

## Part E - Polymorphism

# Function Templates

### Workshop 10

In this workshop, you code a template for converting a mark to a letter grade.

## LEARNING OUTCOMES

Upon successful completion of this workshop, you will have demonstrated your abilities to

- code a function template
- code an explicit specialization for a function template
- reflect on what you have learned from this workshop

## PART A: GRADEIT - BASIC TASK

### Definition

Create a function that takes in two integers (a mark and a maximum possible mark) and returns a single character for the corresponding grade, using the following mapping (where  $i$  is the percentage corresponding to the mark):

Percentage	Grade
$i > 79$	A
$69 < i \leq 79$	B
$59 < i \leq 69$	C
$50 < i \leq 59$	D
$i \leq 50$	F

The prototype for the function should be as follows

```
char gradeIt(int mark, int maxMark);
```

## Template

Store a template for your function is a header file named **grade.h**.

### Explicit Specialization

Code an explicit specialization of your template for **char** inputs, where the maximum mark is 'A', and which returns the mark.

Add your specialization to the header file named **grade.h**.

### Client Module

The main program that uses your implementation is listed on the left, while the results are shown on the right:

```
// Workshop 10 - gradeIt
// w10.cpp

#include <iostream>
#include "grade.h"

int main() {
    int t1Marks[] = { 28, 44, 12, 30 };
    int t1MaxMark = 47;
    double t2Marks[] = { 28.0, 22.5, 24.8, 21.6 };
    double t2MaxMark = 47.0;
    char t3Marks[] = { 'A', 'D', 'C', 'F' };
    char t3MaxMark = 'A';

    for (int i = 0; i < 4; i++)
    {
        std::cout << gradeIt(t1Marks[i], t1MaxMark) << " ";
        std::cout << gradeIt(t2Marks[i], t2MaxMark) << " ";
        std::cout << gradeIt(t3Marks[i], t3MaxMark) << std::endl;
    }
    std::cout << std::endl;
}
```

D	C	A
A	F	D
F	D	C
C	F	F

## Typing script

Create a script of your complete solution using the following commands:

```
+ At the prompt, type: script w10.txt
+ At the prompt, type: whoami
+ At the prompt, type: cat grade.h
+ At the prompt, type: g++ -o w10 w10.cpp
+ At the prompt, type: w10
+ At the prompt type: exit
```

These commands will produce a file named **w10.txt**. Download this file to your local computer.

## PART 2: GRADEIT WITH A CLASS

Upgrade your **gradeIt** template to take in two different types and use safe casting to cast the second type to the first type. Provide a specialization that takes in a **Student** as the first type and **int** as the second type (paste the **Student** class definition below into your **grade.h**) and calculates the grade using the **Student**'s **mark** member variable.

### Client Module

The main program that uses your implementation is listed on the left, while the results are shown on the right:

```
///////////
//(To be pasted into your grade.h)
class Student{
    double mark;
public:
    Student(double i){ mark = i; }
    double getMark(){ return mark; }
};

/////////
// Workshop 10 - GradeIt with a class
// w10B.cpp

#include <iostream>
#include "grade.h"

int main() {
    int maxMark = 100;
    double mark = 69.55;
    int mark2 = 69;
    Student fred(mark);
    std::cout << gradeIt(mark, maxMark) << std::endl;
```

```
    std::cout << gradeIt(mark2, maxMark) << std::endl;
    std::cout << gradeIt(fred, maxMark) << std::endl;
}
```

B  
C  
B

## Typing script

Create a script of your complete solution using the following commands:

```
+ At the prompt, type: script w10B.txt
+ At the prompt, type: whoami
+ At the prompt, type: cat grade.h
+ At the prompt, type: g++ -o w10b w10B.cpp
+ At the prompt, type: w10b
+ At the prompt type: exit
```

These commands will produce a file named **w10B.txt**. Download this file to your local computer.

## SUBMISSION

Submit your w10.txt and w10B.txt files through the following email.

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