COMP20005 Workshop Week 6

	Preparation: • open grok in a tab • open github.com/anhvir/c205 in another tab, and click on ws6.pdf to open this slide set
	Plan:
1	Recursive Functions: When & How Scopes
2	***15 min Group Work:*** *ex. 6.2 (discussion: scopes)* *ex. 5.14(coding: log*)*
3	Pointers, Pointers as Function Arguments
4	***Individual Work + Zoom + grok:*** • *try today's sample test if you haven't* • *ex. 6.5, 6.6 (coding: sorting 2, 3 integers)* • *try quizes in ws6.pdf pp 18-21* • *ex. 6.9 (coding: coin change revisited)*
5	Notes on the coming MST, walking through a sample test.

Recursive functions

- ***What:*** A function that calls itself.
- ***When:***
  - a task of size `n` can be reduced to a task (or tasks) of size `< n`, and
  - solution for small, trivial `n` can be easily found.
- Example: f(n) = compute n!, ie. 1*2*3*...*(n-1)*n
  - `f(n) = f(n-1)*n` and `f(0) = 1;`
- ***How*** to write a recursive function?
  - solve all trivial cases (*base cases*) first, then
  - solve the general case by calling the function itself.

```
int fact(int n){


}
```

Recursive functions: Example

- How to write a recursive function?
  - solve all trivial cases (*base cases*) first, then
  - solve the general case by calling the function itself.
- Example: write a recursive function to return the n-th Fibonacci number.

  The Fibonacci numbers are

  ```
  1, 1, 2, 3, 5, 8, ...
  ```

where the 0-th and 1-st numbers are 1, and each subsequent number is the sum of its 2 immediate predecessors.

Recursive functions: Example

- How to write a recursive function?
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  The Fibonacci numbers are

  1, 1, 2, 3, 5, 8, ...

where the 0-th and 1-st numbers are 1, and each subsequent number is the sum of its 2 immediate predecessors.

And so:

General case: $f(n) = f(n-1)+f(n-2)$ when $n>1$

Base cases: $f(0) = f(1) = 1$ when $n=0, 1$

Recursive functions: Example

Example: write a recursive function to return the n-th Fibonacci number. The Fibonacci numbers are **1, 1, 2, 3, 5, 8, …** where the 0-th and 1-st numbers are 1, and each subsequent number is the sum of its 2 immediate predecessors.

```
int fib(int n) {




}
```

Scopes, local & global variables

```
#include <stdio.h>
int fact(int n);

int main(int argc, char *argv[]){
    int n= 3, val;
    val= fact(n);
    printf("%d! = %d\n", n, val);
    return 0;
}

int fact(int n) {
    int i, f= 1;
    for (i=1; i<=n; i++) {
        f *= i;
    }
    return f;
}
```

`argc`, `argv`, `n`, and `val` available here

`n`, `i`, and `f` available here

function `fact` available here

Scopes, local & global variables

```
#include <stdio.h>
int ga, gb;
int fact(int n);

int main(int argc, char *argv[]){
    int n= 3, val;
    val= fact(n);
    printf("%d! = %d\n", n, val);
    return 0;
}

int fact(int n) {
    int i, f= 1;
    for (i=1; i<=n; i++) {
        f *= i;
    }
    return f;
}
```

scope of *local* variables `argc`, `argv`, `n`, and `val`

scope of *local* variables `n`, `i`, and `f`

scope of function `fact`

scope of global varables `ga` and `gb`

A Rule: Never use global variables

```
#include <stdio.h>
int ga, gb;
int fact(int n);

int main(int argc, char *argv[]){
    int n= 3, val;
    val= fact(n);
    printf("%d! = %d\n", n, val);
    return 0;
}

int fact(int n) {
    int i, f= 1;
    for (i=1; i<=n; i++) {
        f *= i;
    }
    return f;
}
```

scope of *local* variables `argc`, `argv`, `n`, and `val`

scope of *local* variables `n`, `i`, and `f`

scope of function `fact`

Group work: 5.14 (W5X) 6.2 (W6), time limit: 15 min

***6.2**: For each of the 3 marked points, write down a list of all of the program-declared variables and functions that are in scope at that point, and for each identifier, its type. Don't forget* **main**, **argc**, **argv**. *Where there are more than one choice of a given name, be sure to indicate which one you are referring to.*

```
1  int bill(int jack, int jane);
2  double jane(double dick, int fred, double dave);
3
4  int trev;
5
6  int main(int argc, char *argv[]) {
7       double beth;
8       int pete, bill;      /* -- point #1 -- */
9       return 0;
10 }

11 int bill (int jack, int jane) {
12      int mary;
13      double zack;         /* -- point #2 -- */
14      return 0;
15 }

16 double jane(double dick, int fred, double dave) {
17      double trev;         /* -- point #3 -- */
18      return 0.0;
19 }
```

6.3

What's wrong with these functions?

Should we employ variable/ function names in this way?

```
1   int dumb(int dumb) {
2         return dumb+1;
3   }

11  int dumber (int dumber) {
12        int dumber= 6;
13        return dumb(dumber+1);
14  }
```

Never use a same identifier for more than one object/purpose!

Variable and address, operators & and *

What happens when:

```
int n=10;
```

is executed?

Variable and address, operators & and *

What happens when:

```
int n=10;
```

is executed?

unary operators & and * : referencing and dereferencing

```
int n=10;
int *pn;

pn= &n;
```

Check your understanding:

a) The datatype of `pn` is _____

b) If n is at the address 4444, then `pn` has the value of _____

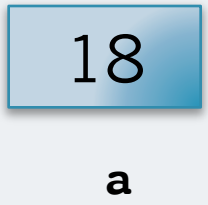
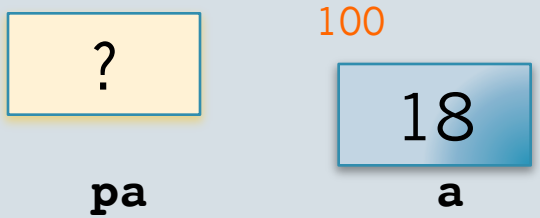
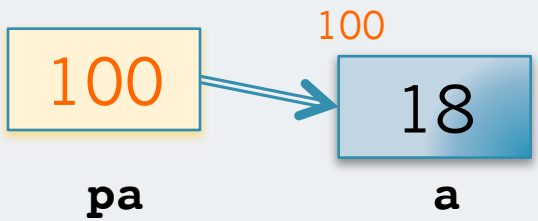
c) The value of `*pn` is _____

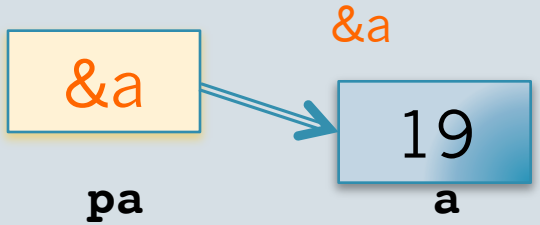
d) After

```
*pn= 100;
```

the value of `pn` is _____, of `n` is _____

Pointers: check your understanding

`int a= 18;`		**a** is a location in the memory, interpreted as an **int,** with value of 18
`int *pa;`		**pa** is an **int pointer**, it can hold the address of an **int**
`pa= &a;`		**pa** now holds the address of **a**, or, it "points" to **a**. ***pa** is another method to access **a**

`*pa= *pa + 1;`		These statements are equivalent:
		`*pa = *pa + 1;`
		`a = a + 1;`
		`*pa = a + 1;`
		`a = *pa + 1;`

Pointers – application in function parameters

1	`int n=10;`	
2	`printf("%d", n);`	What sent to `printf` ?
3	`scanf("%d", &n);`	What sent to `scanf`? What scanf do to `&n`, to `n`?
4	`void int_swap(int *a, int *b);`	
5	`swap(&n, &m);`	What passed to `swap`? Can this call make change to `&n` or `&m`? Can this call make change to `m` or `n`?

example: pointers as function parameters

Pointers can be used to change the value of variables *indirectly*

Example: Function call in line 4 leads to the change of value of sum and product.

```
1   int main(...) {
2     int a=2, b=4, sum, product;
3         ...
4     sAndP(a, b, &sum, &product);
5
6     printf("sum=%d",          sum);
7     printf("prod=%d",             product);
8       ...
9   }

11  void sAndP(int m, int n, int *ps, int *pp ) {

12    *ps = m + n ;
13    *pp = m * n ;


14  }
    int_swap(&a, &b ) ← int_swap(int *pa, int
    *pb)
```

&sum and **&product** are kept unchanged, the changes happen to **sum** and **product**

Lab Time: Individual Work, use Zoom/grok

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Quiz 1

With the fragment:

```
int x= 10;
f(&x);
```

which function below will set `x` *to zero?*

A:

```
int f(int n) {
   return 0;
}
```

B:

```
void f( int *n) {
  &n= 0;
}
```

C:

```
void f (int *n) {
   n= 0;
}
```

D:

```
void f( int *n) {
  *n= 0;
}
```

Quiz 2

Given function:

```
void f(int a, int *b) {
    a= 1;
    *b = 2;
}
```

what are values of `m` *and* `n` *after the following fragment:*

```
m= 5;
n= 10;
f(m, &n);
```

A) 5 and 10	B) 1 and 2	C) 5 and 2	D) 1 and 10

Quiz 3

In executing the program:

```
int a=100, b=200;
void f(int a) {
   a++;
   print("1: a= %d b= %d\n", a, b) ;
}
int main(int argc, char *argv[]) {
  int a=5, b= 10;
  f(a);
  print("2: a= %d b= %d\n", a, b) ;
  return 0;
}
```

what will be printed out?:

A	1: a= 6 b= 200 2: a= 5 b= 10	B	1: a= 6 b= 200 2: a= 6 b= 10
C	1: a= 6 b= 10 2: a= 5 b= 10	D	1: a= 6 b= 10 2: a= 6 b= 10

Quiz 4

In executing the program:

```
#define N 3
int f(int);

int main(int argc, char *argv[]) {
  printf("%d \n", f(N));
  return 0;
}

int f(int n) {
  if (n <= 1) return 1;
  return n*n + f(n-1);
}
```

what will be printed out?:

A 14	**B** 1
C 6	**D** 9

Questions on the coming online test?

- Walk thru a sample test?
- Other questions/concerns?