Problem Set 1

Tools for Network Analysis

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1. Using the binomial coefficient definition, calculate
   (a) *[1 point]* $\binom{n}{n}$
   (b) *[1 point]* $\binom{10}{2}$
   (c) *[1 point]* $\binom{1}{2}$

2. The binomial coefficients tell us the number of *different pairs of elements that can be formed*. For instance, $\binom{10}{2}$ counts the number of *pairs* of items -hence 2 in the bottom- that can be formed when we have 10 items to choose from. If a class has 22 students, how many different groups of size 2 could we be formed?

3. For a given integer c, write down the formula that allows us to calculate the value for the binomial coefficient $\binom{c}{2}$.

4. Create a list with your first name and the first name of 5 people in a class. Store the list as `names`, and then create a list called `names in order` with the elements of `names` in alphabetical order. Print the result.

5. Write `Python` code that takes the letters `a,b,c,d,e,f`, and prints all the possible pairs of them so that no pair is repeated, and also no pair is missing. Don't count permutations of the same two elements. Each pair should be printed to screen in a single line (so use the `print` statement).

6. Create a list `fib` with the Fibonacci sequence from the 20th to the 30th terms. Create a list `sqrtbet` with the square root of all integers between the 22nd and 23rd terms (including both). Create a variable `thesum` with the sum of all the elements in `sqrtbet`

Problem Set 1

(1a) $\binom{n}{n}$ $\cancel{n!}/\cancel{n!}(n-n)! = 1/(n-n)! = 1/0! = \boxed{1}$

(1b) $\binom{10}{2}$ $10!/2!(10-2)! = 1\times2\times3\ldots\times10/2\times1(8)! = 3,628,800/2(40,320)$

$3,628,800/80,640 = \boxed{45}$

(1c) $\binom{1}{2}$ $1!/2!(1-2)! = 1/2(-1)! = 1/-2 = \boxed{-1/2}$

→ n not ≥ m

(2) $\binom{22}{2}$ $22!/2!(22-2)! = \boxed{22!/2(20)!}$

(3) $\binom{c}{2} = \boxed{c!/2!(c-2)!}$

(4) Python Code:

```
names = ['Chris', 'Frank', 'Eli', 'Beatrice', 'Amy', 'Dan']
names_in_order = ['Amy', 'Beatrice', 'Chris', 'Dan', 'Eli', 'Frank']
print(names_in_order)
```

(5) $\binom{6}{2}$ $6!/2!(6-2)! = 720/2(4)! = 720/48 = 15$ possible pairs

01 25
02 34
03 35
04 45
05
12
13
14
15
23
24

a, b, c, d, e, f ab, ac, ad, ae, af, bc, bd, be, bf, cd, ce, cf, de, df, ef

Python Code: 01, 02, 03, 04, 05, 12, 13, 14, 15, 23, 24, 25, 34, 35, 45

```
letters = ['a', 'b', 'c', 'd', 'e', 'f']
pairs = []
n = 0
n2 = 1
.....
```

Problem Set 1

(5) Continued Code.....

```
  for e in letters:
Indent ->  if n2<=5:
->        Pairs.append(letters[n]+letters[n2])
          n2=n2+1

n=1
n2=2
for e in letters:
->  if n2<=5:
->     Pairs.append(letters[n]+letters[n2])
       n2=n2+1
n=2
n2=3
for e in letters:
->  if n2<=5:
->     pairs.append(letters[n]+letters[n2])
       n2=n2+1
n=3
n2=4
for e in letters:
->  if n2<=5:
->     Pairs.append(letters[n]+letters[n2])
       n2=n2+1
n=4
n2=5
for e in letters:
->  if n2<=5:
->     Pairs.append(letters[n]+letters[n2])
       n2=n2+1
print(pairs)
```

Problem Set 1

(6) Terms 20 - 30, Fibonacci Sequence

20: 6,765
21: 10,946
22: 17,711
23: 28,657
24: 46,368
25: 75,025
26: 121,393
27: 196,418
28: 317,811
29: 514,229
30: 832,040

fib

[17,711 / 28,657 √] Sqrtbet. — [Sum of all square roots] thesum

Python Code:

```
fib=[6765,10946,17711,28657,46368,75025,121393,196418,317811,514229,832040]
Sqrtbet=[]
thesum=0

for e in fib:
    Sqrtbet.append(math.sqrt(e))

for e in sqrtbet:
    thesum = thesum + e

print(thesum)
```