CS2263 Lab 3

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Exercise Zero:

I have been using my personal GitHub account (https://github.com/KMRNicholslson) as an easy way to move code and files from my windows machine to the lab machine (rather than using sftp). So, the following screenshot is using my git repo for CS2263. Please find the repo here: https://github.com/KMRNicholson/cs2263

git clone & push output from lab machine:

```
[knichol1@id415m13 ~]$ git clone https://github.com/KMRNicholson/cs2263.git
Cloning into 'cs2263'...
remote: Enumerating objects: 212, done.
remote: Counting objects: 100% (212/212), done.
remote: Compressing objects: 100% (154/154), done.
remote: Total 212 (delta 88), reused 171 (delta 47), pack-reused 0
Receiving objects: 100% (212/212), 4.39 MiB | 437.00 KiB/s, done.
Resolving deltas: 100% (88/88), done.
[knichol1@id415m13 ~]$ cd cs22
cs2263/      cs2263-labs/
[knichol1@id415m13 ~]$ cd cs2263
[knichol1@id415m13 ~/cs2263]$ ls
W1Ass  W1Lab  W2Ass  W2L5forNextDay  W2L7forNextDay  W2Lab
[knichol1@id415m13 ~/cs2263]$ mkdir W3Lab
[knichol1@id415m13 ~/cs2263]$ git status
# On branch master
nothing to commit, working directory clean
[knichol1@id415m13 ~/cs2263]$ ls
W1Ass  W1Lab  W2Ass  W2L5forNextDay  W2L7forNextDay  W2Lab  W3Lab
[knichol1@id415m13 ~/cs2263]$ cd W3Lab/
[knichol1@id415m13 W3Lab]$ touch arithmetic1.c
[knichol1@id415m13 W3Lab]$ git status
# On branch master
# Untracked files:
#   (use "git add <file>..." to include in what will be committed)
#
#       ./
nothing added to commit but untracked files present (use "git add" to track)
[knichol1@id415m13 W3Lab]$ git add .
[knichol1@id415m13 W3Lab]$ git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#       new file:   arithmetic1.c
#
[knichol1@id415m13 W3Lab]$ git commit -m "Created new directory for lab 3 with starting file"
[master 3527c4b] Created new directory for lab 3 with starting file
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 W3Lab/arithmetic1.c
[knichol1@id415m13 W3Lab]$ git push origin
warning: push.default is unset; its implicit value is changing in
Git 2.0 from 'matching' to 'simple'. To squelch this message
and maintain the current behavior after the default changes, use:

  git config --global push.default matching

To squelch this message and adopt the new behavior now, use:

  git config --global push.default simple

See 'git help config' and search for 'push.default' for further information.
(the 'simple' mode was introduced in Git 1.7.11. Use the similar mode
'current' instead of 'simple' if you sometimes use older versions of Git)

Username for 'https://github.com': kmrnicholson
Password for 'https://kmrnicholson@github.com':
Counting objects: 5, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (4/4), 341 bytes | 0 bytes/s, done.
Total 4 (delta 1), reused 1 (delta 0)
remote: Resolving deltas: 100% (1/1), completed with 1 local object.
To https://github.com/KMRNicholson/cs2263.git
   b8d4e6d..3527c4b  master -> master
[knichol1@id415m13 W3Lab]$ git status
# On branch master
nothing to commit, working directory clean
[knichol1@id415m13 W3Lab]$
```

git pull from windows laptop output:

```
PS C:\Users\Kohdy\Documents\cs2263> git pull
remote: Enumerating objects: 14, done.
remote: Counting objects: 100% (14/14), done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 11 (delta 4), reused 10 (delta 3), pack-reused 0
Unpacking objects: 100% (11/11), done.
From https://github.com/KMRNicholson/cs2263
   ff1caa3..3527c4b  master     -> origin/master
Updating ff1caa3..3527c4b
Fast-forward
 W2Ass/Stack                  | Bin 0 -> 8768 bytes
 W2Ass/Stack.o                | Bin 0 -> 3928 bytes
 W2Ass/compound_test1.result  |  20 ++++++++++++++++++
 W2Ass/compound_test2.result  |   3 +++
 W2Ass/compound_test3.result  |  22 ++++++++++++++++++++
 W2Ass/compound_test4.result  |  49 +++++++++++++++++++++++++++++++++++++++++++++++++
 W2Ass/exit_test1.result      |   2 ++
 W2Ass/peek_test1.result      |   7 +++++++
 W2Ass/peek_test2.result      |   3 +++
 W2Ass/pop_test1.result       |   6 ++++++
 W2Ass/pop_test2.result       |   6 ++++++
 W2Ass/pop_test3.result       |   3 +++
 W2Ass/push_test1.result      |   4 ++++
 W2Ass/push_test2.result      |   6 ++++++
 W2L7forNextDay/2darray       | Bin 0 -> 8616 bytes
 W3Lab/arithmetic1.c          |   0
 16 files changed, 131 insertions(+)
 create mode 100755 W2Ass/Stack
 create mode 100644 W2Ass/Stack.o
 create mode 100644 W2Ass/compound_test1.result
 create mode 100644 W2Ass/compound_test2.result
 create mode 100644 W2Ass/compound_test3.result
 create mode 100644 W2Ass/compound_test4.result
 create mode 100644 W2Ass/exit_test1.result
 create mode 100644 W2Ass/peek_test1.result
 create mode 100644 W2Ass/peek_test2.result
 create mode 100644 W2Ass/pop_test1.result
 create mode 100644 W2Ass/pop_test2.result
 create mode 100644 W2Ass/pop_test3.result
 create mode 100644 W2Ass/push_test1.result
 create mode 100644 W2Ass/push_test2.result
 create mode 100755 W2L7forNextDay/2darray
 create mode 100644 W3Lab/arithmetic1.c
PS C:\Users\Kohdy\Documents\cs2263> git status
On branch master
Your branch is up to date with 'origin/master'.

nothing to commit, working tree clean
```

Exercise One:

arithmetic1.c source:

```
// arithmetic1.c
#include <stdio.h>
#include <stdlib.h>
int main (int argc ,char * * argv)
{
  int    arr1[] = {7, 2, 5, 3, 1, 6, -8, 16, 4};
  char   arr2[] = {'m', 'q', 'k', 'z', '%', '>'};
  double arr3[] = {3.14, -2.718, 6.626, 0.529};
  int len1 = sizeof(arr1) / sizeof(int);
  int len2 = sizeof(arr2) / sizeof(char);
  int len3 = sizeof(arr3) / sizeof(double);
  printf("lengths = %d, %d, %d\n", len1, len2, len3);
  int    * iptr = arr1;
  char   * cptr = arr2;
  double * dptr = arr3;
  printf("values: iptr - %d, cptr - %c, dptr - %f\n", * iptr, * cptr, * dptr);
  printf("addresses: iptr - %p, cptr - %p, dptr - %p\n", iptr, cptr, dptr);
  iptr ++;
  cptr ++;
  dptr ++;
  printf("values: iptr - %d, cptr - %c, dptr - %f\n", * iptr, * cptr, * dptr);
  printf("addresses: iptr - %p, cptr - %p, dptr - %p\n", iptr, cptr, dptr);
  iptr ++;
  cptr ++;
  dptr ++;
  printf("values: iptr - %d, cptr - %c, dptr - %f\n", * iptr, * cptr, * dptr);
  printf("addresses: iptr - %p, cptr - %p, dptr - %p\n", iptr, cptr, dptr);
  iptr ++;
  cptr ++;
  dptr ++;
  printf("values: iptr - %d, cptr - %c, dptr - %f\n", * iptr, * cptr, * dptr);
  printf("addresses: iptr - %p, cptr - %p, dptr - %p\n", iptr, cptr, dptr);
  return EXIT_SUCCESS;
}
```

arithmetic1.c output and git push:

```
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> gcc .\arithmetic1.c -o arith
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> .\arith.exe
lengths = 9, 6, 4
values: iptr - 7, cptr - m, dptr - 3.140000
addresses: iptr - 0061FEE4, cptr - 0061FEDE, dptr - 0061FEB8
values: iptr - 2, cptr - q, dptr - -2.718000
addresses: iptr - 0061FEE8, cptr - 0061FEDF, dptr - 0061FEC0
values: iptr - 5, cptr - k, dptr - 6.626000
addresses: iptr - 0061FEEC, cptr - 0061FEE0, dptr - 0061FEC8
values: iptr - 3, cptr - z, dptr - 0.529000
addresses: iptr - 0061FEF0, cptr - 0061FEE1, dptr - 0061FED0
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git status
On branch master
Your branch is up to date with 'origin/master'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   arithmetic1.c

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        arith.exe

no changes added to commit (use "git add" and/or "git commit -a")
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git add .\arithmetic1.c
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git commit -m "Modified arithmetic.c file from page 55 of text"
[master c3b1f10] Modified arithmetic.c file from page 55 of text
 1 file changed, 34 insertions(+)
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git push origin
Enumerating objects: 7, done.
Counting objects: 100% (7/7), done.
Delta compression using up to 6 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (4/4), 690 bytes | 690.00 KiB/s, done.
Total 4 (delta 1), reused 0 (delta 0)
remote: Resolving deltas: 100% (1/1), completed with 1 local object.
To https://github.com/KMRNicholson/cs2263.git
   3527c4b..c3b1f10  master -> master
PS C:\Users\Kohdy\Documents\cs2263\W3Lab>
```

Yes, the pointer values are incremented properly. cptr increments by 1 byte (DE, DF, E0, E1), meaning we only need one address for each character. iptr increments by 4 bytes (E4, E8, EC, F0), and dptr increments by 8 bytes (B8, C0, C8, D0). All of which are correct for my machine.

They are not the same because the arrays are holding different datatypes which require a different number of bytes to properly store each element.

Exercise Two:

Source code:

```c
// exercisetwo.c
#include <stdio.h>
#include <stdlib.h>

void print_twice(int arr[], int n){
    int* iptr = arr;
    int i = 0;

    while(i < n){
        printf("\n%d\t%d\t%p\t%d", i, arr[i], iptr, *iptr);
        iptr ++;
        i++;
    }
}

int main (int argc ,char * * argv)
{
  int arr[] = {10, 11, 12, 13, 14, 15, 16};
  int len = sizeof(arr) / sizeof(int);

  print_twice(arr, len);

  return EXIT_SUCCESS;
}
```

Git push and output:

```
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> .\e2.exe
0       10      0061FF00        10
1       11      0061FF04        11
2       12      0061FF08        12
3       13      0061FF0C        13
4       14      0061FF10        14
5       15      0061FF14        15
6       16      0061FF18        16
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git status                                    On branch m
aster
Your branch is up to date with 'origin/master'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        arith.exe
        e2.exe
        exercisetwo.c

nothing added to commit but untracked files present (use "git add" to track)
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git add .                                     PS C:\Users
\Kohdy\Documents\cs2263\W3Lab> git status                                On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   arith.exe
        new file:   e2.exe
        new file:   exercisetwo.c

PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git commit -m "Adding executables and source code for exercise
 two"                                                                   [master 08a3b84] Addin
g executables and source code for exercise two
 3 files changed, 24 insertions(+)
 create mode 100644 W3Lab/arith.exe
 create mode 100644 W3Lab/e2.exe
 create mode 100644 W3Lab/exercisetwo.c
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git push origin                               Enumerating
 objects: 8, done.
Counting objects: 100% (8/8), done.
Delta compression using up to 6 threads
Compressing objects: 100% (6/6), done.
Writing objects: 100% (6/6), 22.28 KiB | 5.57 MiB/s, done.
Total 6 (delta 2), reused 0 (delta 0)
remote: Resolving deltas: 100% (2/2), completed with 1 local object.
To https://github.com/KMRNicholson/cs2263.git
   c3b1f10..08a3b84  master -> master
PS C:\Users\Kohdy\Documents\cs2263\W3Lab>
```

Exercise Three

Source:

```c
// exercisethree.c
#include <stdio.h>
#include <stdlib.h>

int arrindex(int* bp, int* sp){
```

```
    return sp - bp;
}

int main (int argc ,char * * argv)
{
  int arr[] = {10, 11, 12, 13, 14, 15, 16};
  int len = sizeof(arr) / sizeof(int); // Get length of array

  for(int i = 0; i < len; i++){
    printf("%d\t%d\n", i, arrindex(&arr[0], &arr[i]));
  }
  return EXIT_SUCCESS;
}
```

Output:

```
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> gcc .\exercisethree.c -o e3
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> .\e3.exe
0       0
1       1
2       2
3       3
4       4
5       5
6       6
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git status
On branch master
Your branch is up to date with 'origin/master'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        e3.exe
        exercisethree.c

nothing added to commit but untracked files present (use "git add" to track)
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git add .
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git commit -m "Adding exercise three files."
[master fe90711] Adding exercise three files.
 2 files changed, 18 insertions(+)
 create mode 100644 W3Lab/e3.exe
 create mode 100644 W3Lab/exercisethree.c
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git push origin
Enumerating objects: 7, done.
Counting objects: 100% (7/7), done.
Delta compression using up to 6 threads
Compressing objects: 100% (5/5), done.
Writing objects: 100% (5/5), 18.05 KiB | 6.02 MiB/s, done.
Total 5 (delta 2), reused 0 (delta 0)
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/KMRNicholson/cs2263.git
   08a3b84..fe90711  master -> master
PS C:\Users\Kohdy\Documents\cs2263\W3Lab>
```

Exercise Four:

Source:

```c
/*
 * wrongindex.c
 */
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
int main(int argc, char * * argv)
{
  int x = -2;
  int arr[] = {0, 1, 2, 3, 4};
  int len = sizeof(arr) / sizeof(int);
  int y = 15;
  int i;
  printf("& x      = %p, & y      = %p\n", & x, & y);

  i = 0;
  while(i < len){
    printf("& arr[%d] = %p\n", i, & arr[i]);
    i++;
  }
  printf("x = %d, y = %d\n", x, y);
  printf("& x      = %p, & y      = %p\n", & x, & y);
  arr[-1] = 7;
  arr[5]  = -23;
  printf("x = %d, y = %d\n", x, y);
  printf("& x      = %p, & y      = %p\n", & x, & y);
  arr[6]  = 108;
  printf("x = %d, y = %d\n", x, y);
  printf("& x      = %p, & y      = %p\n", & x, & y);
  arr[7]  = -353;
  printf("x = %d, y = %d\n", x, y);
  printf("& x      = %p, & y      = %p\n", & x, & y);
  return EXIT_SUCCESS;
}
```

Output with git push:

```
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> .\wrongindex.exe
& x      = 0061FF14, & y      = 0061FEFC
& arr[0] = 0061FF00
& arr[1] = 0061FF04
& arr[2] = 0061FF08
& arr[3] = 0061FF0C
& arr[4] = 0061FF10
x = -2, y = 15
& x      = 0061FF14, & y      = 0061FEFC
x = -23, y = 7
& x      = 0061FF14, & y      = 0061FEFC
x = -23, y = 7
& x      = 0061FF14, & y      = 0061FEFC
x = -23, y = 7
& x      = 0061FF14, & y      = 0061FEFC
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git add .
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git commit -m "Adding exercise four code"
[master d5538b2] Adding exercise four code
 2 files changed, 35 insertions(+)
 create mode 100644 W3Lab/wrongindex.c
 create mode 100644 W3Lab/wrongindex.exe
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git push origin
Enumerating objects: 7, done.
Counting objects: 100% (7/7), done.
Delta compression using up to 6 threads
Compressing objects: 100% (5/5), done.
Writing objects: 100% (5/5), 18.14 KiB | 3.63 MiB/s, done.
Total 5 (delta 2), reused 0 (delta 0)
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/KMRNicholson/cs2263.git
   fe90711..d5538b2  master -> master
PS C:\Users\Kohdy\Documents\cs2263\W3Lab>
```

The stack:

0x0061FEFC: y

0x0061FF00: arr[0]

.

.

.

0x0061FF10: arr[4]

0x0061FF14: x

We see that the stack first stores x, then the set of addresses for the array. The highest index being the highest address. Then y. So yes, the program goes out of bounds from the array on both ends, which causes the variables x and y to change (this is why c can be very vulnerable to attacks).

Exercise Five:

Output:

```
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> rm wrongindex.exe
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> ls


    Directory: C:\Users\Kohdy\Documents\cs2263\W3Lab


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        2020-05-19   4:13 PM          45389 arith.exe
-a----        2020-05-19   4:13 PM           1271 arithmetic1.c
-a----        2020-05-19   4:41 PM          44908 e2.exe
-a----        2020-05-19   4:55 PM          44905 e3.exe
-a----        2020-05-19   4:56 PM            392 exercisethree.c
-a----        2020-05-19   4:41 PM            445 exercisetwo.c
-a----        2020-05-19   5:13 PM            853 wrongindex.c


PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git status
On branch master
Your branch is up to date with 'origin/master'.

Changes not staged for commit:
  (use "git add/rm <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        deleted:    wrongindex.exe

no changes added to commit (use "git add" and/or "git commit -a")
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> git checkout wrongindex.exe
Updated 1 path from the index
PS C:\Users\Kohdy\Documents\cs2263\W3Lab> ls


    Directory: C:\Users\Kohdy\Documents\cs2263\W3Lab


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        2020-05-19   4:13 PM          45389 arith.exe
-a----        2020-05-19   4:13 PM           1271 arithmetic1.c
-a----        2020-05-19   4:41 PM          44908 e2.exe
-a----        2020-05-19   4:55 PM          44905 e3.exe
-a----        2020-05-19   4:56 PM            392 exercisethree.c
-a----        2020-05-19   4:41 PM            445 exercisetwo.c
-a----        2020-05-19   5:13 PM            853 wrongindex.c
-a----        2020-05-19   5:27 PM          45389 wrongindex.exe


PS C:\Users\Kohdy\Documents\cs2263\W3Lab>
```

Using git checkout, we can undo local changes that have not been added to the working tree, by restoring the file from the working tree. Once the changes are added, however, git checkout will not work. At which point, you will need to probably do git revert or reset.