Discussion Week 1

Tuesday

October 6, 2020

Sigal Shaul

About Discussions

- Scheduled for 1 hour
 - o 30 minutes content/practice, 30 minutes Q&A
- Focusing on PA or Content Review
- Friday Discussions
 - Introduction to PA
 - Review of the week's material
- Tuesday Discussions
 - PA common problems/Q&A
 - Review of the week's material

Today

C++ Review

```
void mystery(int* ptr, int y) {
    y = 4;
    ptr = &y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

- a) 15
- b) 21
- c) 4
- d) Error
- e) Something else

```
void mystery(int* ptr, int y) {
    y = 4;
    ptr = &y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

- a) 15
- b) 21
- c) 4
- d) Error
- e) Something else

```
void mystery(int* ptr, int y) {
    y = 4;
    ptr = &y;
}
```

```
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;
    return 0;
}</pre>
```

X Address: 0x40

15

```
void mystery(int* ptr, int y) {
    y = 4;
    ptr = &y;
}
```

```
int main() {
   int x = 15;
   int y = 21;
   int* ptr = &x;
   mystery(ptr, y);
   cout << *ptr;
   return 0;</pre>

x
Address: 0x20

21
```

```
void mystery(int* ptr, int y) {
    y = 4;
    ptr = &y;
}
```

```
int main() {
   int x = 15;
   int y = 21;
   int* ptr = &x;
   mystery(ptr, y);
   cout << *ptr;
   return 0;
}</pre>

x
Address: 0x20

15

y
Address: 0x40

21

ptr
Address: 0x80
```

```
0x20
void mystery(int* ptr, int y) {
                                                        ptr
                                                       Address: 0x120
     y = 4;
     ptr = &y;
                                                       Address: 0x160
int main() {
                                                       Χ
     int x = 15;
                                                                       15
                                                       Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                       21
     mystery(ptr, y);
                                                       Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                        ptr
                                                                      0x20
                                                       Address: 0x80
```

```
0x20
void mystery(int* ptr, int y) {
                                                        ptr
                                                        Address: 0x120
     ptr = &y;
                                                        Address: 0x160
int main() {
                                                        Χ
     int x = 15;
                                                                        15
                                                        Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                        21
     mystery(ptr, y);
                                                        Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                        ptr
                                                                       0x20
                                                        Address: 0x80
```

```
<del>0x20</del>
void mystery(int* ptr, int y) {
                                                                         0x160
                                                          ptr
                                                          Address: 0x120
     y = 4;
     ptr = &y;
                                                          Address: 0x160
int main() {
                                                          Χ
     int x = 15;
                                                                           15
                                                          Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                           21
     mystery(ptr, y);
                                                          Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                          ptr
                                                                          0x20
                                                          Address: 0x80
```

```
0x160
void mystery(int* ptr, int y) {
                                                       ptr
                                                       Address: 0x120
     y = 4;
     ptr = &y;
                                                       Address: 0x160
int main() {
                                                       Х
     int x = 15;
                                 Output is:
                                                                       15
                                                       Address: 0x20
     int y = 21;
                                 15
     int* ptr = &x;
                                                                       21
     mystery(ptr, y);
                                                       Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                       ptr
                                                                      0x20
                                                       Address: 0x80
```

```
void mystery(int* ptr, int y) {
    y = 4;
    *ptr = y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

- a) 15
- b) 21
- c) 4
- d) Error
- e) Something else

```
void mystery(int* ptr, int y) {
    y = 4;
    *ptr = y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

- a) 15
- b) 21
- c) 4
- d) Error
- e) Something else

```
void mystery(int* ptr, int y) {
    y = 4;
    *ptr = y;
}
```

```
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;
    return 0;
}</pre>
```

X Address: 0x20

1

```
void mystery(int* ptr, int y) {
    y = 4;
    *ptr = y;
}
```

```
int main() {
   int x = 15;
   int y = 21;
   int* ptr = &x;
   mystery(ptr, y);
   cout << *ptr;
   return 0;</pre>

x
Address: 0x20

15

21
```

```
void mystery(int* ptr, int y) {
    y = 4;
    *ptr = y;
}
```

```
int main() {
   int x = 15;
   int y = 21;
   int* ptr = &x;
   mystery(ptr, y);
   cout << *ptr;
   return 0;
}</pre>

x
Address: 0x20

21

ptr
Address: 0x80
```

```
0x20
void mystery(int* ptr, int y) {
                                                        ptr
                                                        Address: 0x120
     y = 4;
     *ptr = v;
                                                        Address: 0x160
int main() {
                                                        Χ
     int x = 15;
                                                                        15
                                                        Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                        21
     mystery(ptr, y);
                                                        Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                        ptr
                                                                      0x20
                                                        Address: 0x80
```

```
0x20
void mystery(int* ptr, int y) {
                                                        ptr
                                                        Address: 0x120
     *ptr = v;
                                                        Address: 0x160
int main() {
                                                        Χ
     int x = 15;
                                                                        15
                                                        Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                        21
     mystery(ptr, y);
                                                        Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                        ptr
                                                                       0x20
                                                        Address: 0x80
```

```
0x20
void mystery(int* ptr, int y) {
                                                        ptr
                                                        Address: 0x120
     *ptr = y;
                                                        Address: 0x160
int main() {
                                                        Χ
     int x = 15;
                                                        Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                        21
     mystery(ptr, y);
                                                        Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                        ptr
                                                                       0x20
                                                        Address: 0x80
```

```
0x20
void mystery(int* ptr, int y) {
                                                       ptr
                                                       Address: 0x120
     y = 4;
     ptr* = y;
                                                       Address: 0x160
int main() {
                                                       Х
     int x = 15;
                                 Output is:
                                                                       4
                                                       Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                                       21
     mystery(ptr, y);
                                                       Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                       ptr
                                                                     0x20
                                                       Address: 0x80
```

What's the Difference?

```
void mystery(int* ptr, int y) {
    y = 4;
    ptr = &y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

```
void mystery(int* ptr, int y) {
    y = 4;
    *ptr = y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

What's the Difference?

```
void mystery(int* ptr, int y) {
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

In the first case we are updating the value stored in ptr (a memory address). In the second case we are dereferencing ptr and updating the value stored at the memory address that is stored in ptr.

```
void mystery(int* ptr, int y) {
    *ptr = y;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

```
void mystery(int* ptr2, int & y2) {
    y2 = 4;
    ptr2 = &y2;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

Quick check: what does main print?

```
void mystery(int* ptr2, int & y2) {
    y2 = 4;
    ptr2 = &y2;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

Quick check: what does main print? 15

Quick check: Draw memory model

```
void mystery(int* ptr2, int & y2) {
    y2 = 4;
    ptr2 = &y2;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

```
void mystery(int* ptr2, int & y2)
{
     y2 = 4;
     ptr2 = &y2;
}
```

```
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;
    return 0;
}</pre>
```

X Address: 0x20

15

```
void mystery(int* ptr2, int & y2)
{
    y2 = 4;
    ptr2 = &y2;
}
```

```
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;
    return 0;
}</pre>
```

```
X
Address: 0x20

15

y
Address: 0x40

21
```

```
void mystery(int* ptr2, int & y2)
{
     y2 = 4;
     ptr2 = &y2;
}
```

```
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;
    return 0;</pre>

X
Address: 0x20

y
Address: 0x40

ptr
Address: 0x80

0x20
```

0x20

ptr2

```
Address: 0x120
     y2 = 4;
    ptr2 = &y2;
                                                        Χ
int main() {
                                                                         15
                                                        Address: 0x20
     int x = 15;
     int y = 21;
                                                        y, y2
                                                                        21
     int* ptr = &x;
                                                        Address: 0x40
     mystery(ptr, y);
                                                        ptr
     cout << *ptr;</pre>
                                                                       0x20
                                                        Address: 0x80
     return 0;
```

void mystery(int* ptr2, int & y2)

0x20

```
void mystery(int* ptr2, int & y2)
                                                       ptr2
                                                       Address: 0x120
     ptr2 = &y2;
                                                       Χ
int main() {
                                                                       15
                                                       Address: 0x20
     int x = 15;
     int y = 21;
                                                       y, y2
     int* ptr = &x;
                                                       Address: 0x40
     mystery(ptr, y);
                                                       ptr
     cout << *ptr;</pre>
                                                                     0x20
                                                       Address: 0x80
     return 0;
```

```
Χ
int main() {
                                                                         15
                                                        Address: 0x20
     int x = 15;
     int y = 21;
                                                        y, y2
                                                                         4
     int* ptr = &x;
                                                        Address: 0x40
     mystery(ptr, y);
                                                        ptr
     cout << *ptr;</pre>
                                                                       0x20
                                                        Address: 0x80
     return 0;
```

0x40

ptr2

Address: 0x120

```
y2 = 4;
    ptr2 = &y2;
                                                       Χ
int main() {
                                                                       15
                                                       Address: 0x20
     int x = 15;
     int y = 21;
                                                       y, y2
                                                                       4
     int* ptr = &x;
                                                       Address: 0x40
     mystery(ptr, y);
                                                       ptr
     cout << *ptr;</pre>
                                                                     0x20
                                                       Address: 0x80
     return 0;
```

void mystery(int* ptr2, int & y2)

0x40

ptr2

```
Address: 0x120
    y2 = 4;
    ptr2 = &y2;
                                                       Χ
int main() {
                                 Output is:
                                                                       15
                                                       Address: 0x20
     int x = 15;
                                 15
     int y = 21;
                                                       y, y2
                                                                        4
     int* ptr = &x;
                                                       Address: 0x40
     mystery(ptr, y);
     cout << *ptr;</pre>
                                                        ptr
                                                                      0x20
     return 0;
                                                       Address: 0x80
```

void mystery(int* ptr2, int & y2)

```
void mystery(int* ptr2, int & y2) {
    ptr2 = &y2;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(ptr, y);
    cout << *ptr;</pre>
    return 0;
```

How can we change the code so this line modifies ptr in main?

```
void mystery(int** ptr2, int & y2) {
    *ptr2 = &y2;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(&ptr, y);
    cout << *ptr;</pre>
    return 0;
```

How can we change the code so this line modifies ptr in main?

One solution: Pass in a pointer to the pointer!

Let's look at the memory model

void mystery(int** ptr2, int & y2) {

y2 = 4;

```
*ptr2 = &y2;
int main() {
                                                       Χ
     int x = 15;
                                                                       15
                                                       Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                       y, y2
                                                                       21
     mystery(&ptr, y);
                                                       Address: 0x40
     cout << *ptr;</pre>
                                                       ptr
     return 0;
                                                                      0x20
                                                       Address: 0x80
```

08x0

ptr2

Address: 0x120

Let's look at the memory model

void mystery(int** ptr2, int & y2) {

y2 = 4;

```
*ptr2 = &y2;
int main() {
                                                       Χ
     int x = 15;
                                                                       15
                                                       Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                       y, y2
     mystery(&ptr, y);
                                                       Address: 0x40
     cout << *ptr;</pre>
                                                       ptr
     return 0;
                                                                      0x20
                                                       Address: 0x80
```

0x80

ptr2

Address: 0x120

Let's look at the memory model

void mystery(int** ptr2, int & y2)

```
Address: 0x120
     *ptr2 = &y2;
                                                        Χ
int main() {
                                                                         15
                                                        Address: 0x20
     int x = 15;
     int y = 21;
                                                        y, y2
                                                                         4
     int* ptr = &x;
                                                         Address: 0x40
     mystery(&ptr, y);
                                                         ptr
     cout << *ptr;</pre>
                                                                       0x40
                                                        Address: 0x80
     return 0;
```

0x80

ptr2

```
void mystery(int** ptr2, int & y2) {
    y2 = 4;
    *ptr2 = &y2;
}
Ox80
Address: 0x120
```

```
int main() {
                                                       Χ
     int x = 15;
                                 Output is:
                                                                       15
                                                       Address: 0x20
     int y = 21;
     int* ptr = &x;
                                                       y, y2
                                                                        4
     mystery(&ptr, y);
                                                       Address: 0x40
     cout << *ptr;</pre>
     return 0;
                                                       ptr
                                                                      0x40
                                                       Address: 0x80
```

```
void mystery(int** ptr2, int & y2) {
    *ptr2 = &y2;
int main() {
    int x = 15;
    int y = 21;
    int* ptr = &x;
    mystery(&ptr, y);
    cout << *ptr;</pre>
    return 0;
```

How can we change the code so this line modifies ptr in main?

One solution: Pass in a pointer to the pointer!

Another solution: Reference to a pointer (int *& ptr2)