# INT202 Assessment 3: Problem Solving

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| Contribution to overall module assessment | **10%** |
| Submission deadline | **Sunday, June 6th, 2021 (17:00)** |

## 1. Problems

Q1. A company Director General (DG) wishes to organize a party in order to celebrate an award she received. In her company, the hierarchical relationships form a tree in which the DG is the root. The DG wishes that an employee is not invited at the same time with his or her direct "boss". Furthermore, each employee is associated with a score depending on his or her "likability". Given the following sample input, describe how you will form the list of participants so as to maximize the sum of likability scores, and calculate the maximum likability score. [6 marks]

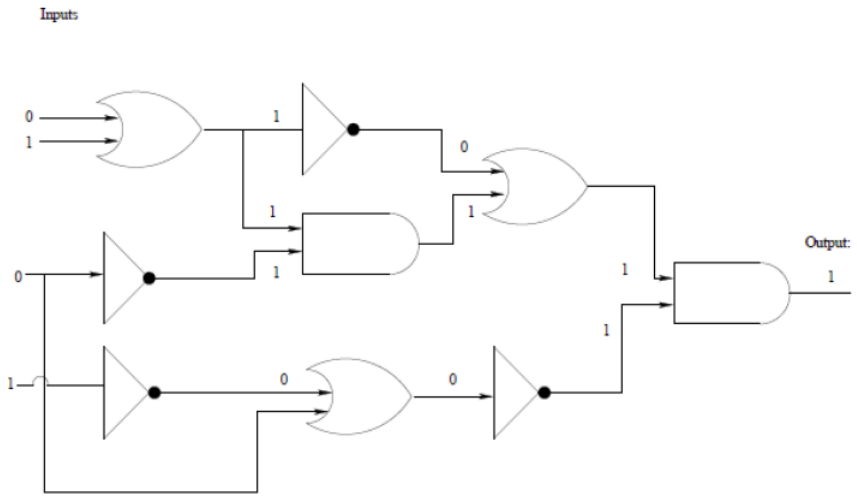
For the sample input,

the first line n is the number of the employees;
the second line lists the likability of each employee to the party;
and in the remaining n lines,
the first number is the employee ID,
the second number is the number of subordinates,
and the remaining numbers are the subordinates IDs.

*The sample Input is:*

*6*
*20 3 5 4 5 30*
*0 2 2 3*
*1 0*
*2 1 1*
*3 1 4*
*4 1 5*
*5 0*

Q2. This question is on problem solving techniques and NP Completeness. In theoretical computer science, the circuit satisfiability problem (also known as CIRCUIT-SAT, CircuitSAT, CSAT, etc.) is the decision problem of determining whether a given Boolean circuit (as shown below) has an assignment of its inputs that makes the output true.



We wish to show that CIRCUIT-SAT is reducible to the CNF-SAT problem. To this end, a Boolean circuit is associated with a set of clauses using the variables $x_1, \cdots, x_n$ that label the input vertices as well as variables $y_v$ for the outputs of vertices v representing gates of the circuit. For example, the set of clauses satisfying the formula x=y is $U=\{\bar{x} \vee y, x \vee \bar{y}\}$, since the formula x=y is equivalent to $(\bar{x} \vee y) \wedge (x \vee \bar{y})$. This equivalence can be checked using a truth table.

(1) Relying on the result from the given example, give the sets u of clauses using the variables x, y, z in the following cases:

a. the clauses in U are satisfied iff $x=\bar{y}$. [0.5 mark]

b. the clauses in U are satisfied iff $x=y \wedge z$. [0.5 mark]

c. the clauses in U are satisfied iff $x=y \vee z$. [0.5 mark]

(2) Show CIRCUIT-SAT is reducible to CNF-SAT based on results of (1). [2.5 mark]

## 2. Submission

Each student must submit the solutions individually in English, and the submission must be a single file in PDF format. Only hand-written submission is accepted, so please scan your solutions into one PDF file. Please rename the PDF file as: StudentID_GivenName_Surname (e.g. 1801234_Rui_Yang) and upload to the submission folder in learning mall by 17:00, Sunday, Jun 6 2021.

Late submission will receive penalty in the marking in accordance with the University Code of Practice on Assessment. For each working day after the deadline, 0.5 marks (out of 10) will be deducted for up to 5 working days. However, the mark will not be reduced below the pass mark for the assessment. Work assessed below the pass mark will not be penalized for late submission of up to 5 days. Work received more than 5 working days after the deadline will receive a mark of 0.

## 3. Plagiarism

This assessment is an individual work. Plagiarism (e.g. copying materials from other sources without proper acknowledgement) is a serious academic offence. Plagiarism will not be tolerated and will be dealt with in accordance with the University Code of Practice on Assessment.

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