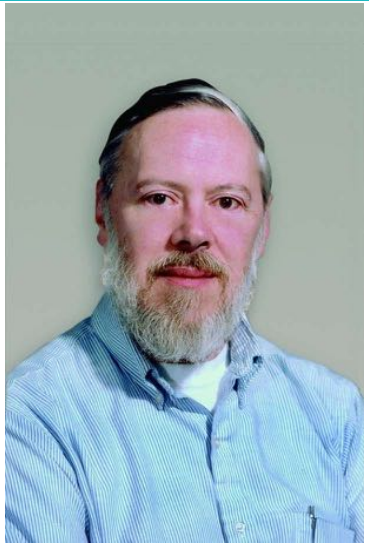
Lecture 1 - Introduction to C Programming Language

Meng-Hsun Tsai
CSIE, NCKU

Origins of C

- C is a by-product of UNIX, developed at Bell Laboratories by Ken Thompson, Dennis Ritchie, and others.
- Thompson designed a small language named B.
- B was based on BCPL, a systems programming language developed in the mid-1960s.

Ken Thompson
(1943-)



Dennis Ritchie
(1941-2011)

Origins of C (cont.)

- By 1971, Ritchie began to develop an extended version of B.
- He called his language NB ("New B") at first.
- As the language began to diverge more from B, he changed its name to C.
- The language was stable enough by 1973 that UNIX could be rewritten in C.

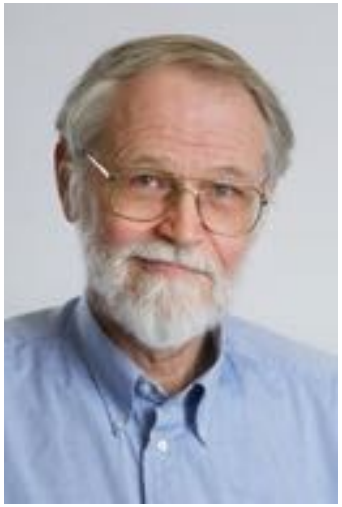
Standardization of C

- *K&R C*
  - *The C Programming Language* (1978) (written by Kernighan and Ritchie)
  - De facto standard
- *C89/C90*
  - ANSI standard X3.159-1989
  - ISO/IEC 9899:1990
- ***C99***
- *C11*
- *C18*

Features taught in this course are introduced/defined in C99.

ISO/IEC Documents

ISO/IEC 9899:1990 ISO/IEC 9899:1990/Amd 1:1995 ISO/IEC 9899:1990/Cor 1:1994 ISO/IEC 9899:1990/Cor 2:1996
ISO/IEC 9899:1999 ISO/IEC 9899:1999/Cor 1:2001 ISO/IEC 9899:1999/Cor 2:2004 ISO/IEC 9899:1999/Cor 3:2007
ISO/IEC 9899:2011 ISO/IEC 9899:2011/Cor 1:2012
ISO/IEC 9899:2018



Brian Kernighan (1942-)

C-Based Languages

- ***C++*** includes all the features of C, but adds classes and other features to support object-oriented programming.
- ***Java*** is based on C++ and therefore inherits many C features.
- ***C#*** is a more recent language derived from C++ and Java.
- ***Perl*** has adopted many of the features of C.
- **Carbon** is developed by Google for possible successor to C++.

Properties of C

- Low-level
- Small
- Permissive

Strengths of C

- Efficiency (low-level)
- Flexibility (small and permissive)
  - C imposes very few restrictions on the use of its features.
- Integration with UNIX
- Portability
  - C compilers are small and easily written.
- Power
  - C has large collection of data types and operators.
- Standard library

Weaknesses of C

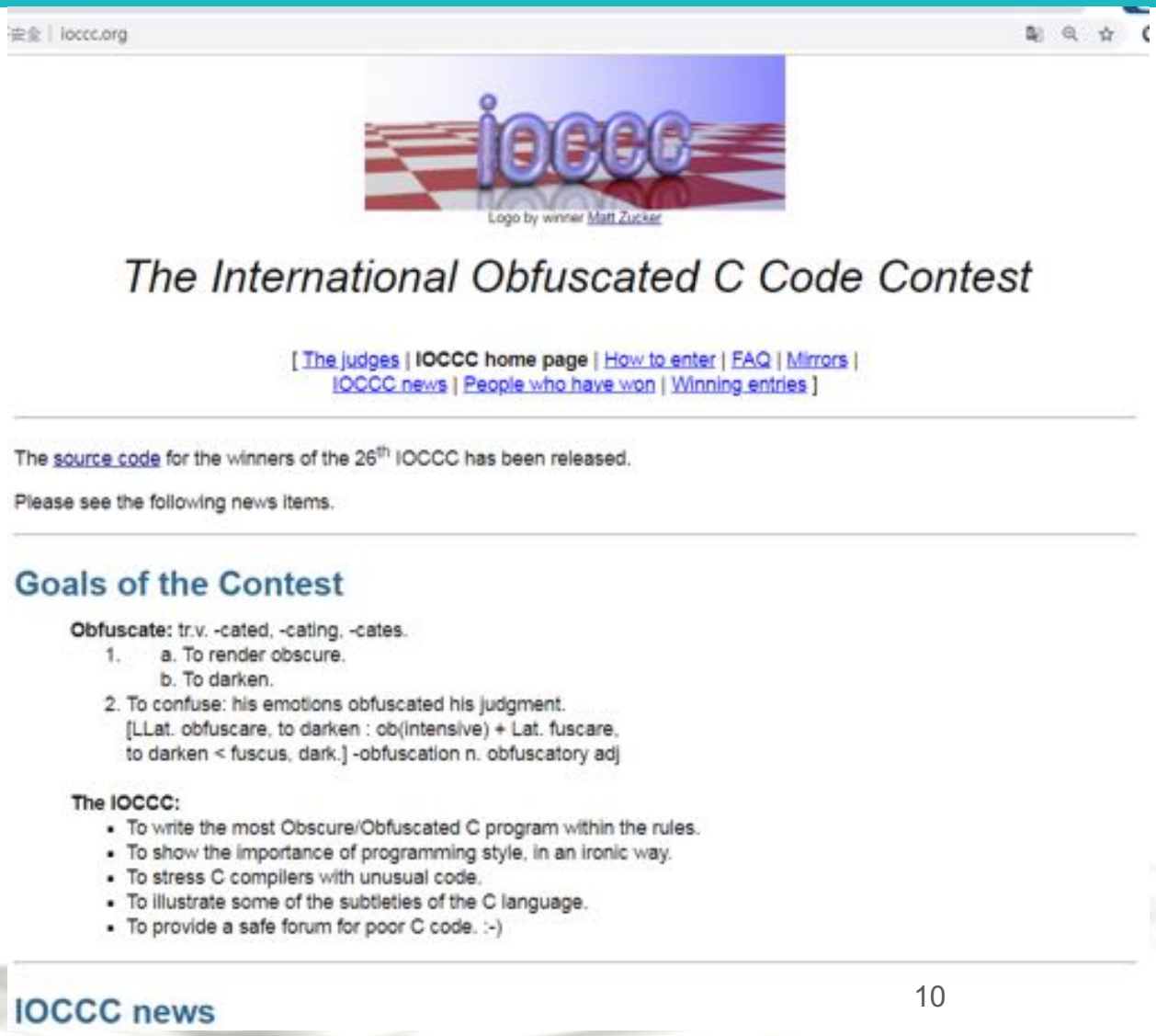
- Programs can be error-prone.
  - Programming mistakes that would be caught in many other languages cannot be detected by a C compiler.
- Programs can be difficult to understand.
  - Programmers who are too clever for their own good can make programs almost impossible to understand.
- Programs can be difficult to modify.
  - Large programs written in C can be hard to change if they haven't been designed with maintenance in mind.

Effective Use of C

- Learn how to avoid pitfalls.
- Use software tools (~~`lint`~~`/splint/cppcheck`, debuggers) to make programs more reliable.
- Take advantage of existing code libraries.
- Adopt a sensible set of coding conventions.
- Avoid “tricks” and overly complex code.
- Stick to the standard.

If you are bored with learning basic C skills…

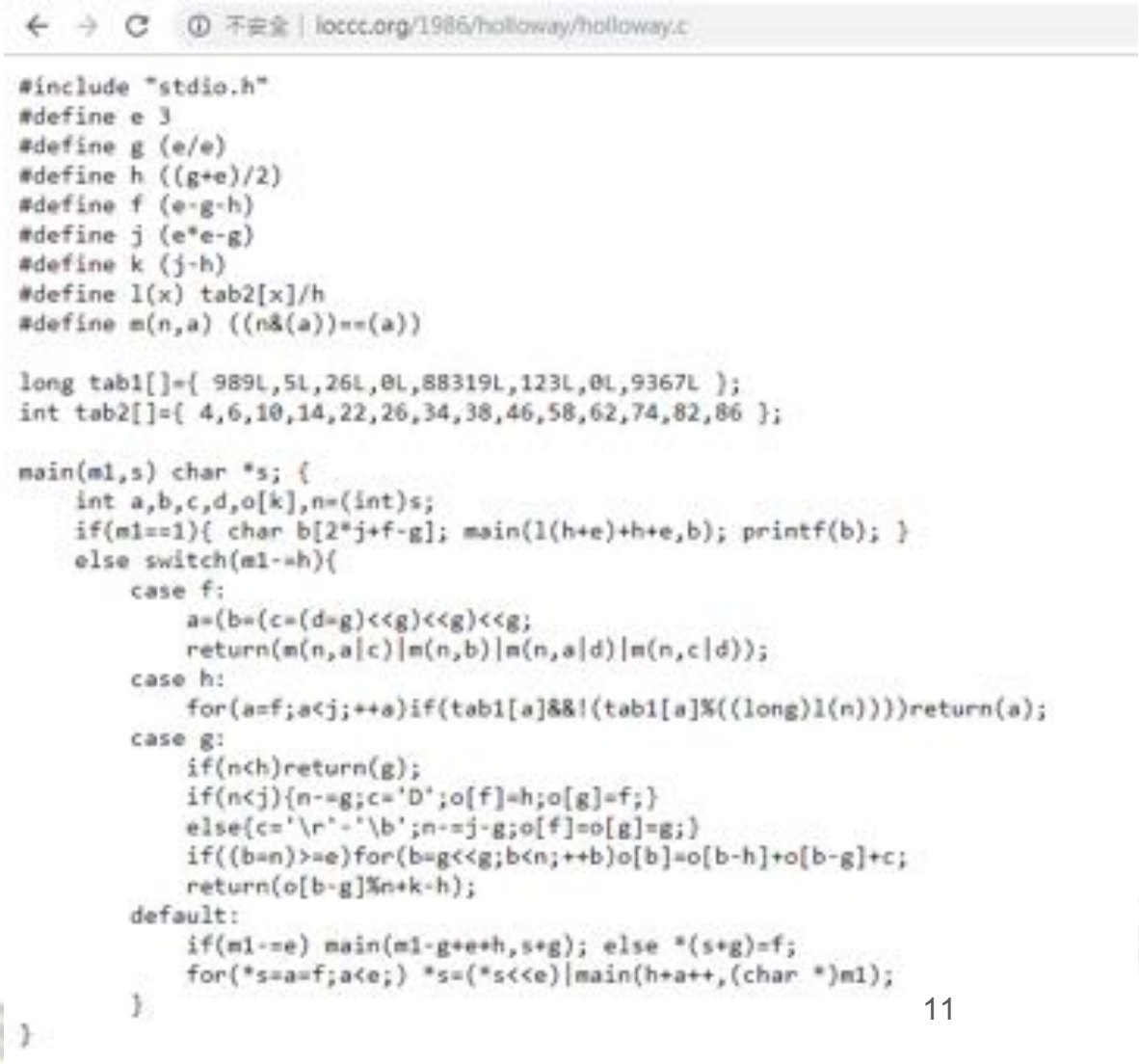
Take a look at the IOCCC website to see how obfuscating C can be!



Source:http://www.ioccc.org/1986/holloway/holloway.c

IOCCC 1986/holloway

It just prints “Hello, world!”



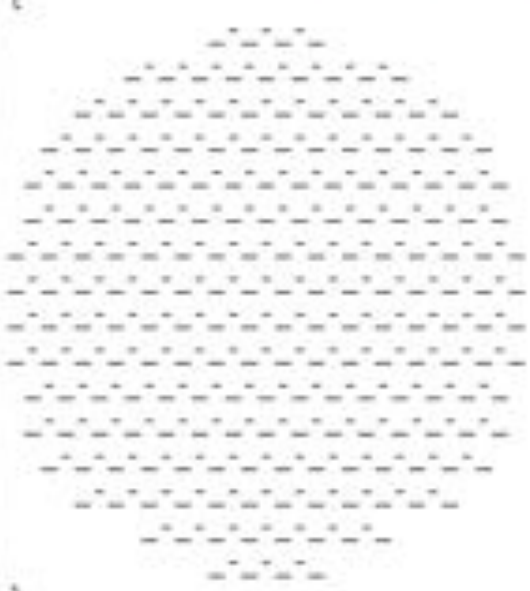
ioccc.org/1986/holloway/holloway.c

```
#include "stdio.h"
#define e 3
#define g (e/e)
#define h ((g+e)/2)
#define f (e-g-h)
#define j (e*e-g)
#define k (j-h)
#define l(x) tab2[x]/h
#define m(n,a) ((n&(a))==(a))

long tab1[]={ 989L,5L,26L,0L,88319L,123L,0L,9367L };
int tab2[]={ 4,6,10,14,22,26,34,38,46,58,62,74,82,86 };

main(m1,s) char *s; {
    int a,b,c,d,o[k],n=(int)s;
    if(m1==1){ char b[2*j+f-g]; main(l(h+e)+h+e,b); printf(b); }
    else switch(m1-=h){
        case f:
            a=(b=(c=(d=g)<<g)<<g)<<g;
            return(m(n,a|c)|m(n,b)|m(n,a|d)|m(n,c|d));
        case h:
            for(a=f;a<j;++a)if(tab1[a]&&!(tab1[a]%((long)l(n))))return(a);
        case g:
            if(n<h)return(g);
            if(n<j){n-=g;c='D';o[f]=h;o[g]=f;}
            else{c='\r'-'\b';n-=j-g;o[f]=o[g]=g;}
            if((b=n)>=e)for(b=g<<g;b<n;++b)o[b]=o[b-h]+o[b-g]+c;
            return(o[b-g]%n+k-h);
        default:
            if(m1-=e) main(m1-g+e+h,s+g); else *(s+g)=f;
            for(*s=a=f;a<e;) *s=(*s<<e)|main(h+a++,(char *)m1);
        }
}
```

They both print out the π value.

ioccc.org/1988/westley.c

```
#define _ -F<00||--F-OO--;
int F=00,OO=00;main(){F_OO();printf("%1.3f\n",4.*-F/OO/OO);}F_OO()
{
```



```
}
```

ioccc.org/1989/roemer.c

```
                                                                char
                                                          _3141592654[3141
      ],__3141[3141];_314159[31415],_3141[31415];main(){register char*
    _3_141,*_3_1415, *_3__1415; register int _314,_31415,__31415,*_31,
  _3_14159,__3_1415;*_3141592654=__31415=2,_3141592654[0][_3141592654
 -1]=1[__3141]=5;__3_1415=1;do{_3_14159=_314=0,__31415++;for( _31415
=0;_31415<(3,14-4)*__31415;_31415++)_31415[_3141]=_314159[_31415]= -
;_3141[*_314159=_3_14159]=_314;_3_141=_3141592654+__3_1415;_3_1415=
_3_1415    +__3141;for                (_31415 = 3141-
        __3_1415  ;                   _31415;_31415--
        ,_3_141 ++,                   _3_1415++){_314
        +=_314<<2 ;                   _314<<=1;_314+=
       *_3_1415;_31                    =_314159+_314;
       if(!(*_31+1)                    )* _31 =_314 /
       __31415,_314                    [_3141]=_314 %
       __31415 ;* (                    _3__1415=_3_141
      )+= *_3_1415                     = *_31;while(*
      _3__1415 >=                      31415/3141 ) *
      _3__1415+= -                     10,(*--_3__1415
     )++;_314=_314                     [_3141]; if ( !
     _3_14159 && *                     _3_1415)_3_14159
     =1,__3_1415 =                     3141-_31415;}if(
     _314+(__31415                      >>1)>=__31415 )
     while ( ++ *                       _3_141==3141/314
    )*_3_141---0                        ;}while(_3_14159
    ) ; { char *                        __3_14= "3.1415";
    write((3,1),                        (--*__3_14,__3_14
    ),(_3_14159                          ++,++_3_14159))+
   3.1415926; }                          for ( _31415 = 1;
   _31415<3141-                          i;_31415++)write(
  31415% 314-(                           3,14),_3141592654[
 _31415    ] +                           "0123456789","314"
 [ 3]+1)-_314;                          puts((*_3141592654=0
_3141592654))                            ;_314= *"3.141592";}
```

Source:http://www.ioccc.org/1989/roemer.c

Source:http://www.ioccc.org/1988/westley.c

IOCCC 1998/banks

It is a flight simulator in 1536 bytes! (X11 needed)

Source:http://www.ioccc.org/1998/banks.c

Source:https://www.tiobe.com/tiobe-index/

Does it deserve to learn C?

Jun 2022	Jun 2021	Change	Programming Language	Ratings	Change
1	2	^	Python	12.20%	+0.35%
2	1	v	C	11.91%	-0.64%
3	3		Java	10.47%	-1.07%
4	4		C++	9.63%	+2.26%
5	5		C#	6.12%	+1.79%
6	6		Visual Basic	5.42%	+1.40%
7	7		JavaScript	2.09%	-0.24%
8	10	^	SQL	1.94%	+0.06%
9	9		Assembly language	1.85%	-0.21%
10	16	^	Swift	1.55%	+0.44%

Source:https://www.tiobe.com/tiobe-index/

Does it deserve to learn C? (cont.)

Very Long Term History

To see the bigger picture, please find below the positions of the top 10 programming languages of many years back. Please note that these are average positions for a period of 12 months.

Programming Language	2022	2017	2012	2007	2002	1997	1992	1987
Python	1	5	8	7	12	28	-	-
C	2	2	2	2	2	1	1	1
Java	3	1	1	1	1	13	-	-
C++	4	3	3	3	3	2	2	5
C#	5	4	4	8	18	-	-	-
Visual Basic	6	15	-	-	-	-	-	-
JavaScript	7	7	10	9	8	20	-	-
Assembly language	8	10	-	-	-	-	-	-
SQL	9	-	-	-	7	-	-	-
PHP	10	8	6	5	6	-	-	-