Maturita - INF Theory 2021/2022

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1. Banking

Exercise: There are 3 banks with 3 different **interest rates**. For example:

Bank	Interest rate
Bank 1	1.5%
Bank 2	2.0%
Bank 3	2.5%

We deposit *1000€* into each bank. In how many years to we have *2000€* in total in each bank? Create **algorithms** to tackle the problem and consider the possible **advantages and disadvantages** of such algorithms.

- Describe the **banking security** in terms of choosing the network **topology** or **data encryption** to defend against hackers. What are the types of hackers?
    1. Banking **network topology** → link

    2. Types of hackers → hackers

2. IP and Network

1. Describe the `IPv4` and `IPv6` addresses → link
2. Describe the history of the **internet** - Arpanet → link
3. What is a **subnet mask**? → link

    The subnet mask splits the IP address into the host and network addresses, thereby defining which part of the IP address belongs to the device and which part belongs to the network

5. What's the role of **internet providers**?

    Internet providers in Slovakia → link

7. **IP addresses** - understand the structure of an IP address and detect an incorrect one.

    → link; *exemplary questions*

3. Text processing

Exercise: convert a message, such as *'Ahoj, ako sa mas?'* to a **bit map** and display its result. Additionally, estimate the size of such a digital picture.

*Hint: in order to estimate the size of a **digital bit map**, we have that `S = color depth * dimensions`. We truncate the output to the width of 8 pixels. E.g.: $(122)_{10} = (1111010)_2 \implies (01111010)_2$

Define the terms: **ASCII**, **Enlarged ACII**, **Unicode**

4. Data compilation and data encryption

What is **data compilation**? How do we compile a text image to a standardised image format?

1. Define the term **data encryption** and what does it incorporate.
2. Why is **data encryption** significant?
3. What is a **public** and a **private** key?
4. What are some of the most common methods of data **encryption**?
5. What is **data decryption**?

Symmetric and asymmetric data encryption sourced document link.

5. Databases

Exercise: A company provides a **database** with the names and the surnames of their employees. Create an algorithm that will create a database of proper **email** addresses in the format: `name.surname@company.com`.

1. What is the **structure** of an email address?
2. Define what **DNS** stands for and explain the term.
3. Discuss some of the **potential risks** of cyber security.
4. **GDPR** threats.

6. PC network

1. What are the **pros and cons** of internet-based services and service providers?
2. **Client server** vs. **Peer-to-peer**
3. Types of connections based on the **lengths**.
4. What is a **networking protocol**? Describe some of it type, such as `HTTP(s)`, `FTP`, `IMAP`, `SMT`, `POP3`, `TCP`, etc.
5. Describe the types of **network topology** and briefly discuss their pros and cons.
6. Describe the term **network traffic**. What are the types of **connections**?
7. Explain **IPS providers**.

Sourced document titled **Internet** link.

7. Message decryption

Exercise: an encrypted message in the form of a sequence of ASCII values is given, e.g.: `122 65 87 88 67 ... XX`. We assume the message to consist **English/Slovak** words exclusively. Find the numerical value of `XX` (so the word has a meaning) and create a **bit map** to represent the message as an image.

1. What is **color depth** and how do we measure it?
2. Define the term **image compression**.

8. Cards of guests

Exercise: we are given and `.xls` **database** with the full names of guests. Create a program which will generate **invitation cards** to every visitor with the credentials obtained from the database.

1. What are **computer graphics**?
2. What are **vector** and **raster graphics**? How do they differ?
3. What kind of printers would you use to **print** the guests?

Computer graphics sourced document link.

9. Search engine and web browser

Describe the components of a **search engine**: 1. **Spider** 2. **Index** (indexing) 3. **Search and retrieval** component Provide examples of **search engines**.

Mention and describe the types of search engines (SE): 1. **Free text** SE 2. **Directory-based** SE 3. **Meta** SE

Mention several examples of **web browser** and describe the function of a **web browser**. Sourced document link.

Exercise: Create a program that will generate a random number from the interval $< 1; 1023 >$. Then, the program will try to guess the number, only being given whether the desired number is **greater** or **smaller** than the current user's input. Compose the algorithm.

10. Computer security

1. Describe the main types of **anti-viruses**.
2. What are some of the **protocols** that ensure network computer security?
3. Define the terms: **anti-spyware**, **anti-malware**.
4. Which protocol ensures the update of an **anti-virus** software on a local machine?

   TL;DR $\rightarrow$ TCP-IP/ISO layers link

Exercise: Detect errors in a table of 8×8 bits by **bit parity**. Propose methods to fix the table.

11. Number base systems

1. **Conversions** between different number base systems: **decimal**, **octal**, **decimal**, **hexadecimal**.
2. **Conversion** of numerical values obtained from number base systems to **ASCII**, **Unicode**, etc.

Exercise: you are given a set of **coordinates** in binary values. Find the real location of the **map**.

12. Digital representation of colours

Exercise 1: convert an `RGB` value from **binary** to **decimal/hexadecimal** format.

1. What do **RGB** and **CMYK** stand for?
2. What are their uses in modern electronics?
3. How do they differ? Provide examples.

Describe the following computer parts: **sockets**, **monitor**, **processing unit**, **I/O devices**.

Exercise 2: Katka has a colour palette. She wants to write a text onto each paper. We need to determine whether the text be in black or white.

Hint: consider the *brightness formula* $C = (R \times 299) + (G \times 587) + (B * 144) \div 1000$, where R, G, B represent respective `RGB` decimal values. If $127 \geq C \implies$ we use a **white** colour and vice versa.

13. Find a secret place

We a given an **image** which depicts 2 solid colours. We need to find a real place on the **map** based on the finding of our conversion; *image* $\rightarrow$ *place*.

Hint: we observe 2 colours in the standard `RGB` format: $(R_1, G_1, B_1) \wedge (R_2, G_2, B_2)$. Then we have the following coordinates.

$R_1^{\circ} \ G_1' \ B_1''$ of geographical **latitude** (N/S) and $R_2^{\circ} \ G_2' \ B_2''$ of geographical **longitude** (W/E)

Example of an **image**:

Figure 1: demo

14. Digitizing of sound

1. Describe the aspects of **digitizing of sound**. Sourced document link.
2. Calculate the **file size** and the **download time** of various audio files.

Provide examples of suitable **audio software** for various professional jobs (based on the budget). Adduce several **audio format file extensions** and describe the differences.

15. Nodes and finding the shortest distance

1. What are **hash functions** and how do we use them?
2. How may **hash function** be used with various **networking protocols**?

Exercise: find the **shortest distance** from N nodes in a planar figure with the distances (between them) and allowed speeds ascribed. For instance, find the shortest distance and/or the shortest route in terms of the total amount of time between the node A and the node E, hence $A \rightarrow E$.

16. File size of images given the colour depth

We disregard any **file compression**!

Exercise 1: Suppose a picture of 256×160 pixels and 4096 colours. Calculate the file size in `MB`.

Exercise 2: Suppose a picture of 650×1150 pixels and 16384 colours. Calculate the file size in `Mb`.

Paper about **digitizing of an image** link.

17. Operating systems (OSs)

1. Describe the term **UI - user interface** of an OS.
2. How does an OS manage tasks concerning **local data management**?
3. How does an OS manage **external devices**?
4. Describe the aspects of security management of an OS.

Compare and contrast the most common types of OS: **macOS**, **Windows**, **Linux**. Discuss why would someone prefer one over another? Adduce examples from **professional jobs**, etc. - Discuss the relation between **software** and **hardware**.

Von Neumann architecture sourced document link.

18. Linux and its distributions

1. Explain the basics of the **Gnu/Linux** operating systems.
2. What is the **Linux Kernel**?
3. What' the primary use of **Linux** devices?
4. Adduce examples with different **Linux distributions**.

19. E-commerce

1. What does the term **e-commerce** stand form?
2. What are the possible **pros & cons** of it?
   - What are **YouTube** copyright laws and why do we need them?
3. Describe the **pros & cons** of internet baking.

Describe the processes how data is **distributed**. How do we ensure secure **data transmissions**? What is **data compression** and why is it essential for modern technologies?

Python exercises

List of `Python` exercises:

1, 5, 8, 9, 10, 11, 13, 14, 17, 18, 20, 22, 25, 26, 27, 30, 31, 34, 37, 39, 41, 42, 43, 45, 46, 47, 48, 56, 58, 59, 62, 64

Exemplary solutions from practical exercises

1. Extra solutions;
2. TBD;