A-1 以下の問に答えよ．(Solve the following problems.)

(1) 次の関数の導関数を求めよ．(Find the derivatives of the following functions.)

(a) $y=(3x^3-1)^5$

(b) $y=xe^{-x}\sin x$

(2) 次の不定積分を求めよ．(Calculate the following indefinite integrals.)

(a) $\int x^2\log x\,dx$

(b) $\int\frac{x+1}{(x-1)^2}dx$

(3) 次の定積分を求めよ．(Calculate the following definite integral.)

$$\int_1^e\frac{(\log x)^2}{x}dx$$

A-2 $f(x)=xe^{2x}$ とする．(Let $f(x)=xe^{2x}$.)

(1) 第１次導関数 $f'(x)$ と第２次導関数 $f''(x)$ を求めよ．

(Find the first derivative $f'(x)$ and the second derivative $f''(x)$.)

(2) 関数 $y=f(x)$ について、増減、極値、凹凸、変曲点を調べて、そのグラフの概形をかけ．

(Make a rough sketch of the graph $y=f(x)$ by determining the intervals on which $f(x)$ is increasing and decreasing, the local maxima and minima, the intervals on which $f(x)$ is concave upward and downward, and inflection points.)

(3) 曲線 $y=f(x)$ $(0\le x\le 1)$ と直線 $x=1$ および x 軸で囲まれる図形を D とする．図形 D の面積 S を求めよ．

(Let D be the region bounded by the graphs $y=f(x)$ $(0\le x\le 1)$, $x=1$, and the x-axis, Find the area S of the region D.)

試験科目	情報科学基礎「微分積分学」

D-1

以下の問いに答えよ。

Answer the following questions.

(1) 次の数値データをこの順番通りに挿入することによって構築される二分探索木を描け。

Draw the binary search tree that is created if the following numbers are inserted in the tree in the given order.

9　6　3　12　10　15　7

(2) 図1に示す二分探索木は空の状態から数値データの並びを挿入することによって構築されたものである。
次のA～Eのうち、図1の木が生成できないものはどれか。

The binary search tree shown in Fig 1 was constructed by inserting a sequence of items into an empty tree. Which of the following input sequences will not produce this binary search tree?

(A)　5　2　4　9　10　7　8　6　12

(B)　5　9　7　8　6　10　12　2　4

(C)　5　9　2　7　6　8　4　10　12

(D)　5　9　2　6　7　8　4　10　12

(E)　5　9　7　2　8　10　6　4　12

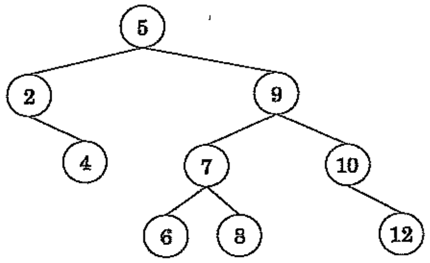

図1 (Fig 1)

(3) 図2の関数MIRRORは、左右のノードを反転した二分木を新たに生成する。図3はMIRROR(root)の実行結果を示している。空欄 [a]，[b] を埋めよ。

The following function named MIRROR() (Fig 2) creates a new tree that is the mirror of the original tree. Fig 3 shows the result of MIRROR(root). Fill in the blanks (a and b) in Fig 2.

```
/* create a new tree that is the mirror
   of the original binary tree
   - node n has the left and right nodes
     (n.left and n.right) */
MIRROR(n)
    if (n = null)  then  return

    /* do the subtrees */
    MIRROR(n.left)
    [   a   ]

    /* swap the left and right subtrees */
    temp  ←  [   b   ]
    n.left  ←  n.right
    n.right ← temp
```

図2 (Fig 2)

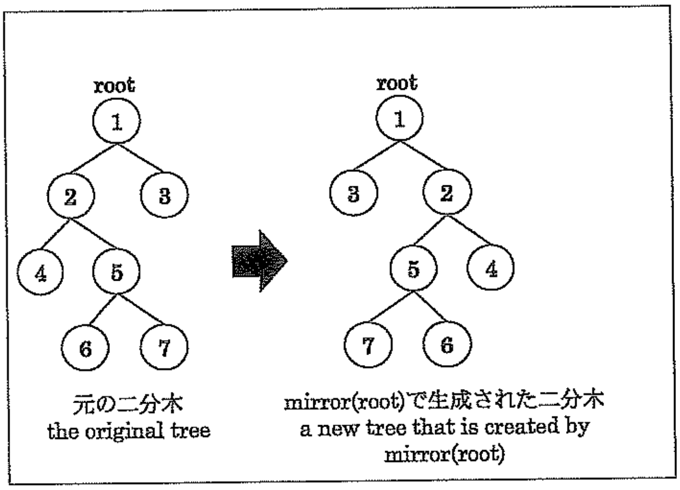

図3 (Fig 3)

試験科目	情報科学基礎「データ構造とアルゴリズム」

令和６年度　九州産業大学大学院入学試験問題用紙（秋期）

情報科学研究科 情報科学専攻 博士前期課程　　　　入試区分：一般入試

D-2

図1に示す幅優先探索（BFS）アルゴリズムを用いて、図2に示すアバターの迷路問題を解くことができる。
Breadth First Search (BFS) algorithm in Fig 1 can be used to solve an avatar maze navigation problem as shown in Fig 2.

- アバターは迷路上のスタート地点Sからゴール地点Gを目指す。

  An avatar should search for a path from the start point S to the goal point G.

- アバターは4方向のうちから１マス選んで移動できる。ただし壁（灰色のブロック）は通れない。
  The avatar can move forward 1 step in one of 4 directions. She can only move to position without walls (gray blocks).

```
Maze solver with BFS:
Create a queue Q.                          /* キューQ を生成 */
Add the starting point into Q.     /* スタート地点を Q に追加 */
while Q is not empty do              /* Q が空でなければ以下を繰り返す */
      Remove the front point from Q.            /* Q の先頭から点を削除 */
      If the point is the goal point, then break.   /* ゴールなら終了 */
      Add the adjacent and unvisited points into Q, in the order of right, down, left and up.
      /*  隣接した未訪問の点は右、下、左、上の順に Q に追加していく */
end while
```

図1 (Fig 1)

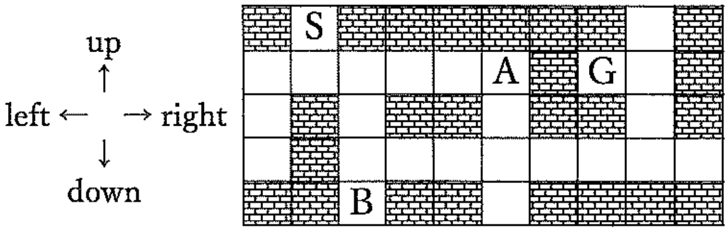

図２ (Fig 2)

このアルゴリズムに関する以下の問いに答えよ。
Answer the following questions for the algorithm.

(1) スタート地点SからゴールGまでの距離（歩数）を求めよ。

What are the steps from the start point S to the goal point G?

(2) 地点A, 地点B のどちらが先に訪問されるか。

Which is visited first, point A or point B?

(3) このアルゴリズムを適用して得られる幅優先木を完成させよ。ここで幅優先木とはすべて訪問した地点を結んでできる木のことである。

Breadth first tree is defined by connecting all the visited positions.

Complete the breadth first tree in the answer sheet.

試験科目	情報科学基礎「データ構造とアルゴリズム」

次頁以降の英文を読み、以下の設問に答えなさい。解答は、すべて解答用紙に記入すること。

設問１．下線部を和訳しなさい。

Question 1: Translate the underlined sentence into Japanese.

設問２．二重下線部を和訳しなさい。

Question 2: Translate the double underlined sentence into Japanese.

設問３．本文中の空欄（１）と（２）に適切なものを(A)～(D)から選び、文を完成させなさい。

Question 3: Choose the best words for the blanks (1) and (2) out of (A)~(D) given below to complete the sentences.

（１）の選択肢

(A) even　　(B) other　　(C) as　　(D) with

（２）の選択肢

(A) along　　(B) due　　(C) them　　(D) how

設問４．次の各文が本文の内容と合っていれば“True”、合わなければ“False”を書きなさい。

Question 4: Write "True" if each of the following sentences matches the content of the article; otherwise, write "False".

（１）Meta 社のプレス向け資料にあるアバターの動きは、「具現化されたインターネット」にほど遠い。

答え/Answer: ______________

（２）現在の VR でユーザーがテーブルに寄りかかろうとすると、手はテーブルを突き抜けてしまう。

答え/Answer: ______________

（３）アバターの動きを衝突検知により制御すると、実際の手の動きと異なるので混乱するかもしれない。

答え/Answer: ______________

（４）知覚の矛盾やネットワーク・インフラの問題の解決には、何年もの作業と巨額の資金が必要だろう。

答え/Answer: ______________

以下の設問に英語で答えなさい。 Answer the following questions in English.

設問５．メタバースが実現可能かどうかについて Meta 社がどのように考えているか書かれている箇所を抜き出しなさい。

Question 5. Extract the part that describes Meta's view on the feasibility of the Metaverse.

設問６．遠方のユーザー間で低遅延のデータ転送を行うための解決策を具体的に挙げた箇所を抜き出しなさい。

Question 6. Extract the part that describes the concrete solution for low latency data transfer between distant users.

試験科目	英語

-- Is the Metaverse Even Feasible?
Just to make the network work will require new technologies and vast sums of money --

If you ask Meta[1], or its peers, whether the metaverse is possible, the answer is confident: Yes—it's just a matter of time. The challenges are vast, but technology will overcome them. This may be true of many problems facing the metaverse: Better displays, more sensitive sensors, and quicker consumer hardware will prove key. But not all problems can be overcome with improvements to existing technology. The metaverse may find itself bound by technical barriers that aren't easily scaled by piling dollars against them.

The vision of the metaverse pushed by Meta is a fully simulated "embodied internet" experienced through an avatar. This implies a realistic experience where users can move through space at will and pick up objects with ease. But the metaverse, as it exists today, falls far short. Movement is restricted and objects rarely react as expected, if at all.

Meta frequently demos an example of this problem—friends surrounding a virtual table. The company's press materials depict avatars fluidly moving around a table, standing up and sitting at a moment's notice, interacting with the table and chairs (1) if it were a real, physical surface.

"That can't happen. The table is not there," says Rosenberg[2]. "In fact, if you tried to pretend to lean on the table, to make your avatar look like that, your hand would go right through it."

Developers can attempt to fix the problem with collision detection that stops your hand from moving through the table. But remember—the table is not there. If your hand stops in the metaverse, but continues to move in reality, you may feel disoriented.

Meta is working on EEG[3] and ECG[4] biosensors which might let you move in the metaverse with a thought. This could improve range of movement and stop unwanted contact with real-world objects while moving in virtual space. However, even this can't offer full immersion. The table still does not exist, and you still can't feel its surface.

Rosenberg believes this will limit the potential of a VR metaverse to "short duration activities" like playing a game or shopping. He sees augmented reality as a more comfortable long-term solution. AR, unlike VR, augments the real world instead of creating a simulation, which sidesteps the problem of perceptional inconsistency. With AR, you're interacting with a table that's really there.

Figuring out (2) to translate our physical forms to virtual avatars is one hurdle, but even if that's solved, the metaverse will face another issue. Moving data between users thousands of miles apart with very low latency.

Users may exist anywhere in the world and the path data travels between users may not be under the platform's control. To solve this, metaverse platforms need more than scale. They need network infrastructure that spans many clusters of servers working together across multiple data centers.

The problems of perceptional inconsistency and network infrastructure may be solvable but, even so, they'll require many years of work and huge sums of money.

※

[1]Meta: business name of Meta Platforms, Inc. (formerly named Facebook, Inc.)

[2]Louis Rosenberg: CEO of Unanimous AI

[3]EEG (electroencephalogram): a recording of brain activity

[4]ECG (electrocardiogram): a simple test to check heart's rhythm and electrical activity

出典：IEEE Spectrum, Matthew S. Smith, 21 March 2022　　より抜粋
URL: https://spectrum.ieee.org/is-the-metaverse-even-feasible

試験科目	英語