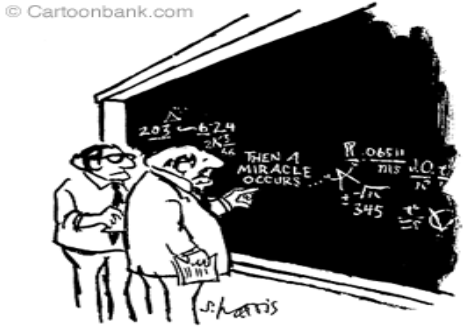
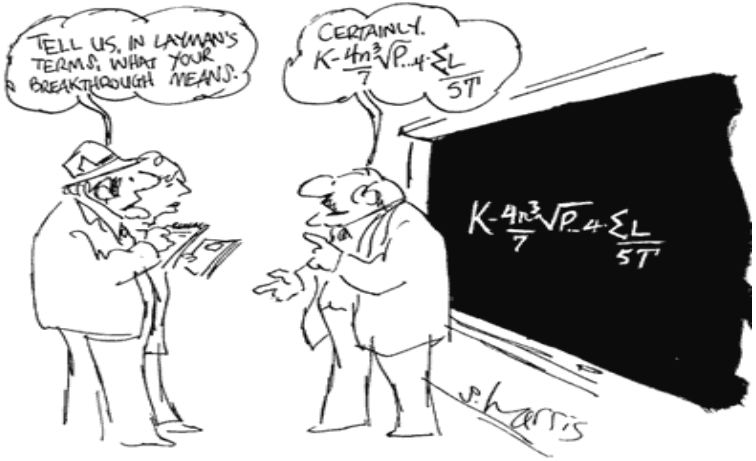
CSE 20
DISCRETE MATH

Spring 2016

http://cseweb.ucsd.edu/classes/sp16/cse20-ac/

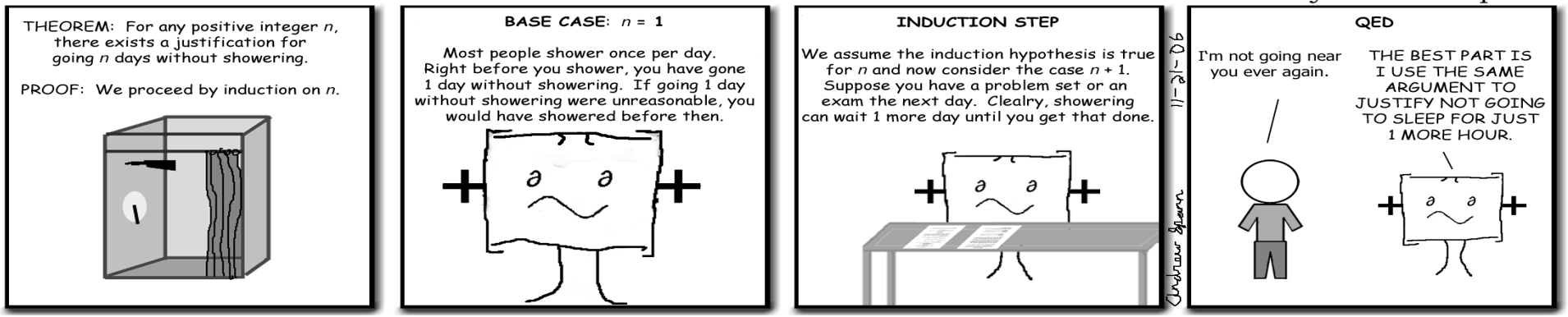
Learning goals





PROOF OF FALSE

by Andrew Spann



About you

CENTR101: CA PCYNH109: AB

To change your remote frequency
1. Press and hold power button until flashing
2. Enter two-letter code
3. Checkmark / green light indicates success

Have you used iClickers before?

A. Yes
B. No

Why use clickers?

About you

CENTR101: CA PCYNH109: AB

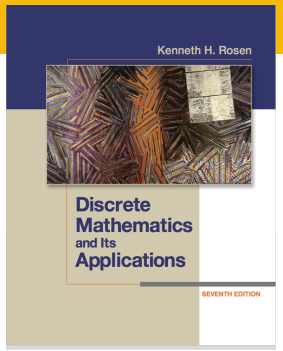
To change your remote frequency
1. Press and hold power button until flashing
2. Enter two-letter code
3. Checkmark / green light indicates success

What other CSE class are you taking this quarter?

A. None.
B. CSE 12.
C. CSE 11.
D. CSE 8B.
E. Some other CSE class.

Introductions

Logistics



Textbook: Rosen 7th Edition

Participation: Class times (iClicker questions) & discussion (quizzes)
https://www1.iclicker.com/register-clicker/
http://sections.ucsd.edu

Exams: Tuesday April 19 ** No makeup exams **
Tuesday May 17
Final Exam **Saturday** June 4

Gradescope: Homework submission and exam return
Piazza: announcements and Q&A. Contact instructors here!
Office hours: instructors and tutors. Discuss HW questions here!
Class podcast: podcast.ucsd.edu

Logistics

- Exams 65% HW + Participation 35%
- Details on class website: http://cseweb.ucsd.edu/classes/sp16/cse20-ac
- Weekly HW, can be done in groups of 1-3, can change groups throughout quarter
- Drop lowest HW score
- Drop lowest midterm score if do better on final
- Can use note sheet for exams
- Participation earned via either class participation or discussion quizzes
- Drop lowest discussion quiz score and two lowest class participation scores
- Credit for participation if answer 80% of clicker question in that day's class
- HW and exams answers evaluated not only on the correctness of your answers, but on your ability to effectively communicate your ideas and convince the reader of your conclusions through proofs and logical reasoning
- Assume some familiarity with programming (not necessarily specific language)

About this class: Academic integrity

You are working on a homework question with your group members and are stuck on a question. You run into a friend who solved the problem already and shows you her solution. You look at it, but put it away before continuing the group conversation. Is this acceptable?

A. Yes
B. No

About this class: Academic integrity

You form a group to work on a homework assignment. There are three group members and three questions. You split up the work so that each student gets one question. After you work on your individual questions for a while, you get together as a group and proofread the solutions, then hand them in. Is this acceptable?

A. Yes
B. No

About this class: Academic integrity

You're working on a homework question and run across a definition you don't understand. You Google the term and, 'lo and behold, the first hit is a full solution to the homework question. You avoid reading the solution and close the browser. You keep working on the solution and hand in the assignment, without mentioning the Google search since you didn't use the result. Is this acceptable?

A. Yes
B. No

About this class: Academic integrity

You're not sure if you are interpreting a homework problem correctly. You write a post on Piazza explaining your approach to answering it, and asking if this is the correct way to interpret the question. Is this acceptable?

A. Yes
B. No

Today's learning goals

- Trace pseudocode given input.
- Explain the higher-level function of an algorithm expressed with pseudocode.
- Identify and explain (informally) whether and why given pseudocode satisfies properties of being an algorithm
- Define the greedy approach for an optimization problem.
- Analyze whether the greedy approach solves an optimization problem.

Algorithms!

Multiply 142 x 17.

What did we do?

Another way? RPM

Write the factors in two columns.

Repeatedly double the LEFT and halve the right.
(Truncate fractions, i.e. toss remainders)

Cross out the LEFT values where the RIGHT values are even.

Add the remaining LEFT values together.

Is there another way? RPM

142	17
~~284~~	8
~~568~~	4
~~1136~~	2
2272	1

2414

Write the factors in two columns.

Repeatedly double the LEFT and halve the right. (Truncate fractions, i.e. toss remainders)

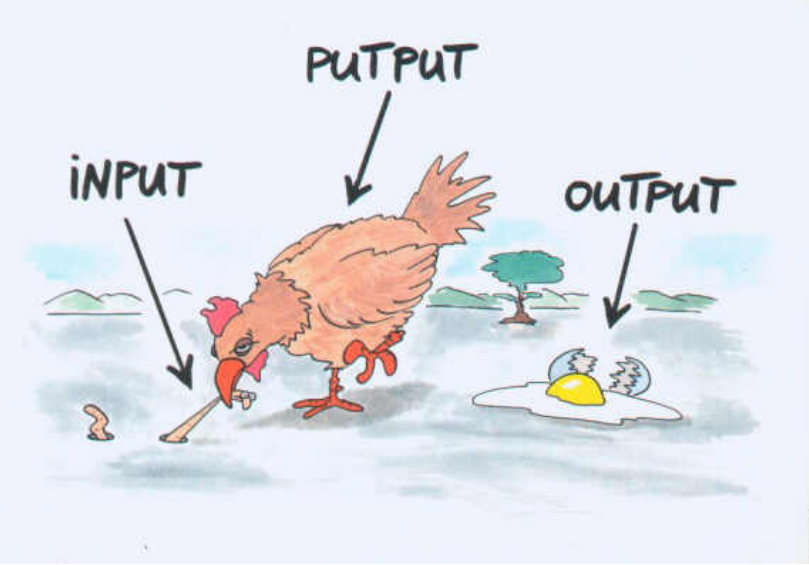
Cross out the LEFT values where the RIGHT values are even.

Add the remaining LEFT values together.

Algorithm?

Rosen 3.1 p. 191

Finite sequence of precise instructions for solving problem.



Algorithm?

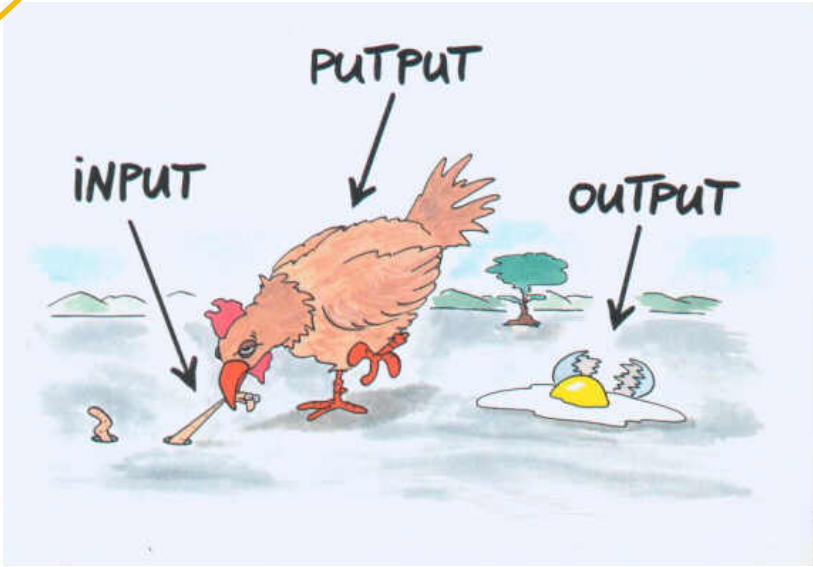
Rosen 3.1 p. 191

Finite sequence of precise instructions for solving problem.

Finiteness

Definiteness

Correctness



To describe an algorithm

Rosen Appendix 3

- English description.

- Pseudocode.

To describe an algorithm

Rosen Appendix 3

- English description.

- Pseudocode.

For RPM: see HW1

To describe an algorithm

Rosen Appendix 3

procedure $alg1(a:$ real number; $n:$ positive integer)

1. $x := 1.0$
2. **for** $i := 1$ **to** n
3. $\quad x := x \cdot a$
4. **return** x

What is / are the input(s)?

A. Only x
B. Only a and n
C. Only a and x
D. Only x and n
E. The variables a, i, x and n

To describe an algorithm

Rosen Appendix 3

procedure $alg1(a:$ real number; $n:$ positive integer)

1. $x := 1.0$
2. **for** $i := 1$ **to** n
3. $\quad x := x \cdot a$
4. **return** x

Definite? Finite?

To describe an algorithm

Rosen Appendix 3

procedure $alg1(a :$ real number; $n :$ positive integer)

1. $x := 1.0$ **Assignment**
2. **for** $i := 1$ **to** n
3. $\quad x := x \cdot a$
4. **return** x

Definite? Finite?

To describe an algorithm

Rosen Appendix 3

procedure $alg1(a:$ real number; $n:$ positive integer)

1. $x := 1.0$
2. **for** $i := 1$ **to** n
3. $\quad x := x \cdot a$
4. **return** x

What does the procedure return when a is 3 and n is 4?

A. 1
B. 12
C. 64
D. 81
E. None of the above.

To describe an algorithm

Rosen Appendix 3

procedure $alg1(a:$ real number; $n:$ positive integer)

1. $x := 1.0$
2. **for** $i := 1$ **to** n
3. $\quad x := x \cdot a$
4. **return** x

What's a description in English of this algorithm?

To describe an algorithm

Rosen Appendix 3

procedure $alg1(a:$ real number; $n:$ positive integer)

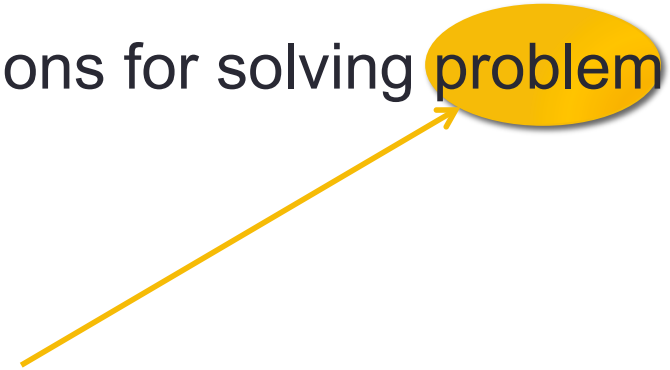
1. $x := 1.0$
2. **for** $i := 1$ **to** n
3. $\quad x := x \cdot a$
4. **return** x

Describe the output of this algorithm as a function of a and n.

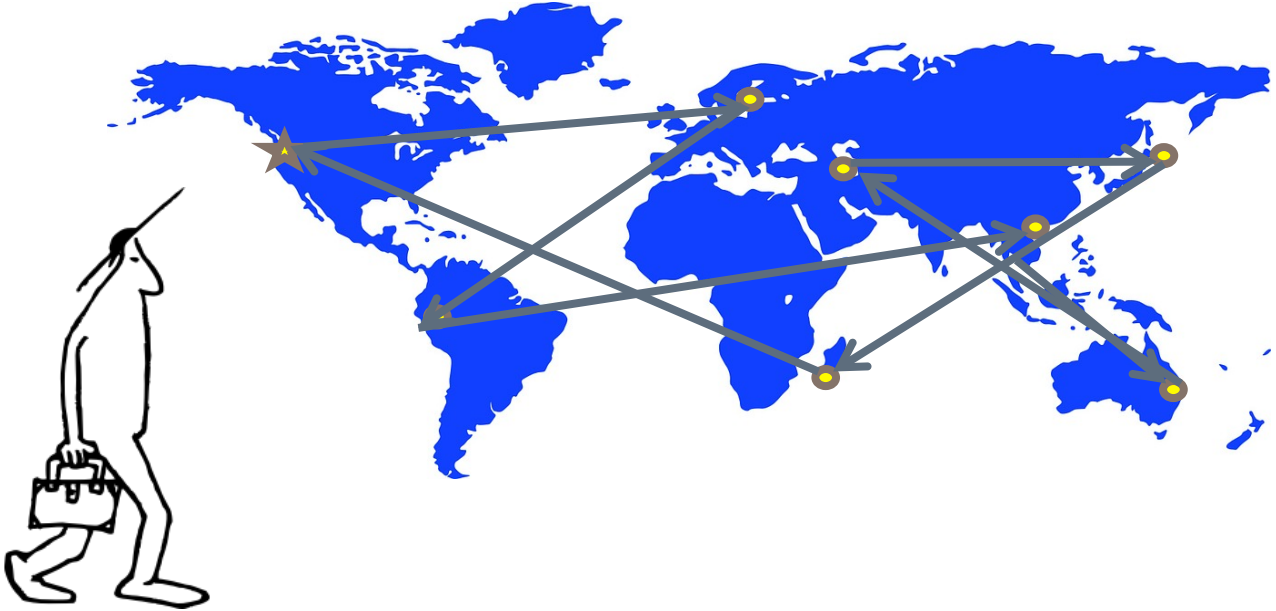
Algorithm?

Rosen 3.1 p. 191

Finite sequence of precise instructions for solving problem.



Optimization



Cookies!

JS p. 77

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

Select 6 cookies

Optimize: maximize total number of chocolate chips

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
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Select 6 cookies

Optimize: maximize total number of chocolate chips

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second, etc.

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
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7	22	28	13	25	4

Select 6 cookies

Optimize: maximize total number of chocolate chips

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second, etc.

Definite? Finite? Correct? i.e. ***Will it always find the optimal solution?***

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

Select 6 cookies
at most one from each row and column
Optimize: maximize total number of chocolate chips

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second (**of allowed remaining cookies**), etc.

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

What cookie is picked first?

A. 4
B. 45
C. 50
D. None of the above

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second (**of allowed remaining cookies**), etc.

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

What cookie is picked next?

A. 48
B. 40
C. 36
D. 4
E. None of the above

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second (**of allowed remaining cookies**), etc.

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
17	32	29	27	35	14
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What cookie is picked next?

A. 48
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Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second (**of allowed remaining cookies**), etc.

Cookies!

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12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second (**of allowed remaining cookies**), etc.

Cookies!

JS p. 77, Rosen p. 198

56	76	69	60	75	51
61	77	74	72	80	58
82	97	94	88	99	92
47	68	59	52	65	40
78	81	79	71	85	62
50	67	73	57	70	46

Select 6 cookies
at most one from each row and column
Optimize: maximize total number of chocolate chips

Greedy approach: pick cookie with most chocolate chips first, then with 2nd most second, etc.

May not find the optimal solution! Proof: counterexample.

Cookies!

JS p. 77, Rosen p. 198

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

Greedy choice:
gets 50+36+29+16+7+2 = 140

12	31	24	16	30	8
17	32	29	27	35	14
38	48	46	43	50	45
5	23	15	9	20	2
33	36	34	26	40	18
7	22	28	13	25	4

Optimal choice:
gets 45+33+30+28+27+23 = 186

For next time

- Discussion section tomorrow
  - Sign up at sections.ucsd.edu tonight
- Start Homework 1
  - Set up course tools
  - Pseudocode and algorithms