universität koblenz
weiter:denken

WeST
Web Science and Technologies

Network Theory and Dynamic Systems

Exam (SS 2024), xx xxxxx 2024

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First and Last Name: _____

Matriculation Number: _____

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Programme of Study: ☐ MSc Web and Data Science
☐ MSc Mathematical Modeling
☐ Other: _____

Examination regulation: ☐ 2023
☐ 2019
☐ 2012 or other

Student's signature: _____

Task:	1	2	3	4	5	6	7	Sum
Total Points:	21	15	12	12	12	14	14	100
Achieved Points:								

Grade: ☐ Very Good
☐ Good
☐ Satisfactory
☐ Sufficient
☐ Fail

In digits: ☐

Marker's signature: _____

Please read the following information carefully before solving!

- This exam paper includes 7 tasks spanning xxx pages. Please ensure that your copy is complete and readable.
- Four additional pages are included at the end of the exam paper, but they will not be assessed or corrected.
- Respond only in the designated fields provided for answers.
- Remember to include your matriculation ID on every page; failure to do so will result in the corresponding page not being evaluated.
- Use a non-erasable writing instrument, i.e. ink/ballpoint pen. Do *not* write with a pencil!

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1 Knowledge Questions — Total: 21 Points

Check the correct answers. Each correct answer gives +0.5 points. If nothing is ticked, then it will be counted as 0 points.

1.1 Network Elements (3 Points)

Please check whether the following statements are true or false.

☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

1.2 Small Worlds (3 Points)

Please check whether the following statements are true or false.

☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

1.3 Hubs (3 Points)

Please check whether the following statements are true or false.

☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

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1.4 Directions and Weights (3 Points)

Please check whether the following statements are true or false.

- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

1.5 Network Models (3 Points)

Please check whether the following statements are true or false.

- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

1.6 Strong and Weak Ties (3 Points)

Please check whether the following statements are true or false.

- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

1.7 Network Dynamics (3 Points)

Please check whether the following statements are true or false.

- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
- ☐ True ☐ False xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

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2 Essay Questions

Total: 15 Points

Question 1: Discuss ..... (5 points)

Question 2: Briefly describe ..... (5 points)

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Question 3: Explain why ..... (5 points)

Do not solve in this space

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3 Practice Questions I: Network Elements — Total: 12 points

You are given the following dataset representing a social network of a group of individuals. The dataset includes information about friendships between individuals. The network can be represented as an undirected graph where nodes represent individuals and edges represent friendships.

1. Calculate the average clustering coefficient of the network.

2. Interpret what the clustering coefficient indicates about the network.

3. Compute the shortest path length between all pairs of nodes.

4. Determine the average shortest path length and interpret its significance.

5. Another Question

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4 Practice Questions II: Strong and Weak Ties — Total: 12 points

The diagram below represents a social network. Are there any nodes that do not satisfy the Strong Triadic Closure property? If such nodes exist, identify them. Please include a comprehensive explanation of your reasoning.

Figure 1: Placeholder for an image

Do not solve in this space

DEMO

5 Practice Questions III: Network Dynamics — Total: 12 points

You are considering the XXX model on the network shown on the following figure. The three active nodes a, b and c can convince their neighbors with probability p1 (a) and p2 (b) and p3 (c). Which node will influence more neighbors on average? Provide your calculations for supporting your reasoning.

Figure 2: Placeholder for the image of the network

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6 Programming Tasks I

Total: 14 points

You are given the following code that performs ..... The code contains .... gaps that have to be filled with the box number containing the correct line of code for each gap from the List of choices given below.

```
def   xxxxxx(xxxxx, xxxx, xxxxx):
  # xxxxxxxxxxxxxxxxxxxxxxxxxxx
  result= 0
  for i in xxxxx(.....................):          (2 points)
    xxxx += ............................ + xxxxxx   (2 points)
  return  xxxxxxx

def   xxxxxx(xxxxx, xxxx, xxxxx):
  # xxxxxxxxxxxxxxxxxxxxxxxxxxx
  for i in xxxxx(.....................):          (2 points)
    xxxx += ............................ + xxxxxx   (2 points)
  return  xxxxxxx
...
...                                               (6 points)
...
```

List of choices

1 xxxxx	**2** xxxxx	**3** xxxxx
4 xxxxx	**5** xxxxx	**6** xxxxx
7 xxxxx	**8** xxxxx	**9** xxxxx
10 xxxxx	**11** xxxxx	**12** xxxxx
13 xxxxx	**14** xxxxx	**15** xxxxx
16 xxxxx	**17** xxxxx	**18** xxxxx
19 xxxxx	**20** xxxxx	**21** xxxxx

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7 Programming Tasks II

Total: 14 points

You are given the following code. After carefully reviewing the code, answer the following questions by circling the right answer.

```
def function_1(xxxxx, xxxxx):
    xxxxxxxx

def function_2(xxxxx, xxxxxx):
    xxxxxxxx

def function_3(self):
    xxxxxxxxxxx

.....
....
```

1. What is .....? (2 points)

A. .....

B. .....

C. .....

D. .....

2. What is .....? (2 points)

A. .....

B. .....

C. .....

D. .....

3. Why .....? (2 points)

A. .....

B. .....

C. .....

D. .....

4. Which of .....? (2 points)

A. .....

B. .....

C. .....

D. .....

5. Which .....? (2 points)

A. .....

B. .....

C. .....

D. .....

6. Assume .....? (2 points)

A. .....

B. .....

C. .....

D. .....

7. What value .....? (2 points)

A. .....

B. .....

C. .....

D. .....

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