

LAB 2 - TASK 4 through TASK 5

Stacks / Millionaire

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COMP-232: Programming Languages
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TASK 4. Stacks

Stacks are used extensively in programming languages to check the syntax of the language. Stacks are based on the Last In First Out (LIFO) principal. This means the last string added to the stack is the first string to be removed. Stacks are similar to a stack of plates where you add a new plate to the top and remove the topmost plate.

In the stacks.c program, our program will support the following commands:

```
push <string>
pop
quit
```

where **<string>** represents a string of up to 100 characters in length.

The push command will push the string onto the stack. Pop will remove the topmost string found on the stack. And quit will exit the program.

After running a command, the contents of the stack will be displayed.

Here's a sample run of the stacks program. Your output should be close to this sample.

```
john@oho:~/COMP232_LABS/LAB2$ stacks
```

```
Enter Command: push one
```

```
-----
Stack Contents:
```

```
  [0] :one:
-----
```

```
Enter Command: push two
```

```
-----
Stack Contents:
```

[1] :two:
[0] :one:

Enter Command: **push three**

Stack Contents:

[2] :three:
[1] :two:
[0] :one:

Enter Command: **push four**

Stack Contents:

[3] :four:
[2] :three:
[1] :two:
[0] :one:

Enter Command: **pop**

POP: four

Stack Contents:

[2] :three:
[1] :two:
[0] :one:

Enter Command: **pop**

POP: three

Stack Contents:

[1] :two:
[0] :one:

Enter Command: **push five**

Stack Contents:

[2] :five:
[1] :two:
[0] :one:

Enter Command: **pop**

POP: five

Stack Contents:

[1] :two:

[0] :one:

Enter Command: **pop**

POP: two

Stack Contents:

[0] :one:

Enter Command: **pop**

POP: one

Stack Contents:

The stack is empty.

Enter Command: **push six**

Stack Contents:

[0] :six:

Enter Command: **push hello world have a great day**

Stack Contents:

[1] :hello world have a great day:

[0] :six:

Enter Command: **pop**

POP: hello world have a great day

Stack Contents:

[0] :six:

Enter Command: **pop**

POP: six

Stack Contents:

The stack is empty.

Enter Command: **quit**

john@oho:~/COMP232_LABS/LAB2\$

To help you get started, here is some code which you can use:

john@oho:~/COMP232_LABS/LAB2\$ **cat stacks.c**

```
#include <stdio.h>
```

```
#include <string.h>
```

```
int main()
```

```
{
```

```
    char command[101];    // <string> can be 100 characters. The 101 is needed to hold \0.
```

```
    int i;
```

```
    char stack[50][101];
```

```
    int stack_counter=0;
```

```
    while (1) {
```

```
        // Read command.
```

```
        printf("Enter Command: ");
```

```
        fgets(command, 100, stdin);
```

```
        command[strcspn(command, "\n")] = '\0';
```

```
        // Handle "quit".
```

```
        // Handle "push".
```

```
        if (strncmp(command, "push", 4) == 0) {
```

```
            strcpy(stack[stack_counter], command+5);
```

```
        }
```

```
        // Handle "pop".
```

```
        // Print stack contents.
```

```
printf("-----\n");  
printf("Stack Contents:\n");  
if (stack_counter == 0)  
    printf("\tThe stack is empty.\n");  
printf("-----\n");  
}  
}
```

TASK 5. Who Wants to Be a Millionaire?

As you get closer to your graduation from Channel Islands, the last thing on your mind is, well, retirement. But you've heard about the power of **compound interest** and you want to learn more. You want to know if contributing to your 401k can make you a millionaire.

To run the **retire** program, there are two input parameters and one optional parameter.

1. How old you are when you start to save?
2. How much you consistently save per month until your retirement age of 65?
3. How much did you start with? This is an optional parameter used when provided.

You can copy/paste the following retire.c template to start with. (Remember to replace Word's curly quotes ("quotes") with straight quotes found on your keyboard.)

```
john@oho:~/232/LAB2$ cat retire.c
#include <stdio.h>
#include <stdlib.h>

#define SALARY 100000          // Your salary is $100k/year

void main(int argc, char *argv[])
{
    int after_tax_distribution = 0;
    int age = 0;
    int amount = 0;
    int distribution = 0;
    int i = 0;
    int matching_401k_amount = 0;
    int max_matching_401k_amount = 0;
    int principal = 0;
    int roth_distribution = 0;    // Need to determine.
    int taxes = 0;
    int taxable_distribution;
    int total_saved = 0;
    int yearly_401k_contribution = 0;

    if (!(argc == 3) || (argc == 4)) {
        printf("Missing input parameters to retire program.\n");
```

```

printf("Usage: retire starting_age amount_saved [initial_amount]\n");
printf("where:\n");
printf("  starting_age is the age at which you start saving.\n");
printf("  amount_saved is the dollar amount saved for retirement per month.\n");
printf("  initial_amount is the amount used to start your retirement account.\n");
printf("The retire program will now exit.\n");
exit(0);
}

```

```

age          = atoi(argv[1]);
amount_saved =
if (argc == 4)
    initial_amount =
else
    initial_amount = 0;

```

```

printf("\n");
printf("Welcome to Your Retirement Calculator\n");
printf("-----\n");
printf(" 1. You start saving at age %d.\n", age);
printf(" 2. The amount saved per month is $%d.\n", amount);
printf(" 3. Optional field. The initial starting amount is $%d.\n", starting_amount);
printf("-----\n");

```

```

for (i=age;i<65;i++) {

```

```

    yearly_401k_contribution = 12 * amount;

```

```

    principal = principal + yearly_401k_contribution;

```

```

    // 6% of salary is matched at 50%.

```

```

    max_matching_401k_amount = SALARY * .06;

```

```

    if (yearly_401k_contribution >= max_matching_401k_amount)

```

```

        matching_401k_amount = 0;

```

```

    else

```

```

        matching_401k_amount = 0;

```

```

    // 1.107 is 10.7%, the average gain over 30 years in an S&P Index Fund.

```

```

    total_saved = (total_saved + (12 * amount)) * 1.107 + matching_401k_amount;

```

```

    printf("At age %d, principal = $%d, total saved = $%d\n",
        i, principal, total_saved);
}

printf("-----\n");
printf("From age %d to 65, if $%d is saved per month:\n", age, amount);
printf("  The principal amount you contributed is : $%d\n", principal);
printf("  The principal amount + your gains is   : $%d\n", total_saved);
printf("-----\n");

printf("\n");
printf("-----\n");
printf("But how much money will I receive per year from 65 to 95?\n");
printf("-----\n");

before_tax_distribution = total_saved/(95-65);

// THE IF STATEMENTS BELOW ARE BASED ON OLD TAX TABLES.
// NEED TO UPDATE AND CORRECT FOR 2025 TAX TABLES.

if (distribution <= 10275)
    taxes = distribution * 0.10;           // 10%
else if (distribution <= 41775)
    taxes = 0;                           // 12%
else if (distribution <= 89075)
    taxes = (10275*0.10) + (41775-10275)*.12 + (distribution-41775)*.22; // 22%
else if (distribution <= 170050)
    taxes = 0;                           // 24%
    else if (distribution <= 215950)
    taxes = 0;                           // 32%
    else if (distribution <= 539900)
    taxes = 0;                           // 35%
    else
    taxes = 0;                           // 37%

after_tax_distribution = before_tax_distribution - taxes;
    roth_distribution = ;

printf("Distribution before taxes is: $%d\n",    before_tax_distribution);
printf("Distribution from a 401k account is: $%d\n", after_tax_distribution);
    printf("Distribution from a ROTH account is: $%d\n", roth_distribution);

```



```

    printf("-----\n");
}

```

To make life easier, we'll define all variables as integers.

Single Taxpayers

2025 Official Tax Brackets

If Taxable Income Is:	The Tax Due Is:
0 - \$11,925	10% of taxable income
\$11,926 - \$48,475	\$1,192.50 + 12% of the amount over \$11,925
\$48,476 - \$103,350	\$5,578.50 + 22% of the amount over \$48,475
\$103,351 - \$197,300	\$17,651 + 24% of the amount over \$103,350
\$197,301 - \$250,525	\$40,199 + 32% of the amount over \$197,300
\$250,526 - \$626,350	\$57,231 + 35% of the amount over \$250,525
\$626,351 and over	\$188,769.75 + 37% of the amount over \$626,350

Below are our assumptions. This is not financial advice.

1. You retire on your birthday at the age of 65.
2. You invest in an S&P 500 Index Fund which we'll assume earns 10.7% per year.
3. Over the past 30 years, the S&P 500 index has delivered a compound average annual growth rate of 10.7% per year.
4. Your employer matches 50% of your 401k contribution up to 6% of your salary.
5. Your employer does "End of Year" 401k Matching. (Not great for you as the employee.)
6. Your lifetime salary is \$100,000/year and you never get a raise!
7. To reduce losing your money in retirement, you move the full amount saved on your birthday at the age of 65 into a money market account that earns 0% interest.

8. You receive the same distribution amount each year from 65 to 95 based on the total saved while working.
9. You stay single (so we only need to use single individual tax rates).
10. Since the amount in your 401k account is taxable, we will use the 2025 Tax Brackets for 30 years. We will ignore California state taxes that tax 9% of your salary.

Below is an example of running the retire program using **OLD** tax tables. 60 represents the person's age when they start to save money. The value of 100 is the amount saved per month (i.e., \$100/mo).

% retire 60 100

Welcome to Your Retirement Calculator

1. You start saving at age 60.
2. The amount saved per month is \$100.

At age 60, principal = \$1200, total saved = \$1928
 At age 61, principal = \$2400, total saved = \$4062
 At age 62, principal = \$3600, total saved = \$6425
 At age 63, principal = \$4800, total saved = \$9040
 At age 64, principal = \$6000, total saved = \$11935

From age 60 to 65, if \$100 is saved per month:

The principal amount saved is : \$6000
 The principal + gains amount is: \$11935

But how much money will I receive per year from 65 to 95?

Distribution before taxes is: \$397
 Distribution if a taxable 401k account is : \$358
 Distribution if a tax free ROTH account is : \$???

You can use the following commands to test your program:

% retire 25 100

<<< You save \$100/month starting at age 25.

% retire 25 100 3000 <<< \$3,000 is the initial deposit when you open your account.

% retire 35 100 <<< You save \$100/month starting at age 35.

% retire 55 1000 <<< You save \$1,000/month at age 55.

Here are some questions which you do not need to turn in, but are interesting to run:

Question 1.

If you delay your contributions into your 401k by 10 years (i.e., you start at age 35 instead of 25), how much less money do you save?

Question 2:

Using your retirement calculator, how much money do you need to contribute to reach \$2.5 million dollars if you start at the age of 25?

During LAB 3, I'll explain how to turn in LAB 1 and LAB 2 work for credit.