Algorithms and data structures

Iniziato	giovedì, 2 giugno 2022, 20:14
Stato	Completato
Terminato	giovedì, 2 giugno 2022, 20:14
Tempo impiegato	15 secondi
Valutazione	**0,00** su un massimo di 36,00 (**0**%)

Domanda 1

Risposta non data

Punteggio max.: 3,00

Write the function

```
void invertString (char *s1, char **s2);
```

which receives an input string (of unknown length) s1 and generates an output string (initially, a NULL pointer) s2. The string s1 includes only uppercase letters. The function allocates the string s2, and then stores into it the same letters stored in s1 but such that all **strictly** ascending sub-sequences of single characters appearing in s1 are transformed into **strictly** descending sub-sequences of single characters into s2. The string s2 must be dynamically allocated by the function.

For example, if s1 is the following:

```
A B C D D D D Z Y X W E F G
```

the function has to store into s2 the following string:

```
D C B A D D Z D Y X W G F E
```

as the sequence "A B C D" is strictly ascending and must be transformed into "D C B A" and the same consideration holds for "D Z" transformed into "Z D", etc.

Domanda 2

Risposta non data

Punteggio max.: 4,00

Suppose an array v stores N integer values (**v[N]**) and we look for a value **key** in the array, using the following 4 functions:

- A sequential linear search with the array being unordered.
- A sequential linear search with the array being sorted.
- A binary sequential search with the array being sorted.
- A binary recursive search with the array being sorted.

Report the code for the recursive search and illustrate how to compute the asymptotic costs of the 4 functions. Which is their final asymptotic complexity? Motivate your answers and give the intuition behind the asymptotic costs.

Domanda 3

Risposta non data

Punteggio max.: 1,00

Insert the following sequence of keys into an initially empty hash table. The hash table has a size equal to M=23. Insertions occur character by character using open addressing with double hashing. Use functions h1(k)=k%M and h2(k)=1+(k%97).
Each character is identified by its index in the English alphabet (i.e., A=1, ..., Z=26). Equal letters are identified by a different subscript (i.e., A and A become A1 and A2).

A L L A

Indicate in which elements are placed the last two letters of the sequence, i.e., L and A, in this order.

Please, report your response as a sequence of integer values separated by one single space. No other symbols must be included in the response. This is an example of the response format: 3 9

Risposta:

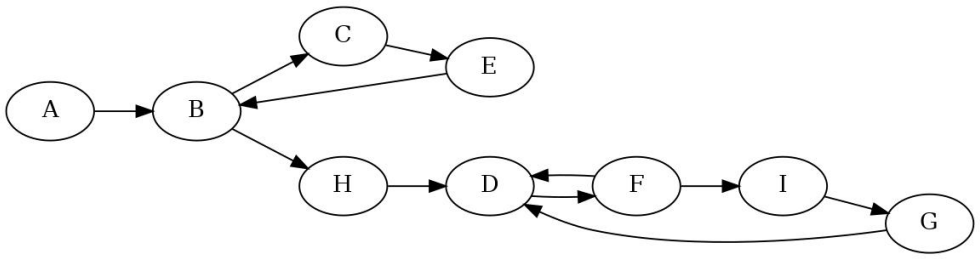
La risposta corretta è : 2 3

Domanda 4

Risposta non data

Punteggio max.: 1,00

Visit the following graph in depth-first, starting at node A. Label nodes with discovery and end-processing times. Start with the discovery time set to 1 on A. When necessary, consider nodes and edges in alphabetic order.



Display the end-processing time of all vertices.

Please, indicate the end-processing time of all vertices sorted in alphabetic order (i.e, display the end-processing time for A B C D etc.). Report a sequence of integer values separated by one single space. No other symbols must be included in the response. This is an example of the response: 15 13 2 16 8 etc.

Risposta:

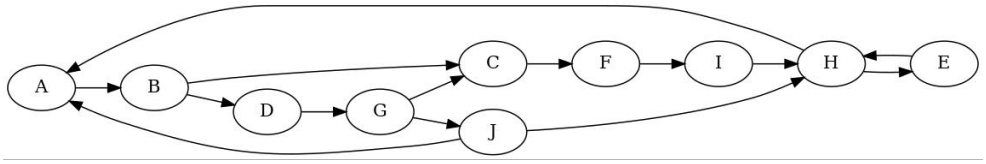
La risposta corretta è : 18 17 6 15 5 14 12 16 13

Domanda 5

Risposta non data

Punteggio max.: 1,00

Visit the following graph in breadth-first, starting at node A.
When necessary, consider nodes and edges in alphabetic order.



Display the minimum distance of all vertices from the starting one.

Please, indicate the distance of all vertices sorted in alphabetic order (i.e, display the distance for A B C D, etc.). Report a sequence of integer values separated by one single space. No other symbols must be included in the response. This is an example of the response: 0 3 2 6 8 etc.

Risposta:

La risposta corretta è : 0 1 2 2 6 3 3 5 4 4

Domanda 6

Risposta non data

Punteggio max.: 2,00

Analyze the following recursive program. Indicate the exact output generated. Please, report the exact program output with no other symbols.

```
#include <stdio.h>
#include <string.h>
void f (char *);
int main(void) {
  char *s = "This 12345 Is A String 678";
  char *d;
  d = strdup (s);
  f (d);
  fprintf (stdout, "%s\n", d);
  return (1);
}
void f (char *s) {
  int i, j;
  i = 0;
  while (i < strlen(s)) {
    if (s[i]==' ' || (s[i]>='0' && s[i]<='9') || (s[i]>='A' && s[i]<='Z')) {
      for (j=i+1; j<strlen(s)+1; j++) s[j-1] = s[j];
    } else {
      i = i + 1;
    }
  }
  return;
}
```

Risposta:

La risposta corretta è : hisstring

Domanda 7

Risposta non data

Punteggio max.: 1,00

Consider a binary tree whose visits return the following sequences.

Pre-order:	A	B	C	F	D	G	L	E	H	I
In-order:	B	F	C	A	G	L	D	H	I	E
Post-order:	F	C	B	L	G	I	H	E	D	A

Report the sequence of keys stored on the leaves of the tree, moving on the tree from left to right.

Please, report the list of keys on the same line, separated by a single space. No other symbols must be included in the response. This is an example of the response format: A X C Y etc.

Risposta:

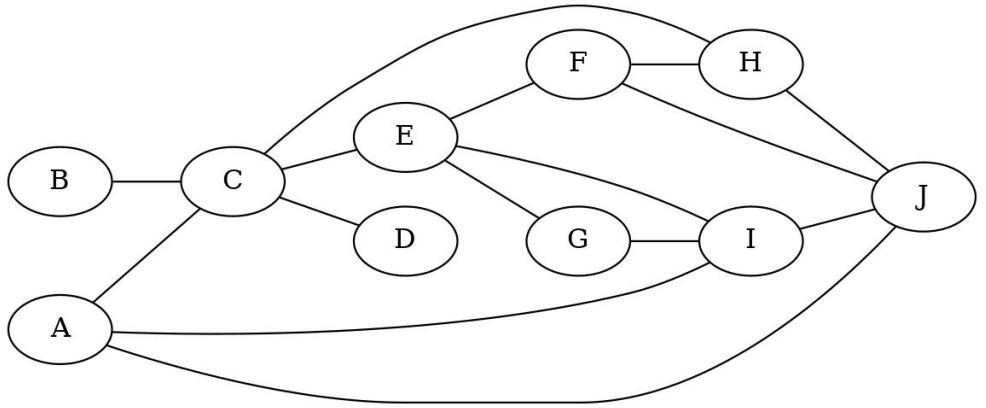
La risposta corretta è : F L I

Domanda 8

Risposta non data

Punteggio max.: 1,00

Given the following graph find all articulation points. If necessary, consider nodes and edges in alphabetical order.



Display all articulation points alphabetically. Please, report only the list of vertices separated by a single space. No other symbols must be included in the response. This is an example of the response format: A B C etc.

Risposta:

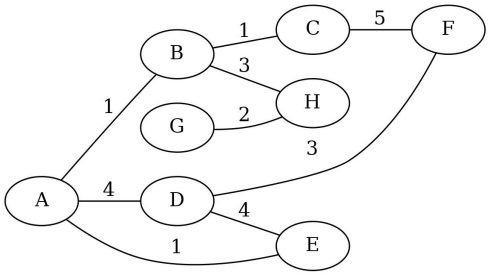
La risposta corretta è : C

Domanda 9

Risposta non data

Punteggio max.: 1,00

Given the following undirected and weighted graph find a minimum spanning tree using the Kruskal algorithm.



Indicate the total weight of the final minimum spanning tree. Report one single integer value. No other symbols must be included in the response. This is an example of the response format: 13

Risposta:

La risposta corretta è : 15

Domanda 10

Risposta non data

Punteggio max.: 1,00

Given the following sequence of integers stored into an array, turn it into a heap, assuming to use an array as an underlying data structure. Assume that, in the end, the largest value is stored at the heap's root. Then, execute the first two steps of heapsort on the heap built at the previous step.

7 8 10 3 5 6 2 13

Report the final content of the entire array at the end of the above process.

Please, show the entire content of the array as a sequence of integer values separated by a single space. No other symbols must be included in the response. This is an example of the response: 0 3 2 6 8 etc.

Risposta:

La risposta corretta è : 8 7 6 2 5 3 10 13

Domanda 11

Risposta non data

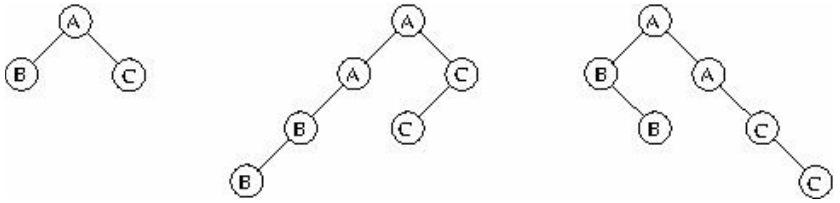
Punteggio max.: 5,00

Write the function

void doubleTree (struct node *root, char flag);

that for each node in a binary tree creates a new duplicate node, and inserts the duplicate as the left child of the original node if flag='L', and as the right child of the original node if flag='R'.
Report the C structure (struct node) storing string keys ('A', 'B', 'C', etc. must be considered as dynamic strings, as they are characters just for the sake of simplicity).

For example, the tree on the left-hand side of the following picture must be transformed into the one in the middle if flag='L', and into the one on the right in flag='R'.



Domanda 12

Risposta non data

Non valutata

If you want to withdraw from the exam, please select true. Otherwise, i.e., you want to take the exam, select false.

(a) False (No, I do not want to withdraw)

(b) True (Yes, I want to withdraw)

La risposta corretta è: True (Yes, I want to withdraw)

Domanda 13

Risposta non data

Punteggio max.: 1,00

Given the following array of integer values, perform the first step of quicksort to sort the array in ascending order, thus from the initial array generate the right and the left partitions.

1 10 6 4 8 5 2 7 11 9

Report 3 integer values: The pivot selected on the original array, the pivot you would select on the left partition generated from the original array, and the pivot you would select on the right partition generated (again) from the original array. No other symbols must be included in the response. This is an example of response format: 13 1 10

Risposta:

La risposta corretta è : 9 2 10

Domanda 14

Risposta non data

Punteggio max.: 2,00

The following data structure specifies a list of element **struct m** in which each element individuates a list of element **struct p**.
The function is supposed to visit the entire list of lists and it displays all data fields.

```
typedef struct m m_t;
typedef struct p p_t;

struct m {
  char *name;
  char *id;
  p_t *p;
  m_t *next;
};

struct p {
  char *name;
  int price;
  p_t *next;
};

void printAll ( m_t *head) {
  m_t *tmp1;
  p_t *tmp2;
  tmp1 = head;
  while (tmp1 != NULL) {
    fprintf (stdout, "%s %s\n", tmp1->name, tmp1->id);
    tmp2 = tmp1->next;
    while (tmp2 != NULL) {
      fprintf (stdout, "  - %s %d\n", tmp2->name, tmp2->price);
      tmp2 = tmp2 ->next;
    }
    tmp1 = tmp1->next;
  }
  return;
}
```

Indicate which of the following statements are correct.

Note that more than one response can indeed be correct and that incorrect answers may imply a penalty on the final score.

Scegli una o più alternative:

- [ ] (a) The line **tmp2 = tmp1->next;** must to be **tmp2 = tmp1->p;**
- [ ] (b) The variable **head** must be passed by reference to function **printAll**, i.e., as m_t **head.
- [ ] (c) The function has a cost that is linear in the number of elements in the main list.
- [ ] (d) A function looking for a specific element in a secondary list has the same asymptotic complexity of function **printAll**.
- [ ] (e) The function has a cost that is linear in the total number of elements (main plus secondary lists).
- [ ] (f) The line **tmp2 = tmp2->next;** must to be **tmp2 = tmp2->p;**

La risposta corretta è: The function has a cost that is linear in the total number of elements (main plus secondary lists)., A function looking for a specific element in a secondary list has the same asymptotic complexity of function **printAll**., The line **tmp2 = tmp1->next;** must to be **tmp2 = tmp1->p;**

Domanda 15

Risposta non data

Punteggio max.: 9,00

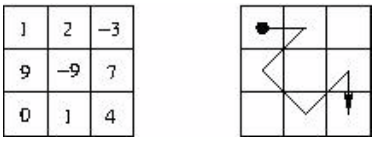
A map is represented as a matrix of integer values. The starting cell of the map is always at the top-left corner (element [0,0]), while the ending cell is always at the bottom-right corner (element [r-1, c-1], where r and c are the numbers of rows and columns of the matrix, respectively). It is possible to walk (i.e., visit) the map by moving from one cell to any adjacent element (8 at most), but each cell has to be visited only once.

Write the recursive the C function **matVisit** that is able to find a path from the starting point to the ending point whose **sum** of the content of the visited cell is maximum. The function receives 4 parameters: the matrix mat, its number of rows r, its number of rows c, and a flag f:

```
void matVisit (int **mat, int r, int c, int f);
```

If there are more paths with the same (maximum) sum, the function has to display the shortest path if f=0 and the longest one if f=1. The desired path has to be displayed with a format similar to the one reported in the example.

The following figure illustrates a matrix mat, with r=2 and c=2, (left-hand side) and the corresponding solution (right-hand side).



The indicated path should be reported with a format similar to the following one:
[0,0]1 - [0,1]2 - [1,0]9 - [2,1]1 - [1,2]7 - [2,2]4 - sum = 24
Specify (in C language) which is the logic followed by the function.

Domanda 16

Risposta non data

Punteggio max.: 2,00

Analyze the following recursive program. Indicate the exact output generated.

Please, report the exact program output with no other symbols.

```
#include <stdio.h>
void f1 (int n);
void f2 (int n);
void f3 (int n);

void f1 (int n) {
  if (n<=0) {
    return;
  }
  printf ("1");
  f2 (n-1);
  return;
}

void f2 (int n) {
  if (n<=0) {
    return;
  }
  printf ("2");
  f3 (n+1);
  return;
}

void f3 (int n) {
  if (n<=0) {
    return;
  }
  printf ("3");
  f1 (n-1);
  return;
}

int main () {
  fprintf (stdout, "f1(5): ");
  f1(5);
  fprintf (stdout, "\n");
  return 1;
}
```

Risposta:

La risposta corretta è : 1231231231231

Domanda 17

Risposta non data

Punteggio max.: 1,00

Given an initially empty BST, perform the following sequence of operations on the BST leaves.
Each positive value indicates a leaf insertion and each negative value a node extraction.

4 6 10 13 7 18 20 3 9 16

Report the key of all leaves of the final BST considering them from left to right.

Please, report all nodes' keys as a sequence of integer values separated by a single space. No other symbols must be included in the response. This is an example of the response format: 23 4 5 3 etc.

Risposta:

La risposta corretta è : 3 9 16 20