CS100 Fall 2016

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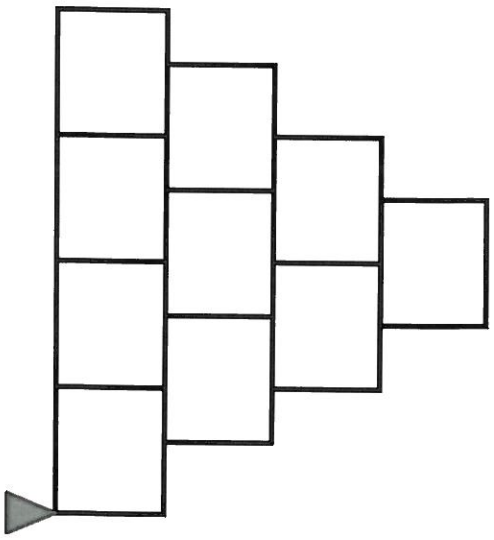
CPADS Exam #1 Strategy Review

1. Propose ***two different strategies*** to draw the following figure – a rotated pyramid, composed of squares of a given size. After drawing the figure, the cursor should be returned to its original position and orientation. You should break the problem down into sub-problems, and use those sub-problems to solve the larger problem, i.e. identify pieces of the drawing that can be turned into functions, and then use those functions to create the pyramid. You should also propose loops, where possible, to reduce repeated instructions. Your strategy should NOT include any Python code, but rather, it should be composed of a series of steps in English, and/or pseudo-code.

   You should also annotate the drawings supplied for each problem with #'s and arrows showing the movement and ordering of operations.

   Hints: Consider how to draw the pyramid (with rows or columns), and where to start drawing (left or right)? You may assume that you have an instruction that draws squares of a given size, starting from the cursor, and draws the square in counter-clockwise fashion. Consider creating new instructions that you can use to draw the diagram.

   Solution:

   Think about how you would instruct someone to draw this figure, if that person only knew how to move, turn, and draw a square.

   1) Identify the possible strategies and sub-problems (here are 2):
      a. **Columns:** Starting from the cursor, the figure is composed of columns, each column one block shorter and shifted up by $\frac{1}{2}$ block as we move to the right.
      b. **Diagonals:** Starting from the cursor, the figure is composed of diagonals, each one block shorter as we move up. The blocks in each diagonal move up by $\frac{1}{2}$ block each step.

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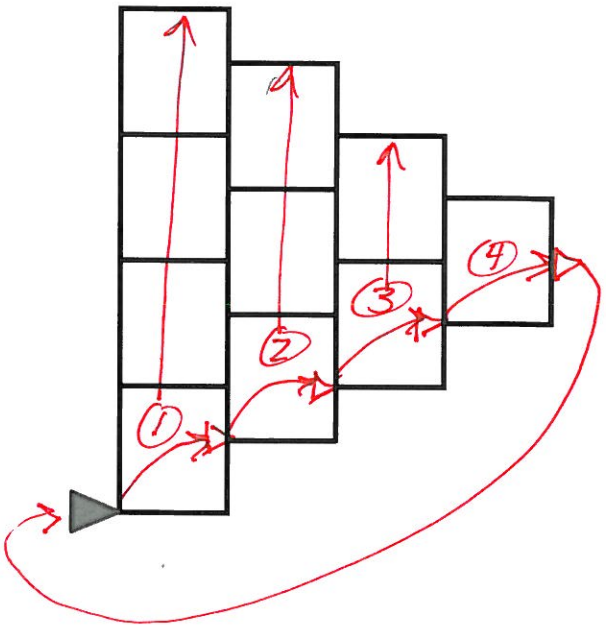
2) Describe approach 1a (using columns):
   a. Pyramid: Describe how to draw the pyramid using columns:
      i. Draw a column of the specified height and block size.
      ii. Move to the right by one block size
      iii. Move up by $\frac{1}{2}$ block size.
      iv. Reduce the column height by one block.
      v. Repeat i to iv above for the specified pyramid height.
      vi. Return the cursor to its original position and orientation.
   b. Column: Describe how to draw a column using squares:
      i. Draw a square of the given size.
      ii. Move up by one block size.
      iii. Repeat i to ii above for the specified # of blocks.
      iv. Return the cursor to its original position and orientation.



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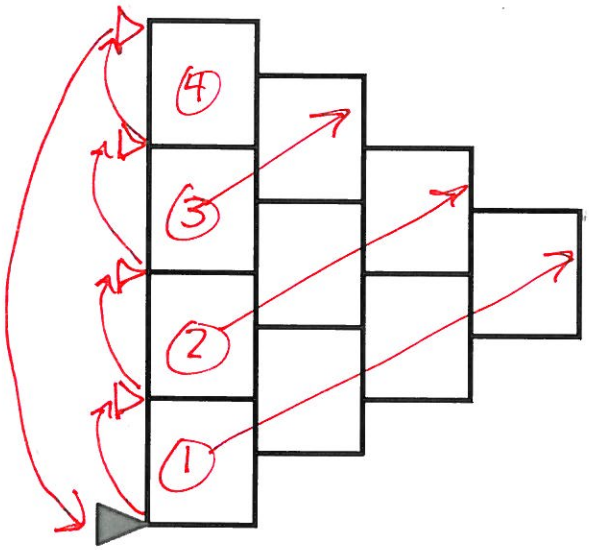
3) Describe approach 1b (using diagonals):
   a. Pyramid: Describe how to draw the figure using diagonals:
      i. Draw a diagonal of the specified height and block size.
      ii. Move up by one block size.
      iii. Reduce the diagonal length by one block.
      iv. Repeat i to iii above for the specified pyramid height.
      v. Return the cursor to its original position and orientation.
   b. Diagonal: Describe how to draw a diagonal using squares:
      i. Draw a square of the given size.
      ii. Move over by one block size
      iii. Move up by $\frac{1}{2}$ block size
      iv. Repeat i to iii above for the specified # of blocks.
      v. Return the cursor to its original position and orientation.



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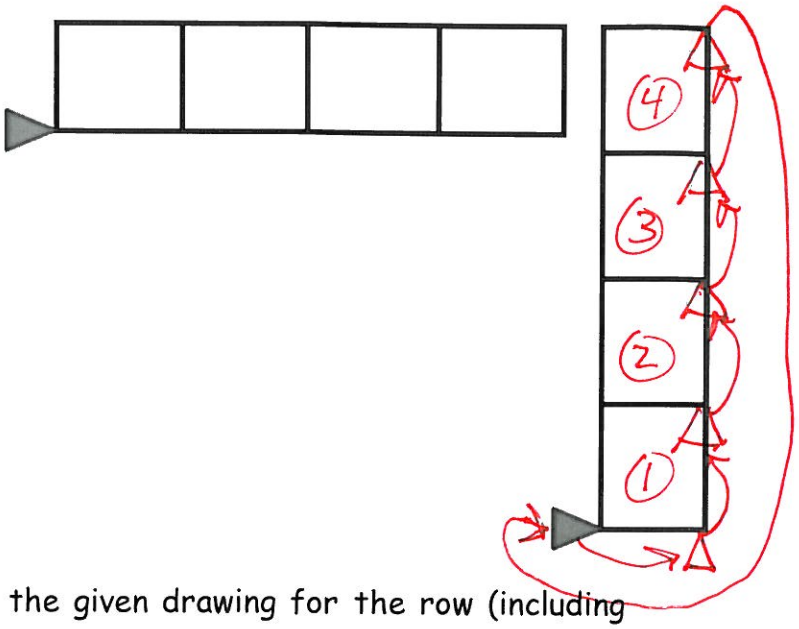
2. Propose a strategy for using an instruction that draws the row shown below to draw the column, also shown below. Propose a new instruction,

drawColumnFromCorner(blocks, size)

that uses

drawRowFromCorner(blocks, size)

to draw a column, of given blocks, with a given size for the blocks. The new instruction should return the cursor to its original position and orientation after drawing the column.



First recognize that if you rotate the given drawing for the row (including the cursor), you get the starting point for drawing a column. Thus, a column is just a row drawn after moving the cursor to the lower right corner of the column and rotating it 90 degrees to the left.

Thus, one strategy for drawColumnFromCorner, using drawRowFromCorner as a basis, is:

1) Move cursor right one block size.
2) Turn cursor left 90 degrees.
3) Call drawRowFromCorner(blocks, size).
4) Return cursor to the original starting position and orientation.

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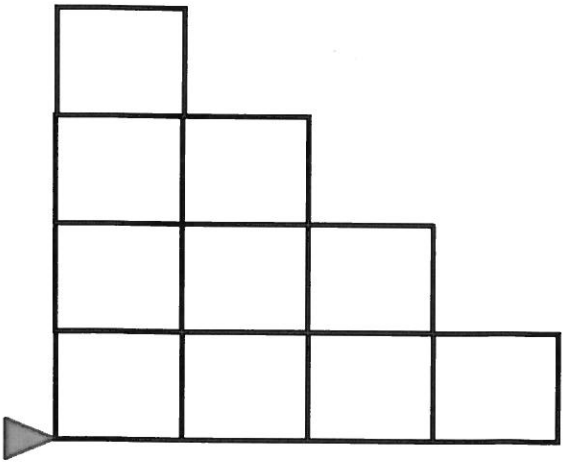
3. Propose ***three different strategies*** to draw the following figure – a staircase that descends from upper-left to lower-right. After drawing the figure, the cursor should be returned to its original position and orientation. You should break the problem down into sub-problems, and use those sub-problems to solve the larger problem, i.e. identify pieces of the drawing that can be turned into functions, and then use those functions to create the staircase. You should also propose loops, where possible, to reduce repeated instructions. Your strategy should NOT include any Python code, but rather, it should be composed of a series of steps in English, and/or pseudo-code.

   You should also annotate the drawings supplied for each problem with #'s and arrows showing the movement and ordering of operations.

   Hints: Consider where to start drawing the staircase, with the top row, or the bottom row. Also, should it be drawn with rows, or with columns? You may assume that you have an instruction that draws a square of a given size, in counter-clockwise fashion starting at the cursor. Consider creating new instructions that you can use to draw the diagram.

Think about how you would instruct someone to draw this figure, if that person only knew how to move, turn, and draw a square.



1) Identify the possible strategies and sub-problems (here are 2):
   a. **Columns:** Starting from the cursor, the figure is composed of columns, each column one block shorter as we move to the right.
   b. **Rows:** Starting from the cursor, the figure is composed of rows, each one block shorter as we move up.

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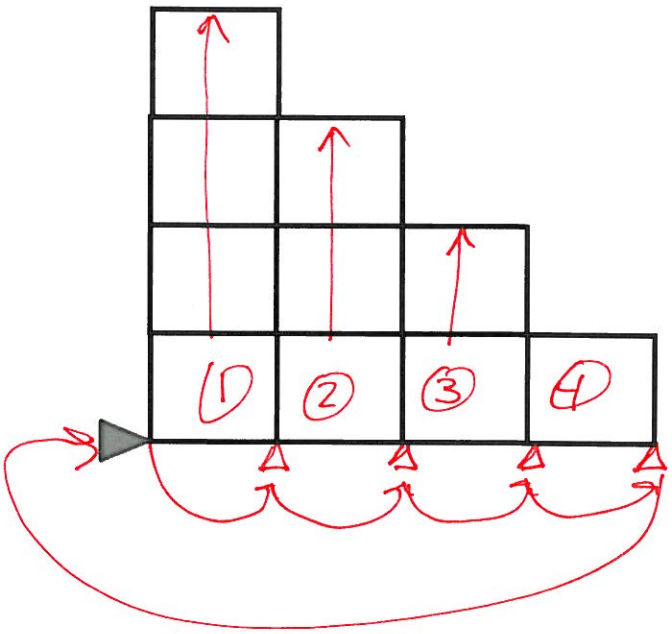
2) Describe approach 1a (using columns):
   a. Staircase: Describe how to draw the staircase using columns:
      i. Draw a column of the specified height and block size.
      ii. Move to the right by one block size
      iii. Reduce the column height by one block.
      iv. Repeat i to iii above for the specified staircase height.
      v. Return the cursor to its original position and orientation.
   b. Column: Describe how to draw a column using squares:
      i. Draw a square of the given size.
      ii. Move up by one block size.
      iii. Repeat i to ii above for the specified # of blocks.
      iv. Return the cursor to its original position and orientation.



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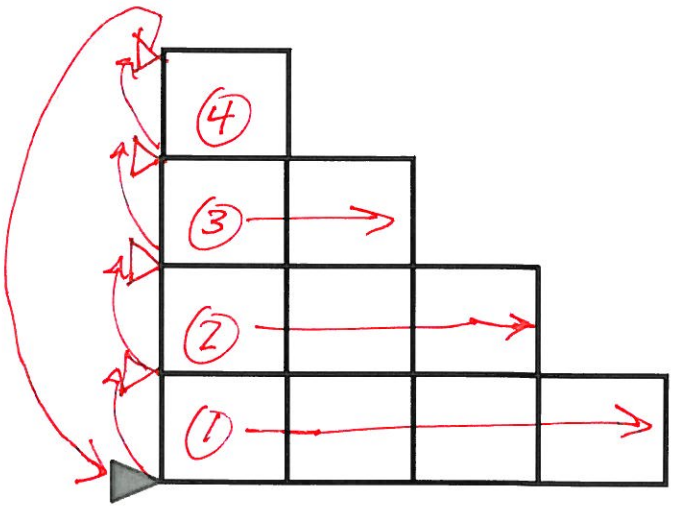
3) Describe approach 1b (using rows, starting from the left):
   a. Staircase: Describe how to draw the staircase using rows:
      i. Draw a row of the specified height and block size.
      ii. Move up by one block size
      iii. Reduce the row length by one block.
      iv. Repeat i to iii above for the specified staircase height.
      v. Return the cursor to its original position and orientation.
   b. Row: Describe how to draw a row using squares:
      i. Draw a square of the given size.
      ii. Move right by one block size.
      iii. Repeat i to ii above for the specified # of blocks.
      iv. Return the cursor to its original position and orientation.



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4) Describe approach 1b (using rows, starting from the top row):
   a. Staircase: Describe how to draw the staircase using rows:
      i. Move the cursor to the lower-left corner of the top row.
      ii. Starting with a row length of one block...
      iii. Draw a row of the specified height and block size.
      iv. Move down by one block size
      v. Increase the row length by one block.
      vi. Repeat iii to v above for the specified staircase height.
   b. Row: Describe how to draw a row using squares:
      i. Draw a square of the given size.
      ii. Move right by one block size.
      iii. Repeat i to ii above for the specified # of blocks.
      iv. Return the cursor to its original position and orientation.