Before we start

Are you eating properly? Do you have adequate access to nutritious food? Do you have stable housing? Are you homeless or couch surfing? If you or someone you know is suffering from food and/or housing insecurities, please note:

The Triton Food Pantry (in the old Student Center),

https://www.facebook.com/tritonfoodpantry/

is free and anonymous, and includes produce.

Financial aid resources, the possibility of emergency grant funding, and off-campus housing referral resources are available. CAPS and college deans can connect students to the above resources.
Before we start

The Office for the Prevention of Harassment & Discrimination (OPHD) provides assistance to students, faculty, and staff regarding reports of bias, harassment, and discrimination. OPHD is the UC San Diego Title IX office. Title IX of the Education Amendments of 1972 is the federal law that prohibits sex discrimination in educational institutions that are recipients of federal funds.

Students have options for reporting incidents of sexual violence and sexual harassment. Information about reporting options may be obtained at OPHD at (858) 534-8298, ophd@ucsd.edu or http://ophd.ucsd.edu. Students may receive confidential assistance at CARE at the Sexual Assault Resource Center at (858) 534-5793, sarc@ucsd.edu or http://care.ucsd.edu or Counseling and Psychological Services (CAPS) at (858) 534-3755 or http://caps.ucsd.edu.

Students may feel more comfortable discussing their particular concern with a trusted employee. This may be a Jacobs School student affairs staff member, a department Chair, a faculty member or other University official. These individuals have an obligation to report incidents of sexual violence and sexual harassment to OPHD. This does not necessarily mean that a formal complaint will be filed. If you find yourself in an uncomfortable situation, ask for help. The Jacobs School is committed to upholding University policies regarding nondiscrimination, sexual violence and sexual harassment.
Is the sentence "This sentence is false" true or false?
Learning goals

"I think you should be more explicit here in step two."

Is the sentence "This sentence is false" true or false?
Learning goals

• How do we decide (and prove) what's true?
  About algorithms and games and strategies / databases / cryptographic systems / compilers / operating systems / circuits …

• How do we exploit these properties to build new systems?
  Use integer representations to build ALU, use strings to build error-correcting codes, use logic to optimize database queries …

• What's impossible? And what can we say about it?
  Logical paradoxes, different sizes of infinity
About you

Have you used iClickers before?
A. Yes
B. No

MANDE B-210: CA    PETER 108: AC

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

Why use clickers?
About you

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.

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

"Minnes" rhymes with Guinness

CSE 4206: office hours + come by anytime I'm in.

Best way to get in touch is via Piazza

- Public post: question about class policy, notes, etc.
- Private post: question about your HW submission, grading, special circumstances.

Website: cseweb.ucsd.edu~/minnes
Email: minnes@eng.ucsd.edu
Logistics

Textbook: Rosen 7th Edition other editions ok; on reserve

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

Exams:      Tuesday Jan 31        ** No makeup exams **  
            Tuesday Feb 28  
            Final Exam ** Saturday ** March 18

Gradescope: Homework submission and exam return.
Piazza: announcements and Q&A.  Contact instructors here! HW solutions here!
Office hours: instructors and tutors. Discuss HW questions here!
Class podcast: podcast.ucsd.edu  (Mandeville video feed is broken; see Lec A)
Logistics

- Exams 65%  
  HW + Participation 35%
- Details on class website: [http://cseweb.ucsd.edu/classes/wi17/cse20-ab](http://cseweb.ucsd.edu/classes/wi17/cse20-ab)
- Weekly HW, can be done in groups of 1-3, can change groups throughout quarter
- Drop two lowest HW scores
- 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)
How to succeed

- Prepare ahead of class
  - Read assigned sections, do reading quiz before class
- Engage in class
  - Discuss questions with your neighbors, look for (counter)examples
  - Go over wrong choices too!
- Re-inforce after class
  - Briefly summarize what you learned
- Start homework early and work in a group
  - Tackle problems together: brainstorm, plan, and solve together
- Seek help and seek to help others, with integrity
About this class: Academic integrity

It's an integrity violation to…
• Click in for someone who is absent
• Sign discussion attendance sheet for someone who is absent
• Ask others to give you specific HW or quiz or test answers
• Share your answers on HW or quiz or test
• Work on HW with anyone else than your HW partners
• Search the internet or other resources not provided for the class for HW solutions or hints
• Share answers or notes while taking an exam

This not a complete list … you are responsible for knowing and following the guidelines Academic integrity violations will be taken seriously and reported immediately
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
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

• How can we determine if an algorithm does what it's supposed to?
  • 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.
  • Give counterexamples to show how an algorithm fails to be correct.
  • Define the greedy approach for an optimization problem.
  • Analyze whether the greedy approach solves an optimization problem.
Multiply 142 x 17.
What did we do?
Russian Peasant Multiplication

Start two columns, LEFT and RIGHT, and put the value of each factor at the top of each column.

Repeatedly double the LEFT and halve the RIGHT until the RIGHT value equals 1. (Truncate fractions, i.e. ignore remainders)

Cross out the LEFT values in each row with even RIGHT value.

Add the remaining LEFT values together.
# Russian Peasant Multiplication

Start two columns, LEFT and RIGHT, and put the value of each factor at the top of each column.

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Cross out the LEFT values in each row with even RIGHT value.

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**Russian Peasant Multiplication**

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Algorithm?

Finite sequence of precise instructions for solving problem.

THE FRIENDSHIP ALGORITHM

PLACe PHONE CALL

HOME?

WHAT IS THE RESPONSE?

DINE TOGETHER

BEGIN FRIENDSHIP!

Rosen 3.1 p. 191
Algorithm?

Finite sequence of precise instructions for solving problem.

Rosen 3.1 p. 191

Definiteness

Finiteness + Correctness
To describe an algorithm

• English description.

• Pseudocode.
To describe an algorithm

procedure $alg_1(a : \text{ real number}; n : \text{ positive integer})$

1. $x := 1.0$
2. for $i := 1 \text{ to } n$
3. $x := x \cdot a$
4. return $x$

Definite? Finite?
To describe an algorithm

\textbf{procedure} \textit{alg1}(a : real number; \textit{n} : positive integer)

1. \texttt{x := 1.0}
2. \texttt{for} \texttt{i := 1} \texttt{to} \texttt{n}
3. \texttt{x := x \cdot a}
4. \texttt{return} \texttt{x}

What is / are the input(s)?

A. Only \textit{x}
B. Only \textit{a} and \textit{n}
C. Only \textit{a} and \textit{x}
D. Only \textit{x} and \textit{n}
E. The variables \textit{a, i, x} and \textit{n}
To describe an algorithm

procedure $alg1(a: \text{ real number}; n: \text{ positive integer})$

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

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

1. \(x := 1.0\)
2. for \(i := 1\) to \(n\)
3. \(x := x \cdot a\)
4. return \(x\)

What's a description in English of this algorithm?
To describe an algorithm

\textbf{procedure} \textit{alg1}(a : real number; n : positive integer)

1. \textit{x} := 1.0
2. \textbf{for} \textit{i} := 1 \textbf{to} \textit{n}
3. \textit{x} := \textit{x} \cdot \textit{a}
4. \textbf{return} \textit{x}

Describe the output of this algorithm as a function of \textit{a} and \textit{n}. 
Algorithm?

Finite sequence of precise instructions for solving problem.

Rosen 3.1 p. 191

Not just arithmetic!
Optimization
Cookies!

Select 3 cookies

Optimize chocolate

*aka maximize total number of chocolate chips*

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Cookies!

Greedy approach: pick cookie with most chocolate chips first, then pick one with 2\textsuperscript{nd} most second, etc.

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Cookies!

Rosen p. 198

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Select 3 cookies

Optimize chocolate
aka maximize total number of chocolate chips

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

Correct? i.e. *Will it always find the optimal solution?*
Cookies!

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Select 3 cookies at most one per row/column
Optimize: maximize total number of chocolate chips

*Greedy approach*: pick cookie with most chocolate chips first, then pick one with 2\textsuperscript{nd} most second (of allowed remaining cookies), etc.
Cookies!

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

What cookie is picked first?
A. 1
B. 9
C. 8
D. Not well defined
Cookies!

Greedy approach: pick cookie with most chocolate chips first, then pick one with 2\textsuperscript{nd} most second (of allowed remaining cookies), etc.

What cookie is picked next?
A. 8
B. 1
C. 4
D. None of the above
Cookies!

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

*Rosen p. 198*

Is this the best we can do?

A. Yes

B. No, but there's no algorithm to find this best.

C. No, and there's an algorithm to find this best.
Cookies!

- Selecting *any 3 cookies* to maximize chocolate:
  - Greedy algorithm is definite, finite, correct.

- Selecting one cookie from *each row / each column*, to maximize chocolate:
  - Greedy algorithm is definite, finite, NOT correct.
For next time

• Discussion section tomorrow
  • Go to your assigned section.
  • If you have a conflict, post a private note on Piazza with request to swap.

• Start Homework 1      Due Sunday at noon
  • Find a group (you can use Piazza to help)
  • Set up course tools
  • Pseudocode and algorithms + number representations