LAB 2 - TASK 4 through TASK 5
Push and Pop / Millionaire

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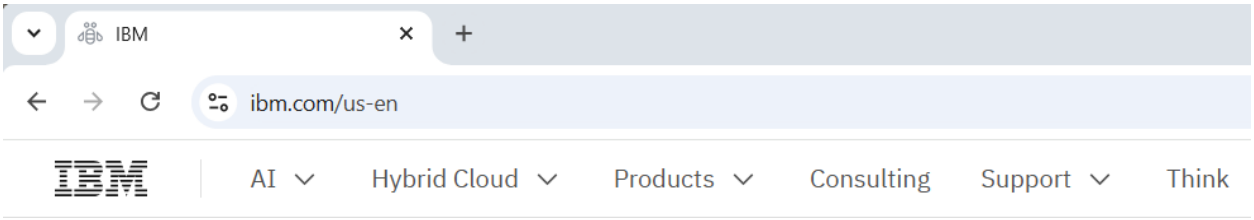
TASK 4. Stacks

When you use a web browser, such as Chrome below, you enter a URL to visit a website. Enter a second URL and you'll visit the next website.

One option supported by all web browsers is the ability to go back to the previously visited website. And once there, be able to go forward to visit the previously viewed website, as shown below with the ← and → arrows.



Stacks are used to implement this feature. Stacks are used extensively in programming languages to check the syntax of the language.

In this assignment, we will prompt the user for a URL and then push the URL entered on the back_stack. The prompt can be:

Enter URL:

The back_stack can be defined as a character array, such as:

```
char    back_stack[50][100];
```

where back_stack can hold up to 50 URLs with each URL a maximum of 99 characters. The '\0' is the 100th character to indicate the end of the stored string.

When the user enters another URL, the URL will be pushed onto the back_stack.

Now if the user types "back" or "<" after the Enter URL: prompt, you will then pop the URL found on top of the back_stack and print it out.

But you will also push the URL that was just popped off the back_stack onto the forward_stack, which can be defined as:

```
char      forward_stack[50][100];
```

After the user has typed “back” or “<” one or more times, the user can now type “forward” or “>”. The URL popped off the forward_stack will be displayed and pushed onto the back_stack.

The user can type “back” or “<” several times. If the back_stack is empty, print:

```
The back stack is empty.
```

The user can type “forward” or “>” several times. If the forward_stack is empty, print:

```
The forward stack is empty.
```

You can also enter the “print” command which will print the current contents on the back_stack and forward_stack. For example, typing print can generate:

Back Stack
ibm.com
repoleaf.com
plus1se.com

Forward Stack
Empty

Or:

Back Stack
ibm.com

Forward Stack
repoleaf.com
plus1se.com

To help you get started, here is some code generated by OpenAI gpt-3.5-turbo LLM for this assignment which you can start with:

/*
Sure! Here is a **self-contained C program** implementing your web browser-like history navigation with back and forward stacks.

```c
*/
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#define MAX_STACK 50
#define MAX_URL 100

int main() {
    char back_stack[MAX_STACK][MAX_URL];
    char forward_stack[MAX_STACK][MAX_URL];
    int back_top = -1, forward_top = -1;
    char url[MAX_URL];

    while (1) {
        printf("Enter URL: ");
        scanf("%99s", url);

        // Handle "quit"
        if (strcmp(url, "quit") == 0) {
            break;
        }

        // Handle "back" or "<"
        if ((strcmp(url, "back") == 0) || (strcmp(url, “<") == 0)) {
            if (back_top < 0) {
                printf("The back stack is empty.\n");
                continue;
            }
            // Pop back_stack to temp
            char temp[MAX_URL];
            strcpy(temp, back_stack[back_top]);
            back_top--;

            // Push temp to forward_stack
            if (forward_top < MAX_STACK - 1) {
                forward_top++;
                strcpy(forward_stack[forward_top], temp);
            }
```

```
        // Print new current URL or indicate no previous
        if (back_top >= 0) {
            printf("%s\n", back_stack[back_top]);
        } else {
            printf("The back stack is empty.\n");
        }
        continue;
    }
```

And here is an example test run. User inputs are in bold.

repoleaf:/home/projects/johnstudent/pushpop$ **pushpop**

Enter URL: **ibm.com**
Enter URL: **repoleaf.com**
Enter URL: **plus1se.com**
Enter URL: **print**
Back Stack
        plus1se.com
        repoleaf.com
        ibm.com
Forward Stack
        Forward Stack is empty.
Enter URL: **back**
repoleaf.com
Enter URL: **<**
ibm.com
Enter URL: **back**
The back stack is empty.
Enter URL: **print**
Back Stack
        Back Stack is empty.
Forward Stack
        ibm.com
        repoleaf.com
        plus1se.com
Enter URL: **forward**
ibm.com
Enter URL: **>**
repoleaf.com

Enter URL: **print**
Back Stack
    repoleaf.com
    ibm.com
Forward Stack
    plus1se.com
Enter URL: **hp.com**
Enter URL: **print**
Back Stack
    hp.com
    repoleaf.com
    ibm.com
Forward Stack
    Forward Stack is empty.
Enter URL: **quit**

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 401lk 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.

Copy/Paste the following retire.c template to start with:

john@oho:~/232/LAB2$ **cat retire.c**

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

#define  SALARY   100000                // $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 principle = 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;

  principle = principle + 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;       // NEED TO CORRECT
  else
    matching_401k_amount = 0;       // NEED TO CORRECT

  // 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, principle = $%d, total saved = $%d\n",
       i, principle, total_saved);
}
```

```
    printf("----------------------------------------------------------------\n");
    printf("From age %d to 65, if $%d is saved per month:\n", age, amount);
    printf("    The principle amount you contributed is : $%d\n", principle);
    printf("    The principle 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 2024 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, principle = $1200, total saved = $1928
At age 61, principle = $2400, total saved = $4062
At age 62, principle = $3600, total saved = $6425
At age 63, principle = $4800, total saved = $9040
At age 64, principle = $6000, total saved = $11935
---------------------------------------------------------------
From age 60 to 65, if $100 is saved per month:
   The principle amount saved is  : $6000
   The principle + 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 : $ ???
---------------------------------------------------------------
```

To get full credit for Task 4, please run the retire program using the following commands.

% script 401k.txt

% retire 25 100

% retire 25 100 2500 <<< $2,500 is the initial deposit when you open your account.

% retire 35 100

% retire 55 1000

% quit

Answer the following two questions:

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 Tasks 1-5 for credit.