Optimizing Diversity in the Bowdoin College Tour Guide Schedule

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Objectives

This project seeks to formulate an algorithm to accelerate the tour guide scheduling process using classic graph theory and AI techniques. The algorithm optimizes the schedule based on guide diversity and allows for further analysis into which diversity attributes may be over or underrepresented among the tour guides.

Background

The Admissions Office gives four tours every weekday, totaling 20 tours per week. There are three guides assigned to each of these tour "slots." Guides give the scheduler their availabilities at the beginning of each semester. Thus, 60 guides are required to fill the schedule (note that it is possible to have a guide fill more than one slot if there are less than 60 guides).

	Monday	Tuesday	Wednesday	Thursday	Friday
9:30	Hallie Carol	Natalie Clark	Michael Staes	Chelsea Bruno	Sawyer Bowman
	Emma Johnson	Kevin Hoose	Phoebe Joaquin	Jasmine Bailey	RJ Dellecese
	Michael Colbert	Andi Noble	Trey Linke	Julian Tamayo	Marcella Jimenez
11:30	Sam Weyrauch	Oriana Farnham	Ally Glass-Katz	Everett Nelor	Sharon Kasasa
	Elise Engquist	Sam Herzig	Ollie Klingenstein	Alex Roche	Abby Turner
	Shan Nagar	Chelsea Bruno	Charlotte W.	Molly Rose	James Denison
1:30	Evan Eklund	Shan Nagar	Ben Geyman	Sam King	Ian McDowell
	Olivia Raisner	Katie Ross	Nicole Wetsman	June Guo	Danae Hirsch
	Elana Vlodaver	Molly Faregeorge	Mollie Friedlander	Hannah LeBlanc	Maya Rieselbach
3:30	Emily Gower	Peter Powers	Peter Yanson	Nina Underman	Danny Mejia-Cruz
	Matt Friedland	Daniel Cohen	Maddy Livingston	Martin Shott	Michelle Johnson
	Divya Hoon	Ally Glass-Katz	Toby Nicholson	Jess Holley	May Kim

Team

Figure 1: Example of finished tour guide schedule.

Acknowledgements

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Methods

The tour guide schedule and guides' availabilities are represented with a graph (see below). Implementing a variation of the common AI technique of local search, the algorithm first finds a valid schedule based on guides' availabilities using the Ford-Fulkerson algorithm of maximum flow. Then, the algorithm searches other valid schedules by making optimal, localized changes.

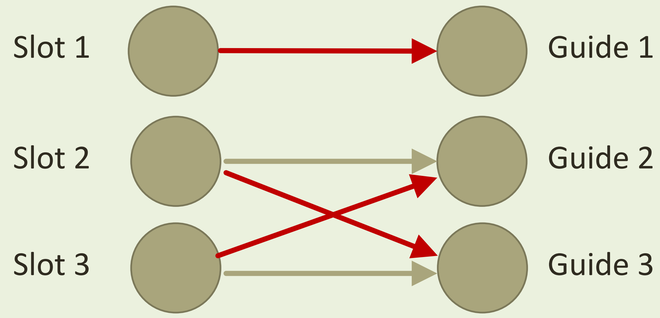

Figure 2: Perfect bipartite matching of graph

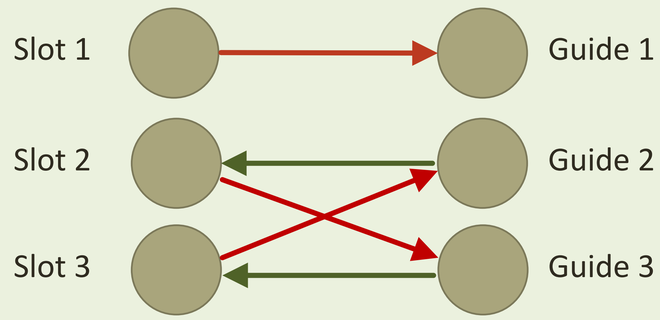

Figure 3: Reverse edges to create an even cycle

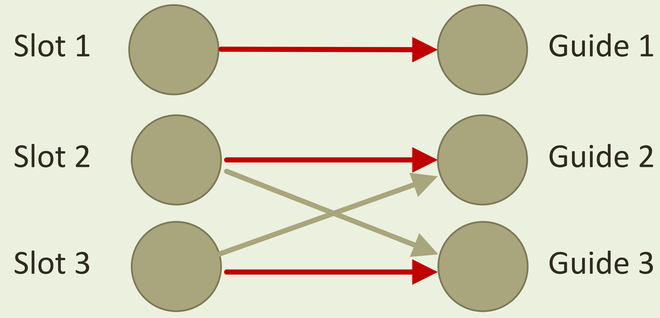

Figure 4: Assign new edges to create new matching

Measuring Diversity

The algorithm considers eight different diversity categories:

- Major
- Class Year
- Hometown
- Gender
- Ethnicity
- Public or Private High School
- Study Abroad
- Athlete

The algorithm can implement a variety of different metrics to define an optimal tour guide team:

- Diverse in **8 out of 8** categories
- Diverse in **7 out of 8** categories
- **Ignore** a category **(7 out of 7)**

Guide	Major	Class Year	Home Region	Gender
A	English	2015	Northeast	Male
B	Computer Science	2014	Southwest	Male
C	Computer Science	2016	International	Female

Figure 5: A diverse team with **8 out of 8** metric

Score(team) = 1: there exists a difference in all categories
Score(team) = 0: there exists at least one category all the same

Results

- **8 out of 8:** total diversity = 10 teams (50%)
- **7 out of 8:** total diversity = 20 teams (100%)
- **Ignore ethnicity:** total diversity = 17 teams (85%)
- **Ignore class year:** total diversity = 11 teams (55%)

Conclusions

Ethnicity is a bottleneck for preventing maximum diversity using the **8 out of 8** metric, as the number of diverse teams increases significantly when it is ignored.