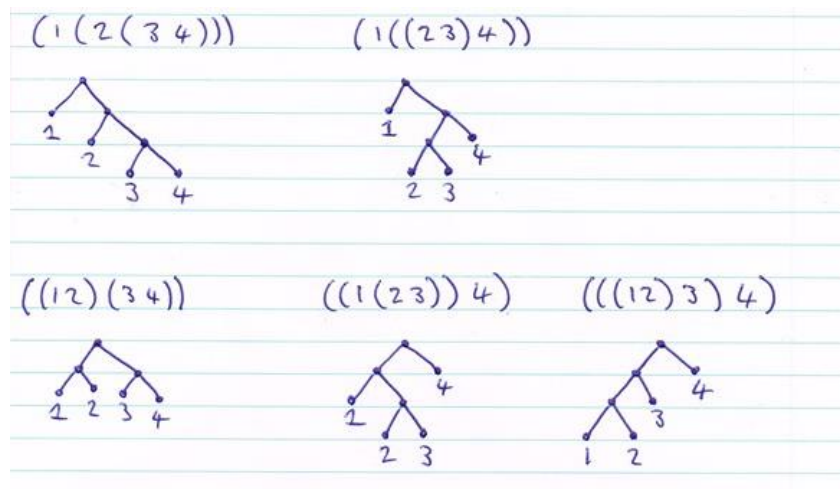# Catalan Questions

Group Members: Ben Highsted, Bradley Carter, Matthew Neil, Maurice Andrews

Task 1: By hand draw the binary tree equivalences for line 3 of our example, that is to say, for C(3).

Task 2: By hand, work out C(4), i.e. given the five numbers 1 2 3 4 and 5, how many different ways can we place brackets to pair off the numbers.

All Possibilities:

(1 (2 (3 (4 5)))),	(1 (2 ((3 4) 5))),	(1 ((2 (3 4)) 5)),	(1 (((2 3) 4) 5)),
(1 ((2 3) (4 5))),	((1 (2 (3 4))) 5),	((1 ((2 3) 4)) 5),	(((1 (2 3)) 4) 5),
((((1 2) 3) 4) 5),	(((1 2) (3 4)) 5),	((1 (2 3)) (4 5)),	(((1 2) 3) (4 5)),
((1 2) (3 (4 5))),	((1 2) ((3 4) 5))		

C(4) = 14   (14 Possibilities)

Task 3: Write a program that uses 64-bit integers to calculate C(n) for n = 1 . . . 35.
(Question corrected to what was said in the email)

Program:

```
public class Catalan {
 public static void main(String[] args) {
  int n = 35;
  long[] answers = new long[n + 1];
  answers[0] = 1;
  for(int i = 1; i<=n; i++){
   for(int j = 0; j<i; j++){
     answers[i] += answers[j] * answers[i - 1 - j];
    }
  }
  for(int i = 1; i< n + 1; i++){
    System.out.println("C(" + i + "): " + answers[i]);
  }
 }
}
```

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Output of the program:

C(1): 1
C(2): 2
C(3): 5
C(4): 14
C(5): 42
C(6): 132
C(7): 429
C(8): 1430
C(9): 4862
C(10): 16796
C(11): 58786
C(12): 208012
C(13): 742900
C(14): 2674440
C(15): 9694845
C(16): 35357670
C(17): 129644790
C(18): 477638700
C(19): 1767263190
C(20): 6564120420
C(21): 24466267020
C(22): 91482563640
C(23): 343059613650
C(24): 1289904147324
C(25): 4861946401452
C(26): 18367353072152
C(27): 69533550916004
C(28): 263747951750360
C(29): 1002242216651368
C(30): 3814986502092304
C(31): 14544636039226909
C(32): 55534064877048198
C(33): 212336130412243110
C(34): 812944042149730764
C(35): 3116285494907301262