EXAMPLE PROGRAM CENTIGRADE TO FAHRENHEIT REPORT

1. Requirements

To produce a program that converts air temperature measured in whole numbers of degrees on the Centigrade scale to the equivalent on the Fahrenheit scale. Assume minimum centigrade temperature of -50 and maximum of 100. Use the following conversion identity:

$$F = \left[\frac{9 \times C}{5}\right] + 32$$

Where

F = Temperature in degrees Fahrenheit.

C = Temperature in degrees Centigrade.

Output should be accurate to one decimal place.

2. Design

A top down analysis is presented in Table 1.

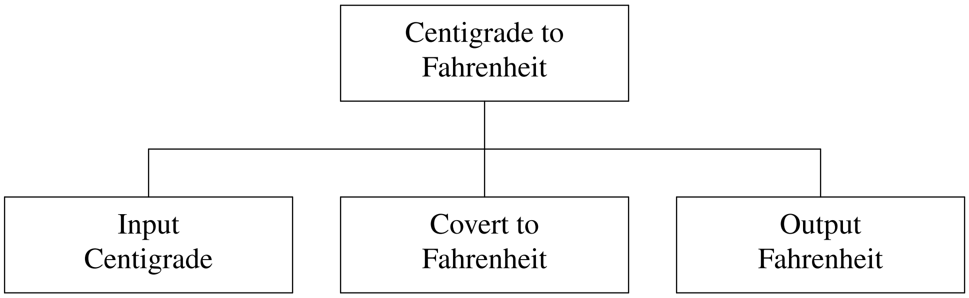

Table 1: *Top down analysis*

A single procedure:

1) `CENT_2_FAHR` (top level procedure): Input Centigrade, convert to Fahrenheit, and output Fahrenheit.

NAME	TYPE	RANGE
CENT_TEMP	CENTIGRADE	-50-100

Note that the type `CENTIGRADE` is programmer defined.

A Nassi-Shneiderman chart is given in Table 2

Input CENTIGRADE
conversion
Output FAHRENHEIT

Table 2: *Nassi-Shneiderman Chart*

3. Implementation

Implementation is as shown in Table 3:

```
-- CENTIGRADE TO FAHRENHEIT CONVERSION
-- 4 August 1997
-- Frans Coenen
-- Dept Computer Science, University of Liverpool

with TEXT_IO;
use TEXT_IO;

procedure CENT_2_FAHR is
        type CENTIGRADE is range -50..100;
        package INTEGER_INOUT is new INTEGER_IO(CENTIGRADE);
        use INTEGER_INOUT;
        package FLOAT_INOUT is new FLOAT_IO(FLOAT);
        use FLOAT_INOUT;
        CENT_TEMP: CENTIGRADE;
begin
-- Input centigrade value
        PUT_LINE("Input temperature in degrees Centigrade: ");
        GET(CENT_TEMP);
-- Conversion and output
        PUT("The equivalent in degrees Fahrenheit is: ");
        PUT(FLOAT(CENT_TEMP) * (9.0/5.0) + 32.0, FORE=>3, AFT=>1, EXP=>0);
        NEW_LINE;
end CENT_2_FAHR;
```

Table 3: *Implementation*

4. Testing

4.1. BVA and limit testing

Use Boundary Value Analysis testing to analyse limits of input variables. Suitable boundary values for both `CENT_TEMP` are -51, -49, 99 and 101 (just above and below the range limits). We should also test the effect of inputs at the limits, e.g. -50 and 100. An appropriate set of test cases is given in Table 4.

TEST CASE	EXPECTED RESULT
CENT_TEMP	FAHR_TEMP
-51	DATA_ERROR
-49	-56.2
99	210.2
101	DATA_ERROR
-50	-58.0
100	212.0

Table 4: *BVA and limit test cases*

A screen dump illustrating the output produced when the above test cases are run is given in Table 5.

```
kuban-209 $ cent_2_fahr
Input temperature in degrees Centigrade:
-51
Ada-runtime: Exception DATA_ERROR propagated out of main.

kuban-210 $ cent_2_fahr
Input temperature in degrees Centigrade:
-49
The equivalent in degrees Fahrenheit is: -56.2

kuban-211 $ cent_2_fahr
Input temperature in degrees Centigrade:
99
The equivalent in degrees Fahrenheit is: 210.2

kuban-212 $ cent_2_fahr
Input temperature in degrees Centigrade:
101
Ada-runtime: Exception DATA_ERROR propagated out of main.

kuban-208 $ cent_2_fahr
Input temperature in degrees Centigrade:
-50
The equivalent in degrees Fahrenheit is: -58.0

kuban-211 $ cent_2_fahr
Input temperature in degrees Centigrade:
100
The equivalent in degrees Fahrenheit is: 212.0
```

Table 5: *BVA and limit testing output*

4.2. Arithmetic testing

In addition we should also carry out some arithmetic testing to ensure the calculation part of the program operates appropriately. This normally involves tests using positive, zero and negative sample input values. Test cases involving positive and negative input values have already been designed with respect to BVA testing (see above) thus we only need to consider an input value of

0. An appropriate test case is defined in Table 6.

TEST CASE	EXPECTED RESULT
CENT_TEMP	FAHR_TEMP
0	32.0

Table 6: *Arithmetic test cases*

A screen dump illustrating the output produced when the above test cases are run is given in Table 7.

```
kuban-213 $ cent_2_fahr
Input temperature in degrees Centigrade:
0
The equivalent in degrees Fahrenheit is:  32.0
```

Table 7: *Arithmetic Testing output*

4.3. Data validation testing.

Results of some further tests using a number of spurious input values not previously incorporated into test cases are given in Table 8.

```
kuban-212 $ cent_2_fahr
Input temperature in degrees Centigrade:
-0.0
The equivalent in degrees Fahrenheit is:  32.0

kuban-213 $ 0
ksh: 0:  not found

kuban-214 $ cent_2_fahr
Input temperature in degrees Centigrade:
3e.5
Ada-runtime: Exception DATA_ERROR propagated out of main.
```

Table 8: *Data validation testing output*