This fourth project will give you experience writing a program that involves branching (if). This project will use the same development process as in Programming Projects #2 & #3, and will be subject to the same rules and grading criteria, with some new criteria added. This specification is less detailed than for previous programming projects. YOU ARE EXPECTED TO KNOW HOW TO PERFORM BASIC TASKS WITHOUT HAVING TO BE TOLD EXPLICITLY.

You’ve just opened a restaurant.

Each meal your restaurant serves can consist of an entree, a dessert, and a drink.

Your restaurant has a menu that features several entrees (chicken, steak, vegetarian lasagna), several desserts (cheesecake, mousse, creme brulee), and several drinks (coffee, tea, soda).

Your restaurant also has a kiddie menu for children, with two additional entrees (hamburger, macaroni and cheese), and two additional drinks (lemonade, milk).

Children can order either from the regular menu or from the kiddie menu. Children CANNOT order coffee or tea. Adults CANNOT order the kiddie entrees or the kiddie drinks.

A customer can order AT MOST one item from each category; for example, they can order chicken as their entree, cheesecake as their dessert and coffee as their drink. But, they AREN'T REQUIRED to order one of each category; for example, they can order no entree or dessert at all, just a cup of coffee.

The prices are:

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adult Menu</strong></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>$14.50</td>
</tr>
<tr>
<td>Steak</td>
<td>$19.25</td>
</tr>
<tr>
<td>Vegetarian Lasagna</td>
<td>$11.00</td>
</tr>
<tr>
<td>Cheesecake</td>
<td>$6.50</td>
</tr>
<tr>
<td>Mousse</td>
<td>$5.25</td>
</tr>
<tr>
<td>Creme Brulee</td>
<td>$7.75</td>
</tr>
<tr>
<td><strong>Kiddie Menu</strong></td>
<td></td>
</tr>
<tr>
<td>Hamburger</td>
<td>$7.00</td>
</tr>
<tr>
<td>Macaroni &amp; Cheese</td>
<td>$4.50</td>
</tr>
</tbody>
</table>

Your community’s sales tax rate is 8.25%.

At your restaurant, all orders have an 18% tip applied automatically. The tip is based on the price of food and drink only, NOT food, drink and tax.

**NOTE:** You are welcome to substitute other items, as long as you do so consistently and continue to follow the rules. For example, you could change chicken to eggplant parmesan, steak to sushi, etc, but the number and categories of items, and the prices, must remain the same.

**IMPORTANT IMPORTANT IMPORTANT IMPORTANT IMPORTANT IMPORTANT!!!**

To get full credit, you MUST use if blocks properly, including nested if blocks.
I. PROJECT DESCRIPTION

Write a program that simulates greeting a customer, taking their order, calculating the bill and producing the check. The computer will be the wait staff, and the user will be the customer.

EXTRA PREPROCESSOR DIRECTIVE

Your program **MUST** start with the following **TWO** preprocessor directives, in this order:

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

II. STRUCTURE OF THE PROGRAM

The program body **MUST** be broken into four subsections:

1. **Greeting subsection:** Greet the customer (user).
2. **Input subsection:** Prompt for and input their order, one item at a time, **IDIOTPROOFING EACH VALUE AS SOON AS IT IS INPUT.**
3. **Calculation subsection:** Determine the price of each item, the subtotal, the tax amount, the tip amount, and the grand total.
4. **Output subsection:** Output their bill in receipt form.

Please note that you are **ABSOLUTELY FORBIDDEN** to have:

- **ANY** executable statements in your declaration section;
- **ANY** declarations in your execution section (body);
- **ANY** inputs or calculations in your greeting subsection;
- **ANY** calculations, or outputs other than prompts and idiotproofing error messages, in your input subsection;
- **ANY** inputs or outputs in your calculation subsection;
- **ANY** inputs or calculations in your output subsection.

That is, the subsections **MUST BE COMPLETELY SEPARATE**, and **MUST BE CLEARLY LABELED.**

For this programming project, *if* blocks are not considered to be inputs, nor calculations, nor outputs; that is, in principle you may have an *if* block in **ANY** subsection of the program body. However, statements **inside** the clauses of an *if* block **MUST** follow the rules above.

III. IMPLEMENTATION ORDER

Because the program will be complicated, you are **STRONGLY** advised to **IMPLEMENT ONE PART AT A TIME**, thoroughly test and debug it, and then go on to the next part. Also, it would probably be best to implement the subsections, **NOT** in the order in which they appear in the program (as described above), but rather in the following order:

1. **Greeting subsection.**
2. **Input subsection** (developed one item at a time). **NOTE:** If you’re unclear on how to idiotproof, then you can skip the idiotproofing during initial implementation and then develop the idiotproofing code later.
3. **Output subsection** (developed one item at a time). Note that, at this stage, some or all of your outputs will be garbage, because you haven’t yet written the calculation subsection.
4. **Calculation subsection** (developed one item at a time).
IV. DETAILS OF THE PROGRAM STRUCTURE

A. Greet the Customer
Welcome the customer to the restaurant.

B. Input the Customer’s Order

1. **Ask (prompt) the customer for their age category (child or an adult).** You can use integer-valued codes to represent the age categories, and you may choose any **REASONABLE** values for coding these items. So, when the program prompts them for their age category, the **OUTPUT** might be something like:

   Which age category are you?
   Please enter:
   1 for adult
   2 for child

2. **Input** the customer’s age category.

3. **IDIOTPROOF** the customer’s age category, to ensure that the value that the user has input is one of the values listed in the prompt. (See the Grading Criteria for details.)

4. **Ask (prompt) the customer for their entree item choice**, giving them a list of entree items to choose from. The list of entree item choices will differ depending on whether the customer is a child or an adult. **DON’T LIST ENTREE ITEM CHOICES THAT ARE INAPPROPRIATE FOR THEIR AGE CATEGORY.** Again, you can use integer-valued codes to represent the entree items, and you may choose any **REASONABLE** values for coding these items. So, when the program prompts them for their entree item choice, the **OUTPUT** might be something like:

   What entree item would you like?
   Please enter:
   0 for no entree
   1 for chicken
   2 for steak
   3 for vegetarian lasagna

   If the customer is a child, the list of entree item choices will be longer.

5. **Input** the customer’s entree item choice.

6. **IDIOTPROOF** the entree item choice, to ensure that the value that the user has input is one of the values listed in the prompt. (See the Grading Criteria for details.)
7. **Ask (prompt) the customer for their dessert item choice**, giving them a list of dessert items to choose from. Again, you can use integer-valued codes to represent the dessert items, and you may choose any **REASONABLE** values for coding these items. So, when the program prompts them for their dessert item choice, the **OUTPUT** might be something like:

What dessert item would you like?
Please enter:
0 for no dessert
1 for cheesecake
2 for mousse
3 for creme brulee

8. **Input** the customer’s dessert item choice.

9. **IDIOTPROOF** the dessert item choice, to ensure that the value that the user has input is one of the values listed in the prompt. (See the Grading Criteria for details.)

10. **Ask (prompt) the customer for their drink item choice**. Again, you can use integer-valued codes to represent the drink item choices, and you may choose any **REASONABLE** values for coding these items. The list of drink item choices will differ depending on whether the customer is a child or an adult. **DON’T LIST DRINK ITEM CHOICES THAT ARE INAPPROPRIATE FOR THEIR AGE CATEGORY.**

11. **Input** the customer’s drink item choice.

12. **IDIOTPROOF** the drink item choice, to ensure that the value that the user has input is one of the values listed in the prompt. (See the Grading Criteria for details.)

**NOTE:** **YOU MUST FULLY IDIOTPROOF EVERY INPUT THAT NEEDS IDIOTPROOFING.**

**YOU ARE RESPONSIBLE FOR DETERMINING ALL POSSIBLE FORMS OF IDIOCY.**

Idiotproofing error messages **MUST** be **HELPFUL** and sufficiently detailed that even an idiot could figure out **SPECIFICALLY** what they’ve done wrong.

**ADVICE:** Avoid using ambiguous names for variables and named constants. Specifically, in this project, **DON’T** use names such as `drink` or `coffee`. Instead, use names that **CLEARLY** state the **ROLE** of the variable or named constant, such as `drink_item` or `coffee_price`.

**NOTE:** If the customer chooses to buy nothing — no entree, no dessert, no drink — then thank them and **EXIT** the program with a return code of zero (using an appropriate named constant), rather than calculating and printing an empty bill.
C. Calculate the Bill
1. **Entree price:** This value isn’t calculated as such, but is obtained from the entree item choice.
2. **Dessert price:** This value isn’t calculated as such, but is obtained from the dessert item choice.
3. **Drink price:** This value is not calculated as such, but is obtained from the drink item choice.
4. **Tax amount:** Calculate the amount of tax on the food and drink. Both food and drink are taxed at the same tax rate (8.25%).
5. **Tip amount:** The restaurant automatically adds a tip of 18% of the total food and drink bill, **excluding tax** — that is, the tip is calculated based on the sum of the entree price, the dessert price and the drink price, **NOT** on the sum of the entree price, the dessert price, the drink price and the tax amount.
6. **Grand Total:** The grand total bill is the sum of the entree price, the dessert price, the drink price, the tax amount and the tip amount.

D. Print the Bill
1. Present the customer with an itemized bill in receipt form, using the placeholder below. For example:

```
---------------------------------------------------
Henry’s Fine Dining -- Receipt
---------------------------------------------------

Chicken: $14.50
Cheesecake: $ 6.50
Coffee: $ 5.00

Food Total: $26.00
Tax: $ 2.14
Tip: $ 4.68

Grand Total: $32.83

Thank you for visiting Henry’s Fine Dining!
---------------------------------------------------
```

2. For all of the outputs in the itemized list (from the entree through the total), use the `printf` placeholder `%5.2f`, like so:
   ```c
   printf(" Chicken: $%5.2f\n", entree_price);
   ```
   The **conversion format** in the placeholder tells the compiler that the `printf` statement will output some literal text, followed by a floating point number that takes up at least five spaces, two of which are to the right of the decimal point.

3. Item names **MUST** line up on the left side of the bill, dollar signs **MUST** line up, and the `printf` placeholder will cause prices to be flush to the right of the line. For the conversion format to work, all dollar amounts **MUST** be `float`.

4. List the bill entries in the order shown, using the name of each menu choice (table, page 1).
5. In some cases, the exact tax amount and tip amount will have more than two digits to the right of the decimal point. We will accept results within five cents of the exactly correct bill.
V. RUNS
In your script, run the program 7 times, using the following inputs, in the following order:

1. adult, no entree, no dessert, no drink
2. adult, chicken, cheesecake, coffee
3. adult, steak, mousse, tea
4. child, vegetarian lasagna, creme brulee, soda
5. child, hamburger, mousse, lemonade
6. child, macaroni and cheese, creme brulee, milk
7. adult, no entree, no dessert, coffee

In addition, run the program once for each possible case of idiocy that a user might exhibit; that is, you must have runs that completely test each and every idiotproof check. You are responsible for determining all possible forms of idiocy. In your script file, the idiotproof test runs must occur after the runs listed above.

Advice: Calculate each (non-idiotproof) run’s result by hand, then compare your hand-calculated values to the output of the program, to determine whether the program is running correctly.

VI. GRADING CRITERIA
A. SUBJECTIVE GRADING OF COMMENTS IN THE PROGRAM BODY
In previous programming projects, one of the grading criteria for comments in the program body has been that every statement in the program body had to be preceded by a clear, helpful explanatory comment.

- For PP#4 and beyond, you may choose to write fewer comments than this (though still in the format described in the PP#2 specification), in which case you agree to accept without argument the graders’ subjective opinion on whether the amount and nature of your comments is sufficient.
- Alternatively, you may choose to continue to comply with the old criterion, preceding every statement in the program body with a clear, helpful explanatory comment, in which case you are guaranteed to get full credit for this aspect of documentation in the program body (assuming that your comments comply with the original grading criteria for comments in the PP#2 specification).
B. NEW GRADING CRITERIA

1. **Format** of *if* statements, *else if* statements and *else* statements:
   For each *if* statement, the *if* keyword **MUST** be followed by a blank space and then the open parenthesis that begins the condition. After the close parenthesis that ends the condition, there **MUST** be a blank space, followed by the block open.
   For each *else if* statement, the same.
   For each *else* statement, there **MUST** be a single blank space between the *else* keyword and the block open. For example:

   ```
   if (dessert_code == no_item_code) {
       dessert_price = no_item_price;
   } /* if (dessert_code == no_item_code) */
   else if (dessert_code == cheesecake_code) {
       dessert_price = cheesecake_price;
   } /* if (dessert_code == cheesecake_code) */
   else if (dessert_code == mousse_code) {
       dessert_price = mousse_price;
   } /* if (dessert_code == mousse_code) */
   else if (dessert_code == creme_brulee_code) {
       dessert_price = creme_brulee_price;
   } /* if (dessert_code == creme_brulee_code) */
   else {
       printf("This last clause wouldn’t really be needed.\n");
   } /* if (dessert_code == creme_brulee_code)...else */
   ```

2. **Format** of *if* conditions and *else if* conditions:
   For each *if* statement and each *else if* statement, in the condition, any binary operators — including relational operators such as == and Boolean operators such as && — **MUST** be surrounded by one or more blank spaces on each side. Unary operators such as ! **MUSTN’T** be surrounded by blank spaces. For example:

   ```
   if (((dessert_code != no_item_code) &&
       (dessert_code != cheesecake_code) &&
       (dessert_code != mousse_code) &&
       (dessert_code != creme_brulee_code)) {
       printf("ERROR: unknown dessert code %d.\n", dessert_code);
       exit(program_failure_code);
   } /* if (((dessert_code != no_item_code) && ... ) */
   ```
3. **Indenting OF if blocks:**
   For a given if block, the if statement, all else if statements (if any), the else statement (if any) and the block closes associated with these statements MUST all line up, both with each other and with other statements as appropriate. For example:

   ```
   scanf("%d", &age_category_code);
   if ((age_category_code != adult_code) &&
       (age_category_code != child_code)) {
     printf("ERROR: unknown age category code %d.\n", age_category_code);
     exit(program_failure_code);
   } /* if ((entree_code != no_item_code) && ...) */
   printf("What entree would you like? Enter:\n");
   ```

4. **Indenting INSIDE if blocks:**
   For a given if block, all statements INSIDE any clause of the if block MUST be indented FOUR SPACES farther than the associated if statement. This applies especially to if blocks nested inside other if blocks. For example:

   ```
   if (age_category_code == adult_code) {
     if ((drink_code != no_item_code) &&
         (drink_code != coffee_code) &&
         (drink_code != tea_code) &&
         (drink_code != soda_code)) {
       printf("ERROR: unknown drink code %d.\n", drink_code);
       exit(program_failure_code);
     } /* if ((drink_code != no_item_code) && ...) */
   } /* if (age_category_code == adult_code) */
   else {
     if ((drink_code != no_item_code) &&
         (drink_code != soda_code) &&
         (drink_code != lemonade_code) &&
         (drink_code != milk_code)) {
       printf("ERROR: unknown drink code %d.\n", drink_code);
       exit(program_failure_code);
     } /* if ((drink_code != no_item_code) && ...) */
   } /* if (age_category_code == adult_code)...else */
   ```

5. **Commenting if blocks:** You MUST follow all of the rules that are specified in the packet titled “Commenting if Blocks,” which will be posted on the course website soon.
6. **Idiotproofing**

(a) **ALL inputs MUST** include idiotproofing checks. Here’s a typical idiotproofing check:

```c
if ((age_category_code != adult_code) &&
   (age_category_code != child_code)) {
   printf("ERROR: unknown age category code %d.\n",
          age_category_code);
   exit(program_failure_code);
} /* if ((entree_code != no_item_code) && ...) */
```

Notice the `exit` statement, which causes the program to immediately terminate. **ALL idiotproofing checks MUST** include an `exit` statement. Notice that the `exit` statement is **INSIDE** the if block, and should be indented appropriately (see above). Also, your program **MUST** have a named constant `program_failure_code` whose value is `-1`.

(b) Each idiotproofing check **MUST occur IMMEDIATELY after the associated `scanf` statement. ALL IDIOTPROOFING MUST BE COMPLETED BEFORE ANY CALCULATIONS ARE PERFORMED;** that is, idiotproofing belongs in the input subsection.

(c) Idiotproof error messages **MUST CLEARLY AND UNAMBIGUOUSLY** state the nature of the error. Thus, no two error messages should be the same.

**VII. WHAT TO SUBMIT**

Submit cover, summary essay, script and extra credit bonus form (if any) in the usual style, format and order, and upload your source file and script file to Desire2Learn in the usual way.
VIII. EXTRA CREDIT

You can receive an extra credit bonus of as much as 5% of the total value of Programming Project #4 by doing the following:

1. Attend at least one CS1313 help session for at least 30 minutes, through Wed March 30.
2. During the help session that you attend, work on CS1313 assignments (ideally PP#4, but any CS1313 assignment is acceptable). **YOU CANNOT GET EXTRA CREDIT IF YOU DON'T WORK ON CS1313 ASSIGNMENTS DURING THE HELP SESSION.**
3. Before you leave the help session, fill out **BOTH** halves of the form on the last page of this project specification and have the help session leader (instructor or TA) sign **BOTH** halves. **THE FORM CANNOT BE SIGNED UNTIL IT IS COMPLETELY FILLED OUT.**
4. Attach the bottom half of the form to your PP#4 script printout, **AFTER** the script itself, and keep the top half for your own records.

**BONUS VALUE NOTICE:** Through Wed March 9, the extra credit bonus will be worth 5% of the total value of PP#4; from Mon March 21 through Wed March 23, the extra credit bonus will be worth **only 2.5%** of the total value of PP#4; from Mon March 28 through Wed March 30, the extra credit bonus will be worth **only 1.25%** of the total value of PP#4. That is, **YOU'LL GET TWICE AS MUCH EXTRA CREDIT DURING THE FIRST WEEK AS THE SECOND WEEK, AND TWICE AS MUCH EXTRA CREDIT DURING THE SECOND WEEK AS THE THIRD WEEK.**

**NOTE:** This extra credit bonus **WON'T** be available on any other programming project unless explicitly stated so in the project’s specification.
CS1313 PROGRAMMING PROJECT #4 BONUS REQUEST FORM

Name ____________________________ Lab ________
Help Session Date ________________
Help Session Time (Arrive) __________ Help Session Time (Depart) __________

Instructor Signature ________________________________

Keep this copy for your records.

CS1313 PROGRAMMING PROJECT #4 BONUS REQUEST FORM

Name ____________________________ Lab ________
Help Session Date ________________
Help Session Time (Arrive) __________ Help Session Time (Depart) __________

Instructor Signature ________________________________

Submit this copy.
In your submission, attach this copy **AFTER** your script file printout.
If you put this in the wrong place in your submission, then you **WON’T** get the extra credit.