Today in CS161

- ***Week #8 Practicing!***
  - **Writing Programs to Practice**
    - Write a program that counts the number of vowels in a sentence, ended by a period
    - Write a program that creates an advertisement for the Oregonian – taking out all vowels except those that start as the first character of a word

Counting Vowels – Solution #1

- Count the number of vowels…using arrays of characters…word by word…
- First, write the algorithm:
  - Prompt the user to enter in a sentence
  - Read a word
    - For every character in the word, if the character is an a, e, i, o or u increment a counter by 1.
    - Do this until the '\0' is reached.
  - Display the results

Welcome…and Read a word…

```
//inform the user of the rules
void welcome()
{
    cout <<"Please enter a sentence - terminated by a period" <<endl;
    cout <<"When you are done hit enter" <<endl <<endl <<endl;
}

//Read in a word
void read_word(char aword[])
{
    cin.width(MAX);  //make sure the word isn't too long!
    cin >>aword;     //skips leading whitespace and reads until
    whitespace
    cin.get();
}
```

Count Vowels

```
//Count the vowels in the word
int count_vowels(char array[])
{
    int length = strlen(array);      //find out how many characters to go thru
    int num_vowels = 0;
    for (int i = 0; i < length; ++i)
        if (array[i] == 'a' || array[i] == 'A' ||
            array[i] == 'e' || array[i] == 'E' ||
            array[i] == 'i' || array[i] == 'I' ||
            array[i] == 'o' || array[i] == 'O' ||
            array[i] == 'u' || array[i] == 'U') // It is a vowel!
                     ++ num_vowels;  //add one to the vowel counter

    return num_vowels;
}
```

Time to End…

```
//Is it time to end? If the end of the word is a period....
bool time_to_end(char aword[])
{
    bool yes;
    int length = strlen(aword);
    if (aword[length-1] == '.')
      yes  = true;      //yep - end of the sentence!
    else
       yes = false;
    return yes;
}
```

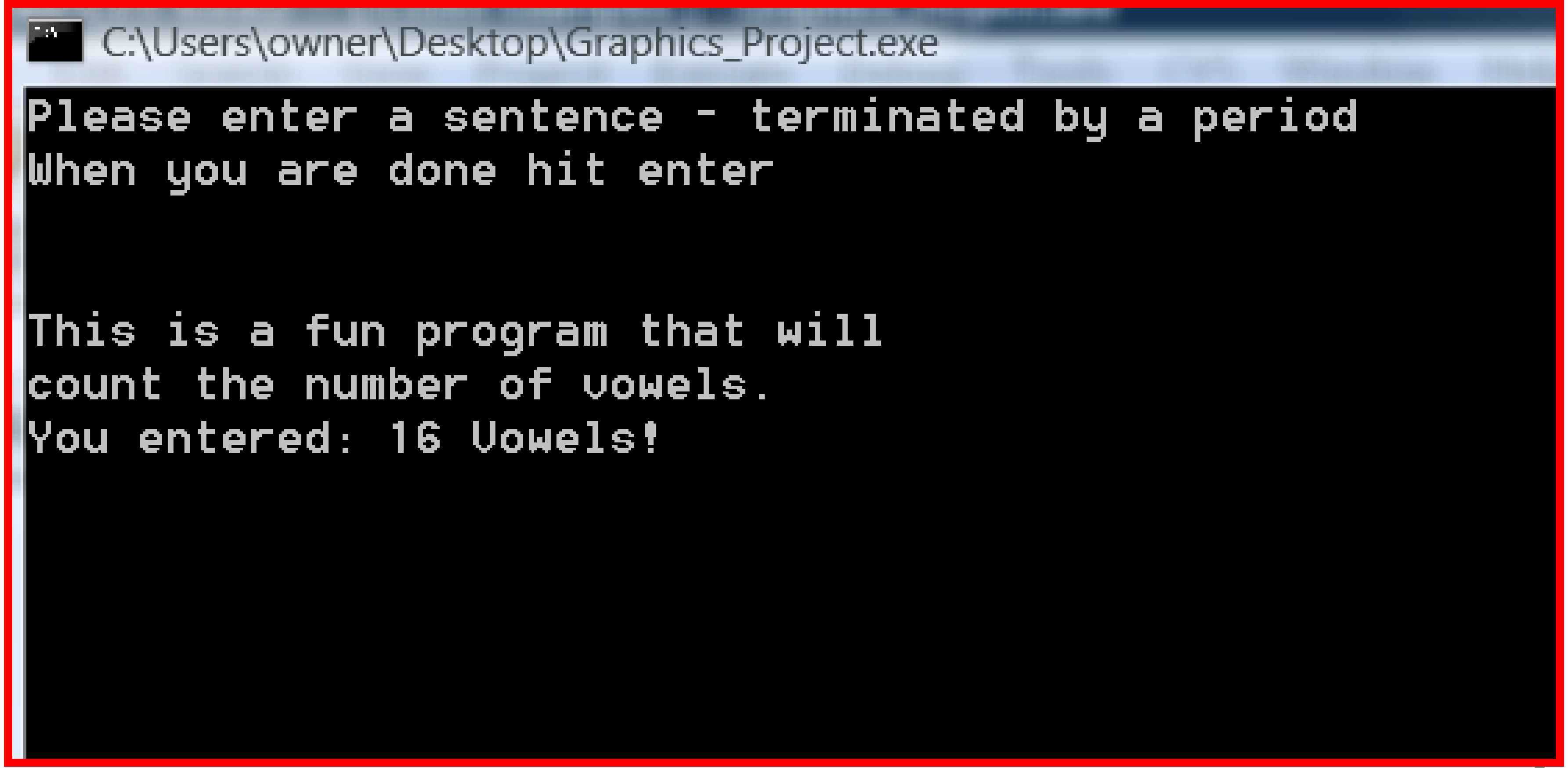
Main…

```
int main()
{
    char word[MAX];              //it will hold the current word
    int vowels = 0;              //vowel counter

    welcome();
    do
    {
            read_word(word);                    //read in a word
            vowels += count_vowels(word);  //keep track of # vowels
    } while (!time_to_end(word));

    cout <<"You entered: " <<vowels <<" Vowels!" <<endl;
    cin.get();
    return 0;
}
```

Putting it all together.

```
#include <iostream>
#include <cstring>

using namespace std;

//This program is written by Karla Fant to demonstrate
//the use of functions, arrays of characters, and the subscript operator
//to access individual elements of an array

void welcome();                          //describes the rules
int count_vowels(char word[]);   //counts the vowels in a word
void read_word(char word[]);     //reads in a word from the user
bool time_to_end(char word[]);  //does the word end in a period?

const int MAX = 21;            //maximum array size for this program
```

Running the program



```
C:\Users\owner\Desktop\Graphics_Project.exe
```

```
Please enter a sentence - terminated by a period
When you are done hit enter


This is a fun program that will
count the number of vowels.
You entered: 16 Vowels!
```

Counting Vowels – Solution #2

- Count the number of vowels…using arrays of characters…reading in the entire sentence
- First, write the algorithm:
  - Prompt the user to enter in a sentence
  - Read a sentence
    - For every character in the sentence, if the character is an a, e, i, o or u increment a counter by 1.
    - Do this until the '\0' is reached.
  - Display the results

Main…simplified!

```
int main()
{
    char array[MAX];            //it will hold the current sentence (131)
    int vowels = 0;             //vowel counter

    welcome();
    read_sentence(array);                    //read it all in!
    vowels += count_vowels(array);  //keep track of # vowels

    cout <<"You entered: " <<vowels <<" Vowels!" <<endl;

    cin.get();
    return 0;
}
```

Read in a sentence…..

```
//Read in the entire sentence
//and ignore the ending period and newline that follows

void read_sentence(char array[])
{
    cin.get(array,MAX,'.');   //read in an entire sentence
    cin.ignore(100,'\n');  //ignore the period and newline afterwards
}
```

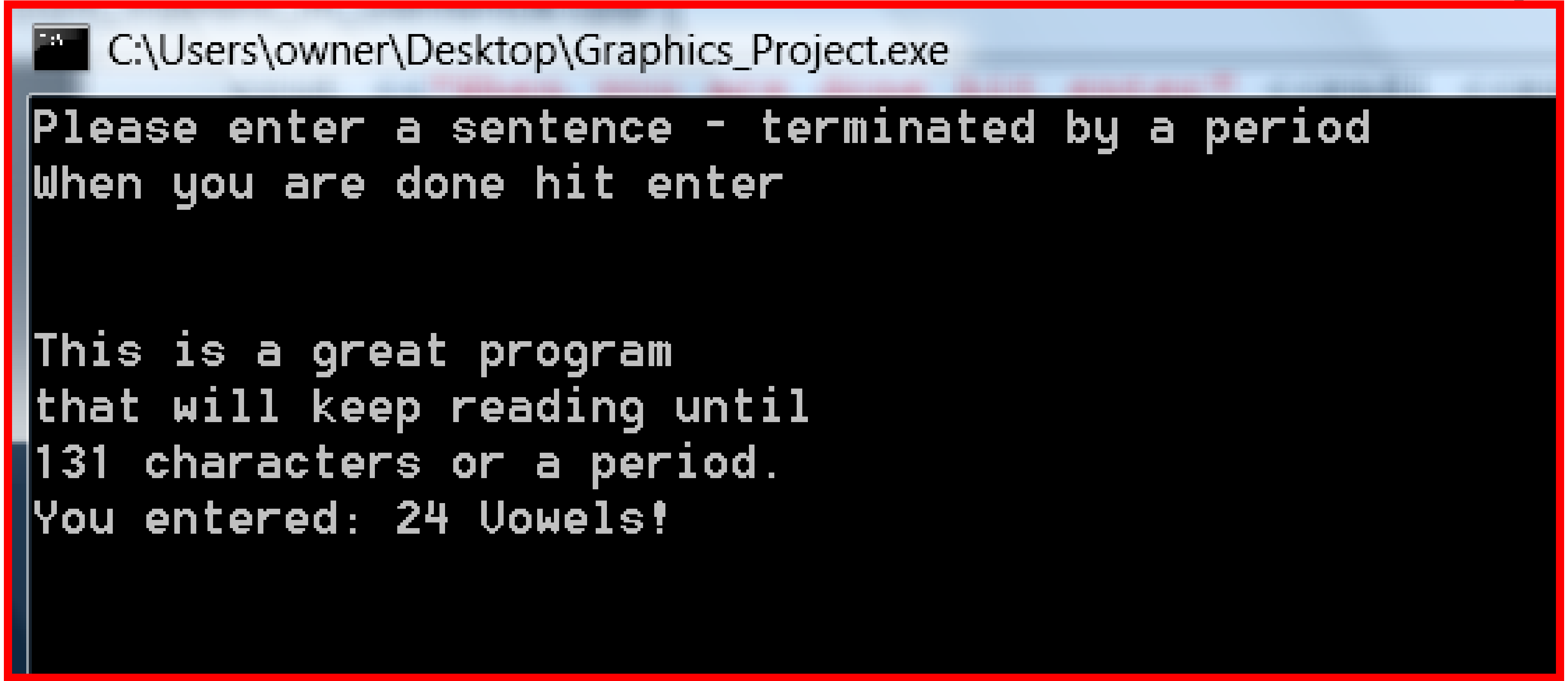
***nothing else changes! ***

***the function to count vowels remains exactly the same!!! ***

Putting it all together.

```
#include <iostream>
#include <cstring>

using namespace std;

//This program is written by Karla Fant to demonstrate
//the use of functions, arrays of characters, and the subscript operator
//to access individual elements of an array

void welcome();                          //describes the rules
int count_vowels(char array[]);          //counts the vowels in an array
void read_sentence(char array[]);        //reads in an entire sentence

const int MAX = 131;          //maximum number of characters in a sentence
```

Running the program



C:\Users\owner\Desktop\Graphics_Project.exe

```
Please enter a sentence - terminated by a period
When you are done hit enter


This is a great program
that will keep reading until
131 characters or a period.
You entered: 24 Vowels!
```

Changing it…adding an isvowel function

- If we wrote one more function
  - Let’s call it “isvowel”
  - We can re-use that function any time we are wondering if a character is a vowel.

```
//Check to see if a particular character is a vowel
bool isvowel(char ch)
{
    //First let's lower case the character:
    ch = tolower(ch);

    if (ch == 'a' || ch == 'i' || ch == 'e' || ch == 'o' || ch == 'u')
       return true;
    return false;  //not a vowel!
}
```

Count Vowels

```
//Count the vowels in the word
int count_vowels(char array[])
{
   int length = strlen(array);      //find out how many characters to go thru
   int num_vowels = 0;
   for (int i = 0; i < length; ++i)
      if (isvowel(array[i])) // It is a vowel!
                ++ num_vowels;  //add one to the vowel counter

   return num_vowels;
}
```

- The benefit is now we can use the "isvowel" function for other programs! Let's see…

Creating an Advertisement…

- Our next program today is to create an advertisement in the want-ad's. Since each line costs money, we will see what the ad is like if we take out all of the vowels
- Of course, we don't want to take out any vowels that are the first letter of a word…as those words would just not make sense
- If the word is less than 4 characters, then all vowels stay…
  - Let's think about what functions we will need…and the best way to start with that is to write an algorithm!

Creating an Advertisement…Algorithm

- Algorithm…working word by word
  - Welcome the user. Ask them to enter in a line for an advertisement. After each line they will be asked whether or not there will be another line
  - Prompt the user to enter in the first line of the ad
  - Read in a word
    - Find out the length of the word
    - If it is less than 4 characters, display it as is
    - Otherwise, display the first character of the word
    - For all of the rest of the characters in the word, display them ONLY if they are not a vowel
  - Continue with the next word, until a newline is next in the input buffer
  - Ask the user if they have another line. If so, continue reading and processing each word

Welcome…and Read a word…

```
//inform the user of the rules
void welcome()
{
    cout <<"Please enter the first line of your advertisement" <<endl;
    cout <<"The resulting ad will be displayed and you will be asked ";
    cout <<"if you have another line ...";
    cout <<"When you are done hit enter" <<endl <<endl <<endl;
}
//Read in a word
void read_word(char array[])
{
    cin.width(MAX);      //make sure all words are within range
    cin >>array;         //skip leading whitespace, read in characters
                         //until whitespace is encountered but not read
}
```

Display the word

```
//Display the word...using the rules outlined earlier
void display_word(char array[])
{
    int length = strlen(array);    //what is the length?

    if (length < 4)                 //a short word...just display it!
      cout <<array <<' ';
    else
    {
       cout <<array[0];            //otherwise the first character is always
                                   //displayed
       for (int i=1; i<length; ++i)   //go through all characters in the word
          if (!isvowel(array[i]))    //it is not a vowel
            cout <<array[i];         //so output the character
       cout <<' ';                  //have a space occur after the word
    }
}
```

Is it a vowel?...*reused!*...

```
//Check to see if a particular character is a vowel
bool isvowel(char ch)
{
    //First let's lower case the character:
    ch = tolower(ch);

    if (ch == 'a' || ch == 'i' || ch == 'e' || ch == 'o' || ch == 'u')
      return true;
    return false;  //not a vowel!
}
```

Is it the end of a line?   Or play again?

```
//Find out if we are at the end of a line....
bool end_of_line()
{
    if (cin.get() == '\n')     //we know there will be whitespace....
      return true;             //we are at the end
    return false;              //nope...not yet
}
//Does the user want to enter in another line?
bool again()
{
    char response;             //holds the y or n entered by the user

    cout <<endl <<endl <<"Would you like to enter another line? Y or N ";
    cin >>response;    cin.get();

    if (response == 'y' || response == 'Y') //YES!!
      return true;
    return false;
}
```

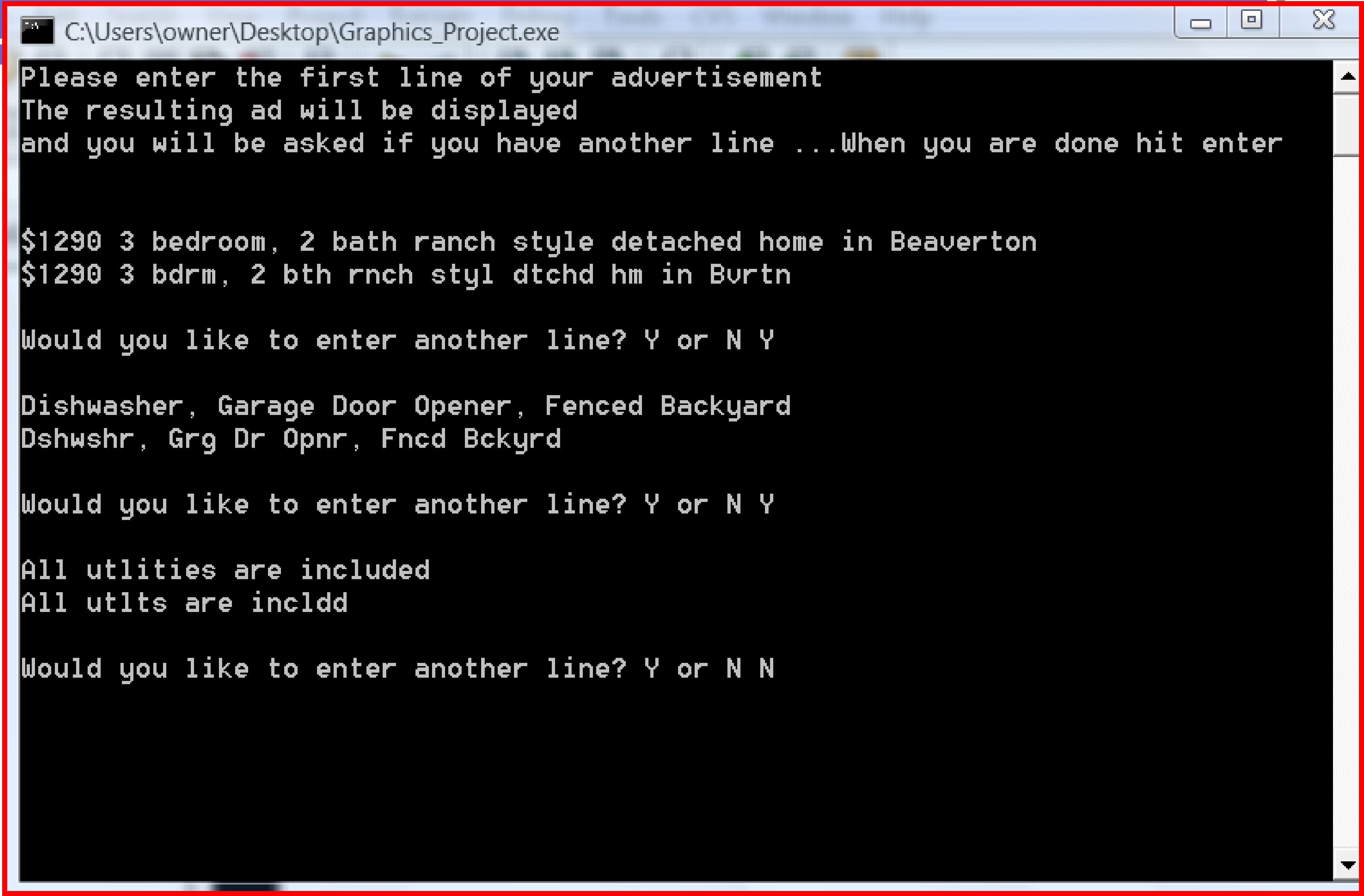
Main…*think of this as the glue!*

```
int main()
{
   char array[MAX];            //it will hold the current word
   welcome();
   do
   {
     do
     {
       read_word(array);       //read a word
       display_word(array);    //display the appropriate parts of the word
     } while (!end_of_line()); //continue for the rest of the line
   } while (again());          //does the user want to do this again?

   cin.get();
   return 0;
}
```

Putting it all together.

```
#include <iostream>
#include <cstring>
#include <cctype>
using namespace std;
//This program is written by Karla Fant to demonstrate
//how we can read in an array and output only select elements of the
//array. This program creates an advertisement where the vowels are
//stripped away -- the exceptions are when the vowel is located
//as the first element or if the word is short (less than 4 characters)

void welcome();                  //describes the rules
void read_word(char word[]);     //read a word
void display_word(char word[]);  //display the word without vowels
bool isvowel(char);              //is the character a vowel?
bool end_of_line();              //Did we reach the end of the line?
bool again();                    //does the user want to enter another?
```

Running the program



```
Please enter the first line of your advertisement
The resulting ad will be displayed
and you will be asked if you have another line ...When you are done hit enter


$1290 3 bedroom, 2 bath ranch style detached home in Beaverton
$1290 3 bdrm, 2 bth rnch styl dtchd hm in Bvrtn

Would you like to enter another line? Y or N Y

Dishwasher, Garage Door Opener, Fenced Backyard
Dshwshr, Grg Dr Opnr, Fncd Bckyrd

Would you like to enter another line? Y or N Y

All utlities are included
All utlts are incldd

Would you like to enter another line? Y or N N
```

Today in CS161

- ***Next Topic: Practicing!***
  - **Writing Programs to Practice**
    - Write a game program (1 player) of Mad Math
    - Reuse the functions to provide for multiple players
    - Rewrite the same program using “structures” to group together related topics
      - Greatly simplifying the ability to have multiple players!

Mad Math – One Player

- A game that displays an equation and the player must come up with the correct answer. As their score increases, so does their level
- First, write the algorithm:
  - Describe the rules
  - Get the users name and capitalize each word
  - Play the game
    - Display an equation
    - Get the answer
    - Check to see if the answer is correct
    - Increase/decrease the points
    - Display the points
    - Continue until the user is done

Welcome…and Explain the Rules

```
//describe this game to the user
void welcome()
{
    cout <<"Welcome to the Mad about Math program\n\n";
    cout <<"The goal is to get as many equations correct\n";
    cout <<"You get 1 point for each correct answer and -2 for each wrong!"
        <<endl <<endl;

    cout <<endl <<endl <<"Let's begin " <<endl <<endl;
    srand(time(0));
}
```

Get the Name of the Player

```
void get_name(char name[])
{
    cout <<"What is your name? ";
    cin.get(name,MAX);
    cin.ignore(100,'\n');
    capitalize(name);          //make sure each word is capitalized
}
```

Capitalize each word of the name

```
//Capitalize the first letter of each word in the name
void capitalize(char name[])
{
    int length = strlen(name);
    name[0] = toupper(name[0]);  //capitalize the first character of the
    name

    //Find the blanks in a name
    for (int i=0; i< length; ++i)
        if (name[i] == ' ')  //the next character needs to be capitalized
            name[i+1] = toupper(name[i+1]);
}
```

Show an equation

```
//Play the game! The argument indicates the complexity of the numbers
int equate(int max)
{
    int first;     //first number
    int second;    //second number
    int operation; //type of operation
    int answer ;    //answer supplied by user
    int correct;   //correct answer

    first = rand() % max;
    second = rand() % max;
    operation = rand() % 4;
```

Show an equation

```
if (operation == 0)              //additiom
 {      cout <<"SOLVE:  " <<first <<" + " <<second <<"  Equals: ";
        correct = first + second;
  }
else if (operation == 1)        //subtraction
 {    cout <<"SOLVE:  " <<first <<" - " <<second <<"  Equals: ";
        correct = first - second;
  }
else if (operation == 2)       //multiplication
 {   cout <<"SOLVE:  " <<first <<" x " <<second <<"  Equals: ";
       correct = first * second;
  }
else                           //division
    {    cout <<"SOLVE:  " <<first <<" / " <<second <<"  Equals: ";
          correct = first / second;
    }
    cin >>answer;  cin.get();
    if (answer == correct)
       return 1;
    return -2;
}
```

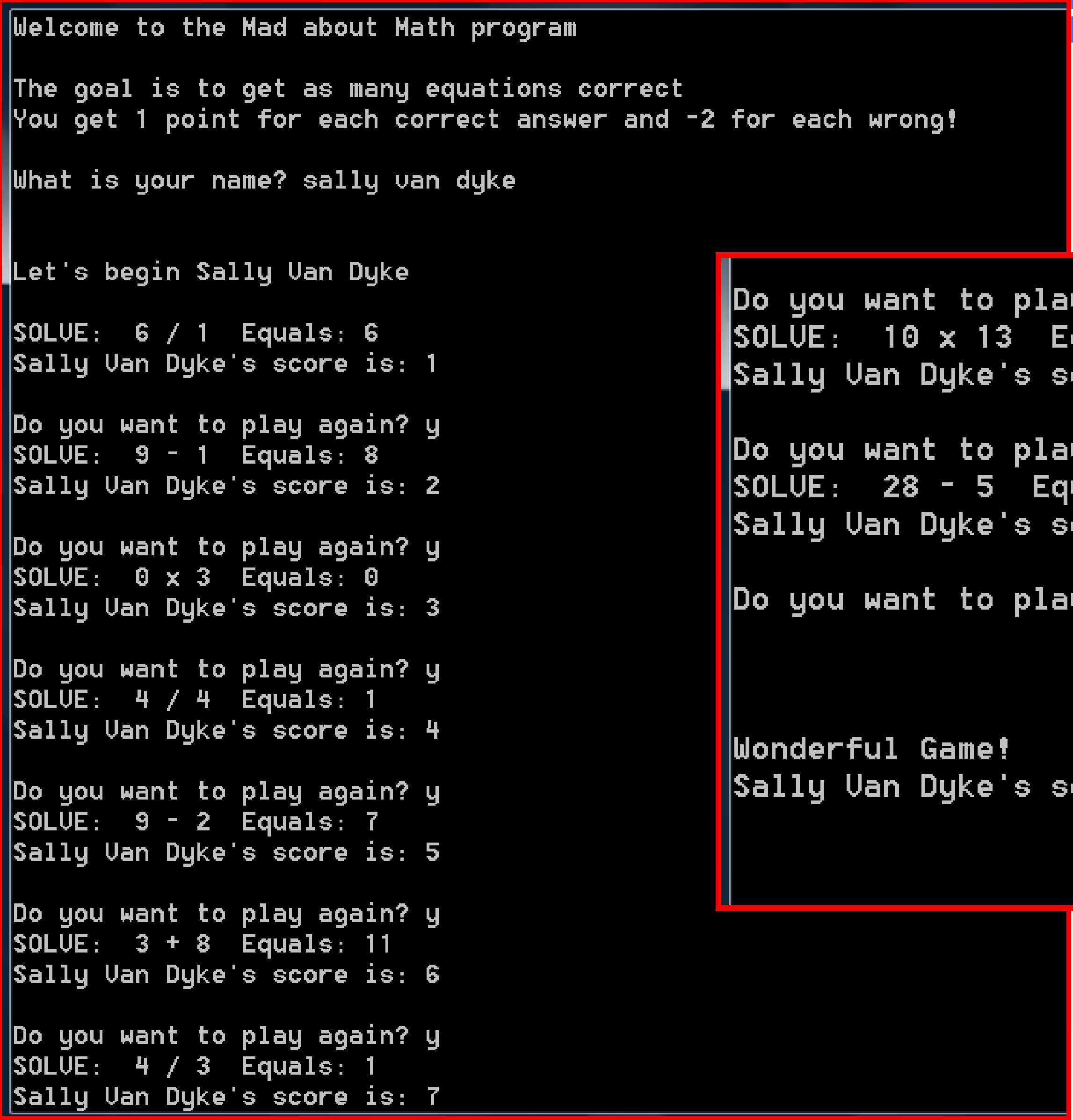
Show an equation…continued

```
//Does the user want to play again?
bool play_again()
{
    char answer;
    cout <<"Do you want to play again? ";
    cin >>answer;  cin.get();
    return (answer == 'y' || answer == 'Y');
}
```

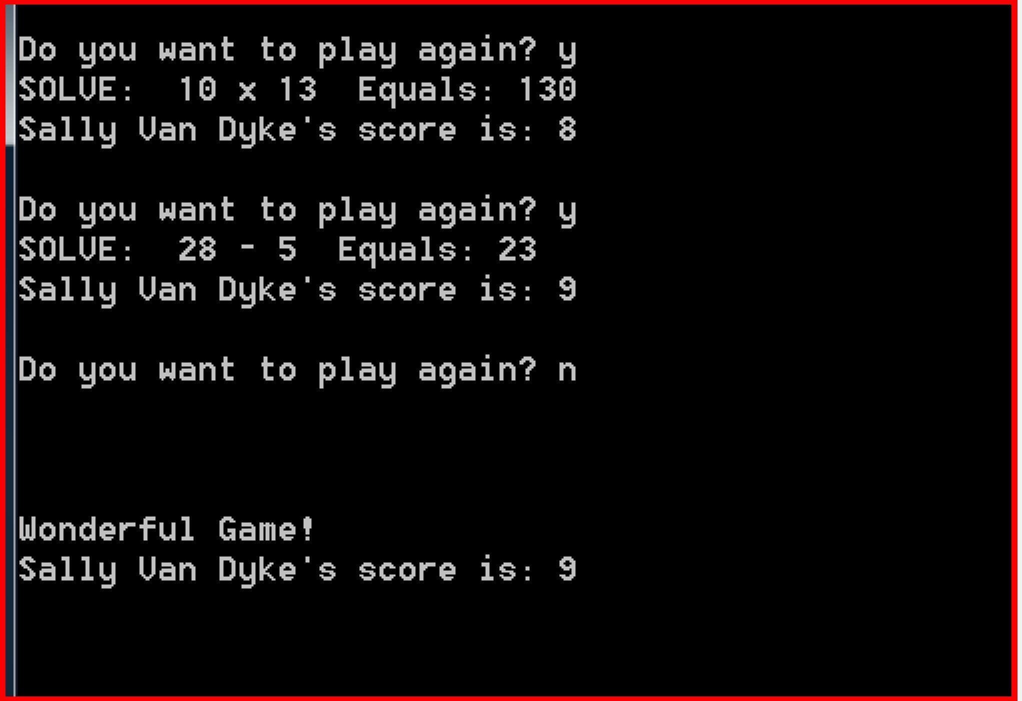
Main…

```
int main()
{   int level = 10; //simplest level
    char player[MAX];
    int points = 0; //player's points
    welcome();
    get_name(player);
    do
    {           //show the equation
                 points += equate(level);
                 show_score(player,points);
                 progress(level,points);     //should they progress a level?

    } while (play_again());
    ending_message(player, points);
    cin.get();  return 0;
}
```

Running the program



```
Welcome to the Mad about Math program

The goal is to get as many equations correct
You get 1 point for each correct answer and -2 for each wrong!

What is your name? sally van dyke


Let's begin Sally Van Dyke

SOLVE:   6 / 1   Equals: 6
Sally Van Dyke's score is: 1

Do you want to play again? y
SOLVE:   9 - 1   Equals: 8
Sally Van Dyke's score is: 2

Do you want to play again? y
SOLVE:   0 x 3   Equals: 0
Sally Van Dyke's score is: 3

Do you want to play again? y
SOLVE:   4 / 4   Equals: 1
Sally Van Dyke's score is: 4

Do you want to play again? y
SOLVE:   9 - 2   Equals: 7
Sally Van Dyke's score is: 5

Do you want to play again? y
SOLVE:   3 + 8   Equals: 11
Sally Van Dyke's score is: 6

Do you want to play again? y
SOLVE:   4 / 3   Equals: 1
Sally Van Dyke's score is: 7
```



```
Do you want to play again? y
SOLVE:   10 x 13   Equals: 130
Sally Van Dyke's score is: 8

Do you want to play again? y
SOLVE:   28 - 5   Equals: 23
Sally Van Dyke's score is: 9

Do you want to play again? n



Wonderful Game!
Sally Van Dyke's score is: 9
```

Mad Math Game…Adding another player

- If we have written the functions for the single player problem well enough, we can simply reuse them for the next player…let's see:

```
int play_game(char player[], int & points, int & level)
{
    cout <<player <<"'s turn: ";
    points += equate(level);
    show_score(player,points);

    progress(level,points);                    //should they progress a level?
}
```

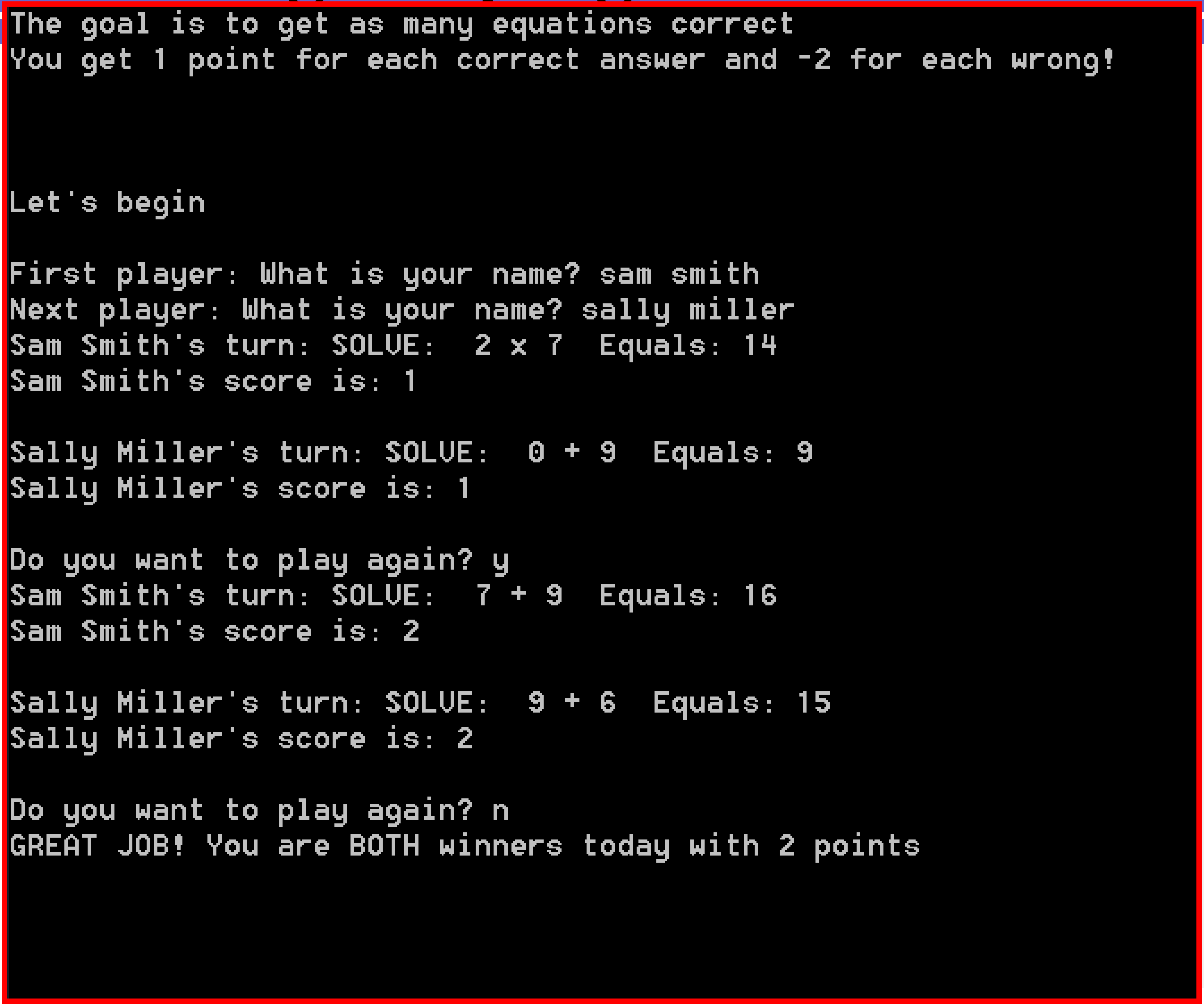
Main…with two players

```
int main()
{   int player1_level = 10;    //simplest level
    int player2_level = 10;

    char player1[MAX];         //player1
    char player2[MAX];         //player2
    int player1_points = 0;
    int player2_points = 0;

    welcome();
    cout <<"First player: ";
    get_name(player1);          //get the names of the two players
    cout <<"Next player: ";
    get_name(player2);
```

Main…with two players

```
do
   {            //let each player do an equation...
                 play_game(player1, player1_points, player1_level);
                 play_game(player2, player2_points, player2_level);

   } while (play_again());

 if (player1_level == player2_level && player1_points == player2_points)
       cout <<"GREAT JOB! You are BOTH winners today "
       <<"with " <<player1_points <<" points" <<endl <<endl;
   else if (player1_level > player2_level || player1_points > player2_points)
     cout <<"THE WINNER IS: " <<player1
         <<"with " <<player1_points <<" points" <<endl <<endl;
   else
      cout <<"THE WINNER IS: " <<player2 <<" with "
          <<player2_points <<" points" <<endl <<endl;
```

Running the program



```
The goal is to get as many equations correct
You get 1 point for each correct answer and -2 for each wrong!




Let's begin

First player: What is your name? sam smith
Next player: What is your name? sally miller
Sam Smith's turn: SOLVE:  2 x 7  Equals: 14
Sam Smith's score is: 1

Sally Miller's turn: SOLVE:  0 + 9  Equals: 9
Sally Miller's score is: 1

Do you want to play again? y
Sam Smith's turn: SOLVE:  7 + 9  Equals: 16
Sam Smith's score is: 2

Sally Miller's turn: SOLVE:  9 + 6  Equals: 15
Sally Miller's score is: 2

Do you want to play again? n
GREAT JOB! You are BOTH winners today with 2 points
```

What is a Structure

- Using structures (a new concept we will use in CS162), we can simplify this further and easily allow additional players
- Think about what a player is…a player has a name, a score, and a level
- A structure is a way for us to group different types of data together under a common name
- With an array, we are limited to having only a single type of data for each element...
  - We'd need an array of players names
  - Another for the players scores
  - Another for the players levels. Too complicated!

What is a Structure

- With a structure, on the other hand, we can group each of these under a common heading
  - So, each player can now have a name, score, and level tied to it
  - And, we can then generalize this to allow for an array of players…and add as many as we want!

Why would we use a Structure

- Some people argue that with C++ we no longer need to use the concept of structures
- And, yes, you can do everything that we will be doing with structures, with a “class” (which we learn about next term!)
- My suggestion is to use structures whenever you want to group different types of data together, to help organize your data

How do you define a Structure?

- We typically define structures "globally"
  - this means they are placed outside of the main
- We do this because structures are like a "specification" or a new "data type"
  - which means that we would want <u>all</u> of our functions to have access to this way to group data, and not just limit it to some function by defining it to be local

How do you define a Structure?

- Each component of a structure is called a member and is referenced by a member name (identifier).
- Structures differ from arrays in that members of a structure do not have to be of the same type. And, structure members are not referenced using an index.

How do you define members of a Structure?

- A structure might look like:

```
struct storeitem
{
        char item[20];
        float cost;
        float price;
        int barcode;
};
```

- In this example, `item`, `price`, `cost` and `barcode` are member names. `storeitem` is the name of a new derived data type consisting of a character array, two real numbers, and an integer.

How do you define members of a Structure?

- A structure might look like:

```
struct player   //a player is: name, a score, and a level
{
        char name[MAX];
        int points;
        int level;
};      //<---- notice the semicolon!
```

How do you define instances of a Structure?

- Once your have declared this new derived data type, you can create instances -- variables (or “objects”) which are of this type (just like we are used to):

```
                player player1;

Or, create an array:
                player all_players[100];
```

How do you define instances of a Structure?

- By saying:

```
player player1;
```

  - From this statement, player1 is the variable (or object)
  - It has a name, score (#points) and level.
  - Just think of *player* as being a type of data which consists of an array of characters, two integers in this case.

How do you access members of a Structure?

- By saying:

```
player player1;
```

  - To access a member of a structure variable, we use a dot (the “direct member access” operator) after the structure variable’s identifier:

```
player1.name     is the array of
characters


player1.points         is the integer


player1.level          is the level
```

How do you access members of a Structure?

- We can work with these members in just the same way that we work with variables of a fundamental type:
- To read in a name, we can say:

  cin >>player1.name

  Or, cin.get(player1.name, 21);
- To display the score, we say:

  cout <<player1.points

What operations can be performed?

- Just like with arrays, there are very few operations that can be performed on a complete structure
- We can’t read in an entire structure at one time, or write an entire structure, or use any of the arithmetic operations...
- We can use assignment, to do a “memberwise copy” copying each member from one struct variable to another

How do you define arrays of Structures?

- But, for structures to be meaningful when representing a deck cards, a store inventory, or a number of players for a game.
  - we may want to use an array of structures
  - where every element represents a different player in the game…

How do you pass Structures to functions?

- To pass a structure to a function, we must decide whether we want pass by reference or pass by value
- By reference, we can pass 1 player:

```
 return_type function(player & arg);


//or an array of players:
return_type function(player arg[]);
```

Mad Math Game…2 players…

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

//This program simulates a "mad about math" game
//written by Karla Fant for CS161 demonstrations

const int MAX = 21;
const int NUM = 2;
struct player   //a player has a name, a score, and a level
{
        char name[MAX];
        int points;
        int level;
};     //<---- notice the semicolon!

void welcome(char name[]);         //display the rules
void capitalize (char name[]);    //capitalize each word in a name
```

This is the same as before….

```
//capitalize the first character of each word in a name

void capitalize(char name[])
{
    int length = strlen(name);
    name[0] = toupper(name[0]);  //capitalize the first character of the name

    //Find the blanks in a name
    for (int i=0; i< length; ++i)
       if (name[i] == ' ')  //the next character needs to be capitalized
          name[i+1] = toupper(name[i+1]);
}
```

This is the same as before….

```
void get_name(char name[])
{   cout <<"What is your name? ";
    cin.get(name,MAX);
    cin.ignore(100,'\n');
    capitalize(name);         //make sure each word is capitalized
}
//describe this game to the user
void welcome()
{
    cout <<"Welcome to the Mad about Math program\n\n";
    cout <<"The goal is to get as many equations correct\n";
    cout <<"You get 1 point for each correct answer and -2 for each
     wrong!"
        <<endl <<endl;
    cout <<endl <<endl <<"Let's begin " <<endl <<endl;
    srand(time(0));
}
```

New Stuff…using the struct!

```
int play_game(player & a_player)
{
    // Tell which player's turn it is…
    cout <<a_player.name <<"'s turn: ";

   // Give the player an equation to calculate
    a_player.points += equate(a_player.level);

    // Show their score
    show_score(a_player.name,a_player.points);

    // should they progress a level?
    progress(a_player.level,a_player.points);
}
```

Main…now using the structure!

```
int main()
{
    player players[NUM];     //we have two players

    welcome();

    //initialize the level and points
    for (int i = 0; i < NUM; ++i)
    {
        players[i].level = 10;
        players[i].points = 0;
        cout <<"For player # " <<i+1 <<": ";
        get_name(players[i].name);
    }
```

Main…now using the structure!

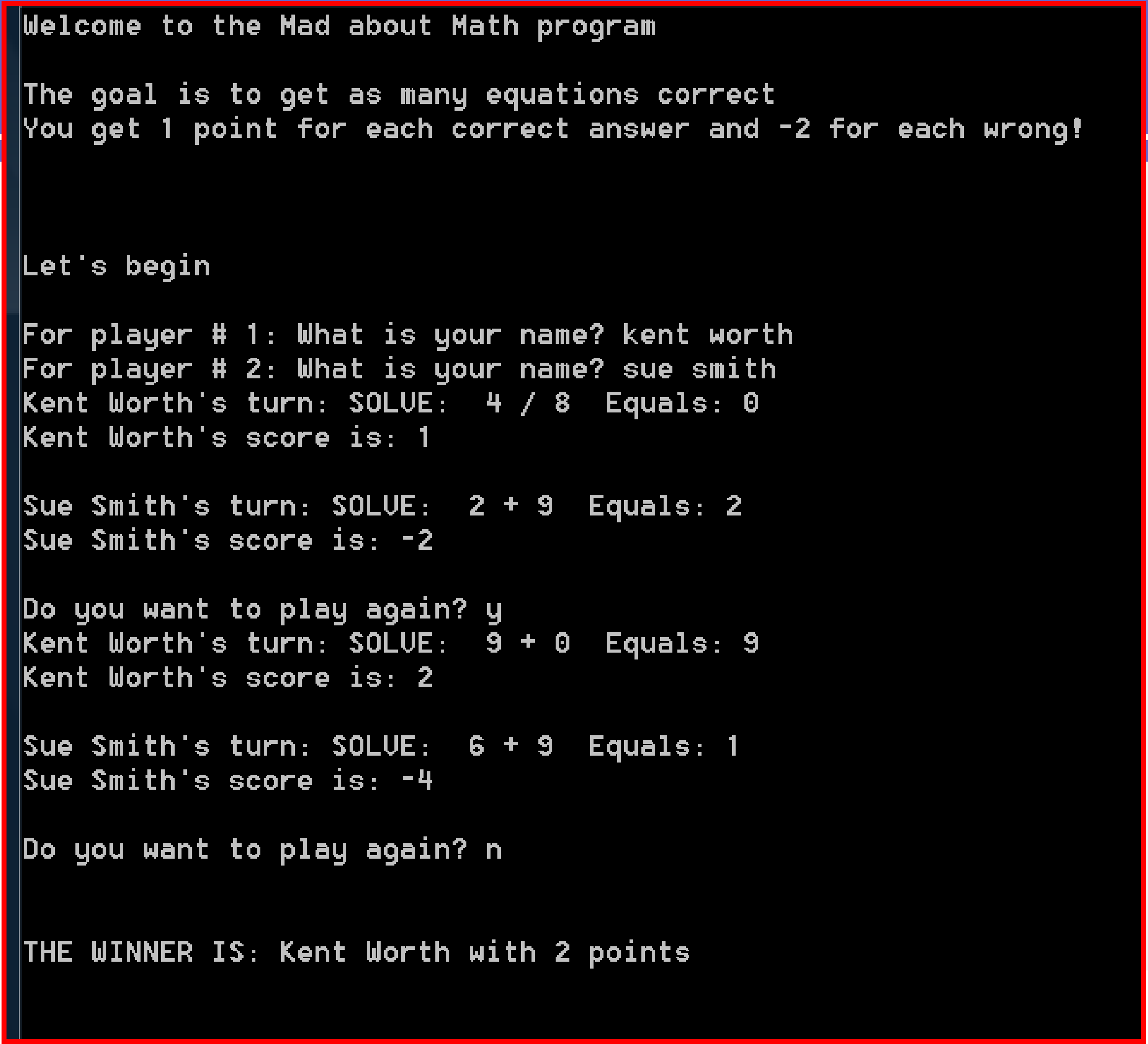
```
//Time to play the game!
do
   {
      for (int i = 0; i < NUM; ++i)  //let each player do an equation...
         play_game(players[i]);

   } while (play_again());

   winning_message(players);



   cin.get();
   return 0;
}
```

Display the winning message…

```
void winning_message(player all[])
{
    int highest_score = -99;
    int highest_index = -99;
    bool found_tie = false;

    //Find the higihest score
    for (int i = 0; i < NUM; ++i)
    {
        //find the player with the highest score
        if (all[i].points > highest_score)
        {
            highest_score = all[i].points;
            highest_index = i;
        }
    }
```

Display the winning message…

```
//Now see if there is a tie
    for (int i = 0; i < NUM; ++i)
    {
       //find the player with the highest score
       if (all[i].points == highest_score && i != highest_index)
       {
         found_tie = true;
         cout <<"GREAT JOB! We have a tie today! "
             <<all[i].name <<" and " <<all[highest_index].name << " have "
             <<highest_score <<" points" <<endl <<endl;
       }
    }
    if (!found_tie) //there was not a tie
    {
        cout <<"THE WINNER IS: " <<all[highest_index].name
          <<"with " <<highest_score <<" points" <<endl <<endl;
     }
```



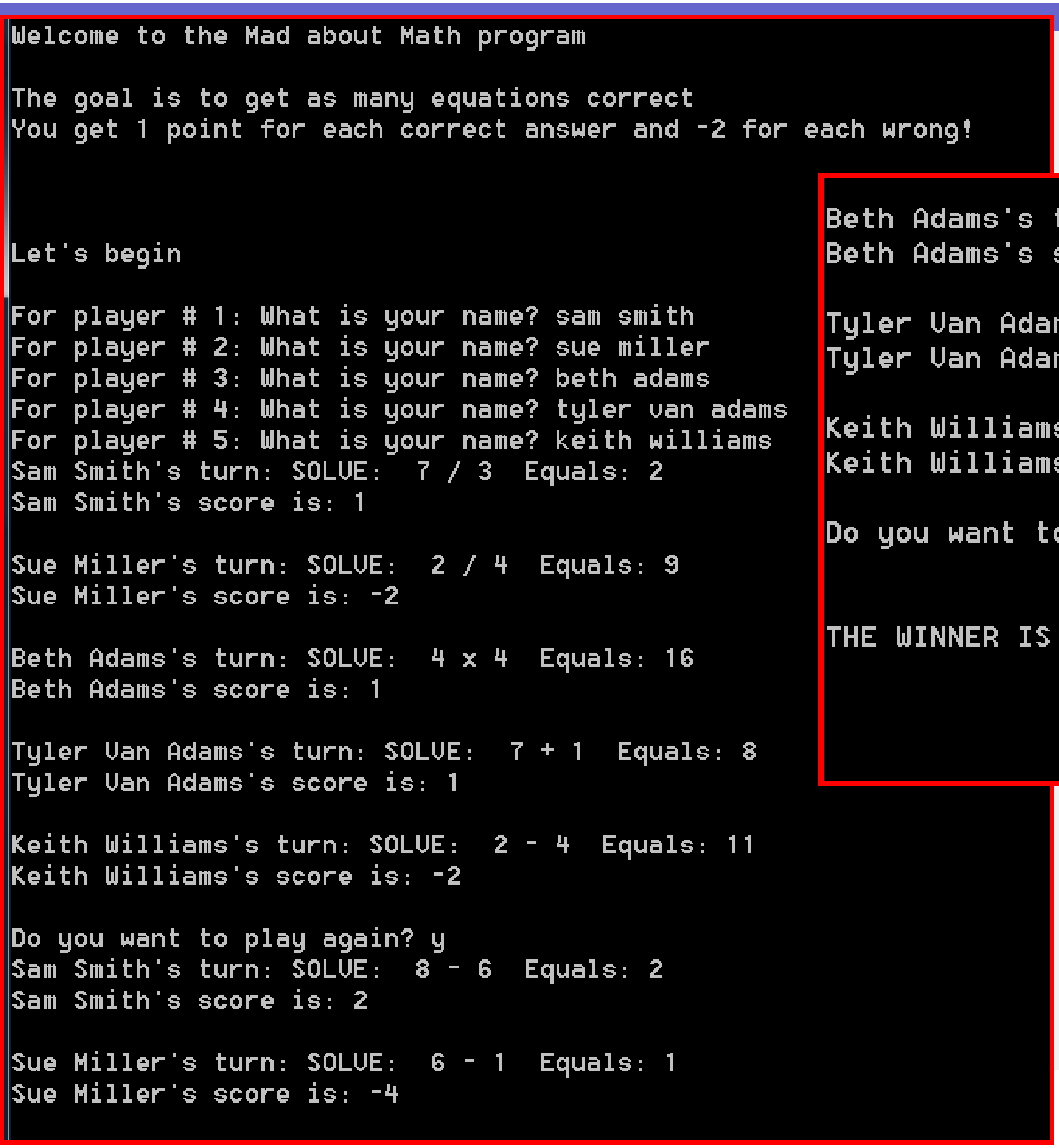
```
Welcome to the Mad about Math program

The goal is to get as many equations correct
You get 1 point for each correct answer and -2 for each wrong!



Let's begin

For player # 1: What is your name? kent worth
For player # 2: What is your name? sue smith
Kent Worth's turn: SOLVE:  4 / 8  Equals: 0
Kent Worth's score is: 1

Sue Smith's turn: SOLVE:  2 + 9  Equals: 2
Sue Smith's score is: -2

Do you want to play again? y
Kent Worth's turn: SOLVE:  9 + 0  Equals: 9
Kent Worth's score is: 2

Sue Smith's turn: SOLVE:  6 + 9  Equals: 1
Sue Smith's score is: -4

Do you want to play again? n


THE WINNER IS: Kent Worth with 2 points
```

Mad Math Game…Many Players!

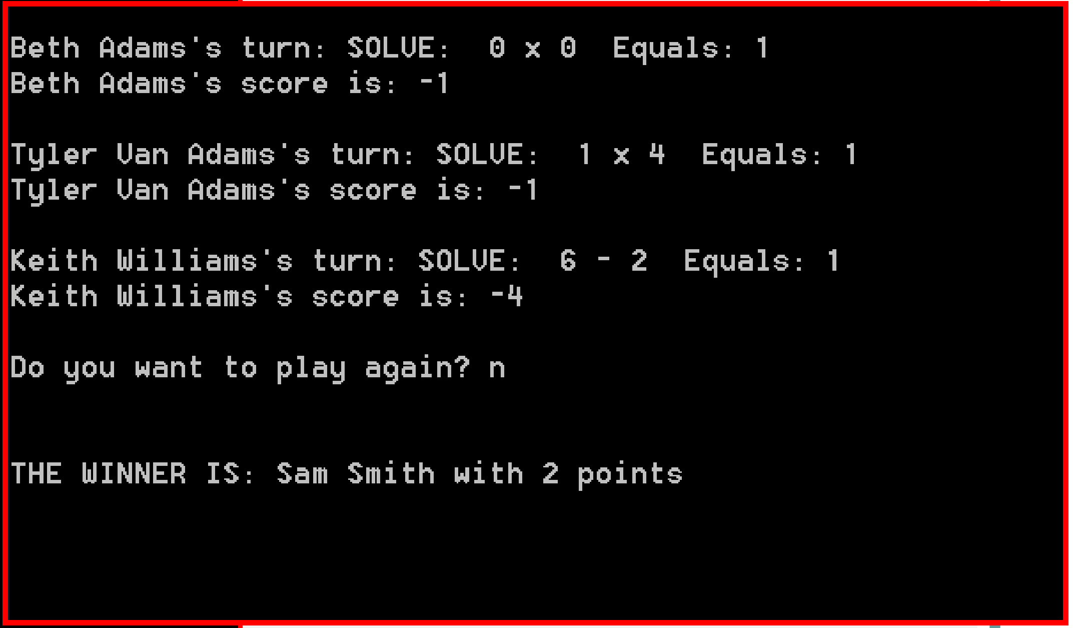
- With structures and arrays of structures we can make a slight jump with minimal code modifications to allow for many players!

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

// This program simulates a "mad about math" game
// written by Karla Fant for CS161 demonstrations

const int MAX = 21;
const int NUM = 5;                    ***THE ONLY CHANGE ***
```

Running the program



```
Welcome to the Mad about Math program

The goal is to get as many equations correct
You get 1 point for each correct answer and -2 for each wrong!



Let's begin

For player # 1: What is your name? sam smith
For player # 2: What is your name? sue miller
For player # 3: What is your name? beth adams
For player # 4: What is your name? tyler van adams
For player # 5: What is your name? keith williams
Sam Smith's turn: SOLVE:  7 / 3  Equals: 2
Sam Smith's score is: 1

Sue Miller's turn: SOLVE:  2 / 4  Equals: 9
Sue Miller's score is: -2

Beth Adams's turn: SOLVE:  4 x 4  Equals: 16
Beth Adams's score is: 1

Tyler Van Adams's turn: SOLVE:  7 + 1  Equals: 8
Tyler Van Adams's score is: 1

Keith Williams's turn: SOLVE:  2 - 4  Equals: 11
Keith Williams's score is: -2

Do you want to play again? y
Sam Smith's turn: SOLVE:  8 - 6  Equals: 2
Sam Smith's score is: 2

Sue Miller's turn: SOLVE:  6 - 1  Equals: 1
Sue Miller's score is: -4
```



```
Beth Adams's turn: SOLVE:  0 x 0  Equals: 1
Beth Adams's score is: -1

Tyler Van Adams's turn: SOLVE:  1 x 4  Equals: 1
Tyler Van Adams's score is: -1

Keith Williams's turn: SOLVE:  6 - 2  Equals: 1
Keith Williams's score is: -4

Do you want to play again? n


THE WINNER IS: Sam Smith with 2 points
```