EME 152 Discussion 5

October 27, 2021

Agenda

- Ch computational arrays (review)
- Basic plotting
  - plotxy()
  - unwrap()
- C++ classes
  - Public vs. private members
  - Declaring member functions
- File system
  - Read
  - Write

Ch computational arrays (review)

How to declare a computational array/matrix:

```
array double mat[r][c] = { a11, a12, ... aNN };
```

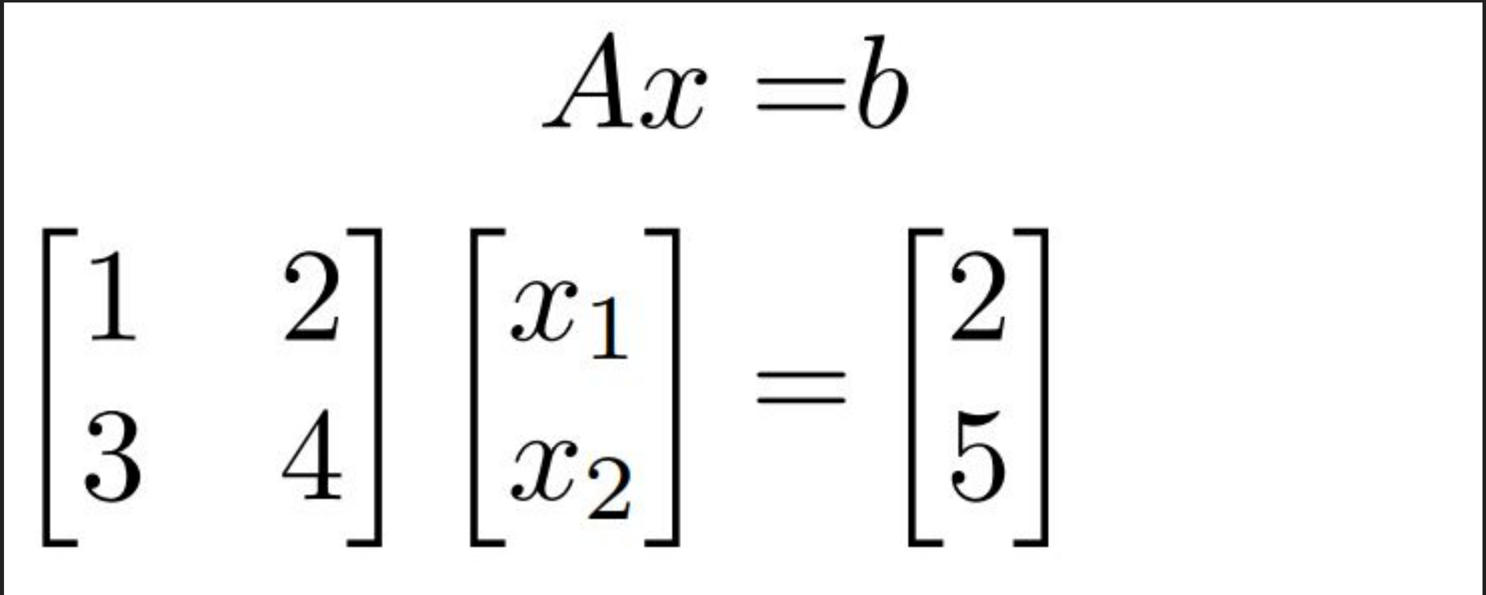
How to assign or retrieve a value within the matrix:

```
mat[0][0] = a11;

printf("a11 = %lf\n", mat[0][0]);
```

Ch computational arrays (review)

Solve the following linear equation using computational arrays:



$$Ax = b$$

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$$

Ch computational arrays (review)

Solution:

```
linsolve(x, A, b);
```

Output:

```
x=1.0 0.5
```

Basic Plotting

Plot the volume of a cylinder as a function of its radius, in meters. Set the height to 10m with the radius varying from 0m to 10m.

Basic Plotting

Solution:

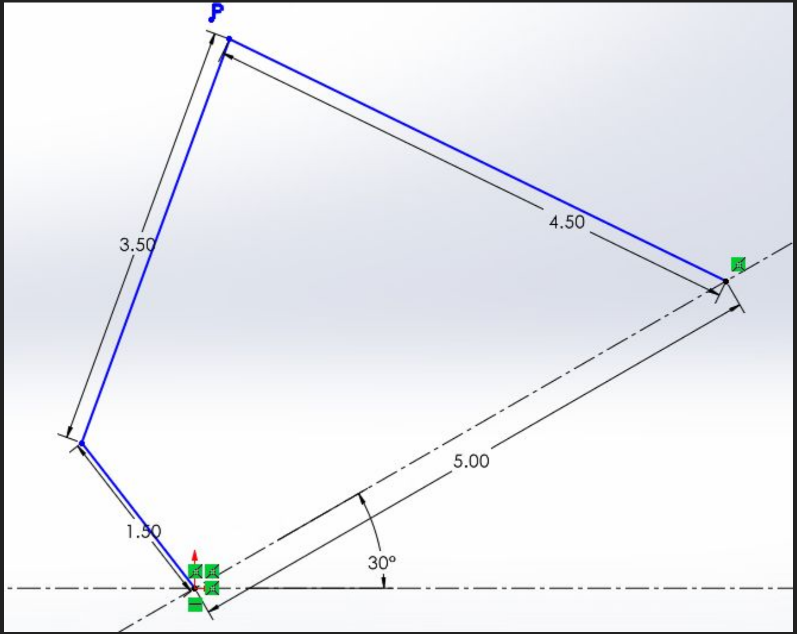
```
#include <chplot.h>

...

plotxy(x, y, N, "Plot Title", "X-axis Label", "Y-axis Label");
```

Advanced Plotting

Plot the output position P of this mechanism as a function of the input link angle (theta2.) Plot the “wrapped” (-pi, pi) and “unwrapped” (0, 2pi) positions in a subplot.



Advanced Plotting

Solution:

Unwrapping:

```
unwrap(unwrappedArray, originalArray);
```

Plotting:

```
subplot.subplot(r, c);
plot = subplot.getSubplot(0, 0);
plot->data2D(x, y);
```

Classes

- A class is a data structure in Ch/C++ programs
- Classes are an extension of the C “struct” (structure)
- Ch/C++ classes also support:
  - Public and private members
  - Member functions
- CPlot is an example of a Ch class.
  - `data2d()` is an example of a CPlot member function.

Source: C for Engineers and Scientists

Classes - Access Modifiers

- Like C structs, C++ classes may have members (variables, functions, etc.) However, C++ members may be declared public or private.
  - Public members may be accessed just like C struct members by any function or class.
  - Private members may only be accessed by that class’s own member functions.
  - “Public” and “private” are called access modifiers.

Source: C for Engineers and Scientists

Classes - Member Function

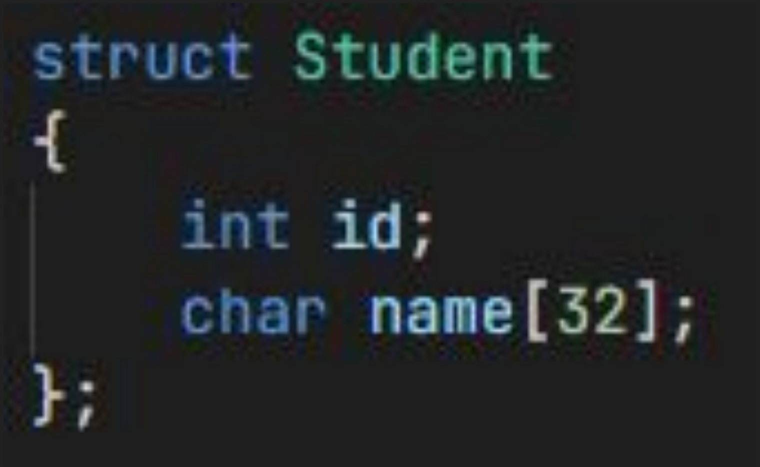
- A member function is a function that resides within a class. Member functions have access to all members within a class, including private members.
- To create a class member function, perform the following steps:
    - Declare the function within the body of the class declaration.
    - Define the function using the scope resolution operator, '::'.

Source: C for Engineers and Scientists

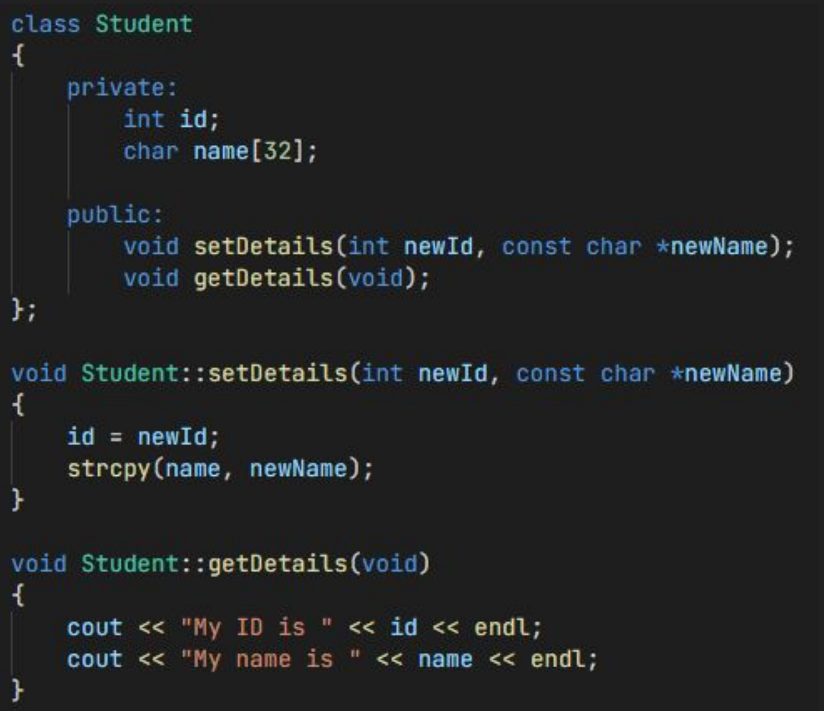
Classes - Comparison

Right: C++ class with member functions.

Bottom: The same structure in C.



```
struct Student
{
        int id;
        char name[32];
};
```



```
class Student
{
    private:
        int id;
        char name[32];

    public:
        void setDetails(int newId, const char *newName);
        void getDetails(void);
};

void Student::setDetails(int newId, const char *newName)
{
    id = newId;
    strcpy(name, newName);
}

void Student::getDetails(void)
{
    cout << "My ID is " << id << endl;
    cout << "My name is " << name << endl;
}
```

Using a third party class in Ch

- If/when you use third party C++ packages, typically you will only have access to the header files: This means you will only have access to the public member variables and functions.
- The header files along with documentation should provide the programmer with enough information to use the provided classes. The actual implementation is hidden from the programmer.

Source: C for Engineers and Scientists

File System

- In C, file manipulation is done via the functions `fopen()`, `fclose()`, and file pointers. Other useful functions are `fprintf()`, `fscanf()`, and `feof()`.
- `fprintf()` and `fscanf()` are analogues of `printf()` and `scanf()`. `feof()` is used to detect if a file pointer is pointing to the end of a file.

Source: C for Engineers and Scientists

File System

`fopen(filename, mode);`	Open a file and return the input stream.
`fclose(stream);`	Close the file. (End the stream.)
`fprintf(stream, format, …);`	Write formatted data to the stream.
`fscanf(stream, format, …);`	Read formatted data from the stream.
`feof(stream);`	Check if the end of file is reached.

Thank you!

Questions?