ECE 220 Midterm 2
HKN Review Session

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Pointers

- * is the dereference operator
- & is the reference operator
- Example: int swap function
    - void charSwap(char * a, char * b){
        - char temp;
        - temp = *a;
        - *a = *b;
        - *b = temp;}
    - char c1 = ‘a’;
    - char c2 = ‘b’;
    - charSwap(&c1, &c2);

char * string = “arrays and pointers and stuff”

- An array is a collection of items in memory together, which can
- Declare an array of 10 ints
    - int arr[10];
- Strings are arrays of characters and are NULL terminated
    - Instead an array of characters
    - char str[10];
- 2D arrays are also supported in C
    - int 2d_arr[10][10];
    - row * num_cols + cols

“Recursion” and “Backtracking”

- Recursion generally involves using a solution to a more basic problem, and a reductive step with base case implementation to ultimately deliver the answer to the caller.
  - In general, it can function somewhat as a loop

- Backtracking is a generally recursive use of a global/shared resource to produce / find a particular result
  - In general involving permuting/modifying that static resource in some way
  - Then checking if that permutation actually worked, if yes, return the result
  - Else: backtrack, and undo that permutation

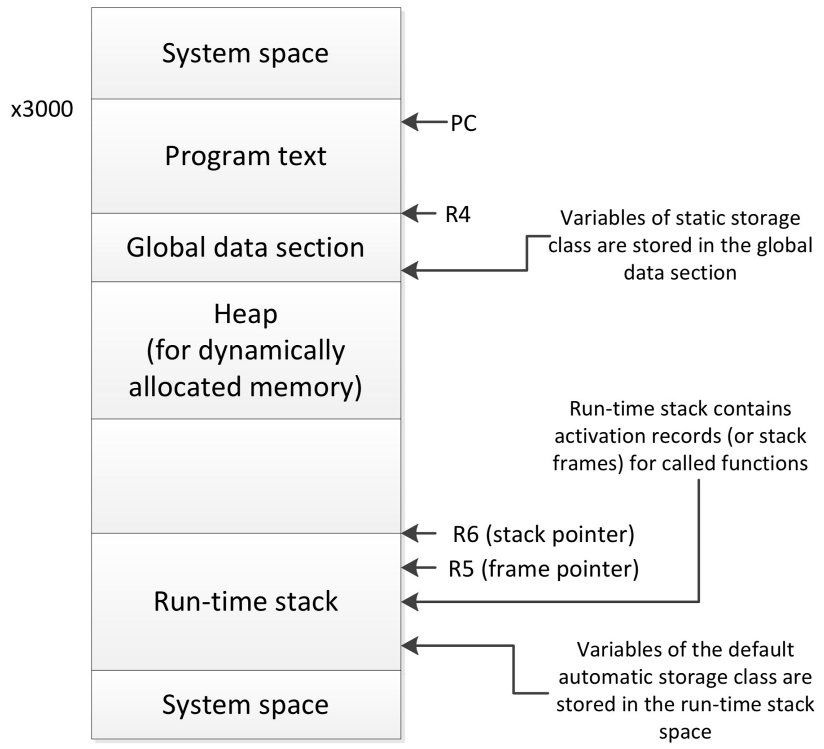
Types

- Cool things about types in C
    - Types can be changed dynamically with a cast! ie (5/7)==0, but (((float) 5)/7)!=0
    - Unsigned vs Signed! Unsigned vars will Zero-EXT, Signed vars Sign-EXT, when casted to a longer data type ((int) ((char) -5)) != ((unsigned int) ((unsigned char) -5)) , when doing comparison operations (<, >, etc.)
    - Why does the type of a pointer matter? The amount of bytes that are returned when a pointer is dereferenced, The amount the actual pointer value changes when a quantity is added to it.
    - Array pointer duality: Where arrays are represented by pointers to the first element of an array, and can be dereferenced and incremented in order to access other elements.
    - char alf[4] = “abc” is the same as char alf[4] = {‘a’, ‘b’, ‘c’, 0} (the Null character is automatically there in the first case because the compiler knows you need one) HOWEVER! If declared char * alf = “abc”; alf could point to read only memory, so it is non-writable.

Structs

- Cool things about structs in C
    - They basically just store memory offset information for the C compiler to use to look up particular data
    - `typedef struct point_t{int x; int y;} point_t; //allows you to use point as a datatype`
    - Using typedef adds point to the list of types, otherwise you would need to write struct point_t instead of point_t when using that data type

Run-Time Stack


System space
x3000
Program text
PC
R4
Global data section
Variables of static storage class are stored in the global data section
Heap (for dynamically allocated memory)
Run-time stack contains activation records (or stack frames) for called functions
R6 (stack pointer)
R5 (frame pointer)
Run-time stack
Variables of the default automatic storage class are stored in the run-time stack space
System space

Important Registers:

- R4: Global data section
- R5: Base of runtime stack
- R6: Top a runtime stack
- R7: Return address

Updating the runtime stack

Push:

```
ADD R6, R6, #-1   ;Update pointer
STR R0, R6, #0    ;Data in R0
```

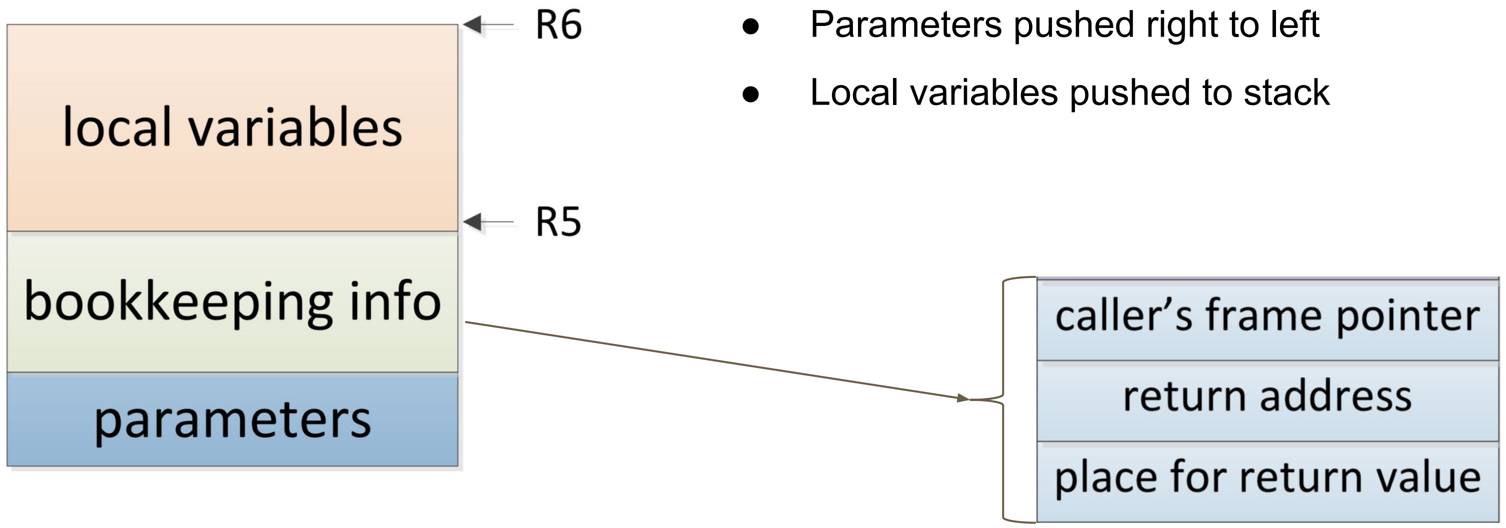
Pop:

```
ADD R6, R6, #1    ;Update pointer
```

Run-Time Stack (Continued)

Bookkeeping Info:

- Callee frame pointer
- Return address
- Return value



- **Things to Remember:**
- Activation record: how to create and tear-down
- The record is popped when exiting the function
- Update the stack frame
- Parameters pushed right to left
- Local variables pushed to stack

Cheat Sheet

- C to LC-3 example (check Patt and Patel)
- Examples of your weakest areas
  - Pointer Examples
  - Linked List Examples
  - Tree Traversals
  - Backtracking
  - Syntax?
- You have a lot of space

Practice Problems

https://goo.gl/RauPo4