Network Algorithms Welcome!!

A.A. 2015/16

Introduction

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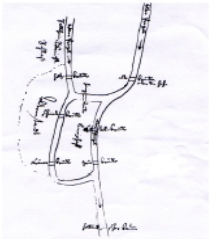
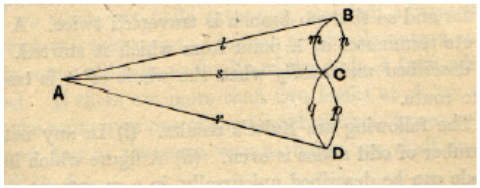
Network Algorithms

A.A. 2015/16

The Starting Point(1)

- It is usual to position the birthdate of the modern *graph theory* in 1736, when Euler formulated his Königsberg bridge problem.
- Euler solved this problem proving, in a constructive fashion, a characterization of Eulerian graphs. This is considered the first graph algorithm solving a "real life" problem.

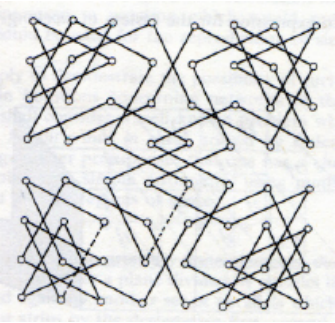




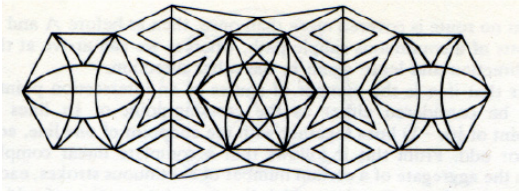
The Starting Point (2)

Since then, graph algorithms have been used to solve many problems in several applicative fields:

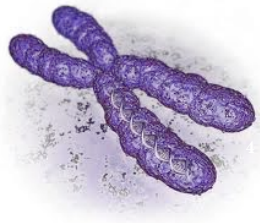
- games and puzzles:



- topology



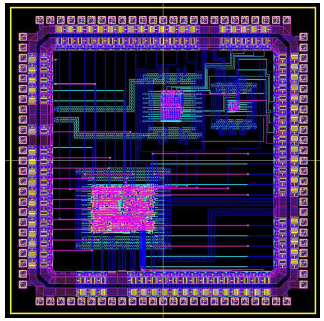
- biology



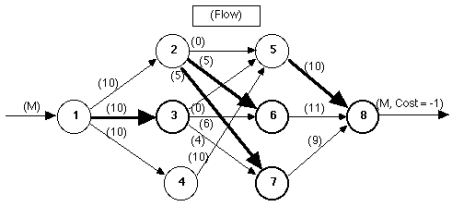
The Starting Point (3)

Specifically, in computer science:

- Electronic engineering:

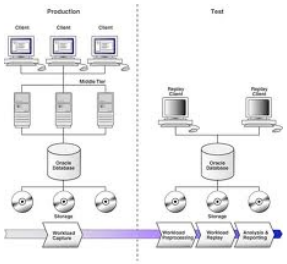


- Operative research:



The Starting Point (4)

- Artificial intelligence:
- Data bases:



- communication:

The Starting Point (5)

- networks:

This course will be focused on:

- Cable networks
- Wireless networks
  - Fixed
  - Mobile

The Starting Point (6)

- All over the world, courses of Network Algorithms are thought.
- Almost all of them have a theoretical approach:

(in the last years)

- Princeton Univ. (Robert Tarjan)
  http://www.cs.princeton.edu/courses/archive/spr11/cos423/
- Cornell Univ. (Eva Tardos)
  http://www.cs.cornell.edu/courses/cs684/2001fa/
- Universiteit Utrecht (Hans Bodlaender)
  http://www.cs.uu.nl/docs/vakken/na/
- Tel Aviv Univ.(Guy Even) http://hyde.eng.tau.ac.il/CO/
- Uni Freiburg
  http://ac.informatik.uni-freiburg.de/teaching/ss_12/network-algorithms.php
- Purdue University www.cs.purdue.edu/
- Univ. of Athens (Fotakis) ...

The Arrival Point

- Aim:
  to convince you that graph algorithms are not old-fashioned, though dated; instead, they are useful instruments to solve important and living problems.
- A number of advanced techniques for efficient algorithm design are studied, often at the hand of problems from networks and graphs. In many network applications, graphs are used as a model. In other applications, the graph model may be less obvious, but appears to be very useful.
- The translation of network problem to graph model is treated, and algorithmic problems and their solutions on networks and graphs are looked into.

Arrival Point

Starting Point

Which Route? (1)

Several topics will be dealt with, all in the same way:

- Definition of the network problem
- Model as (classical) graph problem
- Known solutions for the graph problem
- Other possible approaches based on the properties of the considered networks

Some classical topics

Some research topics (suitable for theses and new results)

Which Route? (2)

- The first topics will be more classical, and they will exploit some things you studied in the past, in order to start in an "easy" way; then the topics will become less and less standard…
- Why (my) research topics? three reasons:
  - Passion for these topics
  - International context
  - Chance to approach research topics in the algorithm field and produce new and interesting results (master theses…)

Which Route? (3)

Topics surely dealt with in this course:

- Cable networks:
  - The routing problem
    i.e.
    The minimum cost path problem
  - The interconnection topology layout problem
    i.e.
    The orthogonal grid drawing
  - The problem of minimizing boolean circuits
    i.e.
    The minimum set cover problem
  - The problem of infecting a network with a worm
    i.e.
    The minimum vertex cover problem

Which Route? (4)

Topics surely dealt with in this course (2):

- Wireless ad hoc networks:
  - The frequency assignment problem
    i.e.
    A vertex coloring problem
  - The minimum energy broadcast problem
    i.e.
    The minimum spanning tree problem

Which Route? (5)

Topics surely dealt with in this course (3):

- Sensor networks:
  - The centralized deployment problem
    i.e.
    The minimum cost perfect matching problem on bipartite graphs
  - The self-deployment problem
    i.e.
    The Voronoi diagram construction problem

Which Route? (6)

Books:

- Many topics deal with recent research, so:
  few books and many papers
- In the web page of the course:
  list of papers I have used.
- Attending lessons is particularly important!
  Even because…

Exam Procedure

- Only oral exam
- A (small!) number of lessons will be held by students.
- These have a twofold aim: from the one hand they get close students to research; from the other hand they are a good exercise to learn to extract the main ideas from a paper.
- These lessons will exonerate students by a part of the oral exam and are compulsory.

Relation with Other Courses

- No previous exams are required to attend this course, nevertheless A DEEP FAMILIARITY WITH ALGORITHMS AND DATA STRUCTURES IS NECESSARY.

At the End of this Course…

I would be happy to have your comments, especially about possible improvements.

Namely:

- What to deep in,
- What to skip,
- What to add,
- Any other suggestion…