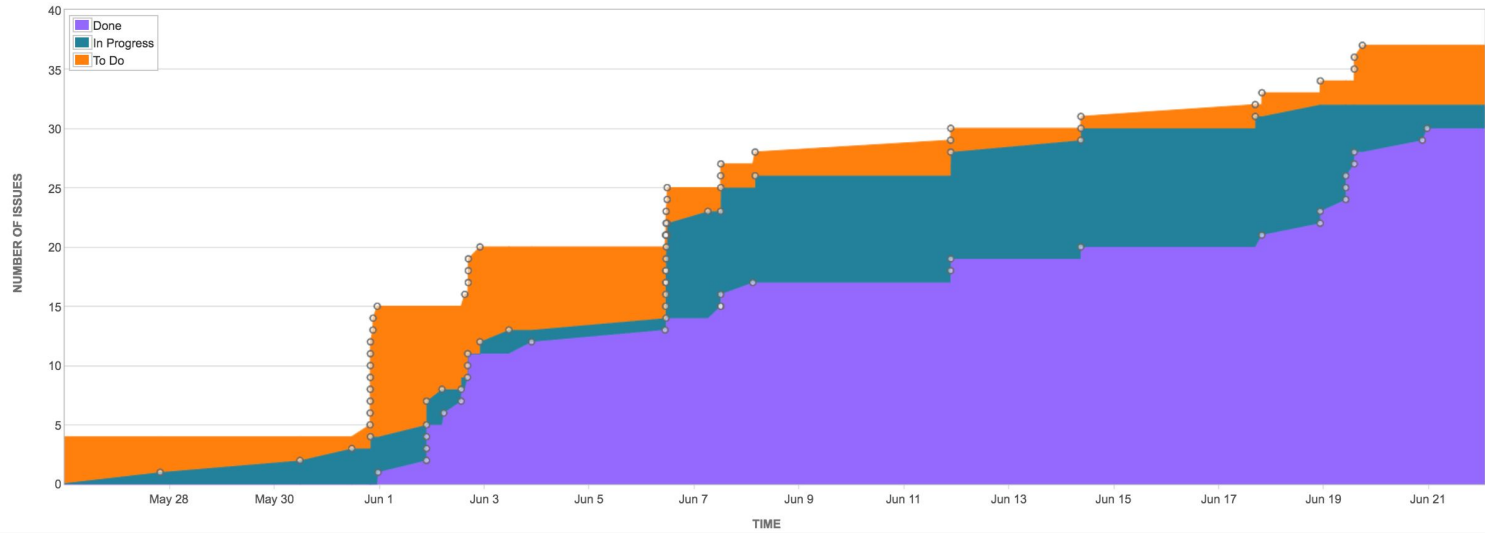
## Cumulative Flow Diagram [Switch report](#)

Board



25/May/17 to 21/Jun/17 (All Time)

[Refine report](#)



Cumulative Flow Diagram

Element	Class, %	Method, %	Line, %
antlr.preprocessor			
app	100% (0/0)	100% (0/0)	100% (0/0)
app.database	100% (0/0)	100% (0/0)	100% (0/0)
app.exceptions	100% (4/4)	100% (5/5)	100% (10/10)
app.io	100% (0/0)	100% (0/0)	100% (0/0)
app.io.input	28% (2/7)	23% (3/13)	27% (77/282)
app.io.output	100% (0/0)	100% (0/0)	100% (0/0)
app.maps	100% (0/0)	100% (0/0)	100% (0/0)
app.maps.cache	100% (1/1)	100% (7/7)	100% (19/19)
app.maps.data	66% (2/3)	100% (22/22)	100% (60/60)
app.maps.google	100% (2/2)	66% (8/12)	65% (43/66)
app.model	100% (0/0)	100% (0/0)	100% (0/0)
app.model.bus	100% (1/1)	100% (4/4)	100% (26/26)
app.model.iterator	100% (0/0)	100% (0/0)	100% (0/0)
app.model.route	100% (1/1)	75% (6/8)	83% (46/55)
app.model.route.trip	100% (1/1)	100% (7/7)	95% (21/22)
app.model.school	75% (9/12)	82% (61/74)	75% (166/220)
app.model.school.time	100% (2/2)	91% (11/12)	93% (28/30)
app.model.stop	100% (0/0)	100% (0/0)	100% (0/0)
app.model.stop.bus	100% (2/2)	72% (13/18)	75% (31/41)
app.model.stop.busyard	100% (1/1)	100% (3/3)	100% (5/5)
app.model.student	100% (1/1)	100% (3/3)	100% (7/7)
app.serialization	100% (8/8)	92% (46/50)	90% (75/83)
app.service	0% (0/4)	0% (0/9)	0% (0/68)
com			
com.google			
com.google.gson			
com.google.gson.annotations			
com.google.gson.internal			
com.google.gson.internal.bind			
com.google.gson.reflect			
com.google.gson.stream			
com.google.maps			
com.google.maps.errors			
com.google.maps.internal			
com.google.maps.model			
com.microsoft			
com.microsoft.schemas			
com.microsoft.schemas.office			
com.microsoft.schemas.office.x2006			
com.microsoft.schemas.office.x2006.encryption			
com.microsoft.schemas.office.x2006.encryption.impl			
com.microsoft.schemas.office.x2006.keyEncryptor			
com.microsoft.schemas.office.x2006.keyEncryptor.certifi...			
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com.oracle			
com.oracle.deploy			

# Tech&Tools



**Jenkins**





# Pain Points:

- Scheduling
- GitHub
- Planning for integration

Thanks!

