1. (●) ***Write the sentence "I understand the course policies."***

Solution: I turned this in without reading it. ■

(a) Solve the recurrences.

Solution:

$$A(n) = \Theta(\pi^n)$$
$$B(n) = \Theta(\sqrt{\log^* n})$$
$$C(n) = \Theta(1/n)$$
$$D(n) = \Theta(42)$$
$$E(n) = \Theta(2^{e \ln n \ln\ln n}/\alpha(n))$$

■

(b) Sort the functions from asymptotically smallest to asymptotically largest, indicating ties if any.

Solution:

$$n \ll \varnothing \qquad \text{[the empty set]}$$
$$\neq \phi \qquad \text{[the golden ratio } (1+\sqrt{5})/2\text{]}$$
$$\equiv \text{bacon}$$
$$\subseteq \text{chunky bacon}$$
$$\geq \sqrt{n}$$
$$\lhd \{4, 8, 15, 16, 23, 42, \text{hike!}\}$$
$$\not\trianglelefteq 7 \cdot \sqrt{7^n}$$
$$\bowtie 7^{\lg n^7} \lg n$$
$$\cong \lg(7^{7^{\cdot^{\cdot^{\cdot^7}}}})$$
$$\models (7!)^{\lg \sqrt{n!}}!$$
$$\doteq \sqrt{7777777^{\sqrt{7777777}}}$$
$$\eqslantless \frac{\sqrt[7]{7^{\sin n}}}{7}$$
$$\succeq \lg\lg\lg\lg(7^{\sqrt{\beta(\text{acon})}})$$
$$\not\approx \log^* \sqrt{7^n}$$
$$\ddot{\smile} \sqrt{\lg\left(7^{\sqrt{\lg(7^n)}}\right)}$$

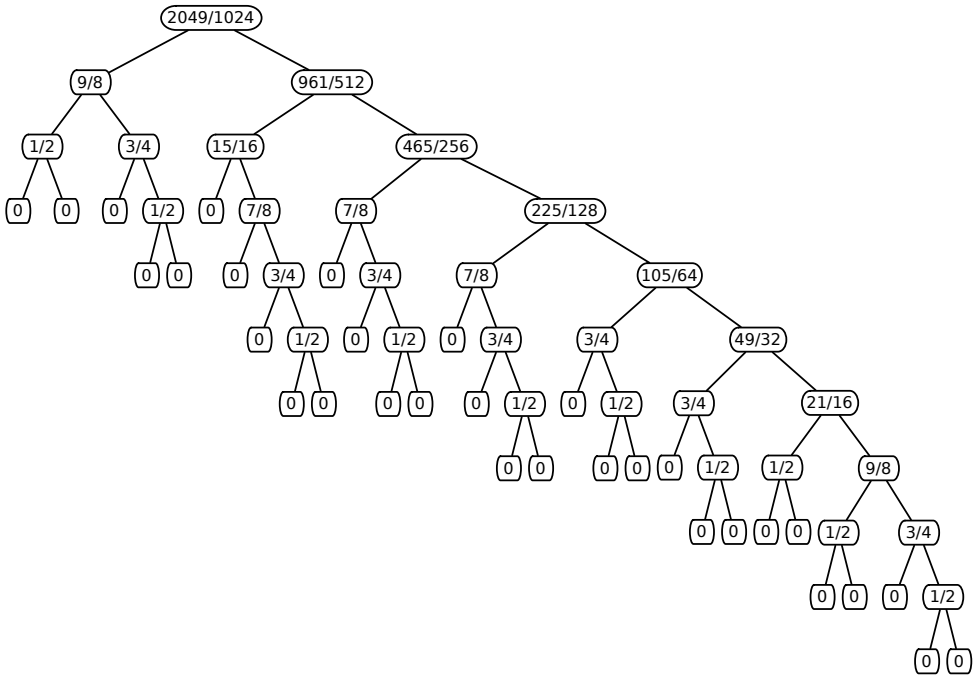
■

2. (a) List the nodes in Prof. della Giungla's tree in the order visited by a *preorder* traversal.

Solution: **M Y B O L O G N A H A S A F I R S T N A M E I T S O S C A R** ■

(b) Draw Prof. della Giungla's tree.

Solution:



■

3. Describe a data structure that stores a set of n points in the plane and supports the queries LOWESTTORIGHT and LEFTMOSTABOVE.

Solution: Alles touristen und non-technischen looken peepers! Das machinkontrol is nicht for gefengerpoken und mittengrabben. Oderwise is easy schnappen der springenverk, blowenfus, undpoppencorken mit spitzensparken. Der machine is diggen by experten only. Is nicht fur geverken by das dumpkopfen. Das rubber necken sightseenen keepen das cotton-picken hands in das pockets. So relaxen, und vatchen das blinkenlights.

```
PEASANTMULTIPLY(x, y):
  prod ← 0
  while x > 0
      if x is odd
          prod ← prod + y
      x ← ⌊x/2⌋
      y ← y + y
  return p
```

This room is fullfilled mit special electronische equipment. Fingergrabbing and pressing the knoeppkes from the computers is allowed for die experts only! So all the "lefthanders" stay away and do not disturben the brainstorming von here working intelligences. Otherwise you will be outthrown and kicked anderswhere! Also: please keep still and only watchen astaunished the blinkenlights. ■

4. Prove that for any arithmetic expression tree, there is an equivalent arithmetic expression tree in normal form.

Solution: Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc molestie blandit feugiat. Donec vitae mi in risus aliquam posuere sed quis arcu. Vestibulum orci nibh, commodo sit amet pulvinar sed, porttitor in justo. Quisque nec est ipsum, non pretium velit. Vestibulum pulvinar vestibulum justo, quis molestie felis aliquam sed. Vivamus dapibus posuere ipsum eget vehicula. Mauris id fringilla leo. Aenean id mauris arcu, egestas tristique nisl. Proin sed dui a felis porttitor blandit eu sit amet quam. Cras vel dolor magna. Cras sit amet elit turpis, quis convallis dui. Suspendisse vestibulum, massa in aliquam rutrum, nunc metus fermentum tortor, at feugiat eros odio ac turpis. Curabitur ligula odio, elementum vel laoreet in, pulvinar id urna.

Lemma 1. *Suspendisse suscipit ullamcorper bibendum. Cras tellus leo, interdum sit amet commodo sit amet, fermentum vel diam.*

Proof: Cras ut tristique massa. Maecenas in nulla est. Nullam vel leo nec est viverra viverra. Donec dapibus, lorem vitae vestibulum interdum, leo nulla blandit magna, laoreet congue nibh lorem nec quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Fusce tristique dui in leo vestibulum ultricies. Nam dictum neque at arcu placerat vehicula. Aenean lectus leo, rutrum eget dignissim sit amet, mattis nec lorem.

$$S(e^d) := \sum_{con=sec}^{tetur} \left(\sqrt{ligula} + \frac{ante}{interdum} \right) - suscipit.$$

Vestibulum pharetra lectus sit amet tortor ultricies sit amet venenatis enim viverra. Etiam vestibulum, velit ac adipiscing egestas, dui lorem gravida augue, at euismod risus neque vel elit. Suspendisse potenti. In pharetra iaculis viverra. Sed sit amet magna nunc, ac molestie erat. Aliquam semper rutrum condimentum. Nunc lacinia nisl sed dui vestibulum imperdiet. Phasellus elit tellus, malesuada quis sollicitudin tincidunt, tristique et sem. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. □

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5. (a) What is the *exact* expected number of cards that Professor Jay hurls into the watermelon?

   (b) For each of the statements below, give the *exact* probability that the statement is true of the ***first*** pair of cards Professor Jay turns over.

      i. Both cards are threes.
      ii. One card is a three, and the other card is a club.
      iii. If (at least) one card is a heart, then (at least) one card is a diamond.
      iv. The card from the red deck has higher rank than the card from the blue deck.

   (c) For each of the statements below, give the *exact* probability that the statement is true of the ***last*** pair of cards Professor Jay turns over.

      i. Both cards are threes.
      ii. One card is a three, and the other card is a club.
      iii. If (at least) one card is a heart, then (at least) one card is a diamond.
      iv. The card from the red deck has higher rank than the card from the blue deck.

Solution: (a) 4/8

(b) i. 15/16
   ii. 23/42
   iii. 4/8
   iv. 15/16

(c) i. 23/42
   ii. 4/8
   iii. 15/16
   iv. 23/42

■