Midterm 2, PART I.
CS 165, Mathematica.
Instructor: Ramin Naimi

Name: _____
Thursday 11 Mar 2004

Closed book. Closed Notes. Please write very legibly.

1. (40 points) Give the output for each of the following inputs. No need for explanations if your answer is correct. But wrong answers with (brief) explanations may earn partial credit.

   (a)
   ```
   In[]: {r,s,t,u,v,w} //. {a_, b__, c_} -> {b}
   Out[]:
   ```

   (b)
   ```
   In[]: Range[6] //. {a_, b___, c_} -> {b}
   Out[]:
   ```

   (c)
   ```
   In[]: {2,15,3,11,14,9} //. {a___,b_,c___,d_,e___} :>
           {a,c,e} /; (b+1==d || b==d+1)
   Out[]:
   ```

   (d)
   ```
   In[]: (#^2 + #)&[3]
   Out[]:
   ```

   (e)
   ```
   In[]: Map[({#[[2]], #[[1]]})&, Table[{i, i^2}, {i, 1, 3}]]
   Out[]:
   ```

   (f)
   ```
   In[]: f[x_]:= 2x; Nest[f, 5, 3]
   Out[]:
   ```

   (g)
   ```
   In[]: f[ch_]:= FromCharacterCode[ToCharacterCode[ch] + 1];
         Map[f, {"C", "a", "t"}]
   Out[]:
   ```

   Hint: ToCharacterCode[“string”] gives a list of the integer codes corresponding to the characters in a string. FromCharacterCode[n] gives a string consisting of the character with integer code n.

   (h)
   ```
   In[]: Mod[15, 3] == 0 && Mod[15, 4] != 0
   Out[]:
   ```

   Hint: Mod[m, n] gives the remainder on division of m by n.

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For this part (II), you may use the computer for running Mathematica (help, and entering functions), but *nothing else*: e.g., no web-browsers or email, and no saving or opening of any files — nothing but Mathematica.

Do **only two** of the following problems. Please circle the two you are choosing.

(a) (30 points) Write a rule for finding a palindrome in any given list of strings. (A palindrome is a string that reads the same forward and backward; e.g.: mom, refer, cddc are all palindromes; glass, xyz, are not palindromes). Example:

```
 In[ ]: {"hi","mom","break"} apply-your-rule-here
Out[ ]: {mom}

 In[ ]: {"hi","human","break"} apply-your-rule-here
Out[ ]: {"hi","human","break"}
```

If there is more than one palindrome in the input list, it's enough that your rule find at least one of them.

(b) (30 points) Write a function `primesBetween[m_,n_]` that outputs a list of all prime numbers `p` such that `m<p<n` (note that these are *strict* inequalities). Example:

```
 In[ ]: primesBetween[4,12]
Out[ ]: {5,7,11}

 In[ ]: primesBetween[4,11]
Out[ ]: {5,7}
```

(c) (30 points) Write a function `josephuskp[k_,p_]` that shows the survivor in a list of p people when every kth person is removed; make your function also show the list of survivors each time a person is removed. (Recall that the people are seated in a circle.) Example:

```
 In[ ]: josephuskp[3,5]
Out[ ]: {{1,2,3,4,5}, {4,5,1,2}, {2,4,5}, {2,4}, {4}}
```