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CMPT 1109

Programming I

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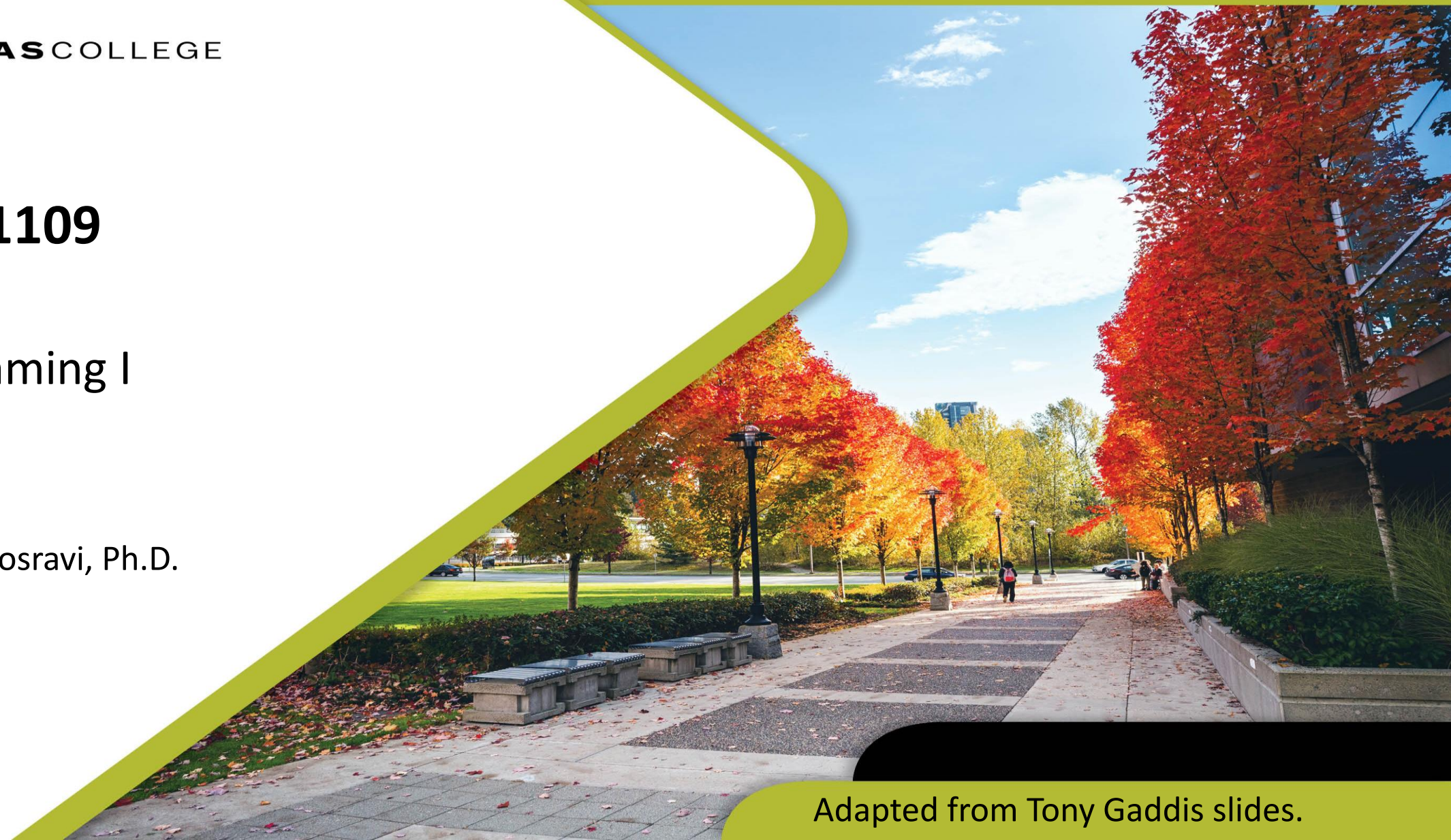
Lecture 10



Adapted from Tony Gaddis slides.

Plan for Today

- Abstract Data Types
- Structures
- Accessing Structure Members
- Initializing a Structure
- Arrays of Structures
- Nested Structures
- Structures as Function Arguments
- Returning a Structure from a Function
- Pointers to Structures
- Enumerated Data Types

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Abstract Data Types

Abstract Data Types

- **Abstract data types (ADTs)** are data types created by the programmer.
- ADTs have their own range (or domain) of data and their own sets of operations that may be performed on them.
- Users of an abstract data type does not need to know the implementation of the data type, e.g., how the data is stored
- **Abstraction**: a definition that captures general characteristics without details.
  - Example: An abstract triangle is a 3-sided polygon.
  - A specific triangle may be scalene, isosceles, or equilateral.
- **Data Type** defines the values that can be stored in a variable and the operations that can be performed on it.

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Combining Data into Structures

Combining Data into Structures

- We have so far written programs that keep data in individual variables.
- If we need to group items together, C++ allows us to create arrays.
- However, **all elements in an array must be of the same data type**.
- Sometimes a relationship exists between items of different types.
- For example, a payroll system might keep the variables shown here.
- **Structure**: A C++ construct that allows multiple variables to be grouped together. C++ gives us the ability to package them together into a **structure**.

Variable Definition	Data Held
`int empNumber;`	Employee number
`string name;`	Employee's name
`double hours;`	Hours worked
`double payRate;`	Hourly pay rate
`double grossPay;`	Gross pay

Example `struct` Declaration

- Before a structure can be used, it must be declared.
- The declaration inside curly brackets must have **;** after closing **}**.
- **`struct`** names commonly begin with an uppercase letter.
- Multiple fields of same type can be in comma-separated list.

```
struct Student
{
        int studentID;
        string name;
        short yearInSchool;
        double gpa;
};
```

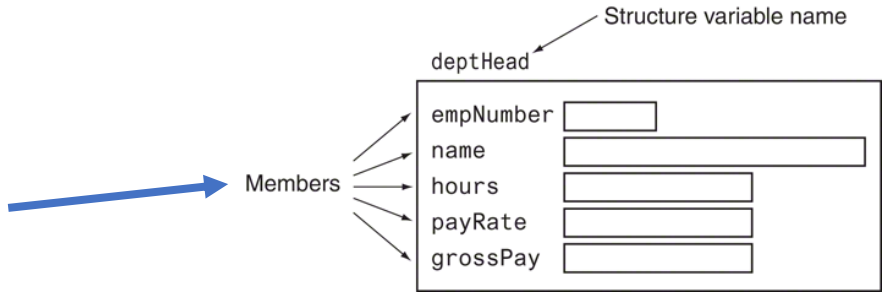
structure tag

structure members

Abstract Data Types

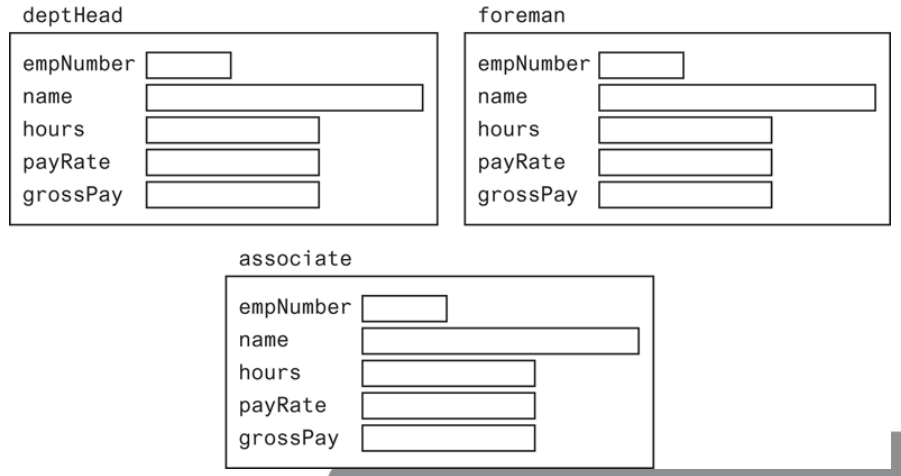
- Note the **`struct`** declaration in our example does **not** define a variable.
  - It simply tells the compiler what a `PayRoll` structure is made of.
  - It creates a new data type named **`PayRoll`**.

```
struct PayRoll
{
    int empNumber;
    string name;
    double hours, payRate, grossPay;
};
```



  - We can define variables of this type with simple definition statements, just as we would with any other data type.

```
PayRoll deptHead, foreman, associate;
```



- Each of the variables defined in this example is a separate **instance** of the PayRoll structure and contains its own members.

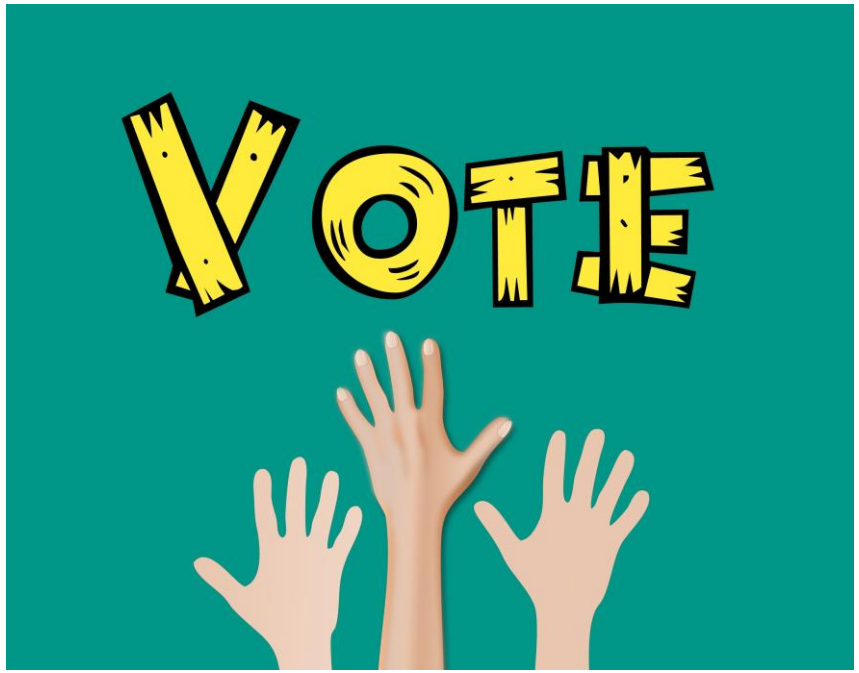
Poll 1 (Extra Credit)

A struct declaration allocates memory for the structure's member variables.

a) True

b) False

Please use the "Poll" window to participate for extra credit! One answer only please!



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Accessing Structure Members

Accessing Structure Members

- The dot operator (`.`) allows us to access structure members in a program.
- The following statement demonstrates how to access the **`empNumber`** member:

```
deptHead.empNumber = 475;
```

- With the dot operator, we can use member variables just like regular variables.

```
cout << deptHead.empNumber << endl;
cin >> deptHead.grossPay;
```

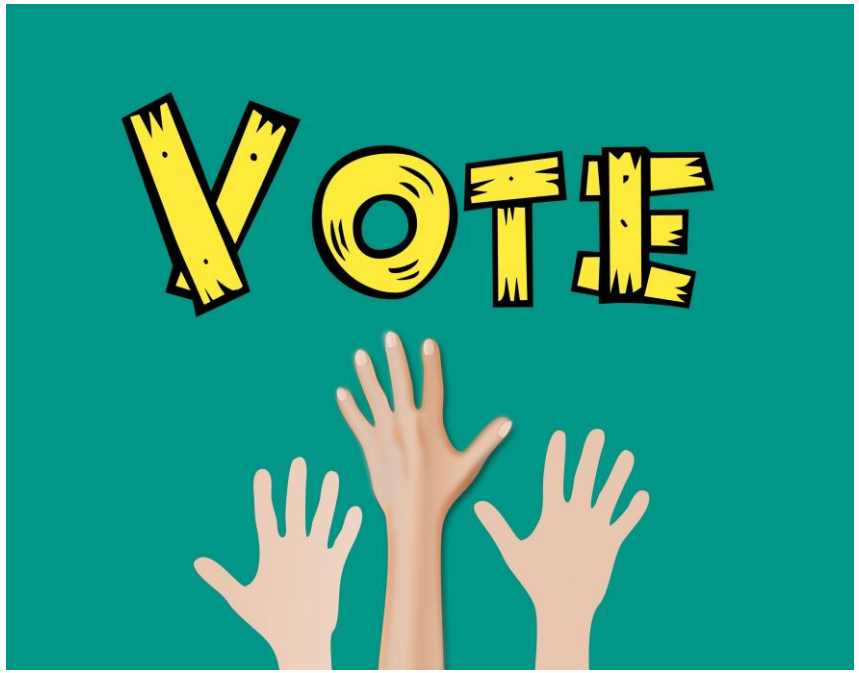
Poll 2 (Extra Credit)

The contents of a structure variable can be displayed by passing the entire variable to `cout`.

a) True

b) False

Please use the "Poll" window to participate for extra credit! One answer only please!



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```

- With the dot operator, we can use member variables just like regular variables.

```
cout << deptHead.empNumber << endl;
cin >> deptHead.grossPay;
```

- The contents of a structure variable **cannot** be displayed by passing the entire variable to **`cout`**.

```
cout << employee << endl;  // Will not work!
```

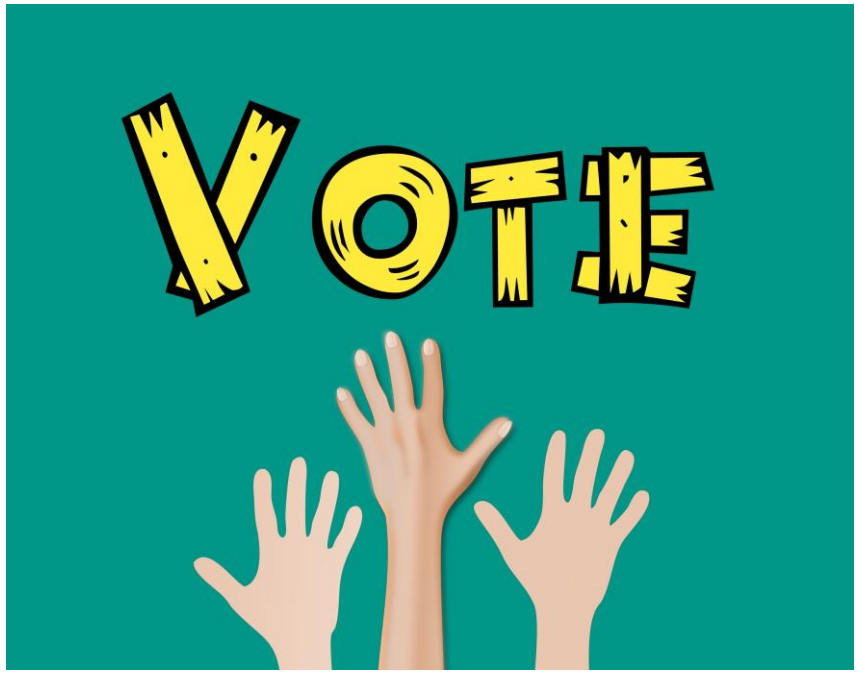
Poll 3 (Extra Credit)

We can perform comparison operations directly on structure variables. For example, assume `circle1` and `circle2` are `Circle` structure variables. The following statement is syntactically legal.

```
if (circle1 == circle2)
```

a) True

b) False



Please use the "Poll" window to participate for extra credit! One answer only please!

Accessing Structure Members

- The dot operator (**.**) allows us to access structure members in a program.
- The following statement demonstrates how to access the **empNumber** member:

```
deptHead.empNumber = 475;
```

- With the dot operator, we can use member variables just like regular variables.

```
cout << deptHead.empNumber << endl;
cin >> deptHead.grossPay;
```

- The contents of a structure variable **cannot** be displayed by passing the entire variable to **cout**.

```
cout << employee << endl;  // Will not work!
```

- We **cannot** perform comparison operations directly on structure variables.

```
if (deptHead1 == deptHead2) // Will not work!
```

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Initializing a Structure

Initializing a Structure

- The members of a structure variable may be initialized with starting values when the structure variable is defined.
- Assume the following structure declaration exists in a program:

```
struct CityInfo
{
    string cityName;
    string province;
    long population;
    int distance;
};
```

- A variable may then be defined with an initialization list, as shown in the following:

```
CityInfo location = { "Asheville", "BC", 80000, 28 };
```

- We do **not** have to provide initializers for all the members of a structure variable.

```
CityInfo location = { "New Westminster" };
```

- **If we leave a structure member uninitialized, we must leave all the members that follow it uninitialized as well. C++ does not provide a way to skip members in a structure.**

Initializing a Structure

- The members of a structure variable may be initialized with starting values when the structure variable is defined.
- Assume the following structure declaration exists in a program:

```
struct CityInfo
{
    string cityName;
    string province;
    long population;
    int distance;
};
```

Since C++11, we can omit the = sign in the initialization statement.

- A variable may then be defined with an initialization list, as shown in the following:

```
CityInfo location = { "Asheville", "BC", 80000, 28 };
```

- We do **not** have to provide initializers for all the members of a structure variable.

```
CityInfo location = { "New Westminster" };
```

- If we leave a structure member uninitialized, we must leave all the members that follow it uninitialized as well. C++ does not provide a way to skip members in a structure.

Example

```
// This program demonstrates partially initialized
// structure variables.
#include <iostream>
#include <string>
#include <iomanip>
using namespace std;

struct EmployeePay
{
    string name;     // Employee name
    int empNum;          // Employee number
    double payRate;      // Hourly pay rate
    double hours;        // Hours worked
    double grossPay;     // Gross pay
};

int main()
{
    EmployeePay employee1 = { "Doja Cat", 141, 18.75 };
    EmployeePay employee2 = { "Justin Bieber", 142, 17.50 };

    cout << fixed << showpoint << setprecision(2);

    // Calculate pay for employee1
    cout << "Name: " << employee1.name << endl;
    cout << "Employee Number: " << employee1.empNum << endl;
    cout << "Enter the hours worked by this employee: ";
    cin >> employee1.hours;
    employee1.grossPay = employee1.hours * employee1.payRate;
    cout << "Gross Pay: " << employee1.grossPay << endl << endl;

    // Calculate pay for employee2
    cout << "Name: " << employee2.name << endl;
    cout << "Employee Number: " << employee2.empNum << endl;
    cout << "Enter the hours worked by this employee: ";
    cin >> employee2.hours;
    employee2.grossPay = employee2.hours * employee2.payRate;
    cout << "Gross Pay: " << employee2.grossPay << endl;
    return 0;
}
```

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Arrays of Structures

Arrays of Structures

- An array of structures is defined like any other array. Assume the following structure declaration exists in a program:

```
struct BookInfo
{
    string title;
    string author;
    string publisher;
    double price;
};
```

- The following statement defines an array, **bookList**, that has **20** elements.

```
BookInfo bookList[20];
```

- The following expression refers to the title member of **bookList[5]**:

```
bookList[5].title;
```

- The following loop steps through the array, displaying the data stored in each element:

```
for (int index = 0; index < 20; index++)
        cout << bookList[index].title << endl;
```

Initializing a Structure Array

- To initialize a structure array, simply provide an initialization list for one or more of the elements.
- For example, given the following **`struct`** definition:

```
struct PayInfo
{
    int hours;          // Hours worked
    double payRate;     // Hourly pay rate
};
```

- We could initialize an array of **`PayInfo`** structures like this:

```
const int NUM_WORKERS = 3;      // Number of workers
PayInfo workers[NUM_WORKERS] = {
                               {10, 9.75 },
                               {15, 8.62 },
                               {40, 15.65}
};
```

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Nested Structures

Nested Structures

- It is possible for a structure variable to be a member of another structure variable. consider the following structure declarations:

```
struct Costs
{
    double wholesale;
    double retail;
};
struct Item
{
    string partNum;
    string description;
    Costs pricing;
};
```

- Assume the variable **widget** is defined as follows:

```
Item widget;
```

- The following statements show examples of accessing members of the **pricing** variable, which is inside **widget**:

```
widget.pricing.wholesale = 100.0;
widget.pricing.retail = 150.0;
```

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Structures as Function Arguments

Structures as Function Arguments

- Structure variables may be passed as arguments to functions.
- assume the following structure declaration exists in a program:

```
struct Rectangle
{
    double length;
    double width;
    double area;
};
```

- And let us imagine the following function definition exists in the same program:

```
double multiply(double x, double y)
{
    return x * y;
}
```

- Assuming **box** is a variable of the **Rectangle** structure type, the following function call will pass **box.length** into x and **box.width** into **y**. The return value will be stored in **box.area**

```
box.area = multiply(box.length, box.width);
```

Structures as Function Arguments

- Sometimes it is more convenient to pass an entire **`struct`** variable into a function instead of individual members.
- For example, the following function definition uses a **`Rectangle`** structure variable as its input parameter:

```
void showRect(Rectangle r)
{
     cout << r.length << endl;
     cout << r.width << endl;
     cout << r.area << endl;
}
```

- The following function call passes the **box** variable into **`r`**:

```
showRect(box);
```

- If a function is to access the members of the original argument, a reference to the **`struct`** variable may be used as the parameter.

```
showRect(box);

void showRect(Rectangle r)
{
     cout << r.length << endl;
     cout << r.width << endl;
     cout << r.area << endl;
}
```

Example

```
// This program has functions that accept structure variables
// as arguments.
#include <iostream>
#include <string>
#include <iomanip>
using namespace std;

struct InventoryItem
{
    int partNum;                  // Part number
    string description; // Item description
    int onHand;                   // Units on hand
    double price;                 // Unit price
};

void getItem(InventoryItem& p)   // Uses a reference parameter
{
    // Get the part number.
    cout << "Enter the part number: ";
    cin >> p.partNum;

    // Get the part description.
    cout << "Enter the part description: ";
    cin.ignore();  // Ignore the remaining newline character
    getline(cin, p.description);

    // Get the quantity on hand.
    cout << "Enter the quantity on hand: ";
    cin >> p.onHand;

    // Get the unit price.
    cout << "Enter the unit price: ";
    cin >> p.price;
}

void showItem(InventoryItem p)
{
    cout << fixed << showpoint << setprecision(2);
    cout << "Part Number: " << p.partNum << endl;
    cout << "Description: " << p.description << endl;
    cout << "Units On Hand: " << p.onHand << endl;
    cout << "Price: $" << p.price << endl;
}

int main()
{
    InventoryItem part;

    getItem(part);
    showItem(part);
    return 0;
}
```

Constant Reference Parameters

- Sometimes structures can be quite large.
- Passing large structures by value can decrease a program's performance **because a copy of the structure has to be created**.
- **When a structure is passed by reference, however, it isn't copied**. A reference that points to the original argument is passed instead.
- So, it is often preferable to pass large objects such as structures by reference.
- The disadvantage of passing an object by reference is that the function has access to the original argument – it can accidentally change the argument's value.
- This can be prevented by passing the argument as **a constant reference**.

```
void showItem(const InventoryItem& p)
{
    cout << fixed << showpoint << setprecision(2);
    cout << "Part Number: " << p.partNum << endl;
    cout << "Description: " << p.description << endl;
    cout << "Units On Hand: " << p.onHand << endl;
    cout << "Price: $" << p.price << endl;
}
```

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Returning a Structure from a Function

Returning a Structure

- A function may **`return`** a structure.
- Here, it is necessary for the function to have a local structure variable to hold the member values that are to be returned.
- We already that C++ only allows us to **`return`** a single value from a function.
- Structures provide a way around this limitation!
- Although a structure may have several members, a structure variable is a single value.

```
// This program uses a function to return a structure. This
// is a modification of Program 11-2.
#include <iostream>
#include <iomanip>
#include <cmath>  // For the pow function
using namespace std;

// Constant for Pi.
const double PI = 3.14159;

// Structure declaration
struct Circle
{
    double radius;      // A circle's radius
    double diameter;    // A circle's diameter
    double area;        // A circle's area
};

// Function prototype
Circle getCircle();

int main()
{
    Circle c;      // Define a structure variable

    // Get data about the circle.
    c = getCircle();

    // Display the circle data.
    cout << "The radius and area of the circle are:\n";
    cout << fixed << setprecision(2);
    cout << "Radius: " << c.radius << endl;
    cout << "Area: " << c.area << endl;
    return 0;
}

Circle getCircle()
{
    Circle tempCircle;  // Temporary structure variable

    // Store circle data in the temporary variable.
    cout << "Enter the diameter of a circle: ";
    cin >> tempCircle.diameter;

    // Calculate the circle's radius and area.
    tempCircle.radius = tempCircle.diameter / 2.0;
    tempCircle.area = PI * pow(tempCircle.radius, 2.0);

    // Return the temporary variable.
    return tempCircle;
}
```

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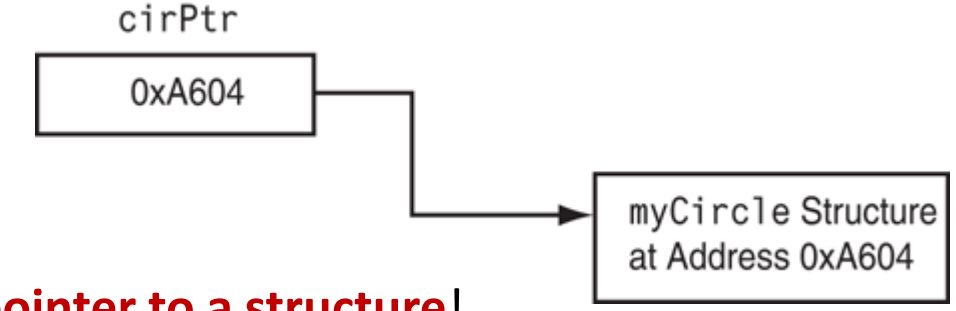
Pointers to Structures

Pointers to Structures

- Defining a variable that is a pointer to a structure is as simple as defining any other pointer variable:

```
Circle myCircle = { 10.0, 20.0, 314.159 };
Circle* cirPtr = nullptr;
cirPtr = &myCircle;
```



- **Be extremely careful when dereferencing a pointer to a structure**!

```
*cirPtr.radius = 10; // Illegal!!!
```

- The dot operator has higher precedence than the indirection operator, so the indirection operator tries to dereference **`cirPtr.radius`**, not **`cirPtr`**.
- To dereference the **`cirPtr`** pointer, a set of parentheses must be used.

```
(*cirPtr).radius = 10; // OK
```

- **Due to the awkwardness of this notation, C++ has a special operator for dereferencing pointers to structures**.

The Structure Pointer Operator

- C++ has a special operator for dereferencing pointers to structures.
- It consists of a hyphen (**-**) followed by the greater-than symbol (**>**).
- Consider the statement from the previous example:

```
(*cirPtr).radius = 10; // OK
```

- This statement is exactly equivalent to:

```
cirPtr->radius = 10;
```

- The structure pointer operator takes the place of the dot operator in statements using pointers to structures.
- The operator automatically dereferences the structure pointer on its left. There is no need to enclose the pointer name in parentheses.
- The structure pointer operator is supposed to look like an arrow, thus visually indicating that a “pointer” is being used.

Example

```
// This program demonstrates a function that uses a
// pointer to a structure variable as a parameter.
#include <iostream>
#include <string>
#include <iomanip>
using namespace std;

struct Student
{
    string name;  // Student's name
    int idNum;              // Student ID number
    int creditHours;        // Credit hours enrolled
    double gpa;  // Current GPA
};

void getData(Student*);  // Function prototype

int main()
{
    Student freshman;

    // Get the student data.
    cout << "Enter the following student data:\n";
    getData(&freshman);     // Pass the address of freshman.
    cout << "\nHere is the student data you entered:\n";

    // Now display the data stored in freshman
    cout << setprecision(3);
    cout << "Name: " << freshman.name << endl;
    cout << "ID Number: " << freshman.idNum << endl;
    cout << "Credit Hours: " << freshman.creditHours << endl;
    cout << "GPA: " << freshman.gpa << endl;
    return 0;
}

void getData(Student* s)
{
    // Get the student name.
    cout << "Student name: ";
    getline(cin, s->name);

    // Get the student ID number.
    cout << "Student ID Number: ";
    cin >> s->idNum;

    // Get the credit hours enrolled.
    cout << "Credit Hours Enrolled: ";
    cin >> s->creditHours;

    // Get the GPA.
    cout << "Current GPA: ";
    cin >> s->gpa;
}
```

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Dynamically Allocating a Structure

Dynamically Allocating a Structure

- We can also use a structure pointer and the new operator to dynamically allocate memory for a structure variable.
- For example, the following code defines a **`Circle`** pointer named **`cirPtr`** and dynamically allocates a **`Circle`** structure.
- Values are then stored in the dynamically allocated structure's members.

```
Circle* cirPtr = nullptr;   // Define a Circle pointer
cirPtr = new Circle;        // Dynamically allocate a Circle structure
cirPtr->radius = 10;        // Store a value in the radius member
cirPtr->diameter = 20;      // Store a value in the diameter member
cirPtr->area = 314.159;     // Store a value in the area member
```

- We can also dynamically allocate an array of structures.

```
Circle* circles = nullptr;
circles = new Circle[5];
for (int count = 0; count < 5; count++)
{
    cout << "Enter the radius for circle "
        << (count + 1) << ": ";
    cin >> circles[count].radius;
}
```

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Enumerated Data Types

Enumerated Data Types

- An **enumerated data type** is a programmer-defined data type **whose value is restricted to a range of values** known as **enumerators**, which represent integer constants.
- An enumerated type declaration begins with the key word **enum**, followed by the name of the type, followed by a list of identifiers inside braces, and is terminated with a semicolon.
- The example declaration below creates an enumerated data type named **Day**.

```
enum Day { MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY };
```

- The identifiers **MONDAY**, **TUESDAY**, **WEDNESDAY**, **THURSDAY**, and **FRIDAY**, which are listed inside the braces, are known as **enumerators**.
- These enumerators represent the values that belong to the **Day** data type.
- Enumerators must be legal C++ identifiers.
- The following statement assigns the value **WEDNESDAY** to the **workDay** variable:

```
Day workDay = WEDNESDAY;
```

Enumerated Data Types

- So, what exactly is an enumerator?
- Think of it as an integer named constant.
- Internally, the compiler assigns integer values to the enumerators, beginning at 0.
- Therefore, the following decleration

```
enum Day { MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY };
```

- will be represented in memory by:

```
MONDAY    = 0
TUESDAY   = 1
WEDNESDAY = 2
THURSDAY  = 3
FRIDAY    = 4
```

- Using the Day declaration, the following code

```
cout << MONDAY << ", " << TUESDAY << ", " << WEDNESDAY << ", " << THURSDAY << ", " << FRIDAY << endl;
```

- will produce **0, 1, 2, 3, 4**

Assigning an integer to an enum Variable

- We **cannot** directly assign an **`int`** value to an enum variable. This will **not** work:

```
workDay = 3;// Error!
```

- When assigning a value to an **`enum`** variable, we should use a valid enumerator.
- However, if circumstances require that we store an **`int`** value in an **`enum`** variable, we can do so by casting the integer.

```
workDay = static_cast<Day>(3);
```

- This statement will produce the same results as:

```
Day workDay = THURSDAY;
```

Assigning an Enumerator to an `int` Variable

- Although we cannot directly assign an **`int`** value to an **`enum`** variable, we can directly assign an enumerator to an **`int`** variable.

```
int x;
x = THURSDAY;
cout << x << endl;
```

- When this code runs, it will display 4.

- We can also assign a variable of an enumerated type to an int variable, as shown here:

```
Day workDay = FRIDAY;
int x = workDay;
cout << x << endl;
```

- When this code runs, it will display 3.

Comparing Enumerator Values and Operating on Them

- Enumerator values can be compared using the relational operators.
- The following code will display the message "**Friday is greater than Monday.**":

```
if (FRIDAY > MONDAY)
        cout << "Friday is greater than Monday. \n";
```

- You can also compare enumerator values with integer values.

```
if (MONDAY == 0)
        cout << "Monday is equal to zero.\n";
```

- We **cannot** perform math operations with enum variables.

```
day2 = day1 + 1;  // ERROR! This will not work!
```

- We would need to use an explicit cast to convert the result to a **Day** variable.

```
day2 = static_cast<Day>(day1 + 1);  // This works.
```

Example

```
// This program demonstrates an enumerated data type.
#include <iostream>
#include <iomanip>
using namespace std;

enum Day { MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY };

int main()
{
    const int NUM_DAYS = 5;     // The number of days
    double sales[NUM_DAYS];     // To hold sales for each day
    double total = 0.0;         // Accumulator
    int index;                  // Loop counter

    // Get the sales for each day.
    for (index = MONDAY; index <= FRIDAY; index++)
    {
        cout << "Enter the sales for day "
            << index << ": ";
        cin >> sales[index];
    }

    // Calculate the total sales.
    for (index = MONDAY; index <= FRIDAY; index++)
        total += sales[index];

    // Display the total.
    cout << "The total sales are $" << setprecision(2)
        << fixed << total << endl;

    return 0;
}
```

Example

```
// This program demonstrates an enumerated data type.
#include <iostream>
#include <iomanip>
using namespace std;

enum Day { MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY };

int main()
{
    const int NUM_DAYS = 5;     // The number of days
    double sales[NUM_DAYS];     // To hold sales for each day
    double total = 0.0;         // Accumulator
    int index;                  // Loop counter

    // Get the sales for each day.
    for (index = MONDAY; index <= FRIDAY; index++)
    {
        cout << "Enter the sales for day "
             << index << ": ";
        cin >> sales[index];
    }

    // Calculate the total sales.
    for (index = MONDAY; index <= FRIDAY; index++)
        total += sales[index];

    // Display the total.
    cout << "The total sales are $" << setprecision(2)
         << fixed << total << endl;

    return 0;
}
```

Program does not define a **Day** variable. So, we do not have to name the data type. This would make the **enum** **anonymous**.

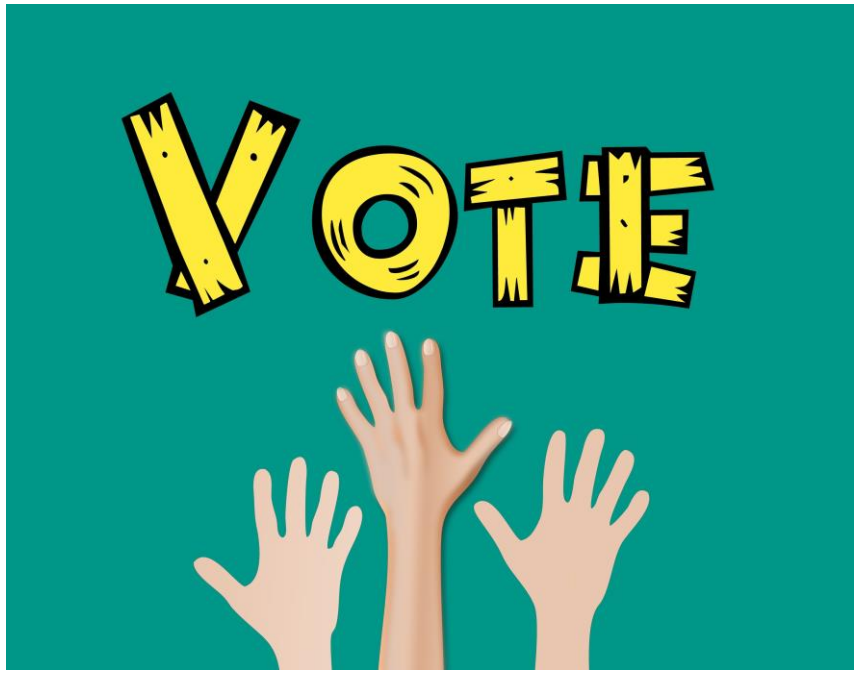
Poll 4 (Extra Credit)

The following expressions are both syntactically legal if Day is an `enum` type.

```
Day workDay = MONDAY;
workDay++;
```

a) True

b) False



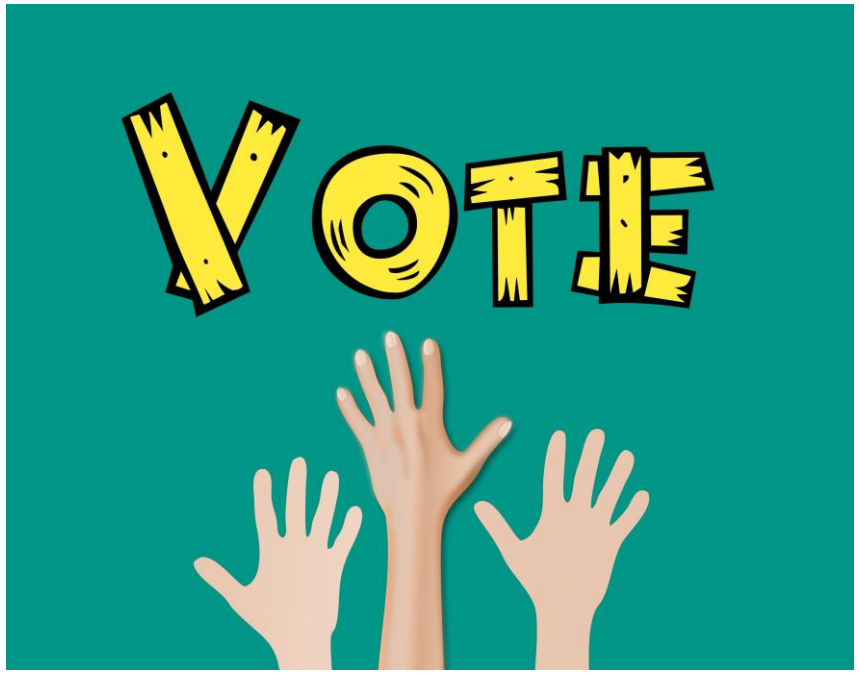
Please use the "Poll" window to participate for extra credit! One answer only please!

Poll 4 (Extra Credit)

The following expressions are both syntactically legal if Day is an `enum` type.

```
Day workDay = MONDAY;
workDay++;
```

This does not work wither because the increment operator does not work with an `enum` variable.



Please use the "Poll" window to participate for extra credit! One answer only please!

Specifying Integer Values for Enumerators

- By default, the enumerators in an enumerated data type are assigned the integer values 0, 1, 2, etc.
- If this is not appropriate, we can specify the values to be assigned:

```
enum Water { FREEZING = 32, BOILING = 212 };
```

- If we leave out the value assignment for one or more of the enumerators, it will be assigned a default value.

```
enum Colors { RED, ORANGE, YELLOW = 9, GREEN, BLUE };
```

- In the above example, the enumerator **RED** will be assigned the value **0**, **ORANGE** will be assigned the value **1**, **YELLOW** will be assigned the value **9**, **GREEN** will be assigned the value **10**, and **BLUE** will be assigned the value **11**.

Enumerator Scope

- Enumerators must be unique within the same scope.
- For example, an error will result if both of the following enumerated types are declared within the same scope.

```
enum Presidents { MCKINLEY, ROOSEVELT, TAFT };
enum VicePresidents { ROOSEVELT, FAIRBANKS, SHERMAN };  // Error!
```

- In the above example, the reason is that **ROOSEVELT** is declared twice.
- The following declarations will also cause an error if they appear within the same scope.

```
enum Status { OFF, ON };
const int OFF = 0;          // Error!
```

Using Strongly Typed enums in C++ 11

- We mentioned earlier that we cannot have multiple enumerators with the same name, within the same scope.
- Since C++ 11, we can use a new type of **enum**, known as a strongly typed **enum** (also known as an **enum** class), to get around this limitation.

```
enum class Presidents { MCKINLEY, ROOSEVELT, TAFT };
enum class VicePresidents { ROOSEVELT, FAIRBANKS, SHERMAN };
```

- Although both **enums** contain the same enumerator (**ROOSEVELT**), these declarations will compile without an error.
- When we use a strongly typed enumerator, we must prefix the enumerator with the name of the **enum**, followed by the **::** operator (i.e., the **scope resolution operator**).

```
Presidents prez = Presidents::ROOSEVELT;
VicePresidents vp = VicePresidents::ROOSEVELT;
```

Using Strongly Typed enums in C++ 11

- If we want to retrieve a strongly typed enumerator's underlying **int** value, we must use a cast operator.

```
int x = static_cast<int>(Presidents::ROOSEVELT);
```

- When we declare a strongly typed **enum**, we can optionally specify any integer data type as the underlying type.
- To do so, we simply add a colon (**:**) after the **enum** name, followed by the desired data type.
- For example, the following statement declares an **enum** that uses the **char** data type for its enumerators:

```
enum class Day : char { MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY };
```

In-Class Exercise #1

Complete the following program skeleton.

```
#include <iostream>
#include <cstring>
#include <iomanip>
using namespace std;

int main()
{
    char place[] = "The Windy City";
    // Complete the program. It should search the array place
    // for the string "Windy" and display the message "Windy
    // found" if it finds the string. Otherwise, it should
    // display the message "Windy not found."
    return 0;
}
```

Thank you.

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