COMP9020 Foundations of Comp Science T1-2020

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Time taken	51 mins 28 secs
Grade	**75.00** out of 100.00

Question **1**
Correct
Mark 25.00 out of 25.00

Type in your solution to Exercise 1a.

Answer: 01010101

See the solution to Exercise 1

Refer to lecture 1, slide 40-41

The correct answer is: 01010101

Question **2**
Incorrect
Mark 0.00 out of 25.00

Consider the function:

$f : \mathbb{R} \times \mathbb{R} \longrightarrow \mathbb{R} \times \mathbb{R}$ given by $f : \ (x, y) \mapsto (2x - 3y, 3y - 2x)$.

Select one:
- f is 1-1 but not onto
- f is neither 1-1 nor onto
- f is both 1-1 and onto
- f is not 1-1 but onto

An example that shows that f is not 1-1 is: $f(0, 0) = f(3, 2)$.

For the function to be onto, all pairs $(u, v) \in \mathbb{R} \times \mathbb{R}$ would have to be in the image of f. However, the pair (u, v) resulting from applying f always satisfies $u + v = 0$. Hence, the pair $(1, 0)$, for example, is not in the image of f. This means that the function is not onto either.

Refer to lecture 3, slide 13-14

The correct answer is: f is neither 1-1 nor onto

Question **3**
Correct
Mark 25.00 out of 25.00

Consider the 1×3 matrices $\mathbf{A} = [5 \ \ 2.2 \ \ 2]$ and $\mathbf{B} = [6 \ \ 8 \ \ -9]$ and $\mathbf{C} = [-2.8 \ \ 0 \ \ -7]$.

Compute the value of the inner product $(\mathbf{A} + \mathbf{B}) \cdot \mathbf{C}^\mathsf{T}$.

Answer: 18.2

$\mathbf{A} + \mathbf{B} = [11 \ \ 10.2 \ \ -7]$.
$(\mathbf{A} + \mathbf{B}) \cdot \mathbf{C}^\mathsf{T} = 11 \cdot -2.8 + 10.2 \cdot 0 + -7 \cdot -7$.

Refer to lecture 3, slide 24-29

The correct answer is: 18.2

Question **4**

Correct

Mark 25.00 out of 25.00

Consider the relation $\mathcal{R} \subseteq \mathbb{Z} \times \mathbb{Z}$ given by $(x, y) \in \mathcal{R}$ iff $-2 \mid (y - x)$. Tick all of the properties that $\mathcal{R}$ has.

Select one or more:

- [x] Reflexivity ✔
- [x] Transitivity ✔
- [ ] Antireflexivity
- [ ] None of the other properties
- [ ] Antisymmetry
- [x] Symmetry ✔

It is easy to see that if $x = y$ then $y - x\ (= 0)$ is an even number. Hence, $(x, x) \in \mathcal{R}$ for all integers x, which is why the relation is reflexive and not antireflexive.

Observe that $(x, y) \in \mathcal{R}$ if, and only if, x and y are of the same "parity", that is, if they are both even or both odd. Hence $\mathcal{R}$ is symmetric.

The relation is not anti-symmetric since, for example, $(0, 2) \in \mathcal{R}$ and $(2, 0) \in \mathcal{R}$ but $0 \neq 2$.

The relation is transitive: For all $x, y, z \in \mathbb{Z}$, if $(x, y) \in \mathcal{R}$ and $(y, z) \in \mathcal{R}$ then x and y are of the same parity and y and z are of the same parity, hence x and z must be of the same parity too. This implies $(x, z) \in \mathcal{R}$.

Refer to lecture 3, slide 43

The correct answers are: Reflexivity, Symmetry, Transitivity