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Data Analytics for YRBS (Youth Risk Behavior Survey) Data using Machine Learning and Data Mining Techniques

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Computer Science Advisory Board Meeting
May 5, 2017

Overview

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- YRBSS (CDC)
- YRBS Data Mart (WPU)
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Project Description

- An inter-disciplinary research project:
  - ➢ Department of Public Health (WPU) – Dr. Corey H. Basch and Dr. Alex Kecojevic
  - ➢ Department of Computer Science (WPU) – Dr. Cyril S. Ku and Ms. Ana K. Ocampo (Research Assistant)
  - ➢ Department of Health and Behavior Studies (Columbia University) – Dr. Charles E. Basch
- Data Warehouse:
  - ➢ YRBSS (Youth Risk Behavior Surveillance System) from CDC (Centers for Disease Control and Prevention)
- Data Analytics Environment at WPU:
  - ➢ MySQL Server (YRBS Data Mart)
  - ➢ MySQL Workbench
  - ➢ R Studio (R Console/RGui)
  - ➢ WEKA (Waikato Environment for Knowledge Analysis)

Research Goal

- The goal of the research is to use knowledge discovery approach instead of the traditional statistics-based approach to find interesting or hidden relationships, including anomaly detection and data prediction
    - ➢ Collaborate with the Public Health Department (William Paterson) and Health and Behavior Studies (Columbia) on their behavioral research in terms of data collection, analysis, and prediction
    - ➢ Correlate the results from statistics and the results from machine learning

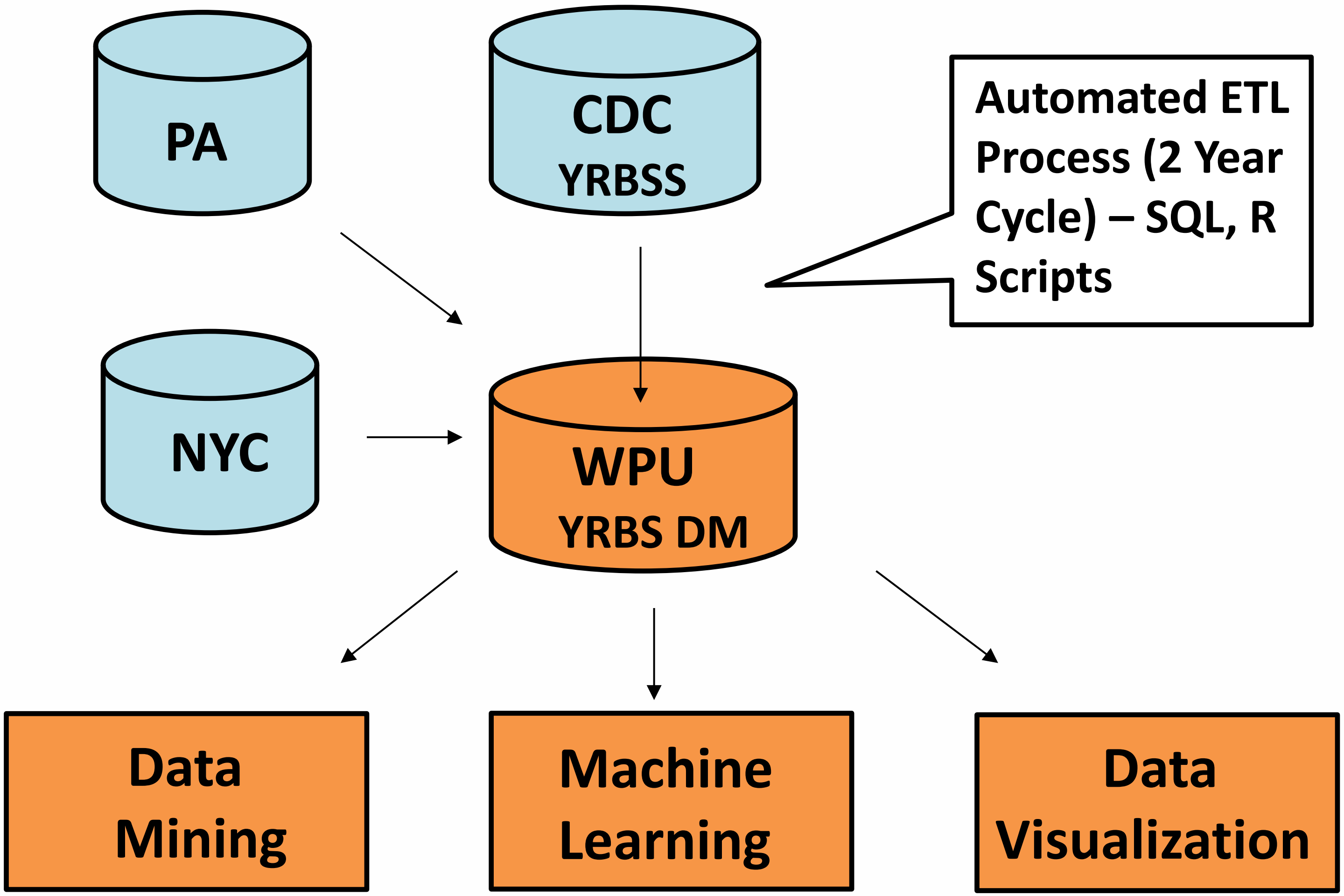
YRBSS (CDC)

- Developed in 1990 to monitor priority health risk behaviors that contribute to the leading causes of death, disability, and social problems among youth and young adults in the U.S.
  - ➢ Behaviors that contribute to unintentional injuries and violence
  - ➢ Sexual behaviors related to unintended pregnancy and sexually transmitted infections, including HIV infection
  - ➢ Alcohol and other drug use
  - ➢ Tobacco use
  - ➢ Unhealthy dietary behaviors
  - ➢ Inadequate physical activity
  - ➢ Monitors the prevalence of obesity and asthma and other health-related behaviors plus sexual identity and sex of sexual contacts
- From 1991 through 2015, the YRBSS has collected data from more than 3.8 million high school students in more than 1,700 separate surveys

YRBS Data Mart (WPU)

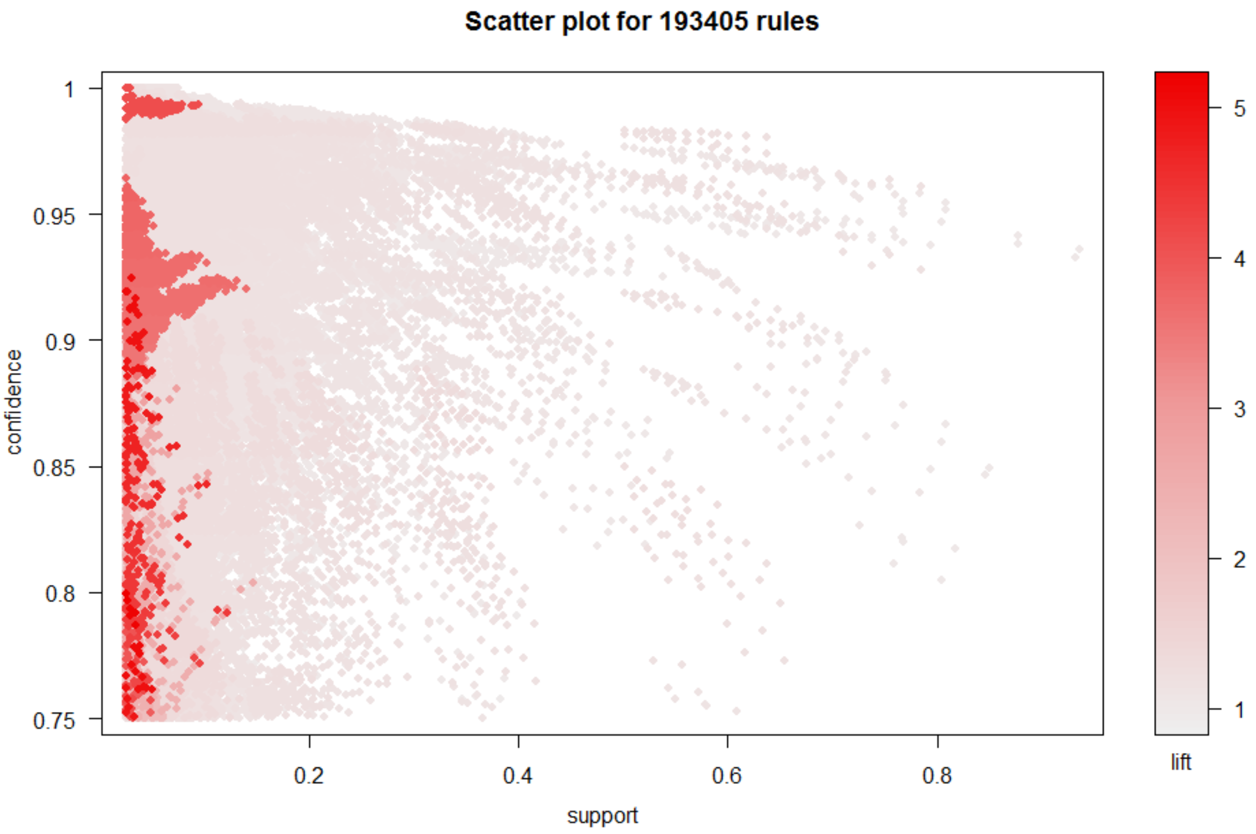
- Aggregated subsets of YRBSS from CDC and survey data from New York City and Pennsylvania
  - ➢ National (2011, 2013, 2015)
  - ➢ New Jersey (2011, 2013)
  - ➢ New York (2011, 2013, 2015)
  - ➢ New York City (2011, 2013, 2015)
  - ➢ Pennsylvania (2015)
  - ➢ Philadelphia (Pending)

Client/Server Architecture



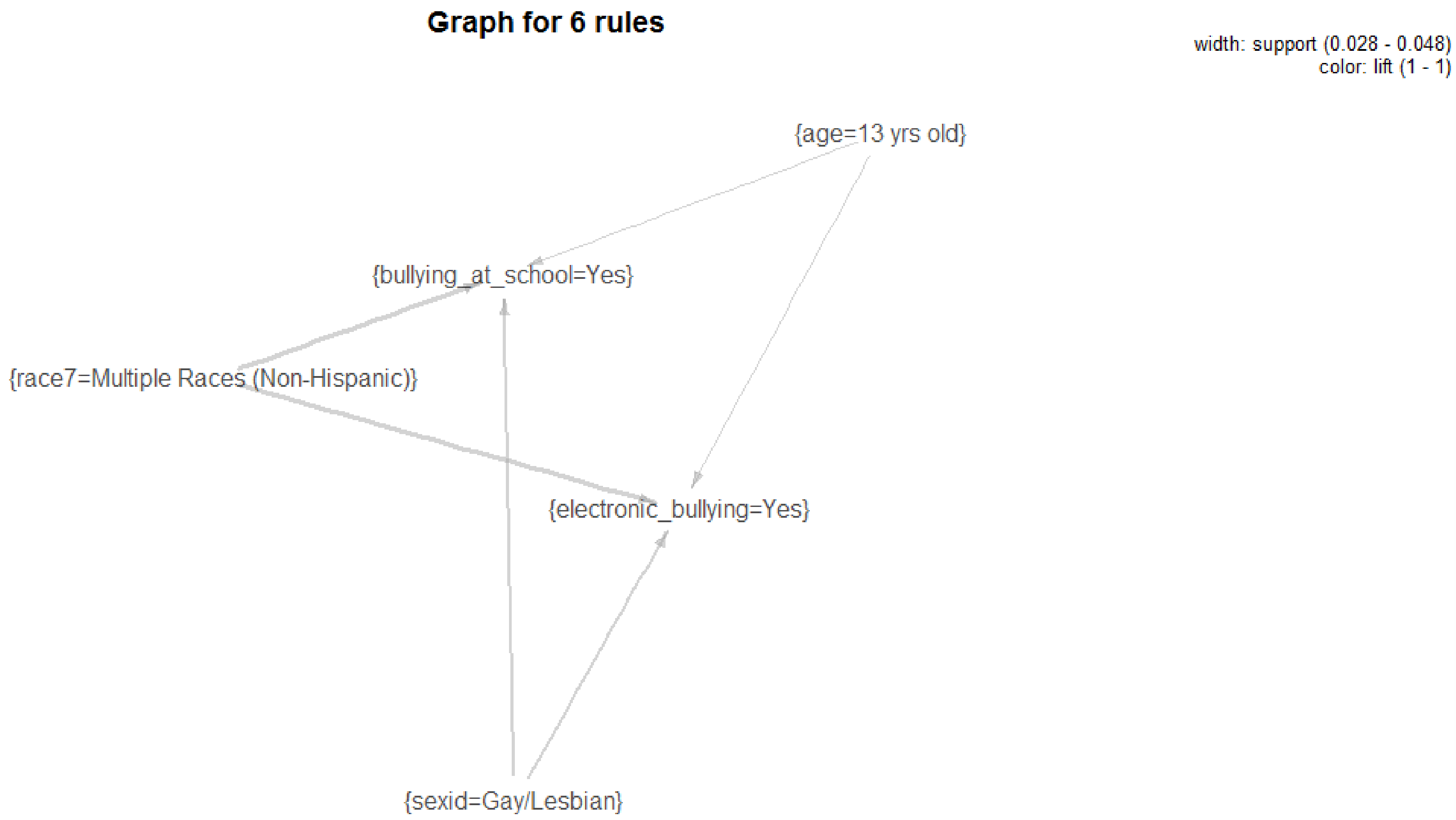
Preliminary Studies

- Used a subset of the New York dataset (2015)
- Focused on machine learning algorithms to explore relationships and patterns between variables in the dataset
- Performed association mining rule to discover frequent co-occurring associations among variables (focused on two variables: bullied at school, electronic bullying)
- The following slide shows the association scatter plot generated after running the Apriori Algorithm, showing only association rules with confidence > 0.75



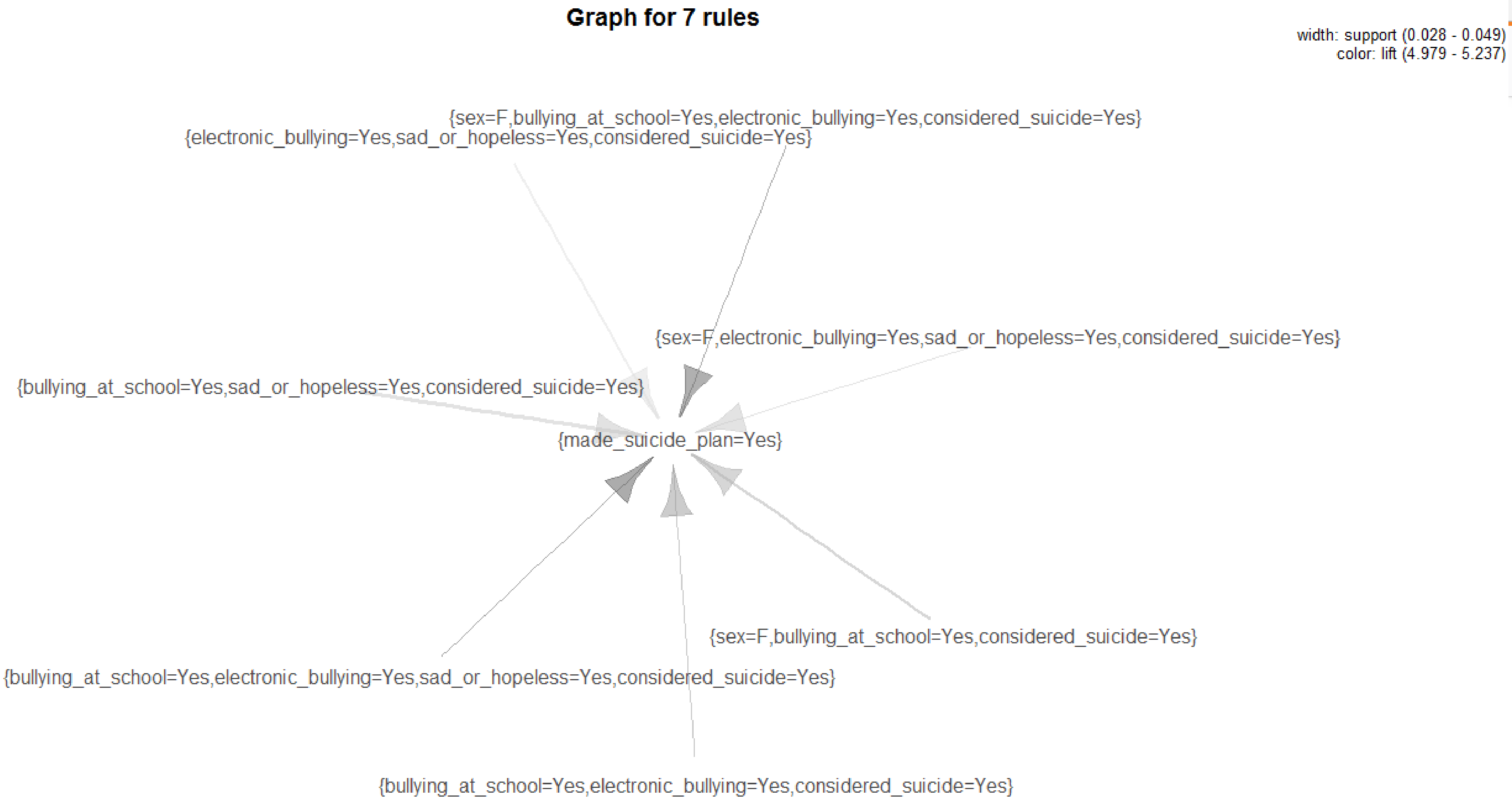
Metrics for Association Rule

- **Support** – how frequently the items in the rule occur together
- **Confidence** – probability of both the antecedent and the consequent appearing together *(the conditional probability of the consequent given the antecedent)*
- **Lift** – strength of a rule over the random co-occurrence of the antecedent and the consequent, given their individual support



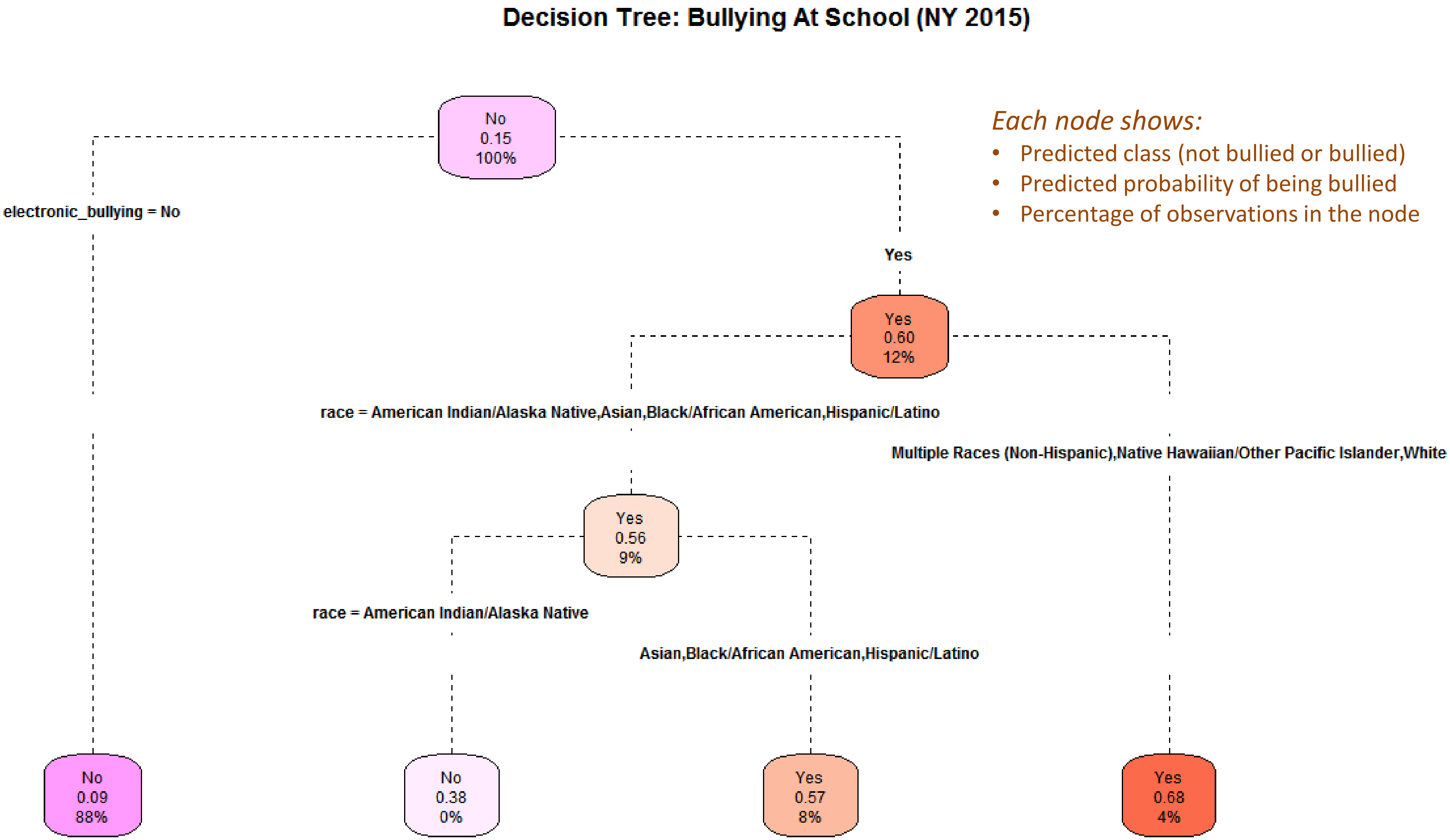
antecedent	consequent	support	confidence	lift
{age=13 yrs old}	{bullying_at_school=Yes}	0.028011204	1	1
{race7=Multiple Races (Non-Hispanic)}	{bullying_at_school=Yes}	0.047619048	1	1
{sexid=Gay/Lesbian}	{bullying_at_school=Yes}	0.040616246	1	1
{age=13 yrs old}	{electronic_bullying=Yes}	0.028011204	1	1
{race7=Multiple Races (Non-Hispanic)}	{electronic_bullying=Yes}	0.047619048	1	1
{sexid=Gay/Lesbian}	{electronic_bullying=Yes}	0.040616246	1	1

Example of strong association rules


Graph for 7 rules
width: support (0.028 - 0.049)
color: lift (4.979 - 5.237)
{sex=F,bullying_at_school=Yes,electronic_bullying=Yes,considered_suicide=Yes}
{electronic_bullying=Yes,sad_or_hopeless=Yes,considered_suicide=Yes}
{sex=F,electronic_bullying=Yes,sad_or_hopeless=Yes,considered_suicide=Yes}
{bullying_at_school=Yes,sad_or_hopeless=Yes,considered_suicide=Yes}
{made_suicide_plan=Yes}
{sex=F,bullying_at_school=Yes,considered_suicide=Yes}
{bullying_at_school=Yes,electronic_bullying=Yes,sad_or_hopeless=Yes,considered_suicide=Yes}
{bullying_at_school=Yes,electronic_bullying=Yes,considered_suicide=Yes}

Preliminary Studies

- Used classification to indicate if a student is bullied at school based on their race, and their answer from the question of being electronically bullied (yes/no)
- The following decision tree was generated to show the results


Decision Tree: Bullying At School (NY 2015)
No
0.15
100%
electronic_bullying = No
Yes
Yes
0.60
12%
race = American Indian/Alaska Native,Asian,Black/African American,Hispanic/Latino
Multiple Races (Non-Hispanic),Native Hawaiian/Other Pacific Islander,White
Yes
0.56
9%
race = American Indian/Alaska Native
Asian,Black/African American,Hispanic/Latino
No
0.09
88%
No
0.38
0%
Yes
0.57
8%
Yes
0.68
4%

Each node shows:

- Predicted class (not bullied or bullied)
- Predicted probability of being bullied
- Percentage of observations in the node

Future Research Plan

- The goal of the research is to use knowledge discovery approach instead of the traditional statistics-based approach to find interesting or hidden relationships, including anomaly detection and data prediction
  - ➢ Use various data mining and machine learning (neural network algorithms) techniques of classification, association, and clustering analyses on the YRBS data
  - ➢ Summer 2017: extending tanning trending to 2015 using current statistical method; using machine learning algorithm (e.g., decision tree) for prior years to predict and correlate 2015 results; establish criteria to predict future tanning trending

Acknowledgement

- This research was supported in part by the ART (Assigned Released Time for Research) program, Office of the Provost; and in part by the Student Research Funds of the College of Science and Health, William Paterson University.

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