Weekly homework assignments in the Networks Course at AIT 2012

- **Week 1**:

  Only theoretical lectures were given, no homework.

- **Week 2**:

  Compulsory:

  - Install Gephi on your computer and draw a small graph composed of a few nodes using Gephi, hand in the exported picture of the graph. (3 points)

  Optional:

  - Write a program that lists the second neighbors of each node for a network read from a link list. (3 points)
  - Draw the network of "E_coli_transcription.txt" (2 points):
    - apply a layout and adjust the position of the nodes so that the overall picture of the graph is "nice",
    - apply a color gradient for the node color showing the degree of the nodes,
    - make the nodes and links slightly opaque,
    - extract the degree of the nodes into a separate file.
  - Write a program that reads a link list as input and calculates the diameter of the network. (3 points)

  You can collect at most 5 points, (even if you fulfill all tasks).

- **Week 3**:

  The optional tasks are the following:

  - Perform the following analysis on the E_coli_transcription network (4 points):
    - calculate both directed and undirected average shortest path length for the nodes, export the results into a file,

    - prepare two figures in which the nodes are colored according to the two alternative closeness value. (Label the nodes by their name contained in the link list, and apply a suitable layout algorithm).
    - prepare a third figure, in which they are colored according to their clustering coefficient.
  - Write a program generating **directed** Erdős-Rényi graphs with adjustable N and p parameters, exporting the result into a link list. (4 points)

  You can collect at most 4 points, (even if you fulfill both tasks).

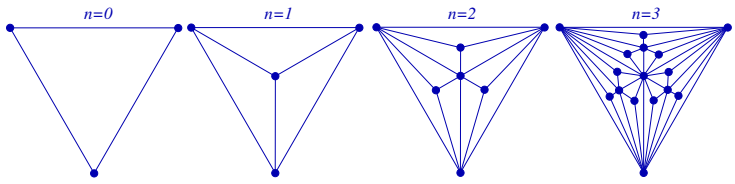
- **Week 4**:

  Compulsory (3 points):

  - Install Gnuplot on your computer.
  - Calculate both the in-degree and out-degree distribution of "Yeast_transcription.txt", and plot them together on one chart with Gnuplot. Hand in the figure showing the two curves.

  Optional:

  - Write a program that generates a Watts-Strogatz random graph:
    - The input is N, k, and p,
    - the output is the list of links.
    - Please visualize a sample generated with the program containing only a few rewired links. (3 points)
  - Assume we generate a graph in the following way:

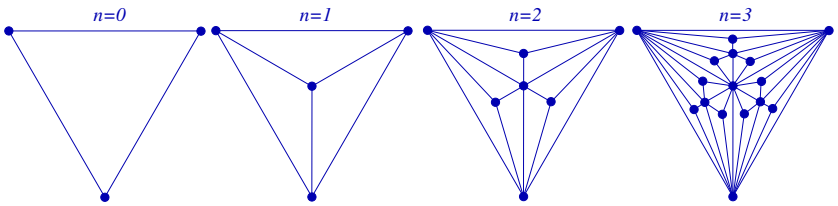
    Thus, at each iteration we insert a new node into the middle of the triangles born in the previous step, and connect it to the corners of the triangles.
    $\longrightarrow$ Calculate $\langle C \rangle$ at $n = 2$ and $n = 3$. (2 points)

You can collect at most 5 points.

- **Week 5**:

  The optional tasks are the following:

  - Assume we generate as in last week's homework:

    * Calculate the degree distribution at $n = 2$ and $n = 3$. (2 points)

  - Calculate the degree distribution and the cumulative degree distribution of "Dorog_net.txt". Prepare an image showing together the two on log-scale. (3 points)

  - Write a program that can generate the networks shown in the first task for a general n. Show the resulting graphs at iteration $n = 4$ and $n = 5$. (5 points)

  You can collect at most 5 points, (even if you fulfill all tasks).

  Week 6:

  The midterm test was taken, no homework was given.

  Week 7:

  Compulsory:

  - Write a short abstract for your term project (at most 1 page) summarizing the goal and the outline of the procedures planned for achieving the goal. (2 points)

  Optional:

  - Write a program that implements the Maximum-likelihood estimation of the degree exponent, and plot the estimated γ as a function of $k_{\min}$ for "Hun_Wikipedia_degree_dist.txt". (2 points)

- Calculate the cumulative degree distribution of "Dorog_net.txt" and determine the degree exponent by fitting $P(k)$ in Gnuplot. Prepare an image showing $P(k)$ together with the fitted power-law. (2 points)

You can collect at most 4 points.

- **Week 8-13**:

  The students received personalized homework assignments related to their chosen term projects in order to help their progress with the projects.