Dr. Uta Ziegler
Department of Computer Science

Research Interests:

- Artificial Intelligence
- Graph Theory
- Algorithm Development
- Computer Networking

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- AI contains many different methods which can be applied to analyze existing data -- protein sequences, folding patterns, control of gene expressions -- for a variety of purposes: visualization, prediction, detection of abnormalities.
- I have experience with neural networks, rule-based expert systems and some reinforcement learning.

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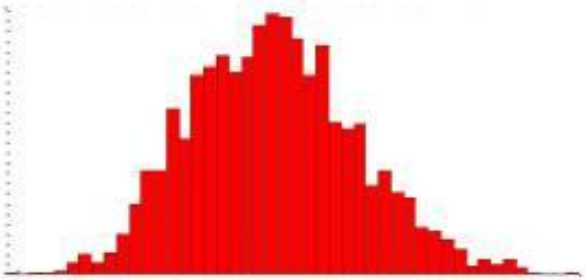
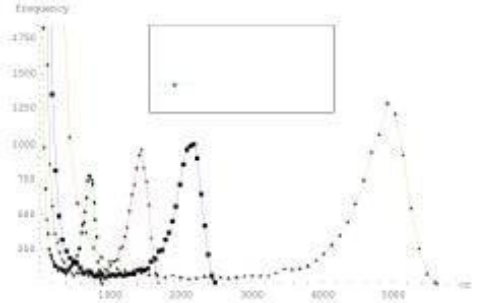
Algorithm Development to generate large knots and compute their ropelength

Uta Ziegler in collaboration with Claus Ernst (WKU) & Yuanan Diao (UNC Charlotte)

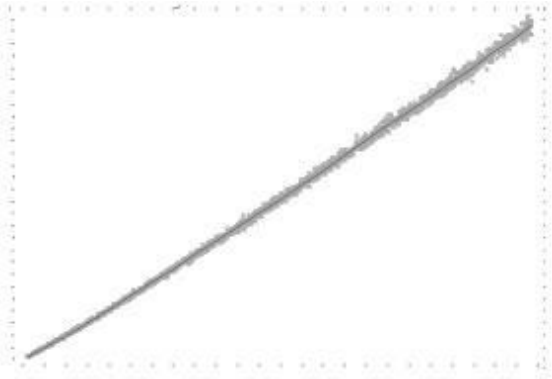
What's a knot? A physical knot is like a rope with its two ends tied up together.



Distribution of the rope length of 2000 prime knots with 200 crossings



Frequency of prime RP-graphs



Empirical ropelength as a function of the number of crossings

Why is this interesting?

- Knots exist in synthetic high polymer strands; the knotted strands behave differently than unknotted strands.
- Knots also exist in circular DNA.
- The formations of knots are affected by various factors, one of them is the rope length (and rigidity) of the polymers and DNA.

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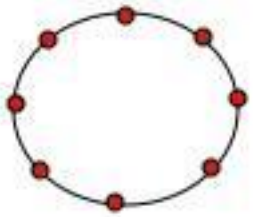
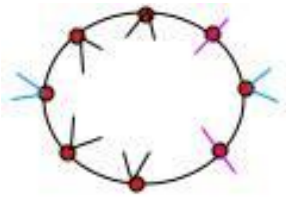
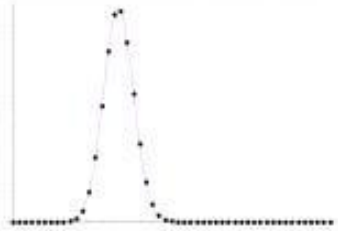
Uniform generation of random large knot diagrams in O(n)

Step 1:Create a Hamilton Cycle with n vertices



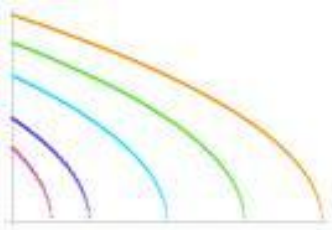
Step 2: Uniformly pick the two edge endpoints for each vertex



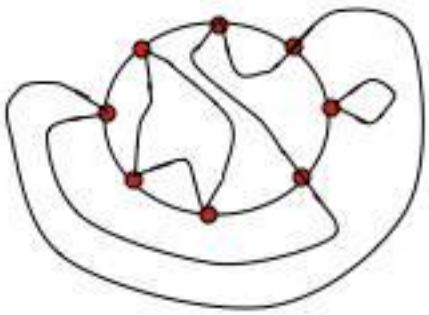


Step 3: Uniformly pick a vector to connect outside edge endpoints

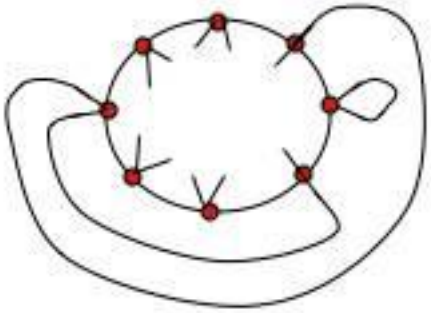
There are 6 outside edge endpoints. 3 **start** an edge and 3 **end** an edge. One possible vector is 110100, where 1 indicates the start of an edge and 0 the end.



Step 4: Connect the edges starting at top vertex, going clockwise



Step 5: Repeat for inside edges; e.g. using vector 1100110100



Number of knot diagrams as a function of the number of vertices of different types

Approximating data through normal distributions and estimating μ and ♦