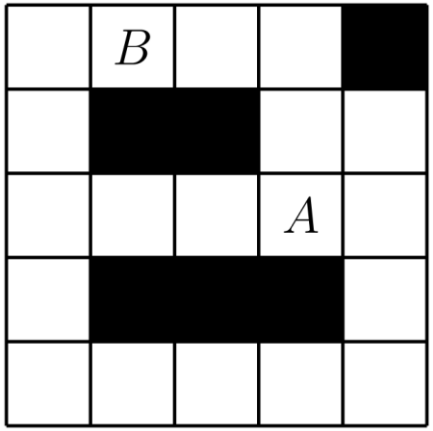
HW3

EE 4033 Algorithms, Fall 2018

107/11/28

Hand-Written Problems

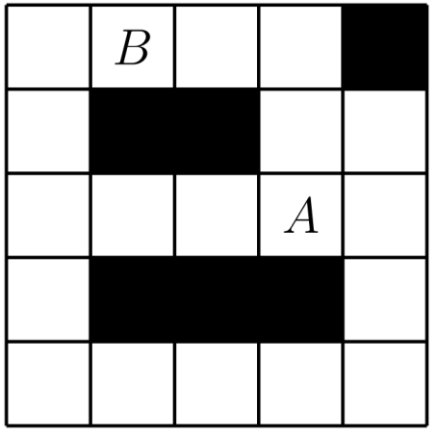
- **Problem 1**
  - Model a maze into a graph problem



  - Clearly explain your graph
    - Vertices, edges (directed/undirected), weights (if exists)...

Hand-Written Problems

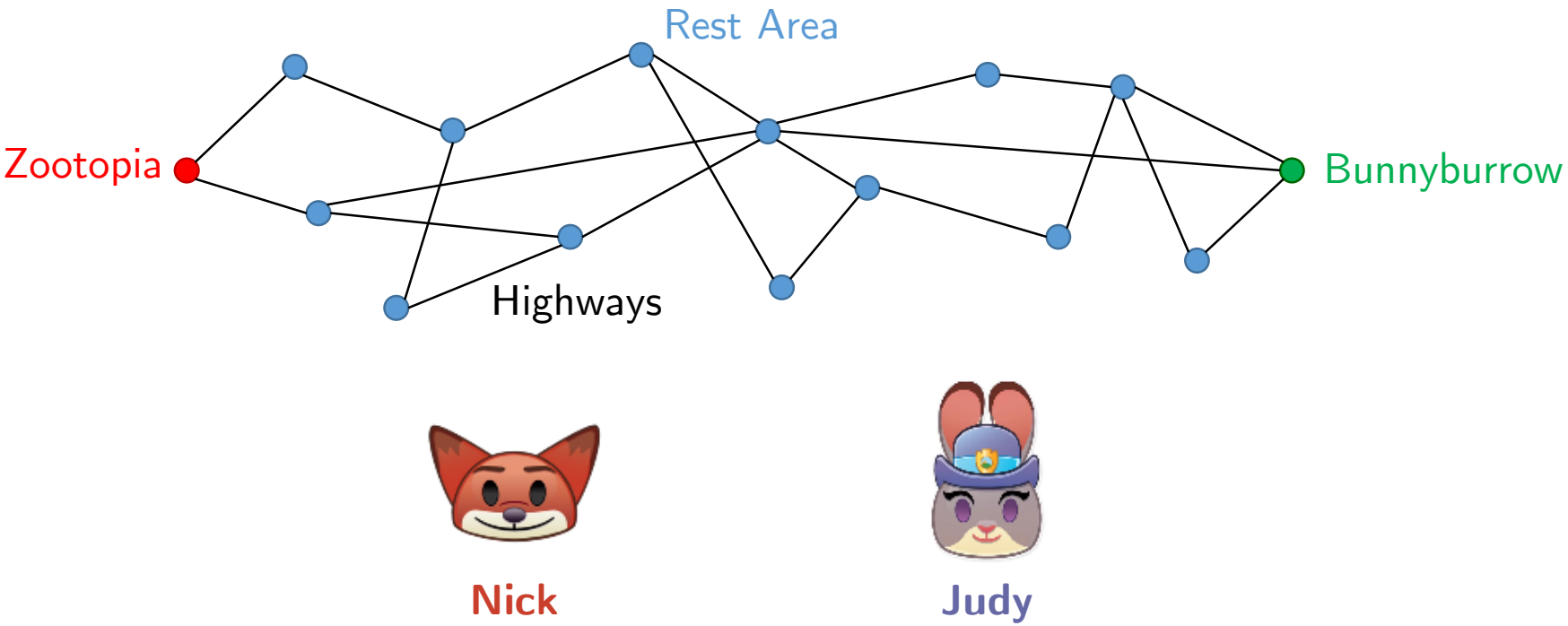
- **Problem 1**
  - Model a maze into a graph problem



  - Find the shortest path from A to B
    - Apply suitable graph algorithms
    - Solution may not exist

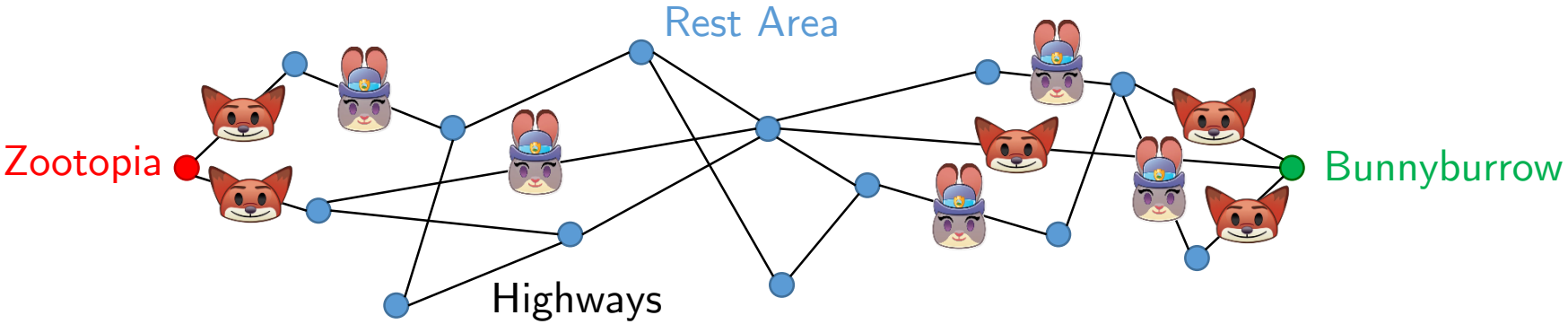
Hand-Written Problems

- **Problem 2**



Hand-Written Problems

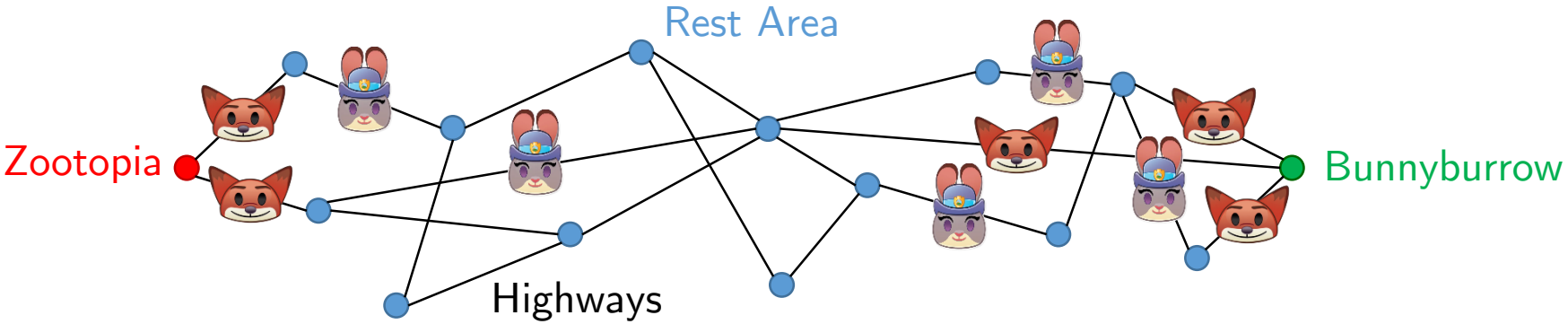
- **Problem 2**



  - Must take turns driving (at least once) at rest areas
  - **Nick** must be driving upon leaving Zootopia and arriving at Bunnyburrow

Hand-Written Problems

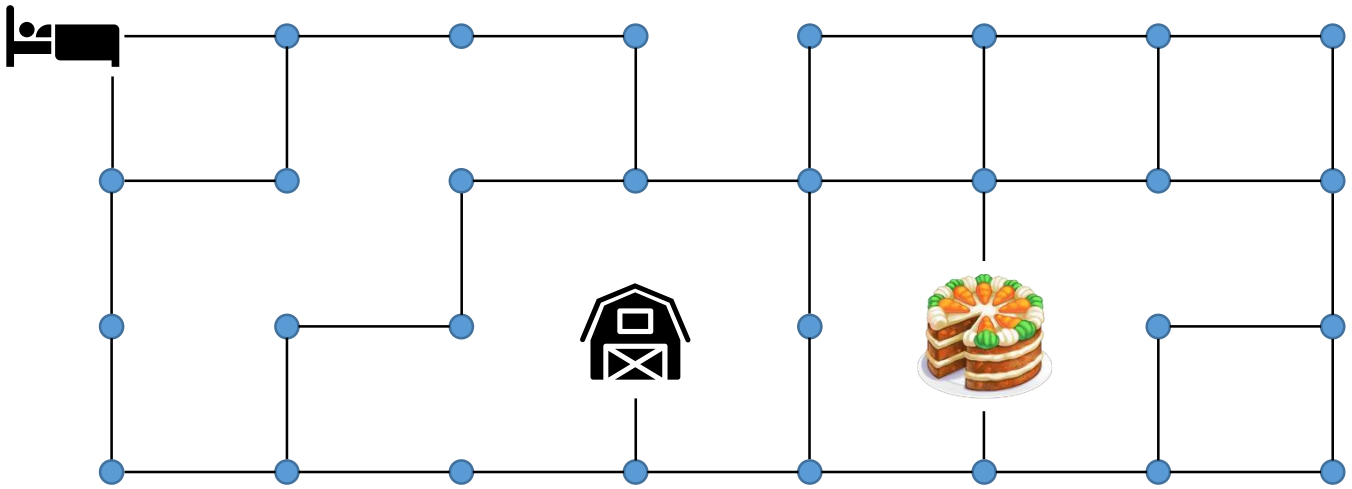
- **Problem 2**



  - Clearly explain your graph
    - Vertices, edges (directed/undirected), weights (if exists)...
  - Find the shortest path
    - Apply suitable graph algorithms
    - Solution may not exist

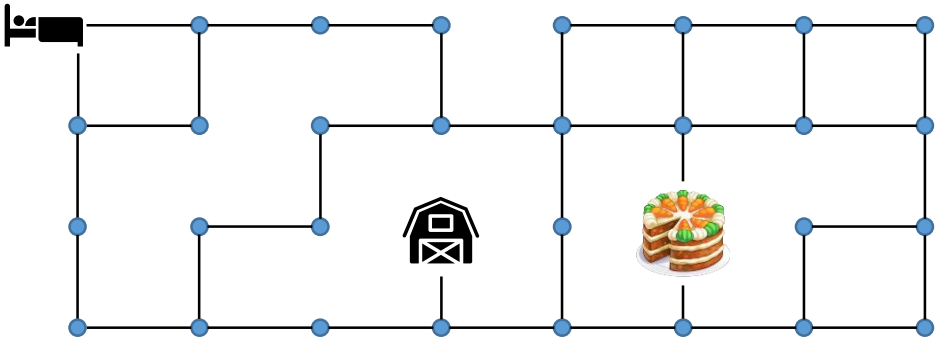
Hand-Written Problems

- **Problem 3**



Hand-Written Problems

- **Problem 3**



  - All road segments are of equal length
  - Clearly explain your graph
    - Vertices, edges (directed/undirected), weights (if exists)...
  - Find the shortest path from the hotel to the house
    - Stop by the patisserie if it does not increase the length of the path by at most a factor of α

Hand-Written Problems

- **Problem 4**
  - Design a feature that helps users find potential friends

Frd	A	B	C	D
A		V		V
B	V		V	V
C		V		V
D	V	V	V	

Int	A	B	C	D
A		0.8	0.6	0.5
B	0.7		0.4	0.2
C	0.5	0.3		0.7
D	0.4	0.2	0.9	

- **Users**: $V = \{A, B, C, D\}$
- **Interest**: $I(A, B) = 0.7$; $I(B, A) = 0.8$
- **Connections**: $P(A, D) = \{\langle A, D\rangle, \langle A, B, D\rangle, \underbrace{\langle A, B, C, D\rangle}_{p}\}$
- **Length**: $L(p) = |p| - 2 = 4 - 2 = 2$
- **Strength**: $S(p) = I(A, B) \times I(B, C) \times I(C, D) = 0.7 \times 0.3 \times 0.9 = 0.189$

Hand-Written Problems

- **Problem 4**

Frd	A	B	C	D
A		V		V
B	V		V	V
C		V		V
D	V	V	V	

Int	A	B	C	D
A		0.8	0.6	0.5
B	0.7		0.4	0.2
C	0.5	0.3		0.7
D	0.4	0.2	0.9	

  - Given the information above, find the **strength** of the strongest **connection** between a given user u and **every other** user v with a **length** of **at most** k
  - For example, given $u = A$, $k = 1$:

$P(A,B) = \{\langle A,B\rangle, \langle A,D,B\rangle, \langle A,D,C,B\rangle\}$
0.7 0.08 0.112

$P(A,C) = \{\langle A,D,C\rangle, \langle A,B,C\rangle, \langle A,B,D,C\rangle, \langle A,D,B,C\rangle\}$
0.28 0.21 0.098 0.024

$P(A,D) = \{\langle A,D\rangle, \langle A,B,D\rangle, \langle A,B,C,D\rangle\}$
0.4 0.14 0.189

Output

$$\begin{cases} \boldsymbol{B}: 0.7 \\ \boldsymbol{C}: 0.28 \\ \boldsymbol{D}: 0.4 \end{cases}$$

Remarks

- Try not to describe your algorithms with codes
  - If you use any algorithm that is taught in class or described in the textbook, do not copy them down to your answer sheet. Writing its name is sufficient.
- We give partial credits
  - Try not to leave any problems blank
  - Answers with more efficient algorithms get higher scores

Programming Problems

- **Problem 1**
  - Course Schedule Arranging
    - Some courses have prerequisites
    - Some courses may not be available in every school term
    - Goal is to graduate as soon as possible

Programming Problems

- **Problem 1**

Course ID	Course Title	Prerequisites	Availability	
			Spring	*Fall*
0	Psychology	—		✓
1	Criminology	Psychology	✓	
2	Constitutional Law	Psychology	✓	
3	Criminal Law	Criminology, Constitutional Law	✓	✓

  - Example (joined the academy in Spring, 2016)
    - Minimum courses required to graduate: 4
    - An optimal schedule (required terms to graduate = 4)

	Courses
Spring, 2016	—
Fall, 2016	Psychology
Spring, 2017	Criminology, Constitutional Law
Fall, 2017	Criminal Law

Programming Problems

- **Problem 1**

Course ID	Course Title	Prerequisites	Availability	
			Spring	*Fall*
0	Psychology	—		✓
1	Criminology	Psychology	✓	
2	Constitutional Law	Psychology	✓	
3	Criminal Law	Criminology, Constitutional Law	✓	✓

	Courses
Spring, 2016	—
Fall, 2016	Psychology
Spring, 2017	Criminology, Constitutional Law
Fall, 2017	Criminal Law

Course Information

Prerequisite Pairs

input.txt	output.txt
4 4 0 1 1 0 2 0 3 2 1 0 2 0 3 1 3 2	4 -1 0 1 2 3

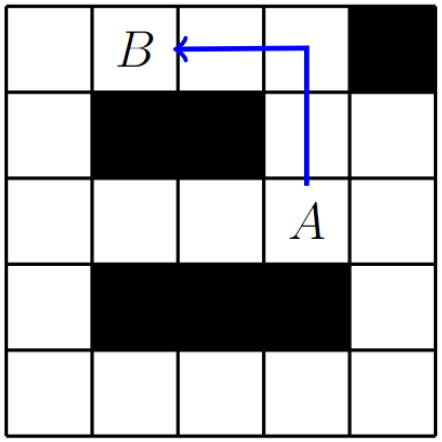
Minimum terms required to graduate

Programming Problems

- **Problem 1**
  - Model the scenario into a graph problem
  - Solve the problem using graph algorithms
  - Explain your work in the report

Programming Problems

- **Problem 2**
  - Write a program that solves any rectangular maze



input.txt	output.txt
1 3 1 1 0 1 0 0 1 1 1 1 1 2 1 1 0 0 0 1 1 1 1 1 1	1 1 4 4 4

0: wall
1: path
2: start
3: end

1: north
2: east
3: south
4: west

Programming Problems

- For **both** Problem 1 and Problem 2, we will give a bonus for better performances (10 points each) if the running time of your program is faster than 90% of all students in the class.
- The running time will be evaluated by TA's testing data (not released to students).

Remarks

- Read the HW instructions very carefully
  - Failing to follow them may lead to loss of credits
- All the inputs are of arbitrary size
- Use the provided `selfCheck.py` to check the format of your `.zip`/`.tar` file before uploading
  - Do not include redundant files for it might cause troubles when judging

Remarks

- About referencing
  - Starting from HW3, all referencing specifications can be listed **either** on your hand-written answer sheet, **or** in the pdf file of your programming report.
  - If URLs are too long, you can print them out or simply write down the name/title of the webpage