

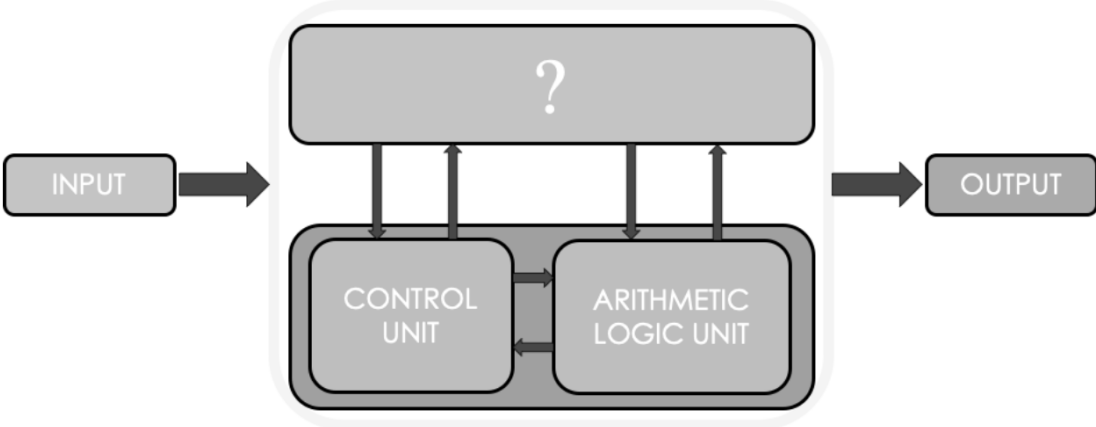
Analysis 1-2021

Foundations of modeling


This exam consists of 40 multiple-choice questions. For each question, only one answer is correct. Each question is worth one point. The cesuur is 26.5, which means that you need 27 points to pass.

Write your answers on the answer sheet provided!

| | | |
|----------|---|----------------------|
| 1 | _____ is a type of computer program that is designed to run a computer's hardware and application programs. | |
| | A | System software |
| | B | Programming software |
| | C | A compiler |
| | D | Application software |

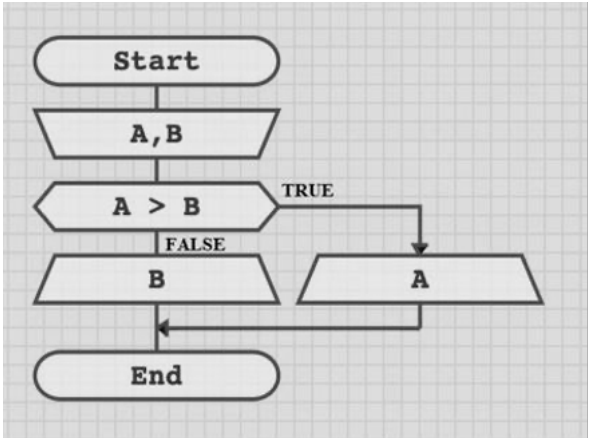
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|----------|--|-------------------------------|
| 2 | <p>Select the proper term for the component labeled by the question mark (?), according to von Neumann architecture (model).</p>  <pre> graph LR INPUT[INPUT] --> CPU subgraph CPU [CPU] CU[CONTROL UNIT] <--> ALU[ARITHMETIC LOGIC UNIT] end CPU --> OUTPUT[OUTPUT] QM[?] --- CPU </pre> <p>The diagram illustrates the von Neumann architecture. It features a central box labeled 'CPU' which contains two sub-components: 'CONTROL UNIT' and 'ARITHMETIC LOGIC UNIT', connected by a double-headed arrow. To the left of the CPU is a box labeled 'INPUT' with an arrow pointing into the CPU. To the right is a box labeled 'OUTPUT' with an arrow pointing away from the CPU. Above the CPU box is a separate box containing a question mark '?', which is connected to the CPU box by a double-headed arrow, indicating bidirectional communication.</p> | |
| | A | CPU – central processing unit |
| | B | Motherboard |
| | C | Hardware |
| | D | Memory |

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| 3 | Which of the following sentences is true about INFORMATION? | |
| | A | Information is processed data. |
| | B | Information is accurate and timely. |
| | C | Information can lead to an increase in understanding and decrease in uncertainty. |
| | D | All of the above. |

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| 4 | What kind of step does this flowchart symbol represents?  | |
| | A | Input (read) x. |
| | B | Process (perform arithmetic operation on) x. |
| | C | Output (print) the value of x. |
| | D | Output (print) the character 'x'. |

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| 5 | Please select the proper terms to fill in the blanks (1) and (2) of the following definition: "A Python program is a sequence of (1) _____ and (2) _____." | |
| | A | 1: inputs 2: outputs |
| | B | 1: steps 2: conditions |
| | C | 1: instructions 2: jumps |
| | D | 1: expressions 2: commands |

| | | |
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| 6 | While exploring an alien world, an astronaut has found an alien equation stating: $3 + 1 = 10$. What can the astronaut conclude? | |
| | A | The aliens are using binary numbers (base 2). |
| | B | The aliens are using a numeral system with base 3. |
| | C | The aliens are using a numeral system with base 4. |
| | D | The aliens are using decimal numbers (base 10). |

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| 7 | What does this algorithm do?  <pre> graph TD Start([Start]) --> Input[/A, B/] Input --> Decision{A > B} Decision -- TRUE --> OutputA[/A/] Decision -- FALSE --> OutputB[/B/] OutputA --> End([End]) OutputB --> End </pre> | |
| | A | Given two inputs, outputs the first input value. |
| | B | Given two inputs, outputs the second input value. |
| | C | Given two inputs, outputs the minimum input value. |
| | D | Given two inputs, outputs the maximum input value. |

| | | |
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| 8 | In Roman numerals, I=1, V=5, X=10, L=50, C=100, D=500, M=1000. What number is MDCXLIX? | |
| | A | 1449 |
| | B | 1461 |
| | C | 1649 |
| | D | 1661 |

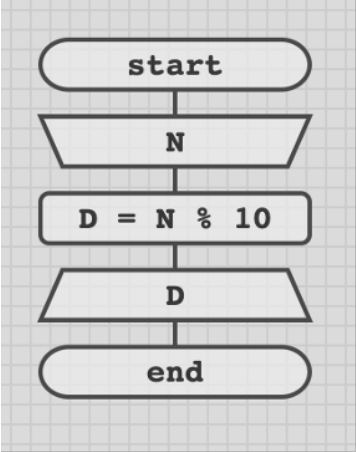
| | | |
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| 9 | Which of the statements is true about non-positional numeral systems? | |
| | A | Each symbol represents the same value regardless of its position. |
| | B | Each symbol value depends on where it occurs in the representation. |
| | C | The digit in the last position determines how one reads the number. |
| | D | None of the above. |

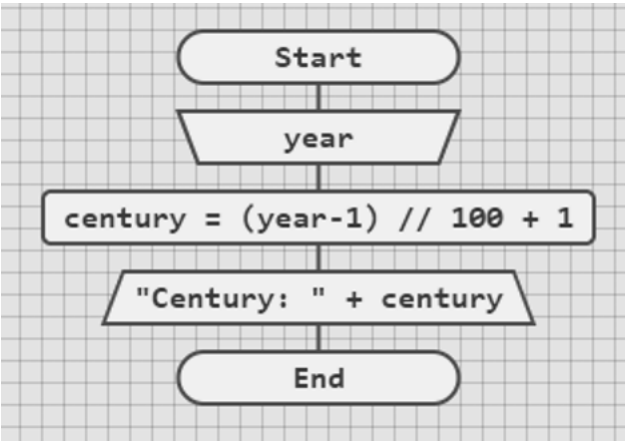
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|----|---|--|---|---|---|---|---|---|---|
| 10 | Let X be a hexadecimal number $X = 12F$. If we shift digits of the number X by one place to the left, we get a new hexadecimal number $Y = 12F0$. | | | | | | | | |
| | X: | 0 | 0 | 0 | 0 | 0 | 1 | 2 | F |
| | Y: | 0 | 0 | 0 | 0 | 1 | 2 | F | 0 |
| | How many times is the number Y greater than the number X? | | | | | | | | |
| | A | $Y = 2 \cdot X$ (Y is two times greater than X) | | | | | | | |
| | B | $Y = 10 \cdot X$ (Y is ten times greater than X) | | | | | | | |
| | C | $Y = 15 \cdot X$ (Y is fifteen times greater than X) | | | | | | | |
| | D | $Y = 16 \cdot X$ (Y is sixteen times greater than X) | | | | | | | |

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| 11 | The following line is inputted by a user into the Python console: <code>type(10 / 2)</code> What will be the output? | |
| | A | <code><class 'float'></code> |
| | B | <code><class 'int'></code> |
| | C | <code>5.0</code> |
| | D | <code>5</code> |

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| 12 | Which of these is a valid variable name in Python? | |
| | A | <code>Average-of-class-1</code> |
| | B | <code>AVERAGE_OF_CLASS1</code> |
| | C | <code>1_Average_of_class</code> |
| | D | <code>average of class 1</code> |

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| 13 | What would be the output of the following code? <pre> A = 12 B = 34 temp = True if A < B: temp = False print(temp,C) </pre> | |
| | A | <code>True, C</code> |
| | B | <code>False, C</code> |
| | C | <code>False, 0</code> |
| | D | <code>Name 'C' is not defined</code> |

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| 14 | <p>If you input 15 in the algorithm given below, what output should you get?</p>  <pre> graph TD start([start]) --> N[/N/] N --> D1[D = N % 10] D1 --> D[/D/] D --> end([end]) </pre> | |
| | A | 1 |
| | B | 1.5 |
| | C | 5 |
| | D | 150 |

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| 15 | <p>What would be the output of the following algorithm if a user inputs year = 1601 ?</p>  <pre> graph TD Start([Start]) --> year[/year/] year --> D1[century = (year-1) // 100 + 1] D1 --> D2[/"Century: " + century/] D2 --> End([End]) </pre> | |
| | A | Century: 17 |
| | B | Century: 16 |
| | C | Century: 15 |
| | D | Century: 18 |

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| 16 | Suppose p and q are Boolean variables in Python. How can we express the implication $p \rightarrow q$ in Python? | |
| | A | This is not possible in Python. |
| | B | $p \Rightarrow q$ |
| | C | $q \text{ if } p$ |
| | D | $\text{not } p \text{ or } q$ |

| 17 | What are the correct answers for two blank spaces B1 and B2 in the truth table below? <table border="1"> <thead> <tr> <th>p</th><th>q</th><th>$(p \rightarrow q) \wedge (q \rightarrow p)$</th></tr> </thead> <tbody> <tr> <td>F</td><td>F</td><td>T</td></tr> <tr> <td>F</td><td>T</td><td>B1?</td></tr> <tr> <td>T</td><td>F</td><td>B2?</td></tr> <tr> <td>T</td><td>T</td><td>T</td></tr> </tbody> </table> | | p | q | $(p \rightarrow q) \wedge (q \rightarrow p)$ | F | F | T | F | T | B1? | T | F | B2? | T | T | T |
|-----------|---|--|---|---|--|---|---|---|---|---|------------|---|---|------------|---|---|---|
| p | q | $(p \rightarrow q) \wedge (q \rightarrow p)$ | | | | | | | | | | | | | | | |
| F | F | T | | | | | | | | | | | | | | | |
| F | T | B1? | | | | | | | | | | | | | | | |
| T | F | B2? | | | | | | | | | | | | | | | |
| T | T | T | | | | | | | | | | | | | | | |
| | A | B1=T B2=F | | | | | | | | | | | | | | | |
| | B | B1=F B2=F | | | | | | | | | | | | | | | |
| | C | B1=T B2=T | | | | | | | | | | | | | | | |
| | D | B1=F B2=T | | | | | | | | | | | | | | | |

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| 18 | Consider the logical expression $(P \wedge Q) \vee \neg(R \rightarrow S \wedge \neg T)$. How many rows do you need in a truth table for this expression? | |
| | A | 4 |
| | B | 10 |
| | C | 25 |
| | D | 32 |

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| 19 | Which of the following sentences is a non-statement: | |
| | A | Analysis class is on Thursday. |
| | B | Most of the matter in the universe cannot be seen. |
| | C | Alzheimer's disease is the fourth leading cause of death in the United States. |
| | D | Be careful what you pretend to be. |

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| 20 | What will be the printout after executing the following Python program? <pre> a = 1 b = 2 c = 3 a = b == c print(a, b, c) </pre> | |
| | A | 1 2 3 |
| | B | 2 3 3 |
| | C | False 2 3 |
| | D | Syntax error: invalid syntax |

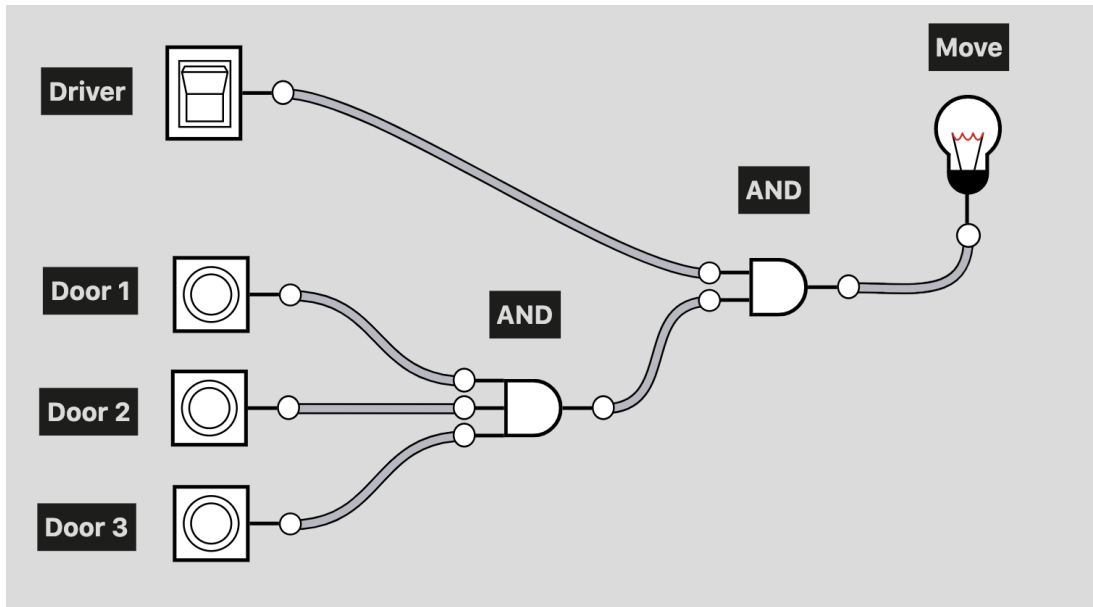
21

A tram is equipped with an ON / OFF switch and three buttons that open the doors. When a driver wants the tram to move, he moves the switch to the ON state (*TRUE*) and when he wants the tram to stop, he moves the switch to the OFF state (*FALSE*).

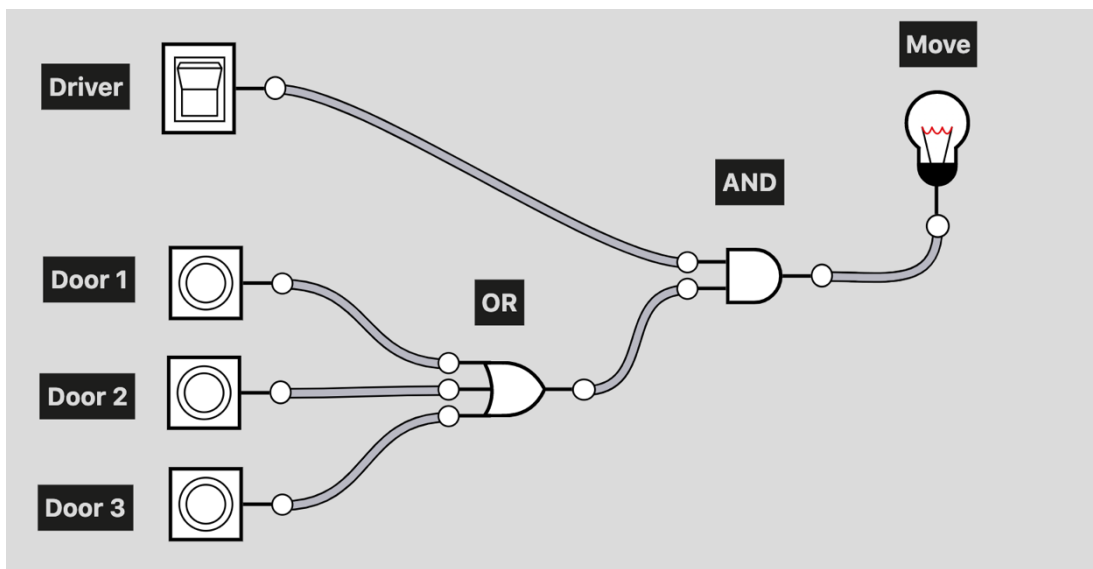
Passengers can press buttons to open the doors. When a passenger presses the door button, it sends the value *TRUE*. Otherwise it sends the value *FALSE*.

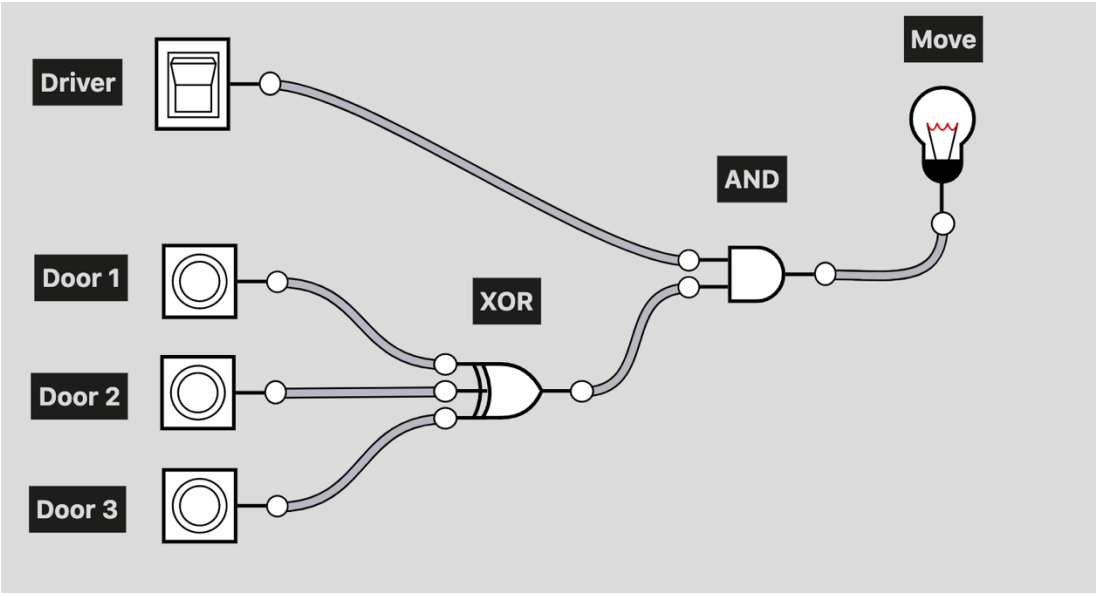
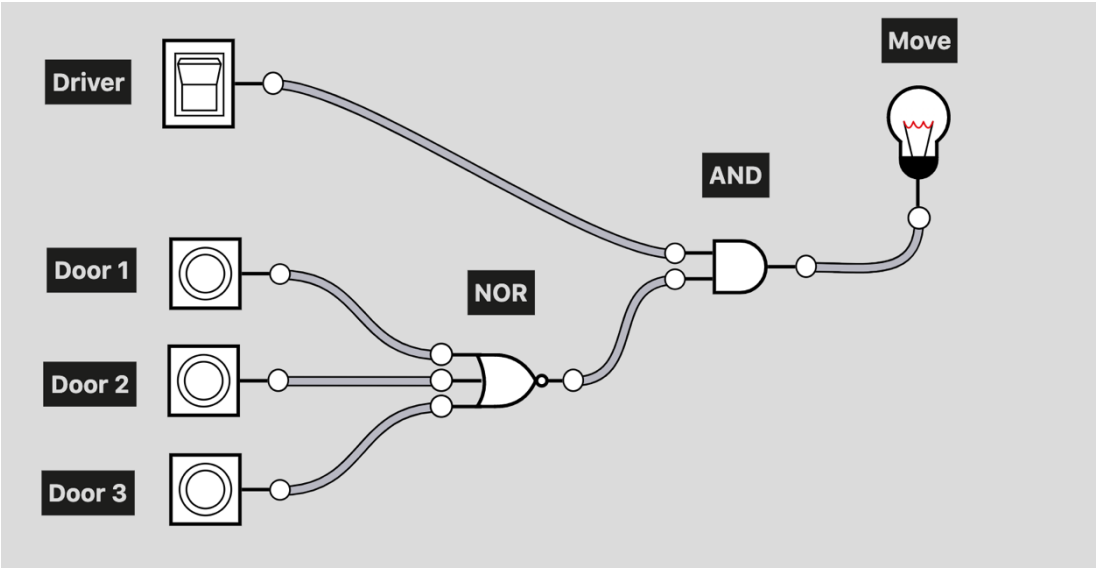
In order to prevent injuries, a tram must not be allowed to move if any of its doors are open. What is the correct way to connect the door buttons?

- A** Using an AND gate to connect the door buttons and another AND gate to connect its output with driver's switch:



- B** Using an OR gate to connect the door buttons and another AND gate to connect its output with driver's switch:



| | |
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| | <p>C Using an XOR gate to connect the door buttons and another AND gate to connect its output with driver's switch:</p>  |
| | <p>D Using a NOR gate to connect the door buttons and another AND gate to connect its output with driver's switch:</p>  |

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| 22 | <p>Simplify the following Boolean expression: $x==0 \text{ and } \text{not}(x<0 \text{ or } y\%2==0)$</p> |
| A | $x==0 \text{ and } x \geq 0 \text{ and } y\%2==0$ |
| B | $x==0 \text{ or } x \geq 0 \text{ and } y\%2 \neq 0$ |
| C | $x \geq 0 \text{ and } y\%2 \neq 0$ |
| D | $x==0 \text{ and } y\%2 \neq 0$ |

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| 23 | <p>Someone has written the following erroneous code to compute the maximum of three integers:</p> <pre> a = int(input("Enter a: ")) b = int(input("Enter b: ")) c = int(input("Enter c: ")) if a > b and a > c: max = a elif b > c and b > a: max = b else: max = c print("The maximum is", max) </pre> <p>For which of the following inputs will we get a wrong result?</p> | |
| | A | 1 2 3 |
| | B | 3 2 1 |
| | C | 2 2 1 |
| | D | -1 -1 -1 |

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| 24 | <p>Are the following logical expressions equivalent? * Hint: use truth tables</p> <p>a) $P \wedge Q$ and $\sim(Q \rightarrow \sim P)$</p> <p>b) $P \leftrightarrow Q$ and $(P \wedge Q) \vee (\sim P \wedge \sim Q)$</p> | |
| | A | a) equivalent b) equivalent |
| | B | a) equivalent b) not equivalent |
| | C | a) not equivalent b) equivalent |
| | D | a) not equivalent b) not equivalent |

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| 25 | <p>In the following code, how often might "Hello World!" be printed?</p> <pre> number1 = int(input("Enter Number 1: ")) number2 = int(input("Enter Number 2: ")) if number1 < 0: if number2 < 0: print("Hello World!") else: print("This is not the desired condition") if number2 > 0: if number1 < 0: print("Hello World!") else: print("This is not the desired condition") </pre> | |
| | A | minimum: 0 maximum: 1 |
| | B | minimum: 0 maximum: 2 |
| | C | minimum: 1 maximum: 1 |
| | D | minimum: 1 maximum: 2 |

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| 26 | Which of the following logic statements is a tautology? | |
| | A | $(P \rightarrow Q) \vee (Q \rightarrow P)$ |
| | B | $(P \rightarrow Q) \wedge (Q \rightarrow P)$ |
| | C | $(P \Leftrightarrow Q) \vee (Q \Leftrightarrow P)$ |
| | D | None of the above |

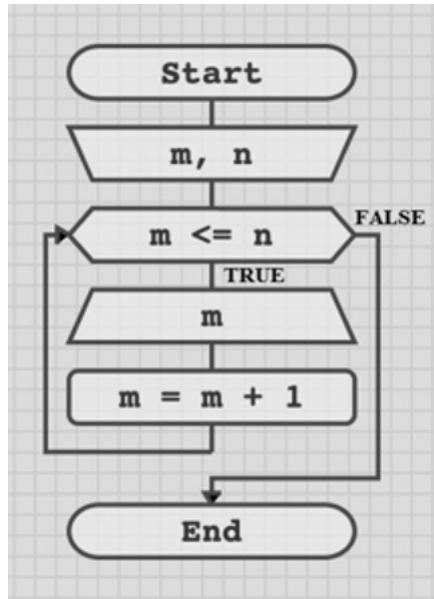
| | | |
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| 27 | <p>Consider the following arguments:</p> <p>Argument A: “If it is cold, then I wear my coat. It is not cold. Therefore, I am not wearing my coat”</p> <p>Argument B: “I study or I play video games. I don’t study. Therefore, I play video games.”</p> <p>Are the given arguments valid or invalid?</p> | |
| | A | Both arguments are VALID. |
| | B | Both arguments are INVALID. |
| | C | Argument A is VALID, while argument B is INVALID. |
| | D | Argument A is INVALID, while argument B is VALID. |

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| 28 | <p>Which statement is True?</p> <p>Tip! Use truth tables if you do not see the correct answer directly.</p> | |
| | A | $\sim(P \text{ AND } Q)$ is equivalent to $(\sim P \text{ OR } \sim Q)$. |
| | B | $\sim(P \text{ AND } Q)$ is equivalent to $\sim(\sim P \text{ OR } \sim Q)$. |
| | C | $\sim(P \text{ AND } Q)$ is equivalent to $(\sim P \text{ AND } \sim Q)$. |
| | D | $\sim(P \text{ AND } Q)$ is equivalent to $\sim(\sim P \text{ AND } \sim Q)$. |

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| 29 | You are asked to write a program that will ask a user his/her age and name. Moreover, this program will print user's name a number of times that equals to the user's age. Which of the following codes will do this? | |
| | A | <pre>age = int(input("Please indicate your age:")) name = input("What is your name: ") i = 0 while i < age: print(name) i = i+1</pre> |
| | B | <pre>age = int(input("Please indicate your age:")) name = input("What is your name: ") i = 0 while i <= age: print(name) i = i+1</pre> |
| | C | <pre>age = int(input("Please indicate your age:")) name = input("What is your name: ") i = 1 while i < age: print(name) i = i+1</pre> |
| | D | <pre>age = int(input("Please indicate your age:")) name = input("What is your name: ") i = 1 while i =< age: print(name) i = i+1</pre> |

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| 30 | What will be the printout after executing the following Python code? <pre>A = (1, 2, 3) print(type(A))</pre> | |
| | A | 1 2 3 |
| | B | <class 'int'> <class 'int'> <class 'int'> |
| | C | <class 'tuple'> |
| | D | <class 'list'> |

31 If user inputs 3 for **m** and 6 for **n**, how many OUTPUT steps will this algorithm execute?



A 3

B 4

C 5

D 6

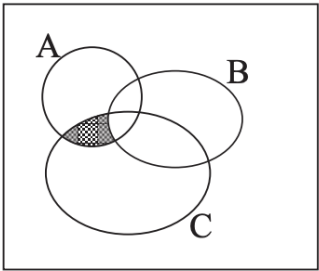
32 Let $A = \{1 + (-1)^n \mid n \in \mathbb{N}\}$.
What is $|A|$?

A \emptyset

B 1

C 2

D ∞ (infinity)

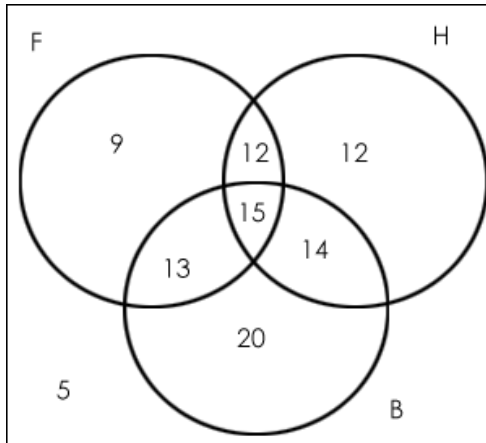
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| 33 | What is a proper set notation to describe the shaded region in the following diagram? | |
| |  | |
| | A | $A \cap B \cap C$ |
| | B | $(A - B) \cup (C - B)$ |
| | C | $(A \cup C) - B$ |
| | D | $(A \cap C) - B$ |

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| 34 | What output do you get when you type <code>len(range(2,10,3))</code> in the Python console? | |
| | A | 0 |
| | B | 3 |
| | C | 8 |
| | D | 9 |

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| 35 | 24 points are plotted in the Cartesian coordinate system (see image below). Which point lies on coordinates (2, -3)? <div> </div> | |
| | A | D |
| | B | E |
| | C | I |
| | D | N |

| | | |
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| 36 | Consider the following syllogisms: 1) Some gamers are rich. No teachers are rich. Therefore, some teachers are not gamers. 2) Nobody who is illogical can pass this exam. All students are illogical. Therefore, no student can pass this exam. | |
| | A | 1) is VALID, 2) is VALID. |
| | B | 1) is NOT VALID, 2) is VALID. |
| | C | 1) is VALID, 2) is NOT VALID. |
| | D | 1) is NOT VALID, 2) is NOT VALID. |

- 37** A group of students train different sports, which include football (F), hockey (H) and basketball (B). The expressions in the Venn diagram below denote the cardinality of the respective subsets. Note: there are also 5 students that do not train these three sports.



How many do NOT train hockey?

A 12

B 41

C 42

D 47

- 38** In a storage, there are 12 new computers, 6 computers with Linux installed, and no other.
- a) What is the maximum possible number of computers in the storage?
- b) What is the minimum possible number of computers in the storage?

A a) 12
b) 6

B a) 18
b) 6

C a) 12
b) 12

D a) 18
b) 12

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| 39 | What is a list in Python? | |
| | A | A list is an immutable ordered sequence of elements. |
| | B | A list is a mutable ordered sequence of elements. |
| | C | A list is a mutable unordered sequence of elements. |
| | D | A list is an immutable unordered sequence of elements. |

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| 40 | What will be the printout after executing the following Python code? <pre> A = [6, 1, 9, 4, 2, 8, 3, 5, 7] n = len(A) for i in range(n): for j in range(n-i-1): if A[j] < A[j+1]: temp = A[j] A[j] = A[j+1] A[j+1] = temp print(A) </pre> | |
| | A | [1, 2, 3, 4, 5, 6, 7, 8, 9] |
| | B | [9, 8, 7, 6, 5, 4, 3, 2, 1] |
| | C | [6, 1, 9, 4, 8, 2, 5, 3, 7] |
| | D | Python will raise an error because the inner loop goes out of range. |

Answers:

| | |
|----|---|
| 1 | A |
| 2 | D |
| 3 | D |
| 4 | A |
| 5 | D |
| 6 | C |
| 7 | D |
| 8 | C |
| 9 | A |
| 10 | D |
| 11 | A |
| 12 | B |
| 13 | D |
| 14 | C |
| 15 | A |
| 16 | D |
| 17 | B |
| 18 | D |
| 19 | D |
| 20 | C |
| 21 | D |
| 22 | D |
| 23 | C |
| 24 | A |
| 25 | A |
| 26 | A |
| 27 | D |
| 28 | A |
| 29 | A |
| 30 | C |
| 31 | B |
| 32 | C |
| 33 | D |
| 34 | B |
| 35 | D |
| 36 | B |
| 37 | D |
| 38 | D |
| 39 | B |
| 40 | B |