Recording

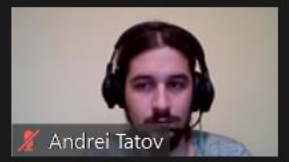
LZW DECODING

HOMEWORK

0 1 2 3 5 4 5 7 11 13 6 4

Y: 0
A: 1
S: 2
*:3
G:4

Previous	Current String	Output (current string value)	New Dictionary String
/	0	Y	-
Y	1	A	YA:5
A	2	S	AS:6
S	3	*	S*:7
*	5	YA	*Y:8
YA	4	G	YAG:9



Recording

LZW DECODING

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YA	4	G	YAG:9
G	5	YA	GY:10
YA	7	S*	YAS:11
S*	11	YAS	S*Y:12
YAS	13	???	???

Recording

LZW DECODING

HOMEWORK

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YA	7	S*	YAS:11
S*	11	YAS	S*Y:12
YAS	13	YASY	YASY:13
YASY	6	AS	YASYA:14
AS	4	G	ASG:15
G	/	-	-

Recording

DESIGN BY INDUCTION

THEORY

1. **BASE CASE**
   solve a small instance of the problem
2. **ASSUMPTION**
   assume you can solve smaller instances of the problem
3. **INDUCTION STEP**
   make solution of problem from solutions of the smaller problems

Recording

THE SUCCESSFUL PARTY PROBLEM

PROBLEM

You are arranging a party and have a list of n people that you could invite. In order to have a **successful party**, you want to invite as many people as possible, but **every invited person must be friends with at least k of the other party guests**. For each person, you know his/her friends. **Find the set of invited people.**

Recording

THE SUCCESSFUL PARTY PROBLEM

PROBLEM

WHAT WE KNOW

the friends of each person

WHAT WE NEED TO FIND

the list of people that we can invite such that we have a successful party

SUCCESSFUL PARTY

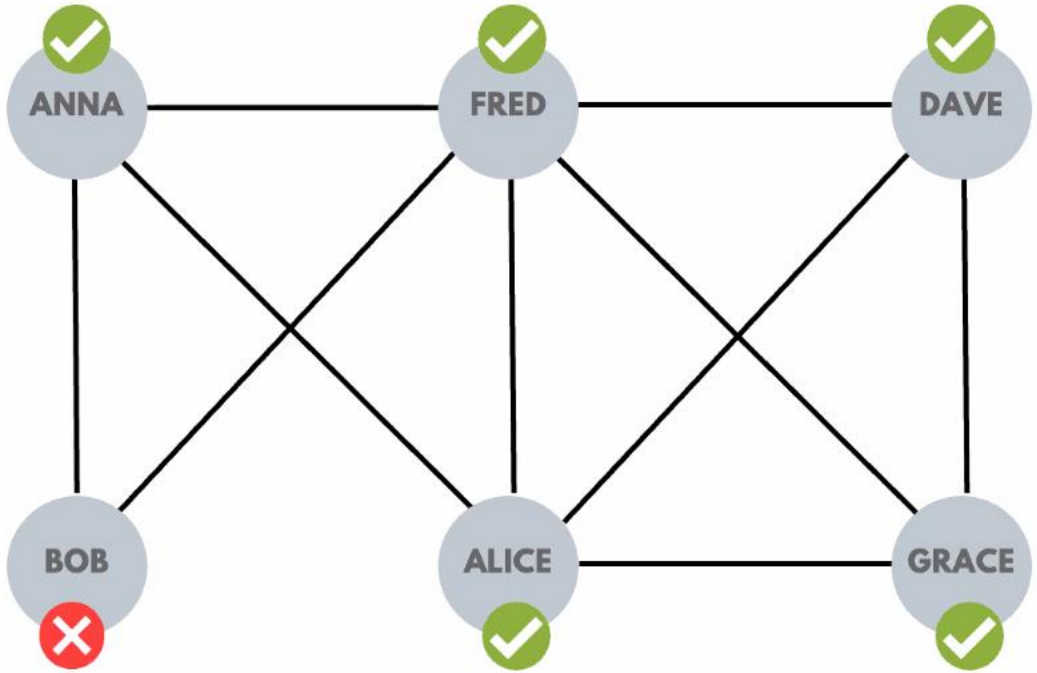
Invite as many people as possible such that, each person must be friends with at least K of the other party quests.

Recording

THE SUCCESSFUL PARTY PROBLEM

QUESTION

If k=3, is a succesful party possible?



Recording

THE SUCCESSFUL PARTY PROBLEM

QUESTION

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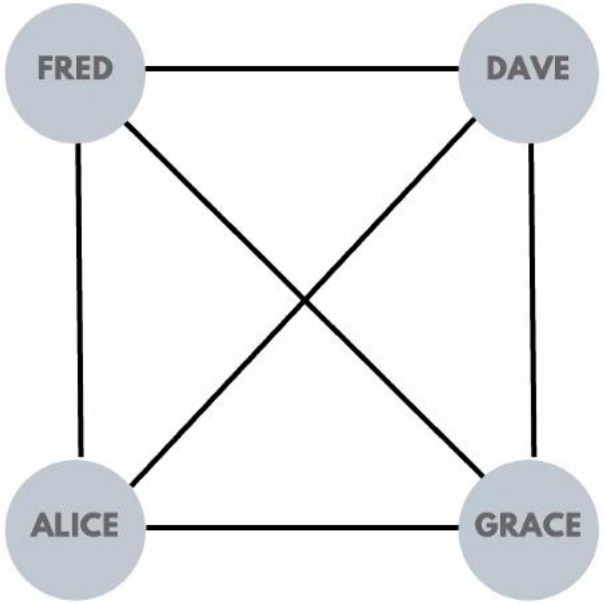

THE SUCCESSFUL PARTY PROBLEM

QUESTION

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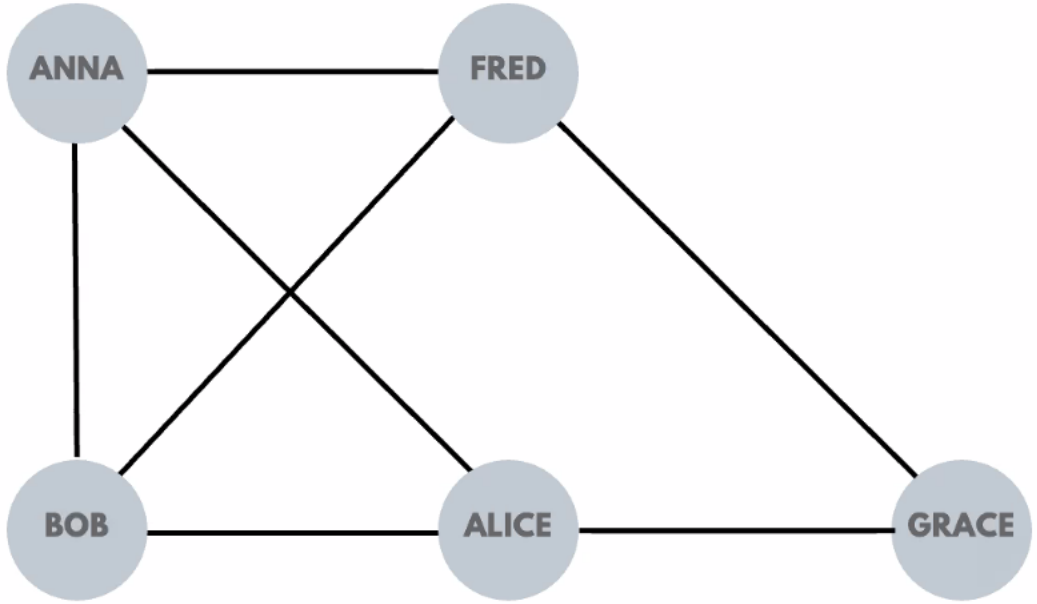

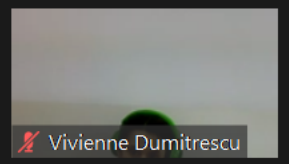

Recording

THE SUCCESSFUL PARTY PROBLEM

QUESTION

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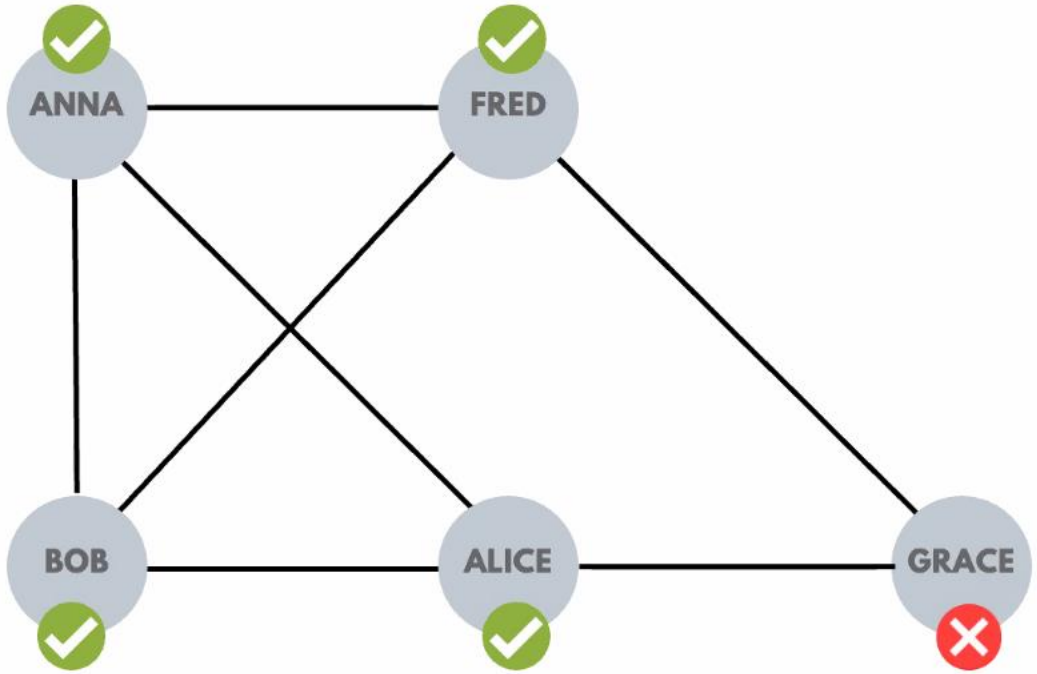
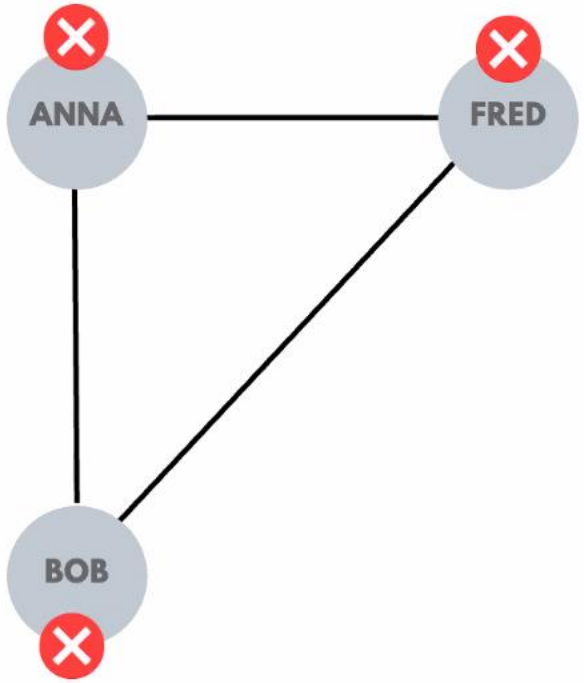


Recording

THE SUCCESSFUL PARTY PROBLEM

QUESTION

If k=3, is a succesful party possible?



ANSWER

NO, A SUCCESFUL PARTY IS NOT POSSIBLE.

Recording

THE SUCCESSFUL PARTY PROBLEM

SOLUTION DIRECT APPROACH

DIRECT APPROACH

remove persons who have less than k friends

REMOVE FIRST ONE PERSON, THEN CONTINUE WITH AFFECTED PERSONS?

REMOVE ALL PERSONS WITH LESS THAN K FRIENDS, THEN DEAL WITH THE PERSONS THAT ARE LEFT WITHOUT ENOUGH FRIENDS?

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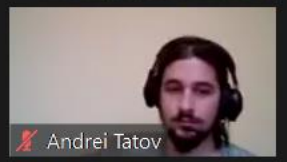


Recording

DESIGN BY INDUCTION

THEORY

INSTEAD OF THINKING ABOUT OUR ALGORITHM AS A SEQUENCE OF STEPS TO BE EXECUTED, THINK OF PROVING A THEOREM THAT THE ALGORITHM EXISTS.

Recording

DESIGN BY INDUCTION

THEORY

1. **BASE CASE**
   solve a small instance of the problem
2. **ASSUMPTION**
   assume you can solve smaller instances of the problem
3. **INDUCTION STEP**
   make solution of problem from solutions of the smaller problems

Recording

THE SUCCESSFUL PARTY PROBLEM

SOLUTION DESIGN BY INDUCTION

1 BASE CASE

solve a small instance of the problem

n = number of people
k = minimum number of required friends

n<=k

NO ONE CAN BE INVITED

n=k+1

If every person knows all of the others
EVERYONE IS INVITED
else
NO ONE CAN BE INVITED

2 ASSUMPTION

assume you can solve smaller instances of the problem

Assume we know how to select the invited persons out of a list of n-1

3 INDUCTION STEP

make solution of problem from solutions of the smaller problems

Prove for n

If all n persons have > k friends
EVERYONE IS INVITED
else
if at least 1 person has < k friends
REMOVE & SOLVE FOR N-1

Recording

THE SUCCESSFUL PARTY PROBLEM

SOLUTION DESIGN BY INDUCTION

FUNCTION PARTY(PS : PERSONSET)

```
N = CARD (PS)

IF N <= K THEN          // NO PERSON IS INVITED
   RETURN NULL;

IF N = K+1 THEN
      IF (*EVERYBODY IS FRIEND WITH EVERYBODY IN PS)          // EVERYONE IS INVITED
            RETURN ALL PERSONS FROM PS

IF (*EVERYBODY FROM PS HAS AT LEAST K FRIENDS FROM PS)
      RETURN ALL PERSONS FROM PS                              // EVERYONE IS INVITED

* FIND FIRST PERSON P WHO HAS LESS THAN K FRIENDS
PS2 =  PS – {P}          // REMOVE
RETURN PARTY(PS2) // SOLVE FOR N-1
```

BASE CASE

BASE CASE

INDUCTION STEP

INDUCTION STEP

Recording

THE CELEBRITY PROBLEM

PROBLEM

A **celebrity** in a group of people is someone who is **known by everybody but does not know anyone**. You are allowed to ask anyone from the group a question such as **"Do you know that person?"** pointing to any other person from the group. **Identify the celebrity (if one exists) by asking as few questions as possible**

Recording

THE CELEBRITY PROBLEM

PROBLEM

WHAT WE KNOW

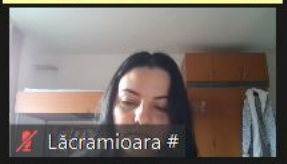
Given a n*n matrix with know[p, q] = true if p knows q and know[p, q] = false otherwise

WHAT WE NEED TO FIND

Determine whether there exists an i such that:
Know[j; i] = true (for all j, j≠ i) and Know[i; j] = false (for all j, j≠i)

CELEBRITY

someone who is known by everybody but does not know anyone



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THE CELEBRITY PROBLEM

PROBLEM

GIVEN A N*N MATRIX WITH KNOW[P, Q] = TRUE IF P KNOWS Q AND KNOW[P, Q] = FALSE OTHERWISE

row \ column	0	1	2	3	4
0					
1					
2					
3					
4					

THE CELEBRITY PROBLEM

QUESTION

Do we have a celebrity?

Person 0 knows: 1, 3

Person 1 knows: 3

Person 2 knows: 1, 3, 4

Person 3 knows: -

Person 4 knows: 2, 3

row \ column	0	1	2	3	4
0		1		1	
1				1	
2		1		1	1
3					
4			1	1	

THE CELEBRITY PROBLEM

QUESTION

Do we have a celebrity?

Person 0 knows: 1

Person 1 knows: 3

Person 2 knows: 1, 3, 4

Person 3 knows: 2

Person 4 knows: 2, 3

row \ column	0	1	2	3	4
0		1			
1				1	
2		1		1	1
3			1		
4			1	1	

Recording

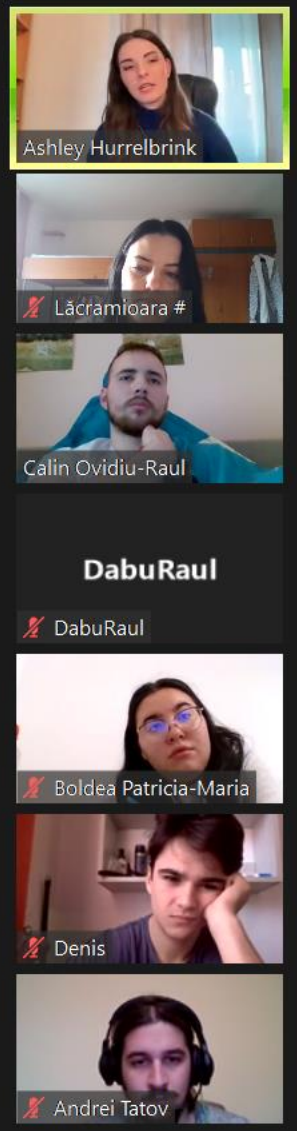
THE CELEBRITY PROBLEM

SOLUTION DESIGN BY INDUCTION

The key idea here is to ***reduce the size*** of the problem from n persons to n-1, but ***in a clever way*** – by *eliminating someone who is a non-celebrity*.

After each question, we can eliminate a person

- if knows[**i**,j] then ***i*** cannot be a celebrity => elim i
- if not knows[i,**j**] then ***j*** cannot be a celebrity => elim j



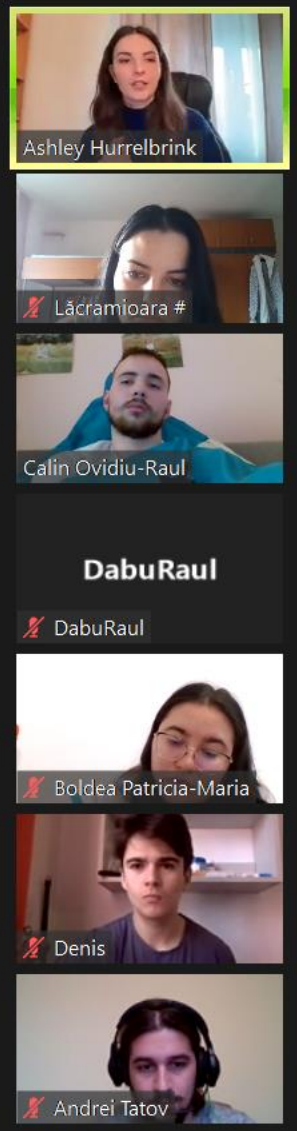
THE CELEBRITY PROBLEM

SOLUTION DESIGN BY INDUCTION

```
Function Celebrity_Sol3(S:Set of persons) return person

   if card(S) = 1 return S(1)
   pick i, j any persons in S

   if knows[i, j] then // i no celebrity
      elim=i
   else // if not knows[i, j] then j no celebrity
      elim=j

   p = Celebrity_Sol3(S-elim)

   if p != 0 and knows[elim,p] and not knows[p,elim]
      return p
   else
      return 0 // no celebrity
```

eliminate

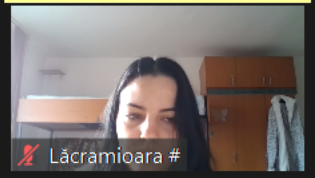
Verify for n-1



LAB 7 Application

Implement the solution for one of the presented problems

- THE SUCCESSFUL PARTY PROBLEM
- THE CELEBRITY PROBLEM
- THE SKYLINE PROBLEM



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TEST 2

SUBJECTS

LAB 6 Data compression algorithms

- HUFFMAN & LZW

LAB 7 Design by induction

- THEORY
- SUCCESFUL PARTY, CELEBRITY, SKYLINE PROBLEMS