



Exercise sheet 1

Exercise 1.1 Definitions

- i. What is the difference between a distributed system and a parallel computer?
- ii. Why do we use distributed systems although they are complicated? Give examples.
- iii. What are the three V's for BigData, name and explain them.

Exercise 1.2: Topologies

Consider a hypercube with dimension d .

- i. Given two arbitrary nodes u and v from the hypercube. How many shortest paths are there between u and v ?
- ii. How many different node pairs are there, that are connected with shortest path of length k ?
- iii. Given the broadcast algorithm from the lecture to produce spanning trees on the hypercube. How many different spanning trees could be generated from the same start node by varying the dimension used for sending?
- iv. Would it be possible to do multiple broadcasts in parallel with the previous algorithm from the same start node? i.e. in the unit time model there exist at most one message on an edge.

Exercise 1.3: Distribution of Information

- i. Implement the Flooding algorithm with acknowledgments using the simulation framework teachnet (provided at the ISIS course website). After finishing the implementation, test your algorithm on a ring topology and compare the amount of messages sent with the "Broadcast on Unidirectional Rings" using the same topology.
- ii. Implement the Echo algorithm using teachnet and evaluate the correctness of the amount of messages sent to be $(2e)$ on various topologies. Highlight all edges that are part of the spanning tree.
- iii. An improvement of the Echo algorithm has been introduced (see lecture) that sends a set of tabu node IDs together with an explorer. Examine the behavior of the algorithm compared to the classical Echo algorithm in terms of message reduction under the assumption of the following topologies:
 - a) Bidirectional ring with n nodes
 - b) Binary X-tree of height h (with $2^{h+1} - 1$ nodes)

Additional notes and assessment:

- important parts of the implementation have to be annotated with comments
- each exercise has to be completed handled in teams of 3-4 students
- the exercise sheet is successfully completed, if exercise 1 was presented and the solution was explained satisfactorily