CS1110

Lecture 22: **Prelim 2 Review Session**

Announcements

Processed prelim regrade requests: on the front table.

Reminders:
Exam: 7:30–9:00PM, Tuesday Apr 16th Kennedy 116 (Call Auditorium, same as before). Arriving early recommended.

Next Tuesday: lectures replaced by professor office hours in Thurston 102; and labs are staff office hours. *Next Wed-Fri*: all labs, staff and consulting hours canceled.

We will start (and, we hope, finish) grading Thursday evening/night.

Material emphasized

Recursion (A4, Lab 6)

Defining and using classes (A4, A6, Lab 8)

For- and while-loops (A4, A6, Lab10)

Code development from invariants (A6, Lab10)

[We will assume knowledge of the material covered previously, in the sense that you should know how to, say, create lists, draw folders and frames, manipulate strings, make appropriate test cases. and so on. This shouldn't require additional studying.]

Hint: re-read spec after doing problem.

Additional sources of practice problems

- Fall 2012 Prelim 2, questions 4, 5.
- Fall 2012 Final questions, questions 4, 6, 7 *given* the invariant for insertion sort and the helper function push_down.
- The worked exercises on loop invariants
- Loop problems at http://codingbat.com/python (interactive programming exercises). You can try solving the problems via both loops and recursion, often.

Provide a recursive implementation

```
def merge(s1,s2):
    """Returns: string of characters of s1 and s2, in alphabetical order.
    Examples: merge('ab', '') = 'ab'
    merge('abbce', 'cdg') = 'abbccdeg'
    Precondition: s1 a string with characters in alphabetical order
    s2 a string with characters in alphabetical order"""

    if s1 == ''  or  s2 == '':
        return s1 + s2
    if s1[0] <=  s2[0]:        # Pick first from s1 and merge the rest
        return s1[0]+merge(s1[1:],s2)
    else:                      # Pick first from s2 and merge the rest
        return s2[0]+merge(s1,s2[1:])
```

Provide a recursive implementation

```
def skip(s):
    """Returns: copy of string s, odd letters(i.e., 1st, 3rd, 5th) dropped.
    Example: 'abcd' -> 'bd'.   '' -> ''   'abc' -> 'b', 'zzz' -> 'z'   """

     if len(s) <= 1:    # One base case
         return ''
     else:  # s >= 2  characters (if exactly 2, another base case)
         return s[1] + (skip(s[2:]) if len(s) > 2 else '')
```

Provide a for-loop implementation

```
def skip(s):
    """Returns: copy of string s, odd letters(i.e., 1st, 3rd, 5th) dropped.
     Example: 'abcd' -> 'bd'.   '' -> ''   'abc' -> 'b', 'zzz' -> 'z'  """

     out = ''  # progress towards output
     # Inv: chars s[0..i-1] have been processed. Done when i is len(s)
     for i in range(len(s)):
          if (i % 2 == 1):
               out += s[i]
     return out
```

Provide a while-loop implementation

```
def skip(s):
    """Returns: copy of string s, odd letters(i.e., 1st, 3rd, 5th) dropped.
    Example: 'abcd' -> 'bd'.   '' -> ''   'abc' -> 'b', 'zzz' -> 'z'   """

     out = ''  # progress towards output
     if len(s) <=1:    # actually these two lines are optional
          return out
     i = 1
     # Inv: chars s[0..i-1] have been processed. Done when i is len(s)
     while (i  < len(s)):
               out += s[i]
               i += 2
     return out
```

Defining a class

```
class Paper(object):
    """An instance is a  scientific paper.
    Class variables:
    number [int]: number of papers that have been created. >= 0

    Instance variables:
    title [string]: title of this paper.  At least one char long.
    cites [list of Papers]: papers that this book cites
    cited_by [list of Papers]: papers that this paper is cited by
    """

    number = 0  # initial value is 0
```

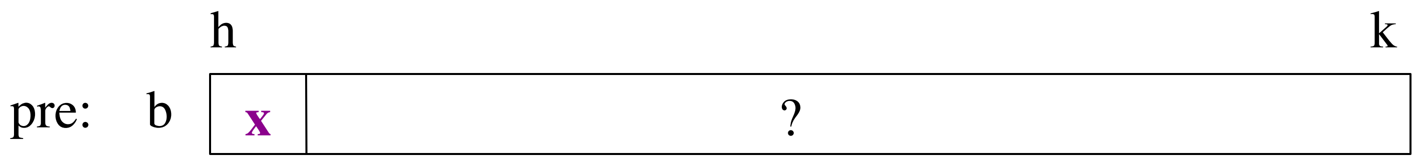
```
def __init__(self, title, cites=None):
 """Initializer.  A new paper with title <title>,  citing the papers in list
<cites> (set to [] if <cites> is None), and with cited_by set to []. Unlike
in A4, this initializer should also update the  relevant attributes of any
papers in the list <cites>. Pre: arg values as in class specification.
 Don't forget to update the class variable. """
```

Write the body of __init__

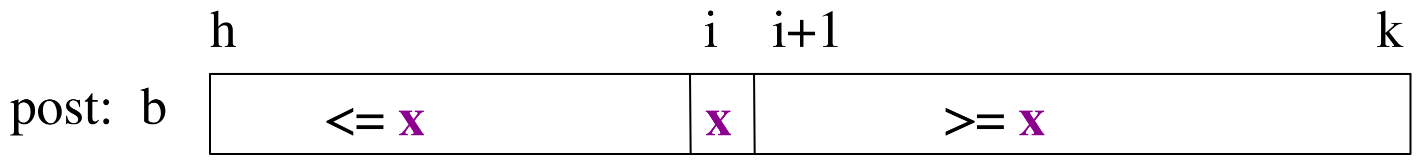
```
def __init__(self, title, cites=None):
  # spec on previous slide
   self.title = title


   self.cites = ([] if cites is None else cites)
   for p in self.cites:
       p.cited_by.append(self)


   self.cited_by = []


   Paper.number += 1   # note how to reference the class variable.
```

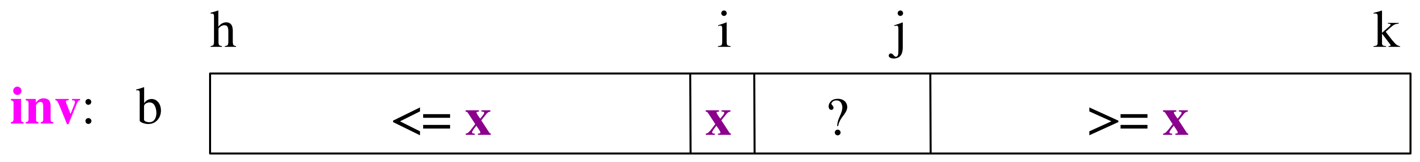
Implement according to invariant

- Given a sequence b[h..k] with some value x in b[h]:



- Swap elements of b[h..k] and store in i to truthify post:





Partition Algorithm Implementation

```
def partition(b, h, k):
    """Partition list b[h..k] around a pivot x = b[h]"""
    i = h; j = k
    # invariant: b[h..i-1] < b[i], b[j+1..k] >= b[i]
    while i < j:
        if b[i+1] >= b[i]:
            # Move to end of block.
            b[i+1], b[j] = b[j], b[i+1]
            j = j - 1
        else:   # b[i+1] < b[i]
            b[i], b[i+1] = b[i+1], b[i]
            i = i + 1
    # post: b[h..i-1] < x, b[i] is x, and b[i+1..k] >= x
    return i
```

```
def evaluate(p, x): """Returns: The evaluated polynomial p(x).
We represent polynomials as a list of floats:
        [1.5, -2.2, 3.1, 0, -1.0] is 1.5 - 2.2x + 3.1x**2 + 0x**3 - x**4
We evaluate by substituting in for the value x.  For example
  evaluate([1.5,-2.2,3.1,0,-1.0], 2) = 1.5-2.2(2)+3.1(4)-1(16) = -6.5
   evaluate([2], 4) = 2
 Precondition: p is a list (len > 0) of floats, x is a float"""
```

One implementation

```
def evaluate(p, x):
    """(spec on previous slide)"""
    sum = 0    # sum of all the coeffs*x**y for coeffs seen so far
    xval = 1    # value to multiply with next coeff yet unseen
    for c in p:  # c is next unseen coefficient
        sum = sum + c*xval
        xval = xval * x
    return sum
```

Alternate implementation

```
def evaluate(p, x):
    """(spec on previous slide)"""
    i=0; xval = 1; sum = p[i]  # no point in multiplying by 1; showing
                                # i for clarity; it's not really necessary here
    i = 1
    while i < len(p):
        # Invariant: xval = x**(i-1); sum = eval(p[..i-1], x)
        xval *= x                       # or, xval = xval*x
        sum += p[i]*xval                # or, sum = sum + p[i]*xval
        i +=  1                         # or, i = i + 1
    return sum
```