Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Computer science

Higher level

Paper 1

26 pages

14. (a) *Award **[3 max]***

*Award **[1]** for a correct row loop*
*Award **[1]** for a correct column loop*
*Award **[1]** for initializing SUM and summing inside the loop using correct array indexes*

Example 1:

```
SUM=0
loop I from 0 to 6
       //accept DICEDIAL.length-1
       // or len(DICEDIAL)-1 instead of 6
   loop J from 0 to 2
        //accept DICEDIAL[I].length-1
       // or len(DICEDIAL[I])-1 instead of 2

      SUM = SUM + DICEDIAL[I][J]
   end loop
end loop
```

Example 2:

```
I =0
SUM=0
loop while I <= 6
      j=0
      loop while J <= 2
         SUM =SUM + DICEDIAL[I][J]
         J = J + 1
      end loop
      I = I + 1
end loop
```

(b) *Award **[4 max]***

Example 1 (if-else statement):
*Award **[1]** for initializing VAL to 0 and return VAL / return 0 (in case no duplicates)*
*Award **[3 max]** for determining a correct value (1 mark for each correct condition and change of the value of VAL if needed)*

***Note**: Award marks for determining a correct return value in each of possible cases: three different values in row R- no duplicates, any two numbers/values in row R are the same and all three values in row R are the same.*
*Award **[1]** for correct use of row index and column index in the DICEDIAL array*

***Note**: the method heading may not appear in a candidate's response.*

```
DuplicateNum (DICEDIAL, R)
    VAL=0
    if DICEDIAL[R][0] = DICEDIAL[R][1]
        then
            VAL= DICEDIAL[R][0] // or VAL= DICEDIAL[R][1]
        else
           if DICEDIAL[R][0] = DICEDIAL[R][2]
               then VAL= DICEDIAL[R][0]
               else
                    if DICEDIAL[R][1] = DICEDIAL[R][2]
                          then VAL= DICEDIAL[R][1]
                     end if
             end if
     end if
return VAL
end DuplicateNum
```

Example 2 (several if statements- inefficient, but it outputs a correct value):
*Award **[1]** for each correct if statement, **x4***
*Award **[1]** for correct use of row index and column index in the DICEDIAL array*

```
if //three different numbers
  DICEDIAL[R][0]!=DICEDIAL[R][1]
     and DICEDIAL[R][0]!=DICEDIAL[R][2]
         and DICEDIAL[R][1]!=DICEDIAL[R][2]
  then
      RESULT=0
end if
if DICEDIAL[R][0]=DICEDIAL[R][1] and DICEDIAL[R][0]=DICEDIAL[R][2]
  then //three same numbers
      RESULT = DICEDIAL[R][0]
end if
//any two same
if DICEDIAL[R][0]=DICEDIAL[R][1] or DICEDIAL[R][0]=DICEDIAL[R][2]
  then
      RESULT = DICEDIAL[R][0]
end if
if DICEDIAL[R][1]=DICEDIAL[R][2]
     then
          RESULT = DICEDIAL[R][1]
end if
return RESULT
```

***Note**: Accept answers written in Java/ Python. The following example answer is written in Java.*

```
public int DuplicateNum (int[][] DiceDial, int row)
{
if(DiceDial[row][0] == DiceDial[row][1]  || DiceDial[row][0] ==
DiceDial[row][2])
       {
       return DiceDial[row][0];
       }
    else if(DiceDial[row][1] == DiceDial[row][2])
                  {
                     return DiceDial[row][1];
                  }
                 else return 0;
}
```

Example 3 (single loop):
*Award **[1]** for initializing VAL to 0 and return VAL*
*Award **[1]** for correct loop*
*Award **[1]** for correct condition and change of VAL*
*Award **[1]** for if statement after the loop*
*Award **[1]** for correct use of row index and column index in the DICEDIAL array*

```
DuplicateNum (DICEDIAL, R)
VAL=0
loop K from 0 to 1
    if (DICEDIAL[R][K]== DICEDIAL[R][K+1])
          then
             VAL= DICEDIAL[R][K]// or DICEDIAL[R][K+1]
    end if
end loop // determines VAL
         //comparing only DICEDIAL[R][0] with DICEDIAL[R][1]
         // and DICEDIAL[R][1] with DICEDIAL[R][2]
if (DICEDIAL[R][0] == DICEDIAL[R][2])
          then
             VAL= DICEDIAL[R][0] //or DICEDIAL[R][2]
end if
return VAL
end DuplicateNum
```

Example 4 (nested loops):
*Award **[1]** for initializing VAL to 0 and return VAL*
*Award **[1]** for correct outer loop*
*Award **[1]** for correct inner loop*
*Award **[1]** for correct condition and change of VAL*
*Award **[1]** for correct use of indexes in the DICEDIAL array*

```
VAL =0
 loop K from 0 to 1
   loop J from K + 1 to 2
       if DICEDIAL[R][K] == DICEDIAL[R][J]
          then VAL = DICEDIAL[R][K]
       end if
   end loop
end loop
return VAL
```

(c) *Award **[8 max]***

Example 1:
*Award **[1]** for initializing HIGHEST*
*Award **[1]** for correct row loop (I)*
*Award **[1]** for calculating the sum of all elements in the I^{th} row*
*Award **[1]** for using correct indexes in the DICEDIAL array*
*Award **[1]** for comparing the row sum with the highest row sum so far*
*Award **[1]** for and changing the value of HIGHEST if needed*
*Award **[1]** for outputting the highest row sum once*
*Award **[1]** for the second loop*
*Award **[1]** for comparing the row total with the highest row total*
*Award **[1]** for outputting row numbers (rows with the highest total)*

***Note**: The method heading may not appear in candidates' responses.*

```
highestRT(DICEDIAL)

  HIGHEST = 0  // any number <= 0 OR the first-row total
  loop I from 0 to 6
     SUM = DICEDIAL[I][0] + DICEDIAL[I][1] + DICEDIAL[I][2]
     //inner loop may be used instead of this statement
    //(see Example 2)- to calculate SUM of values in row I
     if SUM > HIGHEST // or >=
          then HIGHEST = SUM
      end if
   end loop
   output('the highest row total:', HIGHEST)
   output('the highest row total occurs in the following rows:')
   loop I from 0 to 6
     SUM = DICEDIAL[I][0] + DICEDIAL[I][1] + DICEDIAL[I][2]
     if SUM = HIGHEST
          then output (I)
      end if
    end loop
end highestRT
```

Example 2:
*Award **[2 max]** for defining the ROWTOTALS array (1 mark for correct row loop (I) and 1 mark for calculating the sum of all elements in the I^{th} row of the DICEDIAL array)*
*Award **[1]** for initializing HIGHEST*
*Award **[3 max]** for searching for the highest (1 mark for the correct loop, 1 mark for comparing the row sum with the highest row sum so far and 1 mark for and changing the value of HIGHEST if needed)*
*Award **[1]** for outputting the highest row sum once*
*Award **[3 max]** outputting the numbers of rows with the highest total (1 mark for a loop, 1 mark for comparing the row total with the highest total and 1 mark for outputting the corresponding index in the ROWTOTALS array)*

```
loop I from 0 to 6
   S = 0
   loop K from 0 to 2
      S = S + DICEDIAL[I][K]
   end loop
   ROWTOTALS[I] = S
end loop
     //ROWTOTALS[R] holds the sum of all
     //numbers in row R of the DICEDIAL array

HIGHEST = 0  //any number <= 0 OR ROWTOTALS[0]

loop I from 0 to 6
 if ROWTOTALS[I] > HIGHEST
        then   HIGHEST = ROWTOTALS[I]
   end if
end loop     //searching for the highest row total

output('the highest row total:', HIGHEST)

output('the highest row total occurs in the following rows:')

loop I from 0 to 6
    if ROWTOTALS[I] = HIGHEST
       then output(I)
   end if
end loop
```

Example 3:
*Award **[1]** for initializing MAXT*
*Award **[1]** for correct row loop (R)*
*Award **[1]** for calculating the sum of all elements in row R (using correct indexes in the DICEDIAL array)*
*Award **[1]** for comparing the row sum with the highest row sum so far (S == MAXT), and changing*
the value FLAGMAXTIND[R] to 1 if they are equal
*Award **[1]** for comparing the row sum with the highest row sum so far (S > MAXT) and updating the highest row sum so far*
*Award **[1]** for reinitializing FLAGMAXTIND array*
*Award **[1]** for changing the value FLAGMAXTIND[R] to 1*
*Award **[1]** for outputting the highest row total only once*
*Award **[2]** for outputting row numbers with the highest total (1 mark for a loop, 1 mark for output within if statement)*

```
// assume FLAGMAXTIND - zero array initialized
MAXT = 0
loop R from 0 to 6
      S = DICEDIAL[R][0]+ DICEDIAL[R][1]+ DICEDIAL[R][2]
      if S = MAXT
          then
                FLAGMAXTIND[R]=1
        end if
       if S > MAXT
           then
                MAXT = S
                loop K from 0 to 6
                     FLAGMAXTIND[K]=0
                end loop
                FLAGMAXTIND[R]=1
       end if
end loop

output('The highest row total is', MAXT)

output(' and it occurs in the following rows:')
loop R from 0 to 6
         if FLAGMAXTIND[R] == 1 // or FLAGMAXTIND[R] != 0
              then
                  output(R)
         end if
end loop
```