Week 13 Recitation

Robert Woodward

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- Questions about lecture / homework so far?
- How to use Algorithm2e package for writing algorithms. See algo_example.tex for what was done in class, or visit `http://www.ctan.org/tex-archive/macros/latex/contrib/algorithm2e/` to see the package documentation.

  1. Start with an empty document
  2. Write the algorithm for finding the maximum element in a finite sequence (Slide 14 in Class Slides). [Only \usepackage{algorithm2e}]
     - Always state the input (using \KwIn) and output (using \KwOut)
     - How to use \For, \If
     - Always end with a "return" (using \Return) even when not returning any values
     - Always use \gets for assignments (Note: Always declare and initialize your local variables)
     - End each line with \;
     - Adding a \caption to describe the algorithm, and using \sc to denote the algorithm name
     - Adding \DontPrintSemicolon (Or \dontprintsemicolon depending on the algorithm2e version installed) will remove the semicolons from the end of the lines
  3. Change the package to: \usepackage[linesnumbered]{algorithm2e} – Now line numbers appear. You should always number your lines for quick referral.
  4. Change the package to: \usepackage[linesnumbered,ruled]{algorithm2e} – The caption moves to the top, and it adds horizontal lines to separate the algorithm
  5. Change the package to: \usepackage[linesnumbered,ruled,vlined]{algorithm2e} – The "Ends" for the if statement and for loop do away (Helps save on space).
  6. Write the algorithm for the greedy change-making (Slide 19 in Class Slides).

Also note, that you should use common functions and operands such as UNION, POWERSET, etc. as often as needed, unless you are asked to define them.

TUG (TEX Users' Group) is a great resource on learning LATEX. For information on algorithm2e from TUG, visit `http://www.tug.org/texlive/Contents/live/texmf-dist/doc/latex/algorithm2e/`.

- Rosen 3.3.7 (Similar to Homework problem 3.3.8)

  a) Evaluate $3x^2 + x + 1$ at $x = 2$ using the algorithm POLYNOMIAL, given in the problem description on page 199, by working through each step of the algorithm showing the values assigned at each assignment step.

  We want to run POLYNOMIAL$(2, 1, 1, 3)$, therefore to show the steps used in the algorithm, you show the changes in assignments incrementally.

  In this problem, we start with the first line:

  - $power = 1, y = 1$

  Then, you incrementally show each iteration of i in the for loop, and the changes of $power$ and y:

  - $i = 1, power = 2, y = 3$
  - $i = 2, power = 4, y = 15$

  b) Exactly how many multiplications and additions are used to evaluate a polynomial of degree n at $x = c$?

  Look before the for loop, how many multiplications and additions are there:

  - Multiplications: 0
  - Additions: 0

  Inside of the for loop, how many multiplications and additions are there:

  - Multiplications: 2
  - Additions: 1

  How many times does the for loop iterate: n

  How many total multiplications and additions are there:

  - Multiplications: $0 + n \times 2 = 2n$
  - Additions: $0 + n \times 1 = n$

- Rosen 3.1.1) List all the steps used by Algorithm 1, on page 169, to find the maximum of the list $\{1, 8, 12, 9, 11, 2, 14, 5, 10, 4\}$.

  To show the steps used in an algorithm, you show the changes in assignments incrementally.

  In this problem, we start with line 1 of the MAX method as defined in algo_example:

  - $max = 1$

Then, you incrementally show each iteration of i in the for loop of line 2, and the results if max changes:

- $i = 2, max = 8$
- $i = 3, max = 12$
- $i = 4$
- $i = 5$
- $i = 6$
- $i = 7, max = 14$
- $i = 8$
- $i = 9$
- $i = 10$

Putting all of this together, the answer would be:
$max = 1$
$i = 2, max = 8,$
$i = 3, max = 12,$
$i = 4,$
$i = 5,$
$i = 6,$
$i = 7, max = 14,$
$i = 8,$
$i = 9,$
$i = 10$

- Rosen 3.1.31 – Solution in algo_example.tex file

  Note that there is a difference between:

  - \If with \Else: There is an "End" after the If, which we do not want!
  - \uIf with \Else: There is not an "End" after the If, then the Else directly follows.
  - \lIf with \lElse: They do not expand the "If" and "Else" to a second line (Helps save on space).

- Rosen 3.1.53b) Use the greedy algorithm (Algorithm 6 on page 175) to make change using quarters, dimes, nickels, and pennies for 69 cents

  $c_1 = 25$, $c_2 = 10$, $c_3 = 5$, $c_4 = 1$.

  $n = 69$

  $C = \emptyset,$
  $i = 1, C = \{25\}, n = 44$
  $i = 1, C = \{25, 25\}, n = 19$

$i = 2, C = \{25, 25, 10\}, n = 9$
$i = 3, C = \{25, 25, 10, 5\}, n = 4$
$i = 4, C = \{25, 25, 10, 5, 1\}, n = 3$
$i = 4, C = \{25, 25, 10, 5, 1, 1\}, n = 2$
$i = 4, C = \{25, 25, 10, 5, 1, 1, 1\}, n = 1$
$i = 4, C = \{25, 25, 10, 5, 1, 1, 1, 1\}, n = 0$

- Rosen 3.1.55b) Use the greedy algorithm (Algorithm 6 on page 175) to make change using quarters, dimes, and pennies for 69 cents

  $c_1 = 25$, $c_2 = 10$, $c_3 = 1$.

  $n = 69$

  $C = \emptyset$,
  $i = 1, C = \{25\}, n = 44$
  $i = 1, C = \{25, 25\}, n = 19$
  $i = 2, C = \{25, 25, 10\}, n = 9$
  $i = 3, C = \{25, 25, 10, 1\}, n = 8$
  $i = 3, C = \{25, 25, 10, 1, 1\}, n = 7$
  $i = 3, C = \{25, 25, 10, 1, 1, 1\}, n = 6$
  $i = 3, C = \{25, 25, 10, 1, 1, 1, 1\}, n = 5$
  $i = 3, C = \{25, 25, 10, 1, 1, 1, 1, 1\}, n = 4$
  $i = 3, C = \{25, 25, 10, 1, 1, 1, 1, 1, 1\}, n = 3$
  $i = 3, C = \{25, 25, 10, 1, 1, 1, 1, 1, 1, 1\}, n = 2$
  $i = 3, C = \{25, 25, 10, 1, 1, 1, 1, 1, 1, 1, 1\}, n = 1$
  $i = 3, C = \{25, 25, 10, 1, 1, 1, 1, 1, 1, 1, 1, 1\}, n = 0$

- (Last 10 minutes) Quiz