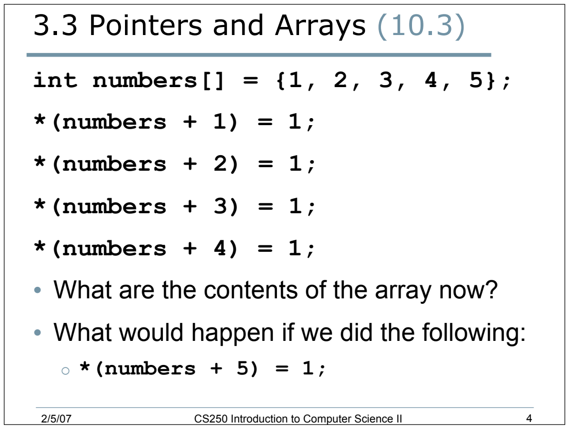
Pointers and Strings
Chapters 10, 12

3.1 Pointers and Arrays (10.3)

- An array of **`ints`** can be declared as
  - **`int numbers[] = {1, 2, 3, 4, 5};`**
- **`numbers`** is also a pointer to the first element in the array
- Therefore, it can be dereferenced to access the elements of the array
  - **`*numbers = 2;`**
  - What are the contents of the above array now?

3.2 Pointers and Arrays (10.3)

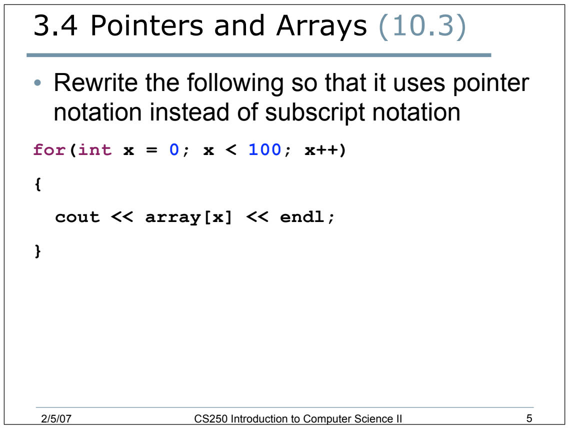
- The name of the array is a pointer to the ***first*** element in the array
- What about the other elements in the array?
  - You can add 1 to the array name to access the second element
  - You can add 2 to the array name to access the second element….and so on
- When adding a number to the array name, you are actually adding that number times the size of the element in the array



3.3 Pointers and Arrays (10.3)

```
int numbers[] = {1, 2, 3, 4, 5};
*(numbers + 1) = 1;
*(numbers + 2) = 1;
*(numbers + 3) = 1;
*(numbers + 4) = 1;
```

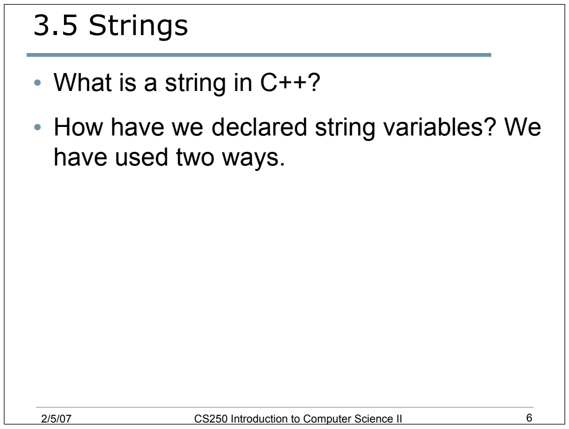
- What are the contents of the array now?
- What would happen if we did the following:
  - `*(numbers + 5) = 1;`



3.4 Pointers and Arrays (10.3)

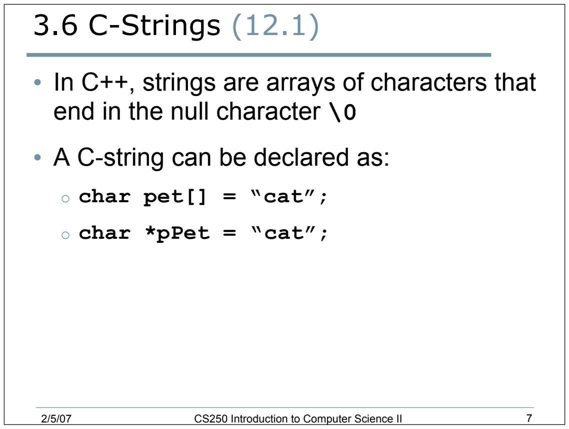
- Rewrite the following so that it uses pointer notation instead of subscript notation

```
for(int x = 0; x < 100; x++)
{
  cout << array[x] << endl;
}
```



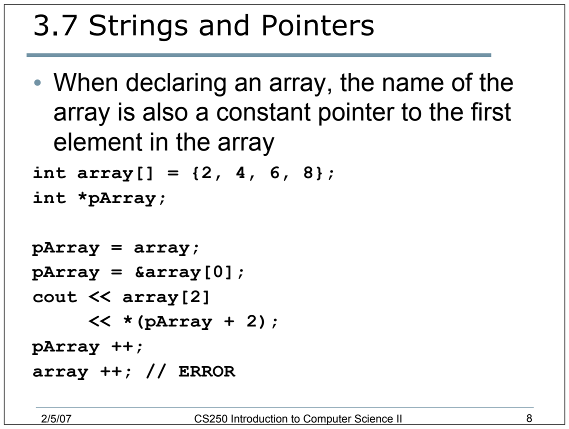
3.5 Strings

- What is a string in C++?
- How have we declared string variables? We have used two ways.



3.6 C-Strings (12.1)

- In C++, strings are arrays of characters that end in the null character `\0`
- A C-string can be declared as:
  - `char pet[] = “cat”;`
  - `char *pPet = “cat”;`

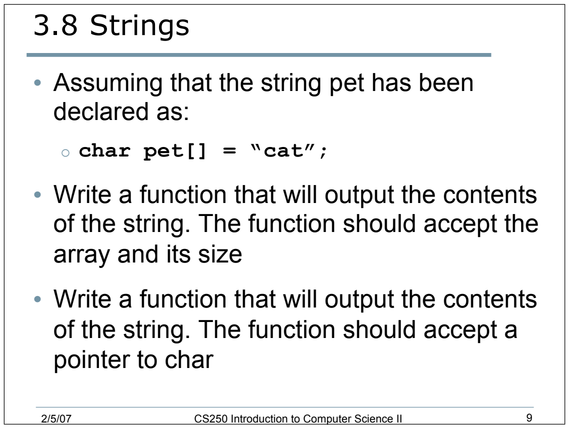


3.7 Strings and Pointers

- When declaring an array, the name of the array is also a constant pointer to the first element in the array

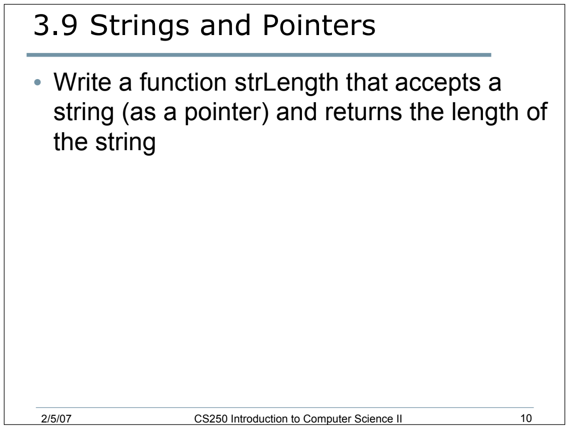
```
int array[] = {2, 4, 6, 8};
int *pArray;

pArray = array;
pArray = &array[0];
cout << array[2]
     << *(pArray + 2);
pArray ++;
array ++; // ERROR
```



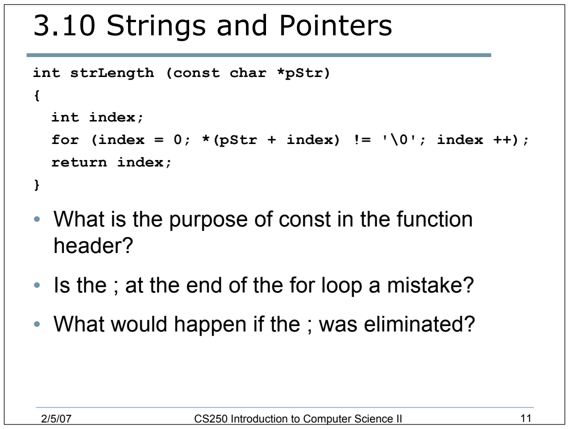
3.8 Strings

- Assuming that the string pet has been declared as:
  - `char pet[] = “cat”;`
- Write a function that will output the contents of the string. The function should accept the array and its size
- Write a function that will output the contents of the string. The function should accept a pointer to char



3.9 Strings and Pointers

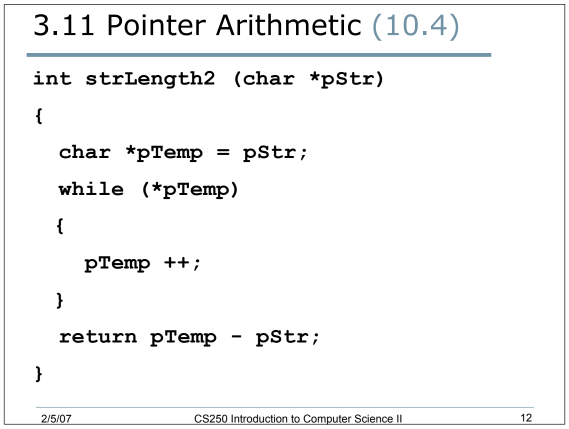
- Write a function strLength that accepts a string (as a pointer) and returns the length of the string



3.10 Strings and Pointers

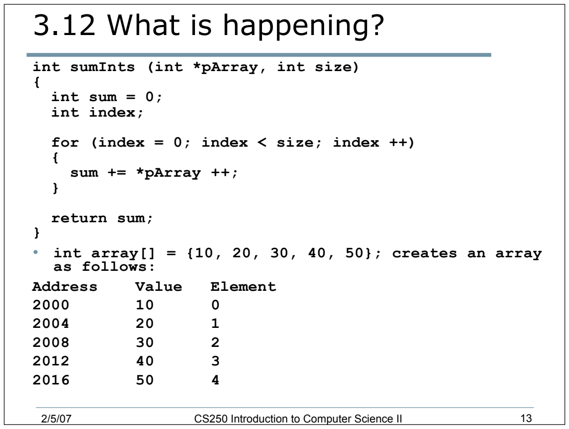
```
int strLength (const char *pStr)
{
  int index;
  for (index = 0; *(pStr + index) != '\0'; index ++);
  return index;
}
```

- What is the purpose of const in the function header?
- Is the ; at the end of the for loop a mistake?
- What would happen if the ; was eliminated?



3.11 Pointer Arithmetic (10.4)

```
int strLength2 (char *pStr)
{
  char *pTemp = pStr;
  while (*pTemp)
  {
    pTemp ++;
  }
  return pTemp - pStr;
}
```



3.12 What is happening?

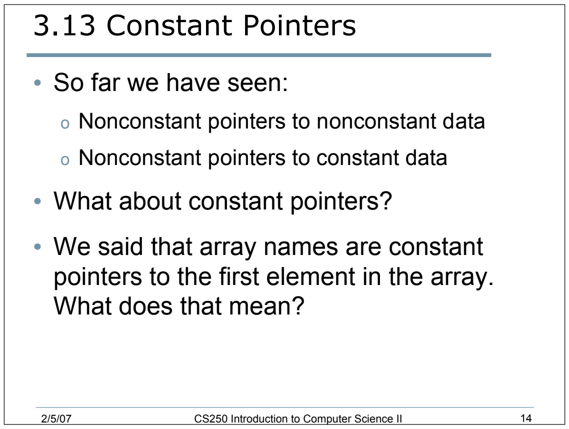
```
int sumInts (int *pArray, int size)
{
  int sum = 0;
  int index;

  for (index = 0; index < size; index ++)
  {
    sum += *pArray ++;
  }

  return sum;
}
```

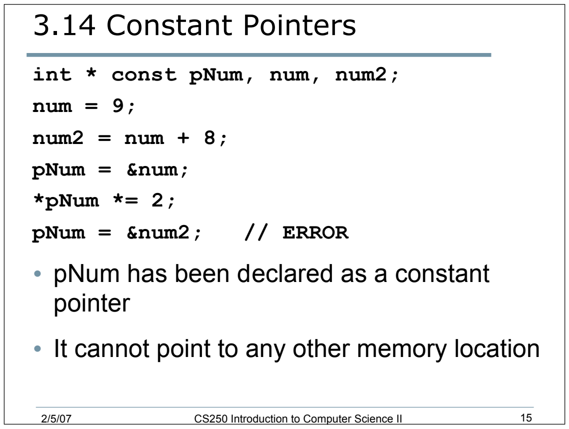
- int array[] = {10, 20, 30, 40, 50}; creates an array as follows:

Address	Value	Element
2000	10	0
2004	20	1
2008	30	2
2012	40	3
2016	50	4



3.13 Constant Pointers

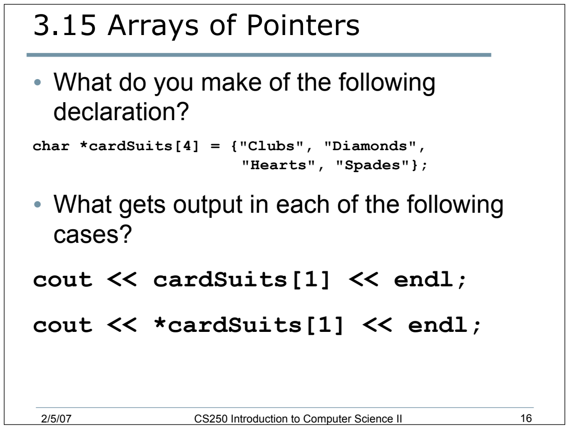
- So far we have seen:
  - Nonconstant pointers to nonconstant data
  - Nonconstant pointers to constant data
- What about constant pointers?
- We said that array names are constant pointers to the first element in the array. What does that mean?



3.14 Constant Pointers

```
int * const pNum, num, num2;
num = 9;
num2 = num + 8;
pNum = &num;
*pNum *= 2;
pNum = &num2;   // ERROR
```

- pNum has been declared as a constant pointer
- It cannot point to any other memory location



3.15 Arrays of Pointers

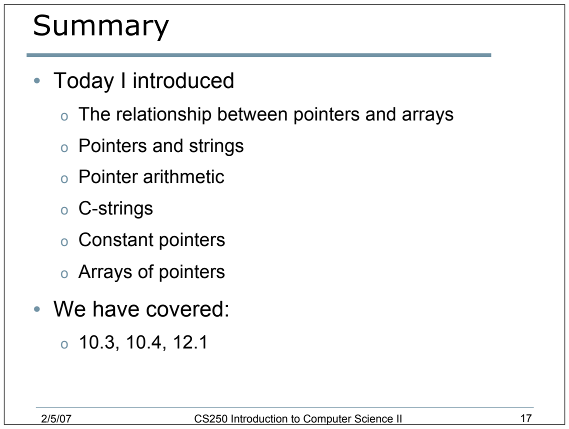
- What do you make of the following declaration?

```
char *cardSuits[4] = {"Clubs", "Diamonds",
                      "Hearts", "Spades"};
```

- What gets output in each of the following cases?

```
cout << cardSuits[1] << endl;

cout << *cardSuits[1] << endl;
```



Summary

- Today I introduced
  - The relationship between pointers and arrays
  - Pointers and strings
  - Pointer arithmetic
  - C-strings
  - Constant pointers
  - Arrays of pointers
- We have covered:
  - 10.3, 10.4, 12.1