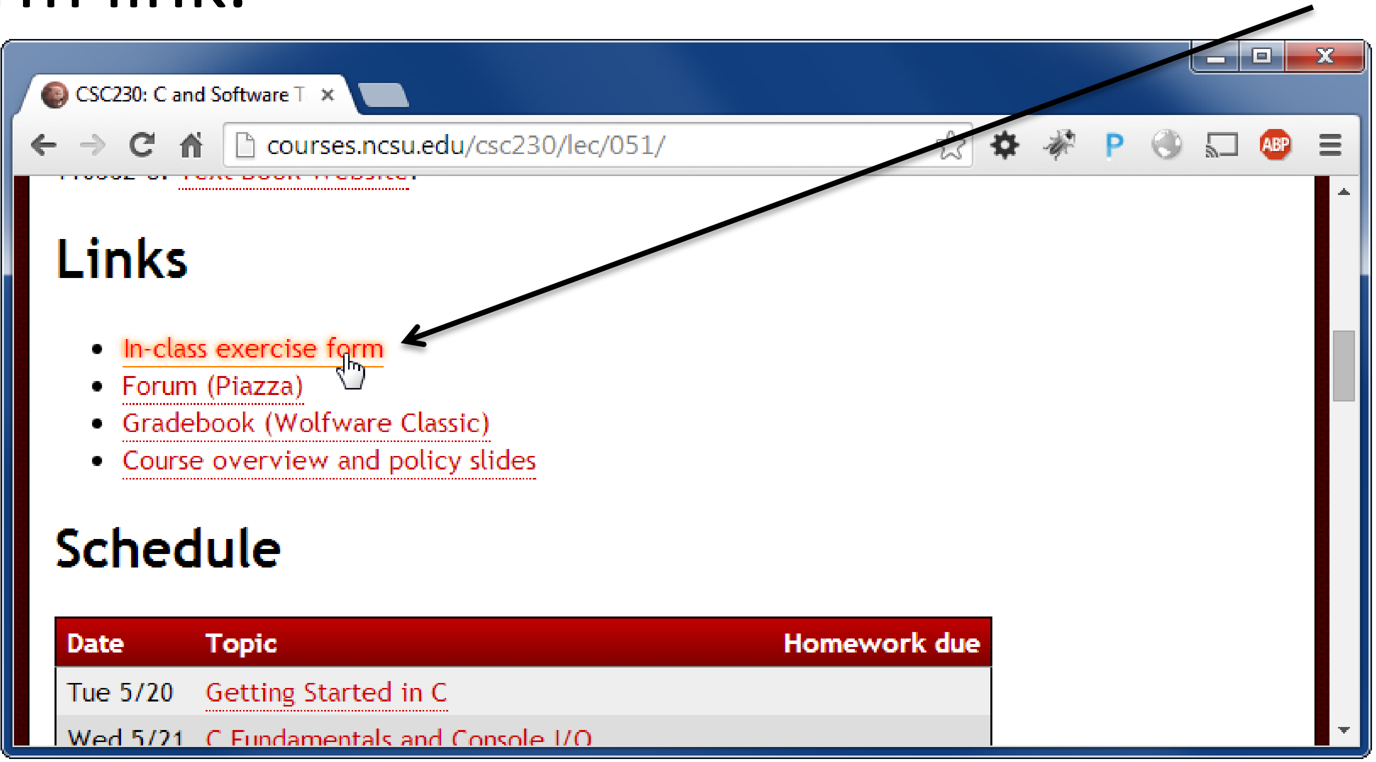
C Fundamentals and Console I/O

CSC230: C and Software Tools

N.C. State Department of Computer Science

Exercise How-to (1)

- Go to the course web page and click the exercise form link.



Links

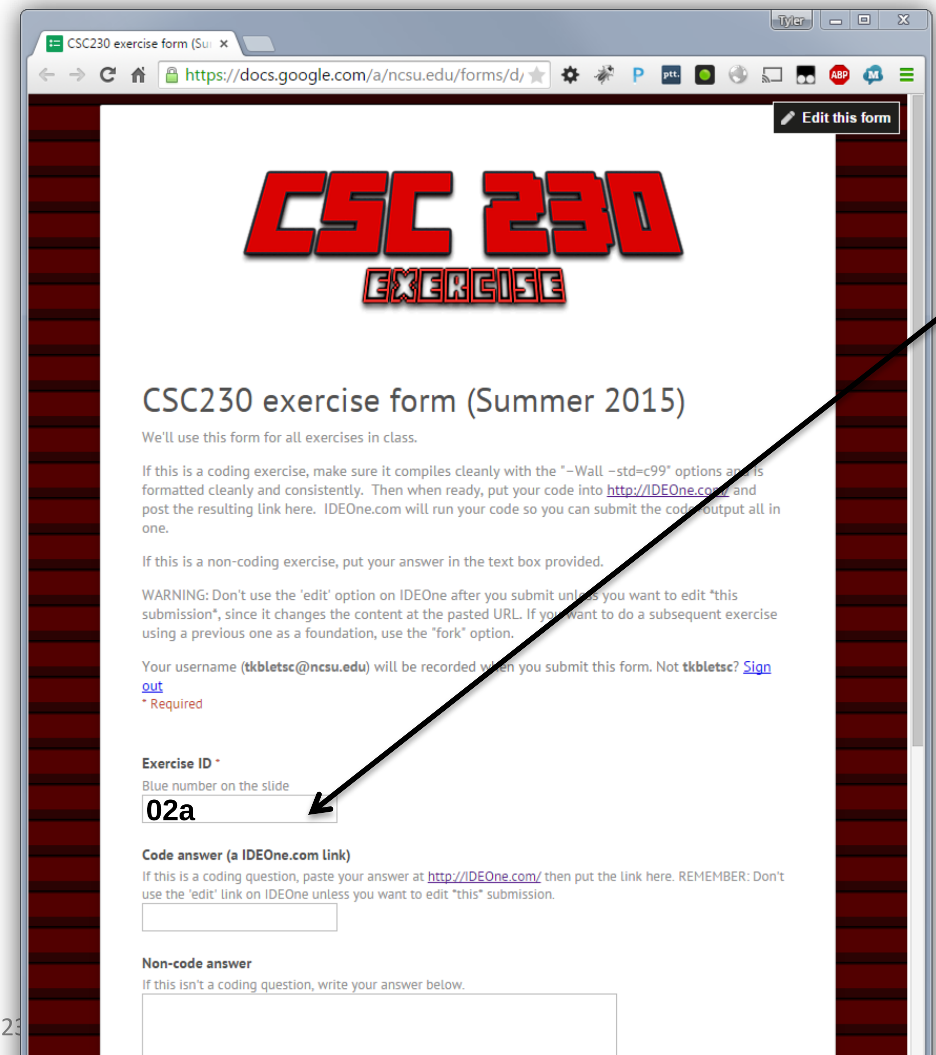
- In-class exercise form
- Forum (Piazza)
- Gradebook (Wolfware Classic)
- Course overview and policy slides

Schedule

Date	Topic	Homework due
Tue 5/20	Getting Started in C	
Wed 5/21	C Fundamentals and Console I/O	

Exercise How-to (2)

- Fill in the GOLD exercise ID.



CSC230 exercise form (Summer 2015)

We'll use this form for all exercises in class.

If this is a coding exercise, make sure it compiles cleanly with the "−Wall −std=c99" options and is formatted cleanly and consistently. Then when ready, put your code into http://IDEOne.com/ and post the resulting link here. IDEOne.com will run your code so you can submit the code+output all in one.

If this is a non-coding exercise, put your answer in the text box provided.

WARNING: Don't use the 'edit' option on IDEOne after you submit unless you want to edit *this submission*, since it changes the content at the pasted URL. If you want to do a subsequent exercise using a previous one as a foundation, use the "fork" option.

Your username (**tkbletsc@ncsu.edu**) will be recorded when you submit this form. Not **tkbletsc**? Sign out

* Required

Exercise ID *

Blue number on the slide

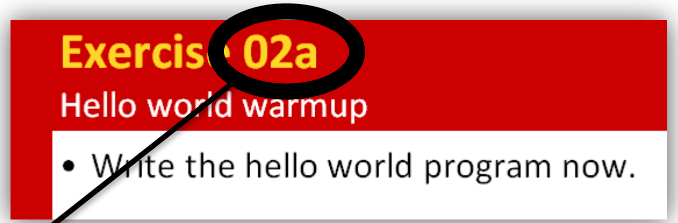
02a

Code answer (a IDEOne.com link)

If this is a coding question, paste your answer at http://IDEOne.com/ then put the link here. REMEMBER: Don't use the 'edit' link on IDEOne unless you want to edit *this* submission.

Non-code answer

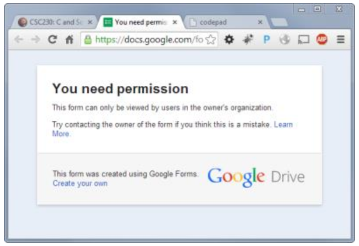
If this isn't a coding question, write your answer below.



Exercise 02a

Hello world warmup

- Write the hello world program now.



You need permission

This form can only be viewed by users in the owner's organization.

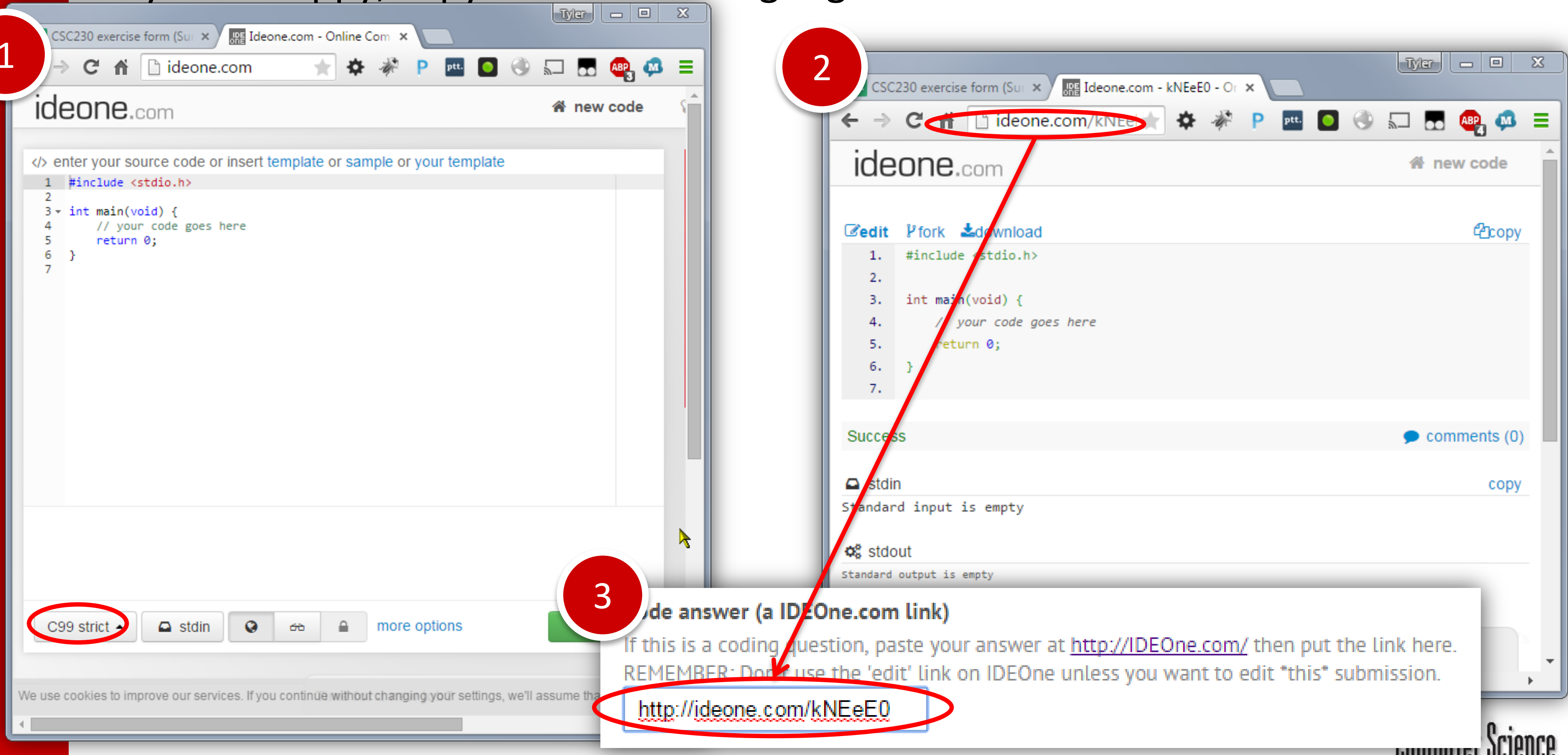
Try contacting the owner of the form if you think this is a mistake. Learn More.

This form was created using Google Forms. Create your own

If you get this, click Google Drive and login with your NCSU account, then try again.

Exercise How-to (3)

- If you're asked to code, code however you see fit, then put the code into **ideone.com** and click **run**. IDEOne will store and run your code for you! When you're happy, copy the URL to the google form.



```
#include <stdio.h>

int main(void) {
    // your code goes here
    return 0;
}
```

```
#include <stdio.h>

int main(void) {
    // your code goes here
    return 0;
}
```

```
Standard input is empty
```

```
Standard output is empty
```

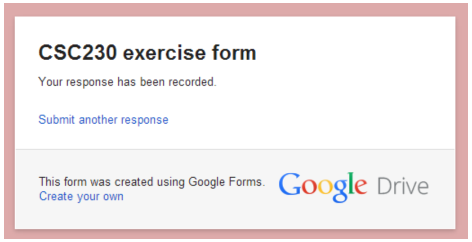
de answer (a IDEOne.com link)

If this is a coding question, paste your answer at http://IDEOne.com/ then put the link here. REMEMBER: Don't use the 'edit' link on IDEOne unless you want to edit *this* submission.

http://ideone.com/kNEeE0

Exercise How-to (4)

- If there’s a non-code question, answer it in the space provided.
- Then hit submit.
- Done!



CSC230 exercise form

Your response has been recorded.

Submit another response

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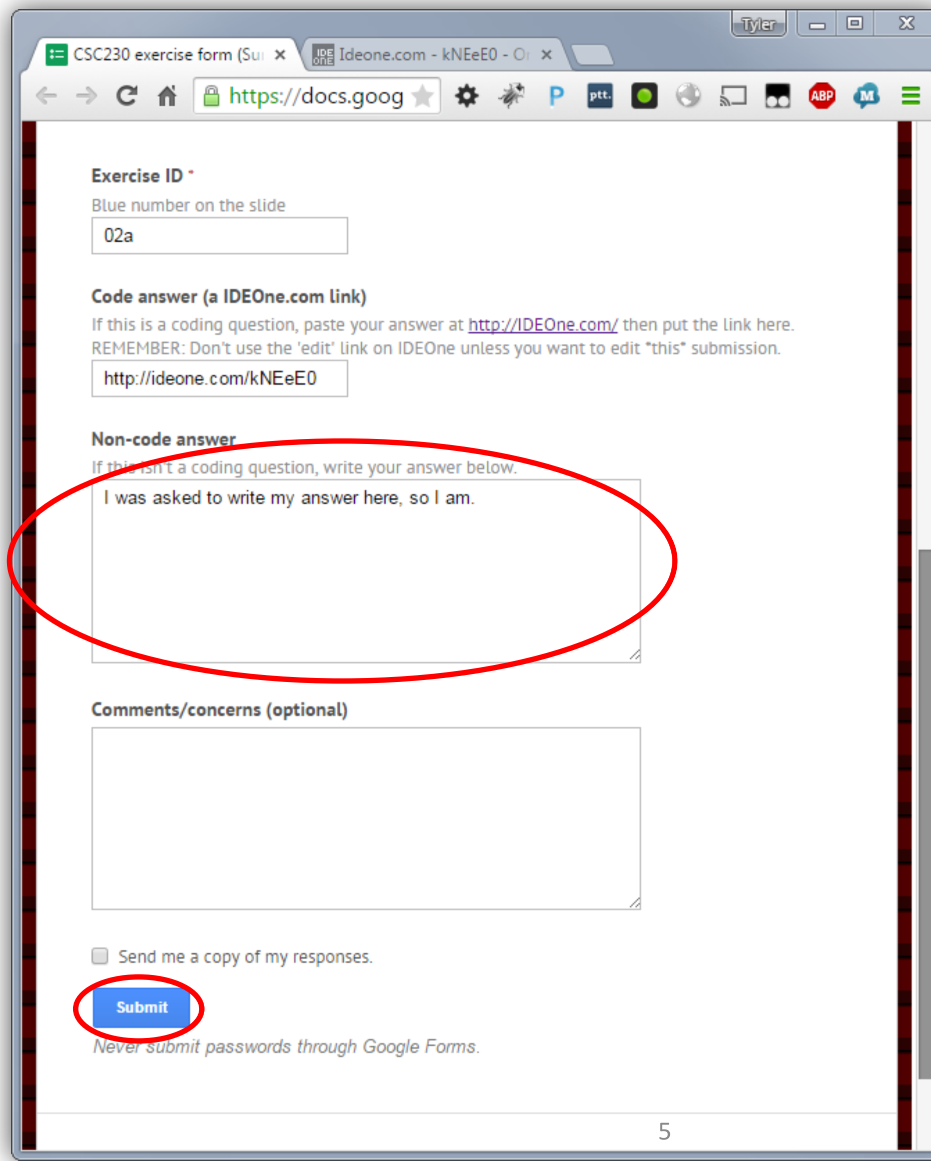
Create your own



Exercise ID *

Blue number on the slide

02a

Code answer (a IDEOne.com link)

If this is a coding question, paste your answer at http://IDEOne.com/ then put the link here.
REMEMBER: Don't use the 'edit' link on IDEOne unless you want to edit *this* submission.

http://ideone.com/kNEeE0

Non-code answer

If this isn't a coding question, write your answer below.

I was asked to write my answer here, so I am.

Comments/concerns (optional)

□ Send me a copy of my responses.

Never submit passwords through Google Forms.

Exercise 02a

Hello world warmup

- Write the hello world program now.

Reminder: Go to course web page for link to exercise form.
Paste code into ideone.com and submit the link.

Outline

- C Coding Style
- Executing Java and C Programs
- Platform Independence?
- Just-in-Time Compilation
- C Compilation Steps
- **`gcc`**
- C99 and C89
- Console I/O
- Streams
- Character I/O
- **`printf`**

C Coding Style (Conventions)

- Universal agreement
  1. clarity and consistency important
  2. indentation, white space, and comments helpful
  3. consistent naming conventions helpful
- See the Style Guidelines for CSC230

Tools (intelligent editors, **`indent`**, etc.) will take care of much formatting for you

Does it Matter?

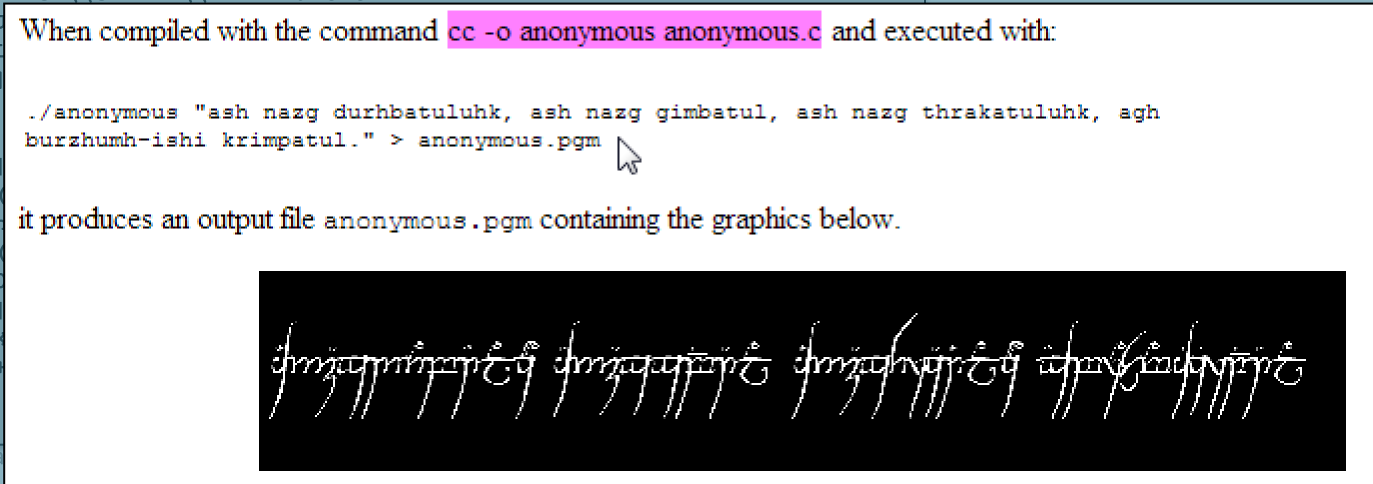
- Entries from the International Obfuscated C Code (IOCC) Contest…

Purpose of program?

```
 #include\
                                  <stdio.h>
                     #include                <stdlib.h>
                     #include                <string.h>

                    #define w "Hk~HdA=Jk|Jk~LSyL[{M[wMcxNksNss:"
                   #define r"Ht@H|@=HdJHtJHdYHtY:HtFHtF=JDBIl"\
                  "DJTEJDFIlMIlM:HdMHdM=I|KIlMJTOJDOIlWITY:8Y"
                 #define S"IT@I\\@=HdHHtGH|KILJJDIJDH:H|KID"\
                "K=HdQHtPH|TIDRJDRJDQ:JC?JK?=JDRJLRI|UItU:8T"
               #define _(i,j)L[i=2*T[j,O[i=O[j-R[j,T[i=2*\
              R[j-5*T[j+4*O[j-L[j,R[i=3*T[j-R[j-3*O[j+L[j,
             #define t"IS?I\\@=HdGHtGIDJILIJDIItHJTFJDF:8J"

    #define y                  yy(4),yy(5),                yy(6),yy(7)
  #define yy(              i)R[i]=T[i],T[i ]            =O[i],O[i]=L [i]
#define Y _(0          ], 4] )_ (1 ], 5] )_ (2      ], 6] )_ (3 ], 7] )_=1
#define v(i)(      (( R[ i ] * _ + T [ i ]) * _ + O [ i ]) * _ + L [ i ]) *2
double b = 32  ,l ,k ,o ,B ,_ ; int Q , s , V , R [8 ], T[ 8] ,O [8 ], L[ 8] ;
#define q( Q,R ) R= *X ++ % 64 *8 ,R |= *X /8 &7 ,Q=*X++%8,Q=Q*64+*X++%64-256,
# define  p      "G\\QG\\P=GLPGTPGdMGdNGtOGlOG"   "dSGdRGDPGLPG\\LG\\LHtGHtH:"
#  define W         "Hs?H{?=HdGH|FI\\II\\GJlHJ"    "lFL\\DLTCMlAM\\@Ns}Nk|:8G"
# define   U           "EDGEDH=EtCElDH{~H|AJk}"       "Jk?LSzL[|M[wMcxNksNst:"
#  define u                  "Hs?H|@=HdFHtEI"             "\\HI\\FJLHJTD:8H"
char  *   x                   ,*X , ( * i )[               640],z[3]="4_",
*Z = "4,8O4.8O4G" r U "4M"u S"4R"u t"4S8CHdDH|E=HtAIDAIt@IlAJTCJDCIlKI\\K:8K"U
 "4TDdWDdW=D\\UD\\VF\\FFdHGtCGtEIDBIDDIlBIdDJT@JLC:8D"t"4UGDNG\\L=GDJGLKHL\
FHLGHtEHtE:"p"4ZFDTFLT=G|EGlHITBH|DIlDIdE:HtMH|M=JDBJLDKLAKDALDFKtFKdMK\
\\LJTOJ\\NJTMJTM:8M4aGtFGlG=G|HG|H:G\\IG\\J=G|IG|I:GdKGlL=G|JG|J:4b"W
S"4d"W t t"4g"r w"4iGlIGlK=G|JG|J:4kHl@Ht@=HdDHtCHdPH|P:HdDHdD=It\
BIlDJTEJDFIdNI\\N:8N"w"4lID@IL@=HlIH|FHlPH|NHt^H|^:H|MH|N=J\\D\
J\\GK\\OKTOKDXJtXItZI|YIlWI|V:8^4mHLGH\\G=HLVH\\V:4n" u t t
"4p"W"IT@I\\@=HdHHtGIDKILIJLGJLG:J
rHt@H|@=HtDH|BJdLJTH:ITEI\\E=ILPII
p"4zI[?Il@=HlHH|HIDLILIJDII|HKDAJ|
THLdFNk|Nc|\
:8K"; main (
int C,char**        A) {for(x=A[1]
C-1;C<3?Q=_=       0,(z[1]=*x++)?(
strstr(Z,z))      &&(X+=C++):(prin
V*=2,s=Q=0,C     =4):C<4?Q-->0?i[(
]=1:_?_-=.5/    256,o=(v(2)-(l=v(0
))/Q:*X>60?y   ,q(L[4],L[5])q(L[6]
Y:*X>57?++X,  y,Y:*X >54?++X,b+=*X
,i[Q][s]+i[Q ][s+1]+i[Q+1][s]+i[Q+
0,s+=2)<640
||(C=1));}
```



When compiled with the command cc -o anonymous anonymous.c and executed with:

```
./anonymous "ash nazg durhbatuluhk, ash nazg gimbatul, ash nazg thrakatuluhk, agh
burzhumh-ishi krimpatul." > anonymous.pgm
```

it produces an output file anonymous.pgm containing the graphics below.

```
            /*                                     ,*/
           #include                              <time.h>
            #include/*                     _  ,o*/  <stdlib.h>
            #define  c(C)/*     -      . */return      ( C); /*    2004*/
             #include   <stdio.h>/*.   Moekan           "'   `\b-'     */
               typedef/*  */char   p;p* u                     ,w       [9
                 ][128] ,*v;typedef  int _;_   R,i,N,I,A               ,m,o,e
            [9],  a[256],k    [9], n[               256];FILE*f       ;_ x   (_ K,_ r
       ,_ q){;   for(;                                         r<     q    ; K       =((
    0xffffff)   &(K>>8))^                                        n[255     &        ( K
  ^u[0        +                                     r  ++      ]     )]);c          (K
 )}        _ E                           (p*r,    p*q  ){     c(          f         =
         fopen                     (r  ,q))}_   B(_ q){c(    fseek        (f,      0
       ,q))}_ D(){c(  fclose(f ))}_  C(  p    *q){c(  0-    puts(q    )   )}_/*   /
     */main(_ t,p**z){if(t<4)c(   C("<in"       "file>"    "\40<l"   "a"  "yout> "
    /*b9213272*/"<outfile>"   ) )u=0;i=I=(E(z[1],"rb")) ?B(2)?0 :   (((o   =ftell
   (f))>=8)?(u     =(p*)malloc(o))?B(0)?0:!fread(u,o,1,f):0:0)?0:  D():0      ;if(
  !u)c(C("      bad\40input  "));if(E(z[2],"rb" )){for(N=-1;256> i;n[i++] =-1   )a[
  i]=0;       for(i=I=0;   i<o&&(R  =fgetc(   f))>-1;i++)++a[R] ?(R==N)?( ++I>7)?(n[
 N]+1       )?0:(n [N   ]=i-7):0:   (N=R)    |(I=1):0;A =-1;N=o+1;for(i=33;i<127;i++
 )(        n[i   ]+  1&&N>a[i])?    N= a     [A=i]     :0;B(i=I=0);if(A+1)for(N=n[A];
I<       8&&   (R  =fgetc(f ))>    -1&& i   <o        ;i++)(i<N||i>N+7)?(R==A)?((*w[I
]             =u [i])?1:(*w[I]=   46))?(a             [I++]=i):0:0:0;D();}if(I<1)c(C(
             "  bad\40la" "yout  "))for(i            =0;256>(R=  i);n[i++]=R)for(A=8;
            A  >0;A --)   R  = ( (R&1)==0)          ?(unsigned int)R>>(01):((unsigned
           /*kero  Q'        ,KSS  */)R>>         1)^        0xedb88320;m=a[I-1];a[I
           ]=(m           <N)?(m=   N+8):        ++        m;for(i=00;i<I;e[i++]=0){
          v=w         [i]+1;for(R                      =33;127  >R;R++)if(R-47&&R-92
          &&       R-(_)* w[i])*(                   v++)=    (p)R;*v=0;}for(sprintf
                 /*'_  G*/  (*w+1,              "%0"     "8x",x(R=time(i=0),m,o)^~
               0)   ;i<       8;++           i)u      [N+ i]=*(*w+i+1);for(*k=x(~
                 0,i=0     ,*a);i>-        1;      ){for (A=i;A<I;A++){u[+a [ A]
               ]=w[A       ][e[A]]  ;     k     [A+1]=x (k[A],a[A],a[A+1]
             );}if     (R==k[I])      c(      (E(z[3  ],"wb+"))?fwrite(
            /* */   u,o,1,f)?D          ()|C("  \n    OK."):0    :C(
           "  \n  WriteError"            ))  for  (i  =+I-
          1  ;i >-1?!w[i][++                 e[+ i]]:0;
            ) for( A=+i--;                 A<I;e[A++]
            =0); (i <I-4                 )?putchar
            ((_   )  46)                  | fflush
           /*'      ,*/                  ( stdout
           ):       0&                    0;}c(C
          ("       \n                   fail")
          )      /*                    dP' /
                dP                    pd  '
               '                      zc
                                     */
                                    }
```

“Rinia is a tool for embedding CRCs in text files”

Ex.: Some GNOME Project Guidelines

- "Programmers should strive to write good code so that it is easy to understand and modify by others
- Important qualities of good code
  - clarity
  - consistency
  - extensibility
  - correctness"

Example… (cont'd)

- "It is important to follow a good naming convention for the symbols in your programs
  - Function names should be of the form **`module_submodule_operation`**, for example, **`gnome_canvas_set_scroll_region`**
  - Symbols should have descriptive names: do not use **`cntusr()`**, use **`count_active_users()`** instead
  - Function names are lowercase, with underscores to separate words, like this:

    `gnome_canvas_set_scroll_region()`"

Example… (cont'd)

- "Macros and enumerations are uppercase, with underscores to separate words, like this: **`GNOMEUIINFO_SUBTREE()`** for a macro
- Typedefs and structure names are mixed upper and lowercase, like this: **`GnomeCanvasItem`**, **`GnomeIconList`**
- Very short and terse names should only be used for the local variables of functions; never call a global variable **`x`**; use a longer name that tells what it does"

Another Ex.: Some Linux Guidelines

- “Tabs are 8 characters, and indentations too
- Put the opening brace last on the line, and put the closing brace first, thusly:

```
if (x is true) {
  we do y
}
```

- Functions have the opening brace at the beginning of the next line, thus:

```
int function(int x)
{
  body of function
}”
```

Our Guidelines! (These Matter!)

- File level comments
  - Author(s) name and unity id(s)
  - Brief purpose of program or module within program
- Function comments
  - Function’s purpose
  - Inputs (global or parameters)
  - Outputs (return values and side effects)
  - Pre-conditions
  - Post-conditions (including side effects)

Our Guidelines! (These Matter!)

- Global Variables
  - Describe purpose
- Magic Numbers
  - Use #define except for obvious numbers (-1, 0, 1, 2)
    - Unless those numbers have a specific named purpose or are an exit code!!!

Our Guidelines! (These Matter!)

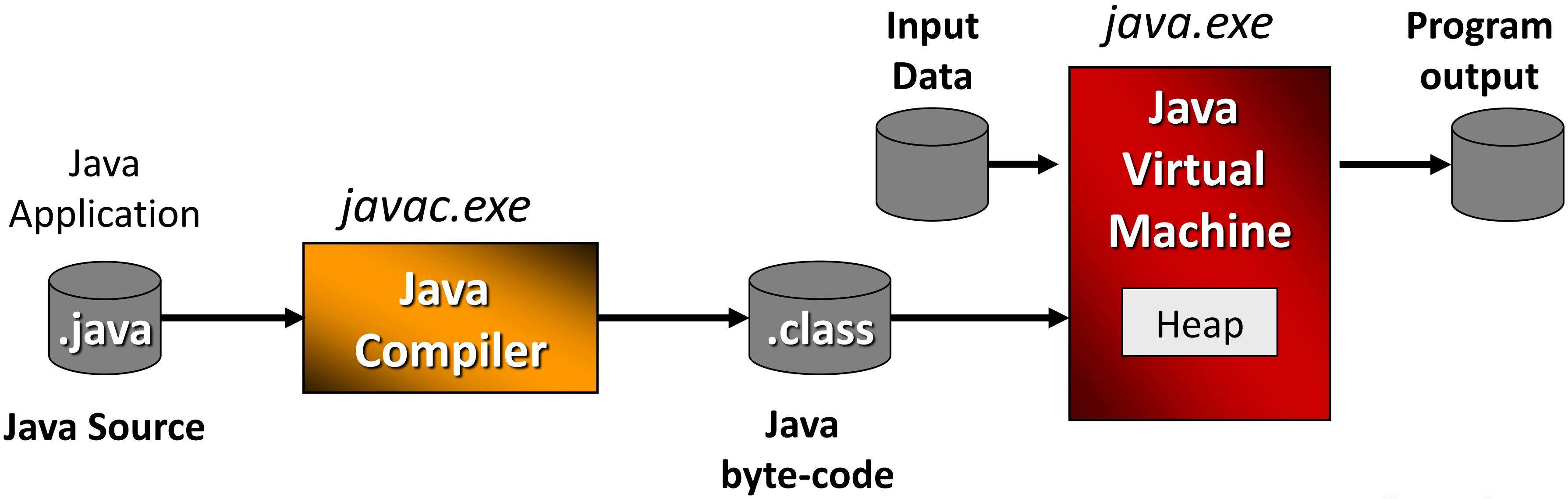
- Indentation
  - All indentation must be spaces (except for Makefiles)
  - The number of spaces for indentation must be consistent
    - 2 to 4 spaces
  - Indent:
    - Statements in a function
    - Statements in a control structure
    - Statements in a block { }

Our Guidelines! (These Matter!)

- Curly Braces
  - Functions – opening curly brace on next line
  - Everything else – opening curly brace at end of control structure
- Statements
  - 1 statement per line

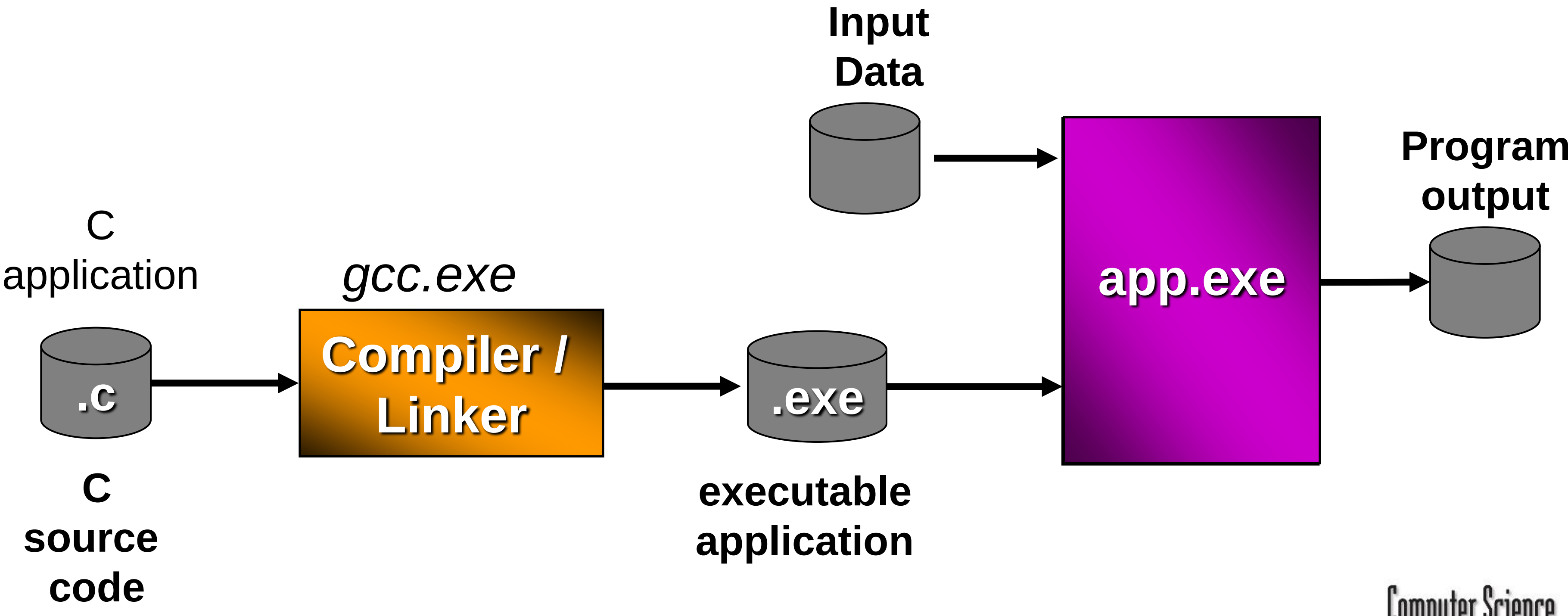
Executing Java Programs

1. Java source code is compiled into platform-independent intermediate form (*bytecode*)
2. This intermediate code is interpreted by the Java Virtual Machine (JVM)



Executing C Programs

1. HLL source code is compiled into the instruction set of the target computer
2. This code is loaded and executed directly by the host



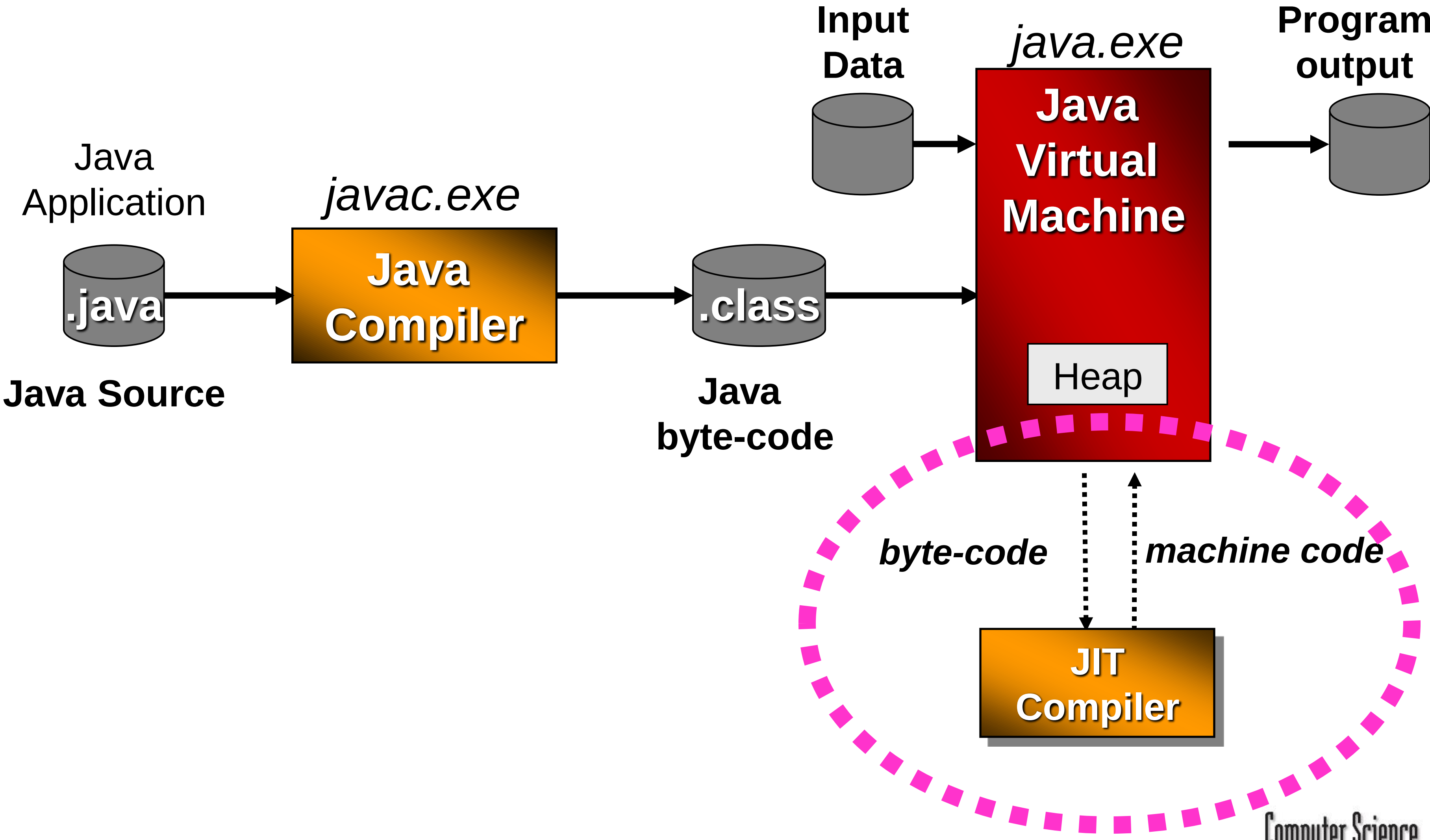
Platform Independence?

- Compiled
  - parts of the compiler (*front end*) are platform-independent
  - parts of the compiler (*back end*) are specific to the platform on which the program will be executed
- Interpreted
  - the Java compiler is platform-independent
  - the JVM is platform-specific

“Just-in-Time” Compiling

- Idea: compile a method to machine code just before first use
  - and reuse that machine code each time the method is invoked
- Benefits of interpreted + speed of compiled

JVM, Again

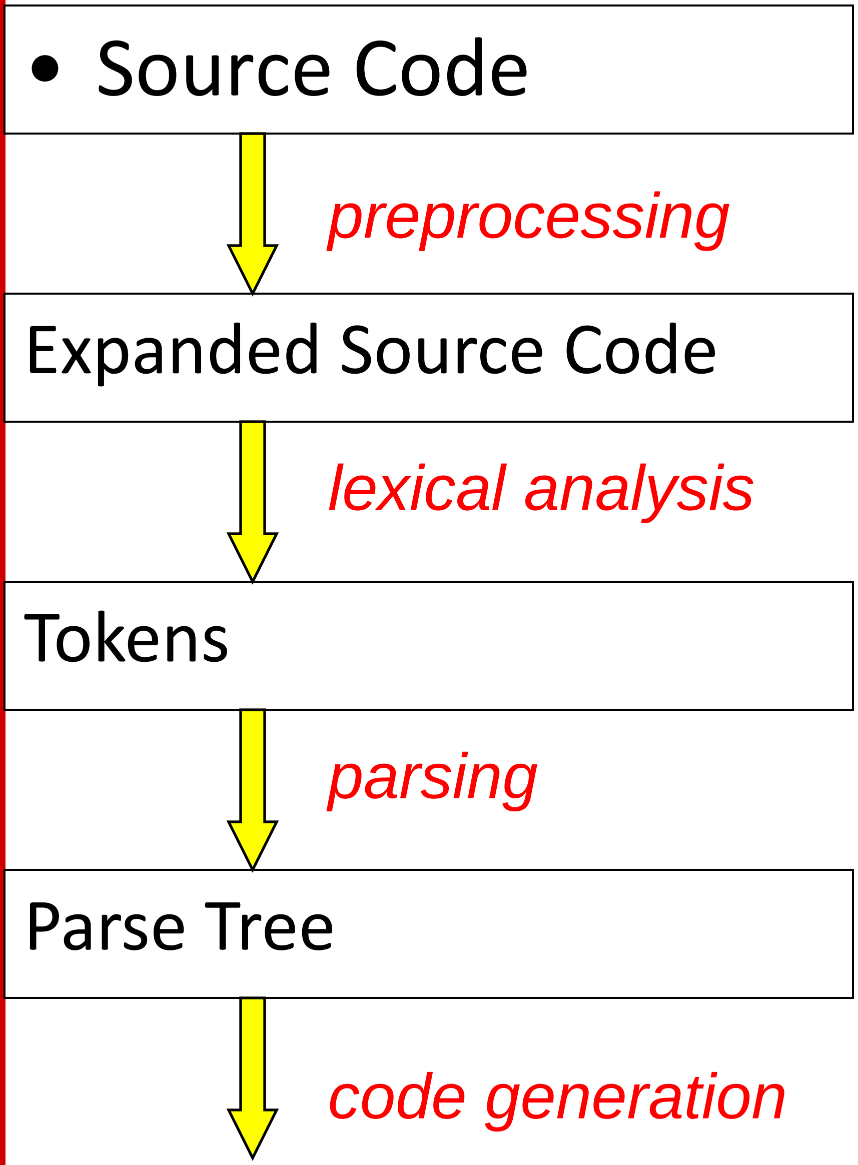

Input
Data
java.exe
Program
output
Java
Virtual
Machine
Heap
Java
Application
javac.exe
Java
Compiler
.java
.class
Java Source
Java
byte-code
byte-code
machine code
JIT
Compiler

Comparison

Property	Better Compiled, or Interpreted?
Execution Speed	?
Error messages, debugging support	?
Platform Independence / Portability	?

- Another (major) benefit of interpreted languages: dynamic typing of variables
  - – not supported in Java, however

Steps in Compiling C Programs



- Source Code

```
#define N 3
a=c+b*N;
```

preprocessing

Expanded Source Code

```
a=c+b*3;
```

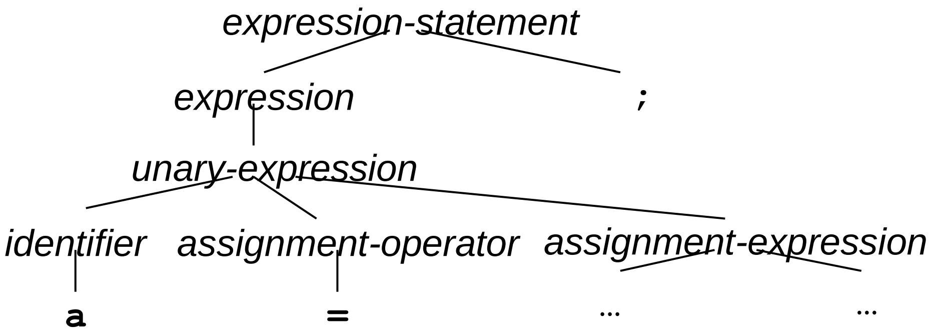
lexical analysis

Tokens

```
a   =   c   +   b   *   3   ;
```

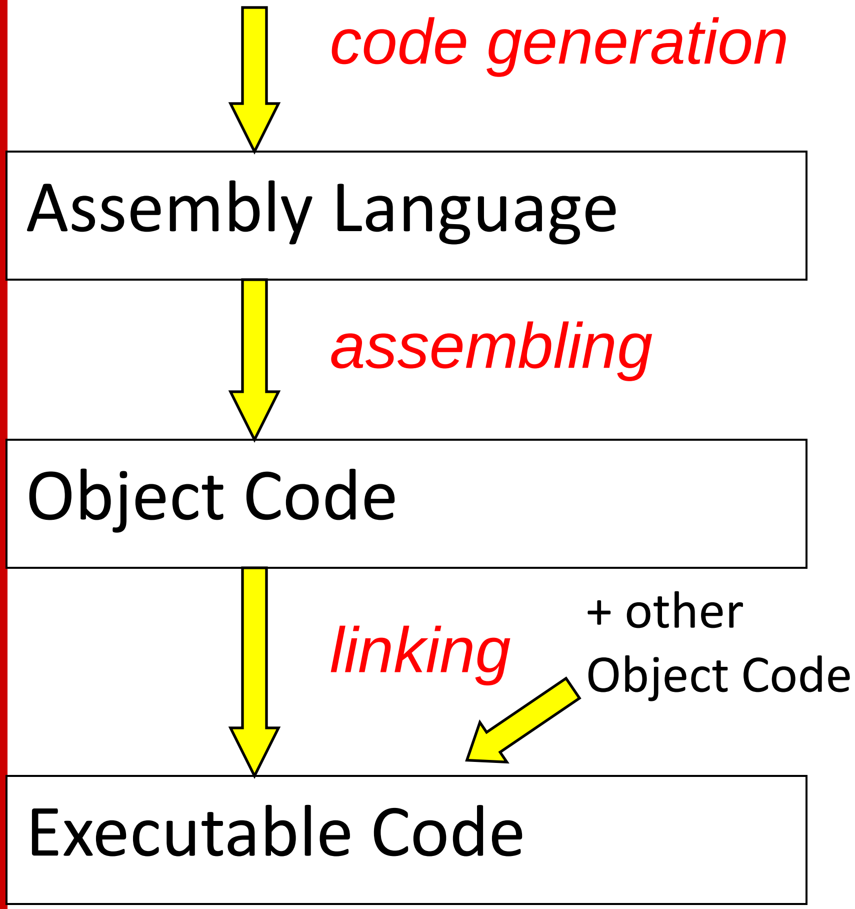
parsing

Parse Tree



code generation

Steps… (cont’d)



```
mov ebx, b
imul ebx, ebx, 3
mov ecx, c
```

```
001110010111
```

```
0011100101110110101…
```

Using the **gcc** Compiler

- **`gcc`** is a high-quality, open source compiler available for most platforms
- At the command prompt, type

```
gcc   -Wall  -std=c99 <pgm.c>
```

where <*pgm.c*> is the C program source file

  - Creates an executable **`a.out`**.

- **`-std=c99`** specifies that C99 standard features are allowed
- **`-Wall`** turns on all the important warning messages

Compiler… (cont’d)

- GNOME (and me): “Make sure your code compiles with absolutely no warnings from the compiler. These help you catch stupid bugs.”

Some Useful gcc Options

-o *file*	Put output in file named **file**
-std=c99	Support C99 language features
-Wall	Enable all warnings
-c	Compile the source code but do not link (i.e., produce only the object file (.o))
-E	Preprocess the source code only (i.e., expand macros, but do not compile the source code) – prints to console
--version	Display version number of gcc
-g	Produce information necessary to **debug** using gdb

`gcc` Options… (cont’d)

-O, -O1	Various optimization levels
-D *name*	Define name as a macro with value 1 (used for conditional compilation)
-l*lib*	Search named **library** when linking (That’s a lower case L, as in “library”)
-I*dir*	Add directory **dir** to the head of the list of directories to search for header files (That’s an upper case i, as in “include”)
-L*dir*	Add directory **dir** to the list of directories to search for libraries containing object files (specified using the **-l** option)

A Word About C99

- The generations of C
  - K&R C
  - C89 (or C90)
  - C99

ISO standards

- We will use C99 in this course
  - for the most part, C99 adds to / clarifies earlier versions, does not invalidate earlier code

(Some) Differences C89↔C99

1. *Comments allowed to be C++ style (//)*
2. `_Bool` *macro is available*
3. *Additional library functions, and a few new header files*
4. *Variable length arrays*
5. *Variable declarations can appear anywhere in the code block*
6. *Variable declarations in* `for` *loops*
7. *Support for non-ASCII character sets ("wide" characters)*

Grey = generally supported in gcc C89 anyway unless compiler is in strict mode

(Some) Differences… (cont’d)

8. *New* **`long long`** *integer data type*
9. *Functions must declare a return value*
10. *Macros may have variable number of arguments, denoted by ellipsis (…)*
11. *Functions may be inlined*
12. *Restricted pointers (prevent aliasing)*

Grey = generally supported in gcc C89 anyway unless compiler is in strict mode

C99… (cont'd)

- *gcc 4.4.6 supports most of C99, but you may not be able to use…*
  - *wide characters*
  - *complex numbers*
  - *extended integer types (`long long`)*

Console I/O in C

- I/O is provided by standard library functions
  - available on all platforms
- To use, your program must have

```
#include <stdio.h>
```

"Standard IO"

Not "studio"!!

- …and it doesn't hurt to also have

```
#include <stdlib.h>
```

"Standard library"

- *These are preprocessor statements; the .h files define function types, parameters, and constants from the standard library*

Streams

- A *stream* is a file or a device from which data is read, and/or to which data is written
- By default, every C program automatically has 3 open streams, called
  - the *standard input*
  - the *standard output*
  - the *standard error*
- If you do not override them…
  - standard input = the keyboard
  - standard output & error = the terminal window

Streams… (cont'd)

- Note: the EOF character on your keyboard is either `ctrl-d` (Unix, Linux, Mac OS X) or `ctrl-z` (Windows)
- You can redirect the standard input from a file, e.g.,

```
pgm99 < infile.txt
```

- You can redirect the standard output to a file, e.g.,

```
pgm99 > outfile.txt
```

Reading One Character from Standard Input

- Definition (from `stdio.h`):

  `int getchar(void)`

```
int c;

c = getchar();
if (c == EOF)
      …
```

Notes

- **`EOF`** defined in **`stdio.h`**
- declaring **`c`** as type **`char`** and then comparing to **`EOF`** may fail ☹

Writing One Character to Standard Output

Definition (from `stdio.h`):

`int putchar(int c)`

```
char c;
int b;
…
b = putchar((int) c);
if (b == EOF)
    …
```

Program `echochar.c`

```c
#include <stdio.h>

int main ( void )
{
    int c;
    c = getchar();
    while (c != '\n') {
        putchar(c);
        c = getchar();
    }
    putchar('\n');

    return 0;
}
```

Example: **`echochar.c`**

- Keyboard input vs. input from a file
  - use editor to type the input in a file called **`in.txt`**
  - then run **`echochar`** with input redirected from the file

```
% ./echochar < in.txt
```

- No changes to the program!

Demo…

The `printf()` function

- **`putchar()`** is too cumbersome to use for extensive, formatted output
- **`printf()`** is a much more convenient library function for formatted output, with built-in conversions of input parameters to printable form
- Def: **`int printf(const char * format, …)`**
  - variable number of arguments
- **`format`** specifies how input arguments must be converted/formatted for output

Parts of `format`

1. % (mandatory)
2. 0 or more flags (infrequently used)
3. Minimum output field width (pad with spaces)
   (useful for making things line up)
4. .Precision (minimum number of digits to right of decimal point)
   (optional, default is 6 digits)
5. type of format conversion (mandatory)

Precision Matters

- **`printf`** the number 33.3:

Format Specifier	Output
`%7.1f`	`   33.3`
`%14.10f`	` 33.3000000000`
`%.20f`	`33.29999999999999715783`

Some Types of Conversions

Print as Type…	Specifier
`char`	`%c`
`unsigned int`	`%u` (in decimal) `%o` (in octal) `%x`, `%X` (in hex) (`%lu`, `%lo`, `%lx` for long)
`signed int`	`%d`, `%i` (in decimal) (`%ld`, `%li` for long)
`float`	`%f`
`float`	`%e`, `%E` (use scientific notation)
(string)	`%s`

Red = most commonly used (by me).

Example

- Program

```
char c = ‘a’;
int i = 9999;
float f = 3.1415926535897932;

printf(“c = %c (%o in octal)\n”, c, c);
printf(“i = %6d (%x in hex)\n”, i, i);
printf(“f = %8.5f (%e in sci. notation)\n”,
        f, f);
```

Output:

```
c = a (141 in octal)
i =   9999 (270f in hex)
f =  3.14159 (3.141593e+00 in sci. notation)
```

Reminder

- Base 16 (“hex”):
- $2F3_{16} = 2 * 16^2 + 15 * 16^1 + 3 = 755_{10}$
- Base 8 (“octal”):
- $463_8 = 4 * 8^2 + 6 * 8^1 + 3 = 307_{10}$

Exercise 02b

Basic I/O

- Write a program that
  - Reads 3 characters from standard input (all on one line, no spaces)
  - Outputs the characters in reverse order to standard output
- Make sure it compiles cleanly with the **`–Wall -std=c99`** options
- Make sure it is formatted cleanly and consistently
- Submit through Google Form

Reminder: Go to course web page for link to exercise form.
Paste code into ideone.com and submit the link.

Any Questions?

BACKUP

Formatting with **`indent`**

- Many editors and IDEs (emacs, vim, Eclipse, Visual Studio, …) automatically do formatting while you write your code
- Another option: use a standalone tool for formatting, e.g., **`indent`**
- Warning: remove tabs from your source code before using **`indent`**

Example: Code Before `indent`

```
#include <stdio.h>
#include <stdlib.h>

static int  computelength (int, int);
int main (void) {
    typedef struct { int         left; int         right; int         length; }
          linesegment;
    linesegment *seg1, *seg2; seg1 = (linesegment *) malloc (sizeof (linesegment
)); seg2 = (linesegment *) malloc (sizeof (linesegment));
                (void) printf ("Enter left edge of segment 1: ");
(void) scanf ("%d", &(seg1->left)); (void) printf ("Enter right edge of segment
1: "); (void) scanf ("%d", &(seg1->right)); (void) printf ("Enter left edge of s
egment 2: "); (void) scanf ("%d", &(seg2->left)); (void) printf ("Enter right ed
ge of segment 2: ");
                            (void) scanf ("%d", &(seg2->right));
                            seg1->length = computelength (seg1->left, seg1->righ
t);
seg2->length = computelength (seg2->left, seg2->right); if (seg1->length == seg2
->length) printf ("segment lengths are equal\n"); else printf ("segment lengths
are NOT equal\n"); return 0; } int computelength (int left, int right) { return
(right-left); }
```

- A mess!

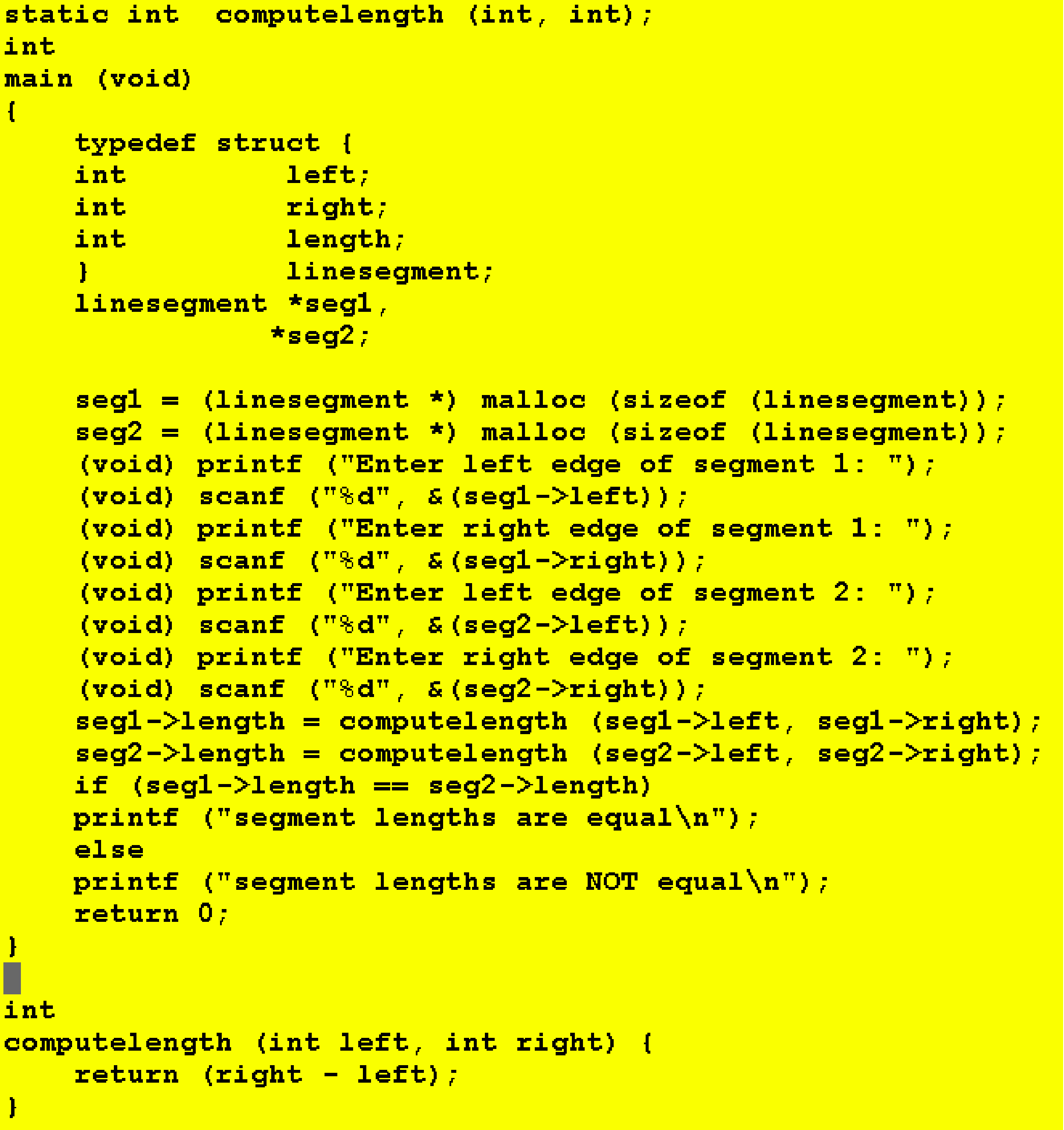
Example: Using `indent`

```
indent prog.c
```

- Lots of options, customize to your preference
  - put these options in a file named `.indent.pro`, in your home directory

- Default indent does NOT meet all of our style guidelines!

Example: after `indent`



```
static int  computelength (int, int);
int
main (void)
{
    typedef struct {
    int         left;
    int         right;
    int         length;
    }           linesegment;
    linesegment *seg1,
               *seg2;

    seg1 = (linesegment *) malloc (sizeof (linesegment));
    seg2 = (linesegment *) malloc (sizeof (linesegment));
    (void) printf ("Enter left edge of segment 1: ");
    (void) scanf ("%d", &(seg1->left));
    (void) printf ("Enter right edge of segment 1: ");
    (void) scanf ("%d", &(seg1->right));
    (void) printf ("Enter left edge of segment 2: ");
    (void) scanf ("%d", &(seg2->left));
    (void) printf ("Enter right edge of segment 2: ");
    (void) scanf ("%d", &(seg2->right));
    seg1->length = computelength (seg1->left, seg1->right);
    seg2->length = computelength (seg2->left, seg2->right);
    if (seg1->length == seg2->length)
    printf ("segment lengths are equal\n");
    else
    printf ("segment lengths are NOT equal\n");
    return 0;
}

int
computelength (int left, int right) {
    return (right - left);
}
```

- Much better!