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VCE Specialist Mathematics ½
Logic & Algorithms I [2.4]
Homework

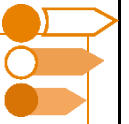
Homework Outline:

Compulsory Questions	Pg 2- Pg 14
Supplementary Questions	Pg 17- Pg 26



Section A: Compulsory Questions

Sub-Section [2.4.1]: Write and Understand Basic Algorithms



Question 1



Construct an algorithm that triples any input given.

Question 2



Construct an algorithm that halves any input given and adds 1.

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Question 3


Construct an algorithm that subtracts 5 from an input and then multiplies by 3.

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Sub-Section [2.4.2]: Understanding and Evaluating Algorithms that have Conditional Statements and Represent Hybrid Functions as Algorithms

Question 4



- a. Turn the following function into an algorithm.

$$f(x) = \begin{cases} x & x \geq 0 \\ -x & x < 0 \end{cases}$$

- b. Evaluate the final output:

```

a ← 1
b ← 1
if a + b < 7
    b ← b - 2
    a ← a + 3.
end if
print a, b.
```


Question 5 Tech-Active.

Following is an algorithm for calculating the Australian tax.

Step 1: Input income.

Step 2a: If $\text{income} \leq 18200$, then $\text{tax} \leftarrow 0$.

Step 2b: Else If $\text{income} \leq 37000$, then $\text{tax} \leftarrow 0.19 \times \text{income} - 3458$.

Step 2c: Else If $\text{income} \leq 90000$, then $\text{tax} \leftarrow 0.325 \times \text{income} - 8453$.

Step 2d: Else If $\text{income} \leq 180000$, then $\text{tax} \leftarrow 0.37 \times \text{income} - 12503$.

Step 2e: Else If $\text{tax} \leftarrow 0.45 \times \text{income} - 26903$.

Step 3: Print tax.

a. Calculate tax for 200000.

b. Calculate tax for 45888.

c. Calculate tax for 90001.

Question 6



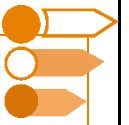
a. Using a flowchart, describe an algorithm of the following hybrid function.

$$f(x) = \begin{cases} 1 & x > 0 \\ 0 & x < 0 \\ \frac{1}{2} & x = 0 \end{cases}$$

b. Write an algorithm for the following hybrid function.

$$f(x) = \begin{cases} 1 & x > 3 \\ 0 & x = 3 \\ -1 & x < 3 \end{cases}$$

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Sub-Section [2.4.3]: Understand and Evaluate Algorithms with Loops

Question 7



Check whether the following algorithm has any problems. If there is a problem, state the problem; if there is no problem, give the final output of the algorithm.

Step 1: $A \leftarrow 60$

Step 2: $A \leftarrow 2A - 50$

Step 3: Repeat 2 while $A > 60$.

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Question 8

Evaluate the final output.

```

 $a \leftarrow 1$ 
 $b \leftarrow 1$ 
while  $a + b < 7$ 
     $b \leftarrow b - 2$ 
     $a \leftarrow a + 3.$ 
end while
print  $a, b.$ 

```

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Question 9

a. Evaluate the final output:

```

 $c \leftarrow 0$ 
for  $a$  from 1 to 2
  for  $b$  from 1 to 2
     $c \leftarrow c - ab$ 
  end for
end for
print  $c$ .

```

b. Construct an algorithm that outputs the largest multiple of 5 that is less than or equal to 100.

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Sub-Section [2.4.4]: Write and Evaluate Functions using Pseudocode

Question 10



Using pseudocode, define a function for finding each of the following:

- a. Finding the area of the triangle given base and height.

- b. Finding the surface area of a sphere given radius.

- c. Define a function for modulus.


Question 11

Evaluate the following algorithm:

- a.** $A \leftarrow []$
 for n from 1 to 6
 if $n = \text{even}$ then
 append 1 to A .
 else
 append 0 to A .

- b.** $A \leftarrow []$
 for n from 1 to 5
 $B \leftarrow 2n + 1$
 append B to A .

- c. $A \leftarrow [1, 1]$
 for n from 1 to 5
 $x \leftarrow A[n] + A[n + 1]$
 append x to A .

Question 12


Using pseudocode, construct an algorithm for the following:

- a. Find the biggest possible product from any 2 numbers from the list = (23, 5, 2, 56, 34).

NOTE: Cannot multiply numbers by themselves.

b. Find the smallest possible sum of 2 numbers from the same list as **part a**.

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Sub-Section: Final Boss

Question 13

Consider the sequence 1, 4, 7, 10, 13, 16, 19... $3(n - 1) + 1$.

Using pseudocode, write an algorithm for:

- a. Calculate the sum of the even terms in the sequence up to the n^{th} term.

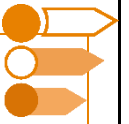
- b. Calculate the product of the odd terms in the sequence up to the n^{th} term.

- c. Construct a table of values to demonstrate each algorithm when $n = 5$.

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Section B: Supplementary Questions

Sub-Section [2.4.1]: Write and Understand Basic Algorithms



Question 14



Construct an algorithm that multiplies any input given by 10.

Question 15



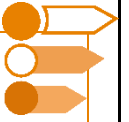
Construct an algorithm that adds any input given by 5.

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Question 16


Construct an algorithm that subtracts any input given by 5 and multiplies by 2.

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Sub-Section [2.4.2]: Understanding and Evaluating Algorithms that have Conditional Statements and Represent Hybrid Functions as Algorithms

Question 17



Using a flowchart, describe an algorithm of the following hybrid function.

$$f(x) = \begin{cases} 3x - 5 & x \geq 0 \\ x - 1 & x < 0 \end{cases}$$

Question 18



Using a flowchart, describe an algorithm of the following hybrid function.

$$f(x) = \begin{cases} 1 & x \geq 0 \\ 0 & x < 0 \end{cases}$$

Question 19


Turn the following function into an algorithm.

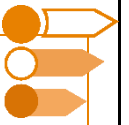
$$f(x) = \begin{cases} x^2 & x \geq 1 \\ -2x + 1 & x < 1 \end{cases}$$

Question 20


Turn the following function into an algorithm.

$$f(x) = \max\{n \in \mathbb{R} | n \leq x\}$$

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Sub-Section [2.4.3]: Understand and Evaluate Algorithms with Loops

Question 21



Check whether the following algorithm has any problems. If there is a problem, state the problem; if there is no problem, give the final output of the algorithm.

Step 1: $A \leftarrow 30$

Step 2: $A \leftarrow 3A - 20$

Step 3: Repeat 2 while $A > 65$.

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Question 22


Evaluate the following algorithm:

```

for  $a$  from 1 to 10
  if  $a = \text{even}$ , then
    print "yes"
  else
    print "no"
end for.

```

Question 23


Check whether the following algorithm has any problems. If there is a problem, state the problem; if there is no problem, give the final output of the algorithm.

```

Step 1:  $A \leftarrow 60$ 
Step 2:  $A \leftarrow 2A - 50$ 
Step 3: Repeat 2 while  $A \leq 130$ .

```


Question 24

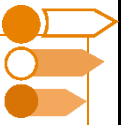
Evaluate the following output:

```

a ← 5
b ← 10
if a − b < 5
    a ← a − 5
    b ← b − 10
end if
print a, b.

```

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Sub-Section [2.4.4]: Write and Evaluate Functions using Pseudocode

Question 25



```

A ← [ ]
for n from 1 to 5
    append n to A.
    if n = 1, then
        return
    else
         $A = \sqrt{n^2 + A[n - 1]}$ 
        if A = integer
            print "A[n - 1], n, A is a perfect triangle."
end for.
    
```

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Question 26

- a. Roger decides to invest \$1000 at an interest rate of 10% compounded monthly. Construct an algorithm that computes the number of years needed for Roger's investment to double.

- b. Jacob decides to invest \$500 at an interest rate of 15% compounded annually. Construct an algorithm that computes the number of years needed for Jacob's investment to increase by 50%.

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Question 27


Using pseudocode, write an algorithm to find all the primes less or equal to 100.

Question 28


Using pseudocode, construct an algorithm for the following:

Find the shortest distance between any 2 *different* coordinates from the list of coordinates.

Y coord = [1, 35, 5, 41, 5]
X coord = [123, 2, 74, 213, 2]



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