Computational Problem Solving I

CPET-121

Coding Challenge 1A : Timber Regrowth

Problem Overview:

A challenge in timber management is to determine how long it takes to reforest (regrow) a timber lot after the trees have been harvested. This time is a function of two factors, the percentage of timber left standing after the harvest, known as the "uncut rate", and the forest "regrowth rate". The "uncut rate" for our state is 35%. This means if a timber lot was 1,000 acres, 350 acres would need to be left standing after the harvest.

The second factor, "regrowth rate", depends on the climate and soil conditions and is typically 2-8%.

For example: Given a 2,000 acre timber lot, with a 35% "uncut rate", after the harvest there would be 700 acres of forest remaining. With a 5.0% regrowth rate, the forest would regrow as follows…

- Start : 700.00 acres
- After (1) year : 700.00 + 700.00 x 5% = 700.00 + 35.00 = 735.00
- After (2) years : 735.00 + 735.00 x 5% = 735.00 + 36.75 = 771.75
- After (3) years : 771.75 + 771.75 x 5% = 771.75 + 38.59 = 810.35

  …
- After (21) years : 1950.17 (almost 100% reforested)

Code Design Specifications:

Design, code and test a procedural C++ program that solves this timber regrowth problem.

This program must meet the following specifications:

- The program should have three inputs:
  - the size of the timber lot, in acres.
  - the regrowth rate, as a percentage.
  - an option: A, B, or C (in upper or lower case).
- Option A :
  - Displays a table of regrowth acres vs year for years (0) through (20). Note, depending on the regrowth rate entered, the regrowth acres could be more than the timber lot size in the 20 years.
    - For Example: 20,000 acres with a 4.5% regrowth rate. Note, in the 20 years the timber lot never regrows back to 20,000 acres.

When input is

```
20000 4.5 A
```

Standard output exactly matches

```
Year =   0, Regrowth =   7000.00 Acres
Year =   1, Regrowth =   7315.00 Acres
Year =   2, Regrowth =   7644.17 Acres
Year =   3, Regrowth =   7988.16 Acres
Year =   4, Regrowth =   8347.63 Acres
```

```
Year =  17, Regrowth =  14793.64 Acres
Year =  18, Regrowth =  15459.35 Acres
Year =  19, Regrowth =  16155.02 Acres
Year =  20, Regrowth =  16882.00 Acres
```

- For Example: 35,000 acres with a 7.5% regrowth rate. Note, in the 20 years the timber lot grows to 53036.18 acres. Obviously, this is not possible, but that's how option (A) works. The timber lot is regrown to 35,000 acres between year 14 and 15. Also, note the lower case 'a'.

When input is

```
35000 7.5 a
```

Standard output exactly matches

```
Year =   0, Regrowth =  12250.00 Acres
Year =   1, Regrowth =  13168.75 Acres
Year =   2, Regrowth =  14156.41 Acres
Year =   3, Regrowth =  15218.14 Acres
Year =  13, Regrowth =  31365.06 Acres
Year =  14, Regrowth =  33717.44 Acres
Year =  15, Regrowth =  36246.25 Acres
Year =  16, Regrowth =  38964.72 Acres
Year =  17, Regrowth =  41887.07 Acres
Year =  18, Regrowth =  45028.60 Acres
Year =  19, Regrowth =  48405.75 Acres
Year =  20, Regrowth =  52036.18 Acres
```

- Option B :
  - Like option (A), option (B) displays a table of regrowth acres vs year for years (0) through (20). However, if the timber lot grows back to its original size before reaching 20 years, the program stops at the last year the regrowth was less then (or equal to) the timber lot size.
    - For Example: 35,000 acres with a 7.5% regrowth rate. Note, in this example, the output stops after 14 years because the regrowth "equals" the timber lot size.

When input is

```
35000 7.5 B
```

Standard output exactly matches

```
Year =   0, Regrowth =  12250.00 Acres
Year =   1, Regrowth =  13168.75 Acres
Year =   2, Regrowth =  14156.41 Acres
Year =   3, Regrowth =  15218.14 Acres
Year =   4, Regrowth =  16359.50 Acres
Year =   5, Regrowth =  17586.46 Acres
Year =   6, Regrowth =  18905.44 Acres
Year =   7, Regrowth =  20323.35 Acres
Year =   8, Regrowth =  21847.60 Acres
Year =   9, Regrowth =  23486.17 Acres
Year =  10, Regrowth =  25247.64 Acres
Year =  11, Regrowth =  27141.21 Acres
Year =  12, Regrowth =  29176.80 Acres
Year =  13, Regrowth =  31365.06 Acres
Year =  14, Regrowth =  33717.44 Acres
```

- Option C :
  - Option (C) calculates the regrowth acres vs year for year (0) through the number of years until the regrowth "equals" the timber lot size. The output should be the year and regrowth acreage.
    - For Example: 45,000 acres with a 4.5% regrowth rate.

When input is

```
45000 4.5 C
```

Standard output exactly matches

```
Year =  23, Regrowth =  43346.62 Acres
```

    - For Example: 45,000 acres with a 1.5% regrowth rate.

When input is

```
45000 1.5 c
```

Standard output exactly matches

```
Year =  70, Regrowth =  44658.44 Acres
```

- If any other option other than A, B, or C are entered, the program should display an error message and terminate.
    - For Example: Option 'f'.

When input is

```
4500 1.5 f
```

Standard output exactly matches

```
ILLEGAL OPTION!
```

Grading Criteria:

- Your grade for this Coding Challenge is based on the complete and accurate implementation of the design specifications (80%) and adherence to proper coding style and commenting guidelines (20%).
- Late projects are penalized 10% per day they are late.