

- 1a Explain the concepts of interface, protocol, service, and implementation in the context of a layered network model as used, for example, in the OSI reference model. 10pt
- 1b Java provides a separate networking library with methods to send and receive messages. Does this mean that Java provides its own communication protocol? Explain your answer. 5pt
- 1c Is it possible to let a protocol at layer L_i be completely unaware of the protocol(s) used at a higher layer L_{i+1} ? Explain your answer. 5pt
- 2a What is an Autonomous System in the Internet? 5pt
- 2b The Border Gateway Protocol (BGP) uses distance vector routing. It advertises complete routes instead of the “best” neighbor. Name two important advantages of this approach. 10pt
- 2c Does it make sense to build a “virtual” network of hosts on top of the Internet with its own routing protocol? Explain your answer. 5pt
- 3 In the following questions, you are asked to develop reliable connectionless communication based on UDP.
- 3a How would you let error control take place? 5pt
- 3b How would you let flow control take place? 5pt
- 3c How would you implement reliable multicasting based on UDP? Assume the recipients are known in advance. 5pt
- 3d How would you implement atomic multicasting, that is, a message is delivered to all recipients, or to none at all? Again, assume that all recipients are known in advance. 10pt
- 4a Explain how authentication with public/private key pairs can be established. 5pt
- 4b Explain how Alice can electronically send Bob a signed contract without encrypting the contract for confidentiality. 5pt
- 4c What is a (cryptographic) certificate? 5pt
- 4d Explain how Diffie-Hellman key exchange works. 10pt

Grading: The final grade is calculated by accumulating the scores per question (maximum: 90 points), and adding 10 bonus points. The maximum total is therefore 100 points.