Data Structures II: Brute force

Mauricio Toro
Department of Systems and Informatics
Universidad EAFIT

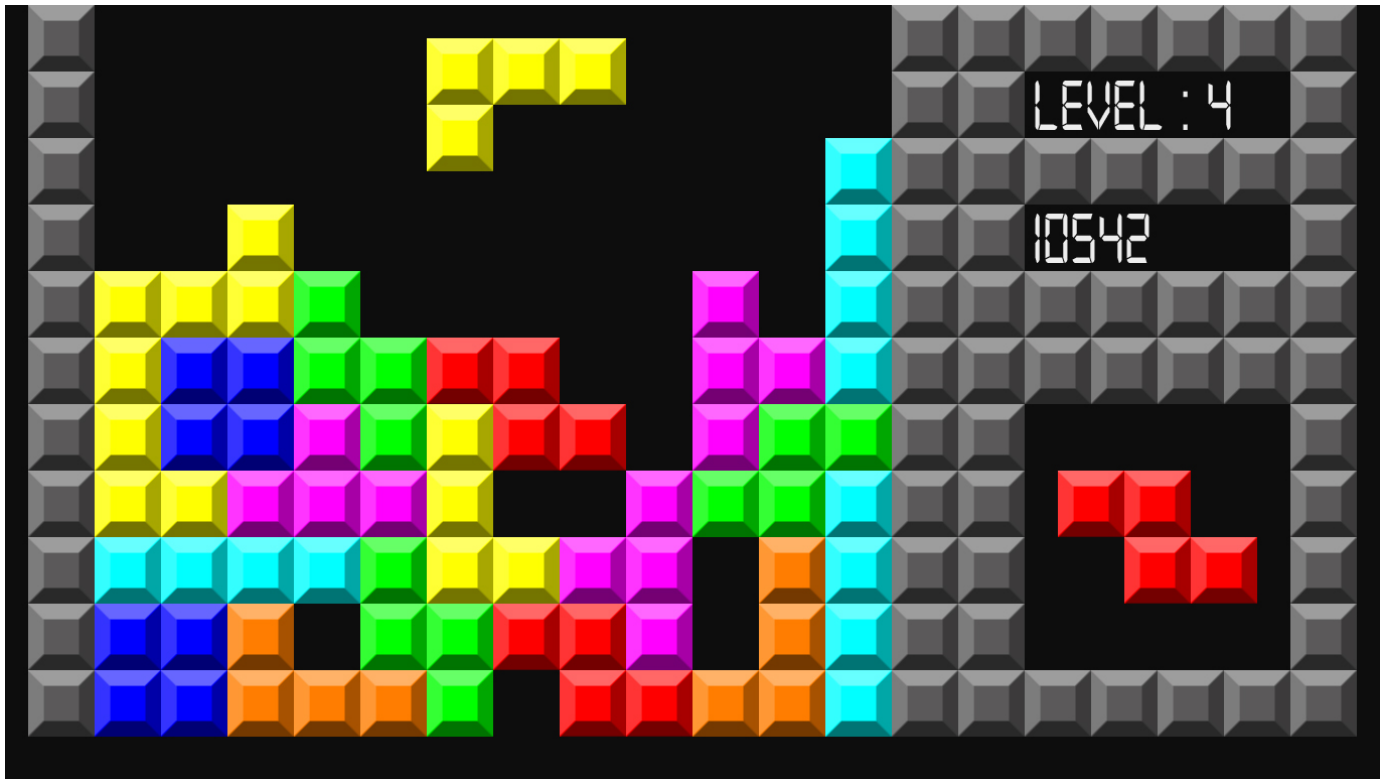
Cocktail of the day: Pisco Sour

Disclaimer: Keep alcohol out of the hands of minors.

Cocktail of the day: Pisco Sour

- 45 ml of Pisco
- 30 ml of lime juice
- 20 ml of simple syrup
- 1 egg white

Tetris can be solved with Brute Force



http://www.cs.jhu.edu/~susan/600.363/tetris.pdf

Backtracking

- Brute force is a general algorithm for finding all (or some) solutions to some computational problems
- Brute force enumerates all possible solutions to the problem.

Brute-Force Search

```
Procedure (P)
   c = first(P)
   while c not null do
      if valid(P,c) then output(P, c)
      c = next(P,c)
   end while
```

Taken from Wikipedia

N Queens

- The *N* queens puzzle asks for all arrangements of eight chess queens on a standard chessboard so that no queen attacks any other.
- Any partial solution that contains two mutually attacking queens can be abandoned, since it cannot possibly be completed to a valid solution.
- https://www.youtube.com/watch?v=Gl75_u4LZU8

N Queens

- The *N* queens puzzle asks for all arrangements of eight chess queens on a standard chessboard so that no queen attacks any other.
- Any partial solution that contains two mutually attacking queens can be abandoned, since it cannot possibly be completed to a valid solution.
- `https://www.youtube.com/watch?v=Gl75_u4LZU8`

N Queens: Try all $n!$ permutations

```
public static void e(int[] a,boolean[] diag1,
                     boolean[] diag2,int n) {
 int N = a.length;
 if (n == 0) {
   printQueens(a);
   System.exit(0);
 }
for...
}
```

Taken from http://introcs.cs.princeton.edu/java/23recursion/Queens2.java.html

N Queens: Try all $n!$ permutations

```
for (int i = 0; i < n; i++) {
 swap(a, i, n-1);
 int k = n-1;
 if (!diag1[k + a[k]] && !diag2[N + k - a[k]]){
                    diag1[k + a[k]] = true;
                    diag2[N + k - a[k]] = true;
                    e(a, diag1, diag2, n-1);
                    diag1[k + a[k]] = false;
                    diag2[N + k - a[k]] = false;
 }
 swap(a, i, n-1);
}
```

N Queens: printQueens

```
public void printQueens(int[] x) {
    int N = x.length;
    for (int i = 0; i < N; i++) {
      for (int j = 0; j < N; j++) {
        if (x[i] == j)
            System.out.print("Q ");
        else
            System.out.print("* ");
      }
        System.out.println();
    }
    System.out.println();
}
```

N Queens: swap

```
public static void swap(int[] a, int i,
                        int j) {
        int temp = a[i];
        a[i] = a[j];
        a[j] = temp;
}
```

References

- Please learn how to reference images, trademarks, videos and fragments of code.
- Avoid plagiarism

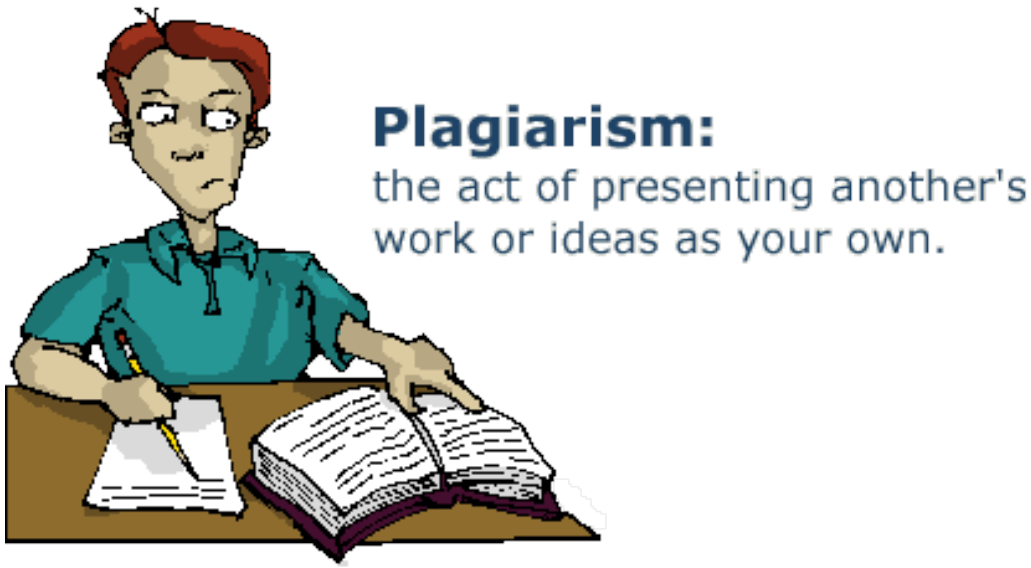


Figure: Figure about plagiarism, University of Malta [Uni09]

References

University of Malta.

Plagarism — The act of presenting another's work or ideas as your own, 2009.

[Online; accessed 29-November-2013].

Further Reading

- Brute Force
  - Anany Levitin, Introduction to the the Design & Analysis of Alogirhtms Chapter 3: Brute Force and Exhaustive Search, Page 97 – 120.
  - http://www.open.edu/openlearn/science-maths-technology/computing-and-ict/computing/the-jewels-heuro?in_menu=306273