Q1

2 Points

Consider the following four graph-theory problems. It turns out that exactly two of these problems can be answered quickly and efficiently, since the running time of the algorithm is polynomial (e.g. $O(n^3)$, $O(nlogn)$) rather than exponential (e.g. $O(2^n)$, $O(n!)$)

Determine which two problems can be solved in polynomial-time.

- [x] `Given a graph G, determine the shortest path from vertex x to vertex y`
- [ ] `Given a graph G, determine the longest path from vertex x to vertex y.`
- [ ] `Given a graph G, determine whether the graph has a Hamiltonian cycle -`
- [x] `Given a graph G, determine whether the graph has an Eulerian cycle - i`

Q2

1 Point

P is the set of problems that can be solved in polynomial time.

More formally, P is the set of decision problems (e.g. given a graph G, does this graph G contain an odd cycle) for which there exists a polynomial-time algorithm to correctly output the answer to that problem.

What is NP? Consider these five options and determine which option is correct..

- ○ `NP is the set of problems that cannot be solved in polynomial time.`
- ○ `NP is the set of problems whose answer can be found in polynomial time.`
- ○ `NP is the set of problems whose answer cannot be found in polynomial tim`
- ◉ `NP is the set of problems that can be verified in polynomial time.`
- ○ `NP is the set of problems that cannot be verified in polynomial time.`

Q3

3 Points

In Boolean logic, a sentence is in 3-Conjunctive Normal Form (abbreviated $3 - CNF$) if it is of the form, $S = C_1 \wedge C_2 \wedge 3 \wedge ... \wedge C_m$, where S is the conjunction of m clauses, with each clause being a disjunction of three literals.

For example, the following sentence is in $3 - CNF$, with $m = 4$ clauses.

$$S = (A \vee B \vee \overline{C}) \wedge (A \vee C \vee \overline{D}) \wedge (\overline{B} \vee C \vee \overline{D}) \wedge (\overline{A} \vee \overline{B} \vee D)$$

For example, the first clause is equivalent to this in English: "either A or B or Not C". As long as one of these three literals is TRUE then this clause evaluates to TRUE. If none of these literals is TRUE (i.e., A=FALSE, B=FALSE, C=TRUE), then this clause evaluates to FALSE.

We say that S is satisfiable if there exists an assignment of TRUE/FALSE values to each variable (A, B, C, D) so that the entire sentence S evaluates to TRUE. What this means is that each of the m clauses must evaluate to TRUE.

The above sentence indeed is satisfiable; one possible assignment is A=TRUE, B=FALSE, C=FALSE, D=TRUE.

The first two clauses are TRUE since A=TRUE, while the last two clauses are TRUE since B=FALSE. Since all four clauses evaluate to TRUE, S is indeed satisfiable.

Consider the following sentence in $3 - CNF$ with $m = 8$ clauses.

$$S = (A \vee \overline{B} \vee D) \wedge (B \vee \overline{C} \vee D) \wedge (C \vee \overline{A} \vee D) \wedge (A \vee \overline{B} \vee \overline{D}) \wedge (B \vee \overline{C} \vee \overline{D}) \wedge (C \vee \overline{A} \vee \overline{D}) \wedge (A \vee B \vee C) \wedge (\overline{A} \vee \overline{B} \vee \overline{C})$$

Determine whether this sentence is satisfiable.

No, this sentence is not satisfiable.
Because we already have A and D are true, and C is false. So, we will not be able to make the sentence is satisfiable.

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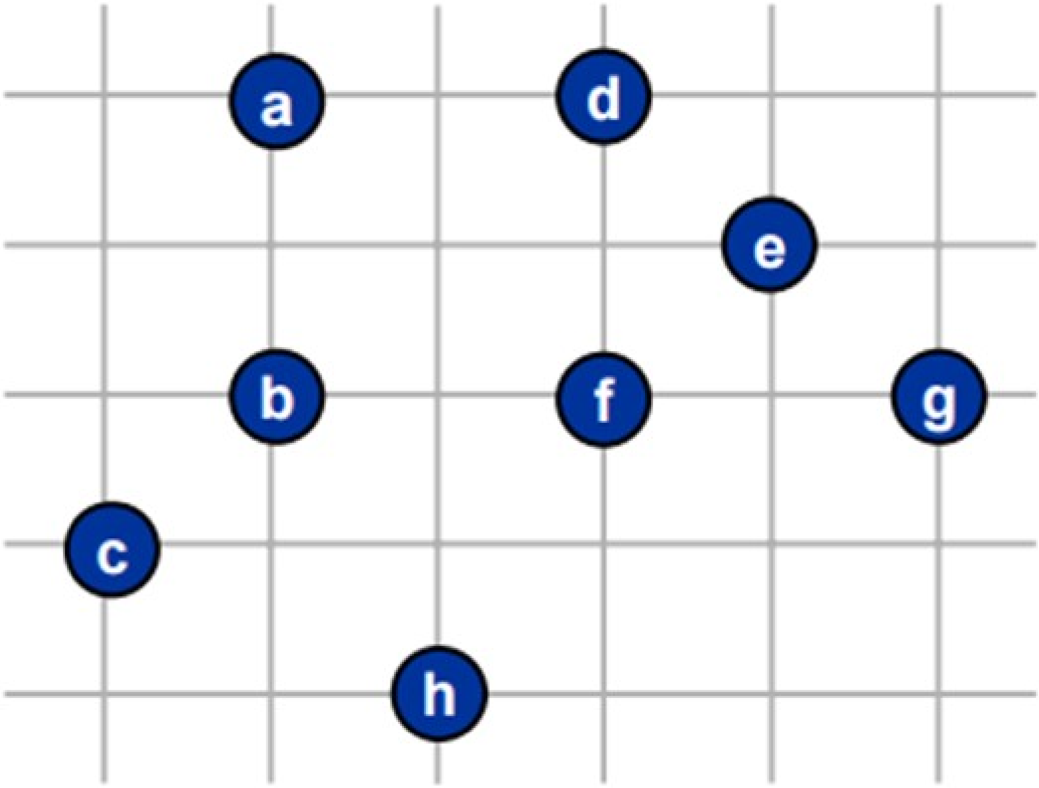
Q4

4 Points

You are a Salesperson (living in House a) who needs to visit your 7 clients (living in Houses b through h) and then return to your house.



The coordinates indicate the distance between each pair of houses. For "diagonal" distances, use the Pythagorean Theorem. For example, a is 2 units away from d, while d is $\sqrt{(2)} = 1.414$ units away from e.

For example, if your tour is $a \to b \to c \to d \to e \to f \to g \to h \to a$, then your total travel distance is

$2 + \sqrt{(2)} + \sqrt{(18)} + \sqrt{(2)} + \sqrt{(2)} + 2 + \sqrt{(13)} + \sqrt{(17)}$ which is 20.21, rounded to two decimal places.

In this question, Determine the minimum Traveling Salesperson Tour for this scenario. Round your answer to two decimal places.

From the question, we can know the minimum traveling tour can be this path:
a - b - c - h - f -g -e -d-a
then, the total travel distance is:
2+√2+√5+√5+2+√2+√2+2 = 14.71

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Quiz 9

GRADED

STUDENT
Kejian Tong

TOTAL POINTS
10 / 10 pts

QUESTION 1
(no title) **2** / 2 pts

QUESTION 2
(no title) **1** / 1 pt

QUESTION 3
(no title) **3** / 3 pts

QUESTION 4
(no title) **4** / 4 pts