Data, Math and Methods

Week 12, Exams preparations

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Today

Week by week topic overview

- **Practice** topics for the exams

Assessments!

- **Marking:**
  - 50% **Multiple Choice test** – 03.06. opens as a Moodle Quiz until the end of the week (one attempt, but can take as long as you want)
  - 50% **Practical Exam** – 10.06. working with code, small functions as questions

  - They will both have mixed-in bonus from the attendance and assignments you submitted over the term.

Topics overview:

- **I.** Functions
- **II.** Operators
- **III.** Prime numbers
- **IV.** **State Machines**
- **V.** **Logic**
- **VI.** Statistics
- **VII.** Color theories
- **VIII.** Searching
- **IX.** **Vectors** and Matrices

Theoretical questions -> Multiple choice test (*Assignment Element 1*)
Practical questions -> Practical exam (*Assignment Element 2*)

Topics overview:

- **I.** Functions
- **II.** Operators
- **III.** Prime numbers
- **IV.** **State Machines**
- **V.** **Logic**
- **VI.** Statistics
- **VII.** Color theories
- **VIII.** Searching
- **IX.** **Vectors** and Matrices

- It's a lot! But it's all that we were able to cover in this course.
  - At the same time, we have not gone super deep in any of these topics – the exam questions will be *mostly* gentle
- **Today** we will go one by one with these topics and recap – and you will answer similar questions to those that will appear in your exams.

Theoretical questions -> Multiple choice test (*Assignment Element 1*)
Practical questions -> Practical exam (*Assignment Element 2*)

I. Functions

- **Linear and quadratic functions**
- Fitting a line for data

- Starter **questions**:
  - What is the difference between the filetypes *int* and *float*? What is a *loss of precision*?
  - Formula for a linear function? Formula for a quadratic function?

I. Functions – Reading?

- **Links for additional materials:**
  - Linear / quadratic functions: https://www.mathsisfun.com/algebra/systems-linear-quadratic-equations.html

PS: remember, basic understanding is enough ;), there won't be anything too devious in the exam.

II. Operators

- **Unary and binary operators**
- Basic logic operators – AND, OR, XOR, =>, <=>, NAND, NOR
  - Truth tables for these operators

- **Questions:**
  - Difference between unary and binary operators? Examples of both?

II. Operators – Reading?

- **Links for additional materials:**
  - Operators examples: https://www.futurelearn.com/courses/maths-puzzles/0/steps/14011
  - NAND logic: https://en.wikipedia.org/wiki/NAND_logic

III. Prime numbers

- **Prime numbers**
- Eratosthenes sieve algorithm

- **Questions:**
  - Define a prime number
  - Would you be able to write a function which checks for remainder after division? And if a number is prime?

III. Prime numbers – Reading?

- **Links for additional materials:**
  - Eratosthenes sieve algorithm: https://www.khanacademy.org/computing/computer-science/cryptography/comp-number-theory/v/sieve-of-eratosthenes-prime-adventure-part-4

IV. State Machines

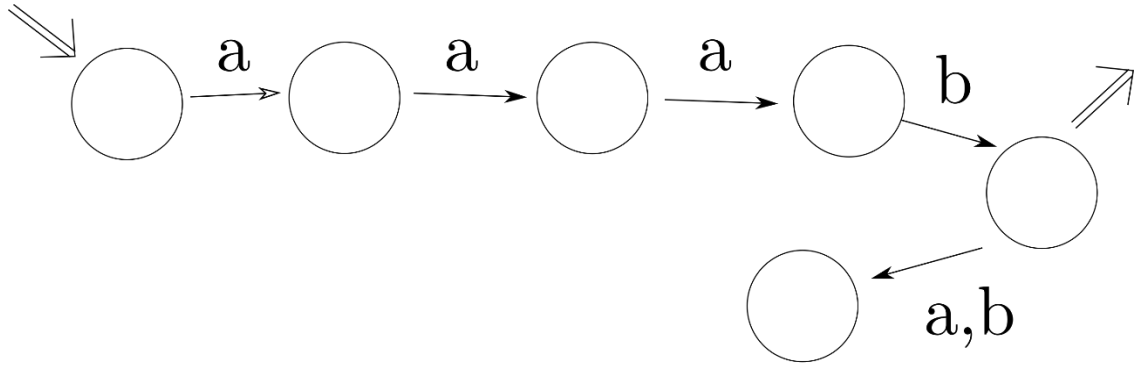
- **Understanding how to reach a state machine schema**
  - Being able to say what a schema would do

- **Questions:**
  - Difference between deterministic and non-deterministic state machine?
  - What does it mean for a word to be accepted?
  - What is an accepting and initial state in state machine?

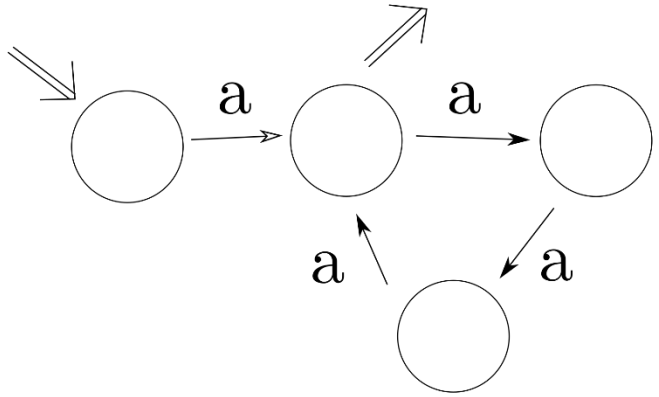
IV. State Machines

Being able to say what a schema would do:

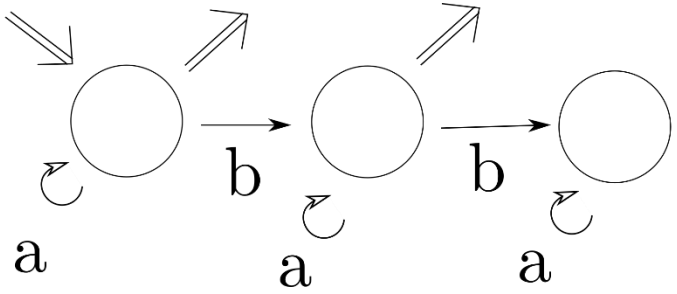
a.)



b.)



c.)



IV. State Machines – Reading?

- **Links for additional materials:**
  - State machines intro: https://www.youtube.com/watch?v=4rNYAvsSkwk
  - State machine usage – in Games: https://www.youtube.com/watch?v=Oz04rH542l8&t=579s

PS: you can also use the tasks in week 6 recap for practice

Pause 1

V. Logic

- **Being able to convert logically equivalent formulas**
  - Evaluating the truth tables for given logical formulas

- **Questions:**
  - Are two formulas logically equivalent? $(\neg a \vee b) \equiv (a \wedge b)$
  - Evaluation table for formula: $(\neg a \wedge b) \vee b$

V. Logic – Reading?

- **Links for additional materials:**
  - Truth tables, logical equivalences: http://sites.millersville.edu/bikenaga/math-proof/truth-tables/truth-tables.html
  - https://www.youtube.com/watch?v=D72f9azH2UI

PS: you can also use the tasks in week 6 recap for practice

VI. Statistics

- **Functions used in statistical analysis**
  - Averages, standard deviations
- **Understanding random sampling**
  - Normal and uniform distributions
- **Questions:**
  - What is the difference between Uniform and Normal (Gaussian) distribution? Could you differentiate on images with sampled noise?
  - What is the difference with small and large standard deviation used as a parameter for the Normal (Gaussian) random function?
  - Can you calculate average from these values [1,3,3,2,1] ?

VI. Statistics – Reading?

- **Links for additional materials:**
  - https://www.quora.com/What-is-the-difference-between-normal-distribution-and-uniform-distribution
  - https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library/random-variables-discrete/v/random-variables?modal=1

PS: note that we won't test probabilistic theory too much – focus on the practical aspects of random functions which we used

VII. Color theories

- **Primary colors, mixing into gamuts, non-RGB color spaces**
- For example: HSV system

- **Questions:**
  - What are primary colors?
  - What is a gamut? Which ones do you know? Are they the same?
  - Describe the colorimetric experiment.
  - What is the HSV color space?

VII. Color theories – Reading?

- **Links for additional materials:**
  - Primary colors and color theories www.handprint.com/HP/WCL/color6.html

VIII. Searching

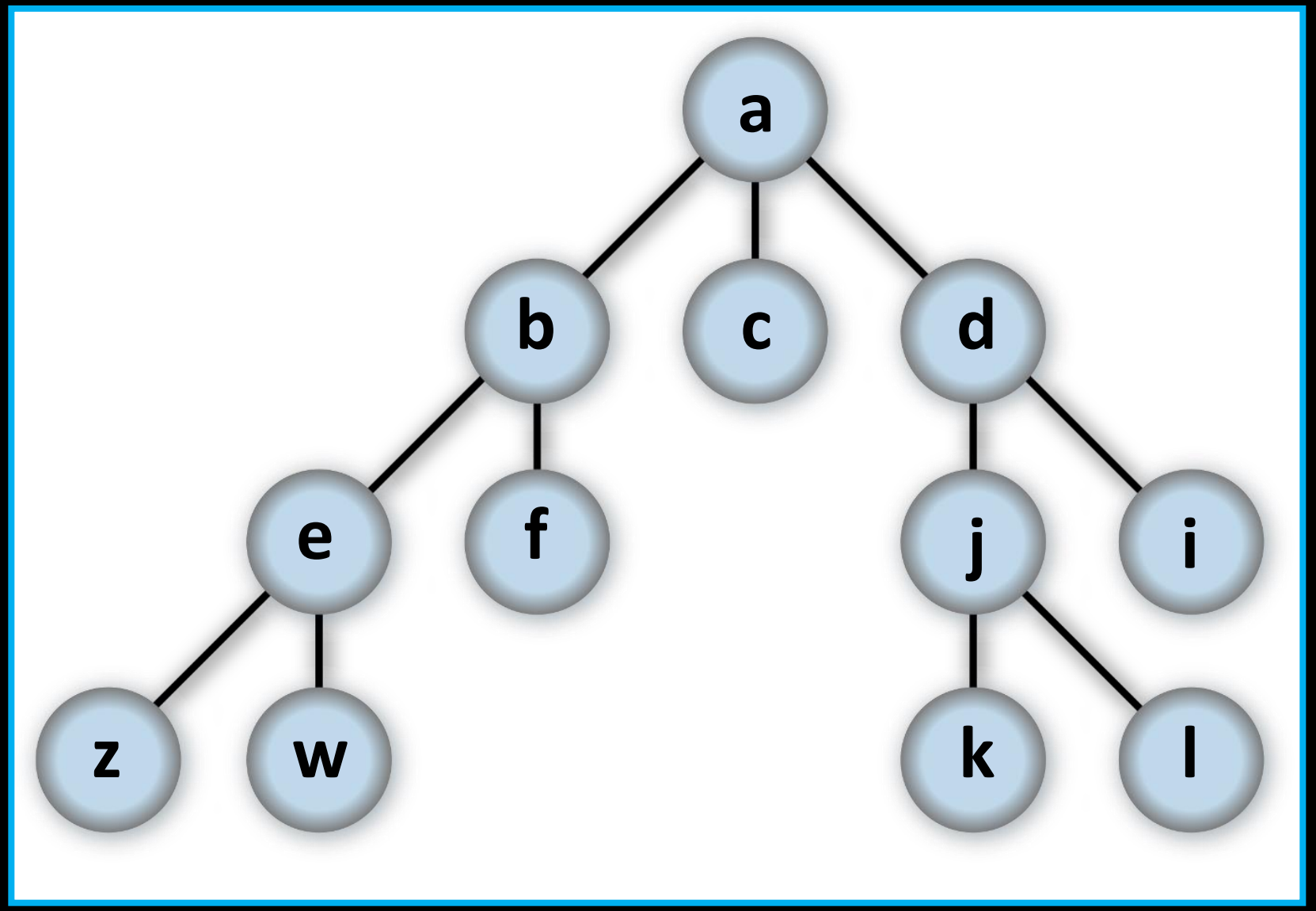
- **Given an algorithm which visits nodes in a tree, be able to tell in which order we will visit nodes**
- This will for example mean reading a code and predicting how it will go through the input data
  - For example: Depth-first and Breadth-first search

VIII. Searching

Describe the order of visited nodes if we start in “a” / “d”

- If we are using Depth-first search

- If we are using Breadth-first search



VIII. Searching – Reading?

- **Links for additional materials:**
  - Depth First Search https://brilliant.org/wiki/depth-first-search-dfs/
  - Breadth First Search https://brilliant.org/wiki/breadth-first-search-bfs/
  - Video DFS / BFS: https://www.youtube.com/watch?v=TIbUeeksXcI

IX. Vectors and Matrices

- **Rewriting vector operations we studied into pieces of code**
- Remembering properties needed for matrix-matrix multiplication

- **Questions:**
  - What do you need to describe a vector? (The minimal information necessary to precisely describe one)
  - What is the result of adding two vectors? What is the result of a dot product operation?
  - How do you interpolate between two vectors? What must be true for the used coefficients?
  - What dimensionalities do two matrices have for multiplication?

IX. Vectors and Matrices – Reading?

- **Links for additional materials:**
  - Vectors: https://www.math10.com/en/geometry/vectors-operations/vectors-operations.html
  - Matrices: https://www.cliffsnotes.com/study-guides/algebra/linear-algebra/matrix-algebra/operations-with-matrices

Pause 2

Programming task

- **Practice functions as a preparation for the exams**
- Starter code with tasks:
  - week12_exam-prep/w12_practice_tasks.ipynb

The End