Artificial Intelligence: Project 1

Context Aware Intelligent Tour Guide

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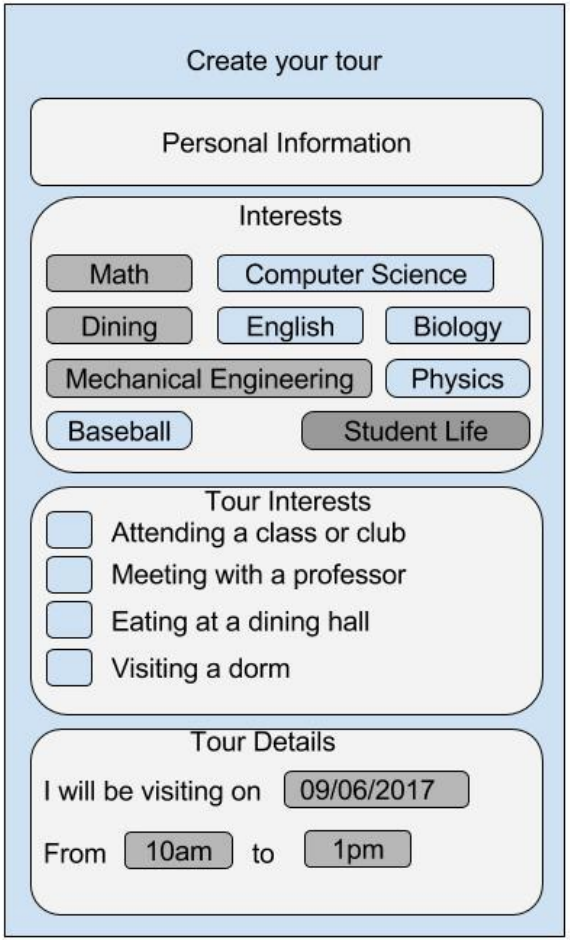
Problem statement

- Lafayette College wants to upgrade their college tour procedure.
- Recommender system incorporates visitors academic, cultural and athletic interests
- Must address all use cases to provide users with relevant, personalized output itineraries.

Input

- Personal Information
- Academic, athletic and extracurricular interests
  - Selected from pool of predefined tags
- Tour interests
  - Class, club, professor, information session
- Tour details
  - Start time and location, end time, time flexibility
- Use buildings that were assigned to classes of a certain major to guess tags



Groups as an average visitor

The algorithm does not differentiate between individuals and groups, however it is possible to simulate groups on the implementation side by

1. Averaging the interest tags over the group members by tag frequency
2. Forcing the same start and end time as well as start location of the tour when “visit as a group” is chosen

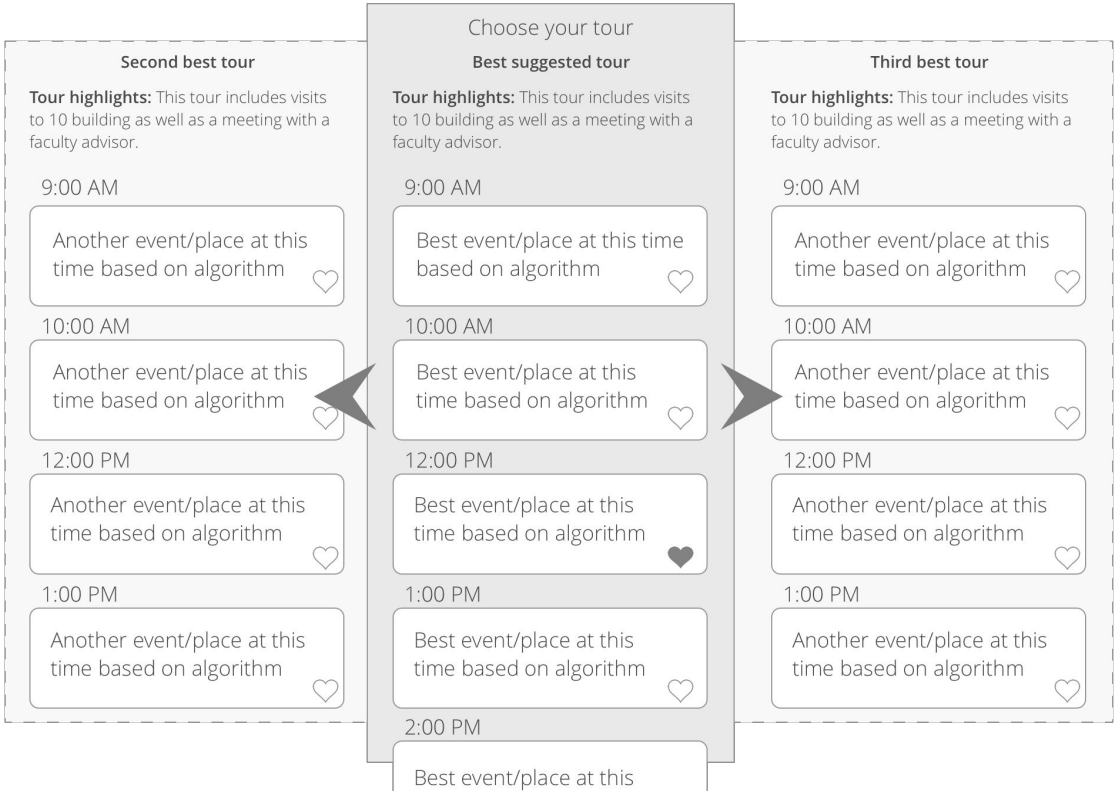
The algorithm will however ask for number of visitors per session to respect building capacity.

Knowledge

- Building/landmark/event
  - Name, use, location, capacity
  - Time schedule
  - Baseline time spent
  - Distance between buildings
- Expected weather
- User input

Output

- A list of itineraries:
  - Highlighted features
  - List of places/events
  - Reasons/Uses
  - Visual instructions
- Implicit feedback loop



Assumptions

- Tours will be generated as if for a single user
- User knows physical location of buildings
- Users walk approximately at the same speed
- User will be at stated location at stated time
- User spends expected time at each location

Constraints

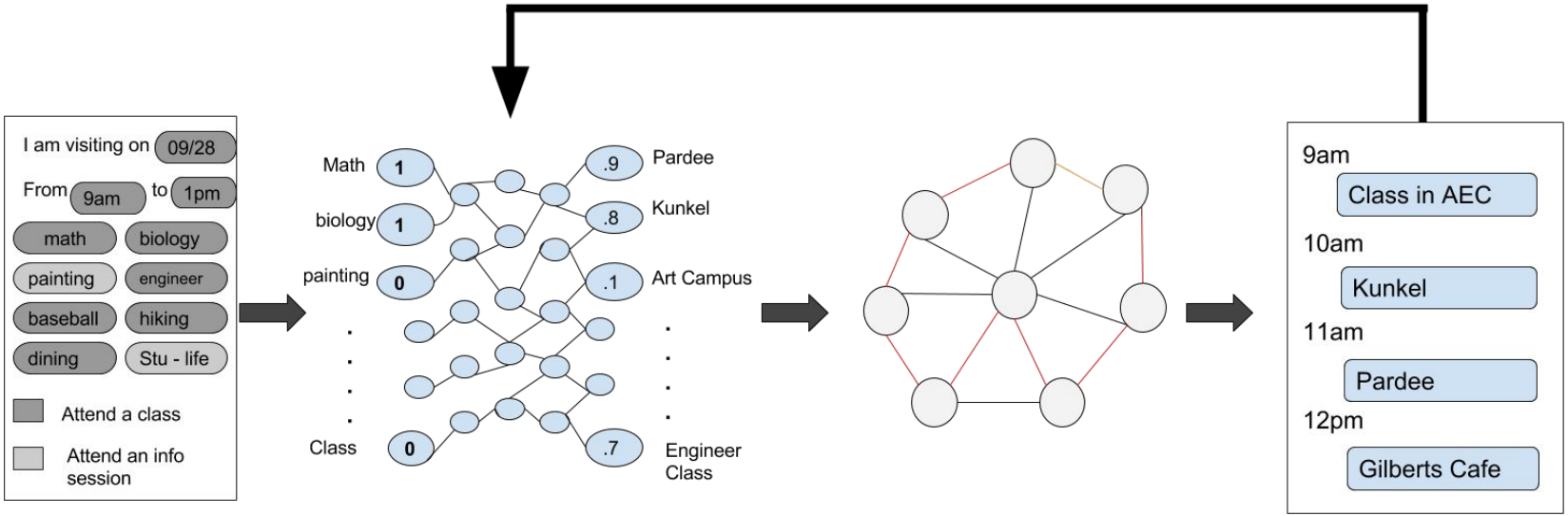
- Starting location will be a node/location specified by user, must be known to system
- End location must be the same as the start location.
- At least one itinerary must be produced for all inputs
- Time span defined in the student's input will loosely constrain the length of the tour.
- Some buildings have restrictive access.

Evaluation criteria

- Use cases
  - How flexible is it? Extreme cases?
- Time
  - At different times of the day? Of different lengths?
- Interests
  - Meet the user's preferences? Promote interests for the school/ major(s)?
- Others
  - Building capacity? Scalability? Limitations?

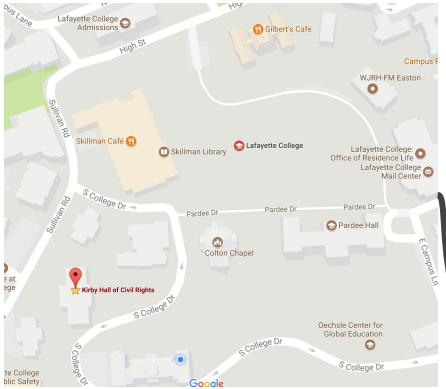
Solution - high level

- Pre-processing step + two AI subproblems:
  - Interest mapping and graph generation
  - Graph traversal and Itinerary generation

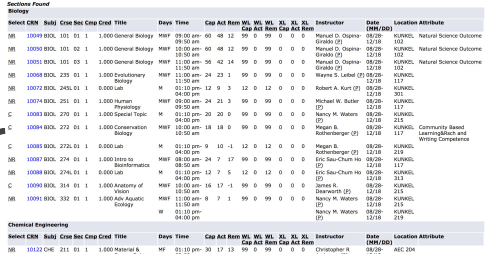


Preprocessing step

Knowledge discovery and Data parsing

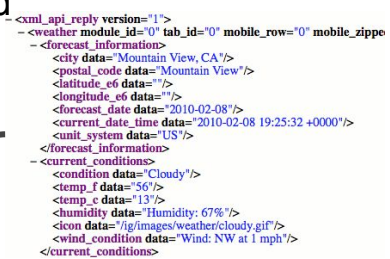


Geotagged Campus Map



Banner Course Offering Schedule

Clubs & Sports Meeting times and locations



Weather API

Pre-processing algorithm

Faculty advisor meetings and visitor-related events

Preprocessing step 1

Building a list of tagged buildings

Desired output:

Acopian = [Engineering, Science, ..]

Hugel = [Science, ..]

William's = [Painting, ..]

Farinon = [Dining, ..]

Preprocessing step 1

Building a list of tagged buildings

Source 1: Banner Course Offering Schedule

KUNKEL = {Biology, Science, …}

Sections Found

Biology

Select	CRN	Subj	Crse	Sec	Cmp	Cred	Title	Days	Time	Cap	Act	Rem	WL Cap	WL Act	WL Rem	XL Cap	XL Act	XL Rem	Instructor	Date (MM/DD)	Location	Attribute
NR	10049	BIOL	101	01	1	1.000	General Biology	MWF	09:00 am-09:50 am	60	48	12	99	0	99	0	0	0	Manuel D. Ospina-Giraldo (P)	08/28-12/18	KUNKEL 102	Natural Science Outcome
NR	10050	BIOL	101	02	1	1.000	General Biology	MWF	10:00 am-10:50 am	60	48	12	99	0	99	0	0	0	Manuel D. Ospina-Giraldo (P)	08/28-12/18	KUNKEL 102	Natural Science Outcome
NR	10051	BIOL	101	03	1	1.000	General Biology	MWF	11:00 am-11:50 am	56	42	14	99	0	99	0	0	0	Manuel D. Ospina-Giraldo (P)	08/28-12/18	KUNKEL 102	Natural Science Outcome
NR	10068	BIOL	235	01	1	1.000	Evolutionary Biology	MWF	11:00 am-11:50 am	24	23	1	99	0	99	0	0	0	Wayne S. Leibel (P)	08/28-12/18	KUNKEL 117	
NR	10072	BIOL	245L	01	1	0.000	Lab	M	01:10 pm-04:00 pm	12	9	3	12	0	12	0	0	0	Robert A. Kurt (P)	08/28-12/18	KUNKEL 301	
NR	10074	BIOL	251	01	1	1.000	Human Physiology	MWF	09:00 am-09:50 am	24	21	3	99	0	99	0	0	0	Michael W. Butler (P)	08/28-12/18	KUNKEL 117	

Preprocessing step 1

Building a list of tagged buildings

Source 1: Banner Course Offering Schedule

SIMON = {Economics, Social Science, …}

Economics

Select	CRN	Subj	Crse	Sec	Cmp	Cred	Title	Days	Time	Cap	Act	Rem	WL Cap	WL Act	WL Rem	XL Cap	XL Act	XL Rem	Instructor	Date (MM/DD)	Location	Attribute
C	10240	ECON	101	02	1	1.000	Principles	TR	01:15 pm-02:30 pm	35	37	-2	99	0	99	0	0	0	Rexford A. Ahene (P)	08/28-12/18	SIMON 125	Social Science Outcome
NR	10241	ECON	101	03	1	1.000	Principles	TR	08:00 am-09:15 am	35	33	2	99	0	99	0	0	0	Joaquin Gomez-Minambres (P)	08/28-12/18	SIMON 124	Social Science Outcome
NR	10242	ECON	101	04	1	1.000	Principles	TR	09:30 am-10:45 am	35	33	2	99	0	99	0	0	0	Joaquin Gomez-Minambres (P)	08/28-12/18	SIMON L3	Social Science Outcome
NR	10243	ECON	101	05	1	1.000	Principles	TR	01:15 pm-02:30 pm	35	33	2	99	0	99	0	0	0	Matthew F. Larsen (P)	08/28-12/18	SIMON L3	Social Science Outcome
NR	10244	ECON	101	06	1	1.000	Principles	MWF	09:00 am-09:50 am	35	29	6	99	0	99	0	0	0	Ute Schumacher (P)	08/28-12/18	SIMON L3	Social Science Outcome

Preprocessing step 1

Building a list of tagged buildings

Source 2: The Lafayette Directory, ex: https://directory.lafayette.edu/node/152

Acopian Engineering Center

HOME - DIRECTORY - ACOPIAN ENGINEERING CENTER

The 90,000-square-foot Acopian Engineering Center includes laboratories designed specifically for student-faculty research, high-tech classrooms equipped with instructional technology, and student learning centers. It houses the entire Engineering Division's departments and programs, along with computer science.

Preprocessing step 1

Building a list of tagged buildings

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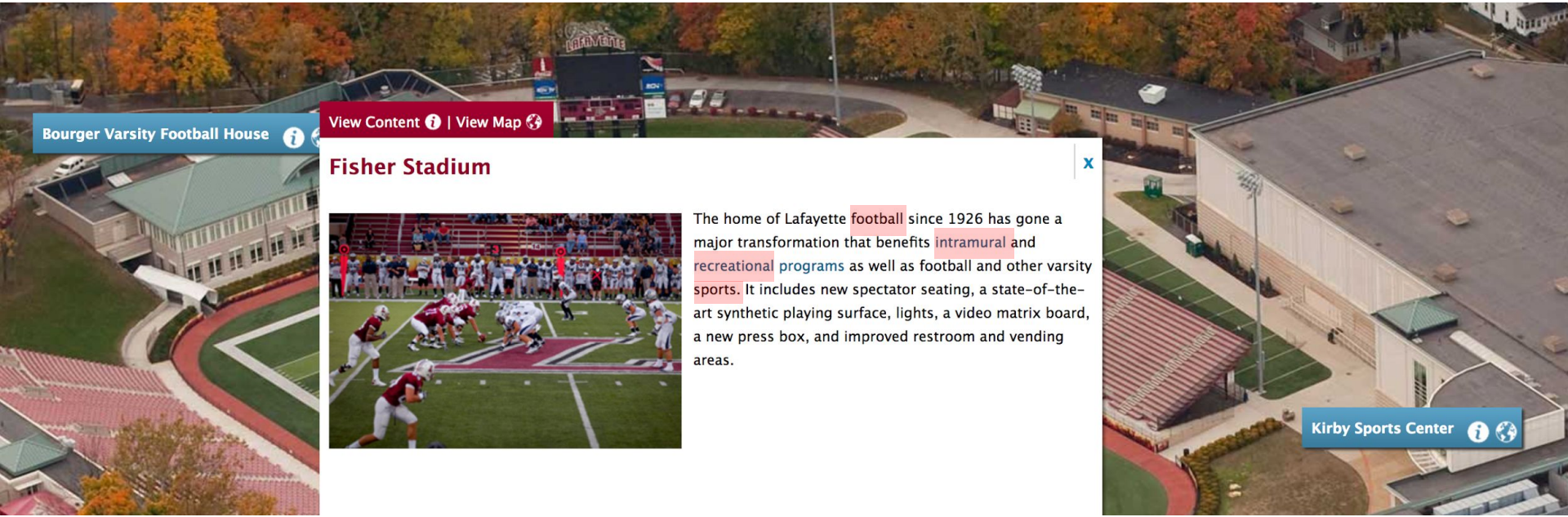
Word2Vec

Acopian = {engineering, research, technology, computer science}

Preprocessing step 1

Building a list of tagged buildings

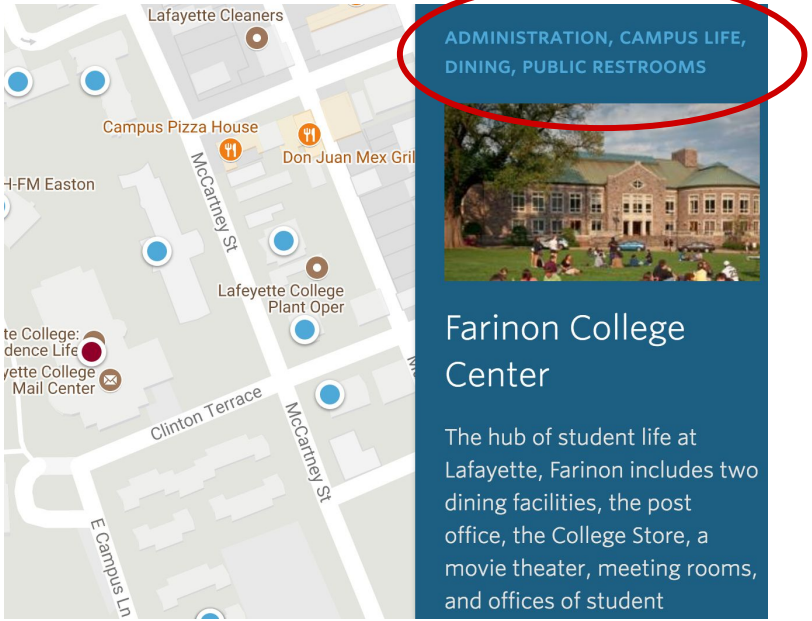
Source 3: virtualtour.lafayette.edu

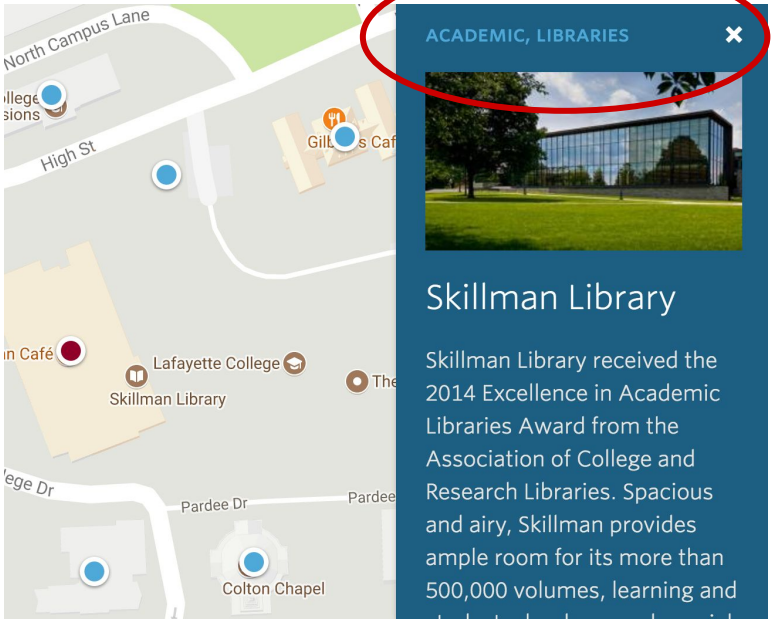


Preprocessing step 1

Building a list of tagged buildings

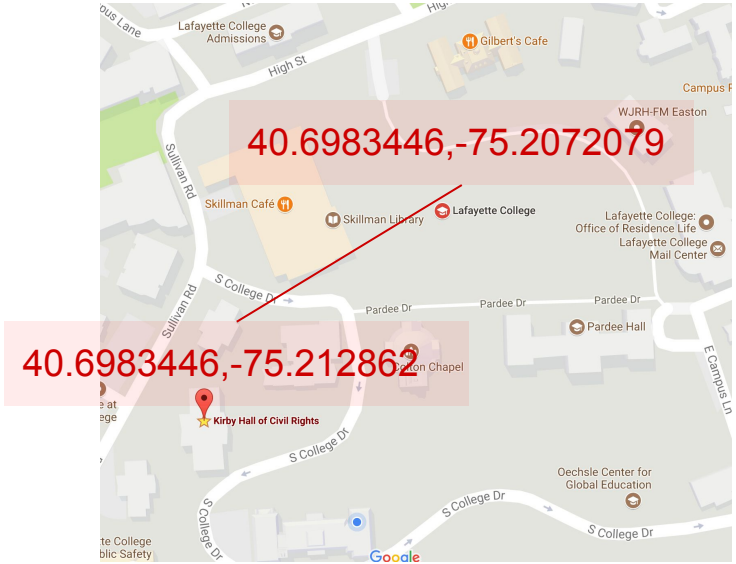
Source 4: campusmaps.lafayette.edu



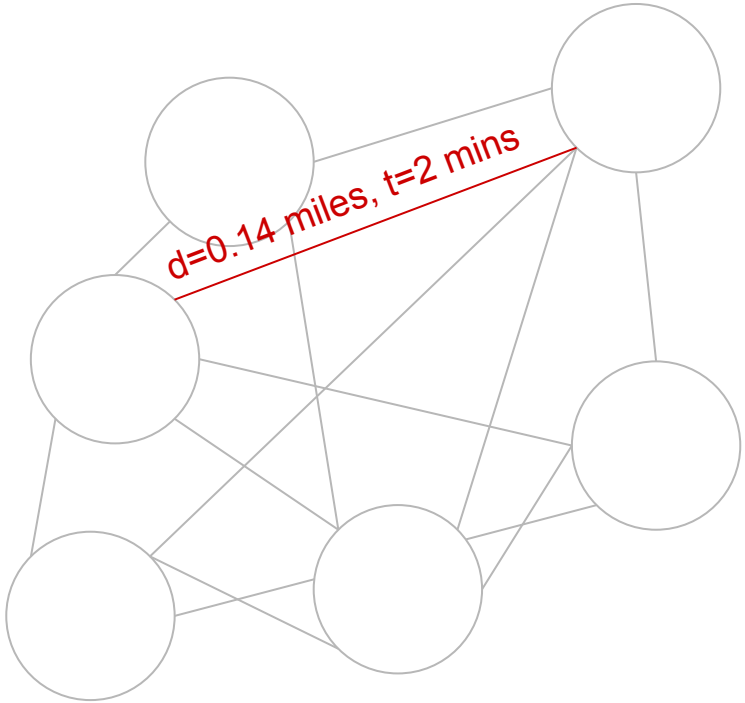


Preprocessing step 2

Building a fully connected graph of buildings



Geotagged Campus Map



First subproblem

Matching User Preference

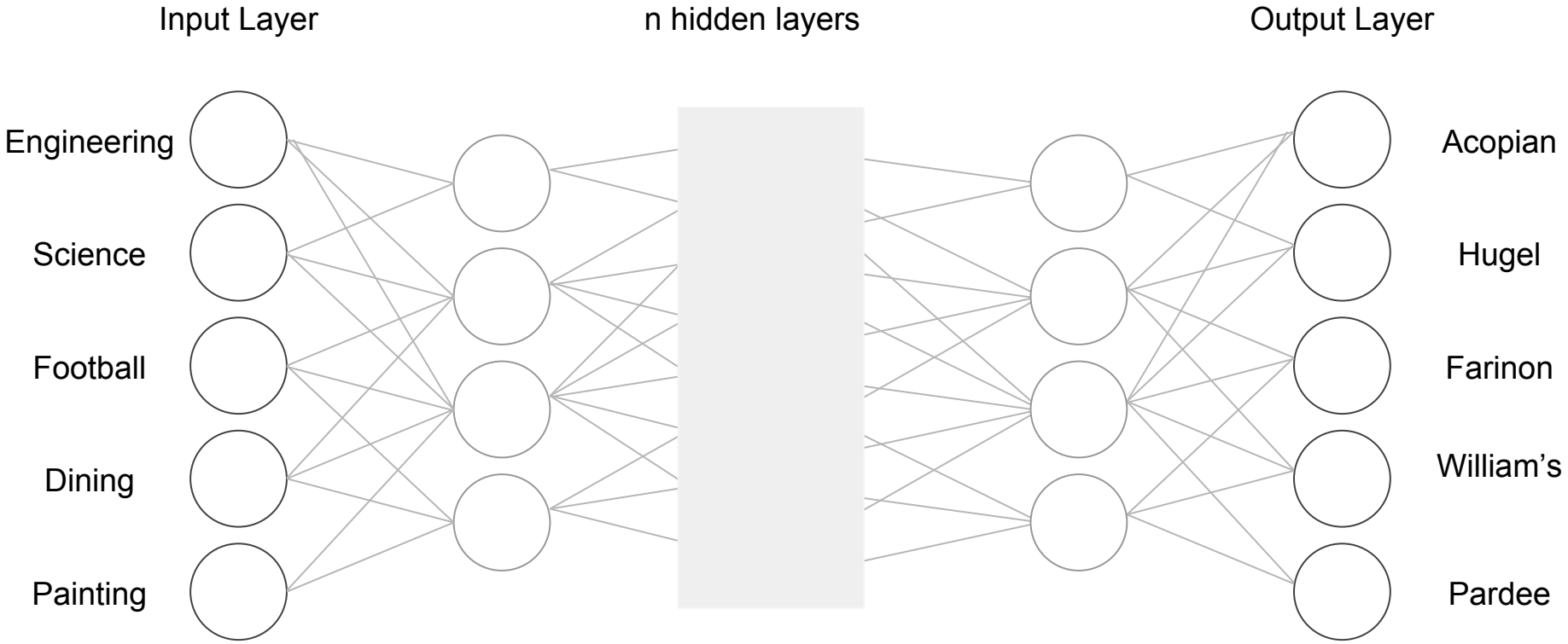
- Neural Network inspired by Word2Vec (Mikolov et al.)

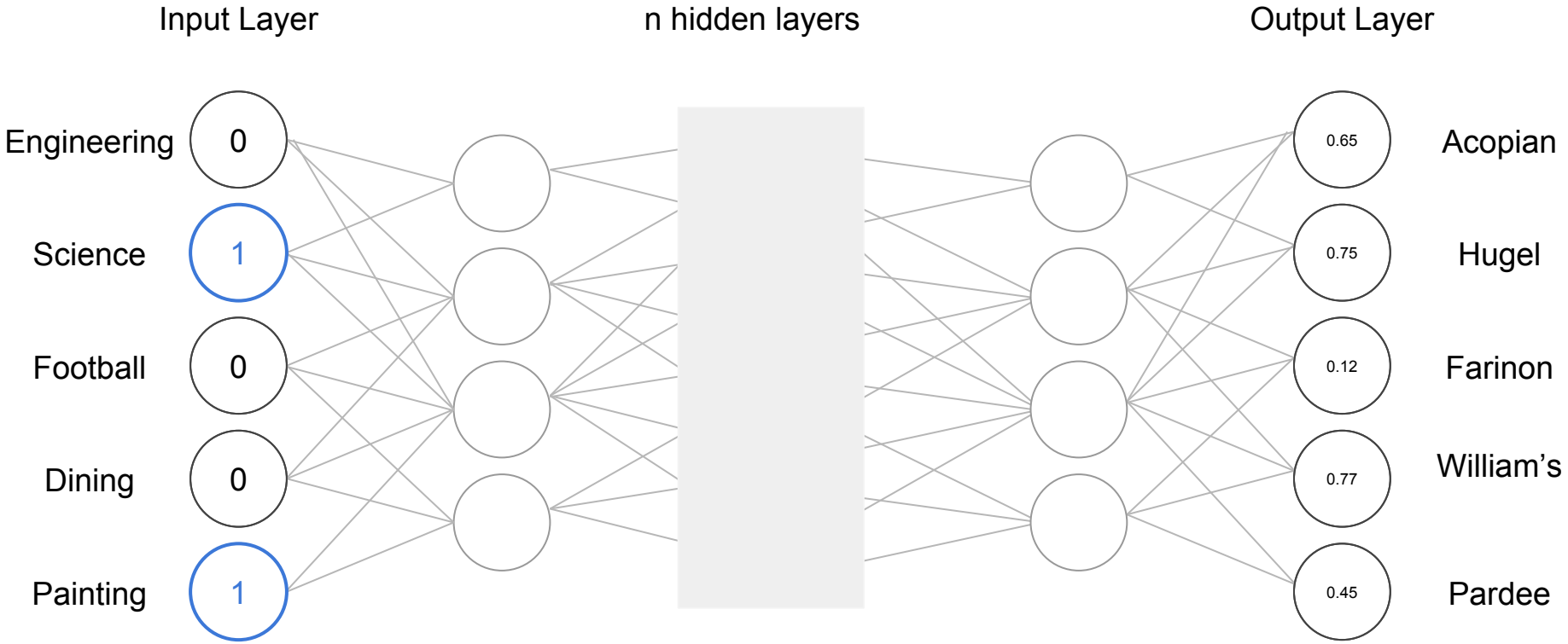
Input:

Engineering, Science, Math

Output:

Acopian (.87), Hugel (.79), Oechsle (.56), ...


Input Layer
n hidden layers
Output Layer
Engineering
Science
Football
Dining
Painting
Acopian
Hugel
Farinon
William’s
Pardee


Input Layer
n hidden layers
Output Layer
Engineering
0
Science
1
Football
0
Dining
0
Painting
1
0.65
Acopian
0.75
Hugel
0.12
Farinon
0.77
William’s
0.45
Pardee

Subproblem

Matching User Preference

Initial Training Dataset:

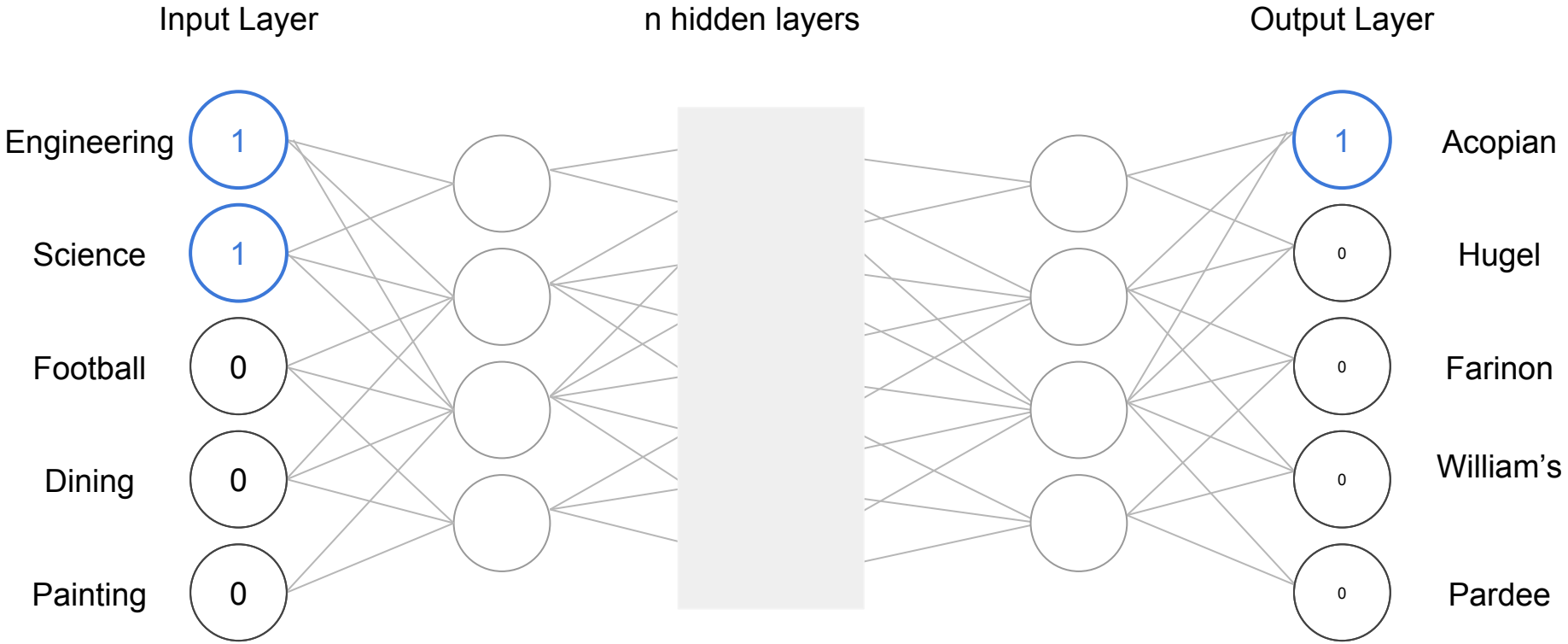
Acopian = [Engineering, Science, ..]

Hugel = [Science, ..]

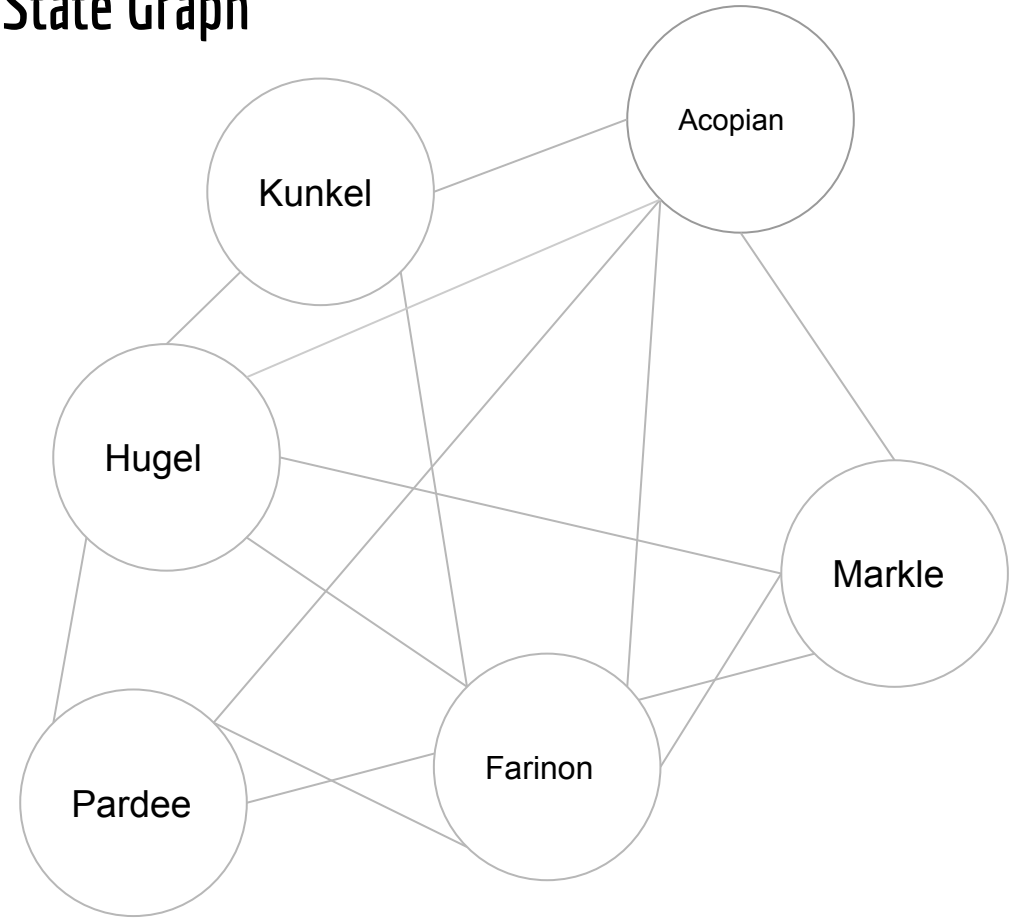
William's = [Painting, ..]

Farinon = [Dining, ..]

Training: Acopian = [Engineering, Science, ..]



State Graph



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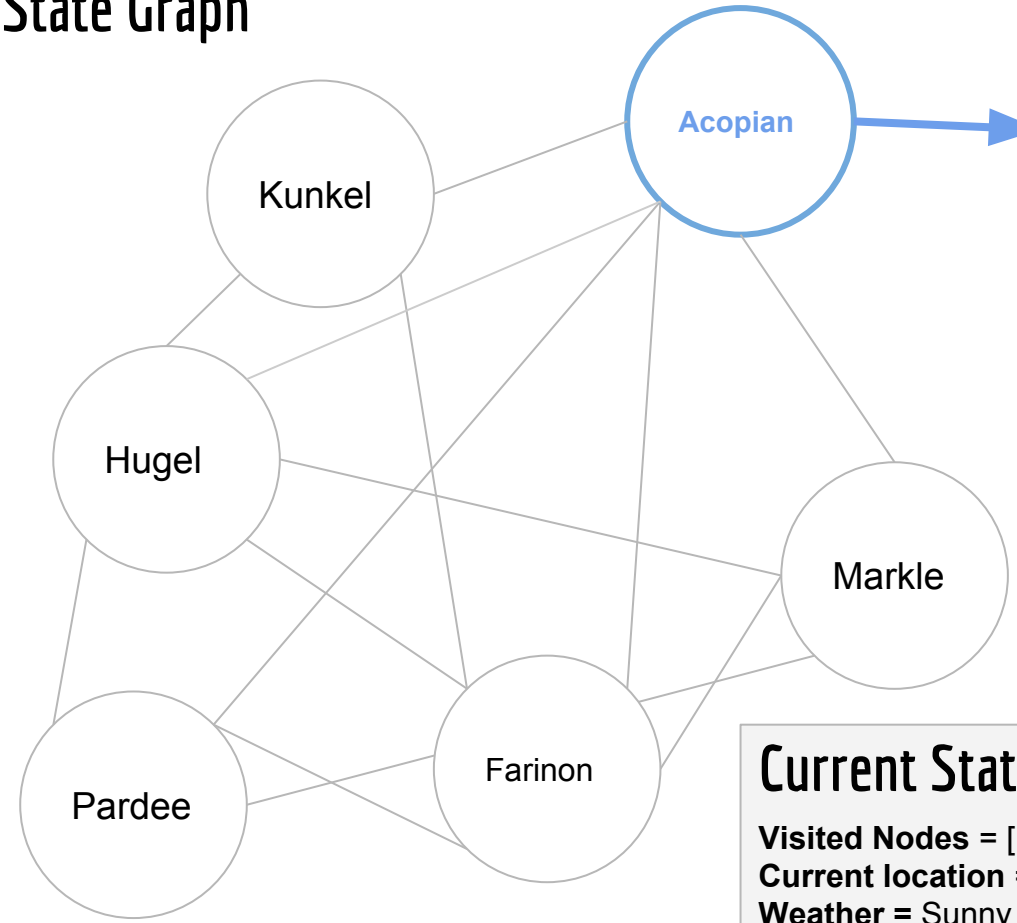


Acopian

Preference score = 0.85
Distance to current location = 0.2m
Travel time = 0.1min
Affected by bad weather? = No
Remaining capacity = 5 visitors
Need key fob? = 10PM - 5AM

Meeting Prof. Liew

Score 3/6
10AM - 11AM
Req. YES

IEEE Club

Score 2/6
10AM - 11:30AM
Req. No

Current State

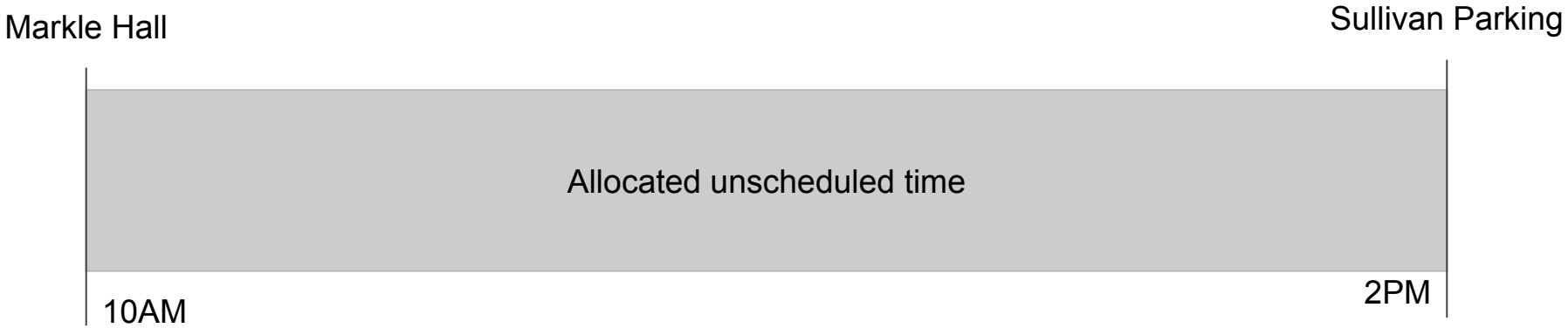
Visited Nodes = [Marquis, Kirby, Kamine]
Current location = Marquis
Weather = Sunny

Current time = 10AM
Tour end time = 2PM
Num of Visitors = 1

Main algorithm

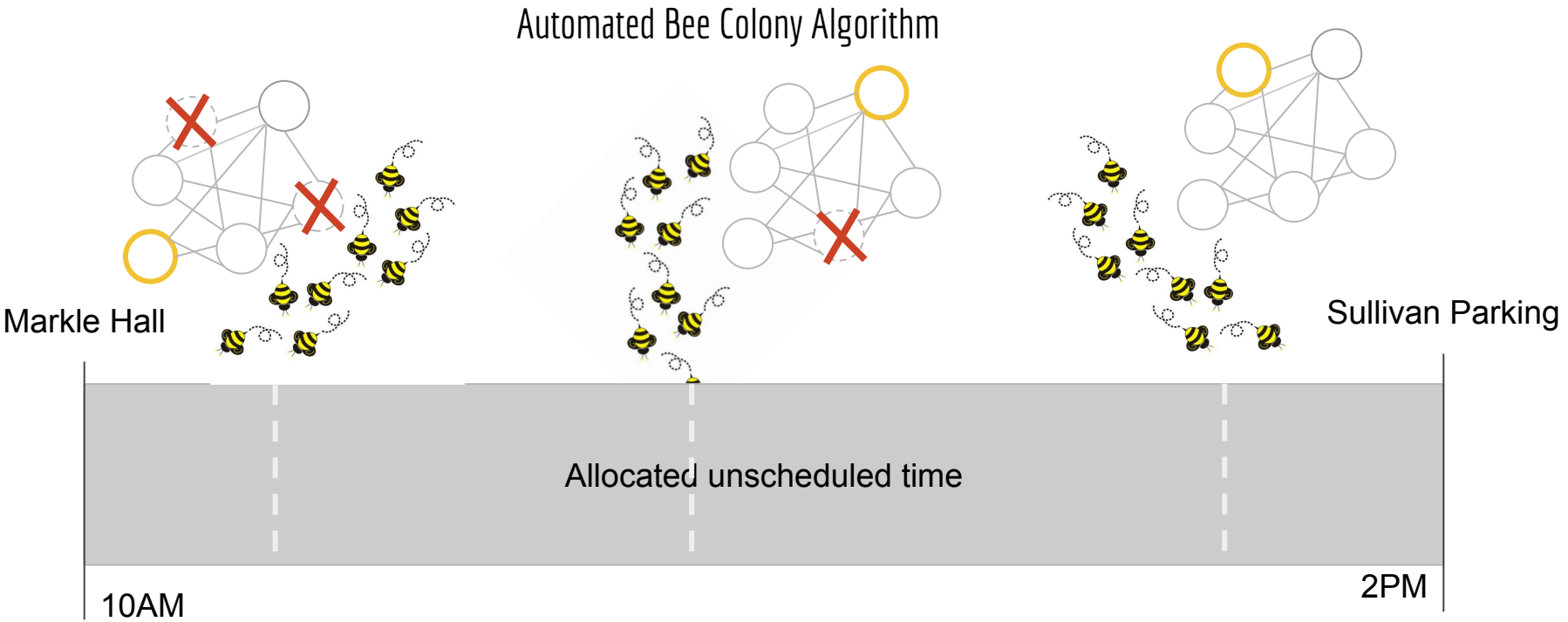
Optimal Path Finding and Itinerary Generation

Automated Bee Colony Algorithm



Main algorithm

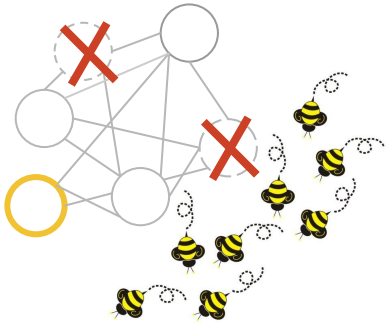
Optimal Path Finding and Itinerary Generation

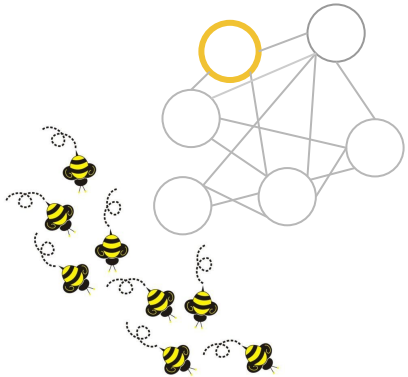


Main algorithm

Optimal Path Finding and Itinerary Generation

Automated Bee Colony Algorithm





Markle Hall

Sullivan Parking

Allocated unscheduled time	Meeting with Prof. in Acopian	Allocated unscheduled time

10AM

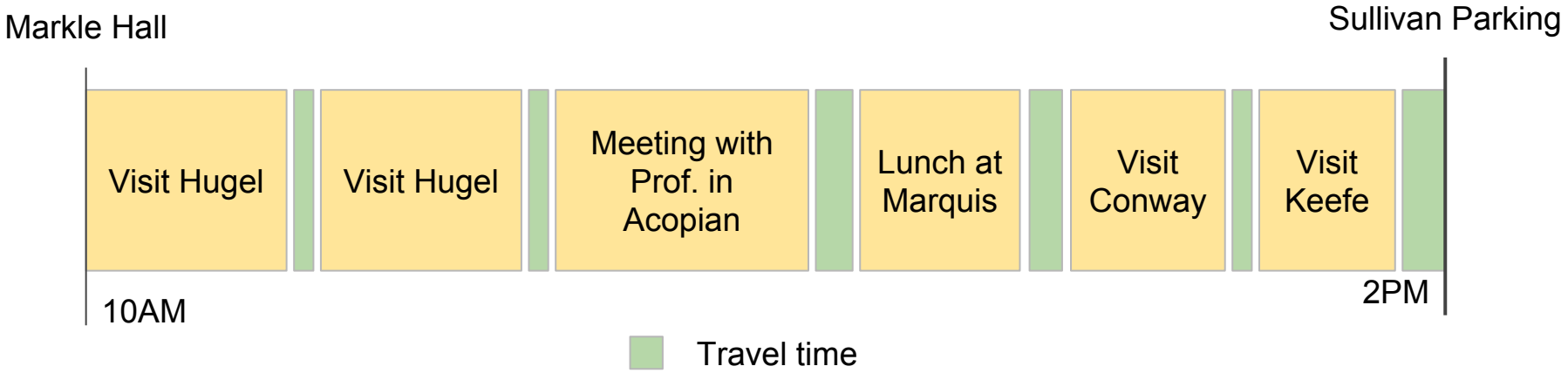
2PM

Goal test

$$(\forall t \in \text{FREE-TIME} : \text{AVAILABLE-NODES}(\text{STATE}_t) = \emptyset) \vee (\text{VISITED-NODES} = V)$$

Evaluation Criteria

Total tour interest score = $\sum$(event scores) - unallocated time



Future work

- Biases in training?
  - Users may “like” newer buildings that do not necessarily match preference
  - Groups of students that are more likely to “like” their buildings?
  - Could UI affect data? Example: Would people default to choosing the first tour?
- Privacy concerns?
  - Algorithm uses real-time location based data
- Expansion?
  - Neural nets are easily portable and scalable

Questions?