Midterm 3
CS 165, Mathematica.
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Name: _____
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Closed book. Closed Notes. Please write very legibly. 20 points per problem.

1. Let the function f be defined for positive integers by

$$f(n) = \begin{cases} 3 & \text{if } n = 1 \\ 0 & \text{if } n = 2 \\ 2f(n-1) + f(n-2) & \text{otherwise} \end{cases}$$

Write the function f in Mathematica and use it to compute $f(20)$. Show all work.

2. Define a function `avg[]` that computes the average (mean) value of its arguments; the function should work for any number of arguments ≥ 1, regardless of whether the arguments are given in a list or as a sequence. Examples:

```
 In[]: avg[6,7]
Out[]: 6.5

 In[]: avg[{6,7}]
Out[]: 6.5

 In[]: avg[6,7,8,9]
Out[]: 8.5

 In[]: avg[{6}]
Out[]: 6
```

3. Use recursion to write a function `mult[m_,n_]` that, for integers $m \leq n$, gives the product $m(m+1)(m+2)\cdots n$. For example, `mult[2,4]` should give 24, since $2 \cdot 3 \cdot 4 = 24$, and `mult[5,5]` should give 5. Your function should work for negative integers as well. You may not use the built-in Mathematica function `Factorial[]`.

4. Use recursion to write a function `fitin[lis_,n_]` that inserts n into a sorted list of numbers in the appropriate place, as in the following examples. Assume that `lis` is sorted in *descending order*, i.e., from large to small. You may not use the built-in Mathematica function `Sort[]`.

```
 In[]: fitin[{8,7,0,-2},3]
Out[]: {8,7,3,0,-2}

 In[]: fitin[{8,7,0,-2},7]
Out[]: {8,7,7,0,-2}
```

5. Use recursion to write a function `sortNumbers[lis_]` that sorts any nonempty list `lis` of numbers in *descending order*. Even if you didn't do the previous problem (correctly), you may for this problem assume that the function `fitin[]` is given to you and use it. You may not use the built-in Mathematica function `Sort[]`. Example:

```
 In[]: sortNumbers[{4,6,0,-9,3,2,6,2}]
Out[]: {6,6,4,3,2,2,0,-9}
```