Challenge November-2018

Vacation Days Advanced

A solution with DT5GL by Jack Jansonius – 19 Nov 2018

Problem description:

Every employee receives vacation days according to the following rules:

1. Every employee receives at least 22 vacation days.
2. Employees younger than 18 or at least 60 years, or employees with at least 30 years of service can receive extra 5 days.
3. Employees with at least 30 years of service and also employees of age 60 or more, can receive extra 3 days, on top of possible additional days already given
4. If an employee has at least 15 but less than 30 years of service, extra 2 days can be given. These 2 days can also be provided for employees of age 45 or more.
5. A college student is eligible to 1 extra vacation day.
6. If an employee is a veteran, 2 extra days can be given.
7. The total number of vacation days cannot exceed 29.

In my opinion it is not a problem to rewrite rules 2 and 3:

1. Every employee receives at least 22 vacation days.
2. Employees younger than 18 receive extra 5 days.
3. Employees with at least 30 years of service and also employees of age 60 or more, can receive extra 8 days.

Implementation of the decision tables in DT5GL:

```
Table 0: Vacation days
If:                                     | 0| 1| 2|
Subtotal <= 28                          | Y| Y| N|
Total    <= 29                          | Y| N| -|
Then:
Vacation_days is Not_restricted         | X|  |  |
Vacation_days is Restricted_to_maximum  |  | X| X|
# .......


Attribute: Subtotal
Summation_of: Initial_days + Extra_days

Table 1: Initial days
If:                                | 0|
'initial statement'                | -|
Then:
Initial_days = 22                  | X|
# .......

Proposition: 'initial statement'
Askable_using: "xxxxx"


Table 2: Extra days
If:                                | 0| 1| 2| 3| 4| 5| 6|
age < 18                           | Y| N| N| N| N| N| N|
age < 45                           | -| Y| Y| Y| N| N| N|
age < 60                           | -| -| -| -| Y| Y| N|
service < 15                       | -| Y| N| N| -| -| -|
service < 30                       | -| -| Y| N| Y| N| -|
Then:
Extra_days = 0                     |  | X|  |  |  |  |  |
Extra_days = 2                     |  |  | X|  | X|  |  |
Extra_days = 5                     | X|  |  |  |  |  |  |
Extra_days = 8                     |  |  |  | X|  | X| X|
# .......

Attribute: age
Askable_using: "What is the years of age of the employee?"
Attribute: service
Askable_using: "What is the years of service of the employee?"


Attribute: Total
Summation_of: Subtotal + Extra_for_student + Extra_for_veteran


Table 3: Extra for student
If:                                | 0| 1| 2|
age <= 30                          | Y| Y| N|
'employee is college student'      | Y| N| -|
Then:
Extra_for_student = 0              |  | X| X|
Extra_for_student = 1              | X|  |  |
# .......
# NB The assumption here is that a college student is not older than 30.

Proposition: 'employee is college student'
Askable_using: "**?"
```

```
Table 4: Extra for veteran
If:                              | 0| 1| 2|
age >= 45                        | Y| Y| N|
'employee is veteran'            | Y| N| -|
Then:
Extra_for_veteran = 0            |  | X| X|
Extra_for_veteran = 2            | X|  |  |
# .......
# NB The assumption here is that a veteran is not younger than 45.

Proposition: 'employee is veteran'
Askable_using: "**?"


GoalAttribute: Vacation_days
Case: Not_restricted
Print: "-------------------------------------------"
Print: "Number of vacation days is: %s." Total
Print: "-------------------------------------------"
Print: "Initial days: %s and Extra days: %s." Initial_days Extra_days
Print: "Extra days for a college student: %s." Extra_for_student
Print: "Extra days for a veteran: %s." Extra_for_veteran
Print: "GoalAttribute Vacation_days: %s." Vacation_days
Print: "-------------------------------------------"

Case: Restricted_to_maximum
Print: "-----------------------------------------------------------"
Print: "Number of vacation days is restricted to the maximum: 29"
Print: "-----------------------------------------------------------"
Print: "Sum of Initial days: %s and Extra days: %s gives: %s." Initial_days
Extra_days Subtotal
Print: "Extra days for a college student: %s." Extra_for_student
Print: "Extra days for a veteran: %s." Extra_for_veteran
Print: "GoalAttribute Vacation_days: %s." Vacation_days
Print: "-----------------------------------------------------------"
```

Various test runs

1. Age=17, College student ➔ 22+5+1=28 days

```
"What is the years of age of the employee?"
> 17
'employee is college student' (y/n)? *> y
-----------------------------------------
Number of vacation days is: 28.
-----------------------------------------
Initial days: 22 and Extra days: 5.
Extra days for a college student: 1.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-----------------------------------------
```

NB Years of service is not relevant in this and the next case so don't ask for it!

2. Age=17, Not a College student ➔ 22+5+0=27 days

```
"What is the years of age of the employee?"
> 17
'employee is college student' (y/n)? *> n
-----------------------------------------
Number of vacation days is: 27.
-----------------------------------------
Initial days: 22 and Extra days: 5.
Extra days for a college student: 0.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-----------------------------------------
```

3. Age=18, Years of Service=2, College student ➔ 22+0+1=23 days

```
"What is the years of age of the employee?"
> 18
"What is the years of service of the employee?"
> 2
'employee is college student' (y/n)? *> y
-----------------------------------------
Number of vacation days is: 23.
-----------------------------------------
Initial days: 22 and Extra days: 0.
Extra days for a college student: 1.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-----------------------------------------
```

4. Age=30, Years of Service=14, Not a College student ➔ 22+0+0=22 days

```
"What is the years of age of the employee?"
> 30
"What is the years of service of the employee?"
> 14
'employee is college student' (y/n)? *> n
-----------------------------------------
Number of vacation days is: 22.
-----------------------------------------
Initial days: 22 and Extra days: 0.
Extra days for a college student: 0.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-----------------------------------------
```

5. Age=44, Years of Service=14 ➔ 22+0=22 days

```
"What is the years of age of the employee?"
> 44
"What is the years of service of the employee?"
> 14
-------------------------------------------
Number of vacation days is: 22.
-------------------------------------------
Initial days: 22 and Extra days: 0.
Extra days for a college student: 0.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-------------------------------------------
```

NB: don't ask if the employee is a college student or a veteran because of the assumption that a college student is not older than 30 and a veteran is older than 44; the first condition in table 3 and 4.

6. Age=44, Years of Service=29 ➔ 22+2=24 days

```
"What is the years of age of the employee?"
> 44
"What is the years of service of the employee?"
> 29
-------------------------------------------
Number of vacation days is: 24.
-------------------------------------------
Initial days: 22 and Extra days: 2.
Extra days for a college student: 0.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-------------------------------------------
```

7. Age=44, Years of Service=30 ➔ 22+8=30 days

```
"What is the years of age of the employee?"
> 44
"What is the years of service of the employee?"
> 30
-----------------------------------------------------------
Number of vacation days is restricted to the maximum: 29
-----------------------------------------------------------
Sum of Initial days: 22 and Extra days: 8 gives: 30.
Extra days for a college student: None.
Extra days for a veteran: None.
GoalAttribute Vacation_days: Restricted_to_maximum.
-----------------------------------------------------------
```

NB: in this case it is pointless to consider if the employee is a college student or a veteran because the maximum has already been exceeded!

8. Age=45, Years of Service=20, Veteran ➔ 22+2+2=26 days

```
"What is the years of age of the employee?"
> 45
"What is the years of service of the employee?"
> 20
'employee is veteran' (y/n)? *> y
-------------------------------------------
Number of vacation days is: 26.
-------------------------------------------
Initial days: 22 and Extra days: 2.
Extra days for a college student: 0.
Extra days for a veteran: 2.
GoalAttribute Vacation_days: Not_restricted.
-------------------------------------------
```

9. Age=45, Years of Service=29, Not a Veteran ➔ 22+2+0=24 days

```
"What is the years of age of the employee?"
> 45
"What is the years of service of the employee?"
> 29
'employee is veteran' (y/n)? *> n
-------------------------------------------
Number of vacation days is: 24.
-------------------------------------------
Initial days: 22 and Extra days: 2.
Extra days for a college student: 0.
Extra days for a veteran: 0.
GoalAttribute Vacation_days: Not_restricted.
-------------------------------------------
```

10. Age=45, Years of Service=30 ➔ 22+8=30 days

```
"What is the years of age of the employee?"
> 45
"What is the years of service of the employee?"
> 30
-----------------------------------------------------
Number of vacation days is restricted to the maximum: 29
-----------------------------------------------------
Sum of Initial days: 22 and Extra days: 8 gives: 30.
Extra days for a college student: None.
Extra days for a veteran: None.
GoalAttribute Vacation_days: Restricted_to_maximum.
-----------------------------------------------------
```

NB: in this case (and the next one) it is pointless to consider if the employee is a veteran because the maximum has already been exceeded!

11. Age=60 ➔ 22+8=30 days

```
"What is the years of age of the employee?"
> 60
-----------------------------------------------------
Number of vacation days is restricted to the maximum: 29
-----------------------------------------------------
Sum of Initial days: 22 and Extra days: 8 gives: 30.
Extra days for a college student: None.
Extra days for a veteran: None.
GoalAttribute Vacation_days: Restricted_to_maximum.
-----------------------------------------------------
```

Demo Goal-driven/Backward-chaining reasoning with condition subtables.

8. Age=45, Years of Service=20, Veteran ➔ 22+2+2=26 days

```
Prove (Vacation_days is Not_restricted)
    >> Conditions Table 0 Rule 0:
    Prove (Subtotal <= 28)
        >> Conditions Table 1 Rule 0:
        >> Succeed...
            Derived value for Initial_days is: 22
        >> Conditions Table 2 Rule 1:
        "What is the years of age of the employee?"
        > 45


        >> Failed...
        >> Conditions Table 2 Rule 2:
        >> Failed...
        >> Conditions Table 2 Rule 4:
        "What is the years of service of the employee?"
        > 20


        >> Succeed...
            Derived value for Extra_days is: 2
        Derived value for Subtotal is: 24
    Succeed
    Prove (Total    <= 29)
            Derived value for Subtotal is: 24
        >> Conditions Table 3 Rule 1:
        >> Failed...
        >> Conditions Table 3 Rule 2:
        >> Succeed...
            Derived value for Extra_for_student is: 0
        >> Conditions Table 4 Rule 1:
        'employee is veteran' (y/n)? *> y
        >> Failed...
        >> Conditions Table 4 Rule 2:
        >> Failed...
        >> Conditions Table 4 Rule 0:
        >> Succeed...
            Derived value for Extra_for_veteran is: 2
        Derived value for Total is: 26
    Succeed
    >> Succeed...
-------------------------------------------
Number of vacation days is: 26.
-------------------------------------------
Initial days: 22 and Extra days: 2.
Extra days for a college student: 0.
Extra days for a veteran: 2.
GoalAttribute Vacation_days: Not_restricted.
-------------------------------------------
Succeed
```

Another solution with DT5GL; not recommended.

But a nice exercise in making bigger, complete decision tables...

```
Table 0: Vacation days
If:                              | 0| 1| 2| 3| 4| 5| 6| 7| 8| 9|
age < 18                         | Y| Y| N| N| N| N| N| N| N| N|
age < 45                         | -| -| Y| Y| Y| Y| N| N| N| N|
age < 60                         | -| -| -| -| -| -| Y| Y| Y| N|
service < 15                     | -| -| Y| Y| N| N| -| -| -| -|
service < 30                     | -| -| -| -| Y| N| Y| Y| N| -|
'student'                        | Y| N| Y| N| -| -| -| -| -| -|
'veteran'                        | -| -| -| -| -| -| Y| N| -| -|
Then:
vacation_days is 22              |  |  |  | X|  |  |  |  |  |  |
vacation_days is 23              |  |  | X|  |  |  |  |  |  |  |
vacation_days is 24              |  |  |  |  | X|  |  | X|  |  |
vacation_days is 26              |  |  |  |  |  |  | X|  |  |  |
vacation_days is 27              |  | X|  |  |  |  |  |  |  |  |
vacation_days is 28              | X|  |  |  |  |  |  |  |  |  |
vacation_days is 30              |  |  |  |  |  | X|  |  | X| X|
'restricted to the maximum'      |  |  |  |  |  | X|  |  | X| X|
# .......

Attribute: age
Askable_using: "What is the years of age of the employee?"
Attribute: service
Askable_using: "What is the years of service of the employee?"
Proposition: 'student'
Askable_using: "employee is a college student?"
Proposition: 'veteran'
Askable_using: "employee is a veteran?"

GoalAttribute: vacation_days
Case: 22
Print: "Number of vacation days is: 22."
Case: 23
Print: "Number of vacation days is: 23."
Case: 24
Print: "Number of vacation days is: 24."
Case: 26
Print: "Number of vacation days is: 26."
Case: 27
Print: "Number of vacation days is: 27."
Case: 28
Print: "Number of vacation days is: 28."
Case: 30
Print: "Number of vacation days is: 30."

GoalProposition: 'restricted to the maximum'
Print: "But restricted to the maximum: 29."
```

8. Age=45, Years of Service=20, Veteran ➔ 22+2+2=26 days

```
"What is the years of age of the employee?"
> 45
"What is the years of service of the employee?"
> 20
"employee is a veteran? (y/n)? > y
Number of vacation days is: 26.
```

11. Age=60 ➔ 22+8=30 days

```
"What is the years of age of the employee?"
> 60
Number of vacation days is: 30.
But restricted to the maximum: 29.
```