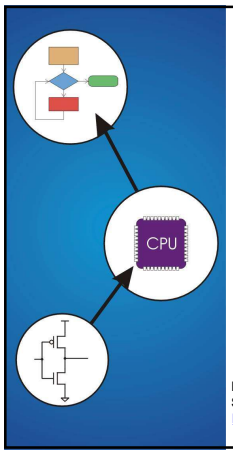
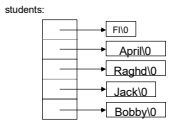


Extra C Material

Based on material in: **The C Programming Language, Second Edition** by Brian W. Kernighan and Dennis M. Ritchie. Prentice Hall, Inc., 1988.

Two dimensional array vs pointer to array

```
char *students[] = {"Fi" , "April", "Raghd", "Jack", "Bobby"};
```




```
char stu_arr[][10] = {"Fi" , "April", "Raghd", "Jack", "Bobby"};
```

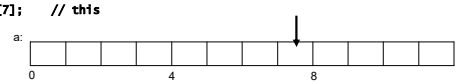
`students[2][3];` and `stu_arr[2][3];` are both valid

1-2

Access two dimensional array with one index

- **Two dimensional arrays are stored in memory as a large one dimensional array**
- **Sometimes it is convenient to index into this array with a single index**
- **First dimension is rows**
- **Second dimension is columns**

```
int a[3][4];
int x;
x = a[1][3]; // this is equivalent to
x = a[7];    // this
```

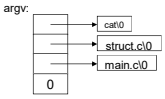


- **Formula for conversion**
  - index = row index * number of columns + column index

1-3

char *argv[]

- argv: Argument Vector
- Pointer to array of character strings
- argv[0]:name of current program
  - Number of args at least 1
- Argv[1- n]: command line arguments
- Terminated by a null pointer



1-4

Function Pointers

Functions are not variables in C

Pointers to functions are

Things you can do with a function pointer

- Assignment
- Store an array of function pointers
- Use as a function argument
- Return function pointer from a function

Ex. int (*foo)(char *, char *);

- foo is a pointer to a function that takes two char * arguments and returns an int;
- Parenthesis needed
  - ➢ int * foo(char *, char *);
  - ➢ foo is a function that takes two char * arguments and returns an int *.

5

Function Pointers

Why parenthesis around function pointer name:

- precedence of * vs ()

Typedef function pointer

- `typedef int (*FOO)(int, int);`
- `FOO` now has the type pointer to function that takes two int arguments

Store a function in a function pointer

```
int bar(int a, int b){
    return a + b;
}
int (*foo)(int, int);
foo = &bar;

typedef int (*FOO)(int, int);
FOO f = &bar;
```

1-6

Unions

Unions are variables that use the same memory area to hold objects of different types and possibly sizes

- Only one object can be stored at any one time
- Bits in memory do not change only how they are interpreted
- Programmers job to keep track of what type is currently being stored in the union

Same operations as a struct:

- . for union variable member
- -> for union pointer member
- Assign to
- Copy
- Take address of

1-7

Unions

Ex.

```
int main() {
    union tag {
        float f;
        int x;
        char *s;
    } t;  // all members reference the same memory/data/bits

    t.f = 999999;
    printf("%f\n", t.f); // print value of float member as a float
    printf("%d\n", t.x); // print value of int member as an int
}
```

- **Can be members of structs or have structs as members**
- **Can only be initialized with a value of the same type as the first member**
  - In this case float

1-8

Bit Fields

Bit Fields are a way to directly access bits

- Save space
- Change individual bit values without masks
  - x = x | xffff;
- Implementation dependent
  - Not very portable
- Fields declared as ints
  - Specify unsigned or signed for better portability
  - Fields behave like small integers

Ex.

```
Struct car{
    unsigned int ignition_on: 1;
    : 7                          // unnamed fields used as padding
    unsigned int engine_status: 3; // fields can have different width
} p_car;
p_car.ignition_on = 1;           // easy to change a bits value
```

1-9