Traffic at UMD

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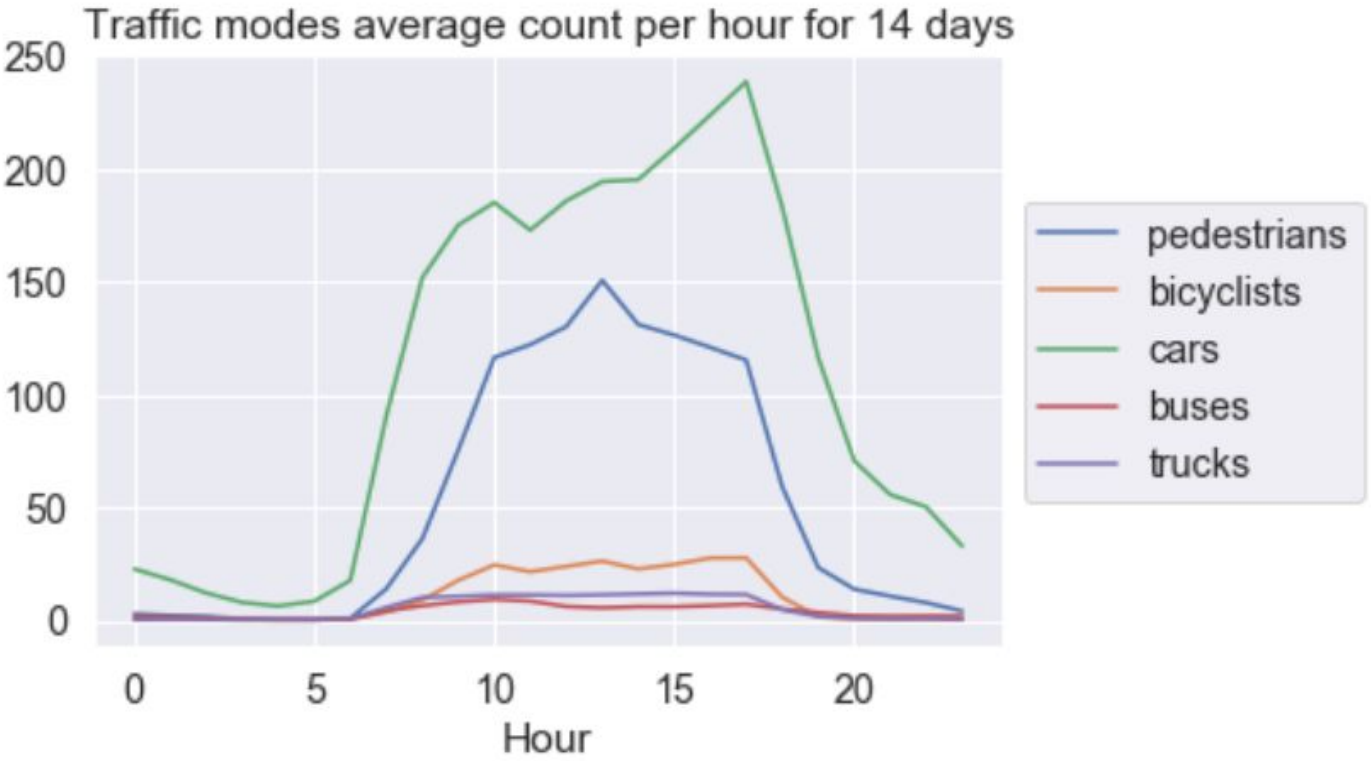
Agenda

1. Background
2. Visualization: Problem disclosure
3. Inferential model: Dynamic analysis
4. Predictive model
5. Suggestion & Conclusion

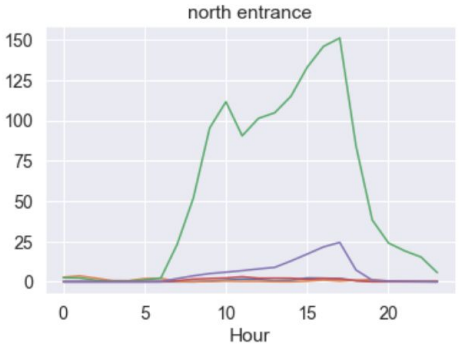
Background

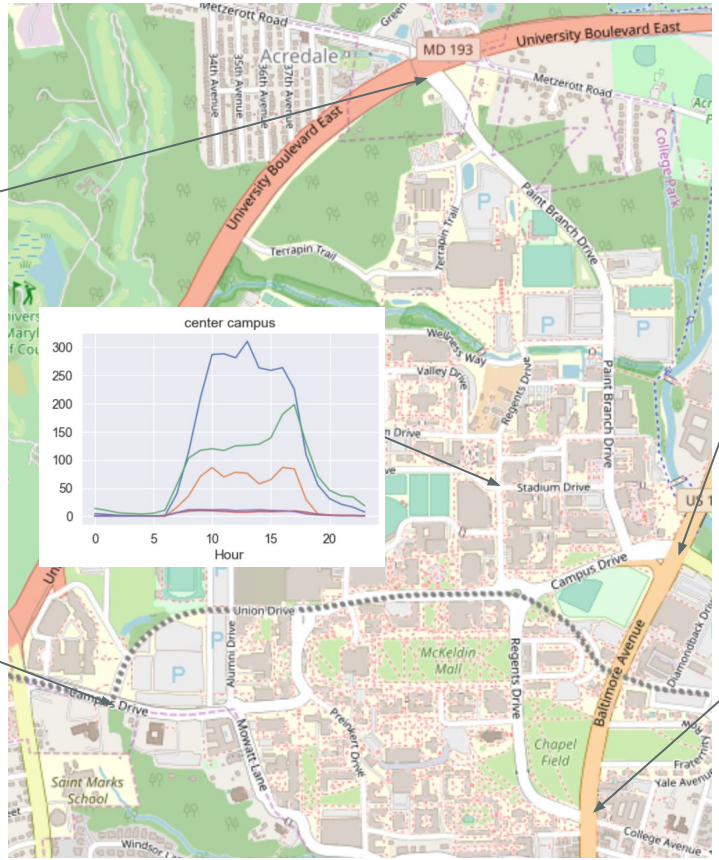
- Discover and solve traffic imbalance on campus by analyzing data gathered from sensors in 5 locations
- Set time interval from 15-min to 1-hour
- Aggregate data to 5 locations instead of 10 sensors

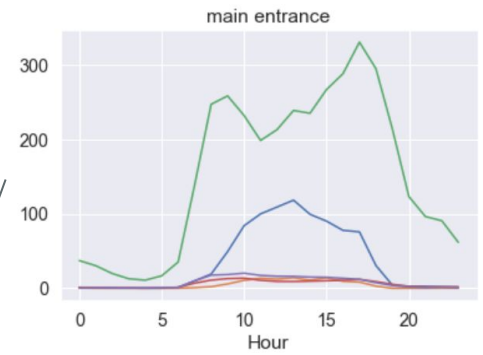
Visualization: Problem disclosure

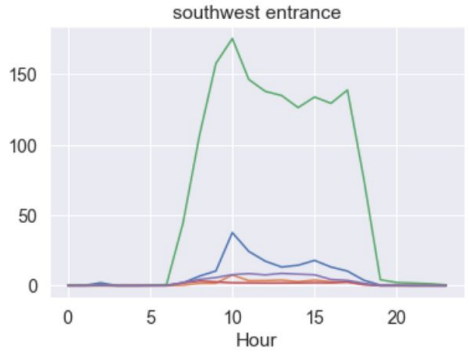


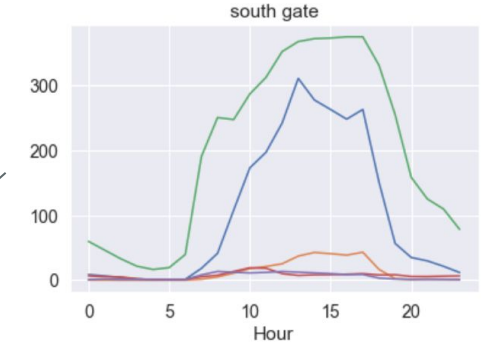
Time trend of traffic in 5 locations



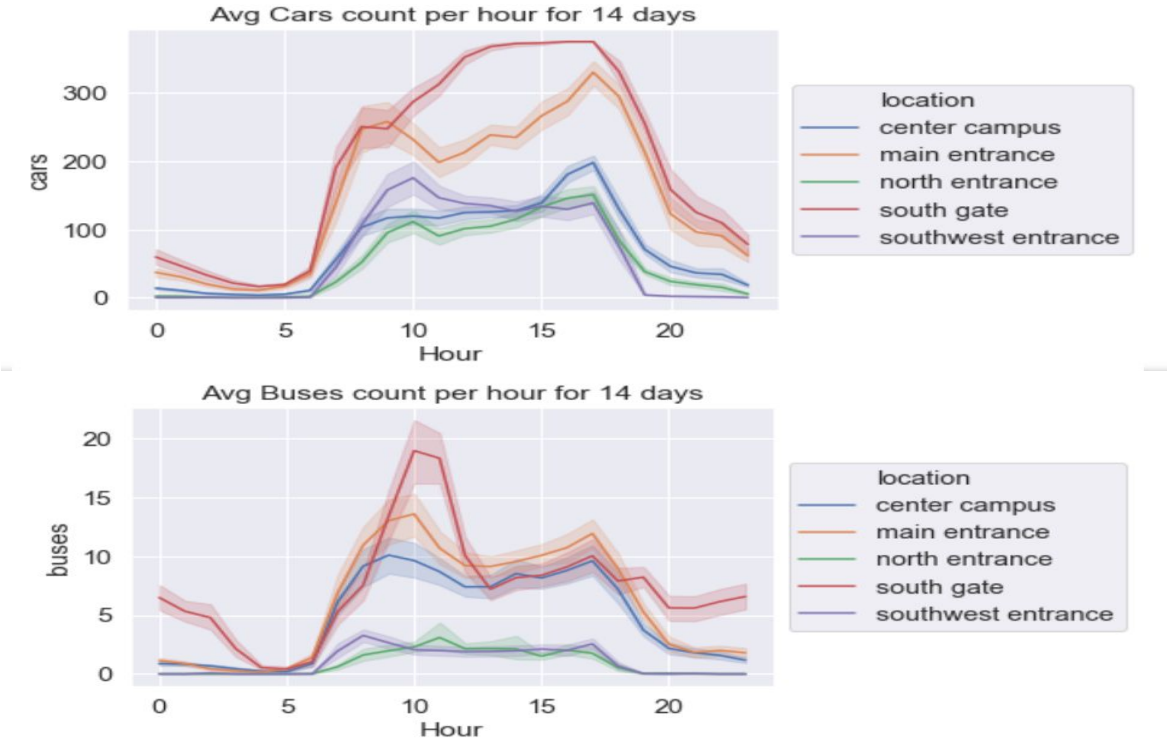








Time trend of cars & buses' count in 5 locations



Inference Model: Dynamic analysis

Linear regression for 5 different modes of traffic.

The most explainable model.

By how much traffic changes in response to different factors?

Dataset: DOTS sensor dataset + NOAA weather dataset + School event schedule

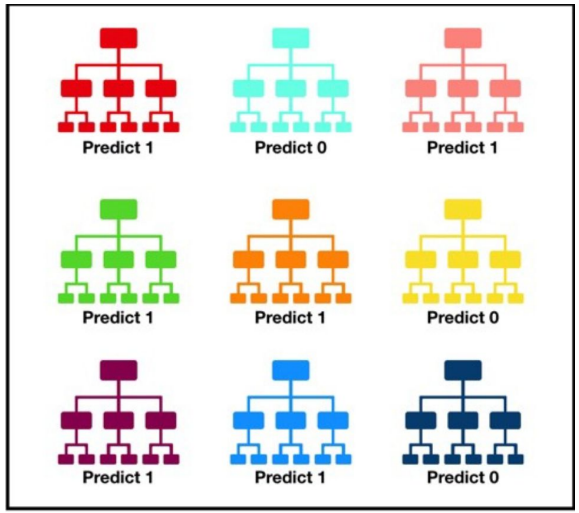
Example: Car Count regression model

Car Count ~ Location + Hour + Weekend + Event + Wind Speed + Temperature +Rain

```
Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                -49.84789    7.68688  -6.485 9.74e-11 ***
locationmain entrance       78.89244    2.74699  28.720  < 2e-16 ***
locationnorth entrance     -19.54983    2.74811  -7.114 1.29e-12 ***
locationsouth gate         124.71020    2.74781  45.385  < 2e-16 ***
locationsouthwest entrance -12.16018    2.75033  -4.421 1.00e-05 ***
Hour1                       -5.22756    6.03471  -0.866 0.386395
Hour2                      -10.20816    6.13388  -1.664 0.096130 .
Hour3                      -14.46227    5.98367  -2.417 0.015686 *
Hour4                      -15.50453    6.12559  -2.531 0.011401 *
Hour5                       -8.34921    6.14712  -1.358 0.174451
Hour6                        0.02007    6.13295   0.003 0.997389
Hour7                       77.24039    6.15015  12.559  < 2e-16 ***
Hour8                      132.52521    6.18897  21.413  < 2e-16 ***
Hour9                      160.01070    6.11688  26.159  < 2e-16 ***
Hour10                     164.55902    6.13204  26.836  < 2e-16 ***
Hour11                     152.97367    6.24768  24.485  < 2e-16 ***
Hour12                     168.50069    6.06749  27.771  < 2e-16 ***
Hour13                     171.90236    6.09706  28.194  < 2e-16 ***
Hour14                     176.07694    6.14877  28.636  < 2e-16 ***
Hour15                     185.36967    6.09794  30.399  < 2e-16 ***
Hour16                     199.87481    6.04358  33.072  < 2e-16 ***
Hour17                     210.95745    6.07120  34.747  < 2e-16 ***
Hour18                     149.94433    6.13080  24.458  < 2e-16 ***
Hour19                      87.27612    6.10809  14.289  < 2e-16 ***
Hour20                      42.10717    6.18118   6.812 1.07e-11 ***
Hour21                      21.62853    6.19516   3.491 0.000485 ***
Hour22                      23.11566    6.19275   3.733 0.000192 ***
Hour23                       5.93765    6.10316   0.973 0.330660
weekend1                   -31.84250    2.60212 -12.237  < 2e-16 ***
event1                      27.12786    3.72077   7.291 3.56e-13 ***
wind_speed                  -0.78627    0.17480  -4.498 7.01e-06 ***
TEMP                         0.87715    0.10323   8.497  < 2e-16 ***
rain                       308.18129  142.35030   2.165 0.030439 *
```

Predictive Model: Random Forest

A ‘forest’ of regression trees that generates most accurate results.




```
Call:
 randomForest(formula = cars ~ event + location + Hour + Weekend +      wind_direction
 + cloud_height + humidity + wind_speed + TEMP,      data = data, importance = TRUE)
               Type of random forest: regression
                     Number of trees: 500
No. of variables tried at each split: 3

          Mean of squared residuals: 934.5604
                    % Var explained: 93.33
> importance(tree_model_car)
                %IncMSE IncNodePurity
event          34.49676        627574
location      405.47846      26456839
Hour          253.43228      46698254
Weekend        46.75356       1597450
wind_direction 43.87919       1556599
cloud_height   26.41015       1524617
humidity       52.85724       4083473
wind_speed     31.13049       2210868
TEMP           53.98512       4406093
```

Dataset: DOTS sensor dataset + NOAA weather dataset + School event schedule

Predictive Model:

Say at 7 p.m. on a humid, warm, sunny weekday , one would expect:

40 cars exiting through South Gate within an hour.

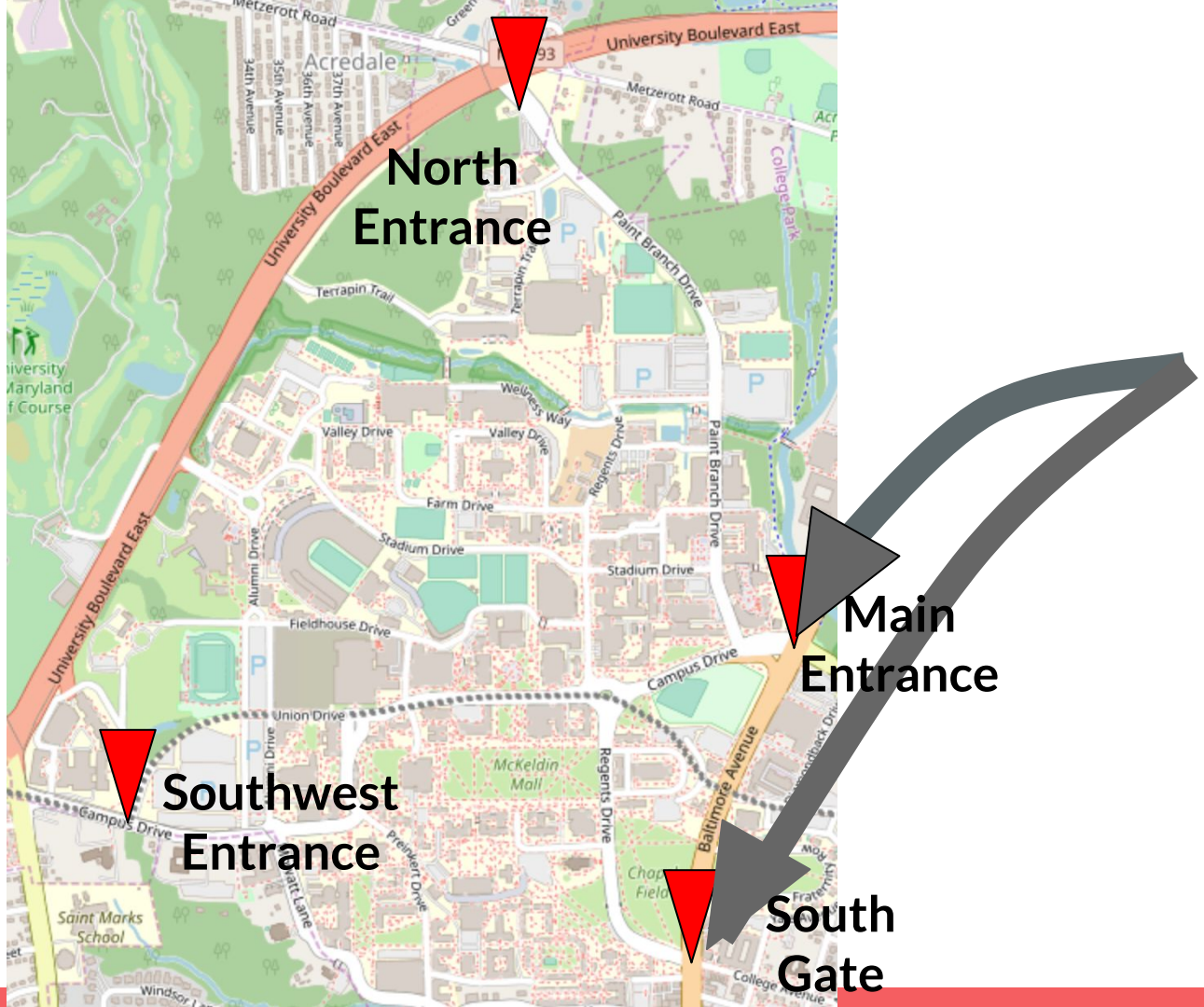
Say at noon on dry, windy, freezing weekend which holds an grand event:

106 cars would be entering the main entrance within an hour.

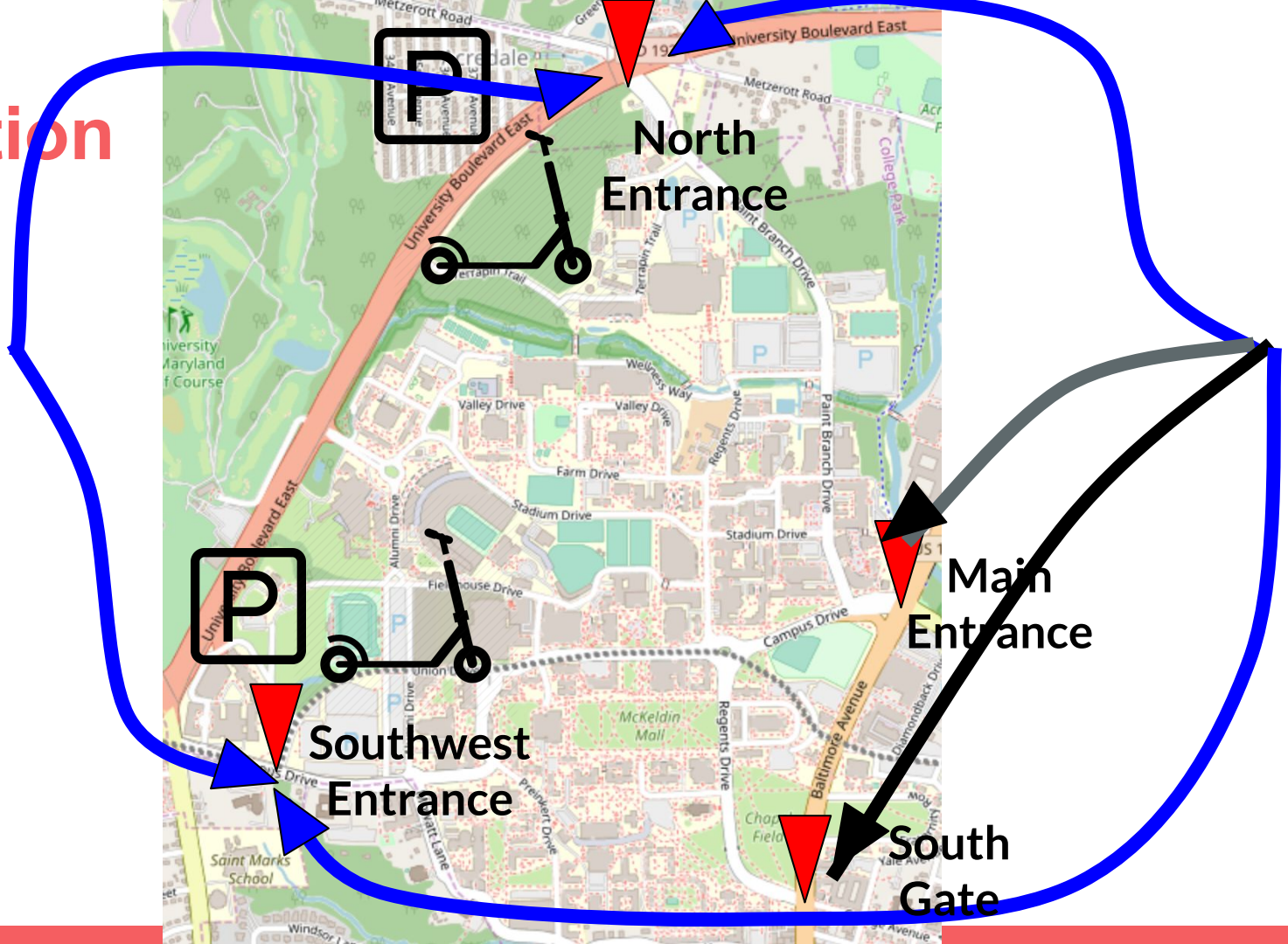
```
> pred_df
                          1        2         3         4
main entrance      35.397179 62.71488 37.543235 105.85835
center campus      13.794380 28.06867 15.898354  49.13396
north entrance      8.507720 16.78706  7.845847  36.24345
south gate         39.675731 76.56405 42.217926 127.17667
southwest entrance  6.912103 13.28832  3.996842  27.82892
```

. . . . . .

Suggestion


North Entrance
Main Entrance
Southwest Entrance
South Gate
University Boulevard East
Metzerott Road
Terrapin Trail
Paint Branch Drive
Wellness Way
Valley Drive
Farm Drive
Stadium Drive
Fieldhouse Drive
Campus Drive
Union Drive
McKeldin Mall
Regents Drive
Baltimore Avenue
Preinkert Drive
Saint Marks School
Acredale
College Park

Suggestion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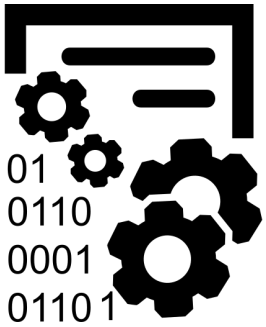
Baltimore Avenue
McKeldin Mall
Preinkert Drive
Saint Marks School

Conclusion

- Traffic is crowding on the east side of campus.
- Bus schedule needs adjustment.
- It’s possible to reduce on-campus cars and increase bicycle/scooter usage.
- More data!

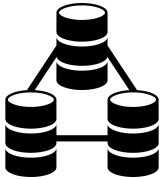
Conclusion

Problem Examination



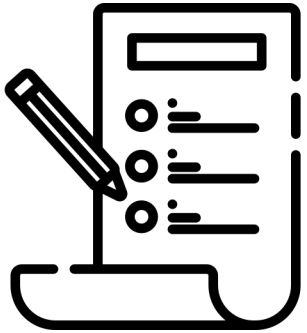
Data Exploration

Time Trend



Inference

Predictive Model Construction



Policy formulation & Resource reallocation

However, there is still some restrictions...

If it is freezingly cold with piercing wind speed...

If there is a large event on a rainy day...

What else…?

What if…...

If it is very humid with unbearable high temperature...

If there is an extremely big rain at the rush hour...