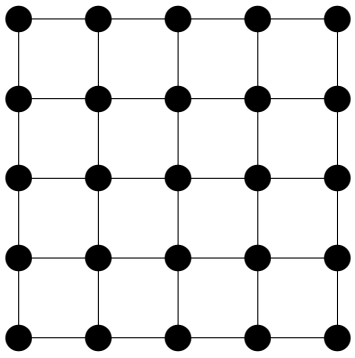
MO412 – Network Science University of Campinas

Homework 05

Assigned on 2020-10-24 **Due on 2020-10-30**

1. (Average degree in lattice) Consider a network $G(n)$ which is a two-dimensional lattice, that is, an $n \times n$ grid. Nodes are linked to their neighbors to their right, left, up and down only. Most nodes have degree 4, but some have degree 3 or even 2. The picture below shows such a network for $n = 5$.



   (a) Determine the number of nodes $N(n)$ of $G(n)$.

   (b) Determine the number of links $L(n)$ of $G(n)$.

   (c) Determine the average degree $\langle k \rangle$ of $G(n)$ as a function of n.

   (d) Let $v(i, j)$ denote the node located at row i and column j in $G(n)$, for $1 \leq i, j \leq n$. Determine a formula for the distance $d(v(i, j), v(r, s))$.

   (e) Determine the average distance $\langle d \rangle$ of $G(n)$ as a function of n.

2. (Rate equation) The rate equation method is a very powerful tool to derive properties of networks evolving by preferential attachment and similar schemes. In this question we will begin a careful examination of the rate equation method, to be continued in the next homework. Our basis will be Section 5.A of the Network Science book by Barabási.

(a) Explain Equation 5.31 of the book.

(b) Explain Equation 5.33 of the book.

(c) Explain Equation 5.33 of the book.

(d) Explain Equation 5.34 of the book.