

Lecture 1 - Introducing C

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C

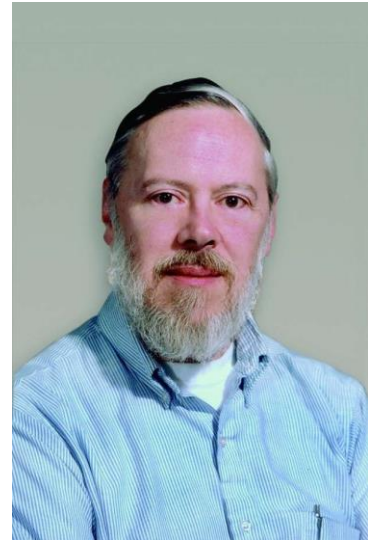


Origins of C

- 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)

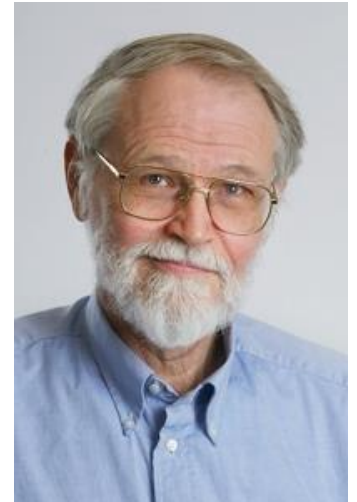
Origins of C (cont.)

- 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*
 - Described in Kernighan and Ritchie, *The C Programming Language* (1978)
 - De facto standard
- *C89/C90*
 - ANSI standard X3.159-1989 (completed in 1988; formally approved in December 1989)
 - International standard ISO/IEC 9899:1990
- *C99*
 - International standard ISO/IEC 9899:1999
 - Incorporates changes from Amendment 1 (1995)



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.

Properties of C

- Low-level
- Small
- Permissive

Strengths of C

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

Weaknesses of C

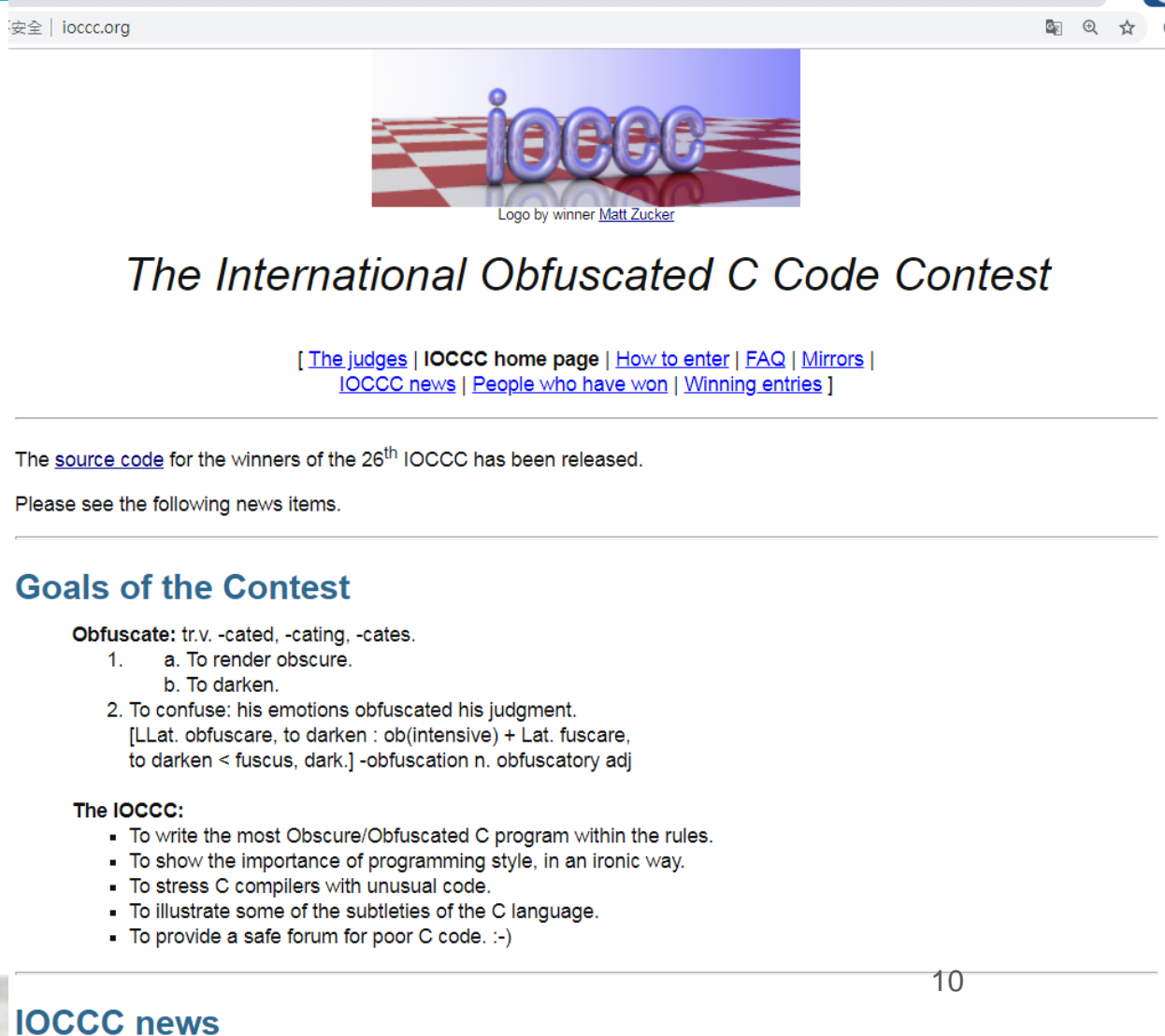
- Programs can be error-prone.
 - Programming mistakes that would be caught in many other languages cannot be detected by a C compiler.
- Programs can be difficult to understand.
 - Programmers who are too clever for their own good can make programs almost impossible to understand.
- Programs can be 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`, `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!



The screenshot shows the IOCCC website with a browser address bar displaying '安全 | ioccc.org'. The main header features a logo with the text 'iocccc' in a stylized, 3D font on a red and white checkered floor. Below the logo, it says 'Logo by winner [Matt Zucker](#)'. The title 'The International Obfuscated C Code Contest' is centered. A navigation bar contains links: [[The judges](#) | [IOCCC home page](#) | [How to enter](#) | [FAQ](#) | [Mirrors](#) | [IOCCC news](#) | [People who have won](#) | [Winning entries](#)]. Below this, a paragraph states: 'The [source code](#) for the winners of the 26th IOCCC has been released. Please see the following news items.' A section titled 'Goals of the Contest' follows, containing two main points: 1. Obfuscate: tr.v. -cated, -cating, -cates. (a. To render obscure. b. To darken.) 2. To confuse: his emotions obfuscated his judgment. [LLat. obfuscare, to darken : ob(intensive) + Lat. fuscare, to darken < fuscus, dark.] -obfuscation n. obfuscatory adj. Below this, 'The IOCCC:' is followed by a bulleted list: To write the most Obscure/Obfuscated C program within the rules. To show the importance of programming style, in an ironic way. To stress C compilers with unusual code. To illustrate some of the subtleties of the C language. To provide a safe forum for poor C code. :-)

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Logo by winner [Matt Zucker](#)

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IOCCC news

IOCCC 1986/holloway

It just prints “Hello, world!”

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```
#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))

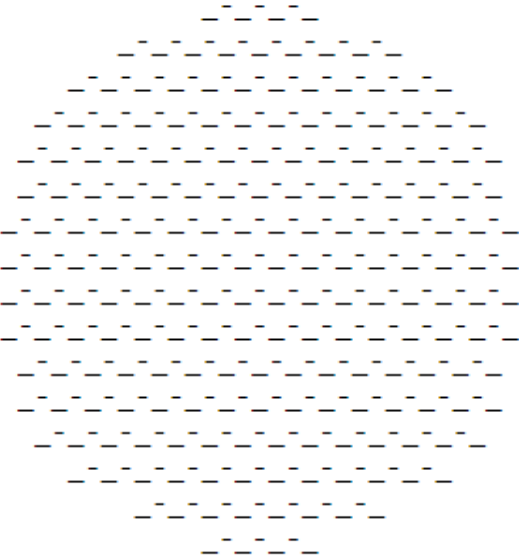
long tab1[]={ 989L,5L,26L,0L,88319L,123L,0L,9367L };
int tab2[]={ 4,6,10,14,22,26,34,38,46,58,62,74,82,86 };

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.



```
#define _ -F<00||--F-00--;
int F=00,00=00;main(){F_00();printf("%.3f\n",4.*-F/00/00);}F_00()
{
```



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```

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--
,_3_141++){_314
_314<<=1;_314+=
*_3_1415;_31
if(!(*_31+1)
__31415,_314
_31415;*(
)+=*_3_1415
_3_1415 >=
_3_1415+= -
)++;_314=_314
_3_14159 && *
=1,_3_1415 =
_314+(_31415
while( ++ *
)*_3_141--=0
);{ char *
write((3,1),
,(_3_14159
3.1415926; }
_31415<3141-
31415 314-(
_31415 ] +
[_31+1)-_314;
_3141592654))

```

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)

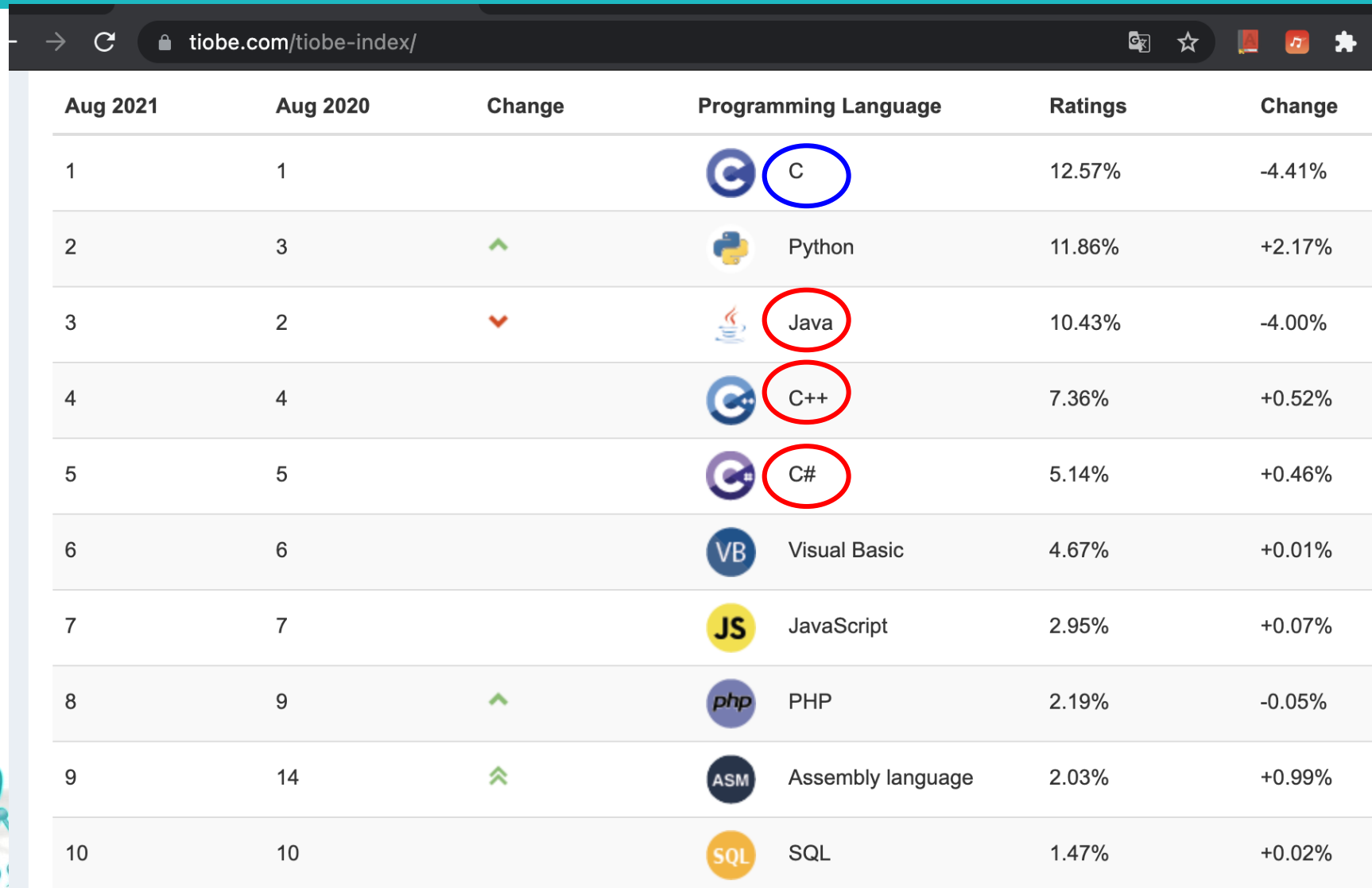
Source: <http://www.ioccc.org/1998/banks.c>













```
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#include <math.h>
#include <sys/time.h>
#include <X11/Xlib.h>
#include <X11/keysym.h>
double L , o , P
, _dt, T, Z, D=1, d,
s[999], E, h= 8, I,
J, K, w[999], M, m, O
, n[999], j=33e-3, i=
1E3, r, t, u, v , W, S=
74.5, l=221, X=7.26,
a, B, A=32.2, c, F, H;
int N, q, C, y, p, U;
Window z; char f[52]
; GC k; main(){ Display*e=
XOpenDisplay( 0); z=RootWindow(e,0); for (XSetForeground(e,k=XCreateGC (e,z,0,0),BlackPixel(e,0))
; scanf("%lf%lf%lf",y +n,w+y, y+s)+1; y ++); XSelectInput(e,z= XCreateSimpleWindow(e,z,0,0,400,400,
0,0,WhitePixel(e,0) ),KeyPressMask); for(XMapWindow(e,z); ; T=sin(O)){ struct timeval G={ 0,dt*1e6}
; K= cos(j); N=1e4; M+= H*_; Z=D*K; F+=*_P; r=E*K; W=cos( 0); m=K*W; H=K*T; O+=D*_F/ K+d/K*E*_; B=
sin(j); a=B*T*D-E*W; XClearWindow(e,z); t=T*E+ D*B*W; j+=d*_D- *_F*E; P=W*E*B-T*D; for (o+=(I=D*W+E
*T*B,E*d/K *B+v+B/K*F*D)*_; p<y; ){ T=p[s]+i; E=c-p[w]; D=n[p]-L; K=D*m-B*T-H*E; if(p [n]+w[ p]+p[s
]= 0|K <fabs(W=T*r-I*E +D*P) |fabs(D=t *D+Z *T-a *E)> K)N=1e4; else{ q=W/K *4E2+2e2; C= 2E2+4e2/ K
*D; N=1E4&& XDrawLine(e ,z,k,N ,U,q,C); N=q; U=C; } ++p; } L+=_ (X*t +P*M+m*1); T=X*X+ 1*l+M *M;
XDrawString(e,z,k ,20,380,f,17); D=v/l*15; i+=(B *l-M*r -X*Z)*_; for(; XPending(e); u *=CS!=N){
XEvent z; XNextEvent(e ,&z);
++*((N=XLookupKeysym
(&z.xkey,0))-IT?
N-LT? UP-N?& E:&
J:& u: &h); --*(
DN -N? N-DT ?N==
RT?&u: & W:&h:&J
); } m=15*F/l;
c+=(I=M/ 1,l*H
+I*M+a*X)*_; H
=A*r+v*X-F*1+(
E=.1+X*4.9/l,t
=T*m/32-I*T/24
)/S; K=F*M+(
h* 1e4/l-(T+
E*5*T*E)/3e2
)/S-X*d-B*A;
a=2.63 /l*d;
X+=( d*1-T/S
*(.19*E +a
*.64+J/1e3
)-M* v +A*
Z)*_; l +=
K *_; W=d;
sprintf(f,
"%5d %3d"
"%7d",p =l
/1.7,(C=9E3+
O*57.3)%0550,(int)i); dt=T*(.45-14/l*
X-a*130-J* .14)*_/125e2+F*_v; P=(T*(47
*I-m* 52+E*94 *D-t*.38+u*.21*E) /1e2+W*
179*v)/2312; select(p=0,0,0,0,&G); v-=
(W*F-T*(.63*m-I*.086+m*E*19-D*25-.11*u
)/107e2)*_; D=cos(o); E=sin(o); } }
```

Does it deserve to learn C?



Aug 2021	Aug 2020	Change	Programming Language	Ratings	Change
1	1		 C	12.57%	-4.41%
2	3	^	 Python	11.86%	+2.17%
3	2	v	 Java	10.43%	-4.00%
4	4		 C++	7.36%	+0.52%
5	5		 C#	5.14%	+0.46%
6	6		 Visual Basic	4.67%	+0.01%
7	7		 JavaScript	2.95%	+0.07%
8	9	^	 PHP	2.19%	-0.05%
9	14	^^	 Assembly language	2.03%	+0.99%
10	10		 SQL	1.47%	+0.02%

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	2021	2016	2011	2006	2001	1996	1991	1986
C	1	2	2	2	1	1	1	1
Java	2	1	1	1	3	18	-	-
Python	3	5	6	8	26	24	-	-
C++	4	3	3	3	2	2	2	6
C#	5	4	5	7	13	-	-	-
Visual Basic	6	13	-	-	-	-	-	-
JavaScript	7	7	10	9	9	22	-	-
PHP	8	6	4	4	10	-	-	-
SQL	9	-	-	-	37	-	-	-
Assembly language	10	11	-	-	-	-	-	-