FOC-2020 -bhh

Problem Solving Applied: Freezing Temperature of Seawater:

Basics: he **salinity** of seawater is a measure of the amount of dissolved material in the seawater. **Seawater** is primarily water with about 3.5% dissolved materials (salts, metals, and gases) . **ote:** The higher the salinity, the lower the temperature at which the seawater freezes.

The following table contains a set of salinity measurements and corresponding freezing temperatures:

Salinity (ppt)	Freezing Temperature (°F)
0 (fresh water)	32
10	31.1
20	30.1
24.7	29.6
30	29.1
35	28.6

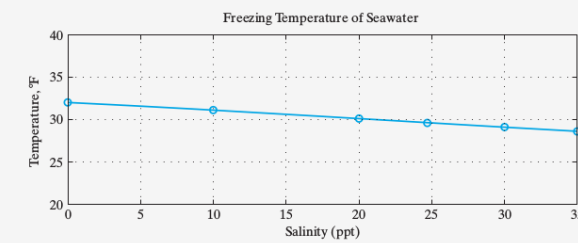


Figure 2.6 *Freezing temperature of seawater.*

1. PROBLEM STATEMENT

Use linear interpolation to compute a new freezing temperature for water with a specified salinity

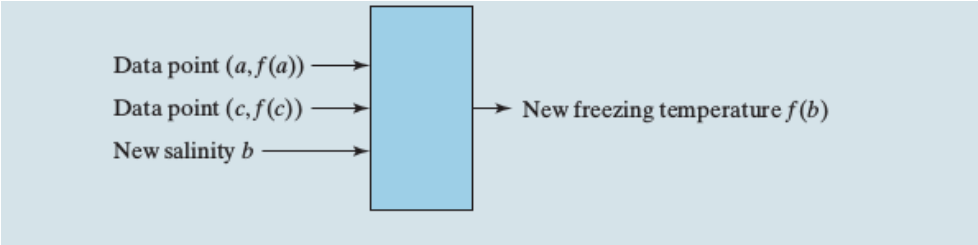
2. INPUT/OUTPUT DESCRIPTION

The following diagram shows that the input to the program includes two consecutive points **(a, f (a)) and (c, f(c))** and the new salinity measurement b, while the output is the new freez- ing temperature:

Example : If a is salinity and then F(a) is Freezing temperature (From the **graph**)

New freez- ing temperature **(f(b)** for New salinity measurement b is given by :

$$f(b) = f(a) + (b - a)/(c - a) * (f(c) - f(a))$$



3. HAND EXAMPLE

Suppose that we want to determine the freezing temperature for water with a salinity meas urement of 33 ppt. From the data, we see that this point falls between 30 and 35 ppt:

a	30	29.1	$f(a)$
b	33	?	$f(b)$
c	35	28.6	$f(c)$

Using the linear equation formula, we can compute $f(b)$:

$$\begin{aligned} f(b) &= f(a) + (b - a)/(c - a) \cdot (f(c) - f(a)) \\ &= 29.1 + 3/5 \cdot (28.6 - 29.1) \\ &= 28.8. \end{aligned}$$

4. ALGORITHM DEVELOPMENT

1. **Read the coordinates of the adjacent points and the new salinity value.**
2. **Compute the new freezing temperature.**
3. **Print the new freezing temperature.**

```
#include <stdio.h>
#include <math.h>
int main(void)
{
     double a, f_a, b, f_b, c, f_c;
     printf ("Use ppt for salinity values. \n");
     printf ("Use degrees F for temperatures.
     \n");
     printf ("Enter first salinity and freezing
     temperature: \n");
     scanf ("%lf %lf",&a,&f_a);
     printf ("Enter second salinity and freezing
     temperature: \n");
     scanf ("%lf %lf",&c,&f_c);
     printf ("Enter new salinity: \n");
     scanf ("%lf",&b);
     f_b = f_a + (b-a)/(c-a)*(f_c - f_a);
     /* Print new freezing temperature. */
     printf("New freezing temperature in degrees
     F: %4.1f \n",f_b);
     /* Exit program.
     return 0;
*/
}
```

5. TESTING

We first test the program using the data from the hand example.

```
Enter first salinity and freezing temperature:
30 29.1
Enter second salinity and freezing temperature:
35 28.6
Enter new salinity:
33
```

```
      New freezing temperature in degrees F: 28.8
```

The value computed matches the hand example.