CS246
Unix: grep
C: pass by value, references

March 4

grep

Global Regular Expression Print

- One of the most used Unix utilities
- Idea: from standard input (or file) find lines that contain a “regular expression”
  - or just a string
- Example
  - LS -R — recursively list all files
  - ls -R | grep c
    - finds all files with the letter c
  - grep Darcy ~/public/206/a4/janeausten.txt
    - find all lines that contain “Copperfield” in my dickens collection
    - really long so
      - grep Darcy ~/public/206/a4/janeausten.txt | wc

the RE part of gREp

- Regular expression
    - a way of allowing for broader classes of matches
        - Anchors
            - ^ the beginning of a line
                - show only directories in ls
                    - ls -l | grep ^d
            - $ the end of the line
                - show all files in ls that end in s
                    - ls -l | grep s$

the RE part of gREp

- . — any single character
    - find all lines containing d, two characters, y
        - grep “d..y” Public/206/a4/janeausten.txt
- [] a character group — match to any single character in group
    - find all lines containing d, a vowel, y
        - grep “d[aeiou]y” Public/206/a4/janeausten.txt
    - find all lines containing d, a letter, y
        - grep “d[a-z]y” ..
    - Same but case insensitive
        - grep “[dD][a-zA-Z][yY]” …
        - grep -i “d[a-z]y” …

the RE part of gREp

- Quantifiers
  - Apply to the **previous** character (or group)
  - * — match to 0 or more
    - .* == match to 0 or more occurrences of any letter
      - d.*y matches dy, day, dly, d_y, duly, daddy, …
  - ? — 0 or 1
    - a? == match to a string that has 0 or 1 a
      - da?y matches dy, day
  - + — 1 or more
    - [a-z]+ one or more instances of any lower case letter
    - d[a-z]+y matches day,dly, daddy, …

grep — escapes and quotes

- suppose you want to find a line containing . *, or +, or [, or any other character used specially in regular expressions
    - precede that char with \
        - sometimes called the “escape character”
    - Find all lines containing the character “.”
        - grep “\.” dickens.txt
- It is often important — and never wrong — to put REs in quotes
        - grep “\.” dickens.txt — lines containing a .
        - grep \. dickens.txt — every line in the file
    - without quotes characters can get interpreted by the shell
        - grep * dickens.txt
            - the * is interpreted by the shell to be a filename expansion operator
                - e.g. grep dickens *.txt

LAB from Monday

- Write your own implementation of strcpy
  - `void strcpy(int destLen, char dest[destLen], char source[]);`

```c
void strcpyGT(int ll, char tgt[ll], char src[]) {
    int i = 0;
    for (; i < ll - 1 && src[i] != '\0'; i++) {
        tgt[i] = src[i];
    }
    tgt[i] = ‘\0';
}
int main(int argc, char const *argv[]) {
    char line[LINE_LEN];
    while (fgets(line, LINE_LEN, stdin) != NULL) {
        char copy[LINE_LEN];
        for (int i = 0; i < LINE_LEN; i++) copy[i] = 'z';
        strcpyGT(LINE_LEN, copy, line);
        printf("%d  %d  %s  %s>>>\n", strlen(line), strlen(copy), line, copy);
    }
    return 0;
}
```

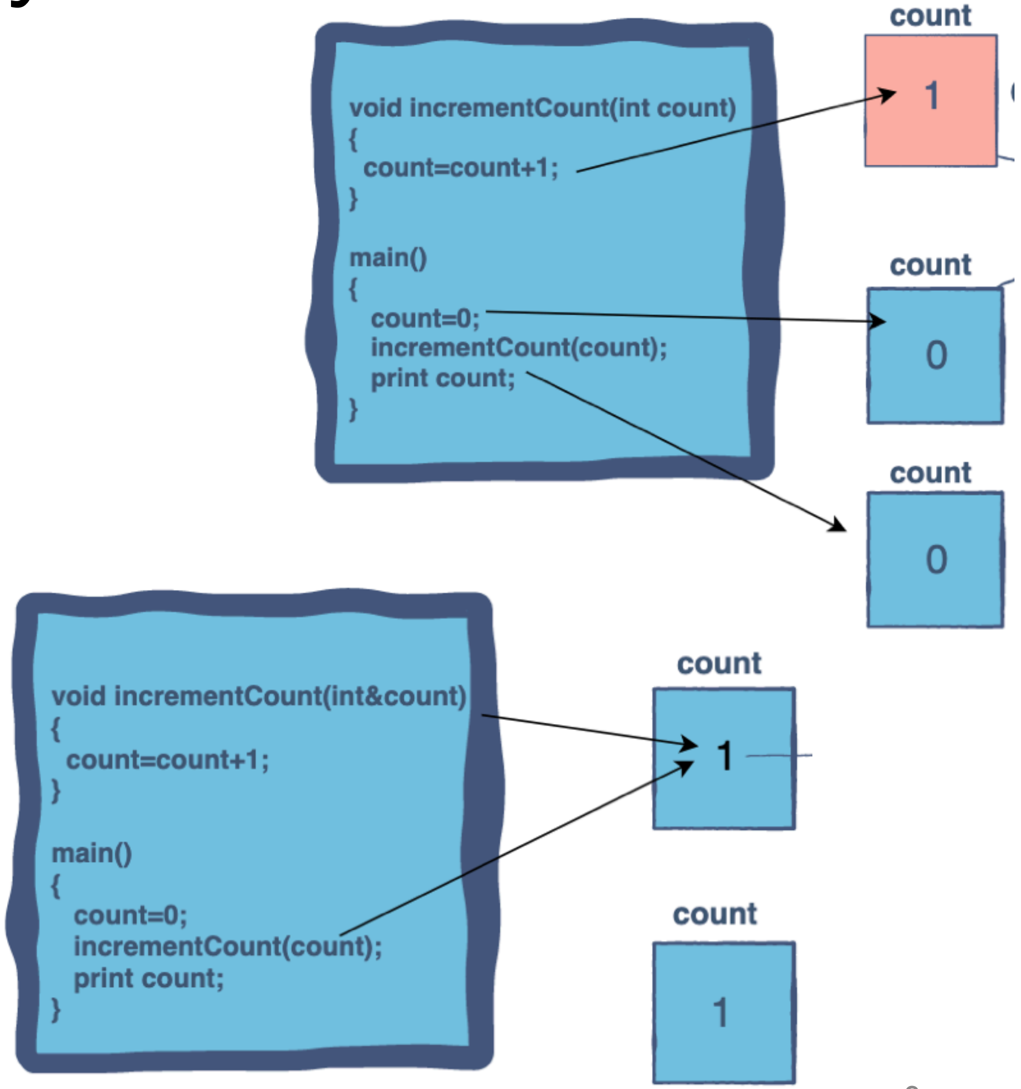
What happens without this???

Homework 3

- posted on class website
- timing — see code in timer.c for today's lecture for 3(!) different ways of timing

Pass by value vs Pass by Reference

- Function Calls
  - Pass by value
    - make a copy and work with that
    - changes inside function do not affect outside
- Pass by reference
  - Work with the same exact thing
  - Change inside function change the outside



```
void incrementCount(int count)
{
 count=count+1;
}

main()
{
  count=0;
  incrementCount(count);
  print count;
}
```

```
void incrementCount(int&count)
{
 count=count+1;
}

main()
{
  count=0;
  incrementCount(count);
  print count;
}
```

PbV or PbR

- Which
    - Java
        - PbV on primitive types
        - PbR on objects
    - C
        - PbV on basically everything
        - BUT there is an catch

PbV or PbR

- Why do I care
  - The effect of changing values in functions
    - javascript “vars” are effectively PbR
  - Speed & memory
    - PbR faster and more memory efficient
    - PbV “safer”?
      - NO side effect programming

& operator

- the “address” operator
  - The memory address of the variable
  - Using & can really observe PbV in action
- Program at right one global variable and a function with no args
  - What is the output?

```
file: p1.c

int gi = 5;

void t()
{
    printf("TF   %d  %d\n", gi, &gi);
    gi = 7;
    printf("TF2  %d  %d\n", gi, &gi);
    return;
}

int main(void)
{
    printf("TM  %d  %d\n", gi, &gi);
    t();
    printf("TM2 %d  %d\n", gi, &gi);
}
```

Show the address in memory as an integer

PbV

- Output here?

```
file: p2.c

void t()
{
    printf("TF  %d  %d\n", gi, &gi);
    gi = 7;
    return;
}

int main(void)
{
    int gi = 5;
    printf("TM  %d  %d\n", gi, &gi);
    t();
    printf("TM2 %d  %d\n", gi, &gi);
}
```

PbV

- Finally, passing a variable
    - memory location of gi in t is different from in main
    - Visible manifestation of PbV

```
file p3.c

void t(int gi)
{
    printf("TF  %d  %d\n", gi, &gi);
    gi = 7;
    printf("TF2 %d\n", gi, &gi);
    return;
}

int main(void)
{
    int gi = 5;
    printf("TM  %d  %d\n", gi, &gi);
    t(gi);
    printf("TM2 %d\n", gi);
}
```

Return

- is also by value
- Must be else you would be getting a memory location from a stack frame that no longer exists

```
file: p4.c

int t(int gi)
{
    printf("TF  %d  %d\n", gi, &gi);
    gi = 7;
    printf("TF2  %d %d\n", gi, &gi);
    return gi;
}

int main(void)
{
    int gi = 5;
    printf("TM  %d  %d\n", gi, &gi);
    int gii = t(gi);
    printf("TM2 %d  %d\n", gii, &gii);
}
```

Pointer types

- `int *p;`
  - holds a pointer to an integer
    - this declaration is not pointing to anything
  - must point to a thing of the type
- All pointers are exactly the same size
  - Actually all pointers are exactly the same
  - So why the restriction that the pointer MUST point to something of it declared type?

Create a variable, gi, then create two variables that hold a pointer to gi.

VSC prefers first form

```
int gi = 5;
int *pgi1  = &gi;
int* pgi2  = &gi;
int * pgi3 = &gi;
```

* Operator

- * is also called the “indirection” operator
- IMPORTANT
    - * operator is not * in type declarations and is not multiply.
        - horrific
- * operator works ONLY on pointer types
    - compile error
- when you have a pointer
    - use * to mean “the value of the thing pointed to”
    - This is logic behind calling * an “indirection” operator

```
file: p5.c

int main(void)
{
    int giv = 5;
    int *gip = &giv;
    printf("TM1%5d%12d%12d\n", giv, &giv, gip);
    *gip = 7; // set value into the pointer
    printf("TM2%5d%12d%12d%5d\n", giv, &giv, gip, *gip);
    // set value into the memory address
    //parens are required
    *(&giv) = 9;
    printf("TM2%5d%12d%12d%5d\n", giv, &giv, gip, *gip);
}
```

Finally, PbR in C

- To get Pass by Reference in C
    - pass a pointer
    - use indirection operator to set the value into pointer

- Used this in HW1!
    - scanf

```
file: p6.c

void t(int *gip) {
    printf("TT1%5d%12d\n", *gip, gip);
    *gip = 7;
    printf("TT1%5d%12d\n", *gip, gip);
}
int main(int argc, char const *argv[])
{
    int giv = 3;
    printf("TM1%5d%12d\n", giv, &giv);
    t(&giv);
    printf("TM2%5d%12d\n", giv, &giv);
    return 0;
}
```

Pointer and Casting

- Because all pointers are the same you can freely cast pointers to other types.
  - Setting/reading — not so much
  - Consider java

  -
    ```
    String s = new String(“A”);
    Integer i = (Integer)s;
    ```
    - kind of legal to do but a bad idea

```
file: p7.c

int main(void)
{
    int iint = 5;
    int *intp = &iint;
    printf("T1int%12d%12d\n", iint, intp);
    *intp = 999999;
    printf("T2int%12d%12d\n", iint, intp);
    char *chrp = (char *)intp;
    *chrp = 'a';
    printf("T3chr%12c%12d\n", *chrp, chrp);
    printf("T3int%12d%12d\n", *intp, intp);

}
```

Pointers and arrays

- Arrays are already pointers!
  - So with array you are doing PbR

```
file: p10.c

void parray(char id, int asz, int arr[asz]) {
    for (int i = 0; i < 10; i++)
        printf("%1c%3d%12d%12d%5d\n", id, i,
arr, &arr[i], arr[i]);
}

int main(void)
{
    int a[10];
    for (int i = 0; i < 10; i++)
        a[i] = (i*29) % 17;
    char id = 'M';
    for (int i = 0; i < 10; i++)
        printf("%1c%3d%12d%12d%5d\n", id, i, a,
&a[i], a[i]);
    parray('A', 10, a);
}
```

Lab — Regular Expressions

- Write regular expressions you could use in grep to find
    - Note that to actually use some of these REs with grep, use quotes
    - all lines with the character z
    - all lines with at least 2 instances of the character z
    - all lines with 2 z's with at least one character between
        - so pizza would not match but pizzaz would
    - all lines that have at least 2 upper case vowels
    - all lines that have 2 upper case vowels (but not I) separated by 10 more more characters (an upper case vowel could be one of intervening characters.
- If you use /home/gtowell/Public/206/a4/dickens.txt for a test file then these are the number of lines that each grep should find
    - z: 3909, 2 z's: 976, 2 z's with a separator: 143, 2 UC vowels: 23877, 2 UC vowels, but not I, separated by at least 10 chars: 2967
- All I need is the 5 regular expressions, but showing the grep commands is OK also. Do NOT send complete results of each grep.