ENGR 132 Exam Practice
Flowcharts and Selection Structures

Problems

Problem 1:

Jerry, a petroleum engineer, has written the following code to track flowrates in a pipeline:

```
if flowrate>150
        fprintf('Flowrate is too high.');
elseif flowrate<75
        fprintf('Flowrate is too low.');
elseif flowrate==0
        fprintf('Warning: Blockage!!');
else
        fprintf('Flow rate is ok.');
end
```

Jerry runs test cases for 200 gpm, 100 gpm, and 50 gpm and receives the expected results.

   A.   What additional test case should Jerry have run?

   B.   Are there any problems with Jerry's code?

Solution

Problem 2:

Below is a flowchart for computing the roots of a polynomial [$ax^2 + bx + c$], where x represents a variable and a, b, and c are constants, using the quadratic equation,

$$roots = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For this flowchart:

Part A: The two decision points in the flowchart check the input variables for special cases. In English, describe one additional check you could do that would either prevent an error or provide important information to the user for certain input values of a, b, and c.

Part B: Run the following test cases (use a table to show all calculated steps for each case):

1. a=1, b=-3, c=2

2. a=1, b=-6, c=8

3. a=-1, b=4, c=-4

Deliverable: A written explanation describing what is happening in the flowchart, a written description of another test of the input, and the results from the three test cases.
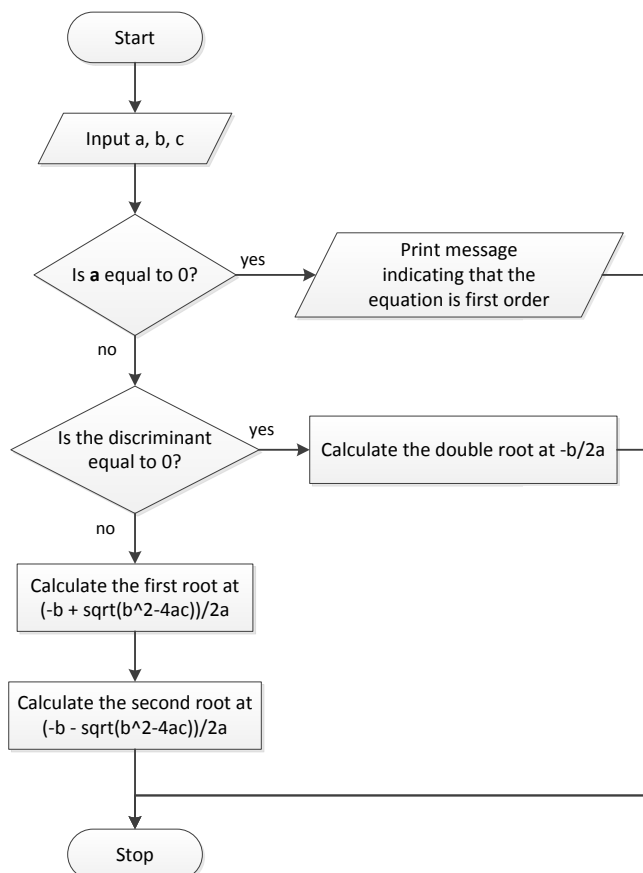
Problem 3:

An engineering student and his family are planning activities for their summer vacation to the Indiana Dunes & Lake Michigan. The student is creating a MATLAB program to help them decide what to do. Here are the criteria:

1. If the temperature is greater than or equal to 90, they will swim.

2. If the temperature is greater than or equal to 80 and less than 90°F, they will go boating.

3. If the temperature is less than 80°F, they will go fishing.

Part A: Create a flowchart showing a pictorial view of your program.

Part B: Write the MATLAB code that determines which activity the family will do based on the outside temperature. In your MATLAB code, use the 'fprintf' command to display selected activity. Include appropriate comments with your code. Begin your code by storing the input temperature (70°F) as the variable 'temp'.

Part C: Test your solution using the temperature of 70°F. What activity is displayed to the command window?

Solution

Problem 4:

Based on the current balance in a money market account at a local Lafayette bank, two different bonus levels are applied to a base interest rate. The following MATLAB code applies after the variable current_balance has been assigned a value:

```
i_rate = 0.4;
if (current_balance >= 6000) & (current_balance < 20000)
      i_rate = i_rate + 0.6;
elseif current_balance >= 20000
      i_rate = i_rate + 1.4;
end
fprintf('Interest rate = %3.2f percent \n',i_rate)
```

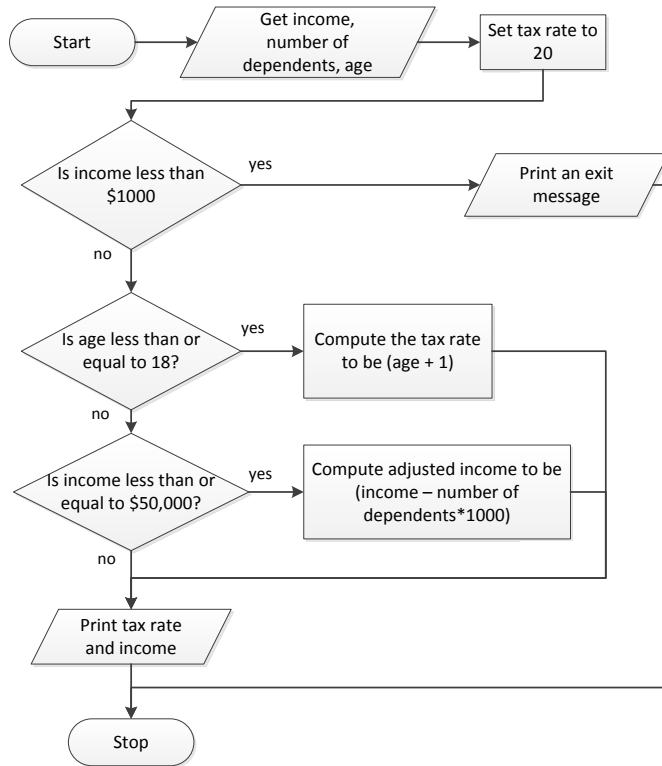Determine exactly what will be printed to the MATLAB command window for current_balance values of:

> **Part A:**   3,000
>
> **Part B:**   20,000

Solution

Problem 5:

Specify and evaluate one test case for every possible flowchart pathway. Assume dependents = 1 for all test cases.

Solution

Solutions

Practice Solution 1

Part A: Jerry should have run a test case for flowrate = 0
Part B: He would have discovered that the 'Flowrate is too low' warning appears instead of the blockage warning, due to the fact that the <75gpm check happens before the ==0 check
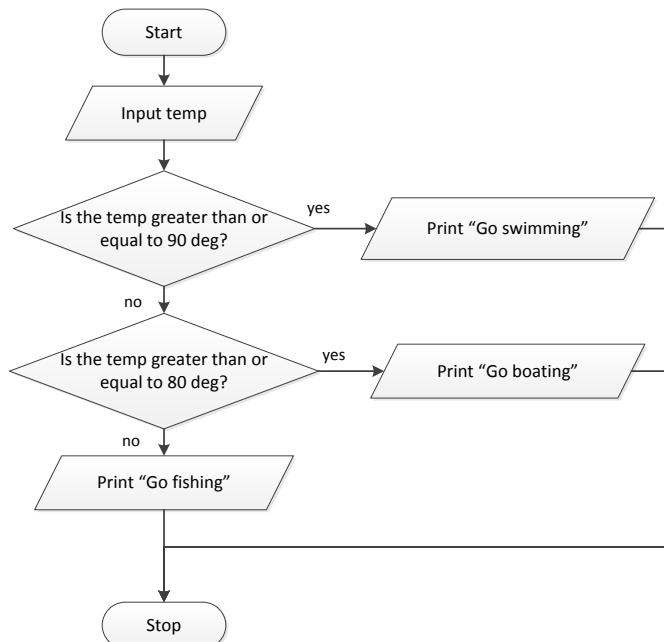
Practice Solution 2

A. It may be helpful to check for the case of a negative value under the square root (b2<4ac). Alternatively, you could prevent errors in the program by first ensuring that all entered values (a,b,c) are real numbers. (Alternative answers accepted at grader's discretion)

B. Test case table shown below with decision point results included:

	a=0? (Y/N)	b2=4ac? (Y/N)	Result
a=1; b=-3; c=2	N	N	1st at 2, 2nd at 1
a=1; b=-6; c=8	N	N	1st at 4, 2nd at 2
a=-1; b=4; c=-4	N	Y	Double Root at 2

Practice Solution 3

Part A:

Part B:

```
% Input temperature
temp = 70; %[degrees F]

% Determine activity and display result
if temp >= 90
      fprintf('Go swimming')
elseif temp >= 80
      fprintf('Go boating')
else
      fprintf('Go fishing')
end
```

Part C:

```
Fishing
```

Practice Solution 4

Part A: `Interest rate = 0.40 percent`

Part B: `Interest rate = 1.80 percent`

Practice Solution 5

income	age	dependents	Result
<= 1000	Any positive number	1	Exit message
> 1000	<= 18	1	Tax rate recalculated, income unchanged
1000 < income <= 50,000	> 18	1	Tax rate 20, income adjusted
> 50,000	> 18	1	Tax rate 20, income as entered.