

## Sample Exam Computational Foundations II (LRG0061, Summer Term 2022)

### Rules:

- These sheets stay closed until the official start of the examination is announced
- Already now put your name and Matrikel number onto the examination front page. Have your passport and student ID available on your desk
- No further items except this examination document, paper given out by us, and a few pens are allowed on your desk.
- If you have a question, raise your hand. If the answer is relevant to everyone, we will put it onto the whiteboard
- If you are done, please stay in your location quietly and double-check everything. If you need to go to the restrooms, raise your hands. Only one person is allowed to leave the room at the same time.

Full Name: \_\_\_\_\_

Matrikel No.: \_\_\_\_\_

### Evaluation

Task 1: Multiple Choice	/ 5
Task 2: Combinatorial Circuits	/ 5
Task 3: Quadrature Phase Shift Keying	/ 5
Task 4: Socket API	/ 5
Task 5: Broadcast Routing	/ 5
Task 6: Shortest Paths	/ 5
<b>Sum</b>	/ 30

**Task 1:** Multiple Choice

(5 points.)

Answer the following questions with yes or no.

*A wrong answer is counted as -1, a correct answer is counted as +1, an answer not given is counted as 0 (if you don't know the answer it is smarter not to give an answer!). If you reach more than 5 points, the points will become bonus points, if you reach less than 0 points, the result is 0 points.*

Are the following statements true or false?		True	False
a	IEEE standard for floating point numbers (754) supports certain special values like infinity		
b	A 3-bit unsigned integer ranges from including 0 to including 7.		
c	When multiplying two 8-bit numbers, the result can be held in 8 bit.		
d	For computing the shortest path between all nodes of a graph, one typically runs Dijkstra with each node as the starting point		
e	In network coding, the transmission capacity can be higher than in network routing.		
f	A sixth question		
g	A seventh question		

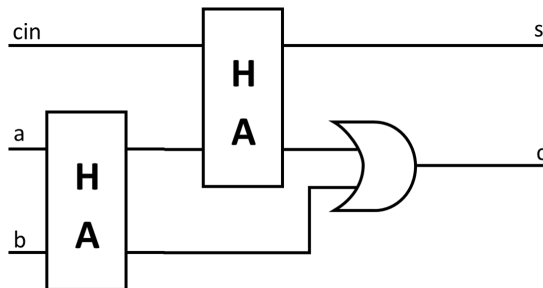
**Task 2:** Combinatorial Circuits

(5 points.)

The following truth table defines a half-adder:

a	b	s	c
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

- a. Give the Sum-of-Products (SOP) representation of the circuit.
- b. Implement (exactly) the SOP for the output  $s$ .
- c. Give the complete truth table of the following circuit, where HA stands for an instance of the half adder.



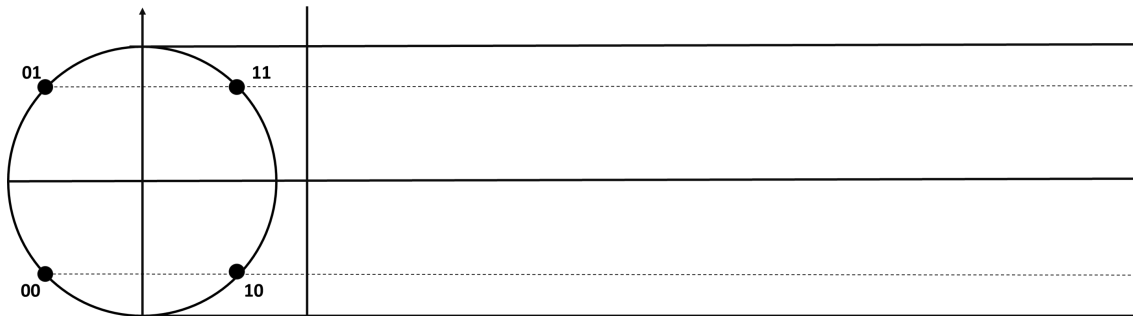
- d. Using ICs of a Full Adder and a Half Adder, build a 2-bit addition circuit (4 inputs, 5 outputs) and give the truth table for rows where the first bit of the first input is 0.

**Task 3:** Quadrature Phase Shift Keying

(5 points.)

The idea of the QPSK phase shift keying is that various phases represent different symbols, such that two bit are transmitted at the same time.

- a. Given a bitstring of 11010011, draw the modulation waveform in the following diagram and mark all keypoints (e.g., points where the waveform intersects the organizational lines) for better readability. Each symbol of two bit shall be transmitted with one roundtrip of the wave.



b.

**Task 4:** Socket API

(5 points.)

The Berkeley socket API is still the basic operating system interface for networking. It provides (among others) the following functions: socket, listen, connect, accept, shutdown, close, send and recv.

- a. List the required socket API functions in the right order to connect to a server.
- b. Describe the difference between TCP/IP and UDP/IP in a single sentence.
- c. What is the API function shutdown good for?

(5 points.)

a. What is redundancy (single sentence)?

b. What is implosion (single sentence)?

c. How does the hop count influence redundancy?

d. Given a hop-count smaller than the network diameter, not all nodes can be reached. Why?

(5 points.)

- How does Dijkstra store shortest path information?
- In which order does the Priority Queue give the gray vertices from the Dijkstra algorithm?