Zadání a řešení testu z informatiky a zpráva o výsledcích přijímacího řízení do magisterského navazujícího studia od podzimu 2018

Zpráva o výsledcích přijímacího řízení

do magisterského navazujícího studia od podzimu 2018

Počet podaných přihlášek	444
Počet přihlášených uchazečů	390
Počet uchazečů, kteří splnili podmínky přijetí	245
Počet uchazečů, kteří nesplnili podmínky přijetí	145
Počet uchazečů přijatých ke studiu, bez uvedení počtu uchazečů přijatých ke studiu až na základě výsledku přezkoumání původního rozhodnutí	245
Počet uchazečů přijatých celkem	246
Percentil pro přijetí	29.00

Základní statistické charakteristiky

	Percentil	Informatika	Matematika	Celkem
Počet otázek		30	25	55
Počet uchazečů, kteří se zúčastnili přijímací zkoušky		180	181	181
Nejlepší možný výsledek		30.00	25.00	55.00
Nejlepší skutečně dosažený výsledek		26.00	24.00	46.00
Průměrný výsledek		12.89	9.58	22.40
Medián		13.25	9.75	22.50
Směrodatná odchylka		5.40	5.01	9.17
Decilové hranice výsledku *	10	5.50	3.25	10.25
	20	8.50	5.75	15.25
	30	10.50	7.00	19.00
	40	11.75	8.25	21.25
	50	13.25	9.75	22.50
	60	14.50	10.50	23.50
	70	15.75	11.50	26.25
	80	17.50	13.25	29.25
	90	20.00	16.25	34.50

* Decilové hranice výsledku zkoušky vyjádřené d1, d2, d3, d4, d5, d6, d7, d8, d9 jsou hranice stanovené tak, že rozdělují uchazeče seřazené podle výsledku zkoušky do stejně velkých skupin, přičemž d5 je medián.

Entrance exam - Computer Science

Jméno a příjmení – pište do okénka	*Číslo přihlášky*	*Číslo zadání*
		288

Algorithms and Data Structures

1 Which one of these statements is true?

A B-trees are a special case of binary search trees.

B The logarithm and square root functions have the same asymptotic growth.

C The worst-case time complexity of inserting an element into a hash table is in $\mathcal{O}(1)$.

D We say that an algorithm is partially correct, if it produces a correct output for at least some of the inputs.

*E The binary heap can be efficiently implemented using an array.

2 Consider a hash table with linear probing and the hash function `h(x) = (5*x + 3) mod 7`. We start with the hash table empty. In what order do we have to insert the values 1, 2, 5, 7, 9, 12, so that the contents of the resulting hash table look as follows: 2, 12, 1, 5, 7, empty field, 9?

A 9, 2, 5, 12, 1, 7

B 2, 9, 5, 12, 1, 7

C 9, 2, 12, 5, 1, 7

*D 9, 2, 12, 1, 5, 7

E 2, 9, 12, 5, 1, 7

3 Which one of the following is **always true** for any binary search tree (BST)?

A The depth of the tree is logarithmic to the number of all nodes.

B Every internal node (i.e., not a leaf) contains exactly two children.

C The minimal key is stored in the root.

D The minimal key is stored in one of the leaves.

*E The node with the maximal key does not have a right child.

4 Consider a directed graph. We run a depth-first search on this graph. The search algorithm assigns to each vertex v two numbers: `v.d` is the discovery time of v, and `v.f` is the finishing time of v. Which one of these statements is true in general?

*A None of the other statements is true in general.

B If there is a path from vertex u to vertex v in the graph then `u.d > v.d`.

C If there is a path from vertex u to vertex v in the graph then `u.d < v.d`.

D If there is a path from vertex u to vertex v in the graph then `u.f < v.f`.

E If there is a path from vertex u to vertex v in the graph then `u.f > v.f`.

5 Let $f(n) \in \mathcal{O}(n)$ and $g(n) \in \mathcal{O}(n^2)$. Which one of the following statements is true?

A $g(n) \in \mathcal{O}(f(n))$

B $f(n) \in \mathcal{O}(g(n))$

C $f(n)/g(n) \in \mathcal{O}(1)$

*D $f(n) * g(n) \in \mathcal{O}(n^3)$

E $g(n)/f(n) \in \mathcal{O}(1)$

Computer systems

6 Which of the following logic circuits is sequential?

A   Demultiplexer
*B Serial binary adder
C   Half adder
D   Parity generator
E   Multiplexer

7 Which of the following algorithms **can not** be used as a strategy for processor scheduling?

A   First come, first served
*B Least recently served
C   Round robin scheduling
D   Earliest deadline first (closest to its deadline)
E   Shortest remaining time first

8 Modern desktop processors (Intel Core i3, i5, i7) **do not** have integrated:

A   Memory controller
B   Floating point unit
C   Graphics processing unit
D   Branch target predictor
*E Universal Serial Bus controller

9 Which hexadecimal number is equivalent to the **octal** number 7264?

A   4BE
B   EC2
C   F4E
*D EB4
E   BE4

10 The algorithm for mutual exclusion that allows two or more processes to share a single-use resource without conflict is:

A   Dijkstra's algorithm
*B Peterson's algorithm
C   Ford-Fulkerson algorithm
D   greedy algorithm
E   Bellman-Ford algorithm

Programming

11 Consider the following program. The `print` function outputs the given number followed by an end-of-line character.

```
function foo(integer n)
begin
        print n
        if n > 0 then
                foo(n-1)
                print n
                foo(n-1)
                print n
        end if
end

program main()
begin
        foo(3)
end
```

How many lines are going to be printed by the program?

- **A** 14
- ***B** 29
- **C** 7
- **D** 30
- **E** The program will run forever and never halt.

12 Which statement is generally true in common OOP languages such as C++, Java, C#?

- **A** The notions "class" and "object" mean the same thing.
- **B** If late binding (virtual method calls) is used, the actual method to be called is decided by the compiler at compile time.
- **C** If a class B inherits from a class A, instances of B can access all attributes (member variables) of A.
- ***D** If a class B inherits from a class A (via public inheritance), every instance of B is considered to also be an instance of A.
- **E** The difference between static and non-static methods (member functions) is that only static methods may access the static attributes (member variables) of a class.

13 Which one of the following statements is **false**?

- ***A** When using call-by-reference, the change of a parameter value inside a function cannot be observed from the outside of the function.
- **B** In purely functional languages, functions have no side effects.
- **C** A recursive function can always be rewritten in an iterative manner.
- **D** The lazy evaluation strategy in functional programming allows working with infinite data structures.
- **E** A tail-recursive function can always be rewritten in an iterative manner.

14 Consider the following function:

```
function fun(unsigned integer n)
begin
        result = 1
        while n != 0
                n = n - 1
                result = result + result
        end while
        return result
end
```

What is the result computed by fun(n)?

A   result = 1

B   result = n

*C   result = 2^n

D   result = $2 * n$

E   result = n^2

---

15 Which statements I, II, and III are true (in common languages such as C++, Java, C#)? Choose the option that contains **all true** statements (and none of the false ones).
I. Local variables of functions are always allocated on the heap.
II. Function calls are implemented using the stack.
III. If an exception is caught (in a catch block), it can be re-thrown (using throw).

A   III
B   I, II
*C   II, III
D   I, III
E   I, II, III

Computer Networks

---

16 Domain Name Space of Internet
A   has a structure of distributed tree for routing (PRR-tree) with the maximum number of levels equal to 256.
B   has a hypercube structure with the maximum number of dimensions equal to 16.
C   has an inverted binary tree structure with the maximum number of levels equal to 1024.

D   has a virtual balanced B^+-tree structure with the maximum number of levels equal to 64.
*E   has an inverted tree structure with the maximum number of levels equal to 128.

---

17 Medium Access Control (MAC) is responsible for
A   redundant data transmissions for forward error correction.
B   redundant data transmissions for error detection and ensuring transmission repetition.
C   the conversion between digital and analog signals in the local area networks and elimination of the collisions between analog and digital signals.
D   elimination of cycles and loops in local area networks.
*E   the coordination of multiple devices' access to shared transmission media and for the elimination of collisions caused by concurrent transmissions (emissions).

---

18 The **only** types of IPv4 addresses are

*A unicast address, broadcast address and multicast address.
 B unicast address, broadcast address, multicast address and anycast address.
 C unicast address, multicast address and anycast address.
 D unicast address, broadcast address and anycast address.
 E unicast address and broadcast address.

**19** Transmission Control Protocol (TCP)

 A is a protocol for real-time data transmission and is often used with multicast communication.
*B provides a connection-oriented and fully-reliable service with flow and congestion control during data transmission.
 C is responsible for finding optimal paths (the optimality criterion is a metric based on costs assigned for passing through network) and for delivering data packets to their receiver.
 D is the simplest transport protocol providing a connection-less and unreliable service.
 E is a supplement to IP protocol that provides information about errors occured during data delivery and basic information about the network state.

---

20 Transmission media in computer networks

*A provide an environment for the functionality of the physical layer.
 B are responsible for packing digital data into frames.
 C are responsible for packing digital data into packets.
 D ensure the communication of particular applications.
 E are responsible for routing and switching data in a network.

Database Systems

---

21 Choose the option that describes the following E-R diagram (in Chen notation) of a database of products and categories:
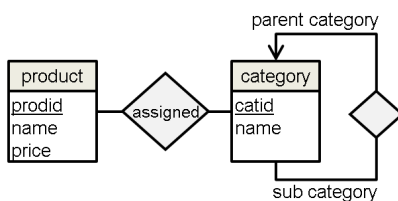
 A Each product can be assigned to at most one category. Categories can be hierarchically structured, and each category can have at most one parent category.
 B Each product can be assigned to multiple categories, and a category must have at least one product assigned. Categories can be hierarchically structured, and each category can have at most one parent category.
*C Each product can be assigned to multiple categories, where a product may not have any category assigned. Categories can be hierarchically structured, and each category can have at most one parent category.
 D Each product can be assigned to exactly one category, and a category must have at least one product assigned. Categories can be hierarchically structured, and each category can have multiple parent categories.
 E Each product can be assigned to multiple categories, where a product must have at least one category assigned. Categories can be hierarchically structured, and each category can have multiple parent categories.

22 An e-shop application contains a non-empty relation `product(`<u>`id`</u>`, name, quantity, price, cate-gory)` with the primary key `id`. Assume that quantity is a non-negative number.
Which one of the following SQL statements returns the total price of all products for which the e-shop has at least one item in the inventory?

  A `SELECT price * quantity FROM product`
*B `SELECT SUM(price * quantity) FROM product`
  C `SELECT price * quantity FROM product WHERE quantity > 0`
  D `SELECT TOTAL(price) * COUNT(quantity) FROM product WHERE quantity > 0`
  E `SELECT SUM(price * quantity) FROM product HAVING quantity > 0`

---

23 Consider the relations `customer(`<u>`custid`</u>`, name, address)` and `account(`<u>`accid`</u>`, custid, balance)`. The attribute `account.custid` is a not-null foreign key to `customer`. Choose the statement that is **incorrect**:

*A Relation `account` contains at least as much tuples as the relation `customer`.
  B If there is at least one tuple in the relation `account` then the relation `customer` is not empty.
  C Relation `account` can be empty.
  D All values of the attribute `account.custid` must have a corresponding `customer.custid`.
  E Relation `customer` can be empty.

---

24 Consider a relation `employee(`<u>`id`</u>`, name, start_date, end_date, salary, superior_id)` that represents a simple registry of employees and their superiors. Dates correspond to the start and end date of the employee's contract, respectively. If end_date is not set, the contract is still active.
What is the result of the following SQL query?

```
SELECT s.name, SUM(e.salary)
FROM employee AS e, employee AS s
WHERE s.id = e.superior_id AND e.end_date IS NULL
GROUP BY s.id, s.name
```

  A Names of all employees and the total amount of money paid as the salaries of all their direct superiors that are currently working for the company.
  B Names of all superiors and the total amount of money paid as the salaries of all their direct subordinates that no longer work for the company.
*C Names of all superiors and the total amount of money paid as the salaries of all their direct subordinates that are currently working for the company.
  D The SQL query is syntactically incorrect thus an error will be returned.
  E Names of all employees and the total amount of money paid as the salaries of all their direct superiors that no longer work for the company.

---

25 Choose the option that contains **only true** statements about relations (tables) in the context of relational database systems:

  A A relation is a matrix, where columns correspond to attributes and rows to tuples. The values in each row must be from the domain of the respective attribute (column), and the matrix is symmetric.
  B A relation is an unsorted set of tuples (rows). The elements of each tuple are arbitrary values set by the user updating the database.
*C A relation is an unsorted bag of tuples (rows). The tuples are members of the Cartesian product of domains of the relation's attributes.
  D A relation constitutes a relationship between two tables and is represented as a set of tuples, where each tuple's element is a foreign key to the corresponding table.
  E A relation is a sorted list of tuples (rows). The elements of each tuple are values from the domain of the respective attribute of the relation.

Software Engineering

26 Which diagram of the Unified Modelling Language (UML) is best suited for the modelling of system processes?

A Class diagram
B Entity-relationship diagram
*C Activity diagram
D Consequence diagram
E Data flow diagram

---

27 Which one of the following statements about design patterns is **false**?

A An example of a design pattern is *Singleton*. It helps secure the existence of at most one instance of a specific class.
*B Design patterns primarily focus on security problems within software.
C A design pattern is not a finished design, but rather a design template that can be used in many different situations.
D Object-oriented design patterns typically show relationships and interactions between classes or objects.
E Design patterns describe solutions to commonly occurring problems within the context of software design.

---

28 Consider the model depicted with the UML class diagram in the figure.
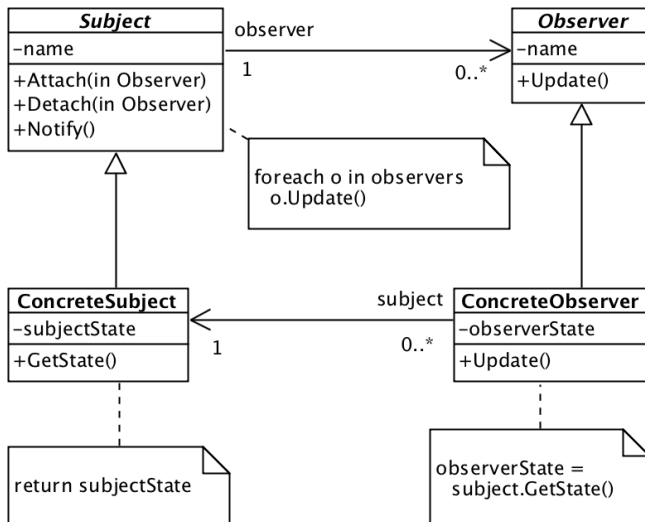
Which one of the following statements is in correspondence with the model?

*A An instance of the ConcreteSubject class might have a reference to zero or more objects of the Observer type.
B Each instance of the Observer class has a reference to exactly one instance of the Subject class.
C Each instance of the Subject class has a reference to exactly one instance of the Observer class.
D An instance of the ConcreteSubject class cannot have any reference to an instance of any other class.
E An instance of the ConcreteObserver class might have a reference to zero or more instances of the ConcreteSubject class.

29 Consider the model depicted with the UML class diagram in the following figure.
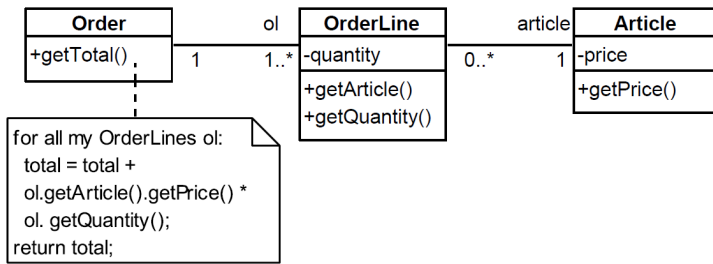
Now consider a change of the model in terms of adding a `subtotal` attribute (with the value `article.getPrice()*quantity`) and a get method for it to the `OrderLine` class, and using it within `getTotal()`. What effect would this change have on the non-functional properties of the system?

A   worse performance of `Order.getTotal()`, better maintainability of the system
*B   better performance of `Order.getTotal()`, worse maintainability of the system
C   no effect
D   worse performance of `Order.getTotal()`, worse maintainability of the system
E   better performance of `Order.getTotal()`, better maintainability of the system

30 Which of the following **is not** a principle of agile development?

*A   Complete product delivery over incremental delivery
B   Individuals and interactions over processes and tools
C   Responding to change over following a plan
D   Customer collaboration over contract negotiation
E   Working software over comprehensive documentation