CS 367 - Recitation #11 **Linking**

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Today's Goals: We want to get comfortable with symbol resolution in linking.

Work in groups of 2-3 students. Every group will turn in what they've got to Blackboard.

Grading is based on participation. Get as much done as you can. You will also be given feedback in the form of a 'score' (3-1) and possibly some comments. This doesn't affect your grade – it is solely for feedback. A score of 3 means everything looks great. A score of two indicates some minor problems. And a score of one indicates that there were some major issues. If you get a 1, don't panic - go see your prof or a GTA to get more extensive feedback.

Task 1: Linking Overview

1. What is a symbol in a program?

Symbols are a variable or function

2. What are the two key functions of a Linker? What does each of these do?

3. Which types of symbols are global?

4. What is a **static** function or **static** global variable? How are the different than non-static ones?

Task 2: Symbol Resolution

1. What is a **Strong** symbol?

Task 3: Symbol Resolution in Practice

```
/* Module A */
int x;
int y = 2;

int main() {
  ...
}
void p1() {
  ...
}
```

```
/* Module B */
double x;
int y;

void p1() {
  ...
}
void p2() {
  ...
}
```

```
/* Module C */
int p2;
char x;
static int y;


void p3() {
  ...
}
```

For each of the following Modules, circle whether the given symbol is Strong, Weak, or N/A. Then list which Module's version of that symbol will be chosen by the linker.

Module A:

1. **x is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
2. **y is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
3. **p1 is** ☐ **Strong** ☐ **Weak** ☐ **N/A**

Module B:

4. **x is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
5. **y is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
6. **p1 is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
7. **p2 is** ☐ **Strong** ☐ **Weak** ☐ **N/A**

Module C:

8. **x is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
9. **y is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
10. **p2 is** ☐ **Strong** ☐ **Weak** ☐ **N/A**
11. **p3 is** ☐ **Strong** ☐ **Weak** ☐ **N/A**

Symbol Resolution: Circle which symbol will be picked by references FROM Module A, UNK, or ERROR

1. **x** ☐ **Module A** ☐ **Module B** ☐ **Module C** ☐ **UNK** ☐ **ERROR**
2. **y** ☐ **Module A** ☐ **Module B** ☐ **Module C** ☐ **UNK** ☐ **ERROR**
3. **p1** ☐ **Module A** ☐ **Module B** ☐ **Module C** ☐ **UNK** ☐ **ERROR**
4. **p2** ☐ **Module A** ☐ **Module B** ☐ **Module C** ☐ **UNK** ☐ **ERROR**
5. **p3** ☐ **Module A** ☐ **Module B** ☐ **Module C** ☐ **UNK** ☐ **ERROR**

Task 4: Symbol Resolution in Practice

1. In the previous exercise, were there errors for one of the symbols? When do you get an error in symbol resolution?

2. In the previous exercise, were there UNK (unknown) for one of the symbols? When do you get an unknown in symbol resolution?

3. In the previous exercise, the final part focused on references from Module A. What about references from Module C; which Module's version of y would Module C use? Why is this different from the version of y that Module A uses?

If you still have some time, fire up Zeus and write a two source file program. Try and create these same problems with symbols! See what happens when you have two Strong symbols, two Weak symbols, a Weak and a Strong, and try playing with static!