# What Does The Internet Look Like?

The Internet has become an indispensable tool in the modern world. The current number of Internet users worldwide is estimated to be around 2 billion. Social networking website Facebook claims over 500 million active users. The Internet is not just used for chatting or searching; weather reports, traffic control, business transactions, mail delivery, and even telephone conversations all increasingly depend on it. However, we know surprisingly little about how it is organised and what it actually looks like on a global scale. Mathematical modelling can provide some clues.

Mathematics and applied mathematics are used in everyday life. Stock markets, mobile phones, car manufacturing, Google, Hollywood special effects, digital TV and satellites all use cutting edge mathematics tools in their basic functions. The Mathematical Modelling Series presents a number of applications of mathematics in domains as varied as the human body, volcanology, telecommunications and finance.
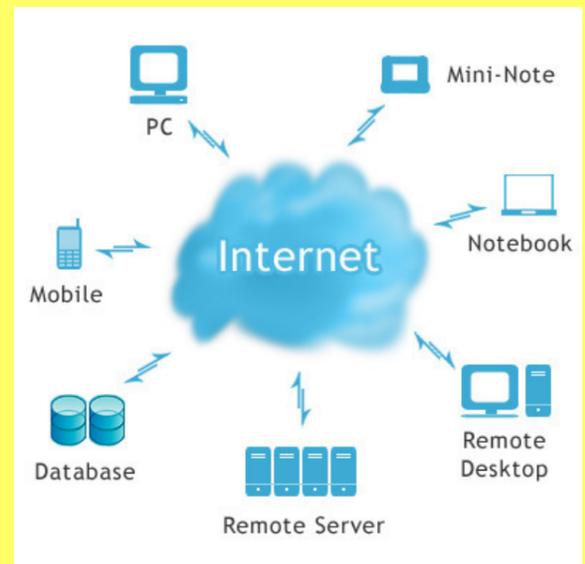
How it works
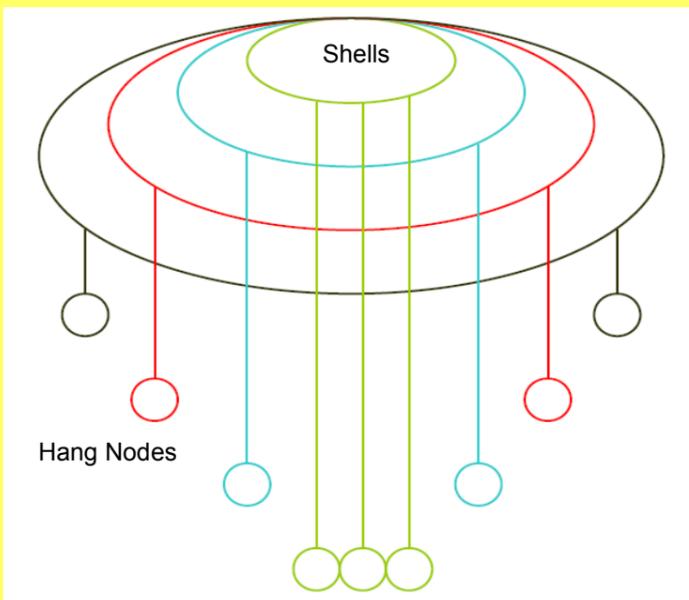
The Internet is a global system consisting of millions of private, public, academic, business, and government computer networks linked together by a broad array of optical and wireless technologies. Since its inception the Internet has grown at a phenomenally fast rate and in a largely unregulated manner. This makes any attempt to accurately describe its global structure very difficult. However, using basic tools from statistics and the branch of discrete mathematics known as graph theory, scientists have made significant progress in recent years. We represent the Internet as a set of abstract points called *nodes* or *vertices* linked together via *edges*. A matrix (call it A) of 0s and 1s tells us which pairs of nodes share a connection. For example, if node 2 connects to node 3 then matrix element $a_{23}=1$ otherwise $a_{23}=0$. By applying statistical analysis to this matrix we can describe the global structure of the Internet in terms of the connectedness of groups of nodes.

Conclusion

One popular model (pictured) describes the Internet in terms of groups of nodes called *shells* arranged top-down from most connected (green) to least connected (black). In addition, the most poorly connected nodes in each shell are called *hang* nodes. This is called the jellyfish model!

Parts of the curriculum used in this project

- Matrices
- Systems of linear equations
- Polynomials and factorization
- Inequalities, absolute values
- Sequences and series
- Discrete Calculus
- Statistics
- Differentiation
- Linear algebra

Acknowledgements & More Information

If you want more information about MACSI and this project
- Contact Martina O' Sullivan (project facilitator) martina.osullivan@ul.ie
- Visit the MACSI website: www.macsi.ul.ie

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